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# WEED CONTROL

NOTES

**TURNING POINT SURVEY OF WEED CONTROL AND PRODUCTION PRACTICES IN SUGARBEET IN MINNESOTA AND EASTERN NORTH DAKOTA IN 2016**

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The second annual weed control and production practices live polling questionnaire was conducted using Turning Point Technology at the 2017 winter Sugarbeet Grower Seminars. Responses are based on production practices from the 2016 growing season. The survey focuses on responses from growers in attendance at the Fargo, Grafton, Wahpeton, ND, and Willmar, MN, Growers Seminars. Respondents from each seminar indicated the county in which the majority of their sugarbeet were produced (Tables 1, 2, 3, 4). Survey results represents approximately 158,272 acres reported by 235 respondents (Table 5) compared to 183,350 acres represented in 2016. The average sugarbeet acreage per respondent grown in 2016 was calculated from Table 5 at 673 acres, compared to 674 acres in 2015.

Survey participants were asked a series of questions regarding their production practices used in sugarbeet in 2016. Thirty-nine percent of respondents indicated wheat was the crop preceding sugarbeet (Table 6), 39% indicated corn, and 9% indicated soybean. Preceding crop varied dramatically by location with 82% of Fargo growers indicating wheat preceded sugarbeet and 74% of Willmar growers indicated corn as their preceding crop. Seventy-nine percent of growers attending the winter meetings used a nurse or cover crop in 2016 (Table 7), which increased from 72% in 2015. Cover crop species also varied widely by location with oat being used by 58% of growers at the Willmar meeting and no cover crop being used by the majority (38%) of growers at the Grafton meeting.

Growers indicated Cercospora Leaf Spot (CLS) was their most serious production problem in sugarbeet in 2016 (Table 8) with 57% of all respondents naming CLS compared to Rhizoctonia being named most serious by 35% of all participants in 2015. Cercospora was devastating to sugarbeet quality in 2016. Weather was the most serious problem for 23% of growers, mainly those in the northern valley, and weeds were named as most serious by 7% of responses.

Waterhemp was named as the most serious weed problem in sugarbeet in 2016 by 59% of respondents (Table 9) compared to 45% in 2015. Ten percent of respondents indicated common lambsquarters, 9% kochia, and 8% said common ragweed were their most serious weed problem. The increased presence of glyphosate-resistant waterhemp and common ragweed are likely the reason for these weeds being named as the worst weeds. Troublesome weeds varied by location with greater than 80% of Willmar and Wahpeton respondents indicating waterhemp was most problematic while kochia was the worst weed for respondents of the Grafton meeting with 38% of responses.

Respondents to the survey indicated making 0 to 5 glyphosate applications in their 2016 sugarbeet crop (Table 10) with a calculated average of 2.28 applications per acre. The calculated average in 2015 was 2.23 applications per acre.

Glyphosate was most commonly applied with a chloroacetamide herbicide postemergence (lay-by) in 2016 with 36% of responses indicating this herbicide combination was used (Table 11). Fifty-five percent and 42% of Wahpeton and Willmar respondents, respectfully, applied glyphosate with Outlook, S-metolachlor, or Warrant but only 26% and 0% of Fargo and Grafton respondents, respectfully, used this combination. Use of chloroacetamides with glyphosate track to areas where glyhphosate-resistant waterhemp is common. Glyphosate alone was the second most common herbicide used in sugarbeet in 2016 with 31% of responses, followed by glyphosate plus a broadleaf herbicide for 21% of the responses. Satisfaction to weed control from glyphosate applied alone is shown in Table 12 and ranged from 15% of responses indicating excellent control to 6% of responses indicating poor weed control. The majority of responses, 42%, indicated glyphosate was still providing good weed control in sugarbeet in 2016.

Preplant incorporated (PPI) or preemergence (PRE) herbicides were applied by 48% of survey respondents in 2016 (Table 13). Less than 10% of Grafton survey participants applied a PPI or PRE herbicide, while 75% of Wahpeton survey participants did apply a PPI or PRE herbicide in sugarbeet in 2016. Once again, a likely reason for this variation is the increased presence of glyphosate-resistant waterhemp in the southern sugarbeet growing areas of the Red River Valley compared to the north end of the Valley. The most commonly used soil herbicide was S-metolachlor with 22% of all responses followed by ethofumesate with 13% of responses. Of the growers who indicated using a soil-applied herbicide, 77% indicated excellent to good weed control from that herbicide (calculated from Table 14).

The application of soil-residual herbicides applied 'lay-by' was implemented by 71% of those responding about their 2016 sugarbeet crop (Table 15). Outlook was the most commonly applied lay-by herbicide with 33% of responses. The majority of growers responding at the Willmar meeting indicated using Outlook (56% of responses), while S-metolachlor was more commonly applied by growers of the Fargo (40% of responses) and Wahpeton (46% of responses) meetings. Satisfaction of weed control from lay-by applications ranged from excellent to poor (Table 16). Of respondents indicating they applied a lay-by herbicide, 78% indicated excellent or good weed control (calculated from Table 16).

Fifty-four percent of survey responses indicated using some form of mechanical weed control or hand labor in 2016 (Table 17). Of the responses given, 32% indicated at least some hand-weeding, 18% used row-cultivation, and 1% indicated using a rotary hoe for weed control in sugarbeet. Nineteen percent reported row-crop cultivation on less than ten percent of their acres (Table 18). One cultivation pass was reported by 94% of respondents who reported cultivating (calculated from Table 19). Respondents who cultivated generally reported good to fair weed control from the cultivation (Table 20).

Hand-weeding the 2016 sugarbeet crop was reported by 47% of respondents (Table 21). Most respondents who hand-weeded indicated less than 10% of their acres were hand-weeded. Less respondents indicated hand-weeding at the Grafton meeting, while more than half the participants of the Fargo and Wahpeton meetings reported some hand weeding. The cost of hand-weeding on a per acre basis ranged from less than $10 to greater than $40 per acre (Table 22). For growers who reported hand-weeding, 61% reported 'excellent' or 'good' hand-weeding control (Table 23).

**Table 1. 2017 Fargo Grower Seminar – Number of survey respondents by county growing sugarbeet in 2016.**

| County | | Number of Responses | Percent of Responses |
|---|---|---|---|
| Barnes | | 3 | 9 |
| Cass | | 7 | 21 |
| Clay | | 11 | 32 |
| Norman[1] | | 8 | 24 |
| Richland | | 1 | 3 |
| Trail | | 3 | 9 |
| Wilkin[2] | | 1 | 3 |
| | Total | 34 | 100 |

[1]Includes Mahnomen County
[2]Includes Otter Tail County

**Table 2. 2017 Grafton Grower Seminar – Number of survey respondents by county growing sugarbeet in 2016.**

| County | Number of Responses | Percent of Responses |
|---|---|---|
| Grand Forks | 1 | 2 |
| Kittson | 4 | 7 |
| Marshall | 5 | 9 |
| Pembina | 19 | 35 |
| Polk | 1 | 2 |
| Walsh | 23 | 43 |
| Other | 1 | 2 |
| Total | 54 | 100 |

**Table 3. 2017 Wahpeton Grower Seminar – Number of survey respondents by county growing sugarbeet in 2016.**

| County | Number of Responses | Percent of Responses |
|---|---|---|
| Cass | 2 | 4 |
| Clay | 3 | 7 |
| Grant | 5 | 11 |
| Otter Tail | 1 | 2 |
| Richland | 7 | 16 |
| Stevens | 1 | 2 |
| Traverse | 5 | 11 |
| Wilkin | 21 | 47 |
| Total | 45 | 100 |

**Table 4. 2017 Willmar Grower Seminar - Number of survey respondents by county growing sugarbeet in 2016.**

| County | Number of Responses | Percent of Responses |
|---|---|---|
| Chippewa | 36 | 33 |
| Kandiyohi | 17 | 16 |
| Pope | 0 | 0 |
| Redwood | 5 | 5 |
| Renville | 31 | 28 |
| Stearns | 3 | 3 |
| Stevens | 1 | 1 |
| Swift | 9 | 8 |
| Other | 7 | 6 |
| Total | 109 | 100 |

**Table 5. Total sugarbeet acreage operated by respondents in 2016.**

| | | Acres of sugarbeet | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Responses | <99 | 100-199 | 200-299 | 300-399 | 400-599 | 600-799 | 800-999 | 1000-1499 | 1500-1999 | 2000+ |
| | | --------------------------------------% of responses---------------------------------- | | | | | | | | | |
| Grafton | 54 | 6 | 15 | 11 | 9 | 17 | 9 | 11 | 9 | 2 | 9 |
| Fargo | 33 | 3 | 0 | 15 | 18 | 18 | 6 | 9 | 12 | 6 | 12 |
| Wahpeton | 42 | 2 | 7 | 2 | 10 | 33 | 17 | 12 | 10 | 5 | 2 |
| Willmar | 107 | 7 | 15 | 15 | 6 | 22 | 10 | 3 | 14 | 2 | 7 |
| Total | 235 | 6 | 11 | 12 | 9 | 22 | 11 | 7 | 12 | 3 | 7 |

**Table 6. Crop grown in 2015 that preceded sugarbeet in 2016.**

| | | Previous Crop | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Location | Responses | Barley | Canola | Corn | Dry Bean | Potato | Soybean | Wheat | Fallow | Other |
| | | --------% of responses-------- | | | | | | | | |
| Grafton | 53 | 2 | 0 | 0 | 9 | 11 | 2 | 74 | 0 | 2 |
| Fargo | 33 | 6 | 0 | 3 | 0 | 0 | 6 | 82 | 0 | 3 |
| Wahpeton | 41 | 0 | 2 | 24 | 0 | 0 | 12 | 61 | 0 | 0 |
| Willmar | 108 | 1 | 0 | 74 | 1 | 0 | 12 | 0 | 0 | 12 |
| Total | 235 | 2 | <1 | 39 | 3 | 3 | 9 | 39 | 0 | 6 |

**Table 7. Nurse or cover crop used in sugarbeet in 2016.**

| Location | Responses | Barley | Oat | Rye | Wheat | Other[1] | None |
|---|---|---|---|---|---|---|---|
| | | --------% of responses-------- | | | | | |
| Grafton | 52 | 21 | 14 | 0 | 27 | 0 | 38 |
| Fargo | 33 | 42 | 3 | 0 | 12 | 0 | 42 |
| Wahpeton | 42 | 45 | 2 | 0 | 40 | 0 | 12 |
| Willmar | 106 | 0 | 58 | 1 | 30 | 2 | 10 |
| Total | 233 | 19 | 30 | <1 | 29 | 1 | 21 |

[1]Includes Mustard and 'Other'

**Table 8. Most serious production problem in sugarbeet in 2016.**

| Location | No. of Responses | CLS[1] | Rhizomania | Aph[2] | Rhizoctonia | Fusarium | Weeds | Root Maggot | Weather | Emergence/ Stand |
|---|---|---|---|---|---|---|---|---|---|---|
| | | --------% of responses-------- | | | | | | | | |
| Grafton | 56 | 4 | 0 | 14 | 9 | 0 | 0 | 2 | 71 | 0 |
| Fargo | 36 | 44 | 0 | 6 | 8 | 0 | 19 | 0 | 11 | 11 |
| Wahpeton | 43 | 84 | 2 | 0 | 5 | 0 | 9 | 0 | 0 | 0 |
| Willmar | 106 | 79 | 2 | 0 | 2 | 0 | 6 | 0 | 10 | 1 |
| Total | 241 | 57 | 1 | 4 | 5 | 0 | 7 | <1 | 23 | 2 |

[1]Cercospora Leaf Spot
[2]Aphanomyces

**Table 9. Most serious weed problem in sugarbeet in 2016.**

| Location | Responses | biww[1] | colq | cora | Foxtail spp. | kochia | gira | rrpw | Smartweed | RR Canola | wahe |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | --------% of responses-------- | | | | | | | | | |
| Grafton | 53 | 6 | 27 | 10 | 0 | 38 | 0 | 12 | 0 | 6 | 2 |
| Fargo | 35 | 0 | 6 | 23 | 0 | 3 | 6 | 6 | 3 | 8 | 46 |
| Wahpeton | 43 | 0 | 2 | 7 | 0 | 0 | 2 | 5 | 0 | 2 | 81 |
| Willmar | 104 | 0 | 6 | 2 | 0 | 0 | 4 | 3 | 0 | 2 | 84 |
| Total | 234 | 1 | 10 | 8 | 0 | 9 | 3 | 6 | <1 | 4 | 59 |

[1]biww=biennial wormwood, colq=common lambsquarters, cora=common ragweed, gira=giant ragweed, rrpw=redroot pigweed, wahe=waterhemp

**Table 10. Average number of glyphosate applications per acre in sugarbeet during 2016 season.**

| Location | Responses | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| | | --------% of responses-------- | | | | | |
| Grafton | 51 | 4 | 22 | 57 | 16 | 0 | 2 |
| Fargo | 35 | 0 | 14 | 63 | 23 | 0 | 0 |
| Wahpeton | 46 | 0 | 4 | 39 | 50 | 7 | 0 |
| Willmar | 106 | 1 | 11 | 42 | 40 | 5 | 1 |
| Total | 238 | 1 | 13 | 48 | 34 | 3 | 1 |

**Table 11. Herbicides used in a weed control systems approach in sugarbeet in 2016.**

| | | Glyphosate Application Tank-Mixes | | | | | |
|---|---|---|---|---|---|---|---|
| Location | Responses | Gly Alone | Gly+Lay-by | Gly+Broadleaf | Gly+Grass | Other | None Used |
| | | --------------------------------------% of responses---------------------------------- | | | | | |
| Grafton | 51 | 80 | 0 | 16 | 0 | 0 | 4 |
| Fargo | 43 | 30 | 26 | 37 | 7 | 0 | 0 |
| Wahpeton | 58 | 17 | 55 | 22 | 5 | 0 | 0 |
| Willmar | 187 | 21 | 42 | 19 | 14 | 3 | 1 |
| Total | 339 | 31 | 36 | 21 | 10 | 1 | 1 |

**Table 12. Satisfaction in weed control from glyphosate applied in sugarbeet in 2016.**

| | | Satisfaction of Weed Control from Glyphosate | | | | | |
|---|---|---|---|---|---|---|---|
| Location | Responses | Excellent | Good | Fair | Poor | Unsure | Not Used Alone |
| | | ---------------------------------% of responses---------------------------- | | | | | |
| Grafton | 49 | 47 | 49 | 2 | 0 | 2 | 0 |
| Fargo | 34 | 6 | 65 | 21 | 3 | 0 | 6 |
| Wahpeton | 46 | 2 | 35 | 41 | 4 | 0 | 17 |
| Willmar | 104 | 9 | 35 | 29 | 10 | 2 | 16 |
| Total | 233 | 15 | 42 | 24 | 6 | 1 | 12 |

**Table 13. Preplant incorporated and preemergence herbicides used in sugarbeet in 2016.**

| | | PPI or PRE Herbicides Applied | | | | | |
|---|---|---|---|---|---|---|---|
| Location | Responses | S-metolachlor | ethofumesate | Ro-Neet SB | S-metolachlor +ethofumesate | Other | None |
| | | ---------------------------------------% of responses---------------------------------- | | | | | |
| Grafton | 50 | 0 | 0 | 0 | 2 | 4 | 94 |
| Fargo | 35 | 37 | 0 | 0 | 3 | 3 | 57 |
| Wahpeton | 44 | 43 | 11 | 2 | 16 | 2 | 25 |
| Willmar | 108 | 19 | 24 | 0 | 6 | 9 | 42 |
| Total | 237 | 22 | 13 | <1 | 7 | 6 | 52 |

**Table 14. Satisfaction in weed control from preplant incorporated and preemergence herbicides in 2016.**

| | | PPI or PRE Weed Control Satisfaction | | | | | |
|---|---|---|---|---|---|---|---|
| Location | Responses | Excellent | Good | Fair | Poor | Unsure | None Used |
| | | ------------------------------% of responses------------------------- | | | | | |
| Grafton | 54 | 13 | 2 | 0 | 2 | 0 | 83 |
| Fargo | 34 | 21 | 21 | 12 | 3 | 0 | 44 |
| Wahpeton | 42 | 12 | 50 | 14 | 2 | 0 | 21 |
| Willmar | 105 | 17 | 30 | 10 | 3 | 1 | 39 |
| Total | 235 | 16 | 25 | 9 | 2 | <1 | 47 |

**Table 15. Soil-residual herbicides applied early postemergence (lay-by) in sugarbeet in 2016.**

| | | Lay-by Herbicides Applied | | | | | |
|---|---|---|---|---|---|---|---|
| Location | Responses | S-metolachlor | Ethofumesate | Outlook | Warrant | Other | None |
| | | --------------------------------------% of responses------------------------------------ | | | | | |
| Grafton | 53 | 0 | 0 | 0 | 0 | 2 | 98 |
| Fargo | 35 | 40 | 3 | 9 | 0 | 6 | 43 |
| Wahpeton | 48 | 46 | 17 | 19 | 6 | 0 | 13 |
| Willmar | 148 | 8 | 7 | 56 | 20 | 1 | 7 |
| Total | 284 | 17 | 7 | 33 | 12 | 2 | 29 |

**Table 16. Satisfaction of weed control from soil-residual herbicides applied early postemergence (lay-by) in sugarbeet in 2016.**

| | | Lay-by Weed Control Satisfaction | | | | | |
|---|---|---|---|---|---|---|---|
| Location | Responses | Excellent | Good | Fair | Poor | Unsure | None Used |
| | | -----% of responses----- | | | | | |
| Grafton | 52 | 0 | 0 | 0 | 15 | 0 | 85 |
| Fargo | 36 | 14 | 33 | 6 | 3 | 0 | 44 |
| Wahpeton | 42 | 10 | 60 | 19 | 2 | 0 | 10 |
| Willmar | 108 | 32 | 48 | 10 | 1 | 1 | 7 |
| Total | 238 | 18 | 37 | 9 | 5 | <1 | 30 |

**Table 17. Mechanical weed control methods used in sugarbeet in 2016.**

| Location | Responses | Rotary Hoe | Row-Cultivation | Hand-Weeded | Other | None |
|---|---|---|---|---|---|---|
| | | -----% of responses----- | | | | |
| Grafton | 51 | 2 | 2 | 12 | 4 | 80 |
| Fargo | 37 | 0 | 8 | 46 | 0 | 46 |
| Wahpeton | 48 | 2 | 4 | 23 | 4 | 67 |
| Willmar | 130 | 1 | 32 | 40 | 3 | 25 |
| Total | 266 | 1 | 18 | 32 | 3 | 46 |

**Table 18. Percent of sugarbeet acres row-crop cultivated in 2016.**

| | | % Acres Row-Cultivated | | | | |
|---|---|---|---|---|---|---|
| Location | Responses | 0 | < 10 | 10-50 | 51-100 | >100 |
| | | -----% of responses----- | | | | |
| Grafton | 51 | 59 | 29 | 8 | 2 | 2 |
| Fargo | 35 | 74 | 23 | 0 | 3 | 0 |
| Wahpeton | 46 | 70 | 22 | 9 | 0 | 0 |
| Willmar | 103 | 48 | 12 | 8 | 7 | 26 |
| Total | 235 | 58 | 19 | 7 | 4 | 12 |

**Table 19. Number of row-crop cultivation passes in sugarbeet in 2016.**

| Location | Responses | 1 | 2 | 3 | 4 | No Row-Cultivation |
|---|---|---|---|---|---|---|
| | | -----% of responses----- | | | | |
| Grafton | 53 | 32 | 0 | 0 | 2 | 66 |
| Fargo | 34 | 24 | 0 | 0 | 0 | 76 |
| Wahpeton | 44 | 16 | 5 | 0 | 0 | 80 |
| Willmar | 105 | 38 | 4 | 0 | 0 | 58 |
| Total | 236 | 31 | 3 | 0 | <1 | 67 |

**Table 20. Satisfaction of weed control from row-crop cultivation in sugarbeet in 2016.**

| Location | Responses | Excellent | Good | Fair | Poor | Unsure | No Row-Cultivation |
|---|---|---|---|---|---|---|---|
| | | -----% of responses----- | | | | | |
| Grafton | 48 | 6 | 0 | 4 | 15 | 8 | 67 |
| Fargo | 35 | 0 | 9 | 17 | 0 | 6 | 69 |
| Wahpeton | 44 | 2 | 0 | 20 | 0 | 2 | 75 |
| Willmar | 105 | 3 | 16 | 18 | 2 | 4 | 57 |
| Total | 232 | 3 | 9 | 16 | 4 | 5 | 64 |

**Table 21. Percent of sugarbeet acres hand-weeded in 2016.**

| Location | Responses | % Acres Hand-Weeded | | | | |
|---|---|---|---|---|---|---|
| | | 0 | < 10 | 10-50 | 51-100 | >100 |
| | | -----------------------------------% of responses----------------------------- | | | | |
| Grafton | 51 | 71 | 12 | 0 | 0 | 18 |
| Fargo | 36 | 42 | 50 | 8 | 0 | 0 |
| Wahpeton | 45 | 67 | 27 | 2 | 2 | 2 |
| Willmar | 103 | 43 | 30 | 19 | 4 | 4 |
| Total | 235 | 53 | 29 | 10 | 2 | 6 |

**Table 22. Cost per acre for hand-weeding for hand weeding sugarbeet in 2016.**

| Location | Responses | Cost of Hand-Weeding per Acre | | | | | |
|---|---|---|---|---|---|---|---|
| | | <$9.99 | $10-$19.99 | $20-$29.99 | $30-$39.99 | $40+ | No Hand-Weeding |
| | | ----------------------------------------% of responses------------------------------------- | | | | | |
| Grafton | 51 | 12 | 0 | 0 | 2 | 14 | 73 |
| Fargo | 35 | 46 | 6 | 0 | 0 | 6 | 43 |
| Wahpeton | 43 | 12 | 9 | 5 | 0 | 5 | 70 |
| Willmar | 105 | 17 | 29 | 6 | 3 | 2 | 44 |
| Total | 234 | 19 | 15 | 3 | 2 | 6 | 55 |

**Table 23. Satisfaction of weed control from hand-weeding sugarbeet in 2016.**

| Location | Responses | Excellent | Good | Fair | Poor | Unsure | No Hand-Weeding |
|---|---|---|---|---|---|---|---|
| | | ---------------------------------% of responses--------------------------- | | | | | |
| Grafton | 50 | 4 | 2 | 6 | 16 | 0 | 72 |
| Fargo | 35 | 31 | 11 | 9 | 9 | 0 | 40 |
| Wahpeton | 44 | 9 | 14 | 2 | 2 | 0 | 73 |
| Willmar | 103 | 6 | 31 | 17 | 4 | 1 | 41 |
| Total | 232 | 10 | 19 | 11 | 7 | <1 | 53 |

# WEED CONTROL FROM ETHOFUMESATE APPLIED POSTEMERGENCE IN SUGARBEET

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## SUMMARY

Ethofumesate applied postemergence (POST) twice at rates ranging from 12 to 64 fl oz/A suppressed but did not control lambsquarters and redroot pigweed. Ethofumesate POST is not an effective lambsquarters or pigweed herbicide and cannot be considered a second mode of action for control.
Ethofumesate alone or ethofumesate plus glyphosate improved waterhemp control compared to glyphosate alone. Control might be related to timing of waterhemp germination and emergence compared to lambsquarters or redroot pigweed.
Ethofumesate applied twice at rates ranging from 12 to 64 fl oz/A alone or with glyphosate at 28 fl oz/A caused only minor sugarbeet injury.

## INTRODUCTION

Ethofumesate is a time-proven herbicide for grass and small-seeded broadleaf weed control in sugarbeet. Field research from Kansas and Colorado in 1970 indicated 'NC 8438' (ethofumesate) provided greater than 90% green foxtail, foxtail millet, and barnyardgrass control and near 90% redroot pigweed control (Sullivan and Fagala, 1970). Ethofumesate is soil-applied at field use rates up to 7.5 pt/A or applied postemergence up to 12 fl oz/A. Ethofumesate is absorbed by emerging shoots and roots and is translocated to the shoots where it is believed to interfere with lipid biosynthesis (Eshel et al., 1978, Abulnaja et al., 1992). Ethofumesate is sold in the United States using the trade names 'Nortron' by Bayer CropScience, 'Ethotron SC' by UPI, and 'Ethofumesate 4SC' by Willowood USA. Willowood USA is collaborating with the Beet Sugar Development Foundation to develop a new label to expand Ethofumesate 4SC postemergence use rates from 0.8 to 8 pt/A to sugarbeet having greater than two true leaves. Ethofumesate applied in combination with glyphosate may provide an effective second mode of action to complement glyphosate, especially for difficult to control broadleaf weeds in sugarbeet including common lambsquarters, kochia, waterhemp, and common ragweed. However, little is known about postemergence broadleaf weed control from ethofumesate, especially at rates greater than 12 fl oz/A.

Probe experiments were conducted in 2017 to evaluate weed efficacy and sugarbeet safety from single or multiple ethofumesate applications alone or with glyphosate applied postemergence. These probe experiments will serve as a basis for Mrs. Alexa Lystad's MS degree research and will provide recommendations for use of ethofumesate for weed control in sugarbeet grower fields in 2018. The objectives of this research were to determine: a) is ethofumesate safe to sugarbeet; and b) does ethofumesate control weeds?

## MATERIALS AND METHODS

Experiments were conducted on indigenous populations of common lambsquarters and redroot pigweed in sugarbeet grower fields near Moorhead and Oslo, Minnesota and Grand Forks, Minto, and Prosper, North Dakota in 2017. Experimental area was prepared with a Kongskilde 's-tine' field cultivator equipped with rolling baskets or with grower cooperator tillage equipment before planting. Experiments were established in fields in 1 or 2 days after grower cooperator planted field to sugarbeet. Herbicide treatments were applied when sugarbeet was at the 2-lf and 6-leaf stage with a bicycle wheel sprayer in 17 gpa spray solution through 8002 XR flat fan nozzles pressurized with CO2 at 40 psi to the center four rows of six row plots 30 feet long. Treatments consisted of two applications of ethofumesate at 6, 12, 18, 24, 32 and 64 fl oz/A either alone or with glyphosate at 28 fl oz/A. All treatments of ethofumesate alone contained Destiny HC at 1.5 pt/A. Treatments of ethofumesate plus Roundup PowerMax (glyphosate) contained Destiny HC at 1.5 pt/A plus N-Pak ammonium sulfate at 2.5% v/v. Destiny HC and N-Pak AMS were provided by Winfield United.

Sugarbeet injury and common lambsquarters and/or redroot pigweed control were a visual estimate of percent fresh weight reduction in the four treated rows compared to the adjacent untreated strip. Experimental design was randomized complete block with 4 replications. Data were analyzed with the ANOVA procedure of ARM, version 2017.4 software package.

**RESULTS**

Common lambsquarters control from two postemergence applications of ethofumesate ranged from 0 to 78% across rates and locations (Table 1). Lambsquarters control averaged across ethofumesate rates alone ranged from 27% at Prosper to 49% at Minto. Lambsquarters control generally increased as ethofumesate rate increased from 6 to 64 fl oz/A. However, lambsquarters control was not adequate at any rate within location or at any location for ethofumesate to be considered a stand-alone herbicide for controlling lambsquarters.

Lambsquarters control from two applications of Roundup PowerMax (glyphosate) at 28 fl oz/A was 70% and 90% at Moorhead and Oslo, respectfully. Ethofumesate + glyphosate tended to improve lambsquarters control compared to ethofumesate or glyphosate alone.

**Table 1. Common lambsquarters control, 27 to 48 DAT, at Moorhead and Oslo, MN and Grand Forks, Minto, and Prosper, ND, 2017**

| Treatment[1] | Rate | Application timing[2] | Moorhead MN | Oslo MN | Grand Forks ND | Minto ND | Prosper ND |
|---|---|---|---|---|---|---|---|
| | fl oz/A | | -------------------% control-------------------- | | | | |
| Ethofumesate / Ethofumesate | 6 / 6 | A/ B | 20 | 20 | 0 | 25 | 13 |
| Ethofumesate / Ethofumesate | 12 / 12 | A/ B | 28 | 35 | 28 | 40 | 15 |
| Ethofumesate / Ethofumesate | 18 / 18 | A/ B | 35 | 38 | 30 | 48 | 30 |
| Ethofumesate / Ethofumesate | 24 / 24 | A/ B | 35 | 40 | 43 | 60 | 33 |
| Ethofumesate / Ethofumesate | 32 / 32 | A/ B | 50 | 40 | 53 | 55 | 35 |
| Ethofumesate / Ethofumesate | 64 / 64 | A/ B | 53 | 58 | 78 | 63 | 33 |
| PowerMax[3] / PowerMax | 28 / 28 | A / B | 70 | 90 | 100 | 98 | 95 |
| Etho + PMax / Etho + PMax | 6 + 28/6 + 28 | A/ B | 78 | 98 | 100 | 90 | 100 |
| Etho + PMax / Etho + PMax | 12 + 28/12 + 28 | A/ B | 78 | 94 | 100 | 98 | 100 |
| Etho + PMax / Etho + PMax | 18 +28/18 + 28 | A/ B | 70 | 100 | 100 | 95 | 100 |
| Etho + PMax / Etho + PMax | 24 +28/24 + 28 | A/ B | 78 | 100 | 100 | 100 | 100 |
| Etho + PMax / Etho + PMax | 32 +28/32 + 28 | A/ B | 78 | 99 | 100 | 100 | 100 |
| Etho + PMax / Etho + PMax | 64 +28/64 + 28 | A/ B | 83 | 99 | 100 | 100 | 100 |
| **LSD (0.05)** | | | **10** | **10** | **10** | **12** | **11** |

[1]Treatments of Ethofumesate + Roundup PowerMax were applied with N-Pak AMS at 2.5% v/v and Destiny HC at 1.5 pt/A; Ethofumesate was applied with Destiny HC at 1.5 pt/A
[2]Application timing A=2 lf sugarbeet; B= 6 lf sugarbeet
[3]PowerMax or PMax=Roundup PowerMax; Etho=ethofumesate

Redroot pigweed control from ethofumesate was evaluated at Minto and Prosper, ND and Oslo, MN. Pigweed control ranged from 15% to 70% across ethofumesate rates and locations (Table 2). Pigweed control averaged across ethofumesate rates was 34%, 22%, and 41%, at Oslo, Minto, and Prosper, respectfully, or similar to lambsquarters control. As with lambsquarters, ethofumesate applied postemergence is not an effective stand-alone herbicide for controlling redroot pigweed.

Waterhemp control from ethofumesate at Moorhead was a different story than redroot pigweed or lambsquarters. Waterhemp control ranged from 95% from two applications of ethofumesate at 12 fl oz/A to 100% control from two applications at 32 fl oz/A. Waterhemp control tended to increase as the ethofumesate rate increased from 6 to 64 fl oz/A. Waterhemp control from ethofumesate was superior to control from glyphosate.

Differences in broadleaf control from ethofumesate might be related to weed species emergence patterns and application timing. We know the number of growing degree days to trigger lambsquarters and redroot pigweed germination and emergence is much less (lambsquarters) to less (redroot pigweed) than waterhemp (Werle, 2014). Also, since we know that ethofumesate does not translocate from treated leaves to new tissue in emerged vegetation (Eshel, 1978), then it is likely that ethofumesate applied postemergence does little to control emerged weeds but is effective on later flushes once activated by precipitation.

**Table 2. Redroot pigweed and waterhemp (Moorhead) control, 30 to 41DAT, at Moorhead and Oslo, MN and Minto, and Prosper, ND, 2017**

| | | | Waterhemp | Redroot pigweed | | |
|---|---|---|---|---|---|---|
| **Treatment[1]** | **Rate** | **Application timing[2]** | **Moorhead MN** | **Oslo MN** | **Minto ND** | **Prosper ND** |
| | fl oz/A | | ---------------------% control ---------------------- | | | |
| Ethofumesate / Ethofumesate | 6 / 6 | A/ B | 83 | 25 | 15 | 23 |
| Ethofumesate / Ethofumesate | 12 / 12 | A/ B | 95 | 35 | 15 | 28 |
| Ethofumesate / Ethofumesate | 18 / 18 | A/ B | 95 | 33 | 18 | 38 |
| Ethofumesate / Ethofumesate | 24 / 24 | A/ B | 98 | 28 | 20 | 40 |
| Ethofumesate / Ethofumesate | 32 / 32 | A/ B | 100 | 33 | 25 | 45 |
| Ethofumesate / Ethofumesate | 64 / 64 | A/ B | 99 | 50 | 40 | 70 |
| PowerMax[3] / PowerMax | 28 / 28 | | 68 | 93 | 95 | 100 |
| Etho + PMax / Etho + PMax | 6 + 28/6 + 28 | A/ B | 95 | 100 | 90 | 100 |
| Etho + PMax / Etho + PMax | 12 + 28/12 + 28 | A/ B | 98 | 95 | 95 | 100 |
| Etho + PMax / Etho + PMax | 18 +28/18 + 28 | A/ B | 100 | 100 | 93 | 100 |
| Etho + PMax / Etho + PMax | 24 +28/24 + 28 | A/ B | 100 | 100 | 90 | 100 |
| Etho + PMax / Etho + PMax | 32 +28/32 + 28 | A/ B | 100 | 99 | 94 | 100 |
| Etho + PMax / Etho + PMax | 64 +28/64 + 28 | A/ B | 100 | 100 | 98 | 100 |
| **LSD (0.05)** | | | **8** | **10** | **8** | **15** |

[1]Treatments of Ethofumesate + Roundup PowerMax were applied with N-Pak AMS at 2.5% v/v and Destiny HC at 1.5 pt/A; Ethofumesate was applied with Destiny HC at 1.5 pt/A
[2]Application timing A=2 lf sugarbeet; B= 6 lf sugarbeet
[3]PowerMax or PMax=Roundup PowerMax; Etho=ethofumesate

Sugarbeet injury from two applications of ethofumesate alone was negligible across locations in these experiments (Table 3). Sugarbeet injury was negligible even when ethofumesate rate increased from 6 to 64 fl oz/A. Sugarbeet injury from ethofumesate plus glyphosate was similar to injury from either ethofumesate or glyphosate alone.

**Table 3. Sugarbeet injury, 27 to 48 DAT, at Moorhead and Oslo, MN and Grand Forks, Minto, and Prosper, ND, 2017**

| **Treatment[1]** | **Rate** | **Application timing[2]** | **Moorhead MN** | **Oslo MN** | **Grand Forks ND** | **Minto ND** | **Prosper ND** |
|---|---|---|---|---|---|---|---|
| | fl oz/A | | --------------------% injury-------------------- | | | | |
| Ethofumesate / Ethofumesate | 6 / 6 | A/ B | 8 | 3 | 0 | 0 | 3 |
| Ethofumesate / Ethofumesate | 12 / 12 | A/ B | 0 | 5 | 0 | 0 | 0 |
| Ethofumesate / Ethofumesate | 18 / 18 | A/ B | 3 | 3 | 0 | 0 | 3 |
| Ethofumesate / Ethofumesate | 24 / 24 | A/ B | 3 | 3 | 0 | 0 | 3 |
| Ethofumesate / Ethofumesate | 32 / 32 | A/ B | 3 | 3 | 3 | 5 | 0 |
| Ethofumesate / Ethofumesate | 64 / 64 | A/ B | 3 | 8 | 0 | 0 | 10 |
| PowerMax / PowerMax | 28 / 28 | A / B | 0 | 3 | 0 | 0 | 3 |
| Etho + PMax / Etho + PMax | 6 + 28/6 + 28 | A/ B | 3 | 5 | 0 | 0 | 0 |
| Etho + PMax / Etho + PMax | 12 + 28/12 + 28 | A/ B | 3 | 3 | 0 | 3 | 0 |
| Etho + PMax / Etho + PMax | 18 +28/18 + 28 | A/ B | 0 | 3 | 0 | 3 | 3 |
| Etho + PMax / Etho + PMax | 24 +28/24 + 28 | A/ B | 7 | 5 | 3 | 0 | 8 |
| Etho + PMax / Etho + PMax | 32 +28/32 + 28 | A/ B | 13 | 5 | 0 | 0 | 0 |
| Etho + PMax / Etho + PMax | 64 +28/64 + 28 | A/ B | 5 | 10 | 5 | 3 | 8 |
| **LSD (0.05)** | | | **NS** | **NS** | **NS** | **NS** | **NS** |

[1]Treatments of Ethofumesate + Roundup PowerMax were applied with N-Pak AMS at 2.5% v/v and Destiny HC at 1.5 pt/A; Ethofumesate was applied with Destiny HC at 1.5 pt/A
[2]Application timing A=2 lf sugarbeet; B= 6 lf sugarbeet
[3]PowerMax or PMax=Roundup PowerMax; Etho=ethofumesate

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# CONTINUED REFINEMENT OF THE WATERHEMP CONTROL STRATEGY IN SUGARBEET

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**SUMMARY**

Chloroacetamide herbicide application timing tended to have a greater effect on waterhemp control than choice of chloroacetamide herbicide.
Split application of chloroacetamide herbicides improved waterhemp control compared to a single chloroacetamide herbicide application.
Applying Dual Magnum preemergence (PRE) fb a chloroacetamide herbicide lay-by improved waterhemp control compared to chloroacetamide alone.
Lambsquarters control from glyphosate + ethofumesate was not affected by chloroacetamide herbicide applied with glyphosate and ethofumesate (data not presented).

**INTRODUCTION**

Survey data indicates waterhemp is the primary weed control challenge in sugarbeet fields in Southern Minnesota Beet Sugar Cooperative, in Minn-Dak Farmers' Cooperative, and in fields south of Grand Forks in American Crystal Sugar Cooperative. Waterhemp populations are a mixture of glyphosate susceptible and resistant biotypes. Roundup PowerMax at 28 fl oz/A controlled 78% of the first flush of emerged waterhemp based on waterhemp counts taken immediately prior to and 9 days following application (Peters, 2015). However, control does not improve by increasing the glyphosate rate or with repeat glyphosate applications. Early-season weed escapes cause late-season weed control failures and weed disasters at harvest. There are no effective POST herbicide options for rescue control of resistant biotypes, especially when waterhemp is greater than 4-inches tall.

Ethofumesate or Ro-Neet provide effective early-season waterhemp control but are expensive or do not provide full-season control (Peters, 2016). Use of site of action (SOA) 15 herbicides (chloroacetamides) applied early postemergence (EPOST) provide the most effective and consistent waterhemp control (Peters, 2015; Peters, 2016; Peters, 2017). However, several important statements should be made about chloroacetamide herbicides and waterhemp control. First, sugarbeet must reach the 2-leaf stage before chloroacetamides can be applied. Thus, planting date influences how and when they can be applied. Second, chloroacetamides need to be activated by timely precipitation in order to control waterhemp. Third, waterhemp seems to be emerging earlier in the spring. Are we selecting for earlier germinating biotypes or have we improved awareness and identification? Maybe some of both. Finally, sugarbeet grower surveys indicate approximately 85% satisfaction (excellent or good response) with current waterhemp control strategies. How can we improve satisfaction to 90% or 95%?

Waterhemp control in soybean was improved using repeat application of chloroacetamide herbicides; a practice referred to as 'layering' (Steckel, 2002). Sugarbeet experiments conducted at Herman and Moorhead, MN in 2015 investigate repeat applications of chloroacetamide herbicides in sugarbeet. Dual Magnum (s-metolachlor) at 0.5 pt/A was applied PRE followed by glyphosate + ethofumesate plus either S-metolachlor, Warrant or Outlook at 2-lf sugarbeet stage. Waterhemp control averaged greater than 90% using the layering strategy compared to S-metolachlor, Warrant, or Outlook applied EPOST (Figure 1).

Outlook often is split-applied at 12 fl oz/A at the 2-leaf sugarbeet stage followed by 12 fl oz/A at the 6-leaf stage. This practice is common when glyphosate plus Outlook is tank-mixed with an insecticide for black cutworm control since there is a concern that applying multiple products formulated as emulsifiable concentrates may injury sugarbeet, especially under cold and wet spring environmental conditions. Split application can also improve waterhemp control consistency (conversation with Jim Radermacher, 2015). Split lay-by application buffers against the possibility of inadequate or untimely precipitation since the first application in May is followed by a second application, 14 to 21 days later, in June.

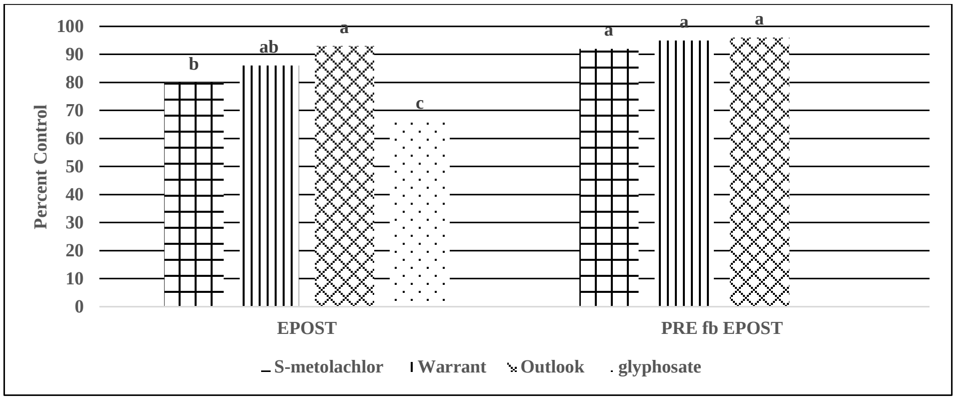


**Figure 1. Waterhemp control from soil-residual herbicides applied early postemergence (EPOST) or S-Metolachlor at 0.5 pt/A preemergence (PRE) followed by soil-residual herbicides applied EPOST, averaged across Herman and Moorhead, MN, 2015.**

Following successes with Outlook, sugarbeet growers and Agriculturalists have asked if Warrant and S-metolachlor should also be split-applied. The objectives of 2016 and 2017 experiments were to evaluate sugarbeet safety and waterhemp control at multiple locations from: a) Dual Magnum PRE-followed by S-metolachlor, Warrant, or Outlook EPOST in single or multiple applications and; b) S-metolachlor, Warrant, or Outlook EPOST in single or multiple applications. This report summarizes experiments conducted at Roseland, MN in 2016 and Lake Lillian, MN, and Galchutt, ND in 2017.

## MATERIALS AND METHODS

Experiments were conducted on natural populations of waterhemp near Moorhead, MN in 2016 and Lake Lillian, MN and Galchutt, ND in 2017. Experimental area was prepared using a field cultivator prior to planting. Hilleshog 'HM4302RR' sugarbeet treated with Tachigaren, at 45 grams product, Cruiser Maxx (contains Cruiser 5FS at 60 gram active ingredient (g a.i.), Apron XL at 15 g a.i., and Maxim 4FS at 2.5 g a.i.) and Vibrance at 2g a.i. per 100,000 seeds was seeded 1.25 inches deep in 22 inch rows at 60,825 seeds per acre on May 12, 2016 at Moorhead. Crystal 'M380' sugarbeet treated with Tachigaren and Kabina at 45 g product and 14 g a.i. per 100,000 seeds, respectfully, was seeded 0.5 inches deep in 22 inch rows at 62,100 seeds per acre on May 8, 2017 at Lake Lillian, MN. 'HM4022RR' sugarbeet treated with Tachigaren, at 45 grams product, Cruiser Maxx (contains Cruiser 5FS at 60 gram active ingredient (g a.i.), Apron XL at 15 g a.i., and Maxim 4FS at 2.5 g a.i.) and Vibrance at 2g a.i. per 100,000 seeds was seeded 1.25 inches deep in 22 inch rows at 60,825 seeds per acre on May 9, 2017 at Galchutt.

**Table 1. Application information for sugarbeet trial near Moorhead, MN in 2016.**

| Application code | A | B | C |
|---|---|---|---|
| Date | May 16 | June 6 | June 20 |
| Time of Day | 9:00 AM | 2:00 PM | 2:30 PM |
| Air Temperature (F) | 51 | 67 | 73 |
| Relative Humidity (%) | 56 | 56 | 37 |
| Wind Velocity (mph) | 7 | 12 | 10 |
| Wind Direction | N | NW | NW |
| Soil Temp. (F at 6") | 48 | 62 | 70 |
| Soil Moisture | Poor | Good | Good |
| Cloud Cover (%) | 80 | 90 | 10 |
| Sugarbeet stage (avg) | PRE | 4-6 lf | 10 lf |
| Waterhemp | - | 0.5 inch | 1-3 inch |

Herbicide treatments were applied at Moorhead on May 16, June 6, and June 20, 2016; May 11, June 1, and June 16, 2017 at Lake Lillian, and May 9, June 1, and June 20, 2017 at Galchutt. All treatments were applied with a bicycle sprayer in 17 gpa spray solution through 8002 XR flat fan nozzles pressurized with $CO_2$ at 40 psi to the center four rows of six row plots 30 feet in length in fields with moderate to heavy infestations of glyphosate-resistant waterhemp. Ammonium sulfate (AMS) in all treatments was 'N-Pak' AMS, a liquid formulation from Winfield United. 'Destiny HC' high surfactant methylated oil concentrate (HSMOC) was also used and is a product from Winfield United.

**Table 2. Application information for sugarbeet trial near Lake Lillian, MN in 2017.**

| Application code | A | B | C |
|---|---|---|---|
| Date | May 11 | June 1 | June 16 |
| Time of Day | 9:00 AM | 9:00 AM | 9:00 AM |
| Air Temperature (F) | 58 | 70 | 79 |
| Relative Humidity (%) | 27 | 27 | 42 |
| Wind Velocity (mph) | 12 | 3 | 5-10 |
| Wind Direction | NNW | SSW | SSE |
| Soil Temp. (F at 6") | 68 | 70 | - |
| Soil Moisture | Good | Good | Good |
| Cloud Cover (%) | - | - | Partly Cloudy |
| Sugarbeet stage (avg) | PRE | 2-4 lf | 6-8 lf |
| Waterhemp | - | 0.5 inch | 1-3 inch |

Sugarbeet injury was evaluated June 24 and July 22, 2016 at Moorhead, June 6, June 26 and July 6, 2017 at Lake Lillian, and June 16, 2017 at Galchutt. Waterhemp control was evaluated June 24, June 28, July 22, and August 24, 2016 at Moorhead, June 15, June 26 and July 6, 2017 at Lake Lillian and June 16, July 5, and July 24, 2017 at Galchutt. Common lambsquarters and redroot pigweed control also was evaluated at each location, but data are not included in this report since glyphosate provided complete or near complete control of both species. All evaluations were a visual estimate of percent fresh weight reduction in the four treated rows compared to the adjacent untreated strip. Experimental design was randomized complete block with 4 replications. Data were analyzed with the ANOVA procedure of ARM, version 2017.4 software package.

**Table 3. Application information for sugarbeet trial near Galchutt, ND in 2017.**

| Application code | A | B | C |
|---|---|---|---|
| Date | May 9 | June 1 | June 20 |
| Time of Day | 12:00 PM | 9:00 AM | 12:00 PM |
| Air Temperature (F) | 64 | 70 | 68 |
| Relative Humidity (%) | 37 | 32 | 47 |
| Wind Velocity (mph) | 10 | 3 | 6 |
| Wind Direction | NW | S | NW |
| Soil Temp. (F at 6") | 54 | 59 | 64 |
| Soil Moisture | Good | Good | Good |
| Cloud Cover (%) | 50 | 10 | 10 |
| Sugarbeet stage (avg) | PRE | 2-lf | 8-10 lf |
| Waterhemp | - | 1 inch | 2 inch |

**RESULTS**

Waterhemp control was influenced by herbicide and application timing at Moorhead in 2016 and Lake Lillian and Galchutt in 2017 (Figure 2, Figure 3, Figure 4). In general, application timing had greater influence on waterhemp control than chloroacetamide herbicide.

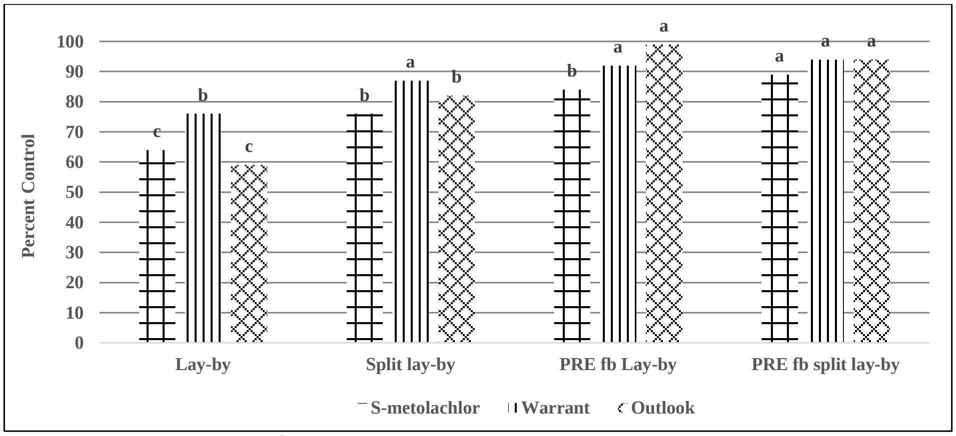


**Figure 2. Waterhemp control from single lay-by or split lay-by herbicide applications and S-metolachlor preemergence (PRE) followed by lay-by or split lay-by herbicide applications, Moorhead, MN in 2016, average of July 22 and August 24 evaluation.**

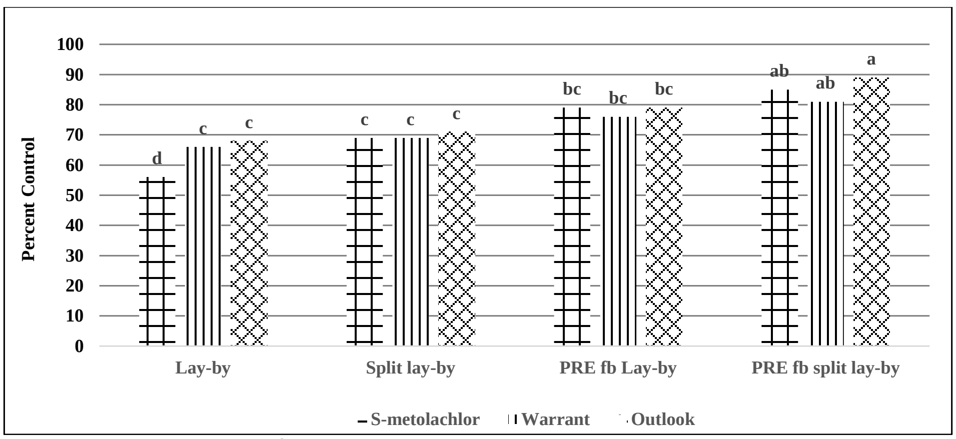


**Figure 3. Waterhemp control from single lay-by or split lay-by herbicide applications and S-metolachlor preemergence (PRE) followed by lay-by or split lay-by herbicide applications, Lake Lillian, MN, 2017, July 6 evaluation.**

There are several factors to consider when selecting a chloroacetamide herbicide for waterhemp control aside from relationships with a company or company representatives. Warrant costs less per acre on a rate basis than Outlook or S-metolachlor. Outlook is more water soluble than either S-metolachlor or Warrant and requires less precipitation for activation. Once activated, Warrant has longer residual than Outlook or S-metolachlor. Outlook and Warrant have a broader weed control spectrum than S-metolachlor. However, sugarbeet can be planted directly into S-metolachlor residues in the event of replant whereas three to four weeks' time is required before residue levels of Outlook and Warrant will allow sugarbeet replanting. Finally, S-metolachlor and Warrant are safer on sugarbeet than Outlook although injury generally is negligible with all chloroacetamide herbicides. Most of the factors to consider when selecting a chloroacetamide herbicide are based more around risk of sugarbeet injury than level of waterhemp control.

Waterhemp control from chloroacetamide herbicides was evaluated across locations in 2014 to 2017. Precipitation followed within 7-days of chloroacetamide activation in 2014 and 2015. However, timely precipitation did not occur in 2016 or 2017. 2016 was a dry spring, creating erratic germination and emergence patterns in experiments and in grower fields. Early postemergence chloroacetamide application was delayed five days to account for erratic emergence at the Moorhead location. Likewise, precipitation was spotty and possibly up to 24 days between the precipitation event that activated PRE herbicides and precipitation events to activate lay-by herbicides in 2017 at Lake Lillian. These climate phenomena partially explain waterhemp control observations in fields in 2016 and 2017 (Figure 2 and Figure 3).

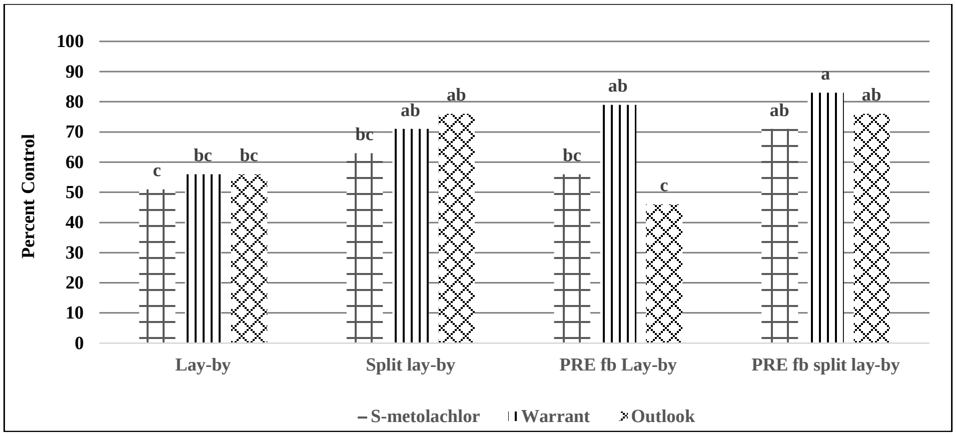


**Figure 4. Waterhemp control from single lay-by or split lay-by herbicide applications and S-metolachlor preemergence (PRE) followed by lay-by or split lay-by herbicide applications, Galchutt, ND, 2017, July 25 evaluation.**

The Galchutt, ND location received timely precipitation for activation of herbicides in 2017 (Figure 4). However, there was significant sugarbeet stand loss caused by rhizoctonia root rot, possibly caused by above average precipitation in June and July. Stand loss created an open canopy suitable for waterhemp germination and emergence well into July. Under these conditions, split application of chloroacetamide herbicides (EPOST fb POST) or PRE followed by split applications of chloroacetamide herbicides tended to provide better waterhemp control than single lay-by application of chloroacetamide herbicide alone or following PRE S-metolachlor.

At each of the three locations, 12 different treatment combinations of herbicide (S-metolachlor, Warrant, and Outlook) and timing (lay-by, split lay-by, PRE fb lay-by, and PRE fb split lay-by) were tested for a total of 36 observable treatments. In an effort to compare these treatments and determine which method of application resulted in the greatest and most constant control across locations, the following steps were taken. At each evaluation from each location, waterhemp control data was ranked in numerical order from greatest control to least control based upon the least significant difference (LSD). Herbicide treatments that were statistically the same as the best treatment at each evaluation timing from each location were grouped into a cluster and labeled 'good'. The remaining treatments were once again ranked and grouped into a second and third cluster based on LSD value and labeled 'fair' and 'poor', respectively. Clusters were titled 'good', 'fair' and 'poor' since treatments in the good cluster generally corresponded to 80% or greater waterhemp control, the fair cluster corresponded to 80 to 65% waterhemp control, and the poor cluster corresponded to 65 to 40% waterhemp control. Chloroacetamide herbicides were combined and were grouped by application timing into four classes: lay-by, split lay-by, PRE fb lay-by, and PRE fb split lay-by. The number of observations corresponding to each cluster (good, fair, or poor) were summed and are presented in Figure 5. Data indicates PRE fb lay-by and PRE fb split lay-by application methods provided the most consistent waterhemp control across locations and years.

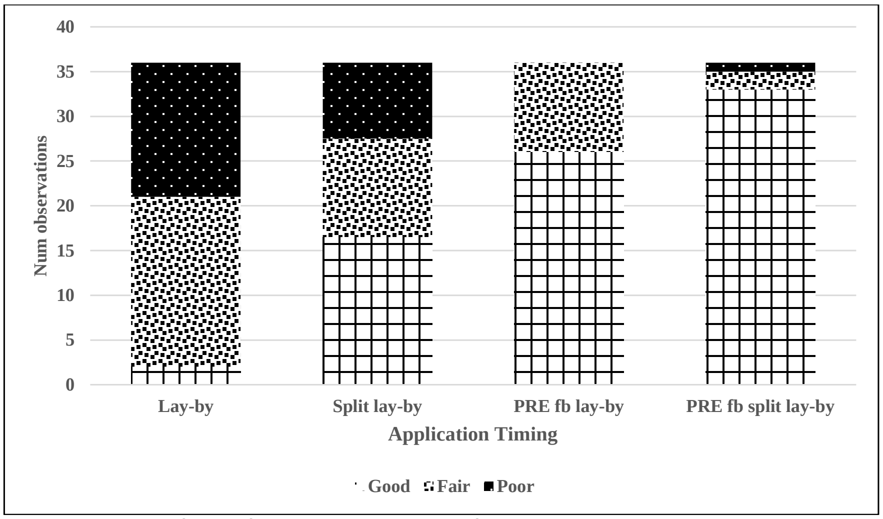


**Figure 5. Number of good, fair, and poor estimates of waterhemp control across herbicides and application timing, summed across evaluations, locations, and years**

## CONCLUSIONS

Sugarbeet planting date is likely the most important factor to consider for herbicide selection and application timing for waterhemp control (Table 4). Split lay-by application of chloroacetamide herbicides is the preferred approach for waterhemp control for early planted sugarbeet. However, PRE followed by a split lay-by application buffers risk against early germinating weeds or uncertainty of when precipitation will occur to activate lay-by herbicides, even in early planted sugarbeet.

Late planted sugarbeet may not reach the sugarbeet 2-lf stage by May 15 (date when the growing degree day model typically forecasts waterhemp germination and emergence). Thus, Dual Magnum and/or ethofumesate should be applied PRE followed by split lay-by application of chloroacetamide herbicides. Timing of the lay-by applications will be dependent on sugarbeet planting date, precipitation to activate PRE, and waterhemp pressure in the field.

Continue to scout sugarbeet fields for waterhemp in July and August. Tank-mixes of Betamix or UpBeet with Roundup plus ethofumesate or cultivation are recommended for POST waterhemp control. Apply in combination with HSMOC adjuvant at 1.5 pt/A and AMS at 8.5 to 17 lb/100 gallon water carrier.

**Table 4. Recommendation for waterhemp control in sugarbeet, by planting date.**

| **Planting Date** | **Recommendation** |
|---|---|
| **Plant Sugarbeet in April** | Split lay-by application (early postemergence / postemergence) of chloroacetamide herbicides applied at 2-lf sugarbeet fb 4 to 6-lf sugarbeet |
| | Dual Magnum and/or ethofumesate PRE followed by a split lay-by application at 2 to 4-lf stage fb 4 to 6-lf stage |
| | Single lay-by application when sugarbeet is at the 2-lf stage or greater |
| **Plant Sugarbeet in May** | Dual Magnum and/or ethofumesate PRE followed by a split lay-by |
| **Either** | Continue to scout fields for late germinating waterhemp in late June and July |
| **Either** | Be prepared to rescue with Betamix + ethofumesate, UpBeet + ethofumesate or Betamix + UpBeet (be aware of resistant biotypes) |

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- North Dakota State University Experiment Station and University of Minnesota Crookston Research and Outreach Center

**COMPARING HERBICIDES FOR BROADLEAF WEED CONTROL IN SUGARBEET**

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The objective of this study was to evaluate broadleaf weed control from single applications of individual herbicides currently registered for use in Roundup Ready (RR) sugarbeet.

**MATERIALS AND METHODS**

An experiment was conducted near Hickson, ND in 2017. Fertilizer was spread April 11 and incorporated the same day with a field cultivator equipped with a spring tooth harrow. The trial site was prepared using a Kongskilde 's-tine' field cultivator with rolling baskets on May 13, 2017. Four-foot-wide strips of bioassay species including canola, amaranth, quinoa, and flax were seeded perpendicular to sugarbeet on May 13. Seedex 'Winchester' sugarbeet, treated with NipsIt Suite, Tachigaren at 45g per unit, and Kabina at 7g per unit, were then seeded in 22-inch rows at 60,560 seeds per acre on May 13 with a John Deere 1700XP 6-row planter. Post emergence (POST) treatments were applied June 9. All herbicide treatments were applied with a bicycle sprayer in 17 gpa spray solution through 8002 XR flat fan nozzles pressurized with $CO_2$ at 40 psi to the center four rows of six row plots 35 feet in length.

All sugarbeet injury and weed control evaluations were a visual estimate of percent fresh weight reduction in the four treated rows compared to the adjacent untreated strip. Experimental design was randomized complete block with 4 replications for each trial. Data were analyzed with the ANOVA procedure of ARM, version 2017.4 software package.

**Table 1. Application Information – Hickson, ND 2017**

| | |
|---|---|
| Date | June 9 |
| Time of Day | 12:30 PM |
| Air Temperature (F) | 82 |
| Relative Humidity (%) | 42 |
| Wind Velocity (mph) | 9 |
| Wind Direction | SE |
| Soil Temp. (F at 6") | 69 |
| Soil Moisture | Fair |
| Cloud Cover (%) | 30 |
| Next Rainfall (amount) | June 11 (0.11") |
| Sugarbeet Stage | 4 leaf |
| Amaranth (and natural redroot pigweed) | 2-6 lf / avg 4 lf |
| RR canola | 2-4 lf/ avg 3 lf (2" tall) |
| Flax | 2-4 inch / avg 3 inch |
| Quinoa (and natural common lambsquarters) | 2-3 inch/ avg 3 inch |
| Yellow Foxtail | 2-3 inch/ avg 3 inch |

**SUMMARY**

UpBeet (triflusulfuron) is the only ALS (group 2) herbicide registered for use in sugarbeet. No sugarbeet injury was observed in this trial from either 0.5 or 1.0 oz/A of UpBeet (Table 2). UpBeet provided the greatest Roundup Ready canola control of all herbicides evaluated. Canola control increased from 73% to 90% at 13 DAT as rate increased from 0.5 to 1.0 oz/A. UpBeet gave 70 to 78% pigweed control and provided some suppression of lambsquarters, flax, and yellow foxtail.

**Table 2. Sugarbeet injury and weed control from herbicides at Hickson, ND in 2017.**

| | | | 16 Jun | ----------------------22 Jun--------------------- | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Herbicide | Rate | Rate Unit | Sgbt | Sgbt | rrpw[3] | colq[4] | cano[5] | flax | yefx[6] |
| | | | ----% inj---- | | -----------------% cntl----------------- | | | | |
| UpBeet[1] | 0.5 | oz/A | 0 | 0 | 70 | 45 | 73 | 45 | 55 |
| UpBeet[1] | 1 | oz/A | 0 | 0 | 78 | 38 | 90 | 65 | 58 |
| Nortron[1] | 12 | fl oz/A | 5 | 0 | 25 | 25 | 20 | 45 | 0 |
| Nortron[1] | 16 | fl oz/A | 0 | 0 | 35 | 38 | 25 | 45 | 0 |
| Nortron[1] | 32 | fl oz/A | 13 | 0 | 50 | 50 | 35 | 48 | 0 |
| Nortron[1] | 64 | fl oz/A | 3 | 0 | 60 | 58 | 53 | 73 | 0 |
| Stinger[1] | 2 | fl oz/A | 20 | -[7] | 3 | 23 | 0 | 0 | 0 |
| Stinger[1] | 4 | fl oz/A | 20 | - | 3 | 20 | 0 | 0 | 0 |
| Roundup PowerMax[2] | 22 | fl oz/A | 0 | 0 | 99 | 91 | 0 | 100 | 100 |
| Roundup PowerMax[2] | 28 | fl oz/A | 0 | 0 | 100 | 92 | 0 | 100 | 100 |
| Roundup PowerMax[2] | 32 | fl oz/A | 3 | 0 | 100 | 95 | 0 | 100 | 100 |
| Betamix[1] | 12 | fl oz/A | 25 | 0 | 35 | 40 | 20 | 25 | 0 |
| Betamix[1] | 16 | fl oz/A | 40 | 10 | 48 | 53 | 18 | 30 | 5 |
| Betamix[1] | 24 | fl oz/A | 45 | 30 | 60 | 65 | 40 | 35 | 0 |
| Spin-Aid[1] | 12 | fl oz/A | 20 | - | 10 | 53 | 13 | 23 | 0 |
| Spin-Aid[1] | 24 | fl oz/A | 33 | - | 13 | 50 | 23 | 18 | 0 |
| Spin-Aid[1] | 36 | fl oz/A | 45 | - | 23 | 68 | 40 | 35 | 0 |
| **LSD (0.05)** | | | **15** | **-** | **14** | **19** | **11** | **18** | **5** |

[1]Herbicide applied with MSO from Loveland at 2 pt/A + AMS at 8.5 lb/100 gal
[2]Herbicide applied with Prefer 90 NIS from West Central at 0.25% v/v + AMS at 8.5 lb/100 gal
[3]rrpw=redroot pigweed + tame amaranth
[4]colq=common lambsquarters + quinoa
[5]cano=Roundup Ready (RR) canola
[6]yefx=yellow foxtail
[7]- = no injury data was recorded due to weed competition. No LSD was calculated due to the missing data.

Nortron (ethofumesate) is the only herbicide found in group 16 and can be applied pre-plant incorporated (PPI), pre-emergence (PRE) or POST in sugarbeet. Current labeling allows for POST application of up to only 12 fl oz/A of Nortron per season. Nortron rates in this trial ranged from 12 to 64 fl oz/A. Very little sugarbeet injury was observed from any rate of Nortron evaluated in this trial at 7 DAT (0 to 13%) and no injury was observed at 13 DAT. At 12 fl oz/A, Nortron provided little control or suppression of any weed species evaluated. Control of all species increased as rate increased, but never above 75%. Nortron did not control yellow foxtail when applied POST at any rate. Though not tested in this trial, data from other trials demonstrates that Nortron improves weed control, including waterhemp or pigweed, when tank-mixed with other herbicides.

Stinger (clopyralid) is the only group 4 (growth regulator) herbicide currently labeled in sugarbeet. Stinger caused 20% sugarbeet leaf curling injury at both 2 and 4 fl oz/A at 7 DAT. This level of injury is generally tolerable early in the season. Stinger provided little to no control of any of the weeds found in this trial. Stinger is an effective herbicide to use in controlling thistle, common ragweed, and giant ragweed, but it has very little if any efficacy against amaranthus species (pigweeds and waterhemp), lambsquarters, or canola. Stinger has no grass activity.

Roundup PowerMax (glyphosate) is a group 9 herbicide and may be applied in Roundup Ready sugarbeet. Roundup is very safe in RR sugarbeet and no notable sugarbeet injury was observed in this trail at any rate tested. Roundup provided the greatest and most consistent control of all species in this trial, with the exception of RR canola. Common lambsquarters was the most difficult weed to control with Roundup, and control varied from 91 to 95% 13 DAT.

Betamix (phenmedipham + desmedipham) is a group 5 (photosynthesis inhibiter) herbicide labeled for use in sugarbeet. Betamix gave moderate sugarbeet injury at all rates tested. Injury ranged from 25 to 45% 7 DAT and 0 to

30% 13 DAT and increased as rate increased. Injury symptoms were leaf burn and some plant height reduction. Betamix provided poor to fair control of pigweed (35 to 60%) and common lambsquarters (40 to 65%), but control improved as rate increased. Weeds were 3 to 4 inches tall at time of application and Betamix is generally considered most effective when applied to cotyledon pigweed or lambsquarters. Betamix provided some suppression of RR canola and flax, but no control of yellow foxtail.

Spin-Aid (phenmedipham) is a group 5 (photosynthesis inhibiter) herbicide labeled for use in sugarbeet. Spin-Aid gave moderate sugarbeet injury at all rates tested. Injury ranged from 20 to 45% 7 DAT and increased as rate increased. Injury symptoms were leaf burn and some plant height reduction. Compared to Betamix (phenmedipham + desmedipham) Spin-Aid (phenmedipham) gave less control of pigweed (10 to 23%) and similar common lambsquarters control (50 to 68%), and control tended to improve as rate increased. Similar to Betamix, Spin-Aid is generally considered most effective when applied to cotyledon pigweed or lambsquarters. Spin-Aid provided some suppression of RR canola and flax, but no control of yellow foxtail.

**CONCLUSIONS**

Only six herbicide options exist for controlling broadleaf weeds POST in sugarbeet. In this trial, only Roundup PowerMax (glyphosate) gave greater than 90% control of any weeds present. UpBeet at 1 oz/A gave the greatest control of RR canola at 90%. Using UpBeet, Nortron, Stinger, Betamix, or Spin-Aid alone will not provide adequate control of pigweeds, common lambsquarters, or yellow foxtail. Using the appropriate herbicide, however, in conjunction with glyphosate, may improve control of difficult to control weeds, such as waterhemp, lambsquarters, and common ragweed and delay the selection of glyphosate resistant weeds.

## EFFICACY OF 'RESCUE' HERBICIDES IN SUGARBEET

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The objective of this trial was to evaluate 'rescue' control of waterhemp using herbicides in sugarbeet. Rescue applications of herbicides are made after an initial herbicide application fails to provide adequate weed control. This is often the situation when glyphosate resistance is first observed in weeds in a field and the initial application of glyphosate failed to provide adequate weed control.

### MATERIALS AND METHODS

An experiment was conducted near Lake Lillian, MN in 2017. The seedbed was prepared using a 's-tine' field cultivator. Crystal 'M380' was seeded in 22-inch rows at 60,500 seeds per acre on May 8. Post emergence (POST) treatments were applied June 6 and 20. All herbicide treatments were applied with a bicycle sprayer in 17 gpa spray solution through 8002 XR flat fan nozzles pressurized with $CO_2$ at 40 psi to the center four rows of six row plots 40 feet in length.

A similar experiment was conducted near Moorhead, MN in 2017. The seedbed was prepared using a Kongskilde 's-tine' field cultivator equipped with rolling baskets on May 10. Hilleshog 'HM4022RR' sugarbeet was seeded in 22-inch rows at 60,560 seeds per acre on May 11 with a John Deere 1700XP 6-row planter. POST treatments were applied June 29 and July 7. All herbicide treatments were applied with a bicycle sprayer in 17 gpa spray solution through 8002 XR flat fan nozzles pressurized with $CO_2$ at 35 psi to the center four rows of six row plots 40 feet in length.

All weed control evaluations were a visual estimate of percent fresh weight reduction in the four treated rows compared to the adjacent untreated strip. Experimental design was randomized complete block with 4 replications for each trial. Data were analyzed with the ANOVA procedure of ARM, version 2017.4 software package.

**Table 1. Application information for trials at Lake Lillian and Moorhead, MN in 2017.**

| | Lake Lillian, MN | | Moorhead, MN | |
|---|---|---|---|---|
| | **A** | **B** | **A** | **B** |
| Date | June 6 | June 20 | June 29 | July 7 |
| Time of Day | 10:00 AM | 9:45 AM | 10:30 AM | 9:30 AM |
| Air Temperature (F) | 78 | 70 | 70 | 75 |
| Relative Humidity (%) | | 48 | 69 | 57 |
| Wind Velocity (mph) | 10 | 11 | 0 | 6 |
| Wind Direction | SE | N | NE | E |
| Soil Temp. (F at 6") | | 71 | 69 | 70 |
| Soil Moisture | Good | Good | Good | Good |
| Cloud Cover (%) | 0 | 10 | 95 | 0 |
| Next Rainfall (amount) | June 11 (1.0") | June 28 (1.0") | July 4 | July 18 |
| Sugarbeet Stage | 4 leaf | 8 leaf | 10-12 leaf | 14-16 leaf |
| Waterhemp | 4 inch | 6 inch | 2.5 inch | 5 inch |
| Common Lambsquarters | 4 inch | 6 inch | 4 inch | 6 inch |

### SUMMARY

<u>Lake Lillian</u>
Waterhemp showed an intermediate level of glyphosate resistance. Roundup PowerMax (glyphosate) at 28 fl oz/A fb Roundup PowerMax at 28 fl oz + Ethofumesate 4 SC (ethofumesate) at 6 fl oz + Destiny HSMOC at 1.5 pt/A + N-

Pak AMS at 2.5 % v/v gave only 63% and 50% waterhemp control at 6 and 16 days after application (DAT) B, respectively (Table 2). At 16 DAT, neither UpBeet (triflusulfuron) at 1 oz/A, Ethofumesate 4 SC at 12 fl oz/A, or a combination of both herbicides gave greater than 25% control of waterhemp. The lack of waterhemp control from UpBeet at 1 oz/A suggests the population may also have been resistant to ALS herbicides. No 'rescue' treatment tested gave acceptable control of waterhemp.

**Table 2. Waterhemp and common lambsquarters control from rescue herbicides at Lake Lillian, MN in 2017.**

| Treatment | Rate/A | Appl[1] | June 26 waterhemp | July 6 waterhemp | July 6 lambsquarters |
|---|---|---|---|---|---|
| | | | -----------------% control----------------- | | |
| UpBeet + MSO | 1 oz + 1.5 pt | B | 3 | 18 | 0 |
| Ethofumesate 4SC + MSO | 12 fl oz + 1.5 pt | B | 8 | 25 | 8 |
| UpBeet + Ethofumesate 4SC + MSO | 1 oz + 12 fl oz + 1.5 pt | B | 3 | 20 | 10 |
| Roundup PowerMax fb Roundup PowerMax+ Ethofumesate + N-Pak AMS + Destiny HC | 28 fl oz fb 28 fl oz + 6 fl oz + 2.5 % v/v + 1.5 pt | A B | 63 | 50 | 100 |
| **LSD (0.05)** | | | **11** | **15** | **4** |

[1]Appl= Application code listed in Table 1.

Common lambsquarters control was 100% from the treatment containing Roundup PowerMax at 16 DAT (Table 2). UpBeet failed to provide any lambsquarters control. Ethofumesate 4 SC and the combination of UpBeet + Ethofumesate gave 10% or less lambsquarters control.

Moorhead

Sugarbeet injury was generally negligible from herbicides applied. Betamix at 3 pt/A gave 10% to 15% visual injury at 8 and 17 DAT (Table 3) even though sugarbeet were 14 to 16 leaf at application. Injury symptoms were necrotic spots on leaves. All other treatments gave 10% or less injury.

Waterhemp showed an intermediate level of glyphosate resistance. Control from two applications of Roundup PowerMax + Ethofumesate was 78% at 8 days after the second application but only 22% at 17 days after the second application. Treatments containing Betamix provided control ranging from 28% to 40% at 8 DAT but declined to 13% to 36% at 17 DAT. At 17 DAT, those treatments that were a tank-mix of two herbicides tended to give better control than individual herbicides, though no treatment gave greater than 36% control (Betamix + Ethofumesate). No treatment tested provided adequate control of waterhemp.

Common lambsquarters control ranged from 0 to 48% control at 17 DAT from treatments not containing Roundup. Two applications of Roundup PowerMax + Ethofumesate gave 100% common lambsquarters control at 17 DAT.

**Table 3. Sugarbeet injury and waterhemp and common lambsquarters control from rescue herbicides at Moorhead, MN in 2017.**

| | | | ----------July 15---------- | | | -----------July 24----------- | | |
|---|---|---|---|---|---|---|---|---|
| Treatment | Rate/A | Appl[1] | sgbt | wahe | colq | sgbt | wahe | colq |
| | | | ------------------------------------%------------------------------------ | | | | | |
| Betamix | 3 pt | B | 10 | 28 | 45 | 15 | 13 | 18 |
| UpBeet | 1 oz | B | 8 | 10 | 3 | 0 | 8 | 0 |
| Ethofumesate 4SC | 12 fl oz | B | 0 | 18 | 15 | 8 | 25 | 33 |
| Betamix + UpBeet | 3 pt + 1 oz | B | 8 | 40 | 45 | 8 | 33 | 20 |
| Betamix + Ethofumesate 4SC | 3 pt + 12 fl oz | B | 8 | 23 | 30 | 10 | 36 | 30 |
| UpBeet + Ethofumesate 4SC | 1 oz + 12 fl oz | B | 0 | 10 | 23 | 0 | 30 | 43 |
| Betamix + | 3 pt + | B | 8 | 30 | 38 | 5 | 33 | 48 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| UpBeet +<br>Ethofumesate 4SC<br>Roundup PowerMax+<br>Ethofumesate fb<br>Roundup PowerMax+<br>Ethofumesate | 1 oz +<br>12 fl oz<br>28 fl oz +<br>6 fl oz fb<br>28 fl oz +<br>6 fl oz | A<br><br>B | 0 | 78 | 100 | 0 | 22 | 100 |
| **LSD (0.05)** | | | **NS** | **24** | **24** | **8** | **18** | **12** |

**CONCLUSIONS**

Treatments that did not contain Roundup PowerMax failed to provide adequate control of waterhemp, regardless of herbicide combination or location. Two applications of Roundup PowerMax failed to provide adequate waterhemp control at 16 DAT at either location. Making 'rescue' applications of POST herbicides to control waterhemp that survived a previous POST application will likely result in little to no improvement in waterhemp control in sugarbeet.

Common lambsquarters control was near perfect at both locations from two applications of Roundup PowerMax. All 'rescue' treatments tested failed to provide greater than 48% lambsquarters control at 16 DAT. However, nearly all herbicides evaluated provided some control. This suggests that, if used in conjunction with glyphosate, these herbicides may help delay the onset of glyphosate resistance in common lambsquarters.

## SCREENING HERBICIDES FOR CROP SAFETY IN SUGARBEET

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The objective of this trial was to screen pre-emergence and post-emergence herbicides alone and in tank-mixes for sugarbeet crop safety.

### MATERIALS AND METHODS

An experiment was conducted near Hickson, ND in 2017. Fertilizer was spread May 2 and incorporated the same day with a field cultivator equipped with a spring tooth harrow. Seedex 'Winchester' sugarbeet, treated with NipsIt Suite, Tachigaren at 45g per unit, and Kabina at 7g per unit was seeded in 22-inch rows at 60,560 seeds per acre on May 3 with a John Deere 1700XP 6-row planter. Pre-emergence (PRE) treatments were applied May 3 immediately after planting. Rain events occurred on May 3, May 7, and May 16 with 0.09, 0.02, and 0.63 inches of rain respectively. Post emergence (POST) treatments were applied June 2. All herbicide treatments were applied with a bicycle sprayer in 17 gpa spray solution through 8002 XR flat fan nozzles pressurized with $CO_2$ at 40 psi to the center four rows of six row plots 35 feet in length. Sugarbeet stand was counted from 10 feet of each of the center two rows on May 26 when sugarbeet were in the cotyledon to 2 leaf stage. Sugarbeet were counted again at harvest. Roundup PowerMax at 32 fl oz/A + Veracity at 3qt/100 gal was applied June 12 and 26 to provide weed control. Escaped weeds were hand pulled throughout the season. Quadris at 16 fl oz/A was broadcast June 24 to control Rhizoctonia root rot. Proline at 5.7 fl oz/A + NIS at 0.125% v/v and AgriTin at 8 fl oz/A + Topsin at 12 fl oz/A were applied July 18 and August 2, respectively, to control Cercospora Leaf Spot. Sugarbeet in the center two rows by 27 feet long were harvested September 7, 2017. Roots were weighed and about 25 lbs of representative roots were collected from each plot and taken to Minn-Dak Farmers Cooperative Quality Lab in Wahpeton, ND for sugar and purity analysis.

All sugarbeet injury evaluations were a visual estimate of percent fresh weight reduction in the four treated rows compared to the adjacent untreated strip. Experimental design was randomized complete block with 4 replications for each trial. Data were analyzed with the ANOVA procedure of ARM, version 2017.4 software package.

**Table 1. Application Information – Hickson, ND 2017**

| Date | May 3 | June 2 |
|---|---|---|
| Time of Day | 3:00 PM | 9:30 PM |
| Air Temperature (F) | 63 | 86 |
| Relative Humidity (%) | 53 | 45 |
| Wind Velocity (mph) | 9 | 9 |
| Wind Direction | NW | S |
| Soil Temp. (F at 6") | 50 | 60 |
| Soil Moisture | Good | Good |
| Cloud Cover (%) | 100 | 5 |
| Next Rainfall (amount) | May 3 (0.09") | June 11 (0.11") |
| Sugarbeet Stage | PRE | cot-4 leaf/ avg 2 leaf |

### SUMMARY

Sugarbeet stand counts were taken 7 days before POST treatments were applied. No significant differences were observed among PRE treatments as compared to the untreated check (Table 2). Sugarbeet stands were consistent across the trial. Sugarbeet were counted again on September 7 following defoliation but prior to harvesting. Sugarbeet treated with Satellite Hydrocap (pendamethalin), Cobra (lactofen), or Ultra Blazer (acifluorfen) showed or tended to show decreased stand compared to the untreated check. The treatment of Satellite Hydrocap + Devrinol 2-XT (napropamide) had the fewest sugarbeet of all treatments.

**Table 2. Sugarbeet stand and injury ratings from herbicides, Hickson, ND 2017.**

| | | | May 26 | Sep 7 | Jun 5 | Jun 5 | Jun 5 | Jun 15 | Jun 22 | Jun 27 |
|---|---|---|---|---|---|---|---|---|---|---|
| Treatment | Rate/A | Timing[1] | Stand | Stand | Inj[2] | Necr | Chlo | Inj | Inj | Inj |
| | | | --- #/100' --- | | --------------------------%------------------------- | | | | | |
| Untreated | | | 188 | 204 | 0 | 0 | 0 | 0 | 5 | 10 |
| KFD 152-02 | 1 pt | PRE | 184 | 204 | 25 | 0 | 25 | 3 | 15 | 8 |
| Devrinol 2-XT | 4 pt | PRE | 194 | 202 | 8 | 1 | 1 | 3 | 13 | 13 |
| KFD 152-02 + Devrinol 2-XT | 1 pt + 4 pt | PRE | 201 | 194 | 30 | 0 | 33 | 8 | 15 | 13 |
| Satellite Hydrocap | 1.58 pt | PRE | 189 | 183 | 25 | 3 | 0 | 33 | 38 | 38 |
| Satellite Hydrocap + Devrinol 2-XT | 1.58 pt + 4 pt | PRE | 199 | 175 | 25 | 3 | 0 | 33 | 40 | 38 |
| Cobra + COC | 10 fl oz + 1.5 pt | POST | 198 | 183 | 65 | 70 | 0 | 70 | 80 | 68 |
| UltraBlazer + COC | 1 pt + 1.5 pt | POST | 198 | 186 | 70 | 80 | 0 | 73 | 68 | 65 |
| **LSD (0.05)** | | | **NS** | **21** | **13** | **7** | **8** | **9** | **9** | **12** |

[1]Timing information displayed in Table 1.
[2]Inj=injury, Necr=necrosis, Chlo=chlorosis

Sugarbeet injury from herbicide treatments varied from 0 to 80% (Table 2). Devrinol 2-XT gave non-significant injury at all visual evaluations. KFD 152-02 (clomazone) applied alone or with Devrinol, showed 25% to 33% chlorosis/bleaching injury early in the season with these injury symptoms diminishing as the season progressed. Satellite Hydrocap applied alone or with Devrinol gave similar sugarbeet injury ranging from 25% to 40% and was generally consistent across evaluations. Variable injury responses were noted from plant to plant from the Satellite application where one plant could be healthy and the adjacent plant showed reduced stature. Cobra or Ultra Blazer applied with crop oil concentrate (COC) gave the greatest amount of injury from 65 to 80%. The injury was leaf necrosis. Both Cobra and Ultra Blazer were applied to small sugarbeet (cot – 4 leaf) and hot weather followed application. These factors may have helped increase injury to such high levels. Injury was generally similar between Cobra and Ultra Blazer, but, as time passed, sugarbeet treated with Ultra Blazer tended to show slightly less injury than those treated with Cobra.

Sugarbeet yield parameters varied by herbicide treatment (Table 3). Root yield was similar from the untreated check, KFD 152-02, Devrinol 2-XT, KFD + Devrinol, Satellite Hydrocap, and Satellite + Devrinol. Sugarbeet treated with Cobra or Ultra Blazer showed 6.2 and 6.8 ton/A reductions in root yield compared to the untreated check. No significant differences were detected in percent sugar, however, there was a tendency from KFD 152-02, Satellite Hydrocap, and Satellite + Devrinol to reduce sugar percentage 0.5% to 0.7% from the untreated check. Purity from these three treatments also tended to be less than the untreated check. Extractable sucrose per acre was greatest from the untreated check. Satellite Hydrocap and Satellite + Devrinol reduced sucrose by about 1,000 lbs/A compared to the check. Cobra and Ultra Blazer reduced extractable sucrose by about 2,000 lbs/A compared to the check.

**Table 3. Sugarbeet yield and quality from herbicides, Hickson, ND 2017.**

| Treatment | Rate/A | Timing[1] | Yield | Sugar | Purity | Ext. Sucrose | Ext. Sucrose |
|---|---|---|---|---|---|---|---|
| | | | ton/A | % | % | lb/ton | lb/A |
| Untreated | | | 31.8 | 16.7 | 90.8 | 288 | 9149 |
| KFD 152-02 | 1 pt | PRE | 31.3 | 16.0 | 89.6 | 270 | 8422 |
| Devrinol 2-XT | 4 pt | PRE | 31.1 | 16.9 | 90.3 | 288 | 8964 |
| KFD 152-02 + Devrinol 2-XT | 1 pt + 4 pt | PRE | 30.8 | 16.9 | 90.8 | 291 | 8967 |
| Satellite Hydrocap | 1.58 pt | PRE | 30.0 | 16.2 | 89.5 | 273 | 8185 |
| Satellite Hydrocap + Devrinol 2-XT | 1.58 pt + 4 pt | PRE | 29.5 | 16.0 | 89.8 | 271 | 7981 |
| Cobra + COC | 10 fl oz + 1.5 pt | POST | 25.2 | 16.6 | 90.5 | 284 | 7082 |
| UltraBlazer | 1 pt | POST | 25.0 | 16.7 | 90.9 | 289 | 7128 |

| | | | | | | |
|---|---|---|---|---|---|---|
| + COC | + 1.5 pt | | | | | |
| **LSD (0.05)** | | **2.9** | **NS** | **NS** | **NS** | **979** |

[1]Timing information displayed in Table 1.

**CONCLUSIONS**

Devrinol 2-XT appears very safe to sugarbeet when applied PRE at 4 pt/A. KFD 152-02 and Satellite Hydrocap tended to impact sugarbeet quality to a greater extent than root yield. Sugarbeet treated with Cobra or Ultra Blazer were severely injured and failed to make a full recovery in time for harvest. Improved crop safety from these products may be seen with reducing rates or delaying application to larger sugarbeet, but additional research should be conducted to test this hypothesis.

## LIBERTY APPLIED WITH ADJUVANTS IN LIBERTYLINK SOYBEAN

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### BACKGROUND

Liberty (glufosinate) is a broad spectrum grass and broadleaf control herbicide used in combination with LibertyLink soybean. Liberty is applied postemergence at 0.53 to 0.65 lb ai/a (29 to 36 fl oz/A) between soybean emergence and pre bloom when weeds are up to three inches tall. A repeat Liberty application can be made at up to 0.53 lb ai/a. Liberty is applied with ammonium sulfate (AMS) at 3 lb/a in at least 15 gal/a water using nozzles and pressure to produce a medium sized droplet. Using Liberty in LibertyLink crops offers growers herbicide diversity since it has a unique site of action (SOA 10) and controls glyphosate-resistant weeds including kochia, common ragweed, and waterhemp.

Ammonium sulfate should always be added when using Liberty herbicide. Ammonium sulfate enhances Liberty absorption and movement through the leaf cuticle. Calcium magnesium, sodium, and potassium have been reported to reduce the efficacy of weak acid herbicides like Liberty. Ammonium sulfate counteracts the antagonistic effects of hard water salts. As water in the spray droplet evaporates, sulfate from AMS binds with antagonistic salts which prevents them from binding with Liberty. In addition, ammonium from AMS binds with Liberty resulting in greater uptake into the plant and greater resultant weed control.

There are many products, including liquid-based products, that improve herbicide uptake and deactivate antagonistic hard water salts. Liquid-based products tend to be easier to handle and have given consistent performance in trials when used with glyphosate. ET-4000 is an acidic ammonium sulfate replacement. ET-4000 is a sulfuric acid based product that turns to a sulfate when in the presence of water. The objective of this study was to evaluate common lambsquarters and waterhemp control from liquid-based AMS replacements applied with Liberty.

### MATERIALS AND METHODS

An experiment was conducted near Moorhead, MN in 2017. The trial site was prepared for planting using a Kongskilde s-tine field cultivator on May 10, 2017. Peterson Farm 'L07-16N' LibertyLink soybean was planted in 22-inch rows at 160,000 seeds per acre on May 11 with a John Deere 1700XP 6-row planter. Postemergence (POST) treatments were applied June 19. All herbicide treatments were applied with a bicycle sprayer in 17 gpa spray solution through 8002 XR flat fan nozzles pressurized with $CO_2$ at 35 psi to the center four rows of six row plots 30 feet in length. Soybean injury and common lambsquarters and waterhemp control were evaluated June 29 and July 11, 2017.

**Table 1. Application 'A' Information – Moorhead, MN 2017**

| | |
|---|---|
| Date | June 19 |
| Time of Day | 9:30 AM |
| Air Temperature (F) | 65 |
| Relative Humidity (%) | 54 |
| Wind Velocity (mph) | 4 |
| Wind Direction | N |
| Soil Temp. (F at 6") | 62 |
| Soil Moisture | Good |
| Cloud Cover (%) | 80 |
| Next Rainfall (amount) | June 28 (0.3 inches) |
| Soybean Stage | 3-trifoliolate |
| Common lambsquarters | 6-in tall |
| Waterhemp | 2-in tall |

All soybean injury and weed control evaluations were a visual estimate of percent fresh weight reduction in the four treated rows compared to the adjacent untreated strip. Experimental design was randomized complete block with 4 replications for each trial. Data were analyzed with the ANOVA procedure of ARM, version 2017.4, software package.

**RESULTS**

Common lambsquarters tends to germinate in late April and early May in western Minnesota and eastern North Dakota. There was a very dense common lambsquarters population at this location even though the first flush was controlled by tillage prior to planting. Waterhemp generally emerges in mid to late May and continues to emerge following precipitation events throughout the summer. Waterhemp density was low to moderate at this location and was clearly impacted by lambsquarters competition and from fewer than normal precipitation events in June and July at Moorhead in 2017.

There was no visual soybean injury from Liberty across adjuvants (Table 2). Lambsquarters was the best indicator species of weed control in this experiment. Lambsquarters control ranged from 84 to 93% across treatments at 10 DAT and from 60 to 74% across treatments at 22 DAT. Applying Moccasin (a soil residual herbicide) with Liberty + AMS or Liberty+ET-4000 gave less lambsquarters control at 10 DAT compared to Liberty+AMS. Liberty+ET-4000+Moccasin gave similar lambsquarters control at 22 DAT compared to Liberty+AMS.

Common lambsquarters control was similar among treatments containing dry or liquid AMS adjuvants with Liberty including ET-4000. No significant differences in lambsquarters control were observed at 10 or 22 DAT from any Liberty alone+adjuvant treatments.

Moccasin was applied with Liberty to provide residual lambsquarters and waterhemp control. However, greater than 0.5 inches of precipitation is recommended to sufficiently activate Moccasin and this precipitation did not occur until August 2, or 44 days after application. Lambsquarters control from Liberty plus Moccasin, 10 DAT was less than from Liberty+AMS, suggesting the tank-mix with Moccasin may have antagonized broadleaf control.

Liberty alone with dry AMS, liquid AMS, or ET-4000, or Liberty tank-mixed with Moccasin provided perfect or near perfect waterhemp control in this experiment.

**Table 2. Soybean injury and weed control from adjuvants with Liberty at Moorhead, MN in 2017.**

| | | | ----------June 29--------- | | | ---------July 11--------- | | |
|---|---|---|---|---|---|---|---|---|
| Treatment | Rate | Appl[1] | soyb[2] | colq | wahe | soyb | colq | wahe |
| | fl oz/A + adjuvant | | %inj | %cntl | %cntl | %inj | %cntl | %cntl |
| Liberty+dry AMS[3] | 29 + 3 lb/a | A | 0 | 92 | 100 | 0 | 69 | 98 |
| Liberty + N-Pak AMS | 29 + 5% v/v | A | 0 | 89 | 100 | 0 | 70 | 100 |
| Liberty + ET-4000 | 29+ 1.5% v/v | A | 0 | 88 | 100 | 0 | 68 | 100 |
| Liberty + ET-4000 | 29 + 3% v/v | A | 0 | 91 | 98 | 0 | 74 | 100 |
| Liberty + Moccasin[4] + N-Pak AMS | 29 + 21 + 5% v/v | A | 0 | 84 | 100 | 0 | 60 | 100 |
| Liberty + Moccasin + ET-4000 | 29 + 21 + 1.5% v/v | A | 0 | 85 | 95 | 0 | 70 | 98 |
| **LSD (0.05)** | | | **NS** | **4** | **5** | **NS** | **9** | **NS** |

[1]Appl refers to application timing and corresponding information in Table 1.
[2]soyb=soybean; colq=common lambsquarters; wahe=waterhemp
[3]Indicates addition of ammonium sulfate (AMS) at 3 lb/A. N-Pak AMS used at 5 %v/v and provided by Winfield. ET-4000 used at 1.5% v/v and provided by MK Ag Service
[4]S-metolachlor by UPI

**CONCLUSIONS**

Dry AMS with Liberty provided fair to good lambsquarters control and excellent waterhemp control. N-Pak AMS or ET-4000 with Liberty generally provided similar lambsquarters control. ET-4000 at 3% v/v with Liberty tended to improve lambsquarters control compared to ET-4000 at 1.5% v/v with Liberty. Lambsquarters control from Moccasin plus Liberty, regardless of adjuvant type, was less than from Liberty+adjuvant, especially 10 DAT. The addition of Moccasin did not provide residual control. Waterhemp control from Liberty was similar among the adjuvants and tank mixes tested.

# SOIL MANAGEMENT PRACTICES

NOTES

**EFFECT OF COMMERCIAL FERTILIZERS AND NUTRIENT MANAGEMENT PRODUCTS ON SUGARBEET YIELD AND QUALITY DURING 2017 GROWING SEASON**

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**Introduction**

Trial results of different fertilizer combinations, biologicals and nutrient management aids were evaluated.

**Materials and methods**

Roundup Ready sugarbeet cultivar with a good disease resistant package was planted on April 29 and May 4, 2017 at Downer and Ada, respectively. Field plots were laid out in a randomized complete block design with four replications. Individual plots measured 11 ft wide and 30 ft long. Sugarbeet was placed 1.25 inches deep with 5 inch row spacing. A 22 inch row spacing was used. The trial was planted in wheat residue and a fairly wet soil seedbed. Roundup herbicide was applied twice for weed control. Recommended NPK fertilizers were applied and N rate was adjusted to residual soil $NO_3$-N of 4 ft soil depth. The middle two rows were harvested using a mechanical harvester and sub sample sent to Crystal Sugarbeet Quality lab at Grand Forks. Downer and Ada plots were harvested on 19th September and 9th October, respectively.

**Table 1. Initial soil properties**

| | $NO_3$-N (lb/ac) | | | Olsen-P (ppm) | K (ppm) | Soil OM% | Soil pH |
|---|---|---|---|---|---|---|---|
| **Depth** | 0-6" | 6-24" | 24-48" | 0-6" | 0-6" | | |
| **Downer** | 19 | 21 | 30 | 10.5 | 97 | 3.1 | 8.6 |
| **Ada** | 16 | 21 | 16 | 9 | 74 | 3.6 | 8.1 |

**Table 2. Mean sugar yield and quality parameters in response to different commercial products.**

| **Trial-Agrispon (Biostimulant), Agricultural Sciences Inc. at Downer, MN** | | | | |
|---|---|---|---|---|
| **Treatments** | **Tons/ac** | **Sugar%** | **RSA (lb/ac)** | **Gross ($/ac)** |
| 1. Recommended NPK | 40.9 | 19.5 | 15123 | 2195 |
| 2. 100%N+Agrispon@13.2oz/a @30 and 60 DAP | 39.9 | 19.1 | 14422 | 2052 |
| 3.90%N+ Agrispon@13.2oz/a@30 and 60 DAP | 40.4 | 19.2 | 14768 | 2120 |
| 4.85%N+ Agrispon@13.2oz/a@@30 and 60 DAP | 38.5 | 19.5 | 14355 | 2100 |
| 5.80%N+ Agrispon@13.2oz/a@@30 and 60 DAP | 39.2 | 19.6 | 14580 | 2130 |
| P<0.05 | NS | NS | NS | NS |
| LSD | 3.54 | 0.86 | 1395 | 257 |
| **Conclusion-** In-season side-dress twice with Agrispon at 30 and 60 DAP with 80% recommended-N had no significant difference with 100% recommended N without Agrispon application. | | | | |
| **Trial- Anuvia Plant Nutrients. SymTRX20S product (16-1-0-20S) and SymTRX12S were compared with MAP as replacement at Ada, MN** | | | | |
| No P and S check | $32.89^{B}$ | 17.9 | $11105^{B}$ | $1469.76^{C}$ |
| MAP (Full rate-105 lbs product) | $38.88^{A}$ | 18.1 | $13387^{A}$ | $1810.22^{A}$ |
| 105 lbs MAP + 83 lbs AMS | $35.20^{AB}$ | 17.9 | $11988^{B}$ | $1602.41^{BC}$ |
| 105 lbs MAP + 100 lbs SymTRX20S | $38.48^{A}$ | 18.2 | $13386^{A}$ | $1830.17^{A}$ |
| 42 lbs MAP + 165 lbs SymTRX12S | $39.14^{A}$ | 17.8 | $13271^{A}$ | $1765.04^{AB}$ |
| P<0.05 | 0.04 | NS | 0.01 | 0.003 |
| LSD | 4.04 | 0.54 | 1260 | 177.6 |
| **Conclusion-** Phosphorus and sulfur had significant postive effect on yield, recoverable sugar and gross return. | | | | |
| **Trial- Pursell Agri-Tech (Coated urea with three rates) at Ada, MN** | | | | |
| N source-Urea | $35.80^{B}$ | $17.64^{B}$ | $12025^{B}$ | $1582.69^{BC}$ |
| N source-ESN | $36.44^{B}$ | $17.98^{A}$ | $12515^{AB}$ | $1687.87^{AB}$ |
| N source-Coated urea with 2% Zn (44.5-0-0) | $38.66^{A}$ | $17.64^{B}$ | $12999^{A}$ | $1713.02^{A}$ |
| N source-Resin coated urea (43.7-0-0) | $37.40^{AB}$ | $17.30^{C}$ | $12273^{AB}$ | $1572.66^{C}$ |
| N source- Coated urea (44.5-0-0) | $35.67^{B}$ | $17.86^{AB}$ | $12169^{B}$ | $1629.62^{ABC}$ |
| N rate-90 lb N/ac | $35.85^{B}$ | $17.52^{B}$ | $11946^{B}$ | $1557.88^{B}$ |
| N rate- 120 lb N/ac | $36.57^{AB}$ | $17.79^{A}$ | $12407^{AB}$ | $1651.08^{A}$ |
| N rate- 150 lb N/ac | $37.95^{A}$ | $17.75^{A}$ | $12837^{A}$ | $1702.55^{A}$ |
| N Source | 0.03 | <0.01 | 0.08 | 0.05 |
| N rate | 0.03 | 0.03 | 0.01 | 0.01 |
| N- Source×rate | 0.57 | 0.01 | 0.78 | 0.57 |
| **Conclusion-** Coated urea with Zn had potentital to increase yield but need more experiment to validate the finding. Significant increase in sugar and return was observed with increasing N rate from 90 to 120 lb N/ac but no difference was found between 120 and 150 lb N/ac. | | | | |

## FALL VS. SPRING NITROGEN APPLICATION ON SUGARBEET PRODUCTION

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**Introduction:** Sugarbeet growers apply fertilizer N either in fall or spring often dependent on workload, soil compaction concerns, and without knowledge of relative N use efficiency. A risk of leaching, denitrification and erosion loss is prolonged for fall-N, but fall-N can be readily available to seed during germination and produce early vigor. Spring-N application reduces the chance of N loss due to a narrow interval between N application and uptake. Further, it is also important to know the relative response from applications of fertilizer N split between fall and spring. For sugarbeet, soil N-availability plays a significant role in yield and quality. Estimation of soil N supply as influenced by relative proportion of fall and spring fertilizer N application has potential to increase sugarbeet N use efficiency. Main objectives were to (i) determine the sugarbeet yield and quality as influenced by N application rate and timing, (ii) determine the ratio of fall and spring N application to optimize yield and quality, and (iii) compare the N use efficiency of two soil types in response to fertilizer N application and timing.

**Materials and Methods**: This field experiment was conducted at Crookston and Downer sites. Treatments consisted of the two fertilizer-N application rates, 130 and 190 lb N/ac; each having 0, 40, 60, 80 and 100 percent of total N applied in fall, and the balance in the spring. Trials were laid out in randomized block design with four replicates. Each plot was 30 ft long and 11 ft wide. During fall 2016, soil samples were collected from 0-6", 6-24" and 24-48" and analyzed for soil nitrate-N. Required amount of urea-N after adjusting for soil residual N were broadcast. Recommended rates of P and K fertilizer were also applied. Spring fertilizer-N treatments were applied just before planting and incorporated. Standard Roundup Ready® cultivar was planted at 22 inch row spacing. Middle two rows of six row plots were harvested and quality traits were evaluated by American Crystal Lab, Grand Forks. Planting occurred on May 4 and April 29 and harvested on September 21$^{st}$ and September 19$^{th}$, at Crookston and Downer, respectively. Economic return was calculated using the beet payment formula used by the American Crystal Sugar. Statistical analyses were conducted using PROC ANOVA in SAS 9.4 and significant mean separation identified using Fisher's LSD at 95% significance level.

**Table 1. Initial soil parameters of Downer and Crookston field experimental sites in fall, 2016.**

| | $NO_3$-N (lb/ac) | | | Olsen-P (ppm) | K (ppm) | Soil OM% | Soil pH |
|---|---|---|---|---|---|---|---|
| **Depth** | 0-6" | 6-24" | 24-48" | 0-6" | 0-6" | | |
| **Downer** | 19 | 21 | 30 | 10.5 | 97 | 3.1 | 8.6 |
| **Crookston** | 17 | 30 | 24 | 42 | 132 | 3.8 | 8.4 |

**Table 2. Sugarbeet yield, quality and economic return in response to urea-N application rate and timing during the 2017 growing season**

| N Rate | ---- Split% ---- | | Crookston | | | | Downer | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| lb N/ac | Fall | Spring | Tons/ac | Sugar % | RSA (lb $ac^{-1}$) | Return ($ $ac^{-1}$) | Tons/ac | Sugar % | RSA | Return ($ $ac^{-1}$) |
| Check | 0 | 0 | 32.7$^{AB}$ | 18.6 | 11437$^{AB}$ | 1570.91$^{AB}$ | 26.8$^{B}$ | 19.6$^{A}$ | 9998$^{B}$ | 1462.22$^{B}$ |
| 130 | 0 | 100 | 31.4$^{AB}$ | 19.0 | 11417$^{AB}$ | 1633.69$^{AB}$ | 34.5$^{A}$ | 19.2$^{AB}$ | 12549$^{A}$ | 1795.26$^{A}$ |
| | 40 | 60 | 32.1$^{AB}$ | 18.5 | 11260$^{AB}$ | 1554.28$^{AB}$ | 33.9$^{A}$ | 19.1$^{ABC}$ | 12310$^{A}$ | 1756.14$^{A}$ |
| | 60 | 40 | 30.1$^{AB}$ | 18.5 | 10356$^{AB}$ | 1401.82$^{AB}$ | 33.0$^{A}$ | 19.2$^{AB}$ | 12044$^{A}$ | 1727.25$^{A}$ |
| | 80 | 20 | 31.5$^{AB}$ | 19.1 | 11511$^{AB}$ | 1653.68$^{AB}$ | 32.8$^{A}$ | 19.1$^{ABC}$ | 11799$^{A}$ | 1670.05$^{AB}$ |
| | 100 | 0 | 31.7$^{AB}$ | 18.8 | 11374$^{AB}$ | 1605.44$^{AB}$ | 31.6$^{A}$ | 19.0$^{ABCD}$ | 11268$^{AB}$ | 1577.73$^{AB}$ |
| 190 | 0 | 100 | 35.0$^{A}$ | 18.4 | 12209$^{A}$ | 1674.65$^{A}$ | 34.7$^{A}$ | 18.7$^{BCD}$ | 12171$^{A}$ | 1680.61$^{AB}$ |
| | 40 | 60 | 29.4$^{AB}$ | 18.6 | 10328$^{AB}$ | 1428.95$^{AB}$ | 34.9$^{A}$ | 18.9$^{ABCD}$ | 12367$^{A}$ | 1725.19$^{A}$ |
| | 60 | 40 | 35.4$^{A}$ | 18.6 | 12403$^{A}$ | 1706.51$^{A}$ | 32.2$^{A}$ | 18.8$^{BCD}$ | 11301$^{AB}$ | 1558.64$^{AB}$ |
| | 80 | 20 | 33.0$^{AB}$ | 18.5 | 11674$^{AB}$ | 1621.62$^{AB}$ | 34.1$^{A}$ | 18.5$^{CD}$ | 11785$^{A}$ | 1599.93$^{AB}$ |
| | 100 | 0 | 26.3$^{B}$ | 18.8 | 9417$^{B}$ | 1326.25$^{B}$ | 34.1$^{A}$ | 18.3$^{D}$ | 11682$^{A}$ | 1569.19$^{AB}$ |
| LSD | | | 8.09 | 0.68 | 2717 | 377.9 | 4.31 | 0.73 | 1588 | 258 |
| Significance ($P<0.05$) | | | * | NS | * | * | * | * | * | * |

At Crookston, the lowest observed yield was associated with the high fertilizer N rate (190 lb N/ac), 100 % applied in the fall. This application scheme yielded significantly less than 100% and 40% spring application of 190 lb N/ac. Spring application of 100% and 40% of 190 lb N/ac also resulted in the higher recoverable sugar per acre (RSA) and economic return; RSA and return calculations involve yield and percent sugar. At Downer, all the N fertilizer treatments resulted in significantly higher yield than the check, irrespective of N rate and application time. Sugar percent was lowest with 100% fall application of 190 lb N/ac. RSA and economic return was lowest for the check plot, although not significantly different from several other N application patterns. These results show that high N application rate in fall might reduce sugarbeet yield and percent sugar while reducing economic return.

# SUGARBEET
# PHYSIOLOGY / STORAGE /
# PRODUCTION PRACTICES / ECONOMICS

NOTES

**THE EFFECT OF CLOSING WHEEL AND SEED TUBE CONFIGURATION ON SUGARBEET YIELD AND QUALITY**

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**Introduction :** Uniform seed spacing of sugarbeet plants is important to reduce weed competition and maximize sugarbeet production. The last several years, with the introduction of numerous seed tube configurations and modifications, and closing wheels, growers are asking which seed tube types, seed tube sensors or closing wheel configurations are recommended to best optimize sugarbeet yield and quality in the field and on their farms.

**Objectives :** With the introduction of John Deere MaxEmerge 2 Planter, many different seed tube sizes and shapes, closing wheel configurations and planter attachments are being marketed. Most were developed or used in corn and soybean growing areas of the United States, but over the year's sugarbeet growers' have adopted these different planter configurations into sugarbeet production as well. Past research has shown that the standard straight sugarbeet tube produced the highest recoverable sugar. Since that research many new and potentially improved seed tubes have been introduced. The objective of this research is to evaluate the affect these new tubes and attachments have on uniformity of seed spacing and yield and quality using various options of these planter attachments or combinations of them. Some of these seed tubes have been evaluated on the planter test stand and have not performed satisfactorily and should be evaluated in the field.

**Materials and Methods:** One sugarbeet field experiment was established on a Colvin silty clay loam location near Ada, MN in 2017. Planting was arranged in a randomized complete block design with five replications. Individual treatment plots measured 11feet wide and 30 feet long. A Roundup Ready Regular Pellet sugarbeet variety with a good disease resistance package was planted on May 4/2017 with a John Deere MaxEmerge II planter. Large sugarbeet plates were used and vacuum set as recommended. Sugarbeet was placed 1.25 inches deep with 4.5-inch in-row spacing. A 22-inch row spacing was used. The trial was planted into wheat residue and a fairly wet soil seedbed. Roundup herbicide was applied twice for weed control, plots were not cultivated. Soil nitrogen, Phosphorous and Potassium levels were adjusted with fertilizer to approximately 130 lbs/acre of available residual soil test plus added fertilizer N. Treatments included in the experiment were (1) Straight tube – reg. closing wheels (2) Straight tube – modified insert regular closing wheels (3) Curved tube - regular closing wheels (4) Curved tube - modified insert - regular closing wheels (5) Precision planting tube – regular closing wheels (6) Straight tube – no insert – spiked wheels (7) Straight tube – 1 schlagel 1 smooth closing wheel. Three fungicide applications, Inspire (July 21 @ 7 fl. oz/A), Supertin/Topsin (Aug 8 @ 6 fl. oz/A & 7.6 fl. oz/A) and Proline (August 22 @ 7 fl. oz/A) were applied for Cercospora leafspot control Total monthly rainfall for April was 1.05 inches, May 1.36 inches, June 2.91 inches, July 2.68 inches, August 1.27 inches, September 5.76 inches and October 0.69inches. The middle two rows were treated and harvested on October 9/2017. Yield determinations were made and quality analysis performed at American Crystal Sugar Quality Tare Lab, East Grand Forks, MN.

**Results and Discussion:** The field or research plot area, due to nearly 11 inches of rainfall October of 2016 was only tilled once that fall. The plot area was fertilized and tilled with a field cultivator in the spring of 2017. High amounts of wheat residue and fairly wet soil conditions may have affected some germination in certain plots. Since rainfall occurred soon after planting no significant results were observed in the seed tube/planter attachment study in 2017. The measurements between plants (target spacing of 4.5 inches / Regular Pellets) obtained around the four-leaf stage of growth were analyzed and histograms of distance distributions were constructed for each treatment (Figure 1). Generally the inclusion of an insert into any style of seed tube reduces the number of plants at the 4.5 inch target spacing (histogragh 3&4), as was observed in past field and grease belt tests, similar treatments with modified inserts seem to produce lower yields and recoverable sugar per acre. In 2017 the root yield was highest on the curved tube with regular closing wheels and the lowest yield treatment was the curved tube with modified insert and regular closing wheels (Table 1). The highest recoverable sugar per acre treatment was the curved tube with regular closing wheels (Table 1). Stand counts were lowest on the precision tube with regular closing wheel whereas the highest stand counts were straight tube with the modified insert although none of the treatments were significantly different.

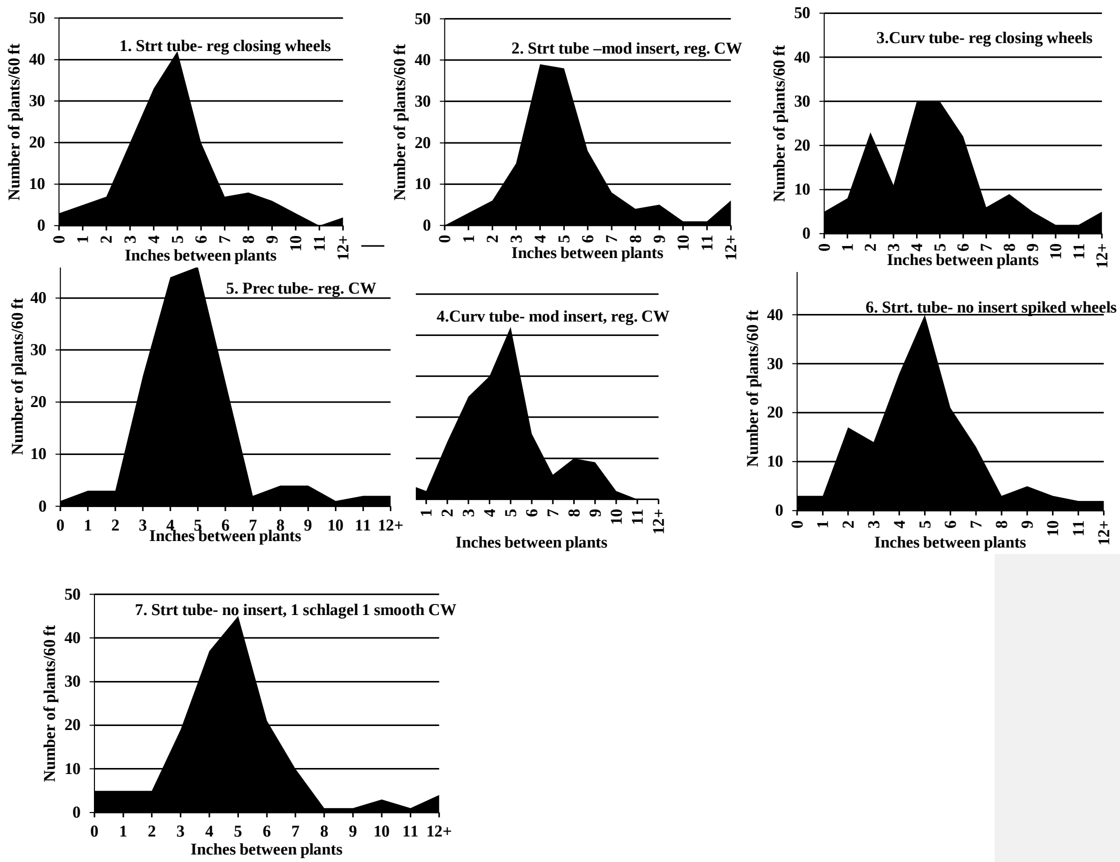
Use of different styles and combinations of closing wheels had little effect on uniformity of plant spacing. Again there was no significant difference of any of the parameters depending on what closing wheels or combination of closing wheels was used. However the two Schlagel closing wheels together had lower yield and recoverable sugar per acre than did the one smooth regular closing wheel and one Schlagel closing wheel treatment or the treatments where the standard smooth closing wheels were used (Table 1). It seems the standard smooth closing wheels tested are still as good as any other of the newer closing wheels examined in this trial for sugarbeet emergence. It is important to note that closing wheels be properly set at ¾ to 1 inch distance apart between wheels for sugarbeets and that the wheels are centered directly over the top of the planted row and also set at a proper down pressure.

This is one year and one location of data. Additional research trials both in the field and on the planter test stand comparing seed tube configurations and planter closing wheels with different size pellets should be examined to reinforce current sugarbeet grower recommendations.

**Table1. Effect of seed tube and closing wheel combinations on sugarbeet root yield, sucrose percentage, recoverable sugar production, population and gross $ return. Ada, MN. 2017.**

| Treatment | Roots yield (Tons/a) | (%) Sucrose | Slm% | RSA (lb/ac) | RST (lb/ton) | Tare % | Gross ($/acre) | Beet counts /60ft of row |
|---|---|---|---|---|---|---|---|---|
| 1. Straight tube - regular closing wheels | 36.5a | 17.6a | 0.94a | 12161a | 333a | 3.5a | 1526.72a | 156a |
| 2. Straight tube - mod. Insert, regular closing wheels | 37.2a | 17.5a | 0.87a | 12355a | 332a | 2.9ab | 1547.29a | 161.4a |
| 3. Curve tube - regular closing wheels | 38.1a | 17.5a | 0.87a | 12628a | 332a | 3.2ab | 1580.18a | 161.2a |
| 4. Curve tube - modified Insert regular closing wheels | 35.5a | 17.6a | 0.81a | 11905a | 335a | 2.9b | 1506.00a | 158.2a |
| 5. Precision tube - regular closing wheels | 36.0a | 17.3a | 0.92a | 11764a | 327a | 3.3ab | 1447.79a | 152.2a |
| 6. Straight tube - no insert spiked wheels | 35.7a | 17.5a | 0.91a | 11879a | 333a | 3.0ab | 1489.81a | 159.4a |
| 7. Straight tube - no insert, 1 Schlagel 1 smooth cw. | 37.5a | 17.6a | 0.88a | 12558a | 335a | 3.3ab | 1587.11a | 158.2a |
| LSD (P<0.05) | NS | NS | NS | NS | NS | 0.6145 | NS | NS |

**Figure 1. Seed spacing as influenced by seed tubes and planter attachments**



**VARIATION IN PLANT TISSUE CONCENTRATION AMONG SUGARBEET VARIETIES**

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**Justification**: Plant tissue analysis has increasingly been used for crops as a tool to fine tune nutrient management. Plant analysis was developed as a diagnostic tool and is generally not been used to determine nutrients to apply. For sulfur, analysis of sulfur in plant tissue is commonly determined using inductively coupled plasma emission spectroscopy (ICP) even though older data that is typically used to develop sufficiency ranges may have been determined by dry combustion. Recent work in Minnesota on corn and soybean has found differences in the assessment of sulfur concentration by ICP versus combustion. Comparison of methods of analysis for sulfur for additional crops such as sugarbeet would help to determine the accuracy of ICP and where additional research in correlation of plant tissue tests to crop yield should be conducted. If differences in the methods can be documented, it would indicate that sugarbeet growers should exercise extreme caution when interpreting plant tissue results for sulfur.

Plant tissue analysis has resulted in more recent questions on boron application than other micro-nutrients. Reports that list boron as being low typically suggest a foliar application of boron containing fertilizer sources. However, there is no documented evidence that tissue sufficiency ranges currently used are accurate and that when a low tissue boron concentration is reported that application will increase crop yield. Comparisons of yield response to tissue concentration are needed to provide evidence that a sufficiency range actually has meaning when deciding if fertilizer should be applied.

Recent surveys of corn, soybean, and hard red spring wheat plant tissue has shown significant variation in nutrient concentration when multiple hybrids/varieties are sampled in the same field at the same time. If taken at face value, tissue nutrient concentration should be reflective of soil nutrient status. Past research on corn, soybean, and wheat showed a significant portion of the variation in nutrient concentration was due to growth stage differences among hybrids/varieties at sampling. What needs to be addressed for sugarbeet if the degree of variation in tissue nutrient concentration in petioles and leaf blades for varieties grown at multiple locations and years and whether plant tissue analysis can be related to root or sugar yield. If there is significant variation in concentration that is reflective of genetics and not of yield potential, there should be a significant degree of caution when interpreting tissue results without further documentation of deficiencies with additional analysis such as soil tests.

**Summary of Literature**: Plant tissue analysis is being utilized more as a tool to determine whether nutrients should be applied in-season to maximize yield of crops. Plant analysis is only suggested for use for diagnosing problems that may occur in field (Kaiser et al., 2013). Fertilizer decisions should be made using soil samples which have been correlated and calibrated to crop response. Never the less, samples are being taken in fields and are being used to sell products which are likely not needed. Databases for "sufficient" levels for nutrients have been developed for use in diagnosing problem areas within fields (Bryson et al., 2014). It is not known whether these sufficiency values were generated using crop response data that documents that yield will be reduced when tissue concentrations are below the stated sufficiency level. It is more likely that the sufficiency values used currently for nutrients such as sulfur or boron are developed based on tissue concentration averages for plots where either nutrient was added but no yield response was achieved. Since both boron and sulfur can be taken up by plants in excess quantities, utilizing averages values of fertilized plots can result in the development of sufficiency ranges that are higher than what would actually be required for maximum crop yield. Most of the research previously cited has shown the effects of boron or sulfur on petiole or leaf blade boron or sulfur concentration the works have not taken the next step in correlating it to crop yield.

Understanding potential sources of variation is important when interpreting plant tissue analysis results. One major source of variation can be differences in uptake patterns among hybrids or varieties. In Minnesota, unpublished survey data for corn and soybean and published data for hard red spring wheat (Kaiser et al., 2014b) found significant variation among hybrids/varieties for a majority of the nutrients analyzed. For the wheat trials, the majority of the variation in nutrient concentration across locations could be attributed to when the samples were collected and the stage of development of the plant at the time of sampling. For all crops the variation in yield could not be explained by one or more nutrients measured in the plant tissue. For sulfur, data collected from multiple crops has noted differences in the amount of sulfur reported in plant tissue based on how the samples are analyzed in the lab (Sterrett et al., 1987). These sources of variation indicate that varieties may have their own sufficiency range for nutrients and that ranges need to be developed based on specific laboratory methods used to determine the concentration of nutrients in plant tissue.

**Objectives**:

1. Compare nutrient concentration in petioles and leaf blades among varieties at three sampling times.
2. Determine if tissue nutrient concentration is predictive of root and sugar yield when sampling adequately fertilized fields.

**Materials and Methods**: Six sugarbeet varieties (listed below) were planted at four locations and tissue analysis samples was collected at three sampling times over the growing season. Varieties were planted in four replications at each site. Sampling times were early- to mid-June, early July, and late July to early August. The newest developed leaf was sampled. The petiole and leaf blade will be sampled at once then separated for individual analysis. All samples were dried, ground, and analyzed for nitrate N via extraction with 5% acetic acid, total N by combustion, and P, K, Ca, Mg, S, B, Cu, Fe, Mn, and Zn by ICP. A single composite soil sample consisting of six to eight cores was taken from the 0-6 and 6-24 inch depths from each site at each plant sampling date. Soil samples were analyzed using recommended procedures of N, P, K, Ca, Mg, S, B, Cu, Fe, Mn, and Zn and for pH, soil organic matter, and cation exchange capacity (CEC). Plant tissue nutrient concentration was correlated with yield and quality to determine what factors may be important for the prediction of root and sugar yield. All data was subject to an analysis of variance procedure assuming fixed effects of location, sampling time, and variety and random blocking effects.

Varieties used in the sampling trial:

Crystal RR018 – Check variety: Good disease tolerance, average yield but below average sugar.
Maribo 109 – Check variety: Good disease tolerance with average sugar content. Below average tons. Tends to have a smaller leaf canopy than other varieties.
Beta 92RR30 –Average tons and average sugar.
Beta 9475 –Good Cercospora leaf spot resistance, high yield, average sugar
Crystal M579 –High sugar content.
Crystal M509 – Good cercospora resistance, low sugar content and high yield.

**Results**: Sample timings were targeted to occur within three week intervals near the 50-80 day suggested for sugarbeet sampling. Actual sampling dates for Clara City, Lake Lillian, Murdock, and Renville, respectively, were 48, 44, 53, and 46 days after planting (DAP) for sample date 1; 69, 65, 74, and 66 DAP for sample date 2; and 89, 96, 96, and 87 DAP for sample date 3 (Table 1). Soil types, chemical properties, and cation exchange capacity was similar among soils at the four locations. Results for chemical soil tests for samples collected from each location at the time samples were collected are summarized in Table 2.

Root yield, sugar content per ton, and sugar content produced per acre varied among the six varieties across all four locations (Table 3). The four site average for each of the variables is given in Table 3. However, analysis indicated a significant interaction between site and variety providing evidence of variation in the ranking of varieties among the sites. Overall, root yield, sugar content, and sugar production followed anticipated patterns based on past varietal response data. Root yield and quality did vary allow for correlation between yield and quality and plant tissue concentration.

Results for the analysis of variance for leaf blade tissue concentration are summarized in Table 4. The effect of time and variety was significant for all nutrient concentrations Nutrient concentrations differed among locations for all nutrients except for calcium. The location by time interaction was significant for nearly all nutrients while the time by variety and the three-way interaction of time x location x variety was consistently non-significant. Similar results were found for petiole concentration (Table 5).

Differences in leaf blade nutrient concentration among varieties, when averaged across time and location, are summarized in Table 6. While significant, the relative differences in plant nutrient concentrations among the varieties were relatively small. The ranking among varieties (maximum to minimum concentrations) were not consistent indicating that varieties with greater nutrient concentration were not greater for all nutrients. This indicates that plant nutrient uptake is not relatively greater for one variety versus another for all nutrients. Table 6 also lists the anticipated sufficiency range according to Bryson et al., 2014. The average for boron tissue concentration was the only instance where a concentration average was close to the low end of the sufficiency range, but the boron concentration in the leaf blade tissue did not necessarily indicate that boron was limiting yield.

Effects on all nutrient concentrations were similar for petioles (Table 7) as with leaf blades. However, the concentration of nutrients tended to be less in the petiole than in the leaf blade tissue. The major exception was potassium where the concentration was greater in the petiole than in the leaf blade. There is no identified sufficiency range for petiole tissue to compare results with established ranges.

The effect of time on macro- and micronutrient concentrations is summarized in Figures 1 and 2, respectively. Mobile nutrients (N, P, Ca, Mg) exhibited a general decrease in concentration for both leaf blade and petiole tissue over time except for potassium where the leaf blade tissue increased and the petiole potassium concentration decreased. The opposite effect was found for immobile nutrients (S, B, Cu, Mn, and Zn) where concentration increased over time. Iron did exhibit a decrease over time, but this decrease was likely due to less soil contamination on leaves later in the growing season. As more leaves developed it was less likely that rain drops would reach the soil surface resulting in splashing of soil particles onto plant tissue. Due to contamination, tissue iron concentration should not be used as a predictor of yield and quality parameters.

Simple correlation between individual nutrient concentration in the leaf blade and petiole at each sampling time and sugarbeet root yield is summarized in Table 8. There were significant positive and negative correlations among many of the nutrients studied. The only nutrient which consistently showed little to no correlation with root yield was tissue phosphorus concentration. There was not instance where a single nutrient always showed a positive correlation with root yield. For example, total nitrogen content in the leaf blade and petiole was positively correlated with root yield at T1 but was negatively correlated by T3. The greatest correlation was between leaf blade Fe and root yield (r=0.69). However, differences in Fe concentration early in the growing season can be impacted by the number and size of leaves on the plant which affects contamination of plant tissue by Fe splashed onto the leaves by raindrops hitting the soil.

Table 9 summarizes the correlation between plant tissue and sucrose content and Table 10 summarizes correlation with sugar production per acre. Similar to root yield, there were no instances where sugar content or yield showed a consistent correlation with any nutrient. It would be expected that if a nutrient is limiting or if yield or quality is a function of nutrient concentration then there should be consistent correlation over time between these factors and the concentration of nutrient in the plant tissue. Nutrient concentration in plant tissue does not necessarily account for variations in plant growth and differences in nutrient remobilization among varieties. The data overall indicates that some caution should be exercised when interpreting plant tissue results as a correlation between yield and quality and a concentration of a specific nutrient at a single point during the growing season does not prove that uptake of any nutrient is driving final yield or sugar production.

Correlations between individual nutrient concentrations and their respective soil test collected at the time of tissue sampling are summarized in Table 11. Significant positive correlations were found between soil test N, P, and K with leaf blade and petiole N, P, and K, respectively. The strongest correlations were for the 0 to 6-inch depth but significant positive correlations were also found between tissue N and K and the 6-24 inches N and K soil test values. For micronutrients, the only significant positive correlation was between leaf blade Cu and Zn and their soil test values and leaf blade boron and the boron soil test at 6-24 inches. Since the sites were maintained at high fertility levels it is not surprising that there was little correlation between soil test values and tissue nutrient concentration. Environmental factors such as temperature and precipitation and crop development at sampling have been shown to influence variation in nutrient concentration among research sites for other crops. Further work is planned for the sugarbeet data but the 2017 data at four sites was not enough to conduct a correlation between outside factors and concentration. Further research is planned using the same varieties in subsequent years which will be needed to fully determine what factors can explain variations in tissue nutrient concentrations among sites and varieties.

**Conclusions**: The data presented in the reports if for the first year of a three-year study assessing the variation in tissue nutrient concentration among sugar beet varieties. The first year data showed that there were clear differences in yield and quality among the sugarbeet varieties used in the study. Tissue (leaf blade and petiole) nutrient concentration will vary among sugarbeet varieties sampled in the same field at the same time. The concentration of mobile nutrients will decrease while the concentration of immobile nutrients will increase when sampling the same leaf relative to the top part of the canopy over time. The decrease or increase will occur for each nutrient similar for the leaf blade and petiole sample.  Due to this variation, a large range in the recommended sampling time for leaf blade samples (50-80 days after planting) should not be used. Data outlining a single sampling time is warranted to narrow down sufficiency levels for most nutrients. The data indicates that significant caution should be exercised when collecting a single sample from a well fertilized field as there is no evidence that the concentration of a nutrient in the leaf or petiole has a direct impact on yield or quality.

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Table 1. Location, planting and sampling information, dominant soil series, and cation exchange capacity (CEC) for each location (CC, Clara City; LL, Lake Lillian; M, Murdock; R, Renville).

| | Date of | | | | Soil | | | CEC | |
|---|---|---|---|---|---|---|---|---|---|
| Location | Planting | Sample 1 | Sample 2 | Sample 3 | Series | Texture† | Classification‡ | 0-6" | 6-24" |
| | | | | | | | | meq/100g | |
| CC | 25-May | 12-Jul | 2-Aug | 22-Aug | Colvin-Quam | SiCL | T Calciaquoll | 31.6 | 25.5 |
| LL | 8-May | 21-Jun | 12-Jul | 2-Aug | Nicollet | SiCL | A Hapludoll | 33.7 | 28.7 |
| M | 29-Apr | 21-Jun | 12-Jul | 2-Aug | Bearden-Quam | SiCL | Ae Calciaquoll | 28.0 | 22.2 |
| R | 6-May | 21-Jun | 11-Jul | 1-Aug | Chetomba | SiCL | T Endoaquoll | 31.1 | 24.4 |

† SiCL, silty clay loam.

‡A, aquic; Ae, aeric; T, typic

Table 2. Summary of soil test results for samples collected with plant tissue samples at Clara City (CC), Lake Lillian (LL), Murdock (M), and Renville (R).

| | | | | | Ammonium Acetate | | | | DTPA | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time | Location | Depth | $NO_3$-N | P | Ca | K | Mg | $SO_4$-S | Cu | Fe | Mn | Zn | B | Cl | O.M. | pH |
| | | in | ---------------------------------------------ppm--------------------------------------------- | | | | | | | | | | | | -%- | |
| 1 | CC | 0-6 | 17.5 | 12 | 5852 | 242 | 832 | 12 | 1.0 | 7.8 | 18.1 | 2.7 | 1.2 | 11.2 | 7.0 | 7.9 |
| | | 6-24 | 11.5 | 3 | 5058 | 153 | 1076 | 10 | 1.4 | 10.0 | 7.2 | 0.6 | 0.8 | 11.6 | 4.0 | 8.1 |
| | LL | 0-6 | 31.0 | 36 | 4833 | 182 | 562 | 15 | 1.0 | 43.8 | 29.5 | 0.9 | 0.6 | 8.6 | 6.2 | 7.0 |
| | | 6-24 | 17.2 | 8 | 4679 | 153 | 548 | 11 | 1.2 | 43.5 | 17.3 | 0.6 | 0.6 | 8.6 | 4.7 | 7.0 |
| | M | 0-6 | 9.3 | 8 | 5960 | 189 | 696 | 12 | 1.0 | 7.1 | 18.6 | 1.9 | 1.6 | 7.8 | 5.3 | 8.0 |
| | | 6-24 | 14.0 | 2 | 6330 | 163 | 869 | 133 | 1.2 | 6.4 | 8.0 | 0.8 | 1.0 | 6.7 | 3.1 | 7.8 |
| | R | 0-6 | 6.9 | 8 | 5152 | 348 | 583 | 12 | 1.4 | 17.2 | 29.9 | 1.6 | 0.9 | 9.6 | 5.1 | 7.5 |
| | | 6-24 | 6.9 | 3 | 5581 | 217 | 608 | 8 | 1.4 | 9.2 | 11.3 | 0.5 | 0.6 | 7.7 | 3.1 | 7.9 |
| 2 | CC | 0-6 | 12.6 | 12 | 5938 | 249 | 817 | 11 | 1.0 | 7.3 | 14.7 | 2.7 | 1.3 | 6.9 | 6.6 | 8.0 |
| | | 6-24 | 3.4 | 3 | 5139 | 134 | 1016 | 10 | 1.5 | 8.2 | 7.4 | 0.8 | 0.7 | 7.8 | 4.3 | 8.2 |
| | LL | 0-6 | 16.4 | 35 | 4772 | 156 | 523 | 14 | 1.0 | 36.0 | 26.4 | 0.8 | 0.5 | 6.7 | 6.0 | 7.3 |
| | | 6-24 | 4.4 | 4 | 4480 | 138 | 543 | 10 | 1.3 | 40.7 | 16.3 | 0.4 | 0.5 | 6.9 | 4.2 | 7.1 |
| | M | 0-6 | 3.5 | 9 | 5877 | 163 | 657 | 11 | 1.1 | 7.6 | 15.3 | 1.9 | 1.5 | 8.0 | 5.2 | 8.1 |
| | | 6-24 | 3.0 | 3 | 6824 | 155 | 717 | 160 | 1.2 | 6.2 | 7.6 | 0.8 | 1.1 | 6.8 | 3.5 | 7.8 |
| | R | 0-6 | 3.4 | 9 | 5126 | 316 | 537 | 11 | 1.3 | 12.1 | 24.0 | 1.4 | 0.8 | 9.0 | 5.2 | 7.7 |
| | | 6-24 | 1.6 | 2 | 5280 | 147 | 693 | 6 | 1.4 | 8.2 | 8.2 | 0.3 | 0.6 | 9.8 | 2.9 | 8.0 |
| 3 | CC | 0-6 | 4.5 | 16 | 5957 | 214 | 801 | 11 | 1.0 | 8.0 | 14.0 | 2.8 | 0.9 | 8.6 | 6.6 | 8.0 |
| | | 6-24 | 7.1 | 2 | 4835 | 138 | 1004 | 9 | 1.6 | 7.6 | 4.5 | 0.8 | 0.6 | 5.7 | 3.1 | 8.2 |
| | LL | 0-6 | 4.3 | 34 | 4718 | 142 | 545 | 14 | 1.1 | 39.6 | 23.3 | 1.0 | 0.6 | 7.6 | 6.2 | 7.3 |
| | | 6-24 | 1.6 | 8 | 3552 | 135 | 550 | 12 | 1.2 | 46.0 | 20.7 | 0.4 | 0.7 | 7.4 | 4.7 | 6.8 |
| | M | 0-6 | 3.5 | 7 | 5943 | 169 | 667 | 11 | 1.3 | 6.2 | 13.4 | 2.0 | 1.2 | 7.1 | 5.2 | 8.1 |
| | | 6-24 | 2.9 | 3 | 6236 | 156 | 723 | 61 | 1.3 | 5.8 | 6.5 | 1.0 | 1.1 | 7.5 | 3.5 | 7.9 |
| | R | 0-6 | 3.4 | 8 | 5034 | 312 | 558 | 11 | 1.4 | 15.0 | 22.6 | 1.4 | 0.8 | 8.6 | 5.2 | 7.6 |
| | | 6-24 | 1.7 | 3 | 5539 | 188 | 688 | 8 | 1.4 | 10.0 | 10.0 | 0.4 | 0.6 | 8.4 | 3.2 | 7.8 |

Table 3. Summary of analysis of variance for the main effect of sugarbeet variety by and across location. Numbers within rows which are followed by the same letter are not significantly different at $P \leq 0.10$.

| Location | Variety | | | | | | |
|---|---|---|---|---|---|---|---|
| | Crystal RR018 | Maribo 109 | Beta 92RR30 | Beta 9475 | Crystal M579 | Crystal M509 | *P*>F |
| | ---Root Yield (tons/acre)--- | | | | | | |
| Clara City | 26.8a | 23.0ab | 19.2b | 26.6a | 26.2a | 25.1a | 0.06 |
| Lake Lillian | 33.6b | 29.0c | 28.0c | 33.9b | 35.0b | 38.2a | <0.001 |
| Murdock | 37.4b | 36.7b | 33.2c | 37.6b | 35.5bc | 41.7a | <0.001 |
| Renville | 32.6b | 29.1c | 30.0c | 34.3ab | 35.0a | 36.3a | <0.001 |
| Average | 32.5b | 29.3c | 27.8d | 33.1b | 32.9b | 35.4a | <0.001 |
| | ---Recoverable Sugar (lbs/ton)--- | | | | | | |
| Clara City | 266bc | 278ab | 272b | 272bc | 289a | 260c | 0.01 |
| Lake Lillian | 269a | 268a | 257b | 263ab | 270a | 249c | <0.001 |
| Murdock | 294ab | 289bc | 297ab | 288bc | 305a | 280c | 0.04 |
| Renville | 285cd | 295b | 302a | 293b | 289bc | 280d | <0.01 |
| Average | 280b | 283b | 281b | 279b | 288a | 267c | <0.001 |
| | ---Recoverable Sugar (lbs/acre)--- | | | | | | |
| Clara City | 7130ab | 6413bc | 5278c | 7254ab | 7561a | 6555ab | 0.05 |
| Lake Lillian | 9056a | 7789b | 7185b | 8912a | 9421a | 9526a | <0.001 |
| Murdock | 11011b | 10614b | 9837c | 10820b | 10832b | 11673 | <0.01 |
| Renville | 9282bc | 8590c | 9067c | 10014ab | 10125a | 10173a | <0.01 |
| Average | 9110a | 8300b | 7873c | 9265a | 9489a | 9490a | <0.001 |

Table 4. Summary of analysis of variance for leaf blade nutrient concentration averaged across four locations in 2017 and three sampling times at each location.

| Nutrient | Time (T) | Location (L) | T x L | Variety (V) | T x V | L x V | T x L x V |
|---|---|---|---|---|---|---|---|
| | | ---------------------------- | ---------------------------- | ----*P*>F---- | ---------------------------- | ---------------------------- | |
| Nitrogen | *** | *** | *** | *** | * | ** | 0.17 |
| Phosphorus | *** | *** | *** | *** | 0.45 | ** | 0.46 |
| Potassium | *** | *** | *** | *** | *** | 0.16 | 0.17 |
| Calcium | *** | 0.21 | ** | *** | *** | * | 0.11 |
| Magnesium | *** | *** | *** | *** | 0.39 | 0.07 | 0.54 |
| Sulfur | *** | *** | *** | *** | ** | 0.31 | 0.60 |
| Boron | *** | *** | *** | *** | 0.06 | * | 0.31 |
| Copper | *** | *** | *** | * | *** | 0.06 | * |
| Iron | *** | *** | *** | *** | *** | 0.37 | 0.06 |
| Manganese | *** | 0.08 | *** | *** | *** | 0.62 | 0.96 |
| Zinc | *** | *** | *** | *** | *** | * | *** |

†Asterisks represent significance at $P<0.05$,*; 0.01, **; and 0.001, ***.

Table 5. Summary of analysis of variance for petiole nutrient concentration averaged across four locations in 2017 and three sampling times at each location.

| Nutrient | Time (T) | Location (L) | T x L | Variety (V) | T x V | L x V | T x L x V |
|---|---|---|---|---|---|---|---|
| | | ---------------------------- | ---------------------------- | ----*P*>F---- | ---------------------------- | ---------------------------- | |
| Nitrogen | *** | *** | *** | *** | * | 0.17 | 0.07 |
| Phosphorus | *** | ** | *** | *** | 0.34 | 0.06 | 0.07 |
| Potassium | *** | *** | *** | *** | ** | 0.06 | * |
| Calcium | *** | 0.23 | *** | *** | ** | ** | * |
| Magnesium | *** | *** | *** | *** | *** | *** | *** |
| Sulfur | *** | *** | *** | *** | 0.23 | 0.18 | 0.40 |
| Boron | *** | *** | *** | *** | *** | 0.61 | 0.79 |
| Copper | *** | ** | *** | *** | 0.13 | 0.24 | 0.24 |
| Iron | *** | *** | *** | *** | * | 0.96 | 0.98 |
| Manganese | *** | 0.37 | *** | *** | 0.22 | 0.93 | 0.92 |
| Zinc | *** | 0.78 | *** | *** | * | 0.65 | 0.81 |

†Asterisks represent significance at $P<0.05$,*; 0.01, **; and 0.001, ***.

Table 6. Varietal differences in leaf blade nutrient concentration across four locations in 2017 and three sampling times at each location. Within rows, numbers followed by the same letter are not significantly different at $P \leq 0.10$.

| | Variety | | | | | | |
|---|---|---|---|---|---|---|---|
| Nutrient | Crystal RR018 | Maribo 109 | Beta 92RR30 | Beta 9475 | Crystal M579 | Crystal M509 | Suffic.† |
| | ------------------------------------------------%------------------------------------------------ | | | | | | |
| Nitrogen | 5.45a | 5.02b | 4.99bc | 4.98bc | 4.90c | 5.03b | 4.3-5.0 |
| Phosphorus | 0.53a | 0.54a | 0.45d | 0.47c | 0.44d | 0.51b | 0.45-1.1 |
| Potassium | 3.81a | 3.61bc | 3.47d | 3.50cd | 3.65b | 3.41d | 2.0-6.0 |
| Calcium | 0.59b | 0.69a | 0.67a | 0.59b | 0.59b | 0.61b | 0.5-1.5 |
| Magnesium | 0.45c | 0.54a | 0.56a | 0.50b | 0.50b | 0.51b | 0.25-1 |
| Sulfur | 0.39a | 0.36b | 0.34c | 0.37b | 0.36b | 0.38a | 0.21-0.5 |
| | ------------------------------------------------ppm------------------------------------------------ | | | | | | |
| Boron | 29b | 32a | 31a | 28c | 29b | 27c | 31-200 |
| Copper | 26ab | 24abc | 24bc | 23bc | 27a | 21c | 11-40 |
| Iron | 443b | 366c | 436b | 437b | 517a | 541a | 60-140 |
| Manganese | 72c | 85b | 87b | 72c | 94a | 77c | 26-360 |
| Zinc | 47a | 41d | 45b | 44bc | 42cd | 48a | 10-80 |

†Suffic, sufficiency range identified by Bryson et al., 2014.

Table 7. Varietal differences in petiole nutrient concentration across four locations in 2017 and three sampling times at each location. Within rows, numbers followed by the same letter are not significantly different at $P \leq 0.10$.

| | Variety | | | | | |
|---|---|---|---|---|---|---|
| Nutrient | Crystal RR018 | Maribo 109 | Beta 92RR30 | Beta 9475 | Crystal M579 | Crystal M509 |
| | ---------------------% | | | | | |
| Nitrogen | 2.50b | 2.64a | 2.62a | 2.42b | 2.42b | 2.66a |
| Phosphorus | 0.34c | 0.42a | 0.35c | 0.33d | 0.33d | 0.37b |
| Potassium | 4.28b | 4.28b | 4.07c | 4.20bc | 4.12c | 4.53a |
| Calcium | 0.34e | 0.47b | 0.41c | 0.37d | 0.41c | 0.52a |
| Magnesium | 0.26c | 0.31a | 0.31a | 0.26c | 0.27b | 0.27b |
| Sulfur | 0.12c | 0.14a | 0.12c | 0.12c | 0.12c | 0.13b |
| | ---------------------ppm | | | | | |
| Boron | 25d | 29a | 27b | 26bc | 25.5cd | 29a |
| Copper | 9.0a | 8.5b | 7.7c | 8.9a | 7.7c | 8.6ab |
| Iron | 218c | 302a | 245bc | 225c | 262b | 270b |
| Manganese | 27d | 32b | 29c | 26d | 36a | 32b |
| Zinc | 16c | 21a | 16c | 17c | 18b | 20a |

Table 8. Simple correlation (r) between sugarbeet root yield and leaf blade and petiole nutrient concentration for the newest fully developed leaf sampled the third week in June, first week in July, and fourth week in July. Correlation r values when between -0.15 and 0.15 are not considered significant at $P \leq 0.10$.

| | N | P | K | Ca | Mg | S | B | Cu | Fe | Mn | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Time 1 Blade | 0.58 | 0.16 | 0.20 | 0.52 | 0.29 | 0.05 | 0.27 | -0.43 | 0.69 | 0.47 | 0.31 |
| Time 1 Petiole | 0.59 | -0.28 | 0.38 | 0.51 | 0.32 | 0.26 | 0.42 | -0.14 | 0.57 | 0.48 | 0.47 |
| Time 2 Blade | 0.11 | 0.03 | -0.18 | -0.50 | -0.65 | 0.56 | 0.28 | 0.40 | -0.42 | -0.48 | 0.07 |
| Time 2 Petiole | -0.46 | -0.07 | -0.55 | -0.39 | -0.64 | 0.01 | -0.29 | 0.08 | -0.61 | -0.54 | -0.35 |
| Time 3 Blade | -0.27 | -0.40 | 0.19 | -0.11 | -0.36 | 0.22 | 0.47 | 0.10 | -0.41 | -0.04 | -0.50 |
| Time 3 Petiole | -0.51 | 0.05 | -0.38 | 0.03 | -0.57 | -0.18 | 0.42 | -0.05 | 0.04 | -0.12 | -0.30 |

Table 9. Simple correlation (r) between sugarbeet sugar content (pounds per ton) and leaf blade and petiole nutrient concentration for the newest fully developed leaf sampled the third week in June, first week in July, and fourth week in July. Correlation r values when between -0.15 and 0.15 are not considered significant at $P \leq 0.10$.

| | N | P | K | Ca | Mg | S | B | Cu | Fe | Mn | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Time 1 Blade | -0.02 | -0.27 | 0.41 | -0.10 | -0.38 | -0.54 | 0.52 | 0.08 | 0.07 | -0.05 | 0.33 |
| Time 1 Petiole | -0.07 | -0.44 | 0.30 | -0.20 | -0.32 | -0.25 | -0.18 | 0.15 | -0.05 | -0.10 | 0.04 |
| Time 2 Blade | -0.47 | -0.58 | 0.26 | 0.01 | -0.40 | -0.21 | 0.62 | 0.33 | -0.43 | -0.15 | 0.01 |
| Time 2 Petiole | -0.62 | -0.45 | -0.03 | -0.13 | -0.62 | -0.27 | -0.16 | 0.07 | -0.40 | -0.26 | -0.12 |
| Time 3 Blade | -0.64 | -0.59 | 0.57 | 0.46 | -0.21 | -0.47 | 0.51 | 0.38 | -0.01 | 0.32 | 0.02 |
| Time 3 Petiole | -0.59 | -0.38 | 0.23 | 0.32 | -0.59 | -0.23 | 0.30 | 0.19 | 0.45 | 0.30 | 0.01 |

Table 10. Simple correlation (r) between sugarbeet sugar production (pounds per acre) and leaf blade and petiole nutrient concentration for the newest fully developed leaf sampled the third week in June, first week in July, and fourth week in July. Correlation r values when between -0.15 and 0.15 are not considered significant at $P \leq 0.10$.

| | N | P | K | Ca | Mg | S | B | Cu | Fe | Mn | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Time 1 Blade | 0.52 | 0.06 | 0.29 | 0.43 | 0.14 | -0.12 | 0.40 | -0.35 | 0.64 | 0.41 | 0.38 |
| Time 1 Petiole | 0.51 | -0.39 | 0.42 | 0.39 | 0.19 | 0.15 | 0.32 | -0.09 | 0.49 | 0.40 | 0.43 |
| Time 2 Blade | -0.04 | -0.15 | -0.10 | -0.45 | -0.71 | 0.43 | 0.43 | 0.46 | -0.50 | -0.47 | 0.08 |
| Time 2 Petiole | -0.59 | -0.20 | -0.50 | -0.38 | -0.77 | -0.07 | 0.30 | 0.11 | -0.66 | -0.56 | -0.34 |
| Time 3 Blade | -0.43 | -0.53 | 0.33 | 0.03 | -0.39 | 0.05 | 0.58 | 0.20 | -0.37 | 0.05 | 0.43 |
| Time 3 Petiole | -0.63 | -0.07 | -0.28 | 0.12 | -0.69 | -0.23 | 0.47 | 0.01 | 0.17 | -0.02 | -0.26 |

Table 11. Correlation between leaf blade and petiole nutrient concentration across locations and sample time with the soil test concentration for the same nutrient for soil samples collected at 0-6 and 6-24 inch soil depths.

| Nutrient | Plant Part | 0-6” Soil Test | 6-24” Soil Test |
|---|---|---|---|
| Nitrogen | Leaf Blade | 0.56 | 0.64 |
| | Petiole | 0.69 | 0.69 |
| Phosphorus | Leaf Blade | 0.52 | 0.26 |
| | Petiole | 0.65 | 0.52 |
| Potassium | Leaf Blade | 0.72 | 0.69 |
| | Petiole | 0.63 | 0.49 |
| Calcium | Leaf Blade | -0.12 | 0.13 |
| | Petiole | -0.06 | 0.13 |
| Magnesium | Leaf Blade | -0.27 | -0.36 |
| | Petiole | -0.08 | -0.20 |
| Sulfur | Leaf Blade | 0.40 | -0.21 |
| | Petiole | 0.45 | 0.31 |
| Boron | Leaf Blade | 0.30 | 0.59 |
| | Petiole | -0.01 | -0.13 |
| Copper | Leaf Blade | 0.54 | 0.23 |
| | Petiole | 0.17 | 0.40 |
| Iron | Leaf Blade | 0.10 | 0.09 |
| | Petiole | 0.20 | 0.16 |
| Manganese | Leaf Blade | -0.01 | 0.13 |
| | Petiole | 0.20 | 0.13 |
| Zinc | Leaf Blade | 0.67 | 0.44 |
| | Petiole | 0.03 | 0.17 |

Correlations between -0.50 and 0.50 are not significant at $P \leq 0.10$

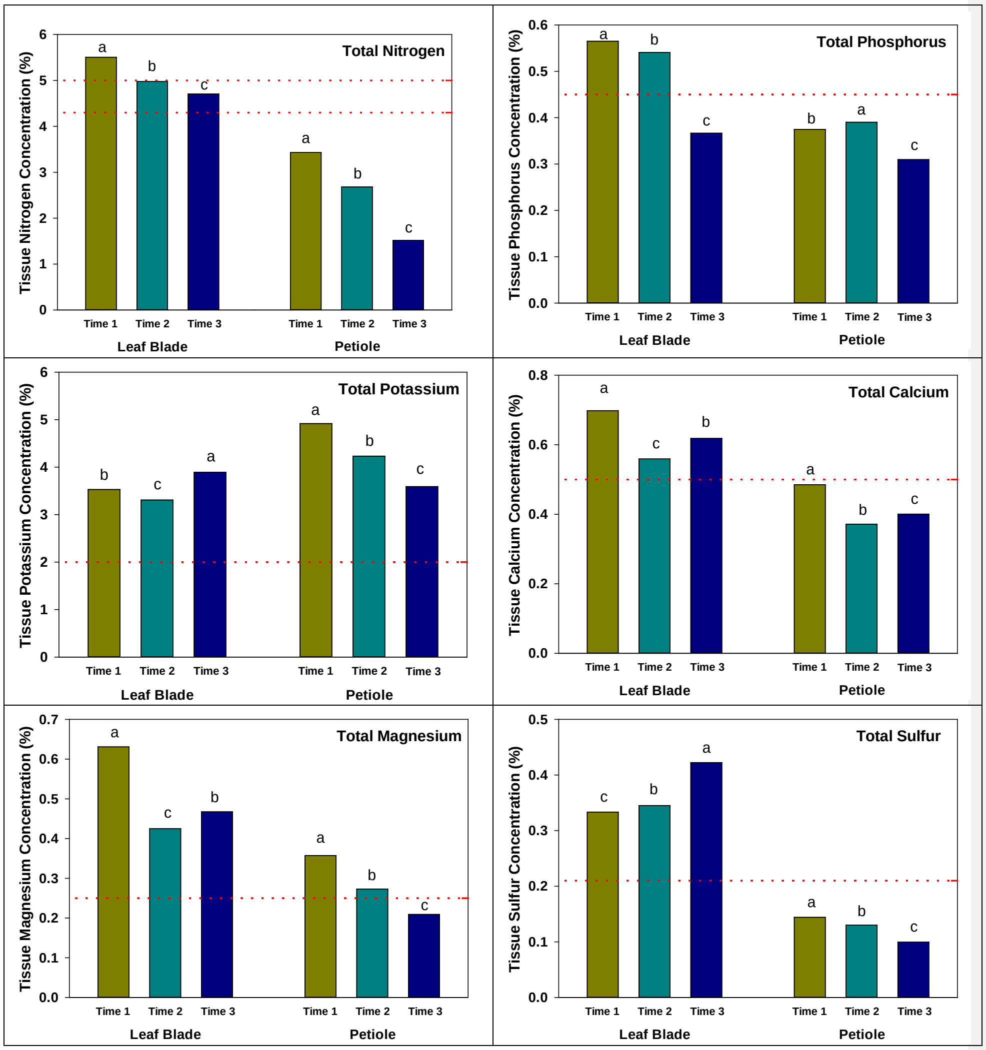


Figure 1. Summary of the impact of time on sugarbeet total macronutrient concentrations for leaf blade and petiole samples collected from six sugarbeet varieties. Letters denote significance among sampling times for leaf blade or petiole samples at $P \leq 0.10$. Horizontal dashed lines represent the upper and lower end of the sufficiency range for leaf blade samples according to Bryson et al., 2014. A single dashed line represents the low end of the sufficiency range.

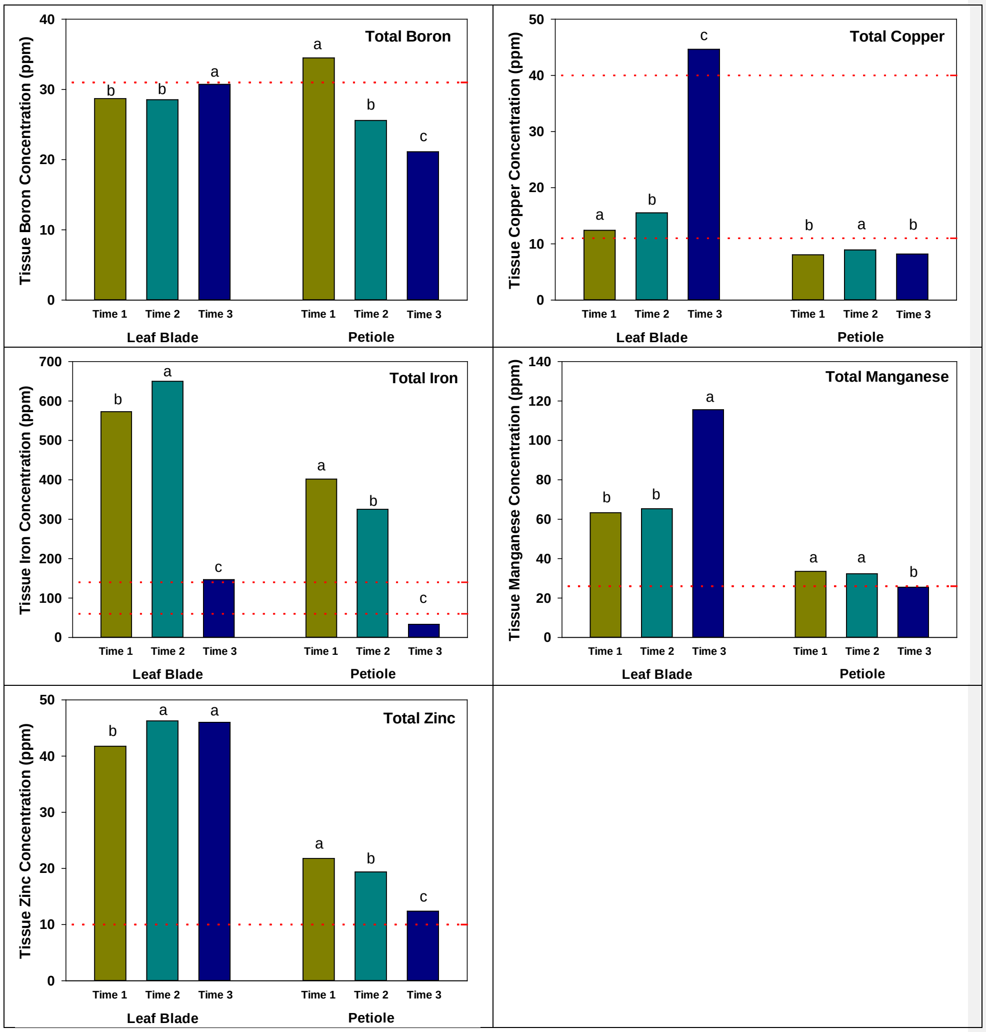


Figure 2. Summary of the impact of time on sugarbeet total micronutrient concentrations for leaf blade and petiole samples collected from six sugarbeet varieties. Letters denote significance among sampling times for leaf blade or petiole samples at $P \leq 0.10$. Horizontal dashed lines represent the upper and lower end of the sufficiency range for leaf blade samples according to Bryson et al., 2014. A single dashed line represents the low end of the sufficiency range.

**EFFECT OF METHYL JASMONATE, SALICYLIC ACID, HEADLINE™ AND STADIUM™ ON ROOT YIELD, SUCROSE YIELD, AND STORAGE PROPERTIES**

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## INTRODUCTION

Methyl jasmonate (MeJA) and salicylic acid (SA) are increasingly being investigated for their ability to enhance yield and protect crop plants and products from environmental stress and disease (Rohwer and Erwin, 2008; Hayat et al., 2010). For a number of crop species and plant products, the application of these compounds improves resistance against a range of pathogens and insect pests and provides protection against environmental stresses including cold temperature, drought, and high soil salinity. MeJA and SA can also affect plant development, growth, and metabolism, and increases in biomass (Pelacho and Mingo-Caster, 1991; Khan et al., 2003; Loutfy et al., 2012), alterations in carbohydrate partitioning (Khodary, 2004; Wang and Zheng, 2005), and improvements in water and nitrogen use efficiency (Kumar et al., 2000; Singh et al., 2010) have been attributed to their use. Previous research established that sugarbeet roots respond to these compounds and documented the ability of postharvest MeJA treatments to reduce rot from three storage pathogens (Fugate et al., 2012; 2013). The effect of preharvest MeJA and SA treatments on sugarbeet production and storage properties, however, has not previously been examined.

Research was initiated in 2014 to determine the effects of an early season MeJA treatment, a late season MeJA treatment, or an early season SA treatment on sugarbeet root yield, sucrose content, and storage properties. A late season SA treatment was not included since preliminary studies indicated a detrimental effect of this treatment on storage properties. All treatments were applied singly or in combination with a late season Headline treatment. At the time these experiments were initiated, Headline was a commonly used fungicide for control of Cercospora leaf spot (causal agent *Cercospora beticola*) and was used by some for possible plant health benefits. Headline treatments were included in this study because of its potential to interact with MeJA or SA treatments due to its purported hormone-like attributes (Köhle et al., 2003).

In 2014, significant increases in root yield and recoverable sugar per acre were observed for plants that received an early MeJA treatment + a late Headline treatment (Fugate et al., 2016). Plants that received the early MeJA + Headline treatment yielded 3.5 tons acre$^{-1}$ more than untreated controls. Recoverable sugar per acre (RSA) for the early MeJA + Headline treatment was 1856 lbs acre$^{-1}$ greater than the RSA of controls. No statistically significant effects on storage traits including root respiration rate, sucrose loss in storage, invert sugar accumulation, or root firmness were observed due to early MeJA + Headline treatment.

In a 2015 repetition of this experiment, MeJA had no beneficial effects on root yield, sucrose content, or sucrose yield at time of harvest. The experiment, however, was compromised by a late season Cercospora infection, and Headline-containing treatments outperformed treatments without Headline. An early season MeJA + Headline treatment, however, affected storage traits, and roots that received this treatment had reduced respiration rates after 30 days in storage, reduced loss to molasses after 30 and 90 days in storage, and improved recoverable sugar per ton after 30 days in storage (Fugate et al., 2017). Postharvest Stadium™ treatments, with or without Headline treatment, were also included in the 2015 experiment. Stadium is a commercial mixture of three fungicides (fludioxonil, azoxystrobin, and difenoconazole) that is marketed for the postharvest protection of potato and other tuber and corm products. Beneficial effects due to Stadium were only observed with roots that received both Stadium and Headline treatments. Roots receiving this treatment had lower respiration rates and reduced sucrose loss to molasses after 90 days in storage, relative to controls (Fugate et al., 2017).

In 2016, the MeJA/SA/Headline field and storage experiments were repeated a third time and results of these experiments are reported here. Field and storage experiments were also carried out in 2017. For 2017 experiments, the early MeJA treatments, with or without Headline, were expanded to include two application times and two rates. SA treatments were eliminated since beneficial effects for these treatments were not found in the previous three years.

**MATERIALS AND METHODS**

Field studies were conducted in Fargo, ND in 2016 and 2017 and at a location near Mooreton, ND in 2017. For Fargo experiments, seed of Crystal ACH 817 was planted using a randomized complete block design with 4 replicates. In 2016, treatments included (1) an untreated control, (2) an early season MeJA treatment, (3) a late season MeJA treatment, (4) an early season SA treatment, (5) a late season Headline treatment, (6) an early season MeJA treatment + a late season Headline treatment, (7) a late season MeJA treatment + a late season Headline treatment, (8) an early season SA treatment + a late season Headline treatment, (9) a postharvest Stadium treatment, and (10) a late season Headline treatment + a postharvest Stadium treatment. MeJA, SA, Headline, and Stadium were applied at rates of 0.01 µM, 10 µM, 9 oz/acre, and 1.6% (v/v), respectively. MeJA and SA solutions contained 10 ppm (v/v) Tween 20 and were applied as foliar sprays. For the Fargo, ND 2017 experiment, treatments included (1) an untreated control, (2) a late season Headline treatment, (3) an early season MeJA treatment of 0.01 µM, (4) an early season MeJA treatment of 1.0 µM, (5) a late season MeJA treatment of 0.01 µM, (6) a late season MeJA treatment of 1.0 µM, (7) an early season MeJA treatment of 0.01 µM + a late season Headline treatment, (8) an early season MeJA treatment of 1.0 µM + a late season Headline treatment, (9) a late season MeJA treatment of 0.01 µM + a late season Headline treatment, and (10) a postharvest Stadium treatment. Headline and Stadium were applied using the same rates as in 2016. Planting, treatment, and harvest dates for 2016 and 2017 are reported in Table 1.

The 2017 Mooreton, ND experiment was planted to two varieties, Hilleshög 4062 and Betaseed 73MN, as a split plot design with 6 replications, using varieties as the main plots. Treatments included (1) an untreated control, (2) a late season Headline treatment, (3) an early June MeJA treatment of 0.01 µM, (4) an early June MeJA treatment of 10 µM, (5) a mid-July MeJA treatment of 0.01 µM, (6) a mid-July MeJA treatment of 10 µM, (7) an early June MeJA treatment of 0.01 µM + a late season Headline treatment, (8) an early June MeJA treatment of 10 µM + a late season Headline treatment, (9) a mid-July MeJA treatment of 0.01 µM + a late season Headline treatment, and (10) a mid-July MeJA treatment of 10 µM + a late season Headline treatment. MeJA and Headline were applied as described above, and planting, treatment, and harvest dates are reported in Table 1.

**Table 1.** Planting, treatment, and harvest dates for the 2016 and 2017 field studies conducted in Fargo, ND and the 2017 study near Mooreton, ND. In 2016, methyl jasmonate (MeJA) was applied as an early season or late season treatment, and salicylic acid was applied as an early season treatment. In 2017, only MeJA was applied.

| | 2016, Fargo | 2017, Fargo | 2017, Mooreton |
|---|---|---|---|
| Planting date | 4 May | 6 June | 9 May |
| Early season treatments | | | |
| date | 29 June | 13 July | 8 Jun; 14 July |
| days after sowing | 56 | 37 | 30; 66 |
| Headline & late season treatments | | | |
| date | 26 Aug | 30 Aug | 21 Aug |
| days before harvest | 33 | 30 | 46 |
| Harvest date | 28 Sept | 29 Sept | 6 Oct |

For all experiments (Fargo in 2016; Fargo and Mooreton in 2017), plants were mechanically defoliated and the roots were hand-harvested, washed, and stored at 5°C (41°F) and 95% relative humidity for up to 100 days. Respiration rate, sucrose content, loss to molasses, recoverable sugar yield, and invert sugar concentration were determined after 30 and 100 days in storage using established protocols (Campbell et al., 2012).

Data were analyzed using the GLM procedure of SAS (ver. 9.1, SAS Institute, Inc., Cary, NC) with $\alpha = 0.05$. Fisher's LSD was used to identify significant differences between treatment means.

## RESULTS

In 2016, MeJA and SA treatments had little effect on root yield or sucrose yield at harvest, or storage properties at 30 or 100 days after harvest (Tables 2, 3, and 4). Relative to the untreated control, no statistical differences were noted except for an increase in root respiration rate after 30 days in storage for roots that received the early MeJA treatment (Table 3) and an increase in recoverable sugar per ton after 100 days in storage for roots that received a late MeJA treatment + Headline (Table 4). Stadium had no statistically significant effects on any storage property after 30 or 100 days storage (Tables 3 and 4).

In 2017, poor germination for the Fargo, ND field experiment required that the field be replanted. The Fargo field was replanted on 6 June and no treatments were applied until mid-July to allow plants sufficient time to become established. At harvest, no significant differences in root yield, sucrose content, recoverable sugar per ton, recoverable sugar per acre, or sucrose loss to molasses were found for any treatments (Table 5). In the 2017 Mooreton, ND experiment, all treatments had similar root yield, sucrose content, recoverable sugar per ton, and sucrose loss to molasses at time of harvest (Table 6). A significant 1149 lbs/acre increase in recoverable sugar per acre, however, was found for plants receiving a mid-June treatment of 0.01 µM MeJA + a late August Headline treatment. Storage studies for roots from both locations are ongoing.

**Table 2.** Harvest data from 2016 Fargo, ND field experiment. Means within a column followed by different letters are significantly different based upon Fisher's LSD, with α = 0.05.

| Treatment | yield (tons/acre) | | root weight (g/root) | | sucrose (%) | | loss to molasses (%) | | Recoverable sugar per ton (lbs/ton) | | Recoverable sugar per acre (lbs/acre) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| control--untreated | 17.4 | a | 609 | a | 16.8 | ab | 1.66 | a | 303 | ab | 5287 | a |
| early MeJA | 17.5 | a | 712 | a | 16.7 | ab | 1.73 | a | 299 | ab | 5212 | a |
| late MeJA | 20.1 | a | 667 | a | 16.6 | ab | 1.68 | a | 298 | ab | 6011 | a |
| early SA | 18.0 | a | 701 | a | 16.1 | b | 1.88 | a | 285 | b | 5049 | a |
| late Headline | 19.5 | a | 690 | a | 17.2 | ab | 1.62 | a | 311 | ab | 6082 | a |
| early MeJA + Headline | 18.1 | a | 784 | a | 17.0 | ab | 1.41 | a | 311 | ab | 5643 | a |
| late MeJA + Headline | 18.1 | a | 619 | a | 17.6 | a | 1.63 | a | 318 | a | 5723 | a |
| early SA + Headline | 18.7 | a | 667 | a | 16.5 | ab | 1.84 | a | 294 | ab | 5491 | a |

**Table 3.** Respiration rate and invert sugar concentration 30 and 100 days after harvest (DAH) for the 2016 Fargo, ND field experiment. Means within a column followed by different letters are significantly different based upon Fisher's LSD, with α = 0.05. Treatment means that are significantly different from the control are highlighted in red.

| Treatment | respiration ($mg\ CO_2/kg/h$) 30 DAH | | respiration ($mg\ CO_2/kg/h$) 100 DAH | | inverts (g/100 g sucrose) 30 DAH | | inverts (g/100 g sucrose) 100 DAH | |
|---|---|---|---|---|---|---|---|---|
| control--untreated | 3.67 | a | 3.88 | b | 0.75 | ab | 0.48 | a |
| early MeJA | 3.49 | a | 4.82 | a | 0.93 | ab | 0.55 | a |
| late MeJA | 3.90 | a | 3.93 | ab | 0.84 | ab | 0.53 | a |
| early SA | 3.71 | a | 4.25 | ab | 1.02 | ab | 0.52 | a |
| late Headline | 3.60 | a | 4.18 | ab | 0.84 | ab | 0.56 | a |
| early MeJA + Headline | 3.75 | a | 3.80 | b | 0.80 | ab | 0.43 | a |
| late MeJA + Headline | 4.01 | a | 4.17 | ab | 0.58 | b | 0.53 | a |
| early SA + Headline | 3.66 | a | 3.96 | ab | 0.66 | ab | 0.73 | a |
| Stadium | 3.85 | a | 4.43 | ab | 1.06 | a | 0.54 | a |
| Stadium + Headline | 3.59 | a | 3.94 | ab | 0.67 | ab | 0.56 | a |

**Table 4.** Sucrose content, loss to molasses and recoverable sugar per ton 30 and 100 days after harvest (DAH) for the 2016 Fargo, ND field experiment. Means within a column followed by different letters are significantly different based upon Fisher's LSD, with α = 0.05. Treatment means that are significantly different from the control are highlighted in red.

| Treatment | sucrose (%) | | | | loss to molasses (%) | | | | recoverable sugar per ton (lbs/ton) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 30 DAH | | 100 DAH | | 30 DAH | | 100 DAH | | 30 DAH | | 100 DAH | |
| control--untreated | 17.4 | a | 17.2 | ab | 1.73 | a | 1.94 | a | 313 | a | 308 | b |
| early MeJA | 17.0 | a | 16.7 | b | 1.80 | a | 1.77 | a | 305 | a | 303 | b |
| late MeJA | 17.6 | a | 17.3 | ab | 1.71 | a | 2.04 | a | 317 | a | 308 | b |
| early SA | 17.0 | a | 16.7 | b | 1.82 | a | 2.01 | a | 304 | a | 301 | b |
| late Headline | 17.6 | a | 17.2 | ab | 1.76 | a | 1.92 | a | 316 | a | 311 | ab |
| early MeJA + Headline | 17.5 | a | 17.2 | ab | 1.84 | a | 1.91 | a | 314 | a | 310 | ab |
| late MeJA + Headline | 18.1 | a | 18.3 | a | 1.85 | a | 1.92 | a | 325 | a | 331 | a |
| early SA + Headline | 17.2 | a | 16.7 | b | 1.66 | a | 1.87 | a | 312 | a | 301 | b |
| Stadium | 16.8 | a | 16.7 | b | 1.85 | a | 2.00 | a | 301 | a | 300 | b |
| Stadium + Headline | 17.0 | a | 17.0 | b | 1.78 | a | 1.99 | a | 306 | a | 306 | b |

**Table 5.** Harvest and storage data for the 2017 Fargo, ND field experiment. Means within a column followed by different letters are significantly different based upon Fisher's LSD, with α = 0.05. Determination of storage properties for these roots is in progress.

| Treatment | yield | | recoverable sugar | | recoverable sugar | | loss to molasses | | sucrose content 0 DAH | | sucrose content 30 DAH | | respiration rate 30 DAH | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | tons/acre | | lbs/acre | | lbs/ton | | % | | % | | % | | mg $CO_2$/kg/h | |
| control--untreated | 16.8 | abcd | 5552 | abc | 330 | a | 1.42 | a | 17.9 | a | 18.7 | a | 4.24 | ab |
| Headline (HDL) | 16.1 | bcd | 5052 | cd | 316 | a | 1.90 | a | 17.5 | a | 18.8 | a | 3.80 | b |
| Jul MeJA, 0.01 µM | 16.7 | abcd | 5534 | abc | 331 | a | 1.51 | a | 18.1 | a | 18.7 | a | 4.31 | ab |
| Jul MeJA, 10 µM | 16.1 | bcd | 5150 | bcd | 319 | a | 1.65 | a | 17.6 | a | 19.3 | a | 4.40 | ab |
| Jul MeJA, 0.01 µM + HDL | 17.5 | abc | 5703 | ab | 326 | a | 1.54 | a | 17.8 | a | 19.3 | a | 4.16 | ab |
| Jul MeJA, 10 µM + HDL | 15.9 | cd | 5060 | cd | 318 | a | 1.59 | a | 17.5 | a | 19.0 | a | 4.38 | ab |

**Table 6:** Harvest and storage data for the 2017 Mooreton, ND field experiment. Means within a column followed by different letters are significantly different based upon Fisher's LSD, with α = 0.05. Values that are statistically different from untreated controls are highlighted in red. Determination of storage properties for these roots is in progress.

| Treatment | yield | | recoverable sugar | | recoverable sugar | | loss to molasses | | sucrose content 0 DAH | | sucrose content 30 DAH | | respiration rate 30 DAH | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | tons/acre | | lbs/acre | | lbs/ton | | % | | % | | % | | mg $CO_2$/kg/h | |
| control--untreated | 32.4 | ab | 7993 | bc | 293 | a | 1.58 | a | 16.2 | ab | 16.2 | abc | 4.32 | a |
| Headline (HDL) | 29.9 | b | 7454 | c | 285 | a | 1.66 | a | 15.9 | ab | 15.9 | bc | 4.21 | a |
| Jun MeJA, 0.01 µM | 30.1 | b | 7497 | c | 292 | a | 1.62 | a | 16.2 | ab | 16.1 | abc | 4.14 | a |
| Jun MeJA, 10 µM | 31.4 | b | 7644 | bc | 286 | a | 1.49 | a | 15.8 | b | 15.9 | c | 4.09 | a |
| Jul MeJA, 0.01 µM | 32.4 | ab | 8520 | ab | 297 | a | 1.45 | a | 16.3 | ab | 16.6 | a | 4.03 | a |
| Jul MeJA, 10 µM | 30.8 | b | 7646 | bc | 287 | a | 1.53 | a | 15.9 | b | 16.1 | abc | 4.09 | a |
| Jun MeJA, 0.01 µM + HDL | 35.4 | a | 9142 | a | 299 | a | 1.18 | a | 16.4 | a | 16.5 | ab | 4.06 | a |
| Jun MeJA, 10 µM + HDL | 33.4 | ab | 8438 | abc | 295 | a | 1.43 | a | 16.2 | ab | 16.3 | abc | 4.02 | a |
| Jul MeJA, 0.01 µM + HDL | 31.8 | ab | 8045 | bc | 291 | a | 1.46 | a | 16.0 | ab | 16.3 | abc | 4.34 | a |
| Jul MeJA, 10 µM + HDL | 30.8 | b | 7678 | bc | 291 | a | 1.53 | a | 16.1 | ab | 16.3 | abc | 4.19 | a |

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# TERMINATING FALL-SEEDED COVER CROPS

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## SUMMARY

1. Seed cereal rye at no more than 25 pounds per acre.
2. Winter wheat is easier to kill than cereal rye in the spring.
3. Use full herbicides rates. Apply SelectMax at 12 to 16 fl oz/A or PowerMax at 32 to 64 fl oz/A.
4. Apply herbicides as early as possible following cover crop green-up with consideration to the weather forecast 5 to 7 days after application.
5. Herbicides work much slower in early spring and may require 2 to 3-weeks to reach 85% burndown control.
6. Cereal rye stubble may suppress emergence and development of broadleaf weeds including nightshade, lambsquarters, and pigweed.

## INTRODUCTION

Sugarbeet farmers have adopted the practice of seeding nurse crops as a companion crop with sugarbeet to reduce stand losses from wind and blowing soils. Spring-seed nurse crops are seeded at sugarbeet planting and are terminated when sugarbeet is at the 4-leaf stage or when small grains are 4 to 5 leaves (tillering). Many farmers have stated they desire to implement cover crops for a longer length of time. That is, seeding cover crops after wheat harvest and prior to sugarbeet planting or after sugarbeet harvest to reduce the chances and amount of blowing soil during the winter and early spring.

Soil health is currently a popular topic in agriculture. The topic is complicated, but the goal essentially is to protect our land resource. Cover crops in sugarbeet production is often discussed since fields are very smooth and contain very little surface crop residue after sugarbeet harvest. In addition, primary and secondary fall tillage is done on fields to be planted to sugarbeet to lessen spring tillage and to conserve moisture in advance of planting next year's sugarbeet crop. Once again, tillage often creates smooth fields that are susceptible to soil erosion, especially in dry and windy conditions.

A probe experiment was initiated in September 2016 with multiple objectives including: a) how effective is spring-applied Roundup PowerMax (glyphosate) or Select Max (clethodim) for killing fall-seeded cover crops; b) when should herbicides be applied to optimize cover crop control and sugarbeet stand establishment; and c) do cover crops provide additional benefits, for example, weed suppression? The goal was to better understand how and when fall-seeded cover crops must be terminated so that sugarbeet can be planted in mid- to late April.

## MATERIALS AND METHODS

Prosper, ND. Stubble was chisel plowed following wheat harvest at the Prosper Experiment Station, near Prosper, ND. Secondary tillage was done using a Kongskilde 's-tine' field cultivator with rolling baskets on September 6, 2017. Experiment was a split plot design with 4 replications. The main (whole) plot was fall seeded cover crop; the subplot was herbicide, herbicide rate, and timing of herbicide application.

Winter wheat at 60 lb/A, cereal rye at 50 lb/A, and a mixture of oat at 40 lb/A and tillage radish at 5 lb/A were spread by hand across respective whole plots in each replication and shallow tilled to incorporate seeds into soil on September 6, 2017. One main plot was left with no cover crop.

Select Max at 6 fl oz/A + 1.5 pt/A methylated seed oil (MSO) and Roundup PowerMax at 28 fl oz/A + Prefer 90 non-ionic surfactant (NIS) at 0.25% v/v with ammonium sulfate (N-Pak-AMS) at 2.5% v/v were applied as treatments on April 17, April 21, and April 29, 2017 when winter wheat was 5, 5, and 7-inches, respectfully, and cereal rye was 8, 9, and 10 inches, respectfully (Table 1). All herbicide treatments were applied with a bicycle sprayer (without the customary hood) in 17 gpa spray solution through 110002 Turbo TeeJet nozzles pressurized with $CO_2$ at 40 psi across plots. Percent visual control or burndown of winter wheat and cereal rye was evaluated on October 27, 2016 and April 13, April 29, May 5, May 12, and May 23, 2017.

**Table 1. Application Information – Prosper, ND 2017**

| Date | April 17 | April 21 | April 29 |
|---|---|---|---|
| Time of Day | 3:00 PM | 3:00 PM | 4:00 PM |
| Air Temperature (F) | 49 | 62 | 58 |
| Relative Humidity (%) | 33 | 38 | 16 |
| Wind Velocity (mph) | 4 | 2 | 6 |
| Wind Direction | NW | W | NE |
| Soil Temp. (F at 6”) | 54 | 56 | 46 |
| Soil Moisture | Good | Good | Good |
| Cloud Cover (%) | 80 | 10 | 30 |
| Winter Wheat | 5 inch | 5 inch | 7 inch |
| Cereal Rye | 8 inch | 9 inch | 10 inch |

‘SV36272RR’ sugarbeet, treated with NipsIt Suite, Tachigaren at 45g per unit, and Kabina at 7g per unit, was seeded in 22-inch rows at 60,560 seeds per acre on May 26, 2017. Roundup PowerMax at 32 fl oz per acre + ClassAct NG at 2.5% v/v was applied on June 19 and July 10, 2017 to control weed escapes in the trial.

Renville, MN. Cereal rye at 100 lb/A was seeded into a preharvest sugarbeet field on September 12, 2016. Rye was harrowed into the soil following seeding using a field cultivator. Roundup PowerMax at 22, 32, and 64 fl oz/A plus Class Act NG at 2.5% v/v or SelectMax at 6 fl oz/A plus Class Act NG at 2.5% v/v was applied to the center 7.3 ft of an 11 ft plot by 30 feet long on April 7, 2017. Herbicide was applied with a bicycle sprayer at 17 GPA through TeeJet 8002XR nozzles at 40 psi.

Evaluations were a visual assessment of cereal rye control (visual reduction in ground cover) on April 17, April 21 and April 28, 2017.

Data were analyzed with the ANOVA procedure of ARM, version 2017.4 software package.

**RESULTS AND DISCUSSION**

Cover Crop Establishment and Overwintering at Prosper. A visual assessment of cover crop establishment was collected on October 27, 2016. In general, cover crop emergence and percent visual ground cover was very good, perhaps exceeding expectations (Table 2). Favorable moisture conditions and warm temperatures in the fall of 2016 promoted cover crop growth. Cereal rye growth was most uniform while winter wheat was the least uniform. Tillage radish emerged but were small, ranging from 0.5 to 1 inch in diameter and 2 to 4 inches long. Ground cover in the no-cover crop main plot was a uniform cover of volunteer spring wheat.

**Table 2. Percent visual ground cover and range of observations across replications, October 27, 2016 at Prosper, ND**

| | Visual Ground Cover | Range of Visual Ground Cover Observations |
|---|---|---|
| Cover Crop | % | % |
| Winter Wheat | 60 | 40-70 |
| Cereal Rye | 85 | 80-90 |
| Oat and Tillage Radish | 68 | 50-80 |
| No Cover Crop[1] | 38 | 30-40 |

[1]Block contained volunteer wheat from previous crop

Cover crop establishment was evaluated April 6 and April 13, 2017 following snow melt. On April 6, the cereal rye whole plots were greening up, but there was very little visual evidence of living winter wheat. Spring green-up and early season growth changed quickly in one week. On April 13 the number of green cereal rye or winter wheat plants per meter square were counted and a visual assessment of green-up was taken in 1m$^2$ quadrats at three evenly spaced points within the cover crop whole plot. Cereal rye ground cover and uniformity were greater than winter wheat which may have suffered some winter-kill damage (Table 3). However, the number of rye or winter wheat plants per $m^2$ were similar. This may be attributed to the aggressive behavior of cereal rye which was well tillered on April 13 and was in general, much more robust than winter wheat.

Seeding rates were determined from the literature and through personal communication. In both cases, there was a wide range of opinions regarding seeding rates. Cereal rye seeding rate of 50 lb/A was much too great as the rye whole plots resembled sod.

**Table 3. Percent visual ground cover, number of plants per square meter and range of observations across replications, April 13, 2017 at Prosper, ND**

| | Visual Ground Cover | Range of Visual Ground Cover Observations | Number of Plants per Square Meter | Range of count Observations per Square Meter |
|---|---|---|---|---|
| Cover Crop | % | % | Number | Number |
| Winter Wheat | 46 | 0-80 | 16 | 0-44 |
| Cereal Rye | 73 | 40-100 | 17 | 6-32 |

Cereal Rye and Winter Wheat Control at Prosper. Percent visual control or burndown was collected April 29 (data not presented), May 5, May 12, and May 23, 2017. In general, winter wheat burndown was faster than cereal rye. Roundup PowerMax at 28 fl oz/A applied on April 17 or April 21 controlled 70% or 75% winter wheat on May 5 or 18 or 14 DAT (days after treatment), respectfully. PowerMax gave only 45% and 25% cereal rye control (Table 4). Winter wheat control from PowerMax ranged from 83 to 98% control by May 12 or 17 to 25 DAT. A minimum of 90% burndown control of cereal rye did not occur until May 23 or 32 to 28 DAT and following PowerMax application on April 21 or April 25. Roundup PowerMax provided greater overall cereal rye and winter wheat control and speed of kill than SelectMax. However, herbicide rate for both Roundup PowerMax and SelectMax probably were not sufficient, especially for early spring application. These results support the recommendation of full herbicide rates, including PowerMax at 32 to 43 fl oz/A and SelectMax at 12 to 16 fl oz/A. The use of appropriate adjuvants will also accentuate herbicide efficacy.

Cereal rye early-season growth and development was very rapid. Herbicide burndown application should be timed as early as possible or immediately after green-up in early spring. However, application timing is a compromise between growth and development of target species and environmental conditions. For example, the April 17 application was followed by wintry weather including 2 to 3 inches of snow and low temperatures. The cereal rye and winter wheat control data suggests herbicides and cover crop efficacy including speed of kill were influenced by environmental conditions.

**Table 4. Percent visual cereal rye and winter wheat control, across herbicide, application timing, and evaluation date, Prosper, ND**

| | | May 5 | | May 12 | | May 23 | |
|---|---|---|---|---|---|---|---|
| | | c rye | w wheat | c rye | w wheat | c rye | w wheat |
| Herbicide[1] | Appl Date | % | % | % | % | % | % |
| PowerMax | April 17 | 55 cd | 70 ab | 65 c | 83 b | 75 c | 85 b |
| Select Max | April 17 | 20 ef | 45 d | 5 f | 60 c | 0 g | 20 f |
| PowerMax | April 21 | 60 bc | 75 a | 83 b | 98 a | 100 a | 99 a |
| Select Max | April 21 | 5 g | 25 e | 25 e | 50 d | 0 g | 55 d |
| PowerMax | April 25 | 20 ef | 30 e | 70 c | 88 b | 98 a | 100 a |
| Select Max | April 25 | 0 g | 10 fg | 20 e | 25 e | 20 f | 45 e |
| **LSD (0.05)** | | **10** | | **7** | | **7** | |

[1]Roundup PowerMax at 28 fl oz/A + Prefer 90 NIS at 0.25% v/v + N-Pak AMS at 2.5% v/v; Select Max at 6 fl oz/A + Noble MSO at 1.5 pt/A

Cereal Rye Control at Renville. Cereal rye control (burndown) was dependent on Roundup PowerMax rate and number of days between application and evaluation. Roundup PowerMax at 64 fl oz/A gave 95% cereal rye control 21 DAT (Table 5). Cereal rye control from PowerMax at 32 fl oz/A was similar to control from PowerMax at 64 fl oz/A on April 21 and April 28 or 14 and 21 DAT. However, numbers of days to achieve similar numeric control from PowerMax at 64 fl oz/A was approximately 7 days faster than from PowerMax at 32 fl oz/A. PowerMax at 64 fl oz/A provided greater rye burndown control than PowerMax at 22 fl oz/A. Cereal rye control from SelectMax at 6 fl oz/A was less than control from PowerMax, regardless of rate.

**Table 5. Percent visual cereal rye control, across herbicide, herbicide rate, and evaluation date, Renville, MN**

| Herbicide[1] | Herbicide Rate | April 17 | April 21 | April 28 |
|---|---|---|---|---|
| | fl oz/A | ----------------------------- | % control | ----------------------------- |
| PowerMax | 22 | 41 b | 61 b | 76 b |
| PowerMax | 32 | 41 b | 73 a | 85 ab |
| PowerMax | 64 | 69 a | 86 a | 95 a |
| SelectMax | 6 | 10 c | 17 c | 31 c |
| **LSD (0.05)** | | **16** | **12** | **10** |

[1]Roundup PowerMax at 28 fl oz/A + Class Act NG at 2.5% v/v; SelectMax at 6 fl oz/A + Class Act NG at 2.5% v/v

Weed Suppression at Prosper. There is some evidence suggesting cover crop stubble suppresses germination and emergence of broadleaf weeds. Percent weed suppression across cover crop and burndown herbicide combination was collected visually on June 6 and June 12 and was collected using stand counts per unit area on June 12. Cereal rye stubble suppressed emergence and growth of hairy nightshade, lambsquarters, and pigweed better than winter wheat stubble or the no stubble blocks, but weed suppression was confounded by incomplete cover crop burndown control in some treatments (Table 6). Cover crop termination date did not affect weed suppression from cereal rye but delaying winter wheat termination to April 25 improved weed suppression. Winter wheat did not suppress hairy nightshade, lambsquarters, and pigweed. However, there were numeric differences in suppression when wheat cover crop termination date was delayed from April 21 to April 25 and from April 17 to April 21. Both visual and stand count data (data not presented) collected June 6 and 12 suggest that cereal rye stubble suppresses broadleaf weeds even after rye was killed with April applications of Roundup PowerMax.

**Table 6. Visual weed suppression from cereal rye and winter wheat stubble, by cover crop termination date**

| | Cereal rye | Winter wheat |
|---|---|---|
| Cover Crop | % | % |
| April 17 | 91 a | 39 c |
| April 21 | 96 a | 51 c |
| April 25 | 93 a | 71 b |
| No Cover Crop | 55 b | 54 b |
| **LSD (0.05)** | **18** | |

ENTOMOLOGY

NOTES

# TURNING POINT® SURVEY OF SUGARBEET INSECT PEST PROBLEMS AND MANAGEMENT PRACTICES IN MINNESOTA AND EASTERN NORTH DAKOTA IN 2016

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Attendees of the 2017 Sugarbeet Winter Grower Seminars answered survey questions about their 2016 insect pest management issues and associated production practices in a live polling questionnaire that was conducted using Turning Point® interactive personal response technology. Initial questioning identified the county in which the majority of each respondent's sugarbeet crop was produced (Tables 1, 2, and 3).

**Table 1. 2017 Fargo Grower Seminar – number of survey respondents by county growing sugarbeet in 2016.**

| County | Number of Responses | Percent of Responses |
|---|---|---|
| Barnes | 3 | 9 |
| Cass | 7 | 21 |
| Clay | 11 | 32 |
| Norman[1] | 8 | 24 |
| Richland | 1 | 3 |
| Traill | 3 | 9 |
| Wilkin[2] | 1 | 3 |
| Total | 34 | 100 |

[1]Includes Mahnomen County
[2]Includes Otter Tail County

**Table 2. 2017 Grafton Grower Seminar – number of survey respondents by county growing sugarbeet in 2016.**

| County | Number of Responses | Percent of Responses |
|---|---|---|
| Grand Forks | 1 | 2 |
| Kittson | 4 | 7 |
| Marshall | 5 | 9 |
| Pembina | 19 | 35 |
| Polk | 1 | 2 |
| Walsh | 23 | 43 |
| Other | 1 | 2 |
| Total | 54 | 100 |

**Table 3. 2017 Wahpeton Grower Seminar – number of survey respondents by county growing sugarbeet in 2016.**

| County | Number of Responses | Percent of Responses |
|---|---|---|
| Cass | 2 | 4 |
| Clay | 3 | 7 |
| Grant | 5 | 11 |
| Otter Tail | 1 | 2 |
| Richland | 7 | 16 |
| Stevens | 1 | 2 |
| Traverse | 5 | 11 |
| Wilkin | 21 | 47 |
| Total | 45 | 100 |

**NOTE:** acreage estimates provided in this report do not include data from the Willmar Seminar location because that survey did not include questions involving insect pest incidence or insect pest management practices.

An estimated 99,491 acres were reported on by a total of 128 respondents at the Fargo, Grafton, and Wahpeton Winter Grower seminars (Table 4). The majority (35%) of respondents reported growing sugarbeet on between 300 and 599 acres in the 2016 production season. An additional 18% produced sugarbeet on 100 to 299 acres and another 32% grew the crop on a reported range of between 600 and 1,499 acres in 2016.

**Table 4. Ranges of sugarbeet acreage operated by respondents in 2016.**

| | | Acres of sugarbeet | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Number of Responses | <99 | 100-199 | 200-299 | 300-399 | 400-599 | 600-799 | 800-999 | 1000-1499 | 1500-1999 | 2000+ |
| | | ---% of responses--- | | | | | | | | | |
| Fargo | 33 | 3 | 0 | 15 | 18 | 18 | 6 | 9 | 12 | 6 | 12 |
| Grafton | 53 | 6 | 15 | 11 | 9 | 17 | 9 | 11 | 9 | 2 | 9 |
| Wahpeton | 42 | 2 | 7 | 2 | 10 | 33 | 17 | 12 | 10 | 5 | 2 |
| Total | 128 | 4 | 9 | 9 | 12 | 23 | 11 | 11 | 10 | 4 | 8 |

From a total of 127 respondents in the Fargo, Grafton, and Wahpeton Grower seminars, 26% reported that the sugarbeet root maggot was their worst insect pest problem during the 2016 growing season (Table 5). The root maggot was reported as the worst insect pest problem by respondents at both the Fargo (21%) and Grafton (47%) locations. Other significant insect pest problems reported included cutworms (6 and 7% of respondents at Fargo and Wahpeton, respectively), wireworms (6 and 5% of respondents at Fargo and Wahpeton, resp.), and white grubs (5% of respondents at the Wahpeton seminar).

**Table 5. Worst insect pest problem in sugarbeet in 2016.**

| Location | Number of Responses | Springtails | Cutworms | Lygus bugs | Wireworms | Root maggot | White grubs | None |
|---|---|---|---|---|---|---|---|---|
| | | ---% of responses--- | | | | | | |
| Fargo | 33 | 3 | 6 | 3 | 6 | 21 | 0 | 61 |
| Grafton | 51 | 0 | 0 | 0 | 0 | 47 | 2 | 51 |
| Wahpeton | 43 | 2 | 7 | 0 | 5 | 5 | 5 | 77 |
| Total | 127 | 2 | 4 | 1 | 3 | 26 | 2 | 62 |

The majority (47%) of respondents that attended the Fargo, Grafton, and Wahpeton Winter Grower Seminars indicated that they used seed treated with Poncho Beta insecticidal seed treatment, whereas Cruiser and NipsIt Inside seed treatment insecticides were only reported as being used by 5 and 3% of respondents, respectively Table 6). A relatively large number (45%) of respondents at these events reported that they did not use any insecticidal seed treatment in 2016. Most of the use of seed treatment insecticides was reported by attendees of the Fargo and Grafton Grower Seminars.

**Table 6. *Seed treatment* insecticide use for sugarbeet insect pest management in 2016.**

| Location | Number of Responses | Poncho Beta | Cruiser | NipsIt Inside | None |
|---|---|---|---|---|---|
| | | ---% of responses--- | | | |
| Fargo | 30 | 57 | 3 | 3 | 37 |
| Grafton | 49 | 67 | 8 | 6 | 18 |
| Wahpeton | 40 | 15 | 3 | 0 | 82 |
| Total | 119 | 47 | 5 | 3 | 45 |

Planting-time granular insecticides were used by a combined average of 29% of grower attendees of the Fargo, Grafton, and Wahpeton seminars (Table 7). An overall average of 24% of growers at these meetings reported using Counter 20G at planting time, whereas only 5% of attendees reported applying Lorsban 15G for planting-time protection of their sugarbeet crop from insect pests. Thirty-one percent of Fargo seminar respondents reported using Counter 20G at planting time, whereas 21 and 22% of respondents at the Grafton and Wahpeton seminars, respectively, reported applying Counter 20G at planting to protect their sugarbeet crop. Overall, 66% of respondents across all three grower seminars reported that they did not use a granular insecticide product at planting in 2016.

**Table 7. *Planting-time granular* insecticide use for sugarbeet insect pest management in 2016.**

| Location | Number of Responses | Counter 20G | Lorsban 15G | Thimet 20G | Other | None |
|---|---|---|---|---|---|---|
| | | --------------------------------------% of responses----------------------------------- | | | | |
| Fargo | 29 | 31 | 3 | 0 | 0 | 66 |
| Grafton | 47 | 21 | 2 | 9 | 2 | 66 |
| Wahpeton | 40 | 22 | 10 | 0 | 3 | 65 |
| Total | 116 | 24 | 5 | 3 | 2 | 66 |

Overall results from this survey across all three seminar locations indicated that 22% of all respondents used low to moderate rates (5.25 to 7.5 lb product/ac) of Counter 20G, while only 6% used the high rate of this material (Table 8). At the Fargo seminar, the majority of respondents that reported using Counter 20G indicated that they applied it at the 7.5-lb rate, whereas, at the Grafton seminar, the majority reported using Counter at its high (9 lb product/ac) rate in 2016. The majority of grower respondents at the Fargo seminar location that reported using Lorsban 15G at planting time indicated that they applied it at the low labeled rate of 6.7 lb product/ac. Attendees of the Grafton seminar that reported using Lorsban 15G were split evenly between using it at its high (13.4 lb/ac) and low (6.7 lb) application rates. At the Wahpeton location, 100% of attendees that reported using Lorsban 15G indicated that they applied it at a moderate rate of 10 lb of product per acre.

**Table 8. Application rates of *planting-time granular* insecticides used for sugarbeet insect pest management in 2016.**

| Location | Number of Responses | Counter 20G | | | Lorsban 15G | | | Other | None |
|---|---|---|---|---|---|---|---|---|---|
| | | 9 lb | 7.5 lb | 5.25 lb | 13.4 lb | 10 lb | 6.7 lb | | |
| | | --------------------------------------% of responses-------------------------------------- | | | | | | | |
| Fargo | 31 | 0 | 23 | 16 | 0 | 0 | 3 | 6 | 52 |
| Grafton | 49 | 14 | 4 | 8 | 2 | 0 | 2 | 0 | 69 |
| Wahpeton | 42 | 0 | 12 | 12 | 0 | 7 | 0 | 5 | 64 |
| Total | 122 | 6 | 11 | 11 | 1 | 2 | 2 | 3 | 63 |

Most of the postemergence insecticide use for sugarbeet root maggot management was reported by growers that attended the Grafton Growers Seminar (Table 9). At that location, the majority (44%) of respondents indicated that they used either Lorsban Advanced or Lorsban 4E (or a generic equivalent material), and an additional 13% reported using Thimet 20G. Similarly, the majority of respondents at the Fargo seminar that reported using a postemergence insecticide for root maggot control indicated that they used either Lorsban Advanced or Lorsban 4E (or a generic equivalent material). An average of 60% of the respondents across all locations indicated that they did not apply a postemergence insecticide to manage the sugarbeet root maggot. The majority of those respondents were attendees of the Fargo and Wahpeton locations, where a respective 82 and 73% of the respondents reported no use of a postemergence insecticide for root maggot control.

**Table 9. *Postemergence* insecticide use for *sugarbeet root maggot* management in 2016.**

| Location | Number of Responses | Lorsban 4E | Lorsban Advanced | Mustang | Asana | Other liquid | Counter 20G | Lorsban 15G | Thimet 20G | None |
|---|---|---|---|---|---|---|---|---|---|---|
| | | ------------------------------------------% of responses--------------------------------------------- | | | | | | | | |
| Fargo | 34 | 9 | 6 | 3 | 0 | 0 | 0 | 0 | 0 | 82 |
| Grafton | 45 | 40 | 4 | 4 | 0 | 0 | 0 | 2 | 13 | 36 |
| Wahpeton | 40 | 8 | 0 | 12 | 0 | 0 | 2 | 2 | 2 | 73 |
| Total | 122 | 20 | 3 | 7 | 0 | 0 | 1 | 2 | 6 | 60 |

Overall satisfaction with insecticide applications made for root maggot management was rated as good to excellent by 78% of respondents when averaged across the Fargo, Grafton, and Wahpeton seminar locations (Table 10). At the Fargo location, 82% of respondents rated their satisfaction with root maggot management efforts as being good to excellent. Similarly, 91% of respondents at the Grafton location rated their satisfaction with root maggot management practices as being good to excellent. The percentages of respondents that indicated good to excellent satisfaction with performance of root maggot management practices were lower at the Wahpeton location; however, that is likely a product of a large portion (55%) of those respondents responding with an answer of "unsure".

**Table 10. *Satisfaction* with insecticide treatments for sugarbeet root maggot management in 2016.**

| Location | Number of Responses | Excellent | Good | Fair | Poor | Unsure |
|---|---|---|---|---|---|---|
| | | ------------------------------------ | ------------------------- | -% of responses- | ------------------------- | ------------------------------------ |
| Fargo | 16 | 44 | 38 | 0 | 0 | 19 |
| Grafton | 32 | 19 | 72 | 6 | 0 | 3 |
| Wahpeton | 11 | 27 | 9 | 0 | 9 | 55 |
| Total | 59 | 27 | 51 | 3 | 2 | 17 |

At the Fargo Growers Seminar, 16% of respondents indicated that their insecticide use in sugarbeet had decreased in comparison to the previous five years, and 74% of respondents at that location reported no change in insecticide use (Table 11). However, 33% of grower attendees at the Grafton location indicated that their insecticide use had increased when compared to the previous five years. This finding is probably due to recent the increases in root maggot populations that reached extremely high levels in 2015 and continued into the 2016 growing season. At the Wahpeton seminar location, 49% of attendees indicated that their insecticide use either did not change or had decreased in comparison to the previous five years. Attendees at that location also had the highest percentage (44%) of no reported insecticide use in 2016.

**Table 11. Insecticide use in sugarbeet during 2016 compared to the previous 5 years.**

| Location | Number of Responses | Increased | Decreased | No Change | No Insecticide Use |
|---|---|---|---|---|---|
| | | ------------------------------------ | ------------------------- | -% of responses- | ------------------------------------ |
| Fargo | 31 | 3 | 16 | 74 | 6 |
| Grafton | 49 | 33 | 6 | 57 | 4 |
| Wahpeton | 41 | 7 | 15 | 34 | 44 |
| Total | 121 | 16 | 12 | 54 | 18 |

At the Fargo Sugarbeet Growers Seminar, 47% of attendees indicated using an online decision-making tool for sugarbeet insect pest management in 2016 (Table 12). Similarly, 66% of the attendees at the Grafton location indicated that they used some form of online information or tool for assistance or guidance with their insect management decision-making procedures. Conversely, only 12% of the attendees at the Wahpeton seminar location indicated use of an online decision-making tool. The majority of respondents at the Grafton location that indicated use of an online insect management tool responded that they used NDSU's online posting of root maggot fly counts for guidance with management decisions. An additional 19% of the Grafton attendees reported using the NDSU root maggot model application on the North Dakota Agricultural Weather Network (NDAWN) website.

**Table 12. Use of online decision-making tools for sugarbeet insect management in 2016.**

| Location | Number of Responses | NDSU Crop & Pest Report | NDAWN Root Maggot Model | Root Maggot Fly Counts (online) | Root Maggot Mobile App | Other | None |
|---|---|---|---|---|---|---|---|
| | | ------------------------------------ | ------------------------- | -% of responses- | ------------------------- | ------------ | ------------ |
| Fargo | 38 | 10 | 10 | 3 | 0 | 24 | 53 |
| Grafton | 62 | 5 | 19 | 31 | 3 | 8 | 34 |
| Wahpeton | 41 | 2 | 2 | 2 | 0 | 5 | 88 |
| Total | 141 | 6 | 12 | 15 | 1 | 11 | 55 |

**SUGARBEET ROOT MAGGOT FLY MONITORING IN THE RED RIVER VALLEY IN 2017**


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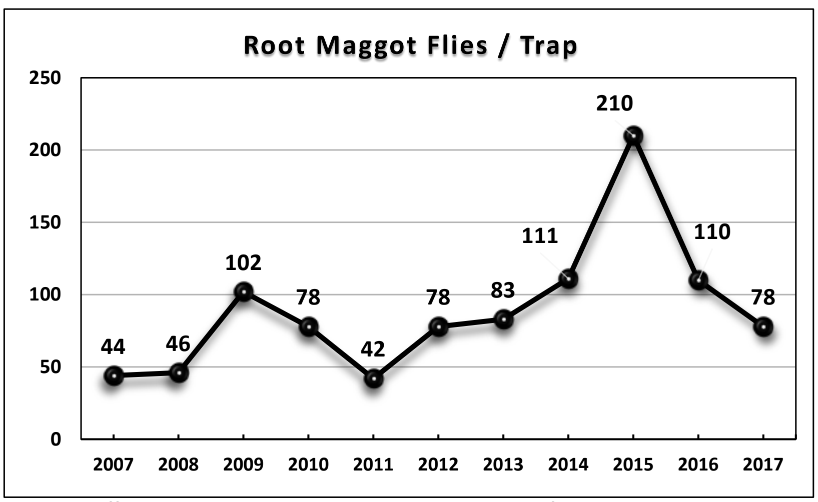
Sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder), fly activity was monitored at 36 grower field sites throughout the Red River Valley during the 2017 growing season. The monitoring program was a result of a collaborative effort between the North Dakota State University Entomology Department and the Minn-Dak Farmers Cooperative. Additionally, the project was jointly funded by the Sugarbeet Research & Education Board of Minnesota and North Dakota and the American Crystal Sugar Company.

For the second consecutive year, fly activity in 2017 were significantly lower than those in 2015, which was the third-highest activity year in the past decade (Figure 1). Valley-wide fly counts for the whole season were about 63% lower than in 2015. This may suggest that control efforts between 2015 and 2017 were effective in reducing overall population levels throughout the Valley. However, it should be noted that a severe hailstorm occurred just two days before expected peak fly activity at South St. Thomas Township (TWP), which usually has some of the highest fly activity levels in the region. The storm is estimated to have killed 40 to 60% of the SBRM fly population at that sampling site and in the surrounding area within the path of the storm. This severe weather event likely contributed to the overall reduction in SBRM fly counts shown in Fig. 1.

**Figure 1. Yearly averages of sugarbeet root maggot flies captured on sticky-stake traps**




**(Blickenstaff and Peckenpaugh, 1976) in the Red River Valley from 2007 to 2017.**

The highest levels of SBRM fly activity were observed near Merrifield/Grand Forks, St. Thomas, and Thompson, ND, as well as Euclid and East Grand Forks, MN. Moderately high levels of activity were recorded near Auburn, Bathgate, Glasston, and Reynolds, ND, and also near Crookston, MN. Fly activity in most of the southern portion of the Valley remained at relatively low or undetectable levels throughout the growing season.

Figure 2 presents SBRM fly monitoring results from three representative sites (i.e., Reynolds, St. Thomas, and Grand Forks [Merrifield], ND). The onset of root maggot fly activity began a few days later than average, with the first captures of flies on sticky stakes occurring on June 2. Significant increases in fly activity occurred during the second week of June, with main peaks in activity occurring between June 7th and 11th in most sites.

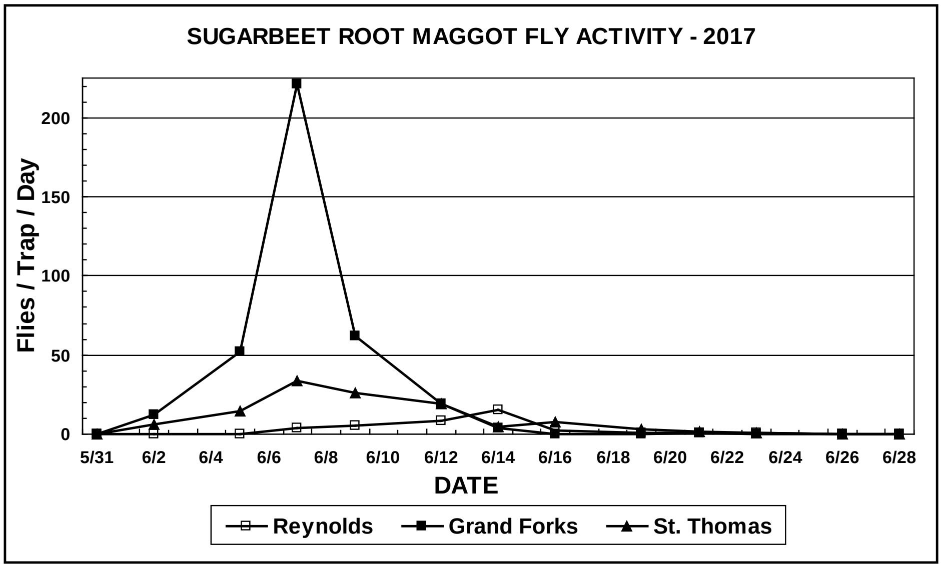



**Fig. 2. Sugarbeet root maggot flies captured on sticky-stake traps at selected sites in the Red River Valley.**

After the larval feeding period ended in August, all 36 fly monitoring sites were rated for sugarbeet root maggot feeding injury in accordance with the 0-9 scale of Campbell et al. (2000). This is carried out on an annual basis as a means of determining whether fly outbreaks and larval infestations were managed effectively.

Root maggot larval feeding injury in most fields was again lower than that observed in the past few years. The highest root injury ratings were observed near Grand Forks (Grand Forks TWP), Merrifield (Brenna TWP), Thompson (Walle TWP), St. Thomas (S. St. Thomas TWP), and Auburn (Martin TWP), ND, with respective average damage ratings of 2.7, 2.0, 1.5, 1.3, and 1.2. Areas where low to moderate feeding injury levels were observed, but still could produce isolated damaging infestations next year included Glasston and Reynolds, ND, and Argyle, Crookston, E. Grand Forks, and Euclid, MN. Feeding injury observed in all other sampled fields was very low. The nearly universal low root injury in those fields, despite the occurrence of moderate to high fly activity levels earlier in the season, suggests that control efforts were effective at managing SBRM infestations in 2016 and 2017. Careful monitoring of fly activity in moderate- and high-risk areas (see Forecast Map [Fig. 1] in subsequent report) will be critical in 2018 to detect unanticipated flare-ups of SBRM fly activity and to prevent economic loss. Vigilant monitoring and effective SBRM management on an individual-field basis by sugarbeet producers may also help prevent significant population increases from one year to another because even moderate levels of root maggot survival in one year can be sufficient to result in economically damaging populations in the following year.

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## SUGARBEET ROOT MAGGOT FORECAST FOR THE 2018 GROWING SEASON

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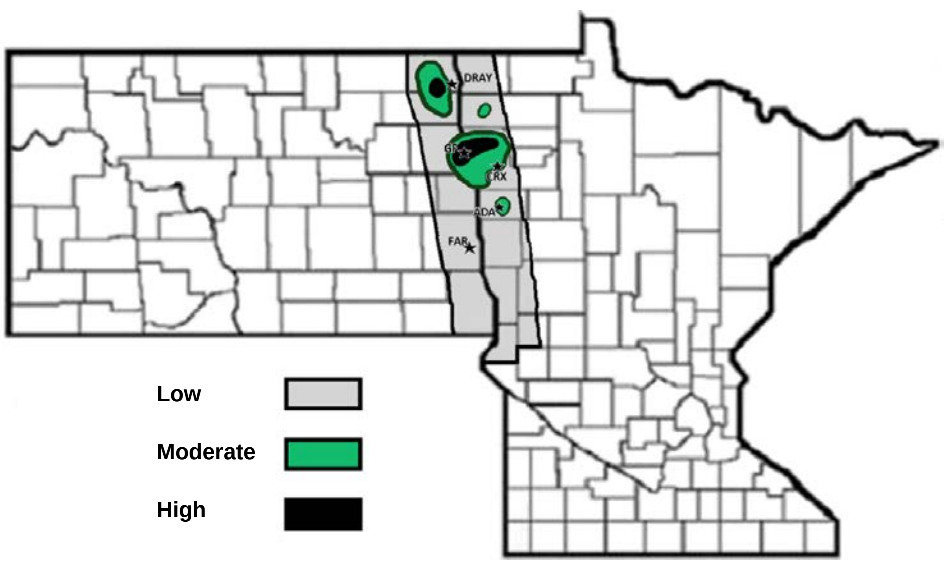
The 2018 sugarbeet root maggot (SBRM) forecast map for the Red River Valley is shown in the figure below. Areas at highest risk include rural Grand Forks, Merrifield, St. Thomas, and Thompson, ND, as well as East Grand Forks and Euclid, MN. Moderate risk is expected near Auburn, Bathgate, Buxton, and Reynolds, ND, and in the vicinity of Argyle and Climax, MN. Other areas that should be monitored closely this year include Glasston and Oakwood, ND, and Ada, Fisher, and Stephen, MN. The remainder of the area is at lower risk. Root maggot infestations are expected to be lower in 2018 than in the past few years. However, some fields will still be at high risk of damaging infestations this year. SBRM populations can increase rapidly from year to year. Proximity to previous-year beet fields where SBRM populations were high and/or control was unsatisfactory during the previous year increases risk. Sugarbeet fields near those where high fly activity occurred in 2017 should be closely monitored in 2018. Growers in high-risk areas should use an aggressive form of at-plant insecticide treatment (i.e., granular insecticide) and a postemergence rescue insecticide (i.e., banded granules or peak-fly spray). Those in moderate-risk areas using insecticidal seed treatments for at-plant protection should monitor fly activity levels in their area, and be ready to apply additive protection if needed. All growers in known SBRM areas should pay close attention to fly activity levels in late-May through June to decide if postemergence treatment is needed. NDSU Entomology will continue to inform growers regarding SBRM activity levels and hot spots each year through radio reports, the NDSU "Crop & Pest Report", and notification of sugar cooperative agricultural staff when appropriate. Root maggot fly count information for the current season and from previous years can be viewed at: http://www.ndsu.edu/entomology/people/faculty/boetel/flycounts/.



**SUGARBEET ROOT MAGGOT CONTROL USING SINGLE- DUAL- AND TRIPLE-COMPONENT INSECTICIDE PROGRAMS**

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**Introduction:**

Severe infestations of the sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder), occur on a frequent basis in central and northern portions of the Red River Valley (RRV) of North Dakota and Minnesota. Published research has demonstrated that this pest is capable of causing more than 45% yield losses in the absence of effective control measures (Boetel et al. 2010). High population levels of this pest often require aggressive pest management programs to ensure adequate protection of the sugarbeet crop. Control programs in areas at high risk of damaging SBRM infestations usually consist of either a granular insecticide or an insecticidal seed treatment at planting, followed by an additive postemergence insecticide application when SBRM populations warrant it. Broadcast applications of sprayable liquid insecticides, applied on an as-needed, rescue basis, are the most commonly used postemergence tools for SBRM control in the RRV. However, the use of postemergence granular insecticide products has increased in recent years. An advantage of postemergence sprays is that growers can use a "wait and see" approach, and make informed decisions on whether rescue insecticide treatments are needed based on current fly activity levels in their fields. This research was carried out to determine the most effective combinations of planting-time and postemergence insecticides to optimize sugarbeet root maggot control.

This project involved two experiments. The objectives of Study I were to: 1) compare Counter 20G granular insecticide with Poncho Beta seed treatment for at-plant SBRM control; 2) assess the efficacy of combining Poncho Beta with Counter 20G at planting time for a one-pass SBRM control system; 3) determine the impacts of additive postemergence applications of Thimet 20G to plots initially treated with either Counter 20G or Poncho Beta seed treatment for SBRM control; 4) measure the performance of Counter 20G as a postemergence control option; and 5) determine if SBRM control can be maximized by employing a three-component (i.e., seed treatment insecticide + at-plant or postemergence granular insecticide + postemergence liquid spray) management program.

The objectives of Study II were to: 1) measure the impact of Lorsban Advanced liquid insecticide spray applications on plots initially treated at planting time with Poncho Beta seed treatment or Counter 20G for root maggot control; and 2) assess the effect of application rate on performance of Lorsban Advanced for postemergence root maggot control.

**Materials and Methods:**

Both experiments were established on a commercial sugarbeet field site near St. Thomas (Pembina County), ND. Betaseed 89RR52 glyphosate-resistant seed was used for all entries in both experiments, and a professional seed preparation company (Germains Seed Technology, Fargo, ND) applied Poncho Beta insecticide to seed for all seed treatment entries. Both experiments were planted on 10 May. All plots were planted using a 6-row Monosem NG Plus 4 7x7 planter set to plant at a depth of 1¼ inch and a rate of one seed every 4½ inches of row length. Plots were six rows (22-inch spacing) wide with the four centermost rows treated. The outer "guard" rows (i.e., rows one and six) on each side of the plot served as untreated buffers. Each plot was 35 feet long, and 35-foot alleys between replicates were maintained weed-free throughout the growing season through tillage operations. The experiment was arranged in a randomized complete block design with four replications of the treatments.

Planting-time insecticide applications. Counter 20G was applied by using band (B) placement (Boetel et al. 2006), which consisted of 5-inch swaths of granules delivered through Gandy™ row banders. Granular application rates were regulated by using a planter-mounted SmartBox™ computer-controlled insecticide delivery system that was calibrated on the planter immediately before all applications.

Postemergence insecticide applications (Studies I and II). Postemergence insecticides in Study I consisted of two granular materials (i.e., Counter 20G and Thimet 20G) and one liquid spray product (i.e., Lorsban Advanced). Postemergence granules (Post B) were applied on 5 June, or about 6 days before peak SBRM fly activity. Band placement of postemergence granules was achieved by using Kinze™ row banders attached to a tractor-mounted tool bar and adjusted to a height needed to deliver the insecticides in 4-inch bands. Similar to at-plant insecticide applications, postemergence granular output rates were also regulated by using a SmartBox™ system mounted on a tractor-drawn four-row toolbar. Postemergence granules were delivered in 4-inch bands by using Kinze™ row banders. All postemergence granular applications were incorporated using two pairs of rotary tines that straddled each row on the tool bar. A paired set of tines was positioned ahead of each bander, and a second pair was mounted behind the granular drop zone. This system effectively stirred soil around the bases of sugarbeet seedlings and incorporated granules as the unit passed through each plot.

The postemergence spray applications of Lorsban Advanced were broadcast-applied on 8 June (i.e., about 3 days before peak SBRM fly activity). Sprays were applied from a tractor-mounted $CO_2$-propelled spray system equipped with an 11-ft boom that was calibrated to deliver a finished spray volume output of 10 GPA through TeeJet™ 110015VS nozzles.

In Study II, all postemergence insecticide treatments involved Lorsban Advanced spray applications that were applied in the same manner as described for Study I. Sprays were applied on 8 June (i.e., about 3 days before peak SBRM fly activity).

Root injury ratings: Sugarbeet root maggot feeding injury was assessed in both studies on 31 July by randomly collecting ten beet roots per plot (five from each of the outer two treated rows), hand-washing them, and scoring them in accordance with the 0 to 9 root injury rating scale (0 = no scarring, and 9 = over ¾ of the root surface blackened by scarring or dead beet) of Campbell et al. (2000).

Harvest: Treatment performance was also compared on the basis of sugarbeet yield parameters. Plots for both studies were harvested on 10 October. Foliage was removed from plots immediately before harvest by using a commercial-grade mechanical defoliator. All beets from the center two rows of each plot were extracted from soil using a mechanical harvester, and weighed in the field using a digital scale. A representative subsample of 12-18 beets was collected from each plot and sent to the American Crystal Sugar Company Tare Laboratory (East Grand Forks, MN) for sucrose content and quality analysis.

Data analysis: All data from root injury ratings and harvest samples were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 2008), and treatment means were separated using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance.

**Results and Discussion:**

Study I. Sugarbeet root maggot feeding injury rating results for Study I are presented in Table 1. The level of root injury that occurred in the untreated check plots (mean = 5.48 on the 0 to 9 scale of Campbell et al. [2000]) suggested that a moderate SBRM infestation was present for this study. This is due, in large part, to a hailstorm that occurred on 9 June (2 days before peak fly activity). It is estimated that the storm killed at least 40 to 60% of the SBRM fly population in the plot area and surrounding fields. Despite that reduction in the local population, there were several significant differences among treatments in this trial. All insecticide-protected plots had significantly lower levels of SBRM feeding injury than the untreated check, regardless of whether they involved a seed treatment, single at-plant granular application, dual-, or triple-application insecticide combination was used for SBRM control.

The lowest overall root injury rating mean (i.e., highest root protection level) in Study I occurred in plots that received the triple-insecticide application treatment comprised of Poncho Beta-treated seed, combined with an at-plant application of Counter 20G at its high (8.9 lb product/ac) rate, and followed by a postemergence application of Lorsban Advanced at 1 pt/ac. Root maggot feeding injury in those plots was significantly lower than that in all other treatments, except a similar treatment that included Poncho Beta plus the at-plant application of Counter 20G at 8.9 lb, but without the post application of Lorsban Advanced. Similarly, there was no significant difference in root protection between a triple-component program consisting of Poncho Beta-treated seed plus a postemergence application of Thimet 20G, followed by a postemergence spray of Lorsban, and similar plots that received Poncho Beta and Thimet, but were not treated with the additional application of Lorsban Advanced. These results suggest that there was no significant improvement in root protection from the postemergence spray of Lorsban Advanced.

In dual insecticide programs, adding a postemergence granular product consistently provided significant improvements in root protection from SBRM feeding injury, irrespective of whether plots were initially protected at planting by Poncho Beta or any rate of Counter 20G. The lowest average SBRM feeding injury for dual-insecticide treatments was observed in plots protected by Poncho Beta-treated seed plus a planting-time application of Counter 20G at its high (8.9 lb product/ac) rate. Root maggot feeding injury in plots treated with this combination was the second-lowest in the entire trial, and it was significantly lower than that observed in plots treated with the similar dual-insecticide program that included Poncho Beta plus Counter applied at its low (5.25 lb) rate at planting.

**Table 1. *Larval feeding injury* in an evaluation of sugarbeet root maggot control by combining planting-time insecticide granules or seed treatments with postemergence insecticides, St. Thomas, ND, 2017**

| Treatment/form. | Placement[a] | Rate (product/ac) | Rate (lb a.i./ac) | Root injury (0-9) |
|---|---|---|---|---|
| Poncho Beta +<br>Counter 20G +<br>Lorsban Advanced | Seed<br>B<br>3 d Pre-peak Broadcast | <br>8.9 lb<br>1 pt | 68 g a.i./unit seed<br>1.8<br>0.5 | 0.88 g |
| Poncho Beta +<br>Counter 20G | Seed<br>B | <br>8.9 lb | 68 g a.i./ unit seed<br>1.8 | 1.48 fg |
| Counter 20G +<br>Thimet 20G | B<br>6 d Pre-peak Post B | 8.9 lb<br>7 lb | 1.8<br>1.4 | 1.55 f |
| Poncho Beta +<br>Counter 20G | Seed<br>6 d Pre-peak Post B | <br>8.9 lb | 68 g a.i./ unit seed<br>1.8 | 1.68 ef |
| Poncho Beta +<br>Thimet 20G +<br>Lorsban Advanced | Seed<br>6 d Pre-peak Post B<br>3 d Pre-peak Broadcast | <br>7 lb<br>1 pt | 68 g a.i./ unit seed<br>1.4<br>0.5 | 1.73 ef |
| Poncho Beta +<br>Counter 20G | Seed<br>6 d Pre-peak Post B | <br>5.25 lb | 68 g a.i./ unit seed<br>1.05 | 1.75 ef |
| Counter 20G +<br>Thimet 20G | B<br>6 d Pre-peak Post B | 7.5 lb<br>7 lb | 1.5<br>1.4 | 1.78 ef |
| Poncho Beta +<br>Thimet 20G | Seed<br>6 d Pre-peak Post B | <br>7 lb | 68 g a.i./ unit seed<br>1.4 | 1.98 def |
| Counter 20G | B | 8.9 lb | 1.8 | 2.23 cde |
| Poncho Beta +<br>Counter 20G | Seed<br>B | <br>5.25 lb | 68 g a.i./ unit seed<br>1.05 | 2.30 cde |
| Counter 20G | B | 7.5 lb | 1.5 | 2.50 cd |
| Counter 20G | B | 5.25 lb | 1.05 | 2.85 c |
| Poncho Beta | Seed | | 68 g a.i./ unit seed | 4.13 b |
| Check | --- | ---- | --- | 5.48 a |
| LSD (0.05) | | | | 0.667 |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]B = banded at planting; Post B = postemergence band; Seed = insecticidal seed treatment

Although trends suggested that higher rates of both at-plant and postemergence granular insecticides provided improved protection from SBRM feeding injury, there were no statistical differences among the three rates of Counter 20G when applied as single at-plant treatments. There also was no significant difference in root protection between at-plant and postemergence applications of when Counter 20G was applied at the low (5.25 lb/ac) rate to plots planted with Poncho Beta-treated seed.

Yield data from Study I are presented in Table 2. Most treatments in this experiment resulted in exceptionally high yields, and relative differences in treatment performance generally followed patterns observed in root maggot feeding injury data for this trial. There were very few significant differences among treatments in relation to recoverable sucrose and root tonnage yield, and there were no significant differences in percent sucrose content among treatments. The infrequent statistical differences in yields is probably due to two factors: 1) the unusually moderate SBRM feeding pressure; and 2) there was a considerable amount of variability within and between replications in this trial due to a couple of heavy rainfall during the growing season that resulted in standing water in the plots. The standing water would have added variability to root yields, but also could have precluded SBRM females from laying eggs in the affected plots.

As observed in the SBRM feeding injury data for this trial, trends suggested better performance with increasing rates of both at-plant and postemergence applications of Counter 20G, although significant rate-related differences were rare. The top-performing entries with regard to both recoverable sucrose and root tonnage included the following: 1) Poncho Beta + Counter 20G applied at planting time at 8.9 lb/ac; 2) the triple-component program consisting of Poncho Beta seed treatment, combined with an at-plant application of Counter 20G at its high (8.9 lb product/ac) rate and a postemergence spray application of Lorsban Advanced at its moderate rate of 1 pt/ac; 3)

Poncho Beta + postemergence Thimet 20G at 7 lb/ac + Lorsban Advanced applied postemergence at 1 pt/ac; and 4) at-plant Counter 20G + postemergence Thimet 20G, both applied at their respective high labeled rates of 8.9 and 7 lb/ac. Yields from these treatments were not statistically different from the single planting-time application of Counter at 8.9 lb/ac or most of the dual-insecticide programs in this trial. However, these top-performing treatments generated between $97 and $159/ac more gross revenue than the at-plant application of Counter at 8.9 lb/ac, and between $201 and $263/ac more revenue than the untreated check plots. These economic benefits would have easily paid for the costs of their use, and provided significant amounts of additional revenue per acre.

The gross economic return generated by using stand-alone planting-time applications of Counter 20G ranged between $104 and $172/ac, which would have significantly exceeded the treatment cost and provided additional net revenue. The use of Poncho Beta as a stand-alone form of protection generated an increase of $57/ac in gross return, which also would have easily paid for the cost of the treatment.

Although these results demonstrate the economic benefits of at-plant protection against SBRM feeding injury and associated yield/revenue loss, they also clearly demonstrate the economic value of applying an additive insecticide, either in the form of a planting-time insecticide (if insecticide-treated seed is used), or a postemergence insecticide application (whether the initial at-plant protection consists of a seed treatment or a conventional insecticide).

**Table 2.** ***Yield parameters*** **from an evaluation of sugarbeet root maggot control by combining planting-time insecticide granules or seed treatments with postemergence insecticides, St. Thomas, ND, 2017**

| Treatment/ form. | Placement[a] | Rate (product/ac) | Rate (lb a.i./ac) | Sucrose yield (lb/ac) | Root yield (T/ac) | Sucrose (%) | Gross return ($/ac) |
|---|---|---|---|---|---|---|---|
| Poncho Beta +<br>Counter 20G | Seed<br>B | <br>8.9 lb | 68 g a.i./ unit seed<br>1.8 | 12,433 a | 40.2 ab | 16.70 a | 1,477 |
| Poncho Beta +<br>Counter 20G +<br>Lorsban Advanced | Seed<br>B<br>3 d Pre-peak Broadcast | <br>8.9 lb<br>1 pt | 68 g a.i./unit seed<br>1.8<br>0.5 | 12,400 a | 41.0 a | 16.48 a | 1,427 |
| Poncho Beta +<br>Thimet 20G +<br>Lorsban Advanced | Seed<br>6 d Pre-peak Post B<br>3 d Pre-peak Broadcast | <br>7 lb<br>1 pt | 68 g a.i./ unit seed<br>1.4<br>0.5 | 12,388 a | 41.0 a | 16.35 a | 1,423 |
| Counter 20G +<br>Thimet 20G | B<br>6 d Pre-peak Post B | 8.9 lb<br>7 lb | 1.8<br>1.4 | 12,173 ab | 40.0 abc | 16.40 a | 1,415 |
| Poncho Beta +<br>Counter 20G | Seed<br>6 d Pre-peak Post B | <br>8.9 lb | 68 g a.i./ unit seed<br>1.8 | 12,083 abc | 39.3 a-d | 16.60 a | 1,425 |
| Poncho Beta +<br>Counter 20G | Seed<br>B | <br>5.25 lb | 68 g a.i./ unit seed<br>1.05 | 12,045 abc | 40.1 ab | 16.35 a | 1,375 |
| Counter 20G +<br>Thimet 20G | B<br>6 d Pre-peak Post B | 7.5 lb<br>7 lb | 1.5<br>1.4 | 11,905 abc | 39.8 abc | 16.20 a | 1,348 |
| Counter 20G | B | 7.5 lb | 1.5 | 11,720 abc | 38.0 cde | 16.70 a | 1,386 |
| Poncho Beta +<br>Thimet 20G | Seed<br>6 d Pre-peak Post B | <br>7 lb | 68 g a.i./ unit seed<br>1.4 | 11,710 abc | 40.2 ab | 16.00 a | 1,275 |
| Counter 20G | B | 8.9 lb | 1.8 | 11,637 abc | 38.9 b-e | 16.20 a | 1,318 |
| Counter 20G | B | 5.25 lb | 1.05 | 11,468 bcd | 37.5 de | 16.55 a | 1,343 |
| Poncho Beta | Seed | | 68 g a.i./ unit seed | 11,372 bcd | 37.0 e | 16.68 a | 1,341 |
| Poncho Beta +<br>Counter 20G | Seed<br>6 d Pre-peak Post B | <br>5.25 lb | 68 g a.i./ unit seed<br>1.05 | 11,192 cd | 38.8 b-e | 15.78 a | 1,199 |
| Check | --- | ---- | --- | 10,560 d | 35.0 f | 16.38 a | 1,214 |
| LSD (0.05) | | | | 917.6 | 2.01 | NS | |

Means within a column sharing a letter are not significantly (*P* = 0.05) different from each other (Fisher's Protected LSD test).
[a]B = banded at planting; Post B = postemergence band; Seed = insecticidal seed treatment

The following treatments failed to provide statistically significant increases in recoverable sucrose yield when compared to the untreated check plots: 1) Counter 20G applied at planting at its low (5.25 lb/ac) rate; 2) Poncho Beta seed treatment; and 3) Poncho Beta + Counter 20G applied postemergence at 5.25 lb/ac.

It should be noted that Counter insecticide can only be applied once per year. Therefore, if Counter is applied at planting, it cannot be applied to the same field at postemergence. It also bears noting that the Counter 20G label has been revised to include a 90-day preharvest interval (i.e., PHI, the number of days that must elapse after application before a crop can be harvested) for sugarbeet. This makes Counter 20G a much more feasible product as a postemergence option for sugarbeet root maggot control than before, as it previously was labeled with a 110-day PHI.

The 90-day PHI should work well for Red River Valley growers choosing to use Counter 20G for SBRM management. Postemergence granule applications for SBRM control in the growing area are typically most effective if made in late-May to early-June. If this product were to be applied to a field on June 1, the 90-day PHI would expire before September 1, which is typically the earliest that preliminary sugarbeet harvest operations begin in the Valley.

Study II. Results from evaluations of sugarbeet root maggot larval feeding injury in Study II are shown in Table 3. Moderate larval feeding pressure developed in this trial, as was evidenced by the moderate root injury rating mean recorded for the untreated check plots (5.98 on the 0 to 9 scale). All insecticide-treated entries provided significant reductions in SBRM feeding injury when compared to the injury recorded in the untreated check plots.

**Table 3. *Larval feeding injury* in an evaluation of sugarbeet root maggot control by combining planting-time insecticide granules or seed treatments with postemergence liquid sprays, St. Thomas, ND, 2017**

| Treatment/form. | Placement[a] | Rate (product/ac) | Rate (lb a.i./ac) | Root injury (0-9) |
|---|---|---|---|---|
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 8.9 lb<br>1 pt | 1.8<br>0.5 | 1.25 e |
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 7.5 lb<br>2 pts | 1.5<br>1.0 | 1.73 de |
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 8.9 lb<br>2 pts | 1.8<br>1.0 | 1.90 cde |
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 7.5 lb<br>1 pt | 1.5<br>0.5 | 2.23 cd |
| Counter 20G | B | 8.9 lb | 1.8 | 2.63 bc |
| Counter 20G | B | 7.5 lb | 1.5 | 2.65 bc |
| Poncho Beta +<br>Lorsban Advanced | Seed<br>3 d Pre-peak Broadcast | 1 pt | 68 g a.i./ unit seed<br>0.5 | 3.10 b |
| Poncho Beta +<br>Lorsban Advanced | Seed<br>3 d Pre-peak Broadcast | 2 pts | 68 g a.i./ unit seed<br>1.0 | 3.25 b |
| Poncho Beta | Seed | | 68 g a.i./ unit seed | 3.38 b |
| Check | --- | ---- | --- | 5.98 a |
| LSD (0.05) | | | | 0.837 |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]B = banded at planting; Seed = insecticidal seed treatment

The following treatments provided the highest levels of root protection in Study II: 1) Counter banded at 8.9 lb product/ac + Lorsban Advanced postemergence at 1 pt/ac; 2) Counter banded at 7.5 lb product/ac + Lorsban Advanced at 2 pts/ac; and 3) Counter banded at 8.9 lb product/ac + Lorsban Advanced postemergence at 2 pts/ac. There were no significant differences in levels of SBRM feeding injury among these three treatments.

In plots initially treated with at-plant applications of Counter 20G at its high (8.9 lb) rate, the addition of a postemergence application of Lorsban Advanced at 1 pt/ac resulted in a significant improvement in root protection from SBRM feeding injury when compared to plots that only received the at-plant application of Counter. Similarly, applying Lorsban Advanced at 2 pts/ac to plots initially treated with Counter at its moderate (7.5 lb) rate resulted in a significant reduction in SBRM feeding injury when compared to plots that only received the moderate rate of Counter. In contrast, there were no significant improvements in protection from SBRM feeding injury by adding postemergence applications of Lorsban Advanced to plots initially protected with Poncho Beta-treated seed.

Yield results for Study II (Table 4) were somewhat supportive of the root maggot feeding injury rating results. As observed in Study I of this project, recoverable sucrose and root tonnage yields were exceptionally high for most treatments. This was partly due to the comparatively low root maggot infestation, but also a result of good growing conditions in the St. Thomas area during 2017.

The top-performing treatments with regard to recoverable sucrose yield in Study II included the following: 1) Counter banded at 8.9 lb product/ac + Lorsban Advanced postemergence at 1 pt/ac; 2) Counter banded at 7.5 lb product/ac + Lorsban Advanced at 1 pt/ac; 3) Counter banded at 8.9 lb product/ac + Lorsban Advanced postemergence at 2 pts/ac; and 4) Counter banded at 7.5 lb product/ac + Lorsban Advanced at 2 pts/ac. There were no significant differences among these treatments with respect to recoverable sucrose yield. The best treatment overall, regarding recoverable sucrose and root yield, and gross economic return, was Counter banded at 8.9 lb product/ac + Lorsban Advanced postemergence at 1 pt/ac. Plots protected by this treatment produced significantly more recoverable sucrose per acre than most other treatments, and significantly more root yield than all treatments, except the combination of Counter banded at 7.5 lb product/ac + Lorsban Advanced postemergence at 2 pts/ac.

**Table 4. *Yield parameters* from an evaluation of sugarbeet root maggot control by combining planting-time insecticide granules or seed treatments with postemergence liquid sprays, St. Thomas, ND, 2017**

| Treatment/ form. | Placement[a] | Rate (product/ac) | Rate (lb a.i./ac) | Sucrose yield (lb/ac) | Root yield (T/ac) | Sucrose (%) | Gross return ($/ac) |
|---|---|---|---|---|---|---|---|
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 8.9 lb<br>1 pt | 1.8<br>0.5 | 12,357 a | 38.9 a | 16.98 a | 1,519 |
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 7.5 lb<br>1 pt | 1.5<br>0.5 | 11,595 ab | 35.7 bcd | 17.33 a | 1,469 |
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 8.9 lb<br>2 pt | 1.8<br>1.0 | 11,487 abc | 35.8 bcd | 17.20 a | 1,432 |
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 7.5 lb<br>2 pts | 1.5<br>1.0 | 11,425 abc | 36.9 ab | 16.70 a | 1,358 |
| Counter 20G | B | 7.5 lb | 1.5 | 11,300 bc | 36.5 bc | 16.75 a | 1,346 |
| Counter 20G | B | 8.9 lb | 1.8 | 11,233 bc | 35.5 bcd | 16.90 a | 1,374 |
| Poncho Beta +<br>Lorsban Advanced | Seed<br>3 d Pre-peak Broadcast | <br>2 pts | 68 g a.i./ unit seed<br>1.0 | 10,642 bcd | 34.6 cde | 16.58 a | 1,256 |
| Poncho Beta +<br>Lorsban Advanced | Seed<br>3 d Pre-peak Broadcast | <br>1 pt | 68 g a.i./ unit seed<br>0.5 | 10,572 cd | 33.9 de | 16.80 a | 1,273 |
| Poncho Beta | Seed | | 68 g a.i./ unit seed | 10,133 d | 32.4 ef | 16.83 a | 1,224 |
| Check | --- | ---- | --- | 9,768 d | 31.1 f | 16.85 a | 1,187 |
| LSD (0.05 | | | | 972.8 | 2.24 | NS | |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]B = banded at planting; Seed = insecticidal seed treatment

Estimated gross revenue from treatment combinations that included Counter 20G at planting, followed by a postemergence application of Lorsban Advanced, ranged from $1,358 to $1,519/ac, which translated to revenue increases of between $171and $332/ac when compared to revenue from the untreated check plots. Plots protected by single, planting-time applications of Counter 20G generated revenue increases of between $159 and $187. Plots planted with Poncho Beta-treated seed (i.e., without an additive postemergence insecticide application) generated a revenue increase of $37/ac; however, applying a postemergence application of Lorsban Advanced to Poncho Beta plots resulted in additional revenue increases ranging from $69 to $86/ac.

In general, the results from Study II indicate that effective root maggot control, even under moderate infestation levels such as those that developed in this trial, can result in significant yield increases. These findings also demonstrate that single-component insecticide programs may not provide sufficient protection from yield losses associated with SBRM larval feeding injury, even under such moderate infestations. Although the returns generated by single control tool entries in this study would easily justify their use, these results demonstrate that more aggressive approaches, combining at-plant and postemergence rescue insecticide protection, can contribute substantially to maximizing economic returns from sugarbeet production in areas affected by this pest.

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**APPLICATION TIMING AND RATE EFFECTS ON POSTEMERGENCE INSECTICIDE SPRAYS FOR ROOT MAGGOT CONTROL**

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**Introduction:**

Severe infestations of the sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder), occur commonly in central and northern portions of the Red River Valley (RRV) growing area of North Dakota and Minnesota. As such the SBRM is an ongoing threat to farm profitability for producers in the area. This intense insect pressure typically requires aggressive pest management programs to ensure adequate protection of the sugarbeet crop. Pest management programs in areas at high risk for damaging SBRM infestations usually consist of either a granular insecticide or an insecticidal seed treatment at planting, followed by an additive postemergence insecticide application when the localized infestation level warrants it. The most commonly used approach for postemergence root maggot control in the RRV is a broadcast application of a sprayable liquid insecticide product.

Beginning with the 2010 growing season, federal label changes resulted in a 10-day reapplication interval for all sprayable liquid insecticide products containing the active ingredient chlorpyrifos (e.g., Lorsban 4E, Lorsban Advanced, and all generic versions). The label revision lengthened the reapplication interval by three days. This change may have compromised the ability of sugarbeet growers to effectively manage the SBRM with chlorpyrifos-based products, because fly activity peaks usually rise and fall relatively quickly, often subsiding in about seven days. In an effort to address this potential problem, research was undertaken to achieve the following objectives regarding postemergence SBRM management: 1) determine the most effective timing schemes for repeated applications of Lorsban Advanced sprays that adhere to its 10-day reapplication restriction; 2) assess the impact of application rate on Lorsban Advanced performance; and 3) evaluate Mustang Maxx as a single postemergence tool and as rotated with Lorsban Advanced applications for postemergence SBRM control.

**Materials and Methods:**

This experiment was conducted on a commercial sugarbeet field site near St. Thomas in rural Pembina County, ND. Betaseed 89RR52 glyphosate-resistant seed was used for all treatments. Plots were planted on 11 May. All plots were planted using a 6-row Monosem NG Plus 4 7x7 planter set to deliver seed at a depth of 1¼ inch and a rate of one seed every 4½ inches of row length. Plots were six rows (22-inch spacing) wide with the four centermost rows treated. The outer “guard” row on each side of the plot served as an untreated buffer. Each plot was 35 feet long, and 35-foot tilled alleys were maintained between replicates throughout the growing season. The experiment was arranged in a randomized complete block design with four replications of the treatments.

Planting-time insecticide applications. Planting-time applications of Counter 20G were applied by using band (B) placement (Boetel et al. 2006), which consisted of 5-inch swaths of granules delivered through Gandy™ row banders. Granular application rates were regulated by using planter-mounted SmartBox™ computer-controlled insecticide delivery system that had been calibrated on the planter before all applications.

Postemergence insecticide applications. Additive postemergence insecticides used included Lorsban Advanced and Mustang Maxx. Treatments that included postemergence applications involved both single and double postemergence spray applications at varying rates. Treatment timings compared included six, five, and three days pre-peak SBRM fly activity (i.e., 5, 6, and 8 June, respectively, and five, four, and eight days after peak fly (i.e., 15, 16, and 19 June, resp.). Liquid insecticide solutions were delivered with a tractor-mounted $CO_2$-propelled spray system equipped with TeeJet™ 110015VS nozzles calibrated to deliver applications in a finished output volume of 10 GPA.

Root injury ratings: Sugarbeet root maggot feeding injury was assessed in this experiment on 1 August, by randomly collecting ten beet roots per plot (five from each of the outer two treated rows), hand-washing them, and scoring them in accordance with the 0 to 9 root injury rating scale (0 = no scarring, and 9 = over ¾ of the root surface blackened by scarring or dead beet) of Campbell et al. (2000).

Harvest: Treatment performance was also compared on the basis of sugarbeet yield parameters. Plots were harvested on 2 October. Foliage was removed from plots immediately before harvest by using a commercial-grade mechanical defoliator. All beets from the center two rows of each plot were extracted from soil using a mechanical harvester, and weighed in the field using a digital scale. A representative subsample of 12-18 beets was collected from each plot and sent to the American Crystal Sugar Company Tare Laboratory (East Grand Forks, MN) for sucrose content and quality analysis.

Data analysis: All data from root injury ratings and harvest samples were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 2008), and treatment means were separated using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance.

**Results and Discussion:**

NOTE: Results of this trial should be interpreted with some degree of discretion, because a strong hailstorm occurred in the plot area just two days before the anticipated peak in SBRM fly activity. As a result, we estimate that at least 40-60% of the fly population in the immediate vicinity of this trial site were likely killed.

Sugarbeet root maggot feeding injury ratings in the untreated check plots averaged 4.8 on the 0 to 9 scale of Campbell et al. (2000) (Table 1). This suggested that a moderate SBRM infestation was present for the experiment.

**Table 1.** ***Larval feeding injury*** **in an assessment of postemergence insecticide spray timing, rate, and frequency impacts on sugarbeet root maggot control, St. Thomas, ND, 2017**

| Treatment/form. | Placement[a] | Rate (product/ac) | Rate (lb a.i./ac) | Root injury (0-9) |
|---|---|---|---|---|
| Counter 20G +<br>Lorsban Advanced +<br>Lorsban Advanced | B<br>5 d Pre-peak Broadcast<br>5 d Post-peak Broadcast | 7.5 lb<br>2 pts<br>2 pts | 1.5<br>1.0<br>1.0 | 1.28 c |
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 8.9 lb<br>2 pts | 1.8<br>1.0 | 1.33 c |
| Counter 20G +<br>Lorsban Advanced +<br>Lorsban Advanced | B<br>5 d Pre-peak Broadcast<br>5 d Post-peak Broadcast | 7.5 lb<br>1 pts<br>1 pts | 1.5<br>1.0<br>1.0 | 1.35 c |
| Counter 20G +<br>Lorsban Advanced +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast<br>8 d Post-peak Broadcast | 7.5 lb<br>1 pt<br>1 pt | 1.5<br>0.5<br>0.5 | 1.38 c |
| Counter 20G +<br>Lorsban Advanced +<br>Lorsban Advanced | B<br>6 d Pre-peak Broadcast<br>4 d Post-peak Broadcast | 7.5 lb<br>2 pts<br>2 pts | 1.5<br>1.0<br>1.0 | 1.40 bc |
| Counter 20G +<br>Lorsban Advanced +<br>Mustang Maxx | B<br>3 d Pre-peak Broadcast<br>4 d Post-peak Broadcast | 7.5 lb<br>1 pt<br>4 fl oz | 1.5<br>0.5<br>0.025 | 1.60 bc |
| Counter 20G +<br>Lorsban Advanced +<br>Lorsban Advanced | B<br>6 d Pre-peak Broadcast<br>4 d Post-peak Broadcast | 7.5 lb<br>1 pt<br>1 pt | 1.5<br>0.5<br>0.5 | 1.70 bc |
| Counter 20G +<br>Mustang Maxx +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast<br>4 d Post-peak Broadcast | 7.5 lb<br>4 fl oz<br>1 pt | 1.5<br>0.025<br>0.5 | 1.80 bc |
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 7.5 lb<br>2 pts | 1.5<br>1.0 | 1.98 bc |
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 7.5 lb<br>1 pt | 1.5<br>0.5 | 2.03 bc |
| Counter 20G | B | 8.9 lb | 1.8 | 2.10 bc |
| Counter 20G +<br>Mustang Maxx | B<br>3 d Pre-peak Broadcast | 7.5 lb<br>4 fl oz | 1.5<br>0.025 | 2.25 bc |
| Counter 20G | B | 7.5 lb | 1.5 | 2.48 b |
| Check | --- | --- | --- | 4.80 a |
| LSD (0.05) | | | | 1.091 |

Means within a column sharing a letter are not significantly (*P* = 0.05) different from each other (Fisher's Protected LSD test).
[a]B = banded at planting

The moderate feeding pressure resulted in very few significant differences among treatments in this experiment. All insecticide treatments, whether involving single at-plant applications, or at-plant/postemergence combinations, provided significant reductions in feeding injury when compared to the untreated check. There were no statistically significant differences in root protection among any of the treatments in this trial that included both a planting-time application of Counter 20G plus at least one postemergence spray of either Lorsban Advanced or

Mustang Maxx. No rate-related differences in performance were observed either, although general patterns indicated that the best protection from root maggot feeding injury was provided by entries that involved combining planting-time with aggressive postemergence control programs comprised of two spray applications.

The following treatments provided the best average protection from SBRM feeding injury in this trial:

1) planting-time Counter 20G at 8.9 lb/ac + two 2-pt/ac applications of Lorsban Advanced at 5 days pre-and 5 days post-peak;
2) planting-time Counter at 8.9 lb/ac + one 2-pt/ac postemergence application of Lorsban Advanced at 3 days pre-peak;
3) planting-time Counter at 7.5 lb/ac + two 1-pt/ac postemergence applications of Lorsban Advanced at 5 days pre- and 5 days post-peak; and
4) planting-time Counter at 7.5 lb/ac + two 1-pt/ac postemergence applications of Lorsban Advanced at 3 days pre-peak and 8 days post-peak.

Treatment timing, in relation to the required 10-day reapplication interval, did not have a significant impact on performance of Lorsban Advanced applications in relation to preventing SBRM feeding injury. Another trend observed suggested that the high (2 pt/ac) rate of Lorsban Advanced tended to provide slightly better root protection than the 1 pt/ac rate. In treatment combinations that included postemergence applications of both Lorsban Advanced and Mustang Maxx, control appeared to be slightly improved by applying the Lorsban Advanced during the pre-peak application, and following with a post-peak application of Mustang Maxx. Another pattern observed was that splitting 2 pts of Lorsban Advanced into two 1-pt applications spaced 10 days apart appeared to provide a slight improvement in root protection, although the difference was not statistically significant.

Yield results and associated gross economic returns from this trial are presented in Table 2. All insecticide treatments provided significant increases in both recoverable sucrose yield and root tonnage. As observed with root injury rating data, there were also very few significant differences among insecticide treatments with respect to recoverable sucrose yield. This was probably a product of the atypically moderate SBRM larval feeding pressure that occurred following the pre-peak-fly hailstorm. Variability within and between replicates in the plot area due to standing water in some plots during the SBRM egg-laying period could have also contributed to the relatively low incidence of significant differences in this experiment.

The best overall treatments in this trial with regard to recoverable sucrose yield included the following:

1) planting-time Counter 20G at 7.5 lb/ac + two 2-pt/ac applications of Lorsban Advanced at 6 days pre-and 4 days post-peak;
2) planting-time Counter at 7.5 lb/ac + two 1-pt/ac postemergence applications of Lorsban Advanced at 6 days pre- and 4 days post-peak;
3) planting-time Counter at 7.5 lb/ac + two 2-pt/ac postemergence applications of Lorsban Advanced at 5 days pre- and 5 days post-peak; and
4) planting-time Counter at 7.5 lb/ac + postemergence Lorsban Advanced (1 pt/ac) at 3 days pre-peak + Mustang Maxx (4 fl oz/ac) at 4 days post-peak.

There were no significant different differences among these four treatments with regard to either recoverable sucrose yield or root tonnage. Although significant yield differences were rare in this study, it should be noted that these top four treatments all included a planting-time application of Counter 20G at its moderate rate (7.5 lb/ac). These results may suggest that, under moderate SBRM feeding pressure, a moderate rate of at-plant protection, followed by more aggressive postemergence control strategy (i.e., two split applications of a postemergence liquid insecticide spray), may allow growers to optimize sucrose yield and revenue.

In comparisons among dual- and triple-insecticide component programs, there were two key findings. First, the top-yielding treatment consisted of Counter 20G applied at planting at 7.5 lb product per acre combined with two postemergence applications of Lorsban Advanced at 2 pts/ac. In that program, adding a second application of Lorsban Advanced generated significantly greater recoverable sucrose yield (1,401 lb increase) and root tonnage (3.5-ton increase), and $223 more in gross revenue than a similar program that only included a single 2-pt/ac application of Lorsban Advanced. Second, the program that included the same moderate rate of Counter (7.5 lb/ac) at planting, followed by two split applications of postemergence Lorsban Advanced at 1 pt/ac (6 days pre- and 4 days post-peak), also produced significantly more sucrose and root yield than when the Lorsban Advanced was applied in a single 2-pt/ac application. The program involving two split postemergence applications of Lorsban Advanced at 1 pt/ac generated $249 more gross economic return than when the Lorsban was applied as a single 2-pt application.

| **Table 2. *Yield parameters* from an assessment of postemergence insecticide spray timing, rate, and frequency impacts on sugarbeet root maggot control, St. Thomas, ND, 2017** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Treatment/form.** | **Placement[a]** | **Rate (product/ac)** | **Rate (lb a.i./ac)** | **Sucrose yield (lb/ac)** | **Root yield (T/ac)** | **Sucrose (%)** | **Gross return ($/ac)** |
| Counter 20G +<br>Lorsban Advanced +<br>Lorsban Advanced | B<br>6 d Pre-peak Broadcast<br>4 d Post-peak Broadcast | 7.5 lb<br>2 pts<br>2 pts | 1.5<br>1.0<br>1.0 | 12,187 a | 39.7 ab | 16.60 a | 1,436 |
| Counter 20G +<br>Lorsban Advanced +<br>Lorsban Advanced | B<br>6 d Pre-peak Broadcast<br>4 d Post-peak Broadcast | 7.5 lb<br>1 pt<br>1 pt | 1.5<br>0.5<br>0.5 | 12,015 a | 38.9 ab | 16.70 a | 1,427 |
| Counter 20G +<br>Lorsban Advanced +<br>Lorsban Advanced | B<br>5 d Pre-peak Broadcast<br>5 d Post-peak Broadcast | 7.5 lb<br>2 pts<br>2 pts | 1.5<br>1.0<br>1.0 | 12,007 a | 40.0 a | 16.43 a | 1,367 |
| Counter 20G +<br>Lorsban Advanced +<br>Mustang Maxx | B<br>3 d Pre-peak Broadcast<br>4 d Post-peak Broadcast | 7.5 lb<br>1 pt<br>4 fl oz | 1.5<br>0.5<br>0.025 | 11,827 ab | 40.2 a | 16.10 a | 1,310 |
| Counter 20G +<br>Lorsban Advanced +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast<br>8 d Post-peak Broadcast | 7.5 lb<br>1 pt<br>1 pt | 1.5<br>0.5<br>0.5 | 11,697 ab | 38.4 abc | 16.50 a | 1,363 |
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 7.5 lb<br>1 pt | 1.5<br>0.5 | 11,544 ab | 37.5 bc | 16.60 a | 1,363 |
| Counter 20G | B | 8.9 lb | 1.8 | 11,499 ab | 38.9 ab | 16.18 a | 1,283 |
| Counter 20G +<br>Mustang Maxx | B<br>3 d Pre-peak Broadcast | 7.5 lb<br>4 fl oz | 1.5<br>0.025 | 11,441 ab | 37.5 bc | 16.50 a | 1,333 |
| Counter 20G +<br>Lorsban Advanced +<br>Lorsban Advanced | B<br>5 d Pre-peak Broadcast<br>5 d Post-peak Broadcast | 7.5 lb<br>1 pts<br>1 pts | 1.5<br>1.0<br>1.0 | 11,347 ab | 39.1 ab | 15.93 a | 1,229 |
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 8.9 lb<br>2 pts | 1.8<br>1.0 | 11,295 ab | 39.8 a | 15.70 a | 1,178 |
| Counter 20G +<br>Mustang Maxx +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast<br>4 d Post-peak Broadcast | 7.5 lb<br>4 fl oz<br>1 pt | 1.5<br>0.025<br>0.5 | 11,264 ab | 37.5 bc | 16.30 a | 1,285 |
| Counter 20G | B | 7.5 lb | 1.5 | 11,258 ab | 37.9 abc | 16.20 a | 1,264 |
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 7.5 lb<br>2 pts | 1.5<br>1.0 | 10,781 b | 36.2 c | 16.20 a | 1,213 |
| Check | --- | --- | --- | 9,182 c | 30.9 d | 16.10 a | 1,030 |
| LSD (0.05 | | | | 1,198.6 | 2.29 | NS | |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]B = banded at planting

Meaningful trends observed in this trial involved treatment timing and order. For example, numerically (i.e., not statistically significant) greater recoverable sucrose yield was produced when the first applications of Lorsban Advanced in dual postemergence sprays were applied earlier (6 days pre- + 4 days post-peak vs. 5 days pre- + 5 days post-peak and 3 days pre- + 8 days post-peak). Also, in postemergence spray programs where Lorsban Advanced and Mustang Maxx were alternated, applying the Lorsban on the pre-peak spray and following it with Mustang Maxx resulted in numerically greater recoverable sucrose yield and significantly more root tonnage than when the Mustang was applied first.

Despite the moderate SBRM feeding pressure that was present during this experiment, most of the SBRM control programs evaluated in this experiment provided effective SBRM control that translated to major yield benefits. Another general conclusion that can be drawn is that the root protection, yield, and revenue benefits from additive postemergence insecticides demonstrate that they are cost-effective tools to use in areas where damaging SBRM populations occur.

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**SAS Institute. 2008. The SAS System for Windows. Version 9.2. SAS Institute Inc., 2002-2008. Cary, NC.**

# DOES APPLICATION RATE OR TIMING IMPACT PERFORMANCE OF THIMET 20G FOR POSTEMERGENCE SUGARBEET ROOT MAGGOT CONTROL?

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**Introduction:**

In recent years, sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder), populations have been at alarmingly high levels in central and northern portions of the Red River Valley. This has provided the impetus to refine postemergence tools for more effective SBRM management. The key objective of this experiment was to assess the impacts of application timing and rate on the performance of Thimet 20G insecticide when applied as a postemergence rescue insecticide for SBRM control in the Red River Valley. A secondary objective was to compare moderate and high rates of Counter 20G (i.e., 7.5 and 8.9 lb product/acre, respectively) as planting-time components in dual-insecticide (i.e., planting-time + postemergence) programs for root maggot control.

**Materials and Methods:**

This study was planted on 10 May at a commercial field site near St. Thomas (Pembina County), ND. Plots were planted using a 6-row Monosem NG Plus 7x7 planter set to plant at a depth of 1¼ inch and a rate of one seed every 4½ inches of row length. Plots were six rows (22-inch spacing) wide with the four centermost rows treated. The outer two rows of each plot served as untreated buffers. Individual plots were 35 feet long, and 35-foot tilled alleys were maintained between replicates throughout the growing season. The experiment was arranged in a randomized complete block design with four replications of the treatments. Counter 20G was applied as a base planting-time insecticide for all plots that received insecticide protection, and it was applied at either the moderate (7.5 lb product/ac) or high (8.9 lb/ac) labeled rate. Band (B) placement (Boetel et al. 2006), which consisted of 5-inch swaths of granules delivered through Gandy™ row banders, was used for all applications of Counter 20G. Granular output rates were regulated by using a planter-mounted SmartBox™ computer-controlled insecticide system that was calibrated on the planter before planting.

Postemergence Thimet 20G granules were applied at either 11 or five days before peak fly activity (i.e., 31 May or 6 June, respectively), and rates of Thimet 20G included 4.9 and 7 lb product/ac. As with at-plant applications, granular output rates were regulated by using a SmartBox™ system mounted on a tractor-drawn four-row toolbar, and placement of insecticide in 4-inch bands was achieved by using Kinze™ row banders. Granules were incorporated by using two pairs of metal rotary tines that straddled each row. A set of tines was positioned ahead of each bander, and a second pair was mounted behind the granular drop zone. Lorsban Advanced, applied in a broadcast at 1 pt product/ac using TeeJet™ 110015VS nozzles, was also included in this experiment for comparative purposes. This application was made on 8 June, which was two days before the initial peak in SBRM fly activity.

Root injury ratings: Root maggot feeding injury assessments were carried out on 31 July by randomly collecting ten beet roots per plot (five from each of the outer two treated rows), hand-washing them, and scoring them in accordance with the 0 to 9 root injury rating scale (0 = no scarring, and 9 = over ¾ of the root surface blackened by scarring or dead beet) of Campbell et al. (2000).

Harvest: Performance was also compared using sugarbeet yield parameters derived by harvesting roots from all treatment plots. All foliage was removed from plots immediately before harvest on 3 October by using a commercial-grade mechanical defoliator. On the same day, all beets from the center two rows of each plot were extracted from soil by using a mechanical harvester, and weighed in the field using a digital scale. A representative subsample of 12-18 beets was collected from each plot and sent to the American Crystal Sugar Company Tare Laboratory (East Grand Forks, MN) for sucrose content and quality analysis.

Data analysis: All data from root injury ratings and yield/quality analyses were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 2008). Treatment means were separated using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance.

**Results and Discussion:**

Root maggot feeding injury results from this trial are presented in Table 1. The SBRM infestation present for this experiment was classified as moderate, as was evidenced by the moderate average feeding injury rating of 5.2 (0 to 9 scale of Campbell et al. 2000) in the untreated check plots. Although all insecticide entries in the experiment provided significant reductions in SBRM feeding injury when compared to the untreated check, the moderate infestation resulted in very few statistically significant differences among insecticide treatments. Most of the dual (i.e., planting-time plus postemergence) insecticide programs that included a planting-time application of Counter 20G at its moderate rate of 7.5 lb product/ac rate, followed by a postemergence application of Thimet 20G provided significant improvements in root protection from SBRM feeding injury when compared to those that only received the single, 7.5-lb application of Counter at planting time. Exceptions to this were the 11-day pre-peak fly applications of Thimet that followed the moderate rate of Counter. When the full 8.9-lb rate of Counter was applied at planting, there were numerical reductions in SBRM feeding injury in plots that received a postemergence application of Thimet, but none of the differences were statistically significant. As observed in previous years of testing, there were no significant differences in root protection from SBRM feeding injury in relation to timing of the Thimet applications, regardless of the rate of the initial at-plant rate of Counter. There also was no significant application rate response in feeding injury ratings between the single, at-plant applications of 7.5 and 8.9 lb of Counter 20G, thus suggesting that the higher rate is probably not necessary in a dual-insecticide program under low to moderate SBRM pressure such as that which occurred during this trial.

**Table 1. *Larval feeding injury* in an evaluation of Thimet 20G application timing and rate on sugarbeet root maggot control, St. Thomas, ND, 2017**

| Treatment/form. | Placement[a] | Rate (product/ac) | Rate (lb a.i./ac) | Root injury (0-9) |
|---|---|---|---|---|
| Counter 20G +<br>Thimet 20G | B<br>5 d Pre-peak Post B | 8.9 lb<br>7 lb | 1.8<br>1.4 | 1.13 c |
| Counter 20G +<br>Thimet 20G | B<br>5 d Pre-peak Post B | 7.5 lb<br>4.9 lb | 1.5<br>1.0 | 1.20 c |
| Counter 20G +<br>Thimet 20G | B<br>5 d Pre-peak Post B | 7.5 lb<br>7 lb | 1.5<br>1.4 | 1.20 c |
| Counter 20G +<br>Thimet 20G | B<br>11 d Pre-peak Post B | 8.9 lb<br>7 lb | 1.8<br>1.4 | 1.20 c |
| Counter 20G +<br>Thimet 20G | B<br>11 d Pre-peak Post B | 7.5 lb<br>7 lb | 1.5<br>1.4 | 1.48 bc |
| Counter 20G +<br>Thimet 20G | B<br>11 d Pre-peak Post B | 7.5 lb<br>4.9 lb | 1.5<br>1.0 | 1.60 bc |
| Counter 20G | B | 8.9 lb | 1.8 | 1.90 bc |
| Counter 20G +<br>Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 7.5 lb<br>1 pt | 1.5<br>0.5 | 2.00 b |
| Counter 20G | B | 7.5 lb | 1.5 | 2.23 b |
| Check | ----- | ---- | ----- | 5.20 a |
| LSD (0.05) | | | | 0.785 |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]B = banded at planting; Post B = postemergence band

The postemergence spray of Lorsban Advanced, applied at its moderate labeled rate (1 pt product/ac) did not provide a significant improvement in root protection when added to plots initially treated with the 7.5-lb rate of Counter 20G at planting. This result may have been caused by the hailstorm and associated heavy rainfall that occurred on June 9, which was just one day after the Lorsban Advanced was applied.

Yield data from this experiment are presented in Table 2. All insecticide-treated entries in this trial, except the single planting-time application of Counter 20G at its moderate rate (7.5 lb product/ac) of resulted in significant increases in recoverable sucrose yields when compared to the untreated check. Plots treated with the combination of Counter 20G at its high (8.9 lb product/ac) rate plus a postemergence application of the high (7 lb/ac) rate of Thimet 20G at 11 days before peak fly generated the highest average recoverable sucrose and root yield in the trial. Roots harvested from that treatment also had the highest percentage sucrose content in the study; however, very few of the differences were statistically significant. There were no significant differences in recoverable sucrose, root tonnage, or percent sucrose between the single planting-time applications of Counter 20G. Similarly, there were no significant differences for any yield parameter between Thimet application rates or timings tested.

**Table 2. Impacts of Thimet 20G application timing and rate on *yield parameters* in an evaluation of sugarbeet root maggot control, St. Thomas, ND, 2017**

| Treatment/form. | Placement[a] | Rate (product/ac) | Rate (lb a.i./ac) | Sucrose yield (lb/ac) | Root yield (T/ac) | Sucrose (%) | Gross return ($/ac) |
|---|---|---|---|---|---|---|---|
| Counter 20G + Thimet 20G | B<br>11 d Pre-peak Post B | 8.9 lb<br>7 lb | 1.8<br>1.4 | 11,179 a | 33.3 a | 17.73 a | 1,472 |
| Counter 20G + Thimet 20G | B<br>11 d Pre-peak Post B | 7.5 lb<br>4.9 lb | 1.5<br>1.0 | 10,689 ab | 32.6 a | 17.25 a | 1,367 |
| Counter 20G + Thimet 20G | B<br>5 d Pre-peak Post B | 8.9 lb<br>7 lb | 1.8<br>1.4 | 10,636 ab | 33.2 a | 16.93 a | 1,322 |
| Counter 20G + Lorsban Advanced | B<br>3 d Pre-peak Broadcast | 7.5 lb<br>1 pt | 1.5<br>0.5 | 10,595 ab | 32.7 a | 17.10 a | 1,337 |
| Counter 20G + Thimet 20G | B<br>5 d Pre-peak Post B | 7.5 lb<br>7 lb | 1.5<br>1.4 | 10,582 ab | 32.4 a | 17.30 a | 1,349 |
| Counter 20G + Thimet 20G | B<br>5 d Pre-peak Post B | 7.5 lb<br>4.9 lb | 1.5<br>1.0 | 10,514 ab | 33.0 a | 16.95 a | 1,300 |
| Counter 20G + Thimet 20G | B<br>11 d Pre-peak Post B | 7.5 lb<br>7 lb | 1.5<br>1.4 | 10,349 ab | 32.7 a | 16.73 a | 1,266 |
| Counter 20G | B | 8.9 lb | 1.8 | 10,332 ab | 33.0 a | 16.68 a | 1,249 |
| Counter 20G | B | 7.5 lb | 1.5 | 9,737 bc | 32.9 a | 16.05 a | 1,086 |
| Check | ----- | ---- | ----- | 8,595 c | 27.6 b | 16.55 a | 1,029 |
| LSD (0.05) | | | | 1,204.6 | 2.41 | NS | |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]B = banded at planting; Post B = postemergence band

Yield trends in this experiment suggested an advantage to using the higher rate of Counter 20G (8.9 lb product/ac) at planting time plus postemergence Thimet 20G earlier (11 days ahead of peak fly activity). This treatment generated $150/ac more gross revenue per acre than when the Thimet was applied at 5 days pre-peak. Similarly, when lower rates of both Counter 20G (7.5 lb/ac) and Thimet 20G (4.9 lb/ac) were used for SBRM management, applying the postemergence Thimet 11 days pre-peak resulted in an increase in gross revenue by $67/ac when compared to revenue from the same program if the Thimet was applied at 5 days ahead of peak fly.

Adding postemergence applications of Thimet 20G to plots initially treated with a planting-time application of Counter 20G at its high (8.9 lb/ac) labeled rate generated gross economic return increases that ranged from $73 to $223 per acre above the revenue from planting-time-only applications of Counter at 8.9 lb per acre. Similarly, plots initially treated at planting with Counter at the moderate (7.5 lb product/ac) rate produced revenue increases of between $180 and $281/ac when a postemergence application of Thimet was added. Plots that received 7.5 lb of Counter at planting and a postemergence rescue application of Lorsban Advanced three days ahead of peak fly generated an increase in gross economic return of $251/ac.

As observed in previous years of testing, the results of this experiment showed that combining at-plant Counter 20G with postemergence applications of Thimet 20G provides effective control of the sugarbeet root maggot, and that Thimet performance is not significantly impacted by application timing (i.e., seven days pre-peak vs. peak fly) or rate. This allows growers a wide window of flexibility in relation to when the Thimet must be applied to achieve satisfactory SBRM control. The additional economic returns from postemergence insecticide applications in this experiment provide ample justification for the use of these materials to provide additive control of the sugarbeet root maggot. The fact that insecticide protection, in the form of either a single at-plant insecticide or a dual-insecticide program, increased gross economic returns by between $57 and $443/ac above the untreated check provides strong evidence regarding the economic importance of the sugarbeet root maggot as a serious pest of sugarbeet. Effective SBRM management programs, such as the dual-insecticide programs tested in this experiment, will be essential to ensuring the profitability of sugarbeet production in areas affected by moderate to high infestations of this pest.

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**Boetel, M. A., R. J. Dregseth, A. J. Schroeder, and C. D. Doetkott. 2006.** Conventional and alternative placement of soil insecticides to control sugarbeet root maggot (Diptera: Ulidiidae) larvae. J. Sugar Beet Res. 43: 47–63.

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**EVALUATION OF EXPERIMENTAL INSECTICIDES FOR MANAGEMENT OF THE SUGARBEET ROOT MAGGOT**

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**Introduction:**

The sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder) is a major pest of sugarbeet in the Red River Valley (RRV). Observations during the past 15+ years suggest that economically significant SBRM infestations frequently develop on between 50,000 and 85,000 acres within the RRV production area each year. Sugarbeet producers in the U.S. have a limited number of insecticides that are currently registered by the U.S. Environmental Protection Agency (EPA) for root maggot management. With so few options available for SBRM control, RRV sugarbeet producers have had to rely heavily on the same insecticide mode of action (i.e., acetylcholinesterase [ACHE] inhibition) to manage this pest for over 40 years.

In areas affected by severe SBRM infestations, many fields frequently require two to three applications of these materials each growing season to achieve satisfactory control. This long-term pattern of repeated use of ACHE-inhibiting insecticides has exerted intense selection pressure for the development of insecticide resistance in root maggot populations in the RRV. Therefore, research is critically needed to develop alternative strategies for root maggot management to ensure the long-term sustainability and profitability of sugarbeet production for growers affected by this pest. This experiment was carried out to achieve the following objectives: 1) test several natural and/or botanical insecticides for efficacy at managing the sugarbeet root maggot; and 2) evaluate commercially available, EPA-labeled conventional chemical insecticides that are currently not registered for use in sugarbeet to determine if their performance would warrant future pursuit of labeling for use in the crop for SBRM control

**Materials and Methods:**

This experiment was carried out on a commercial sugarbeet field site near St. Thomas (Pembina County), ND. The experiment was planted on 11 May using Betaseed 89RR52 glyphosate-resistant seed. All plots were planted using a 6-row Monosem NG Plus 4 7x7 planter set to plant at a depth of 1¼ inch and a rate of one seed every 4½ inches of row length. Plots were six rows (22-inch spacing) wide with the four centermost rows treated. The outer "guard" rows (i.e., rows one and six) on each side of the plot served as untreated buffers. Each plot was 35 feet long, and 35-foot tilled alleys were maintained between replicates throughout the growing season. The experiment was arranged in a randomized complete block design with four replications of the treatments. All insecticide treatments were single, stand-alone (i.e., planting-time or postemergence) applications. For example, there was no at-plant insecticide in plots assigned to receive a postemergence insecticide, and vice versa.

Planting-time insecticide applications. Counter 20G was used for comparative purposes as a planting-time standard chemical insecticide in this experiment. It was applied by using band (B) placement (Boetel et al. 2006), which consisted of 5-inch swaths of granules delivered through Gandy™ row banders. Granular application rates were regulated by using a planter-mounted SmartBox™ computer-controlled insecticide delivery system calibrated on the planter immediately before all applications. Planting-time liquid insecticides included the following: 1) Aza-Direct (active ingredient: azadirachtin, a neem tree-derived insect antifeedant and growth disruptor); 2) Knack 0.86EC (an insect growth regulator insecticide); Endigo (a combination insecticide containing lambda-cyhalothrin [a pyrethroid insecticide] and thiamethoxam [a neonicotinoid]), and Manticor LFR (a combination product comprised of Capture LFR insecticide and Headline fungicide). Planting-time liquid products in this experiment were delivered in 3-inch T-bands over the open seed furrow by using a planter-mounted, $CO_2$-propelled spray system calibrated to deliver a finished spray volume output of 5 GPA through TeeJet™ 400067E nozzles.

Postemergence insecticide applications. Postemergence insecticide treatments in this experiment included the following sprayable liquid products: Captiva (an insect repellent comprised of capsicum [pepper] extract, garlic oil, and soybean oil]), Dibrom Emulsive (a conventional organophosphate insecticide), Ecozin Plus 1.2%ME (azadirachtin), Evergreen Crop Protection 60-6EC (pyrethrum + a synergist), Veratran D (a botanical material containing insecticidal alkaloids from the Sabadilla plant), Warrior II (a pyrethroid insecticide with Zeon U.V.

protection), and Vydate C-LV (a carbamate), and all were compared with Lorsban Advanced as a postemergence chemical insecticide standard. All postemergence spray treatments were broadcast-applied on 9 June (i.e., about 1 day before peak SBRM fly activity). Sprays were applied from a tractor-mounted, $CO_2$-propelled spray system equipped with an 11-ft boom that was calibrated to deliver a finished spray volume output of 10 GPA through TeeJet™ 110015VS nozzles.

Root injury ratings: Sugarbeet root maggot feeding injury was assessed in this trial on 1 August by randomly collecting ten beet roots per plot (five from each of the outer two treated rows), hand-washing them, and scoring them in accordance with the 0 to 9 root injury rating scale (0 = no scarring, and 9 = over ¾ of the root surface blackened by scarring or dead beet) of Campbell et al. (2000).

Harvest: Treatment performance was also compared on the basis of sugarbeet yield parameters. Plots were harvested on 2 October. Foliage was removed from plots immediately before harvest by using a commercial-grade mechanical defoliator. All beets from the center two rows of each plot were extracted from the soil using a mechanical harvester, and weighed in the field using a digital scale. A representative subsample of 12-18 beets was collected from each plot and sent to the American Crystal Sugar Company Tare Laboratory (East Grand Forks, MN) for sucrose content and quality analysis.

Data analysis: All data from root injury ratings and harvest samples were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 2008), and treatment means were separated using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance

**Results and Discussion:**

It is important to note that all insecticide entries in this trial were single-component control tools, which are not recommended in high-risk areas such as St. Thomas, where severe SBRM infestations are common. Another important aspect of this trial was that a hailstorm, including high winds and locally heavy rainfall, occurred on 9 June. This occurred just 2 days before peak fly was expected, and just a few hours after all postemergence spray treatments were applied. As such, the results of this trial should be interpreted with discretion.

Sugarbeet root maggot feeding injury results for this experiment are presented in Table 1. The average level of SBRM larval feeding injury recorded for the untreated check plots was only 5.33 on the 0 to 9 scale of Campbell et al. [2000]), which indicated that a moderate root maggot infestation developed in the plot area for this experiment.

**Table 1. *Larval feeding injury* in an evaluation of experimental at-plant and postemergence sprays for sugarbeet root maggot control, St. Thomas, ND, 2017**

| Treatment/form. | Placement[a] | Rate (product/ac) | Rate (lb a.i./ac) | Root injury (0-9) |
|---|---|---|---|---|
| Manticor LFR (bifenthrin + pyraclostrobin) | 3" T-band | 19 fl oz | 0.2 lb bifenthrin + 0.1 lb pyraclostrobin | 2.25 e |
| Counter 20G | B | 7.5 lb | 1.5 | 2.55 de |
| Endigo ZC | 3" TB | 4.5 fl oz | | 3.38 cd |
| Ecozin Plus 1.2% ME | 2 d Pre-peak Broadcast | 56 fl oz | | 4.00 bc |
| Lorsban Advanced | 2 d Pre-peak Broadcast | 1 pt | 0.5 | 4.30 abc |
| Dibrom | 2 d Pre-peak Broadcast | 1 pt | | 4.33 abc |
| Evergreen Crop Protection | 2 d Pre-peak Broadcast | 16 fl oz | | 4.53 ab |
| Warrior ll | 2 d Pre-peak Broadcast | 1.92 fl oz | 0.03 | 4.68 ab |
| Knack 0.86 EC | 3" TB | 10 fl oz | | 4.70 ab |
| Vydate CLV | 2 d Pre-peak Broadcast | 34 fl oz | 1.0 | 4.78 ab |
| Captiva | 2 d Pre-peak Broadcast | 2 pts | | 4.90 ab |
| Aza-Direct | 3" TB | 56 fl oz | | 5.08 ab |
| Veratran D | 2 d Pre-peak Broadcast | 20 lb | 0.04 | 5.30 a |
| Check | --- | --- | --- | 5.33 a |
| LSD (0.05) | | | | 1.104 |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]B = banded at planting; TB = T-band over open seed furrow

Entries that provided the greatest levels of root protection (i.e., lowest SBRM feeding injury ratings) included planting-time treatments of Manticor LFR (19 fl oz/ac) and Counter 20G at its moderate rate of 7.5 lb product/ac. Manticor outperformed all treatments, except Counter with regard to protection from larval feeding injury, and Endigo ZC (4.5 fl oz/ac) was the only other treatment that provided a level of root protection that was not significantly different from Counter 20G. The only other treatment that provided a significant reduction in root maggot larval feeding injury when compared to the untreated check plots was Ecozin Plus, applied at 56 fl oz/ac.

Yield data from this trial are shown in Table 2. The highest-yielding treatments included the following: 1) Counter 20G, applied at a moderate rate of 7.5 lb product/ac; 2) Warrior II, applied as a postemergence broadcast at 1.92 fl oz/ac; 3) Manticor LFR, applied at 19 fl oz/ac in a 3-inch T-band at planting; and 4) Ecozin Plus, which was applied as a postemergence broadcast at 56 fl oz/ac. All of these treatments produced root yields of more than 34 tons/ac, which were all significantly greater than that recorded for the untreated check. The following treatments were not significantly outperformed by the top four treatments, and produced significantly more recoverable sucrose yield than the untreated check: 1) Vydate C-LV, applied postemergence at 34 fl oz/ac; 2) Dibrom Emulsive, broadcast-applied 1 pt product/ac; and 3) a postemergence spray of Veratran D at 20 lb product/ac.

It bears repeating that all insecticide-treated entries in this experiment were single-application treatments. Also, it should be noted that five of the top seven treatments in relation to recoverable sucrose and root yield are currently not registered for use in sugarbeet, and three of them represent alternative modes of action to the commonly used ACHE inhibitors. As such these results provide encouragement regarding the future of SBRM management. These alternatives, which included Warrior II and Manticor (both pyrethroid insecticides), Ecozin Plus (azadirachtin, a plant-derived insect antifeedant and growth disruptor), and Veratran D (a plant-derived insecticide containing Sabadilla alkaloids) generated recoverable sucrose yield increases ranging from 1,461 to 2,154 lb/ac above the average sucrose yield from the untreated check plots. Also, all of these treatments generated numerically (not statistically significant) more recoverable sucrose than Lorsban Advanced (the postemergence broadcast spray standard in this trial) and Counter 20G (the conventional planting-time standard). It should be noted that Counter 20G and Lorsban Advanced were both applied at their respective moderate rates, and not the maximum rates allowed on the respective labels of those products.

**Table 2.** ***Yield parameters*** **from an evaluation of experimental at-plant and postemergence sprays for sugarbeet root maggot control, St. Thomas, ND, 2017**

| Treatment/form. | Placement[a] | Rate (product/ac) | Rate (lb a.i./ac) | Sucrose yield (lb/ac) | Root yield (T/ac) | Sucrose (%) | Gross return ($/ac) |
|---|---|---|---|---|---|---|---|
| Counter 20G | B | 7.5 lb | 1.5 | 11,446 a | 37.1 a | 16.58 a | 1,358 |
| Warrior ll | 2 d Pre-peak Broadcast | 1.92 fl oz | 0.03 | 10,917 ab | 36.4 ab | 16.28 a | 1,244 |
| Manticor LFR (bifenthrin + pyraclostrobin) | 3” T-band | 19 fl oz | 0.2 lb bifenthrin + 0.1 lb pyraclostrobin | 10,694 abc | 33.8 abc | 16.98 a | 1,311 |
| Ecozin Plus 1.2% ME | 2 d Pre-peak Broadcast | 56 fl oz | | 10,512 abc | 34.2 abc | 16.55 a | 1,241 |
| Vydate CLV | 2 d Pre-peak Broadcast | 34 fl oz | | 10,440 abc | 33.2 bc | 16.80 a | 1,269 |
| Dibrom | 2 d Pre-peak Broadcast | 1 pt | | 10,409 abc | 34.2 abc | 16.35 a | 1,210 |
| Veratran D | 2 d Pre-peak Broadcast | 20 lb | 0.04 | 10,224 a-d | 32.9 bc | 16.60 a | 1,223 |
| Lorsban Advanced | 2 d Pre-peak Broadcast | 1 pt | 0.5 | 10,070 b-e | 32.8 bc | 16.48 a | 1,185 |
| Captiva | 2 d Pre-peak Broadcast | 2 pts | | 10,069 b-e | 33.4 abc | 16.30 a | 1,153 |
| Evergreen Crop Protection | 2 d Pre-peak Broadcast | 16 fl oz | | 9,995 b-e | 32.6 bc | 16.45 a | 1,175 |
| Endigo ZC | 3” TB | 4.5 fl oz | | 9,988 b-e | 33.0 bc | 16.30 a | 1,150 |
| Knack 0.86 EC | 3” TB | 10 fl oz | | 9,500 cde | 31.1 cd | 16.43 a | 1,112 |
| Aza-Direct | 3” TB | 56 fl oz | | 8,965 de | 28.7 d | 16.70 a | 1,080 |
| Check | --- | --- | --- | 8,763 e | 28.1 d | 16.75 a | 1,054 |
| LSD (0.05 | | | | 1,353.7 | 3.82 | NS | |

Means within a column sharing a letter are not significantly ($P = 0.05$) different from each other (Fisher’s Protected LSD test).
[a]B = banded at planting; TB = T-band over open seed furrow

It is encouraging that most of the alternative materials tested provided equivalent protection from SBRM feeding injury to that of the labeled chemical insecticides. Further testing should be carried out on these and other experimental materials to identify potential alternatives to the currently used insecticides. Alternative insecticide options could help prevent or delay the development of insecticide resistance in sugarbeet root maggot populations, and could also provide viable tools for growers to sustainably and profitably produce sugarbeet in SBRM-affected areas if the currently available conventional insecticides become unavailable due to regulatory action.

**References Cited:**

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## MOVENTO HL®: TWO YEARS OF PERFORMANCE TRIALS ON A NEWLY REGISTERED INSECTICIDE FOR SUGARBEET ROOT MAGGOT CONTROL

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**Introduction:**

The sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder) is a serious economic pest of sugarbeet in the Red River Valley (RRV) growing area. Sugarbeet producers in the RRV typically manage this pest by prophylactically applying granular insecticides to at-risk fields during planting operations. In areas where severe SBRM infestations frequently develop, planting-time control efforts are often augmented by one to two postemergence applications. As far back as the mid-1970s, most of these applications have involved the use of insecticides in the organophosphate and carbamate classes to manage the sugarbeet root maggot. Both of these classes cause mortality in insects through the same mode of action, acetylcholinesterase (ACHE) inhibition.

Grower dependence on a single mode of action for SBRM control in the Red River Valley has been largely due to two factors. First, a limited number of insecticide products have been registered for use in the crop for much of this time. Second, despite frequent screening efforts on a variety of insecticides belonging to alternative modes of action, very few insecticidal products tested in screening programs have shown promise as viable options for SBRM control. As a result of this long-term, repeated use of ACHE inhibitor insecticides, the threat of insecticide resistance development in RRV sugarbeet root maggot populations has been a looming concern for pest management advisors and producers for several years.

In July of 2017, the U.S. Environmental Protection Agency approved the registration of Movento HL insecticide for use in sugarbeet. The addition of this product is encouraging from an insect resistance management perspective, because the active ingredient in Movento (spirotetramat) belongs to the lipid biosynthesis inhibitors (LBIs), which will provide an alternative mode of action to the commonly used ACHE inhibitors. Thus far, after significant screening efforts have been conducted on insect species with known resistance to other insecticides, there is no evidence of cross resistance between the LBI insecticides and other classes.

This project was carried out to evaluate the efficacy of Movento HL as a postemergence tool for sugarbeet root maggot control. A secondary objective was to assess the performance of dual-insecticide programs for SBRM management that include Poncho Beta as the planting-time insecticide component and Movento HL as the postemergence rescue component.

**Materials and Methods:**

This experiment was conducted during the 2016 and 2017 growing seasons on commercial sugarbeet field sites near St. Thomas in rural Pembina County, ND. Betaseed 89RR52 glyphosate-resistant seed was used for all treatments in both study years. Plots were planted on 11 May in 2016 and 10 May in 2017. All plots were planted using a 6-row Monosem NG Plus 4 7x7 planter set to deliver seed at a depth of 1¼ inch and a rate of one seed every 4½ inches of row length. Plots were six rows (22-inch spacing) wide with the four centermost rows treated. The outer “guard” row on each side of the plot served as an untreated buffer. Each plot was 35 feet long, and 35-foot tilled alleys were maintained between replicates throughout the growing season. The experiment was arranged in a randomized complete block design. Treatments were replicated four times in 2016 and three times in 2017.

Planting-time insecticide applications. Planting-time applications of Counter 20G were applied by using band (B) placement (Boetel et al. 2006), which consisted of 5-inch swaths of granules delivered through Gandy™ row banders. Granular application rates were regulated by using planter-mounted SmartBox™ computer-controlled insecticide delivery system that had been calibrated on the planter before all applications.

Postemergence insecticide applications. Additive postemergence insecticides applied in this trial included Movento HL, Movento 240SC, Lorsban Advanced, and Mustang Maxx. The original (i.e., 240SC) formulation of Movento was included in the trial for comparative purposes because it had been included in previous NDSU screening trials before the HL formulation was available for testing. Treatment timings evaluated included the following: 1) Lorsban Advanced and Mustang Maxx at two days before peak SBRM fly activity; 2) Movento 240SC and one Movento HL entry at seven days pre -peak; and 3) Movento HL on or within one day of peak fly activity. Liquid insecticide solutions were delivered with a tractor-mounted $CO_2$-propelled spray system equipped with TeeJet™ 110015VS nozzles calibrated to deliver applications in a finished output volume of 10 GPA. All postemergence Movento spray solutions included methylated seed oil at the recommended rate of 0.25% v/v.

Root injury ratings: Sugarbeet root maggot feeding injury was assessed in this experiment on 3 and 1 August in 2016 and 2017, respectively. Sampling consisted of randomly collecting ten beet roots per plot (five from each of the outer two treated rows), hand-washing them, and scoring them in accordance with the 0 to 9 root injury rating scale (0 = no scarring, and 9 = over ¾ of the root surface blackened by scarring or dead beet) of Campbell et al. (2000).

Harvest: Treatment performance was also compared on the basis of sugarbeet yield parameters. Plots were harvested on 20 September in 2016, and on 3 October in 2017. Foliage was removed from plots immediately before harvest by using a commercial-grade mechanical defoliator. All beets from the center two rows of each plot were extracted from soil using a mechanical harvester, and weighed in the field using a digital scale. A representative subsample of 12-18 beets was collected from each plot and sent to the American Crystal Sugar Company Tare Laboratory (East Grand Forks, MN) for sucrose content and quality analysis.

Data analysis: All data from root injury ratings and harvest samples were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 2008). Treatment means were compared by using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance. Initial analyses indicated that there were no significant treatment × year interactions for root injury ratings ($P = 0.7445$), recoverable sucrose yield ($P = 0.2636$), root yield ($P = 0.1345$), or percent sucrose content data ($P = 0.4321$). As such, two-year combined analyses were performed on all data from this experiment.

**Results and Discussion:**

Sugarbeet root maggot feeding injury results from this two-year trial are presented in Table 1. The feeding injury rating mean for the untreated check (5.24 on the 0 to 9 scale of Campbell et al. [2000]) indicated the presence of a moderate SBRM larval infestation across both years. However, feeding injury recorded in all insecticide-protected plots was significantly lower than that in the untreated check.

**Table 1. *Larval feeding injury* in a comparison of Movento HL®, Lorsban Advanced, and Mustang Maxx for postemergence sugarbeet root maggot control, St. Thomas, ND, 2016 – 2017**

| Treatment/form. | Placement[a] | Rate (product/ac) | Rate (lb a.i./ac) | Root injury (0-9) |
|---|---|---|---|---|
| Counter 20G | B | 7.5 lb | 1.5 | 3.27 d |
| Poncho Beta +<br>Mustang Maxx | Seed<br>2 d Pre-peak Broadcast | 4 fl oz | 68 g a.i./ unit seed<br>0.025 | 3.29 d |
| Poncho Beta +<br>Movento 240SC + MSO | Seed<br>7 d Pre-peak Broadcast | 5 fl oz | 68 g a.i./ unit seed<br>0.078 | 3.51 cd |
| Poncho Beta +<br>Lorsban Advanced | Seed<br>2 d Pre-peak Broadcast | 2.0 pts | 68 g a.i./ unit seed<br>1.0 | 3.59 bcd |
| Poncho Beta +<br>Movento HL + MSO | Seed<br>Peak fly | 2.5 fl oz | 68 g a.i./ unit seed<br>0.078 | 4.24 bc |
| Poncho Beta | Seed | | 68 g a.i./ unit seed | 4.27 bc |
| Poncho Beta +<br>Movento HL + MSO | Seed<br>7 d Pre-peak Broadcast | 2.5 fl oz | 68 g a.i./ unit seed<br>0.078 | 4.34 b |
| Check | ----- | ---- | ----- | 5.24 a |
| LSD (0.05) | | | | 0.763 |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]B = banded at planting; Seed = insecticidal seed treatment

The lowest average root maggot feeding injury was observed in plots protected by the single at-plant application of Counter 20G at its moderate (7.5 lb product/ac) rate. Other entries that were not significantly outperformed by this treatment included the following: 1) Poncho Beta + a postemergence application of Mustang Maxx at 4 fl oz of product/ac; 2) Poncho Beta plus a postemergence application of Movento 240SC at 5 fl oz of product/ac (7 days pre-peak); and 3) Poncho Beta seed treatment plus a postemergence application of Lorsban Advanced at its high (2 pts product/ac) labeled rate. There was no significant difference in SBRM feeding injury between applications of Movento HL made at peak fly and seven days pre-peak.

Yield data from this experiment are shown in Table 2. Similar to the results from root ratings, all insecticide treatments provided significant increases in both recoverable sucrose yield and root tonnage. The top-performing treatment with regard to recoverable sucrose and root yield was the combination of Poncho Beta seed treatment plus a postemergence application of Lorsban Advanced. When compared to the untreated check, that entry produced 2,416 lb more recoverable sucrose and 7.4 additional tons per acre in root yield, and generated a revenue benefit of $352/ac. Treatments that were not significantly different from the top treatment with regard to both recoverable sucrose yield and root tonnage included Poncho Beta plus Mustang Maxx and Poncho Beta plus Movento HL (applied at seven days ahead of peak SBRM fly activity).

Applying Movento HL at seven days ahead of peak fly to plots initially protected by Poncho Beta seed treatment generated an increase in revenue of $79/acre when compared to Poncho Beta plots that did not receive a postemergence spray. Although there were no significant differences in coverable sucrose yield or root tonnage between the two Movento HL postemergence spray timings, applying this insecticide earlier (seven days pre-peak) generated $69 more gross revenue than when it was applied at peak SBRM fly activity. Gross economic return increases from insecticide-based programs in this experiment ranged from $165/ac for Poncho Beta plus Movento 240SC at postemergence to the aforementioned $352/ac for the treatment that included Poncho Beta-treated seed plus a postemergence application of Lorsban Advanced.

**Table 2. *Yield parameters* from a comparison of Movento HL®, Lorsban Advanced, and Mustang Maxx for postemergence sugarbeet root maggot control, St. Thomas, ND, 2016 – 2017**

| Treatment/form. | Placement[a] | Rate (product/ac) | Rate (lb a.i./ac) | Sucrose yield (lb/ac) | Root yield (T/ac) | Sucrose (%) | Gross return ($/ac) |
|---|---|---|---|---|---|---|---|
| Poncho Beta +<br>Lorsban Advanced | Seed<br>2 d Pre-peak Broadcast | <br>2.0 pts | 68 g a.i./ unit seed<br>1.0 | 8,039 a | 26.7 a | 15.99 a | 1,063 |
| Poncho Beta +<br>Mustang Maxx | Seed<br>2 d Pre-peak Broadcast | <br>4 fl oz | 68 g a.i./ unit seed<br>0.025 | 7,885 a | 25.9 a | 15.96 a | 1,053 |
| Poncho Beta +<br>Movento HL + MSO | Seed<br>7 d Pre-peak Broadcast | <br>2.5 fl oz | 68 g a.i./ unit seed<br>0.078 | 7,409 ab | 24.9 ab | 15.69 a | 961 |
| Poncho Beta +<br>Movento HL + MSO | Seed<br>Peak fly Broadcast | <br>2.5 fl oz | 68 g a.i./ unit seed<br>0.078 | 6,923 b | 23.4 b | 15.43 a | 892 |
| Counter 20G | B | 7.5 lb | 1.5 | 6,877 b | 23.1 b | 15.66 a | 894 |
| Poncho Beta | Seed | | 68 g a.i./ unit seed | 6,865 b | 23.3 b | 15.49 a | 882 |
| Poncho Beta +<br>Movento 240SC + MSO | Seed<br>7 d Pre-peak Broadcast | <br>5 fl oz | 68 g a.i./ unit seed<br>0.078 | 6,841 b | 23.3 b | 15.49 a | 876 |
| Check | ----- | ---- | ----- | 5,623 c | 19.3 c | 15.27 a | 711 |
| LSD (0.05) | | | | 755.5 | 2.22 | NS | |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]B = banded at planting; Seed = insecticidal seed treatment

There were no significant differences in percent sucrose content between any of the treatments in this trial, but the untreated check had the lowest sucrose concentration, and roots from the treatment that generated the highest root tonnage and sucrose yield (Poncho Beta + Lorsban Advanced) also had numerically higher percent sucrose content than any other treatment in the experiment.

Overall, results from this two-year experiment demonstrate that, even under moderate SBRM infestation, major yield and revenue benefits can be achieved in insecticide-based control programs combining a neonicotinoid seed treatment insecticide and a postemergence sprayable insecticide such as Lorsban Advanced. Results also suggest that yields and revenue are markedly increased by adding a postemergence spray. Major yield increases were also achieved by applying Mustang Maxx at 2 days before peak fly and Movento HL at seven days pre-peak.

Although there were no significant differences in regard to root protection from SBRM feeding activity or resulting yield parameters between the two timings tested for Movento HL applications, results also suggest slight yield improvements by applying this product earlier. This pattern may have been associated with the fact that

Movento is a systemic insecticide. As such, applying it earlier may have resulted in higher concentrations of insecticide active ingredient in roots when SBRM larval feeding injury was occurring.

Further research is needed to evaluate Movento HL under higher SBRM infestation levels to determine its ability to effectively control this pest. Additional research should focus on optimizing the effectiveness of application timing and use rate. The EPA-approved label allows for a much higher application rate of 4.5 fl oz/ac. However, at this time, it is uncertain as to whether applying this product at its maximum labeled rate, even if shown to be effective, would be economically viable.

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**Boetel, M. A., R. J. Dregseth, A. J. Schroeder, and C. D. Doetkott. 2006.** Conventional and alternative placement of soil insecticides to control sugarbeet root maggot (Diptera: Ulidiidae) larvae. J. Sugar Beet Res. 43: 47–63.

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**WIREWORM MANAGEMENT IN SUGARBEET USING PLANTING-TIME GRANULAR, LIQUID, AND SEED TREATMENT INSECTICIDES**

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**Introduction:**

Wireworms occasionally cause significant plant stand and yield loss in Red River Valley (RRV) sugarbeet fields. They also can be problematic for producers in all other sugarbeet production areas of North America. Wireworms are the larval stage of insects commonly referred to as “click beetles”, and about three wireworm species are important pests of several North American field crops. Wireworm infestations are difficult to predict because the most common pest species of this group have between 3- and 5-year life cycles, and populations within an individual field can be at various stages within their life cycle.

For several decades, RRV sugarbeet producers mostly relied on prophylactic applications of planting-time granular insecticides to protect fields from a suite of soil-dwelling insects that threaten the profitability of sugarbeet production, including wireworms, the sugarbeet root maggot, springtails, and white grubs. More recently, growers have also had the option to use a seed-applied or sprayable liquid insecticide to protect crops from soil-inhabiting insect pests. Due to the aforementioned variability and unpredictability of wireworm infestations in North American field crop systems, the current body of literature lacks comprehensive data on the efficacy of insecticides against these pests. This experiment was carried out to compare at-plant granular, liquid, and seed-applied insecticides as tools to control wireworms in sugarbeet.

**Materials & Methods:**

The site chosen for this experiment was an established grower-owned sugarbeet field near Manvel, ND that had an infestation of about 1.2 wireworms per plant. Plots were planted on 20 June, 2017 by using a 6-row Monosem NG Plus 7x7 planter set to plant at a depth of 1¼ inch and a rate of one seed every 4½ inches of row length. Betaseed 89RR52, a glyphosate-tolerant seed variety, was used for all treatments. Individual treatment plots were two rows (22-inch spacing) wide and 25 feet long, and 20-ft wide tilled alleys were maintained between replicates throughout the growing season. The experiment was arranged in a randomized complete block design with four replications of the treatments. Two-row plots are the preferred experimental unit size in wireworm trials because infestations of these pests are often patchy within a field. As such, a smaller test area increases the likelihood of having a sufficiently uniform wireworm infestation among plots within each block.

Insecticidal seed treatment materials were applied to seed by Germain’s Technology Group (Fargo, ND). Granular insecticide treatments were applied by using band placement (Boetel et al. 2006), which consisted of 5-inch swaths that were delivered through Gandy™ row banders. Output rates of the planting-time standard granular material used this experiment were regulated by using a planter-mounted SmartBox™ computer-controlled insecticide delivery system that was calibrated on the planter immediately before all applications. Mustang Maxx was delivered in 3-inch T-bands over the open seed furrow by using a planter-mounted, $CO_2$-propelled spray system calibrated to deliver a finished spray volume output of 5 GPA through TeeJet™ 400067E nozzles.

Treatment efficacy was compared for plant stand data and yield parameters because wireworm larval feeding injury causes stand losses that can lead to yield reductions. Stand counts involved counting all living plants within each 25-ft long row. Plant stand counts were taken on 30 June, and 7, 13, and 27 July, 2017, which were 10, 17, 23, and 37 days after planting (DAP), respectively. Raw stand counts were converted to plants per 100 linear row ft for the analysis. Plots were harvested on 9 October by using a 2-row mechanical harvester to collect all beets from both rows of each plot. Subsamples of 12-18 harvested beets were sent to the American Crystal Sugarbeet Quality Laboratory (East Grand Forks, MN) for quality analyses. Stand and yield data were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 2008), and treatment means were separated using Fisher’s protected least significant difference (LSD) test at a 0.05 level of significance.

**Results and Discussion:**

Results from plant stand counts for this trial are shown in Table 1. There were no significant differences among treatments at the initial stand count (10 DAP). However, at the second and third stand count dates (17 and 23 DAP), all insecticide-treated plots had significantly greater numbers of surviving plants than the untreated check plots, and there were no significant differences among insecticide-protected treatments.

**Table 1. *Plant stand counts* from evaluation of planting-time granular, liquid, and seed treatment insecticides for wireworm control, Manvel, ND, 2017**

| Treatment/form. | Placement[a] | Rate (product/ac) | Rate (lb ai/ac) | Stand count[b] (plants / 100 ft) | | | |
|---|---|---|---|---|---|---|---|
| | | | | 10 DAP[c] | 17 DAP[c] | 23 DAP[c] | 37 DAP[c] |
| Poncho Beta | Seed | | 68 g a.i./ unit seed | 168 a | 213 a | 206 a | 216 a |
| Counter 20G | B | 5.9 lb | 1.2 | 173 a | 209 a | 208 a | 206 ab |
| Counter 20G | B | 4.5 lb | 0.9 | 173 a | 209 a | 203 a | 196 ab |
| Mustang Maxx | 3” T-band | 4 fl oz | 0.025 | 173 a | 199 a | 200 a | 193 ab |
| NipsIt Inside | Seed | ---- | 60 g a.i./ unit seed | 170 a | 205 a | 200 a | 190 b |
| Counter 20G | B | 7.5 lb | 1.5 | 159 a | 192 a | 199 a | 194 ab |
| Cruiser 5FS | Seed | ---- | 60 g a.i./ unit seed | 148 a | 190 a | 198 a | 193 ab |
| Check | --- | ---- | --- | 126 a | 151 b | 148 b | 134 c |
| LSD (0.05) | | | | NS | 24.6 | 25.1 | 24.2 |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher’s Protected LSD test).
[a]B = banded at planting; T-band = 3” swath over open seed furrow at planting; Seed = insecticidal seed treatment
[b]Surviving plant stands were counted on June 30 and on July 7, 13, and 27, 2017 (10, 17, 23, and 37 days after planting, respectively).
[c]DAP = Days after planting

The effects of wireworm feeding on plant roots were more evident by the fourth stand count (37 DAP), when plots planted with Poncho Beta-treated seed had the highest average plant stands in the study. Poncho Beta plots had significantly greater plant stands than the untreated check plots and those planted with NipsIt Inside-treated seed, but they were not statistically different from any other insecticide-treated entry. All insecticide treatments, including NipsIt Inside seed treatment, had significantly greater plant densities per 100 row feet than the untreated check, irrespective of whether they were protected by a planting-time granular, sprayable liquid, or insecticidal seed treatment.

Yield results from this trial are presented in Table 2. All insecticide treatments provided significant increases in both recoverable sucrose yield and root tonnage when compared to yields recorded for the untreated check. There were no significant differences among any of the insecticide-protected treatments, however, plots treated with the lowest rate of Counter 20G (4.5 lb product/ac) generated numerically greater recoverable sucrose than any other insecticide-protected plots in the trial. Revenue benefits from Counter 20G, in comparison to revenue from the untreated check, ranged from $58/ac for the 5.9-lb/ac rate to $110/ac for the 4.5-lb rate. Seed treatment insecticides provided gross economic return increases that ranged from $89/ac in Poncho Beta plots to $111/ac for plots protected by NipsIt Inside. The gross economic return benefit from applying Mustang Maxx averaged $76/ac.

**Table 2. *Yield parameters* from evaluation of planting-time granular, liquid, and seed treatment insecticides for wireworm control, Manvel, ND, 2017**

| Treatment/form. | Placement[a] | Rate (product/ac) | Rate (lb a.i./ac) | Sucrose yield (lb/ac) | Root yield (T/ac) | Sucrose (%) | Gross return ($/ac) |
|---|---|---|---|---|---|---|---|
| Counter 20G | B | 4.5 lb | 0.9 | 6,692 a | 26.7 a | 14.68 a | 544 |
| Counter 20G | B | 5.9 lb | 1.2 | 6,516 a | 26.7 a | 14.40 a | 492 |
| Poncho Beta | Seed | ---- | 68 g a.i./ unit seed | 6,438 a | 25.7 ab | 14.63 a | 523 |
| Cruiser 5FS | Seed | ---- | 60 g a.i./ unit seed | 6,430 a | 25.3 bc | 14.70 a | 538 |
| NipsIt Inside | Seed | ---- | 60 g a.i./ unit seed | 6,396 a | 25.0 bc | 14.83 a | 545 |
| Counter 20G | B | 7.5 lb | 1.5 | 6,268 a | 24.9 bc | 14.73 a | 515 |
| Mustang Maxx | 3” T-band | 4 fl oz | 0.025 | 6,146 a | 24.3 c | 14.73 a | 510 |
| Check | --- | ---- | --- | 5,415 b | 21.7 d | 14.55 a | 434 |
| LSD (0.05) | | | | 562.7 | 1.29 | NS | |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher’s Protected LSD test).
[a]B = banded at planting; T-band = 3” swath over open seed furrow at planting; Seed = insecticidal seed treatment

It should be noted that this trial was planted atypically late in the growing season because the trial was initiated subsequent to the grower detecting a wireworm infestation in an established sugarbeet field. As is typical with sugarbeet research plots, this study was also harvested over two weeks earlier in the season than a typical grower field would be harvested. As such, the resulting sucrose yield, root tonnage, and percent sucrose content values are much lower than would be experienced by a commercial producer. However, these findings provide an excellent window into the significance of wireworms as serious sugarbeet pests and effective tools with which to control them.

Overall, the findings from this trial clearly indicate that wireworms can cause significant harm to sugarbeet seedlings, and the effects result in major yield and revenue losses. Effective wireworm management in this late-planted trial resulted in major increases in gross revenue that would have easily paid for the associated investments and provided significant net revenue benefits. As such, growers managing fields with known wireworm infestation histories should consider the use of one of these prophylactic tools to protect their crops.

**References Cited:**

**Boetel, M. A., R. J. Dregseth, A. J. Schroeder, and C. D. Doetkott. 2006.** Conventional and alternative placement of soil insecticides to control sugarbeet root maggot (Diptera: Ulidiidae) larvae. J. Sugar Beet Res. 43: 47–63.

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# SPRINGTAIL CONTROL IN SUGARBEET: A COMPARISON OF GRANULAR, SPRAYABLE LIQUID, AND SEED-APPLIED INSECTICIDES

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**Introduction:**

Springtails belong to the order Collembola, an order of organisms that is so unique that they are considered by many experts to belong to a separate taxonomic group from that of true insects. Subterranean (soil-dwelling) springtails have been recognized as a serious pest threat of sugarbeet for many growers in the central and southern Red River Valley (RRV) of Minnesota and North Dakota since the late-1990s. Producers in western ND and eastern Montana also frequently have problems with springtails. These tiny, nearly microscopic, blind, and wingless insects spend their entire lives below the soil surface (Boetel et al. 2001).

Although subterranean springtails are present in many fields throughout the RRV, they only occasionally become a major pest problem. Subterranean springtails thrive in heavy soils with high levels of soil organic matter. Cool and wet weather can be conducive to buildups of springtail infestations because such conditions slow sugarbeet seed germination and seedling development, which renders plants extremely vulnerable to attack by springtails that are not negatively impacted by cool temperatures. Therefore, these pests can cause major stand and yield losses. We conducted a field experiment to evaluate the performance of a conventional granular insecticide, an experimental at-plant liquid insecticide, and three insecticidal seed treatments for springtail control in sugarbeet.

**Materials & Methods:**

This experiment was established on the NDSU experiment farm near Prosper, ND. Plots were planted on 19 May, 2017 using a 6-row Monosem NG Plus 7x7 planter set to plant at a depth of 1¼ inch and a rate of one seed every 4½ inches of row length. Betaseed 89RR52, a glyphosate-tolerant seed variety, was used for all treatments. Individual treatment plots were two rows (22-inch spacing) wide and 25 feet long, and 20-ft wide tilled alleys were maintained between replicates throughout the growing season. The experiment was arranged in a randomized complete block design with four replications of the treatments. Two-row plots are the preferred experimental unit size in springtail trials because infestations of these pests are typically patchy. A smaller test area increases the likelihood of having a sufficiently uniform springtail infestation among plots within each block.

Insecticidal seed treatment materials were applied to seed by Germain's Technology Group (Fargo, ND). Granular insecticide treatments were applied by using band placement (Boetel et al. 2006), which consisted of 5-inch swaths that were delivered through Gandy™ row banders. Output rates of the planting-time standard granular material used this experiment were regulated by using a planter-mounted SmartBox™ computer-controlled insecticide delivery system that was calibrated on the planter immediately before all applications. Manticor LFR was applied in 3-inch T-bands over the open seed furrow by using a planter-mounted, $CO_2$-propelled spray system calibrated to deliver a finished spray volume output of 5 GPA through TeeJet™ 400067E nozzles.

Treatment efficacy was compared by using plant stand counts and yield parameters because subterranean springtails cause stand losses that lead to yield reductions. Stand counts involved counting all living plants within each 25-ft long row. Plant stand counts were taken on June 1, 15 and 29, as well as 7 July, which were 13, 27, 41, and 49 days after planting (DAP), respectively. Raw stand counts were converted to plants per 100 linear row ft for the analysis. Plots were harvested on 18 September by using a 2-row mechanical harvester to collect all beets from both rows of each plot. Subsamples of 12-18 harvested beets were sent to the American Crystal Sugarbeet Quality Laboratory (East Grand Forks, MN) for quality analyses. All stand count and yield data were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 2008), and treatment means were separated using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance.

**Results and Discussion:**

Plant stand count data for this trial are presented in Table 1. At the initial stand count date (13 DAP), the insecticide-protected plots had numerically greater numbers of surviving plants per 100 ft of row, but there were no significant differences among treatments, including the untreated check. However, at 27 DAP, all insecticide treatments except Cruiser 5FS resulted in significantly greater plant stands than the untreated check. The following treatments had significantly greater plant stands than both Cruiser and the check at 27 DAP: 1) Poncho Beta; 2) Counter 20G at 4.5 lb product/ac; and 3) Manitcor LFR applied at 19 fl oz/ac.

Stand count comparisons for both 41 and 49 DAP generated the same results in that all insecticide treatments provided significant levels of protection from stand loss associated with springtail feeding injury when compared to the untreated check, irrespective of whether a granular, sprayable liquid, or seed treatment insecticide was used. Additionally, there were no significant differences among insecticide treatments at either 41 or 49 DAP.

**Table 1. *Plant stand counts* from evaluation of planting-time granular, liquid, and seed treatment insecticides for springtail control, Prosper, ND, 2017**

| Treatment/form. | Placement[a] | Rate (product/ac) | Rate (lb ai/ac) | Stand count[b] (plants / 100 ft) | | | |
|---|---|---|---|---|---|---|---|
| | | | | 13 DAP[c] | 27 DAP[c] | 41 DAP[c] | 49 DAP[c] |
| Poncho Beta | Seed | | 68 g a.i./ unit seed | 166 a | 176 a | 198 a | 203 a |
| Counter 20G | B | 4.5 lb | 0.9 | 159 a | 171 a | 191 a | 183 a |
| Counter 20G | B | 5.9 lb | 1.2 | 158 a | 169 ab | 184 a | 190 a |
| Manticor LFR (bifenthrin + pyraclostrobin) | 3” T-band | 19 fl oz | 0.2 lb bifenthrin + 0.1 lb pyraclostrobin | 141 a | 172 a | 196 a | 199 a |
| Cruiser 5FS | Seed | | 60 g a.i./ unit seed | 122 a | 129 bc | 172 ab | 169 ab |
| Check | --- | ---- | --- | 117 a | 127 c | 150 b | 148 b |
| LSD (0.05) | | | | NS | 39.7 | 30.7 | 34.6 |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher’s Protected LSD test).

[a]B = banded at planting; T-band = 3” swath over open seed furrow at planting; Seed = insecticidal seed treatment

[b]Surviving plant stands were counted on June 1, 15, and 29, and on July 7, 2017 (i.e., 13, 27, 41, and 49 days after planting, respectively).

[c]DAP = Days after planting

Yield results from this experiment are presented in Table 2. General treatment performance patterns were similar to those observed in stand count results. Both rates of Counter 20G, as well as Poncho Beta seed treatment, resulted in significantly greater recoverable sucrose yield than the untreated check, and there were no significant differences among these three treatments with regard to recoverable sucrose. Cruiser 5FS seed treatment and Manticor LFR were the only treatments that did not provide a significant increase in recoverable sucrose yield when compared to the untreated check. However, there were no significant differences in recoverable sucrose yield or root yield between Poncho Beta and Cruiser. Plots protected with the moderate rate of Counter 20G (5.9 lb product/ac) generated the highest tonnage in the trial, but that treatment was not significantly superior to the lower rate of 4.5 lb/ac. Additionally, both Counter 20G treatments were the only entries in this experiment that resulted in significant increases in root yield when compared to the untreated check.

**Table 2. *Yield parameters* from evaluation of planting-time granular, liquid, and seed treatment insecticides for springtail control, Prosper, ND, 2017**

| Treatment/form. | Placement[a] | Rate (product/ac) | Rate (lb a.i./ac) | Sucrose yield (lb/ac) | Root yield (T/ac) | Sucrose (%) | Gross return ($/ac) |
|---|---|---|---|---|---|---|---|
| Counter 20G | B | 5.9 lb | 1.2 | 11,139 a | 34.9 a | 17.65 a | 1,377 |
| Counter 20G | B | 4.5 lb | 0.9 | 9,927 ab | 31.9 ab | 17.18 a | 1,192 |
| Poncho Beta | Seed | | 68 g a.i./ unit seed | 9,725 abc | 28.1 bc | 18.55 a | 1,321 |
| Manticor LFR (bifenthrin + pyraclostrobin) | 3” T-band | 19 fl oz | 0.2 lb bifenthrin + 0.1 lb pyraclostrobin | 8,979 bcd | 26.6 bc | 18.28 a | 1,189 |
| Cruiser 5FS | Seed | | 60 g a.i./ unit seed | 8,278 cd | 23.8 c | 18.68 a | 1,130 |
| Check | --- | ---- | --- | 8,266 d | 23.9 c | 18.63 a | 1,122 |
| LSD (0.05) | | | | 1,452.8 | 6.65 | NS | |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher’s Protected LSD test).

[a]B = banded at planting; T-band = 3” swath over open seed furrow at planting; Seed = insecticidal seed treatment

Gross economic return results followed similar patterns to those for recoverable sucrose and root yields; however, percent sucrose influenced these patterns. Plots treated with the moderate rate of Counter 20G (5.9 lb product/ac) generated $1,377/ac in gross revenue, which was $185/ac greater than that from plots treated with the low (4.5 lb) rate of Counter. Similarly, plots treated with the 5.9-lb rate of Counter generated $56/ac more gross revenue than Poncho Beta plots, and $247/ac more revenue than plots planted with Cruiser-treated seed. An additional positive finding from this trial was that plots protected with the experimental material, Manticor LFR, generated an average revenue increase of $67/ac when compared to the untreated check plots. The increases in yield and revenue generated by insecticide treatments tested in this experiment show that effective tools are available for managing subterranean springtails in sugarbeet. These findings also demonstrate the significance of subterranean springtails as serious economic pests of sugarbeet and demonstrate the importance of effectively managing them.

**References Cited:**

**Boetel, M. A., R. J. Dregseth, and M. F. R. Khan. 2001.** Springtails in sugarbeet: identification, biology, and management. Extension Circular #E-1205, North Dakota State University Coop. Ext. Svc.

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**SAS Institute. 2008. The SAS System for Windows. Version 9.2. SAS Institute Inc., 2002-2008. Cary, NC.**

**IMPACTS OF SEED LUBRICANTS ON SEEDLING ESTABLISHMENT AND YIELD: ON-FARM AND SMALL-PLOT TRIALS**

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**Introduction:**

Neonicotinoid seed treatment insecticides (e.g., Cruiser, Poncho, etc.) have been implicated in honey bee kills near corn production fields in Indiana (Krupke et al. 2012). Those authors observed that planter hopper box seed-flow lubricants (e.g., talc) abrade seed-applied insecticides from corn seed coatings, and suggested that the resulting insecticide-laden dust is released into the air in exhaust plumes emitted from vacuum-based planters. As a result, they concluded that this subsequently can either directly or indirectly expose bees and potentially other pollinators. The findings from that research have precipitated public demands ranging from additional use restrictions to a complete ban on all uses of neonicotinoid seed treatment insecticides. In response to public concerns and perceived risk to pollinators from these insecticides, the Environmental Protection Agency (EPA) issued a moratorium on any new uses of currently labeled neonicotinoid products in April of 2015.

Concerns surrounding this phenomenon have also raised questions as to whether talcum or other seed-flow lubricants are necessary during row crop planting. If lubricants are not needed in sugarbeet planting, or if a less-abrasive alternative than talcum could perform at least as well without negatively impacting seed delivery and seedling establishment, it may provide evidence to support continued federal registration of neonicotinoid seed treatment insecticides used in sugarbeet production.

This experiment was carried out to determine if seed-flow lubricants (i.e., talc, graphite, talc/graphite mixture, Fluency Agent™, or Fluency Advanced™ [referred to in previous reports as "Fluency II"]) impact seed delivery, seedling establishment, or resulting sugarbeet yield parameters and revenue. This research could provide critical information to argue for maintaining neonicotinoid seed treatment registrations for use in sugarbeet if the EPA proposes a ban on using these materials in row crop production.

**Materials and Methods:**

This research involved two experiments that were carried out in grower-owned fields during the 2017 growing season. Study I involved a small-plot, replicated trial that was conducted near Hillsboro, ND. Study II was a large on-farm trial that was carried out by using conventional grower-owned equipment for planting and harvest. All seed-flow lubricant materials were applied at manufacturer-recommended rates.

**Study I (small-plot trial):** Plots were planted on 15 May, 2017 by using a 6-row John Deere MaxEmerge II™ planter. The planter was adjusted to deliver seed at a depth of 1¼ inch and a rate of one seed every 4½ inches of row length. Treatments in Study I included the following: 1) John Deere Premium Seed Talc™ (Deere & Co., Moline, IL); 2) John Deere Powdered Graphite™; 3) John Deere Talc/Graphite™ combination seed lubricant (80% talc and 20% graphite); 4) Fluency Agent™ (Bayer Crop Science, Durham, NC); 5) Fluency Advanced™ (a reformulated version from Bayer; NOTE: this was referred to as "Fluency II in previous reports); and a no-lubricant control. Betaseed 83CN, a glyphosate-resistant sugarbeet seed variety in two sizes (miniature pellet ~9/64-inch diam.] and Pro200, an extra-large pellet (~12.5/64-inch diam.) was used for the experiment. All seed included Poncho Beta (i.e., clothianidin + betacyfluthrin at 60:8 g a.i./100,000 seeds, respectively) insecticidal seed treatment to minimize the risk of soil insect feeding injury introducing unwanted variability to the experiment. Each plot was six rows (22-inch spacing) wide with the four centermost rows treated. The outer "guard" rows, one on the outer side of each plot, served as untreated buffer rows. Each plot was 35 feet long, and 25-foot tilled alleys were maintained between replicates throughout the growing season. The experiment was arranged in a split-plot design with three replications of the treatments. Seed size was the whole-plot factor, and seed flow lubricant served as the sub-plot factor.

Treatment performance was compared using plant stand counts and yield parameters. Stand counts were made on 1, 15, and 29 June, 2017, which were 17, 31, and 45 days after planting (DAP), respectively. Those assessments involved counting all living plants in all four 35-ft long rows of each plot. Raw stand count observations were converted to plants per 100 linear row ft for the analyses.

Harvest: Treatment performance was also compared on the basis of sugarbeet yield parameters. The small-plot trial was harvested on 19 September, 2017. Immediately before harvest, the foliage was removed from all treatment plots by using a commercial-grade mechanical defoliator. After defoliation, all beets from the center two rows of each plot were extracted from the soil using a mechanical harvester and weighed in the field using a digital scale. A representative subsample of 12-18 beets was collected from each plot and sent to the American Crystal Sugar Company Tare Laboratory (East Grand Forks, MN) for sucrose content and quality analysis.

Data analysis: All stand count and harvest data were initially subjected to analysis of variance (ANOVA) (SAS Institute, 2008) to determine whole- and sub-plot factor effects. All mean comparisons were carried out by using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance. The initial ANOVAs for the small-plot study at Hillsboro indicated no significant seed size × lubricant ($P > 0.05$) interactions for any of the three stand count dates or any of the yield parameters. As such, combined analyses was conducted to compare seed flow lubricants on the basis of stand count and yield data averaged across both seed sizes.

**Study II (on-farm trial):** The on-farm trial was planted on 1 May, 2017 by using a 12-row John Deere 1730 MaxEmerge Plus™ planter. The planter was operated at 4.5 mph, and adjusted to deliver seed 1¼ inch deep at a rate of one seed every 4¾ inches of row length. Betaseed 8572 seed was used for planting all treatments. All seed was formulated as miniature pellets, and was prepared with the following seed-applied protectants: 1) Poncho Beta insecticide (68 g a.i./100,000-seed unit); 2) Tachigaren fungicide (45 g a.i./ unit); and 3) Kabina ST fungicide (14 g a.i./unit). All plots were also protected against seedling insect pests by applying Counter 20G at 5.9 lb product/ac in a modified (i.e., restricted to prevent granule deposition into seed furrow) band. The entire field also received a planting-time application of 10-34-0 (respective percentage of N, P, and K) starter fertilizer.

Study II included all treatments used in Study I, except the original formulation of Fluency Agent™. Each individual treatment plot was 12 rows (22-inch spacing) wide by 600 ft in length. The experiment was arranged in a randomized complete block design with three replications of the treatments.

Treatment performance was compared according to plant stand counts and yield parameters. Stand counts involved counting all living plants within 1/1000$^{th}$ ac long subsamples, of which four were taken at equally spaced intervals within the length of each treatment plot. Counts were taken on 24 May, and 1 and 22 June, which were 23, 31, and 52 days after planting (DAP), respectively. All plant stand count observations were converted to plants per 100 linear row ft before being subjected to statistical analysis.

Harvest: Sampling for harvest data was conducted twice in this experiment. Hand-harvested yield samples were collected on 12 October, 2017. Conventional drain spades were used to manually dig the samples, and each was comprised of all roots from within an 11.9-ft length of the same center-most row of each plot. One sample was collected at each of four locations within each treatment plot. Pre-harvest samples were collected at the same locations within each plot that stand counts were taken throughout the growing season. Samples were bagged and labeled, and sent to the American Crystal Sugar Company Tare Laboratory (East Grand Forks, MN) for sucrose content and quality analyses.

Machine harvesting procedures, which were carried out on 16 October, 2017, first involved removal of foliage from all treatment plots by using the grower's commercial-grade mechanical defoliator. Harvesting consisted of collecting all roots from each treatment plot with a conventional six-row Art's Way™ 690 sugarbeet harvester. Site-specific root tonnage data was collected from the on-board yield monitoring system in 50-ft increments from within each plot. Quality analysis parameters from pre-harvest samples were used in combination with tonnage data from the harvester yield monitor to calculate recoverable sucrose yield from each plot.

Data analysis: All machine-harvest yield data were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 2008), and treatment means were separated using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance.

**Results and Discussion:**

**Study I (small-plot trial):** Plant stand count results from the initial whole-plot (i.e., seed size) treatment comparisons appear in Table 1. On the first date (17 DAP), plant populations in plots planted with Pro200 (i.e., extra-large) seed were significantly greater than those in plots seeded with miniature pellets. That was the only date on which there was a significant difference in plant population between the two seed sizes tested. The stand counts taken at 31 and 45 DAP indicated that plant populations for the two seed sizes were nearly identical, with only numerical differences between treatments of only three plants per 100 row ft. The relatively small difference between seed sizes during the first stand count, combined with the fact that no significant differences were detected on subsequent dates, suggested that seed size did not play a major role in the results of this trial.

**Table 1. Whole-plot effect of *seed size* on *plant population* in a comparison of sugarbeet seed-flow lubricants in a small-plot field trial (Study I), Hillsboro, ND, 2017**

| Treatment/ form. | Stand counts[a] (plants / 100 row ft) | | |
|---|---|---|---|
| | 17 DAP[b] | 31 DAP | 45 DAP |
| Pro200 | 237 a | 270 a | 270 a |
| Mini | 205 b | 263 a | 267 a |
| LSD (0.05) | 20.8 | NS | NS |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]Surviving plant stands were counted on June 1, 15, and 29, 2017, which were 17, 31, and 45 days after planting (DAP), respectively.
[b]DAP = days after planting

Yield results from the whole-plot factor (i.e., seed size) treatments in the small-plot trial appear in Table 2. There were no significant differences between seed sizes with regard to recoverable sucrose yield, root yield, or percent sucrose content. The relative lack of differences in plant populations (Table 1), coupled with these findings of no significant effects of seed size on yield parameters, further suggested that the main-level factor of seed size had no impact on the overall results of this trial.

**Table 2. Whole-plot effect of *seed size* on *yield parameters* in a comparison of sugarbeet seed-flow lubricants in a small-plot field trial (Study I), Hillsboro, ND, 2017**

| Treatment/ form. | Recoverable sucrose yield (lb/ac) | Root yield (T/ac) | Sucrose content (%) | Gross return ($/ac) |
|---|---|---|---|---|
| Pro200 | 9,218 a | 30.4 a | 16.29 a | 1,068 |
| Mini | 8,846 a | 29.4 a | 16.19 a | 1,013 |
| LSD (0.05) | NS | NS | NS | --- |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).

Results from the combined analysis of plant stand counts for the small-plot trial are presented in Table 3. There were no significant differences in plant stands among any of the hopper-box lubricant treatments or between any lubricant and the no-lubricant control at any of the three stand count dates. Slight numerical differences in stand counts among treatments were somewhat apparent at the first stand count date (i.e., 17 DAP); however, by the last count (45 DAP), the average plant population in the treatment with the lowest plant stands (the no-lubricant control) had only 1.8% fewer plants per 100 ft of row than the treatment with the highest stands (talc/graphite mixture).

| **Table 3. Effects of seed-flow lubricants on sugarbeet *plant population* in a small-plot field trial (Study I), Hillsboro, ND, 2017** | | | | |
|---|---|---|---|---|
| **Treatment/ form.** | **Rate[a]** | **Stand count[b] (plants / 100 row ft)** | | |
| | | **17 DAP[c]** | **31 DAP** | **45 DAP** |
| Talc/graphite mixture (80:20) | 10.4 ml | 236 a | 273 a | 272 a |
| Talc | 20.4 ml | 225 a | 273 a | 271 a |
| Fluency Advanced | 29.6 ml | 208 a | 271 a | 271 a |
| Graphite | 4 ml | 207 a | 269 a | 270 a |
| Fluency Agent | 29.6 ml | 223 a | 258 a | 261 a |
| None | --- | 228 a | 258 a | 267 a |
| LSD (0.05) | | NS | NS | NS |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]Lubricants were applied to seed at rates recommended by respective manufacturers, and are expressed in volume per unit (100,000-ct) of sugarbeet seed.
[b]Surviving plant stands were counted on June 1, 15, and 29, 2017, which were 17, 31, and 45 days after planting (DAP), respectively.
[c]DAP = days after planting

Yield results from the small-plot experiment appear in Table 4. As observed in the stand count analyses, there were no statistical differences among lubricants or between any single lubricant and the no-lubricant control with regard to recoverable sucrose yield, root tonnage, or percent sucrose content. Accordingly, there were only negligible differences in gross economic return among the entries tested. The highest overall gross economic returns in this study were achieved with the following treatments: talc/graphite mixture, talc, and graphite.

| **Table 4. Effects of seed-flow lubricants on sugarbeet *yield parameters* in a small-plot field trial (Study I), Hillsboro, ND, 2017** | | | | | |
|---|---|---|---|---|---|
| **Treatment/ form.** | **Rate[a]** | **Recoverable sucrose yield (lb/ac)** | **Root yield (T/ac)** | **Sucrose content (%)** | **Gross return ($/ac)** |
| Graphite | 4 ml | 9,254 a | 30.5 a | 16.30 a | 1,072 |
| Talc | 20.4 ml | 9,235 a | 30.1 a | 16.40 a | 1,087 |
| Talc/graphite mixture (80:20) | 10.4 ml | 9,209 a | 29.8 a | 16.55 a | 1,092 |
| None | --- | 8,965 a | 30.4 a | 15.97 a | 997 |
| Fluency Advanced | 29.6 ml | 8,870 a | 29.2 a | 16.28 a | 1028 |
| Fluency Agent | 29.6 ml | 8,657 a | 29.2 a | 15.97 a | 967 |
| LSD (0.05) | | NS | NS | NS | |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]Lubricants were applied to seed at rates recommended by respective manufacturers, and are expressed in volume per unit (100,000-ct) of sugarbeet seed.

**Study II (on-farm trial):** Plant stand count data from the on-farm trial appear in Table 5. There were no significant differences in stands were observed among seed lubricants or between any lubricant and the no-lubricant control for any of the stand count dates.

| **Table 5. Effects of seed-flow lubricants on sugarbeet *plant populations* in an on-farm trial (Study II), Glyndon, MN, 2017** | | | | |
|---|---|---|---|---|
| **Treatment/ form.** | **Rate[a]** | **Stand Count[b] (plants / 100 row ft)** | | |
| | | **23 DAP[c]** | **31 DAP** | **52 DAP** |
| Talc | 20.4 ml | 220 a | 213 a | 206 a |
| Talc/Graphite Mix (80:20) | 10.4 ml | 216 a | 212 a | 207 a |
| None | --- | 215 a | 209 a | 207 a |
| Fluency Advanced | 29.6 ml | 210 a | 205 a | 202 a |
| Graphite | 4 ml | 206 a | 206 a | 201 a |
| LSD (0.05) | | NS | NS | NS |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]Lubricants were applied to seed at rates recommended by respective manufacturers, and are expressed in volume per unit (100,000-ct) of sugarbeet seed.
[b]Surviving plant stands were counted on May 24, and on June 1 and 22, which were 23, 31, and 52 days after planting (DAP), respectively.
[c]DAP = days after planting

Yield results from hand-harvesting the plots in Study II are presented in Table 6. Excellent recoverable sucrose and root yields were recorded for all entries in this study, including the no-lubricant control. Yield trends closely corresponded to those from the plant stand assessments. There were no statistical differences with regard to recoverable sucrose, root yield, or percent sucrose content among the seed lubricants, or between any lubricant and the no-lubricant control. Another aspect of these results that corresponded with the plant stand data was that the top-yielding entry, with regard to both recoverable sucrose and root yield, was the talc/graphite combination lubricant.

| **Table 6. *Hand-harvested* yield in an on-farm trial of sugarbeet seed lubricants (Study II), Glyndon, MN, 2017** | | | | | |
|---|---|---|---|---|---|
| **Treatment/ form.** | **Rate[a]** | **Recoverable sucrose yield (lb/ac)** | **Root yield (T/ac)** | **Sucrose content (%)** | **Gross return ($/ac)** |
| Talc/Graphite Mix (80:20) | 10.4 ml | 15,012 a | 39.2 a | 19.96 a | 2,251 |
| Talc | 20.4 ml | 14,800 a | 39.0 a | 19.82 a | 2,198 |
| None | --- | 14,649 a | 38.1 a | 20.04 a | 2,201 |
| Graphite | 4 ml | 14,323 a | 37.1 a | 20.08 a | 2,162 |
| Fluency Advanced | 29.6 ml | 13,919 a | 35.9 a | 20.13 a | 2,110 |
| LSD (0.05) | | NS | NS | NS | |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]Lubricants were applied to seed at rates recommended by respective manufacturers, and are expressed in volume per unit (100,000-ct) of sugarbeet seed.

Yield results from machine-harvesting the plots in Study II appear in Table 7. Treatment performance patterns were very similar to those from hand-harvesting subsamples. The highest average recoverable sucrose yields occurred in plots planted using either Fluency Advanced or the talc/graphite mixture lubricant. Although no statistically significant, the no-lubricant control plots had the lowest recoverable sucrose and root yields. With regard to gross revenue, the top three entries included Fluency Advanced, the no-lubricant control, and the talc/graphite mixture.

| **Table 7. *Machine-harvested* yield in an on-farm trial of sugarbeet seed lubricants (Study II), Glyndon, MN, 2017** | | | | | |
|---|---|---|---|---|---|
| **Treatment/ form.** | **Rate[a]** | **Recoverable sucrose yield (lb/ac)** | **Root yield (T/ac)** | **Sucrose content (%)** | **Gross return ($/ac)** |
| Fluency Advanced | 29.6 ml | 15,126 a | 39.0 a | 20.13 a | 2,291 |
| Talc/Graphite Mix (80:20) | 10.4 ml | 15,034 a | 39.2 a | 19.97 a | 2,255 |
| Talc | 20.4 ml | 14,958 a | 39.4 a | 19.83 a | 2,226 |
| Graphite | 4 ml | 14,932 a | 38.7 a | 20.07 a | 2,252 |
| None | --- | 14,546 a | 37.9 a | 20.04 a | 2,290 |
| LSD (0.05) | | NS | NS | NS | |

Means within a column sharing a letter are not significantly ($P$ = 0.05) different from each other (Fisher's Protected LSD test).
[a]Lubricants were applied to seed at rates recommended by respective manufacturers, and are expressed in volume per unit (100,000-ct) of sugarbeet seed.

Given the highly consistent results between repeated plant population assessments and all yield parameters measured in the two experiments conducted for this project, it appears that the hopper-box seed flow lubricants tested do not impose a statistically significant positive or negative impact on sugarbeet seedling establishment, yield, or gross economic return. Trends across these two studies could suggest that using a talc/graphite mixture, such as the 80:20 product used in these trials, can occasionally optimize plant stands and yield; however, it cannot be concluded that using any seed lubricant during sugarbeet planting is absolutely necessary to achieve acceptable results with planters similar to those used in this experiment (i.e., John Deere MaxEmerge II or John Deere MaxEmerge Plus).

It should be noted that, while planting the Fluency Advanced treatment plots in the on-farm trial, the onboard seed monitor reported the following error message: "DISABLED DUE TO ERRATIC SPACING". Therefore, we make the following recommendations: 1) the exclusion of a seed flow lubricant for use in sugarbeet planting is not recommended at this time; 2) growers interested in or deciding to use Fluency Advanced should test this material on a small acreage with their own planters to determine its utility and safety; 3) use rates of the seed lubricants tested in these experiments should be made according to lubricant and/or planter manufacturer guidelines; and 4) growers that use planter makes and models other than those used in these experiments should review their owner's manual to determine if a seed lubricant is recommended for their planter, as well as carefully and extensively test the seed lubricant(s) they select to determine if they are safe for use with their planters.

Irrespective of the error message, the results of these experiments collectively and strongly suggest that reducing or eliminating talc from use in these planters does not appear to impose deleterious effects on sugarbeet stand establishment that translate to statistically significant yield loss. Therefore, growers could likely deploy insecticidal seed treatments in a safe and effective manner by using any hopper-box lubricant tested in this study (or by excluding a lubricant) without negatively impacting sugarbeet seedling establishment, yield, or gross economic return.

**References Cited:**

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**Entomology Appendix A.:** Agronomic, Rainfall, and Plot Maintenance Information

| | | |
|---|---|---|
| **Location:** | St. Thomas (Pembina County), ND – Wayne Lessard Farm – *Sugarbeet Root Maggot Trials* | |
| **Plot size:** | Six 35-ft long rows, 4 center rows treated | |
| **Design:** | Randomized complete block, 4 replications | |
| **Soil name:** | Glyndon silt loam | |
| **Soil test:** | Organic matter = 3.1% | pH = 7.8 |
| **Soil texture:** | 25.2% sand 53.3% silt | 21.6% clay |
| **Previous crop:** | Potatoes (2016) | |
| **Soil preparation:** | Field cultivator (1x) | |
| **Planting depth:** | 1.25" | |
| **Herbicides applied:** | June 12 | Roundup PowerMAX (32 fl oz/ac) + Veracity (3 qt/100 gal) |
| | June 29 | Roundup PowerMAX (22 fl oz/ac) + Veracity (3 qt/100 gal) + Outlook (18 fl oz/ac) |
| **Rainfall** (after seedbed preparation)**:** | May 16 | 0.15" |
| | May 20 | 0.15" |
| | May 21 | 0.38" |
| | May 22 | 0.08" |
| | May 27 | 0.17" |
| | May 29 | 0.03" |
| | **Total/May** | **0.96"** |
| | June 2 | 0.46" |
| | June 9 | 0.85" |
| | June 10 | 0.04" |
| | June 13 | 0.56" |
| | June 16 | 0.21" |
| | June 19 | 0.11" |
| | June 21 | 0.10" |
| | June 28 | 0.29" |
| | **Total/June** | **2.62"** |
| | July 1 | 0.08" |
| | July 9 | 0.06" |
| | July 11 | 0.29" |
| | July 12 | 0.04" |
| | July 17 | 0.02" |
| | July 19 | 0.15" |
| | July 22 | 0.02" |
| | July 25 | 0.02" |
| | **Total/July** | **0.68"** |
| | **Total/August** | **1.55"** |
| | **Total/September** | **2.99"** |
| **Damage ratings:** | July 31 & August 1 | |
| **Harvest date:** | October 2 & 3 | |
| **Yield sample size:** | 2 center rows x 35 ft length (70 row-ft total) | |

| | | |
|---|---|---|
| **Location:** | Manvel (Grand Forks County), ND – Stuart Ferry Farm – *Wireworm Management Trial* | |
| **Seed variety:** | Betaseed 80RR52 | |
| **Plot size:** | Two 25-ft long rows | |
| **Design:** | Randomized complete block, 4 replicates | |
| **Soil name:** | Bearden silty clay loam | |
| **Soil test:** | Organic matter = 8.0% | pH = 7.5 |
| **Soil texture:** | 9.7% sand 58.6 % silt | 31.8% clay |
| **Previous crop:** | Wheat (2016) | |
| **Soil preparation:** | Heavy harrow with vibra-shank and packer (1x immediately before planting) | |
| **Planting depth:** | 1.25" | |
| **Planting date:** | June 20 | |
| **Herbicides applied:** | June 26 | Roundup PowerMAX (32 fl oz/ac) + Stinger (2 fl oz/ac) + AMS (1 lb) |
| **Fungicides applied:** | July 18 | Penncozeb (2 lbs) + Inspire XT (7 fl oz/ac) + Surfactant (3.2 fl oz/ac) |
| | Aug. 10 | Topsin (16 fl oz/ac) + Supertin (8 fl oz/ac) |
| | Sept. 7 | Priaxor (6.7 fl oz/ac) + Surfactant (3.2 fl oz/ac) |

| | | |
|---|---|---|
| **Rainfall:** | June 21 | 0.06" |
| (after seedbed | June 24 | 0.02" |
| preparation)**:** | June 28 | 3.69" |
| | **Total/June** | **3.77"** |
| | July 1 | 0.06" |
| | July 4 | 0.19" |
| | July 9 | 0.03" |
| | July 11 | 0.52" |
| | July 17 | 0.13" |
| | July 20 | 0.02" |
| | July 22 | 0.03" |
| | **Total/July** | **0.98"** |
| | **Total/August** | **0.69"** |
| | **Total/September** | **4.21"** |

| | |
|---|---|
| **Stand counts:** | June 30; July 7, 13, and 27 |
| **Harvest date:** | October 9 |
| **Yield sample size:** | 2 rows x 25 ft length (50 row-ft total) |

| | | |
|---|---|---|
| **Location:** | Prosper (Cass County), ND – NDSU Experiment Farm – *Springtail Management Trial* | |
| **Seed variety:** | Betaseed 80RR52 | |
| **Plot size:** | Two 25-ft long rows | |
| **Design:** | Randomized complete block, 4 replications | |
| **Soil name:** | Bearden-Lindaas silty clay loam | |
| **Soil test:** | Organic matter = 3.4% | pH = 7.1 |
| **Soil texture:** | 27.0% sand 46.5% silt | 26.6% clay |
| **Previous crop:** | Wheat (2016) | |
| **Soil preparation:** | Field cultivator (2x) | |
| **Planting depth:** | 1.25" | |
| **Planting date:** | May 19 | |
| **Herbicides applied:** | June 1 | Roundup PowerMAX (32 fl oz/ac) + Class Act (1% v/v) + Interlock (12 fl oz/ac) |
| | June 19 | Roundup PowerMAX (32 fl oz/ac) + Class Act (1% v/v) + Interlock (4 fl oz/ac) |
| | July 10 | Roundup PowerMAX (32 fl oz/ac) + Class Act (1% v/v) + Interlock (4 fl oz/ac) |
| **Fungicides applied:** | June 6 | Quadris (14.3 fl oz ac) |
| | June 19 | Quadris (14.3 fl oz ac) |
| | July 21 | Inspire XT (5.3 fl oz/ac) + Topsin (7.6 fl oz/ac) |
| | Aug. 2 | Super Tin (6 fl oz/ac) + Manzate (1.2 qt/ac) |
| **Rainfall:** (after seedbed preparation)**:** | May 20 | 0.38" |
| | May 23 | 0.03" |
| | May 27 | 0.07" |
| | May 28 | 0.03" |
| | May 29 | 0.03" |
| | **Total/May** | **0.54"** |
| | June 6 | 0.33" |
| | June 7 | 0.09" |
| | June 9 | 0.29" |
| | June 11 | 0.17" |
| | June 13 | 1.85" |
| | June 17 | 0.45" |
| | June 27 | 0.08" |
| | June 28 | 0.20" |
| | **Total/June** | **3.46"** |
| | July 4 | 0.63" |
| | July 6 | 0.23" |
| | July 9 | 0.04" |
| | July 18 | 0.47" |
| | July 21 | 0.16" |
| | July 22 | 0.15" |
| | July 31 | 0.29" |
| | **Total/July** | **1.97"** |
| | **Total/August** | **2.07"** |

**Total/September 0.22"**

| | |
|---|---|
| **Stand counts:** | June 1, 15, and 29; July 7 |
| **Harvest date:** | September 18 |
| **Yield sample size:** | 2 rows x 25 ft length (50 row-ft total) |

| | |
|---|---|
| **Location:** | Hillsboro (Traill County), ND – Glen Hultin Farm – *Small-plot Seed Lubricants Test* |
| **Seed variety:** | Betaseed 83CN Mini Pellet & 83CN Pro200 Pellet |
| **Plot size:** | Six 35-ft long rows, 4 center rows treated |
| **Design:** | Randomized complete block, 4 replications |
| **Soil name:** | Bearden–Perella silty clay loam |
| **Soil test:** | Organic matter = 4.5% pH = 7.8 |
| **Soil texture:** | 9.1% sand 54.8% silt 36.2% clay |
| **Previous crop:** | Wheat (2016) |
| **Soil preparation:** | Harrow packer (1x) |
| **Planting depth:** | 1.25" |
| **Planting date:** | May 15 |

| | | |
|---|---|---|
| **Herbicides applied:** | June 5 | Roundup PowerMAX (32 fl oz/ac) + Veracity (3 qt/100 gal) |
| | June 29 | Roundup PowerMAX (22 fl oz/ac) + Veracity (3 qt/100 gal) |
| **Fungicides applied:** | Aug. 10 | Topsin (7.5 fl oz/ac) + Inspire XT (7 fl oz/ac) |

| | | |
|---|---|---|
| **Rainfall** (after seedbed preparation)**:** | May 20 | 0.30" |
| | May 21 | 0.06" |
| | May 28 | 0.15" |
| | **Total/May** | **0.51"** |
| | June 2 | 0.03" |
| | June 7 | 0.14" |
| | June 11 | 0.18" |
| | June 13 | 0.84" |
| | June 17 | 0.35" |
| | June 19 | 0.04" |
| | June 28 | 1.30" |
| | **Total/June** | **2.88"** |
| | July 4 | 0.22" |
| | July 5 | 0.10" |
| | July 6 | 0.19" |
| | July 11 | 0.34" |
| | July 18 | 0.10" |
| | July 21 | 0.12" |
| | July 22 | 0.28" |
| | July 31 | 0.23" |
| | **Total/July** | **1.58"** |
| | **Total/August** | **0.61"** |
| | **Total/September** | **0.66"** |

| | |
|---|---|
| **Stand counts:** | June 1, 15, and 29 |
| **Harvest date:** | September 19 |
| **Yield sample size:** | 2 center rows x 35 ft length (70 row-ft total) |

| | | |
|---|---|---|
| **Location:** | Glyndon (Clay County), MN – David Watt Farm – *On-farm Seed Lubricants Test* | |
| **Seed variety:** | Betaseed 8572 | |
| **Plot size:** | Twelve 600-ft long rows | |
| **Design:** | Randomized complete block, 4 replicates | |
| **Soil name:** | Glyndon loam | |
| **Soil test:** | Organic matter = 4.0% pH = 7.8 | |
| **Soil texture:** | 11.1% sand 62.1% silt 26.9% clay | |
| **Previous crop:** | Wheat (2016) | |
| **Soil preparation:** | Field cultivator with packer (1x) | |
| **Planting depth:** | 1.25" | |
| **Planting date:** | May 1 | |
| **Herbicide applied:** | May 19 | Roundup PowerMAX (28 fl oz/ac) + Brawl (1 pt/ac) |
| | June 12 | Roundup PowerMAX (28 fl oz/ac) + Brawl (1 pt/ac) |
| **Fungicides applied:** | July 7 | Inspire (7 fl oz/ac) + Manzate (1 qt/ac) |
| | July 29 | Tin (8 fl oz/ac) + Topsin (10 fl oz/ac) |
| | Aug. 18 | Proline (7 fl oz/ac) |
| **Rainfall** (after seedbed preparation)**:** | May 5 | 0.07" |
| | May 16 | 0.28" |
| | May 20 | 0.50" |
| | May 28 | 0.19" |
| | **Total/May** | **1.04"** |
| | June 7 | 0.04" |
| | June 11 | 0.19" |
| | June 13 | 1.36" |
| | June 17 | 0.11" |
| | June 27 | 0.19" |
| | June 28 | 0.30" |
| | **Total/June** | **2.26"** |
| | July 4 | 0.20" |
| | July 6 | 0.03" |
| | July 9 | 0.05" |
| | July 18 | 0.22" |
| | July 22 | 0.19" |
| | July 31 | 0.19" |
| | **Total/July** | **0.89"** |
| | **Total/August** | **2.29"** |
| | **Total/September** | **2.75"** |
| **Stand counts:** | May 24; June 1 and 22 | |
| **Harvest date:** | Hand harvest – October 12 | |
| | Machine harvest – October 16 | |
| **Yield sample size:** | Hand harvest – four 0.00025-ac samples per plot | |
| | Machine harvest – twelve 50-ft long rows per plot | |

## **Entomology Appendix B.** 0 to 9 Scale for Rating Sugarbeet Root Maggot Feeding Injury

Treatment performance in preventing sugarbeet root maggot feeding injury was quantified for all root maggot control trials by rating beets on the 0 to 9 root injury rating scale of Campbell et al. (2000). Criteria for respective points on the scale are as follows:

0 = no scars

1 = 1 to 4 small (pin head size) scars

2 = 5 to 10 small scars

3 = 3 large scars or scattered small scars

4 = few large scars and /of numerous small scars

5 = several large scars and/or heavy feeding on laterals

6 = up to 1/4 root scarred

7 = 1/4 to 1/2 of root blackened by scars

8 = 1/2 to 3/4 root blackened by scars

9 = more than 3/4 of root area blackened

**Reference Cited:**

**Campbell, L. G., J. D. Eide, L. J. Smith, and G. A. Smith. 2000.** Control of the sugarbeet root maggot with the fungus *Metarhizium anisopliae*. J. Sugar Beet Res. 37: 57–69.

# PLANT PATHOLOGY

NOTES

**TURNING POINT SURVEY OF FUNGICIDE USE IN SUGARBEET IN MINNESOTA AND EASTERN NORTH DAKOTA IN 2016**

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The second annual fungicide practices live polling questionnaire was conducted using Turning Point Technology at the 2017 Winter Sugarbeet Growers' Seminars. Responses are based on production practices from the 2016 growing season. The survey focuses on responses from growers in attendance at the Fargo, Grafton, Wahpeton, ND and Willmar, MN Grower Seminars. Respondents from each seminar indicated the county in which the majority of their sugarbeets were produced (Tables 1- 4). Survey results represent approximately 158,272 acres reported by 235 participants (Table 5) compared to 183,350 acres represented in 2016. The average sugarbeet acreage per respondent grown in 2016 was calculated from Table 5 at 673 acres, compared to 674 acres in 2015.

Survey participants were asked a series of questions regarding their fungicide practices used on sugarbeet in 2016. Twenty-eight percent of respondents reported that they used five sprays to control Cercospora Leaf Spot (Table 6) while 22% said they used three sprays, 17% used four sprays, 11% used seven sprays, 10% used six sprays, 7% used two sprays, 3% used one spray and 1% both used no sprays and more than seven sprays. Thirty-five percent of respondents both reported a fair amount of effectiveness and a poor amount of effectiveness (Table 7). Twenty-seven percent said they had a good amount of control from CLS spray, 3% had an excellent amount of effectiveness and 1% said they did not use any fungicide for control of CLS. Respondents were then asked when they experienced failure of fungicides to control CLS (Table 8). Twenty-seven percent of respondents reported failure between August 1 and August 15, 17% said field failure occurred between August 16 and August 31, 11% said that failure occurred between September 1 and September 15, 10% said it occurred before July 31, 5% said CLS field failure happened between September 16 and September 30 and 4% said after September 30. Meanwhile, 26% of respondents said they did not experience field failure (Table 9). Participants in the survey were then asked what fungicide was sprayed right before the field experienced failure. Thirty-three percentage of respondents said that Headline was sprayed right before failure, 20% reported Tin, 15% said Priaxor, 9% reported some kind of fungicide mixture, 5% said Topsin while the same percentage also reported Proline and Gem was sprayed right before field failure due to CLS. Four percent said Minerva or Eminent and 3% said the Inspire XT was sprayed right before failure.

Respondents were then asked about soil-borne diseases. Forty percent said their fields were affected by both Rhizoctonia and Aphanomyces, 36% said just Rhizoctonia, 15% had neither disease in their fields and 10% had only Aphanomyces (Table 10). Eighty seven percent of respondents used a Rhizoctonia resistant variety in 2016 (Table 11) while 88% used an Aphanomyces resistant variety (Table 17).

Participants were asked what methods were used to control Rhizoctonia and 55% said they used a seed treatment only, 35% used a seed treatment and a POST fungicide, 4% used a seed treatment plus an in-furrow fungicide while 4% also said they used a seed treatment, in-furrow fungicide and a POST fungicide. Two percent only used a POST fungicide (Table 12). Eighty-five percent of respondents used a Kabina seed treatment while 11% used a Rizolex + Metlock + Kabina mixture, 3% used a different seed treatment and 15 reported not using a seed treatment to control Rhizoctonia (Table 13). Eighty-seven percent of respondents did not use an in-furrow fungicide but 8% of respondents used Quadris in-furrow, 4% used Headline in-furrow to control Rhizoctonia and 1% used a different fungicide (Table 14).

Respondents were asked what POST fungicides were used to control Rhizoctonia and 45% did not use a POST fungicide to control Rhizoctonia. Of the remaining 55%, 44% used Quadris, 5% used Priaxor, 3% used Proline, 1% used Headline while 2% used a different fungicide (Table 15). Participants were then asked to grade the effectiveness of the POST fungicides that were used. Forty-one percent were unsure of the effectiveness, 32% said they performed good, 17% reported fair results, 6% said they performed poorly and 4% said they were excellent (Table 16).

Participants were also asked about use of waste lime to control Aphanomyces. 56% of participants did not use waste lime in their fields while 23% used 5 tons/acre or less. Nineteen percent used between 6 and 10 tons/acre while 2% used more than 10 tons/acre (Table 18). Respondents were also asked about their soil pH. Thirty-six percent said it was between 8.0 and 8.5, 29% said that it was between 7.5 and 8.0, 22% said it was between 7.0 and 7.5, 6% said between 6.5 and 7.0, 5% said between 6.0 and 6.5 and 1% said between 8.5 and 9.0 (Table 19). As a follow-up question, growers were asked whether or not they were concerned about using waste lime on soils above 8.0 pH. Seventy-four percent said no while the remaining 26% said they were concerned (Table 20). Finally, the growers were asked how effective their waste lime was. Fifty percent of respondents did not apply lime, 19% said they had good results, 15% were unsure, 9% reported excellent results, 5% said fair and 1% said poor (Table 21).

**Table 1. 2017 Fargo Grower Seminar – Number of survey respondents by county growing sugarbeet in 2016.**

| County | Number of Responses | Percent of Responses |
|---|---|---|
| Barnes | 3 | 9 |
| Cass | 7 | 21 |
| Clay | 11 | 32 |
| Norman[1] | 8 | 24 |
| Richland | 1 | 3 |
| Trail | 3 | 9 |
| Wilkin[2] | 1 | 3 |
| Total | 34 | 100 |

[1]Includes Mahnomen County
[2]Includes Otter Tail County

**Table 2. 2017 Grafton Grower Seminar – Number of survey respondents by county growing sugarbeet in 2016.**

| County | Number of Responses | Percent of Responses |
|---|---|---|
| Grand Forks | 1 | 2 |
| Kittson | 4 | 7 |
| Marshall | 5 | 9 |
| Pembina | 19 | 35 |
| Polk | 1 | 2 |
| Walsh | 23 | 43 |
| Other | 1 | 2 |
| Total | 54 | 100 |

**Table 3. 2017 Wahpeton Grower Seminar – Number of survey respondents by county growing sugarbeet in 2016.**

| County | Number of Responses | Percent of Responses |
|---|---|---|
| Cass | 2 | 4 |
| Clay | 3 | 7 |
| Grant | 5 | 11 |
| Otter Tail | 1 | 2 |
| Richland | 7 | 16 |
| Stevens | 1 | 2 |
| Traverse | 5 | 11 |
| Wilkin | 21 | 47 |
| Total | 45 | 100 |

**Table 4. 2017 Willmar Grower Seminar - Number of survey respondents by county growing sugarbeet in 2016.**

| County | Number of Responses | Percent of Responses |
|---|---|---|
| Chippewa | 36 | 33 |
| Kandiyohi | 17 | 16 |
| Pope | 0 | 0 |
| Redwood | 5 | 5 |
| Renville | 31 | 28 |
| Stearns | 3 | 3 |
| Stevens | 1 | 1 |
| Swift | 9 | 8 |
| Other | 7 | 6 |
| Total | 109 | 100 |

**Table 5. Total sugarbeet acreage operated by respondents in 2016.**

| | | Acres of sugarbeet | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Responses | <99 | 100-199 | 200-299 | 300-399 | 400-599 | 600-799 | 800-999 | 1000-1499 | 1500-1999 | 2000+ |
| | | --------% of responses-------- | | | | | | | | | |
| Grafton | 54 | 6 | 15 | 11 | 9 | 17 | 9 | 11 | 9 | 2 | 9 |
| Fargo | 33 | 3 | 0 | 15 | 18 | 18 | 6 | 9 | 12 | 6 | 12 |
| Wahpeton | 42 | 2 | 7 | 2 | 10 | 33 | 17 | 12 | 10 | 5 | 2 |
| Willmar | 107 | 7 | 15 | 15 | 6 | 22 | 10 | 3 | 14 | 2 | 7 |
| Total | 235 | 6 | 11 | 12 | 9 | 22 | 11 | 7 | 12 | 3 | 7 |

**Table 6. How many fungicide application did you make to control CLS in 2016?**

| | | Number of applications | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Location | Respondents | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | >7 |
| | | --------% of respondents-------- | | | | | | | | |
| Fargo | 37 | - | - | 16 | 35 | 27 | 22 | - | - | - |
| Grafton | 50 | 2 | 16 | 22 | 56 | 4 | - | - | - | - |
| Wahpeton | 46 | - | - | - | 20 | 30 | 48 | 2 | - | - |
| Willmar | 105 | 1 | - | - | 3 | 14 | 35 | 22 | 24 | 1 |
| Total | 238 | 1 | 3 | 7 | 22 | 17 | 28 | 10 | 11 | 1 |

**Table 7. How effective were your fungicide applications on CLS in 2016?**

| | | Effectiveness of CLS sprays | | | | | |
|---|---|---|---|---|---|---|---|
| Location | Respondents | Excellent | Good | Fair | Poor | Unsure | No applications |
| | | --------% of respondents-------- | | | | | |
| Fargo | 36 | 3 | 47 | 39 | 11 | - | - |
| Grafton | 50 | 6 | 58 | 34 | 2 | - | - |
| Wahpeton | 45 | - | 11 | 29 | 60 | - | - |
| Willmar | 107 | 2 | 12 | 36 | 48 | - | 2 |
| Total | 238 | 3 | 27 | 35 | 35 | - | 1 |

**Table 8. When did you experience failure of fungicides to control CLS?**

| Location | Respondents | Date of fungicide failure | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | No failure | July 31 | August 15 | August 31 | September 15 | September 30 | After September 30 |
| | | ------------------------------% of respondents------------------------- | | | | | | |
| Fargo | 32 | 25 | 9 | 13 | 31 | 9 | 9 | 3 |
| Grafton | 49 | 55 | - | 12 | 8 | 14 | 6 | 4 |
| Wahpeton | 44 | 2 | 18 | 55 | 18 | 5 | 2 | - |
| Willmar | 15 | 7 | 20 | 27 | 13 | 20 | - | 13 |
| Total | 140 | 26 | 10 | 27 | 17 | 11 | 5 | 4 |

**Table 9. If you had failure with fungicides for CLS control, which fungicide did you apply prior to observing field failure?**

| Location | Respondents | Fungicide failure | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Minerva, Eminent | Inspire XT | Proline | Headline | Priaxor | Gem | Tin | Topsin | EBDC | Mixtures |
| | | ------------------------------% of respondents------------------------- | | | | | | | | | |
| Fargo | 21 | - | 10 | 10 | 38 | 10 | - | 19 | - | - | 14 |
| Grafton | 34 | - | 3 | 3 | 6 | 26 | - | 26 | 12 | - | 24 |
| Wahpeton | 40 | 8 | - | 3 | 78 | 8 | - | - | 3 | - | 3 |
| Willmar | 88 | 6 | 2 | 7 | 22 | 16 | 10 | 27 | 6 | - | 5 |
| Total | 183 | 4 | 3 | 5 | 33 | 15 | 5 | 20 | 5 | - | 9 |

**Table 10. What soil-borne diseases affected your sugarbeet production in 2016?**

| Location | Respondents | Root disease | | | |
|---|---|---|---|---|---|
| | | Rhizoctonia | Aphanomyces | Both | Neither |
| | | -----------------------------% of respondents------------------------ | | | |
| Fargo | 34 | 35 | 15 | 35 | 15 |
| Grafton | 49 | 27 | 14 | 57 | 2 |
| Wahpeton | 43 | 47 | 2 | 21 | 30 |
| Total | 126 | 36 | 10 | 40 | 15 |

**Table 11. Did you use a *Rhizoctonia solani* resistant variety in 2016?**

| Location | Respondents | Variety type | |
|---|---|---|---|
| | | Yes | No |
| | | ---------------------% respondents--------------------- | |
| Fargo | 35 | 97 | 3 |
| Grafton | 47 | 94 | 6 |
| Wahpeton | 40 | 90 | 10 |
| Willmar | 98 | 80 | 20 |
| Total | 220 | 87 | 13 |

**Table 12. What methods were used to control *Rhizoctonia solani* in 2016?**

| Location | Respondents | Treatment methods | | | | | |
|---|---|---|---|---|---|---|---|
| | | Seed treatment only | In-Furrow only | Postemergence only | Seed treatment + In-Furrow | Seed treatment + Postemergence | All three treatments used |
| | | ------------------------------% of respondents--------------------------- | | | | | |
| Fargo | 34 | 47 | - | - | - | 53 | - |
| Grafton | 48 | 42 | - | - | 4 | 54 | - |
| Wahpeton | 42 | 86 | - | - | 2 | 10 | 2 |
| Willmar | 99 | 52 | - | 4 | 6 | 30 | 8 |
| Total | 223 | 55 | - | 2 | 4 | 35 | 4 |

**Table 13. Which seed treatment did you use to control *Rhizoctonia solani* in 2016?**

| Location | Respondents | Seed treatment | | | |
|---|---|---|---|---|---|
| | | Kabina | Rizolex + Metlock + Kabina | Other | None |
| | | -------------------------------% of respondents---------------------------- | | | |
| Fargo | 35 | 86 | 14 | - | - |
| Grafton | 49 | 82 | 10 | 4 | 4 |
| Wahpeton | 39 | 87 | 10 | 3 | - |
| Willmar | 101 | 85 | 10 | 4 | 1 |
| Total | 224 | 85 | 11 | 3 | 1 |

**Table 14. Which fungicide did you apply in-furrow to control *R. solani* in 2016?**

| Location | Respondents | In-furrow fungicide use | | | |
|---|---|---|---|---|---|
| | | Headline | Quadris | Other | None |
| | | -------------------------------% of respondents---------------------------- | | | |
| Fargo | 32 | 6 | 9 | - | 84 |
| Grafton | 49 | 2 | 8 | - | 90 |
| Wahpeton | 41 | - | 10 | - | 90 |
| Willmar | 104 | 6 | 7 | 3 | 85 |
| Total | 226 | 4 | 8 | 1 | 87 |

**Table 15. Which POST fungicide did you use to control *R. solani* in 2016?**

| Location | Respondents | POST fungicide | | | | | |
|---|---|---|---|---|---|---|---|
| | | Headline | Quadris | Proline | Priaxor | Other | None |
| | | -------------------------------% of respondents---------------------------- | | | | | |
| Fargo | 34 | - | 59 | - | 3 | - | 38 |
| Grafton | 51 | 4 | 63 | 2 | 14 | - | 18 |
| Wahpeton | 40 | - | 10 | - | - | 5 | 85 |
| Willmar | 102 | 1 | 44 | 5 | 3 | 2 | 45 |
| Total | 227 | 1 | 44 | 3 | 5 | 2 | 45 |

**Table 16. How effective were your POST fungicides at controlling *Rhizoctonia solani* in 2016?**

| Location | Respondents | Effectiveness of fungicides | | | | |
|---|---|---|---|---|---|---|
| | | Excellent | Good | Fair | Poor | Unsure |
| | | -------------------------------% of respondents---------------------------- | | | | |
| Fargo | 30 | 3 | 47 | 13 | - | 37 |
| Grafton | 46 | 2 | 41 | 35 | 7 | 15 |
| Wahpeton | 33 | - | 9 | 3 | 3 | 85 |
| Willmar | 89 | 6 | 30 | 16 | 8 | 40 |
| Total | 198 | 4 | 32 | 17 | 6 | 41 |

**Table 17. Did you use an Aphanomyces resistant variety in 2016?**

| Location | Respondents | Variety type | |
|---|---|---|---|
| | | Yes | No |
| | | ---------------------% respondents--------------------- | |
| Fargo | 25 | 96 | 4 |
| Grafton | 47 | 87 | 13 |
| Wahpeton | 38 | 84 | 16 |
| Total | 110 | 88 | 12 |

**Table 18. What rate of precipitated calcium carbonate (waste lime) did you use?**

| Location | Respondents | Lime use rate | | | |
|---|---|---|---|---|---|
| | | None | >5 T/A | 6-10 T/A | 10+ T/A |
| | | -------------------------------% of respondents---------------------------- | | | |
| Fargo | 33 | 61 | 3 | 27 | 9 |
| Grafton | 52 | 77 | - | 21 | 2 |
| Wahpeton | 41 | 39 | 15 | 44 | 2 |
| Willmar | 101 | 51 | 46 | 4 | - |
| Total | 227 | 56 | 23 | 19 | 2 |

**Table 19. What is your soil pH?**

| Location | Respondents | Soil pH | | | | | |
|---|---|---|---|---|---|---|---|
| | | 6.0-6.5 | 6.5-7.0 | 7.0-7.5 | 7.5-8.0 | 8.0-8.5 | 8.5-9.0 |
| | | -------------------------------% of respondents---------------------------- | | | | | |
| Fargo | 32 | - | 6 | 13 | 31 | 50 | - |
| Grafton | 45 | 9 | 7 | 29 | 27 | 27 | 2 |
| Total | 77 | 5 | 6 | 22 | 29 | 36 | 1 |

**Table 20. Are you concerned about using waste lime on pH soils above 8.0?**

| Location | Respondents | Safety concerns | |
|---|---|---|---|
| | | Yes | No |
| | | ---------------------% respondents--------------------- | |
| Fargo | 32 | 28 | 72 |
| Grafton | 48 | 25 | 75 |
| Total | 80 | 26 | 74 |

**Table 21. How effective was waste lime at controlling Aphanomyces?**

| Location | Respondents | Waste lime effectiveness | | | | | |
|---|---|---|---|---|---|---|---|
| | | Excellent | Good | Fair | Poor | Unsure | No Lime |
| | | -------------------------------% of respondents---------------------------- | | | | | |
| Fargo | 36 | 8 | 19 | - | - | 22 | 50 |
| Grafton | 49 | 6 | 10 | 8 | - | 6 | 69 |
| Wahpeton | 42 | 26 | 19 | 5 | - | 17 | 33 |
| Willmar | 100 | 3 | 24 | 5 | 3 | 16 | 49 |
| Total | 227 | 9 | 19 | 5 | 1 | 15 | 50 |

**INTEGRATED MANAGEMENT OF RHIZOCTONIA ON SUGARBEET WITH RESISTANT VARIETIES, AT-PLANTING TREATMENTS, AND POSTEMERGENCE FUNGICIDES**

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Rhizoctonia damping-off and crown and root rot (RCRR) caused by *Rhizoctonia solani* AG 2-2 have been the most common root diseases on sugarbeet in Minnesota and North Dakota for several years (1, 3-4,6). Disease can occur throughout the growing season and reduces plant stand, root yield, and quality. Warm and wet soil conditions favor infection. Disease management options include rotating with non-host crops (cereals), planting partially resistant varieties, planting early when soil temperatures are cool, improving soil drainage, and applying fungicides as seed treatments, in-furrow (IF), or postemergence. An integrated management strategy should take advantage of multiple control options to reduce Rhizoctonia crown and root rot.

**OBJECTIVES**

A field trial was established to evaluate an integrated management strategy consisting of a resistant (R) and a moderately susceptible (MS) variety with new available seed treatments alone and in combination with two postemergence azoxystrobin application timings for 1) control of early-season damping-off and RCRR and 2) effect on yield and quality of sugarbeet.

**MATERIALS AND METHODS**

The trial was established at three locations, one at the University of Minnesota, Northwest Research and Outreach Center, Crookston, one at Wahpeton (MDFC), ND and one at Renville (SMBSC), MN. All locations were fertilized for optimal yield and quality. At each location, a combination of a R and MS variety treated with penthiopyrad (Kabina ST), fluxapyroxad (Systiva), sedaxane (Vibrance), or untreated was planted in four replicate plots. Plots were set up in a split-split plot design at all 3 locations. Main plots were varieties, the first split was seed treatments, and the last split was postemergence azoxystrobin timings. Seed treatments and rates are summarized in Table 1 and were applied by Germains Seed Technology, Fargo, ND. Each variety by seed treatment combination was planted in triplicate, so that at the 4- or 8-leaf stage, one plot of each variety by seed treatment combination received a postemergence 7-inch band application of azoxystrobin (14.3 fl oz product $A^{-1}$) while one was left as a stand-alone treatment. Controls for each variety included no seed treatment at planting with each postemergence azoxystrobin timing and without postemergence azoxystrobin. Two-year average Rhizoctonia ratings in American Crystal Sugar Company tests for the R and MS varieties were 4.0 and 4.7, respectively (7).

**NWROC site.** Prior to planting, soil was infested with *R. solani* AG 2-2-infested whole barley broadcast at 35 kg $ha^{-1}$ and incorporated with a Rau seedbed finisher. The trial was sown in six-row plots (22-inch row spacing, 30-ft rows) on May 10 at 4.5-inch seed spacing. Counter 20G (8 lb $A^{-1}$) was applied at planting for control of sugarbeet root maggot. Glyphosate (4.5 lb product ae/gallon) was applied on May 15 (22 oz $A^{-1}$), June 1, 7, and 12 (28 oz $A^{-1}$), and July 5 (32 oz $A^{-1}$) for control of weeds. The June 1 application also included *S*-metolachlor (0.94 lb a.i. $A^{-1}$). Postemergence azoxystrobin timings were applied in a 7-inch band in 10 gallon/A using 4002 nozzles and 34 psi on June 12 (4-leaf stage, ~4.5 weeks after planting) or June 20 (8-leaf stage, 6 weeks after planting). Cercospora leaf spot was controlled by Supertin + Topsin M (6 + 10 oz product in 19 gallons of water $A^{-1}$) applied with 8002 flat fan nozzles at 100 psi on July 24 and Inspire (7 oz product in 19 gallons of water $A^{-1}$) on August 8.

**MDFC site.** Prior to planting, soil was infested with *R. solani* AG 2-2-infested whole barley (35 kg $ha^{-1}$). The trial was sown in six-row plots (22-inch row spacing, 30-ft rows) on May 26 at 4.5-inch seed spacing. Glyphosate (4.5 lb product ae/gallon) tank-mixed with N-tense (9.6 oz $A^{-1}$) was applied on May 31. This weed control application was repeated again on June 20 and July 03 (plus Outlook 12 oz $A^{-1}$). Postemergence azoxystrobin was applied in a 7-inch band on June 16 (4-leaf stage, 3 weeks after planting) or June 29 (8-leaf stage, 5 weeks after planting). Cercospora leafspot was controlled by separate applications of TPTH+Topsin (8 & 10 oz $A^{-1}$, respectively) on July 13, Inspire XT+Badge SC (7 & 32 oz $A^{-1}$, respectively) on July 25, TPTH + Manzate (8 & 38.4 oz $A^{-1}$, respectively) on August 04, Minerva Duo (16 oz $A^{-1}$) on Aug 15 and TPTH+ Badge SC (8 & 32 oz $A^{-1}$, respectively) as last application on Aug 29. All fungicides for CLS control were applied utilizing a 3pt-mounted sprayer dispersing the products in broadcast pattern at a water volume of 15 GPA with TeeJet 8002 flat fan nozzles at 80 psi.

**Table 1.** Application type, product names, active ingredients, and rates of fungicides used at planting in a field trial for control of *Rhizoctonia solani* AG 2-2 on sugarbeet. Each at-plant treatment was used in combination with a Rhizoctonia resistant (2-year average rating = 4.0) and moderately susceptible (2-year average rating = 4.8) variety, and all treatment combinations in triplicate, with one set receiving a postemergence 7-inch band application of azoxystrobin (14.3 fl oz $A^{-1}$) at 4- or 8-leaf stage. Standard rates of Apron + Thiram and 45 g/unit Tachigaren were on all seed.

| Application | Product | Active ingredient | Rate |
|---|---|---|---|
| None | - | - | - |
| Seed | Kabina ST | Penthiopyrad | 14 g a.i./unit seed |
| Seed | Systiva | Fluxapyroxad | 5 g a.i./unit seed |
| Seed | Vibrance | Sedaxane | 1.5 g a.i./unit seed |

**Table 2.** Monthly precipitation in inches at three sites during 2017 crop season based on weather stations.

| | Precipitation in inches | | |
|---|---|---|---|
| Month | NWROC | MDFC | SMBSC |
| May | 0.94 | 1.33 | 2.42 |
| June | 3.41 | 3.64 | 1.18 |
| July | 1.42 | 2.62 | 1.97 |
| August | 0.77 | 5.00 | 6.92 |
| September | 4.01 | 4.31 | 1.34 |
| **Total** | **10.55** | **16.91** | **13.83** |

**SMBSC site.** Prior to planting, soil was infested with *R. solani* AG 2-2-infested whole barley (35 kg $ha^{-1}$). The trial was sown in six-row plots (22-inch row spacing, 30-ft rows) on May 12 at 4.6-inch seed spacing. Weeds were controlled by application of Powermax (28 oz $A^{-1}$) + Dual magnum (16 oz $A^{-1}$) on June 5 and Powermax (22 oz $A^{-1}$) on July 06. Postemergence azoxystrobin timings were applied on June 09 (4-leaf, ~4 weeks after planting), or June 20 (8-leaf, ~5 weeks after planting) as 7 inch bands using 80002E nozzles at 40 psi. Fungicides were applied for controlling Cercospora leaf spot on July 10 (TPTH + Topsin, 8 & 20 oz $A^{-1}$, respectively), July 21 (Inspire XT + Badge SC, 7 & 32 oz $A^{-1}$, respectively), July 31 (TPTH + Dithane F-45, 8 & 51.2 oz $A^{-1}$, respectively), Aug 12 (Minerva + Dithane F-45, 13 & 51.2 oz $A^{-1}$, respectively), Aug 23 (TPTH + Badge SC, 8 & 32 oz $A^{-1}$, respectively) and Sept 06 (Proline + Dithane F-45, 5.7 & 51.2 oz $A^{-1}$, respectively). All fungicides for CLS control were applied in a water volume of 19.3 GPA with 11002 nozzles at 70 psi.

At NWROC stand counts were done beginning 2 weeks after planting through 8 weeks after planting. At MDFC stand counts were done 2 through 6 weeks after planting. At SMBSC stand counts were done 3, 5, and 8 weeks after planting. The trial was harvested on September 20 at the NWROC, Sept 19 at Renville and October 09 at Wahpeton. Data were collected for number of harvested roots (NWROC only), yield, and quality. Twenty roots per plot also were arbitrarily selected and rated for severity of RCRR using a 0 to 7 scale (0 = healthy root, 7 = root completely rotted and foliage dead). Disease incidence was reported as the percent of rated roots with a root rot rating of > 2.

Data were subjected to analysis of variance using SAS Proc GLM (SAS Institute, Cary, NC) for main effects of variety, at-plant treatment, postemergence azoxystrobin application, and all possible interactions. Means were separated by Fisher's Protected Least Significant Difference ($P = 0.05$).

**RESULTS AND DISCUSSION**

**NWROC site:** 2017 growing season was drier and cooler at the NWROC during the period of May - August. Rainfall at the NWROC was just 0.94 inch during the month of May compared to a 30-year average of 3.04 inches for May.

Average four-inch bare soil temperatures at the NWROC were 52.4 °F and 61.9 °F for the months of May and June, respectively. Average four-inch soil temperature did not cross 65 °F until July 04. There were no significant ($P > 0.05$) two way or three way interactions for stand data. For harvest data there was a significant seed treatment x postemergence application interaction ($P < 0.05$) for root rot rating and incidence (Tab. 3). Resistant and moderately susceptible variety had similar stands from 2 to 8 weeks after planting (WAP). At-planting (seed) treatments and untreated control had similar stands at 2 WAP and by 3 WAP all the seed treatments had higher stands compared to untreated control. At 5 WAP, Vibrance had highest stands, Kabina and Systiva had intermediate, and untreated control had lowest stands (Fig. 1). Total rainfall for the months of May - August was 6.54 inches in 2017 compared to a 30-year average of 12.88 for the same time period. Soil moisture remained low throughout the growing season, resulting in low Rhizoctonia disease pressure in this trial. As a result, there were no significant differences among treatments for Rhizoctonia root rot or yield and quality parameters between varieties and also untreated control and seed treatments. There were no significant differences between two varieties for harvest data (Tab. 3). Yield, percent sucrose, recoverable sucrose $A^{-1}$ (RSA), percent sucrose and recoverable sucrose $T^{-1}$ (RST) were not significantly different for the seed treatments and untreated control (Tab. 3). Yield, percent sucrose, RSA and RST were not significantly different between Quadris (4- or 8-leaf) and no Quadris application. Some rainfall in September created slight disease pressure in the plots leading to minor differences in disease severity between no Quadris and 4-8 leaf Quadris applications. Root rot severity and percent incidence (percent of roots with a disease rating of > 2.0) was slightly higher in the no Quadris treatments for control and all seed treatments, intermediate in 4-leaf Quadris treatments for control and all seed treatments, and lowest in 8-leaf Quadris for control, Kabina, and Vibrance treatments (Figs. 2A and 2B ). Similar benefit from postemergence Quadris application was also evident in 2016 (5).

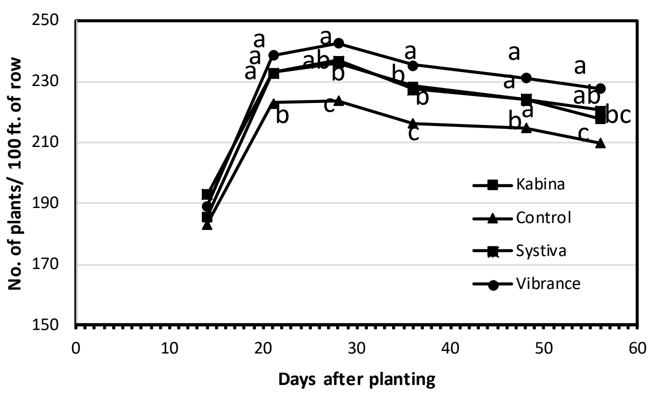


**Fig. 1.** NWROC site: Emergence and stand establishment for fungicide treatments on seed or untreated control. For each stand count date, values sharing the same letter are not significantly different ($P = 0.05$); NS = not significantly different. Data shown represents mean of 24 plots averaged across varieties and postemergence treatments.

**Table 3. NWROC site:** Main effects of variety, at-planting (seed), and postemergence fungicide treatments on Rhizoctonia crown and root rot and sugarbeet yield and quality in a field trial sown May 10, 2017.

| Main effect (Apron + Maxim on all seed) | No. harv. roots/100 ft$^{T}$ | RCRR (0-7)$^{TU}$ | RCRR % incidence$^{TV}$ | Yield ton $A^{-1T}$ | Sucrose$^{T}$ % | lb $ton^{-1}$ | lb $A^{-1}$ |
|---|---|---|---|---|---|---|---|
| Variety$^{W}$ | | | | | | | |
| Resistant | 184 | 0.6 | 4.6 | 19.3 | 18.3 | 345 | 6630 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Moderately Susceptible | 196 | 0.7 | 11.4 | 20.8 | 17.8 | 333 | 6890 |
| | | | | | | | |
| ANOVA p-value | 0.1026 | 0.5862 | 0.3881 | 0.4668 | 0.2156 | 0.1528 | 0.642 |
| LSD (*P* = 0.05) | NS | NS | NS | NS | NS | NS | NS |
| | | | | | | | |
| At-planting treatments[X] | | | | | | | |
| Untreated control | 185 | 0.8 | 9 | 20.6 | 18.0 | 339 | 6969 |
| Kabina ST @14 g a.i./unit | 189 | 0.7 | 10 | 20.0 | 18.0 | 338 | 6724 |
| Systiva @ 5 g a.i /unit | 190 | 0.7 | 9 | 19.7 | 18.0 | 338 | 6665 |
| Vibrance @ 1.5 g a.i./unit | 196 | 0.4 | 4 | 19.7 | 18.1 | 340 | 6681 |
| | | | | | | | |
| ANOVA p-value | 0.3296 | 0.2454 | 0.2666 | 0.5700 | 0.8385 | 0.9038 | 0.4313 |
| LSD (*P* = 0.05) | NS | NS | NS | NS | NS | NS | NS |
| | | | | | | | |
| Postemergence fungicide[Y] | | | | | | | |
| None | 185 | 1.0 a | 14 a | 19.5 | 18.0 | 338 | 6581 |
| 4-leaf Quadris @ 14.3 fl. oz./A | 192 | 0.5 b | 7 b | 20.2 | 18.2 | 341 | 6874 |
| 8-leaf Quadris @ 14.3 fl. oz./A | 192 | 0.4 b | 4 b | 20.3 | 18.0 | 338 | 6825 |
| | | | | | | | |
| ANOVA p-value | 0.0539 | <0.0001 | <0.0001 | 0.2045 | 0.2846 | 0.3927 | 0.1113 |
| LSD (*P* = 0.05) | NS | 0.19 | 3.2 | NS | NS | NS | NS |
| | | | | | | | |
| Vty x Seed | NS | NS | NS | NS | NS | NS | NS |
| Vty x Post | NS | NS | NS | NS | NS | NS | NS |
| Seed x Post | NS | **0.0206** | **0.0086** | NS | NS | NS | NS |
| Vty x Seed x Post | NS | NS | NS | NS | NS | NS | NS |

[T] Numbers followed by the same letter are not significantly different; LSD = Least Significant Difference, *P* = 0.05; NS = not significantly different

[U] RCRR = Rhizoctonia crown and root rot; 0-7 scale (adjusted rating), 0 = root clean, no disease, 7 = root completely rotted and plant dead

[V] RCRR = Rhizoctonia crown and root rot; percent of roots with rating greater than two

[W] Values represent mean of 48 plots (4 replicate plots across 4 at-planting treatments and 3 postemergence treatments)

[X] Values represent mean of 24 plots (4 replicate plots across 2 varieties and 3 postemergence treatments)

[Y] Values represent mean of 32 plots (4 replicate plots across 2 varieties and 4 at-planting treatments)

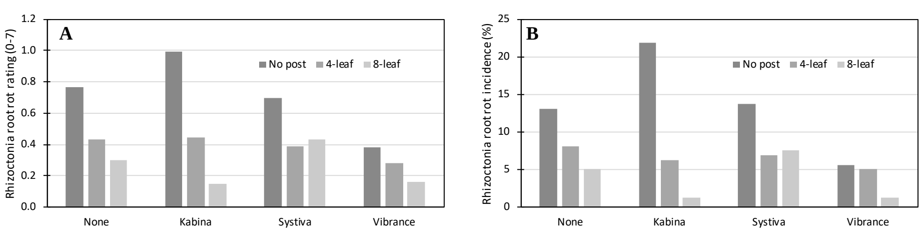


**Fig. 2.** NWROC site: Effect of seed and postemergence treatments on **A)** Rhizoctonia root rot severity (0-7 scale (adjusted rating), 0 = root clean, no disease, 7 = root completely rotted and plant dead) and **B)** Rhizoctonia root rot incidence (percent of roots with rating greater than two).

**MDFC site:** This site received below normal rainfall during May – July and above normal rainfall during August-September. Average 4-inch bare soil temperatures for May (59 °F) and June (68 °F) were lower compared to 2016 (64 °F and 74 °F for May and June, respectively). Average four-inch soil temperature was over 65 °F on June 02, reached ~ 70 °F for a week followed by a ~65 °F from June 17 until July 03. Low early season soil moisture coupled with lower soil temperatures did not create heavy disease pressure at this site. There were significant ($P < 0.05$) variety x seed treatment interactions and variety x seed treatment x postemergence three way interactions interactions for percent sugar, purity, and RST; variety x postemergence interactions for root rot rating (Tab. 4). Both varieties had similar stands until 6 WAP and had similar yield, percent sucrose, RST, and RSA (Tab. 4). There were no significant differences for stands between seed treatments and untreated control until 6 WAP. Yield was not significantly different between untreated control and seed treatments. Some rainfall in August and September created slight disease pressure in the plots leading to minor differences in disease severity and some harvest parameters between no Quadris and 4-8 leaf Quadris applications. Yield was not significantly different between no Quadris and 4- or 8-leaf application. RSA was higher in 8-leaf Quadris application compared to 4-leaf or no Quadris application. Root rot incidence was lower in 4- or 8-leaf application compared to no Quadris. For resistant variety, percent sucrose and RST were highest for untreated control and lowest for Systiva, whereas for moderately susceptible variety Systiva had highest percent sucrose and RST with lowest for Kabina (Figs. 3A and 3B). For resistant variety root rot severity was lowest for 4-leaf Quadris application, intermediate for 8-leaf and highest for no Quadris application (Fig. 3C). For moderately susceptible variety root rot severity was lower for 4- or 8-leaf Quadris application compared to no Quadris application (Fig. 3C). Similar benefit from postemergence Quadris application was also evident in 2016 (5).

**Table 4. MDFC site:** Main effects of variety, at-planting (seed), and postemergence fungicide treatments on Rhizoctonia crown and root rot and sugarbeet yield and quality in a field trial sown May 26, 2017.

| Main effect (Apron + Maxim on all seed) | RCRR (0-7)[TU] | RCRR % incidence[TV] | Yield ton A$^{-1}$[T] | Sucrose[T] % | Sucrose[T] lb ton$^{-1}$ | Sucrose[T] lb A$^{-1}$ |
|---|---|---|---|---|---|---|
| Variety[W] | | | | | | |
| Resistant | 0.3 | 6.1 | 27.0 | 16.2 | 266 | 7195 |
| Moderately Susceptible | 0.6 | 11.3 | 27.0 | 15.3 | 248 | 6698 |
| ANOVA p-value | 0.1203 | 0.1754 | 0.9775 | 0.0587 | 0.0756 | 0.2039 |
| LSD (*P* = 0.05) | NS | NS | NS | NS | NS | NS |
| At-planting treatments[X] | | | | | | |
| Untreated control | 0.5 | 10.8 | 27.2 | 15.9 | 262 | 7116 |
| Kabina ST @14 g a.i./unit | 0.4 | 7.9 | 26.5 | 15.5 | 252 | 6690 |
| Systiva @ 5 g a.i /unit | 0.4 | 7.9 | 27.3 | 15.8 | 257 | 7016 |
| Vibrance @ 1.5 g a.i./unit | 0.4 | 8.1 | 26.9 | 15.9 | 259 | 6963 |
| ANOVA p-value | 0.6365 | 0.5959 | 0.6152 | 0.4018 | 0.3529 | 0.2540 |
| LSD (*P* = 0.05) | NS | NS | NS | NS | NS | NS |
| Postemergence fungicide[Y] | | | | | | |
| None | 0.8 a | 15.2 a | 26.4 | 15.6 b | 254 b | 6720 b |
| 4-leaf Quadris @ 14.3 fl. oz./A | 0.3 b | 5.0 b | 27.1 | 15.7 b | 255 b | 6916 b |
| 8-leaf Quadris @ 14.3 fl. oz./A | 0.3 b | 5.9 b | 27.4 | 16.0 a | 263 a | 7203 a |
| ANOVA p-value | <0.0001 | <0.0001 | 0.0612 | 0.0008 | 0.0002 | 0.0008 |
| LSD (*P* = 0.05) | 0.18 | 4.0 | NS | 0.18 | 4.28 | 240 |
| Vty x Seed | NS | NS | NS | **0.0491** | **0.0485** | NS |
| Vty x Post | **0.0454** | NS | NS | NS | NS | NS |
| Seed x Post | NS | NS | NS | NS | NS | NS |
| Vty x Seed x Post | NS | NS | NS | **0.0209** | **0.0067** | NS |

[T] Numbers followed by the same letter are not significantly different; LSD = Least Significant Difference, *P* = 0.05; NS = not significantly different

[U] RCRR = Rhizoctonia crown and root rot; 0-7 scale (adjusted rating), 0 = root clean, no disease, 7 = root completely rotted and plant dead

[V] RCRR = Rhizoctonia crown and root rot; percent of roots with rating greater than two

[W] Values represent mean of 48 plots (4 replicate plots across 4 at-planting treatments and 3 postemergence treatments)

[X] Values represent mean of 24 plots (4 replicate plots across 2 varieties and 3 postemergence treatments)

[Y] Values represent mean of 32 plots (4 replicate plots across 2 varieties and 4 at-planting treatments)

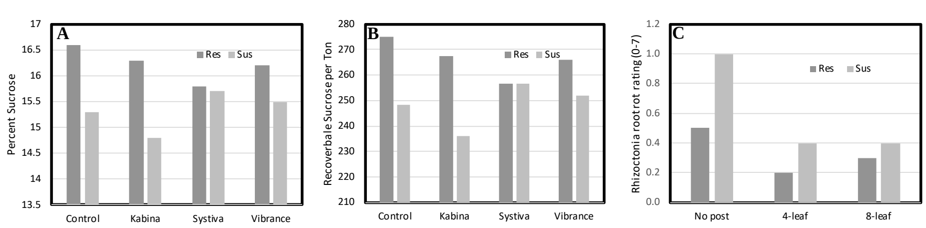

**Fig. 3.** MDFC site: Effect of variety and seed treatments on **A)** percent sucrose and **B)** recoverable sucrose per ton. Effect of variety and postemergence treatments on **C)** Rhizoctonia root rot severity (0-7 scale (adjusted rating), 0 = root clean, no disease, 7 = root completely rotted and plant dead).

**Table 5. SMBSC site:** Main effects of variety, at-planting (seed), and postemergence fungicide treatments on Rhizoctonia crown and root rot and sugarbeet yield and quality in a field trial sown May 12, 2017.

| Main effect (Apron + Maxim on all seed) | RCRR (0-7)[TU] | RCRR % incidence[TV] | Yield ton $A^{-1T}$ | Sucrose[T] % | Sucrose[T] lb $ton^{-1}$ | Sucrose[T] lb $A^{-1}$ |
|---|---|---|---|---|---|---|
| Variety[W] | | | | | | |
| Resistant | 0.2 | 4 | 27.9 | 15.4 | 255 | 7117 |
| Moderately Susceptible | 0.7 | 14 | 29.8 | 14.4 | 232 | 6875 |
| | | | | | | |
| ANOVA p-value | 0.5720 | 0.5290 | 0.0167 | 0.0256 | 0.0301 | 0.2042 |
| LSD (*P* = 0.05) | NS | NS | 1.2 | 0.78 | 19 | NS |
| | | | | | | |
| At-planting treatments[X] | | | | | | |
| Untreated control | 0.4 | 9 | 29.2 | 15.1 | 248 | 7211 |
| Kabina ST @14 g a.i./unit | 0.5 | 9 | 29.5 | 14.8 | 239 | 7014 |
| Systiva @ 5 g a.i /unit | 0.4 | 8 | 28.3 | 15.1 | 246 | 6974 |
| Vibrance @ 1.5 g a.i./unit | 0.5 | 9 | 28.3 | 14.8 | 241 | 6785 |
| | | | | | | |
| ANOVA p-value | 0.7040 | 0.9277 | 0.8082 | 0.2471 | 0.2165 | 0.7068 |
| LSD (*P* = 0.05) | NS | NS | NS | NS | NS | NS |
| | | | | | | |
| Postemergence fungicide[Y] | | | | | | |
| None | 0.6 a | 11 a | 29.1 | 14.9 | 242 | 7024 |
| 4-leaf Quadris @ 14.3 fl. oz./A | 0.5 a | 10 a | 28.5 | 15.0 | 245 | 6950 |
| 8-leaf Quadris @ 14.3 fl. oz./A | 0.3 b | 5 b | 29.0 | 14.9 | 244 | 7014 |
| | | | | | | |
| ANOVA p-value | 0.0086 | 0.0043 | 0.4935 | 0.7539 | 0.6955 | 0.8390 |
| LSD (*P* = 0.05) | 0.19 | 3.7 | NS | NS | NS | NS |
| | | | | | | |
| Vty x Seed | NS | NS | NS | NS | NS | NS |
| Vty x Post | NS | NS | NS | NS | NS | NS |
| Seed x Post | **0.0138** | **0.0222** | NS | NS | NS | NS |
| Vty x Seed x Post | NS | NS | NS | NS | NS | NS |

[T] Numbers followed by the same letter are not significantly different; LSD = Least Significant Difference, *P* = 0.05; NS = not significantly different

[U] RCRR = Rhizoctonia crown and root rot; 0-7 scale (adjusted rating), 0 = root clean, no disease, 7 = root completely rotted and plant dead

[V] RCRR = Rhizoctonia crown and root rot; percent of roots with rating greater than two

[W] Values represent mean of 48 plots (4 replicate plots across 4 at-planting treatments and 3 postemergence treatments)

[X] Values represent mean of 24 plots (4 replicate plots across 2 varieties and 3 postemergence treatments)

[Y] Values represent mean of 32 plots (4 replicate plots across 2 varieties and 4 at-planting treatments)

**SMBSC site:** This site received only 5.52 inches rainfall May-July in 2017 compared to 13.63 inches in 2016 making the early part of growing season on the drier side. The month of August received 6.92 inches rainfall followed by very dry September (1.34 inches and 4.84 inches in 2017 and 2016, respectively). Average four-inch bare soil temperatures at SMBSC were 57.7 °F and 70.2 °F for the months of May and June, respectively. Average four-inch bare soil temperature crossed 65 °F on June 01 which is typical for southern Minnesota. Low soil moisture during the growing season resulted in very low disease pressure at this site. There were significant ($P < 0.05$) seed treatment x postemergence application interactions for root rot rating and incidence and no three way interactions (Tab. 5). From 2 to 9 WAP there were no differences in stand between two varieties. However, by harvest, moderately susceptible variety had higher yield. Resistant variety had higher percent sugar and RST compared to moderately susceptible variety (Tab. 5). Stand data and harvest data were not different between seed treatments and untreated control (Tab.

5). Heavy rainfall in August created slight disease pressure in the plots leading to minor differences in disease severity and incidence between no Quadris and 4-8 leaf Quadris applications. Yield, percent sugar, RSA and RST were not significantly different between Quadris (4- or 8-leaf) and no Quadris application. Root rot severity and percent incidence (percent of roots with a disease rating of > 2.0) was higher for no Quadris and 4-leaf Quadris compared to 8-leaf Quadris for untreated control; highest for no Quadris, intermediate for 8-leaf and lowest for 4-leaf Quadris application for Kabina; higher for 4-leaf Quadris application compared to no or 8-leaf Quadris for Systiva; highest for no Quadris, intermediate for 4-leaf and lowest for 8-leaf Quadris application for Vibrance seed treatment (Figs. 4A and 4B).

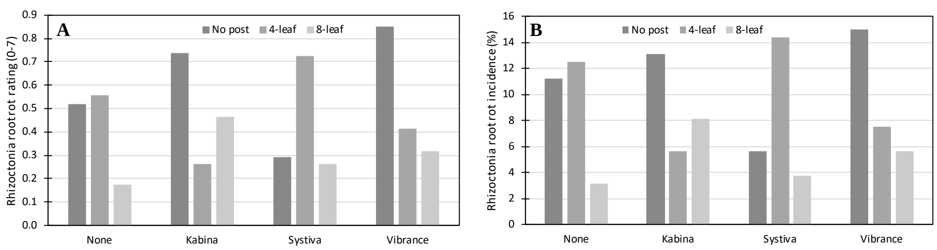


**Fig. 4.** SMBSC site: Effect of seed and postemergence treatments on **A)** Rhizoctonia root rot severity (0-7 scale (adjusted rating), 0 = root clean, no disease, 7 = root completely rotted and plant dead) and **B)** Rhizoctonia root rot incidence (percent of roots with rating greater than two).

## ACKNOWLEDGEMENTS

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## REAL-TIME PCR-BASED DETECTION OF *RHIZOCTONIA* LEVELS IN SOIL

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Rhizoctonia damping-off and crown and root rot (RCRR) caused by *Rhizoctonia solani* AG 2-2 have been the most common root diseases on sugarbeet in Minnesota and North Dakota for several years (1-3,6). Disease can occur throughout the growing season and reduces plant stand, root yield, and quality. Warm and wet soil conditions favor infection. Control options include rotating with non-host crops (cereals), planting partially resistant varieties, planting early when soil temperatures are cool, improving soil drainage, and applying fungicides as seed treatments, in-furrow (IF), or postemergence. An integrated management strategy should take advantage of multiple control options to reduce Rhizoctonia crown and root rot (5).

### OBJECTIVE

To develop a real-time PCR assay for detection and quantification of DNA of *R. solani* AG 2-2 directly from soil samples for use in predicting inoculum potential.

### MATERIALS AND METHODS

**Soil sample collection.** In 2016 we located 16 fields with a history of Rhizoctonia root rot based on the best knowledge of the agriculturists from ACSC (8 fields), MDFC (4 fields), and SMBSC (4 fields). From each field, 5 soil cores were taken at a depth of 6 inches representing approximately 1 acre area. Each soil core was divided in to 0-2 inch, 2-4 inch and 4-6 inch sub-samples. In total, we collected 240 soil samples from all 16 fields (16 x 15). Total soil DNA was isolated from all 240 samples. At each sampling point (16 fields x 5 sites per field = 80 samples) where we collected soil cores, we also collected approximately 1 gallon of soil to determine Rhizoctonia root rot index (RRI) values using a growth chamber assay.

**Growth chamber assay.** For each of the 80 samples, soil was added to four 10 x 10 x 10 cm pots (~350 cc soil/pot). Seed was sown (25 seed/pot, 4 replicate pots/infested soil treatment) and then another 250 cc of soil was added over the seed to each pot. Pots were arranged in a randomized block design and incubated in a growth chamber at 77°F with a 14-hour photoperiod for 4 weeks. Pots were watered once or twice daily to keep soil moisture high to favor infection by *R. solani*. Seedlings were counted three times per week. Dying seedlings were removed and assayed in the laboratory to verify presence of *R. solani*. Four weeks after planting, remaining seedlings were removed from soil, washed, and rated on a 0-3 scale (0 = no disease, 3 = hypocotyl completely necrotic/plant dead). The number of seedlings that died during the 4-week assay along with the ratings after 4 weeks were used to calculate a root rot index (RRI, 0 = no disease, 100 = all plants died during the 4-week assay).

**Root rot rating.** In each of the 16 fields, 10 sugarbeet roots adjacent to the soil sampling site were rated for root rot severity using a 0-7 scale (10 roots x 5 spots = 50 roots per field).

**Soil DNA isolation.** PowerMax® soil DNA isolation kits from MO BIO Laboratories Inc. (Carlsbad, CA) were used for DNA isolation. Manufacturer's protocols were followed, using 5 g (dry wt.) of soil as starting material. Final DNA was eluted in 5 mL of Solution C6, concentrated and stored at -20 °C until downstream PCR application.

**Real-time PCR.** Primers and probe specific for internal transcribed spacer (ITS) region of *R. solani* anastomosis group (AG) 2-2 used in this study were developed by Budge et al. (4). All real-time PCR assays were set up as duplicate 20 µL reactions using LightCycler® 480 Probes Master (Roche Life Science) following manufacturer's protocols. 20x Custom TaqMan® Gene Expression Assay (contains 18 µM each primer and 5 µM 6-FAM™ dye-labeled TaqMan® MGB probe) was obtained from Life Technologies (Carlsbad, CA) and 1 µL of DNA template was used in the assay. Thermal cycling parameters were 50 °C for 2 min, 95 °C for 10 min, followed by 40 cycles of 95

°C for 15 sec and 60 °C for 1 min. *R. solani* AG 2-2 IIIB and IV DNA (10ng/ µL) as positive control and no template control was included in each run. Real-time PCR assays were performed using Roche LightCycler® 480 System.

**RESULTS AND DISCUSSION**

The mean root rot ratings ranged from 1.12 to 3.72 and root rot incidence values ranged from 18 to 68 % for 16 fields. The mean root rot index (RRI) ranged from 0 to 100% for 16 fields. The lowest Ct value of 27.02 (highest Rhizoctonia DNA) was found in one field in MDFC area (MDFC4). There was a significant correlation at the field level between RRI and root rot ratings (r = 0.59 and $r^2 = 0.34$), and RRI and root rot incidence values (r = 0.56 and $r^2 = 0.32$). There was a significant correlation between RRI and DNA of *R. solani* (r= 0.24; $r^2$= 0.06) (Fig. 1). However, some soil samples with higher RRI had lower DNA of *R. solani* Ag 2-2. This could be explained by the presence of other AG groups such as AG 4 in soil which can cause seedling damping off.

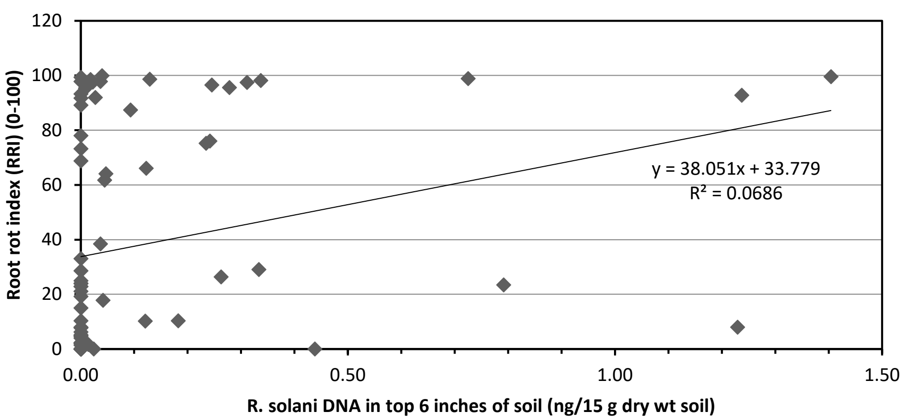


Figure 1. Relationship between Rhizoctonia root rot index and amount of DNA of *Rhizoctonia solani* AG 2-2 in soil

There was also a significant correlation between root rot rating and DNA of *R. solani* (r = 0.31; $r^2$= 0.11) (Fig. 2). However, soil samples from some fields with higher root rot ratings had lower amounts of DNA of AG 2-2. This could be explained by the non-uniform distribution of Rhizoctonia inoculum in the soil. We also observed Aphanomyces in some of the soil samples corroborating the evidence that mixed infestation of soil with Rhizoctonia and Aphanomyces is gradually increasing in our growing region. Out of 80 samples, DNA of Rhizoctonia was detected in twenty nine 0-2 inch samples, fifteen 2-4 inch samples, and eleven 4-6 inch samples. In only 6 out of 80 samples, DNA of Rhizoctonia was detected in all 0-2, 2-4 and 4-6 inches depths.

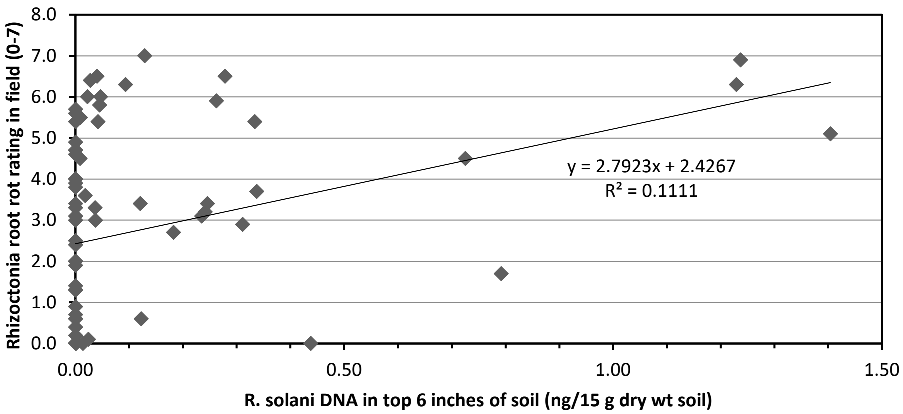


Figure 2. Relationship between Rhizoctonia root rot rating and amount of DNA of *Rhizoctonia solani* AG 2-2 in soil.


**ACKNOWLEDGEMENTS**

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# REMOTE SENSING FOR DETECTION OF RHIZOCTONIA CROWN AND ROOT ROT OF SUGARBEET

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Rhizoctonia crown and root rot (RCRR), caused by *Rhizoctonia solani* AG 2-2, is becoming more frequent and widespread in the sugarbeet-growing regions of Minnesota and North Dakota. In this region, symptoms of RCRR typically begin at about 8 weeks after planting and continue to develop until harvest. Infected plants occur sporadically or in large portions of the field. Advances in remote sensors and vehicle platforms have regenerated interest in within-season aerial mapping/detection of RCRR.

Remotely assessing plant health by measuring the reflectance of incident electromagnetic radiation is well established (Nilsson, 1995). Evaluating the relative canopy reflectance of specific wavelengths can provide insight into the impacts of insects (e.g. Alves et al. 2015), nutrient state (e.g. Felderhof & Gillieson 2012) and disease (well-reviewed in Oerke et al. 2014). Specifically, spectral reflectance has been demonstrated to show the presence of *Rhizoctonia solani* AG 2-2 prior to the development of visible symptoms (Reynolds et al. 2009 and 2012).

Detection of plant diseases is based on pathogen-induced degradation of chlorophyll and subsequent deterioration of palisade parenchyma cells in the leaf (Inoue, 2003). Chlorophyll absorbs red wavelengths of energy, so its degradation results in increased reflectance in the Red wavelengths (~620nm-680nm). Parenchyma cells reflect Near-Infrared (NIR) energy (~700nm-1100nm) and their deterioration results in lowered reflectance of NIR. The comparative ratio of these wavelengths can, therefore, provide insight into the level of stress being endured by a plant. Remotely sensed plant reflectance has been used for detecting sugarbeet diseases including Rhizomania (Steddom et al., 2005), Cercospora leaf spot (Steddom et al., 2005), sugarbeet cyst nematode (Schmitz et al., 2003), and RCRR (Laudien et al., 2003, 2004, 2006, Reynolds et al. 2009 and 2012). Most early research detected RCRR at the end of the growing season but did not address earlier-season detection of the disease or the relationship of reflectance to severity of root rot symptoms. There have been indications, however, that earlier identification of infection may be possible. Reynolds et al. (2009 and 2012) found that specific wavelengths and vegetative indices were more closely associated with plants showing lower root ratings of the disease. While several indices were correlated with disease severity, the narrowband *modified Spectral Ratio* (mSR) index, calculated as [($R$750-$R$445)/($R$705-$R$445) where $R$ is the measure of reflection in that wavelength], appeared to allow for earlier detection of RCRR than did wideband indices such as *Normalized Difference Vegetative Index* (NDVI) or *Optimized Soil Adjusted Vegetative Index* (OSAVI) that were correlated with RCRR infection severity (Reynolds 2010). Unfortunately, this research effort was not able to further pursue and refine the further diagnostic capabilities of reflectance measurements.

The objectives of this study were 1) to establish baseline hyperspectral reflectance data associated with disease severity for RCRR of partially resistant and susceptible sugarbeet varieties 2) to identify the most sensitive and strongest diagnostic reflectance data (wavelengths) for detection of disease.

**<u>Materials and Methods:</u>**

*Field experiments and design* - In 2016/ and 2017 sugarbeet varieties partially resistant (4.0 rating) and susceptible (4.7 rating) to RRCR were planted in field plots (4 replications) at the University of Minnesota, NWROC. Plots were 35 ft long by 4 rows wide. In inoculated plots, *Rhizoctonia solani* AG 2-2 IIIB infested barley grain (at three different rates; 20 kg/ha, 40 kg/ha, and 60 kg/ha) was broadcast at planting to mimic naturally infested Rhizoctonia fields with low, medium, and high levels. For one treatment, near canopy closure, plants were inoculated (four center rows of six-row plots) with *R. solani* AG 2-2 IIIB infested barley grains by placing two whole kernels about 1-inch below the soil surface and adjacent to the root. One treatment included non-inoculated control. Plots were split into a 22-ft section (4-rows wide) for visual assessment of disease (0-7 scale, 0 = root clean, 7 = root completely rotted), with the remaining 13-ft length (4-rows wide) left for reflectance imagery. At each sample date, twelve plants were randomly selected and pulled from one end from the 22' section of each plot and their roots visually assessed for disease symptoms. Simultaneously, one of the oldest leaves from that plant was assessed for reflectance using the specroradiometer.

*Reflectance data* - Hyperspectral reflectance of individual leaves on plants was obtained using an Ocean Optics Flame hyperspectral radiometer. The Ocean Optics Flame is sensitive to the visual and near-infrared wavelengths (VIS/NIR) typically raning from ~350nm to ~1100nm, however due to signal loss at the extreme edges of the sensor, only wavelength responses between 400nm – 950nm were used in data analyses. A self-illuminated, leaf-clip sensor was used with the Ocean Optics radiometer, the illuminator of which provided light over all wavelengths that the senor can read (350nm-1100nm). Consequently, the absolute reflectance, within sensitivity limits, of the plant's leaf surface could be assessed as the percent of light energy being reflected (reflectance). Multispectral imagery was also obtained using multi-sensor arrays which included a standard visual RGB camera and 3 cameras sensitive to specified wavelengths in the Near-InfraRed (NIR) (Sentera, Minneapolis MN). These sensors were mounted on small Unmanned Aerial Systems (i.e. drones). Measurements were obtained weekly starting at 8 weeks after planting and 2 weeks after whole barley inoculation (~11 am to 2 pm).

*Disease data* - Disease ratings were taken from sampled plants at the same time as reflectance data was measured. Tap roots were visually assessed for RCRR using a 0-to-7 scale (Ruppel et al. 1979), where 0 = no visible lesions; 1 = superficial, scattered inactive lesions; 2 = shallow, dry rot cankers or active lesions on ≤5% of root surface; 3 = deep dry-rot cankers at crown or extensive lateral lesions affecting 6 to 25% of the root; 4 = rot affecting 26 to 50% of tap root, with cracks and cankers up to 5 mm deep; 5 = 51 to 75% of tap root blackened, with rot extending into interior and roots usually misshapen with cracks and rifts; 6 = entire root blackened except extreme tip; and 7 = root 100% rotted and foliage dead.

Data analyses – Disease ratings were assigned the percentage of root covered with necrosis associated with that rating (i.e. rating of: 0=0%, 1=2.5%, 2=5%, 3=25%, 4= 50%, 5=75%, 6=95%, 7=100% root covered). The percent of root covered by necrosis values (% necrosis) were then transformed using ArcSine of the square root to normalize the data. To assess the wavelengths of reflected light most influenced by RCRR infection, individual wavelengths (from 400nm to 950nm) were correlated with %necrosis for all individual plants at all dates. The respective correlation coefficients from wavelengths and disease rating were used to calculate the Akaike Information Criteria (AIC) values which were used to rank each wavelength for its ability to predict RCRR disease rating (Akaike 1974). The AIC is a metric used to evaluate best fit, in this case, which wavelengths are most closely associated with RCRR disease rating. Lower AIC ratings indicate better fit (Burnham and Anderson, 2003). The AIC values were then compared using a Relative Likelyhood calculation ($RL_i$ = exp((lowest AIC - $AIC_i$)/2), where $RL_i$ is the Relative Likelyhood at a specific wavelength (i) of it being best fit of all AICs (i.e. most closely associated with RCRR infection).

**Results and Discussion:**

Plots were sampled 7/10, 7/13, 7/14, 7/18, 7/20, 7/26, 8/02, 8/08, and 8/15. Unfortunately, due to equipment failure, data from 7/26 had to be discarded from the analyses. All other dates had expressed symptoms in inoculated plots (for both resistant and susceptible varieties), resulting a gradient of infection throughout the season.

The leaf clip readings from the Ocean Optics Flame Spectroradiometer returned the percent reflectance of light in wavelengths from 350nm to 1100nm (fig 1). Unfortunately, the design of CCD-based sensors, such as those used in most VIS/NIR spectroradiometers, results limitations at the extreme edges of the sensor's range, resulting in increased 'noise' and loss of signal integrity. As can be seen in Fig 1, the signal to noise ratio of data below 450nm and above 950 nm deteriorates rapidly. Consequently, we decided to use reflection responses at wavelengths from 450nm-950nm only for analyses (fig 2).

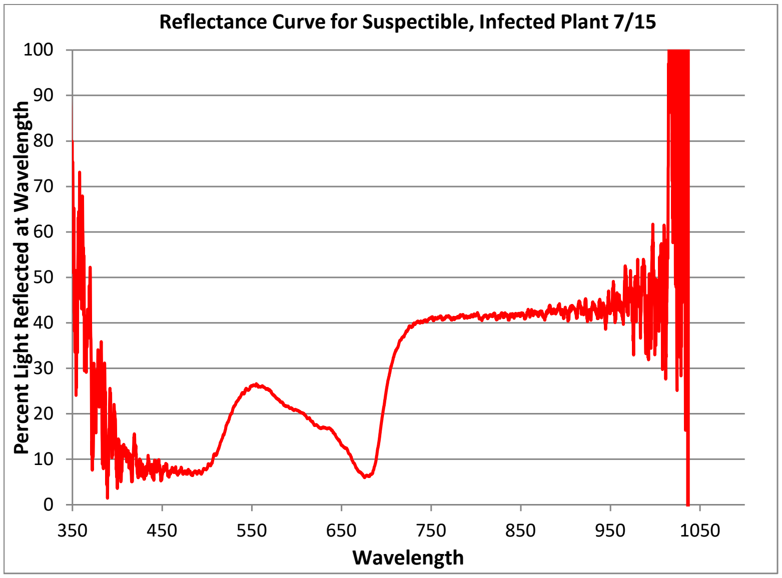


Figure 1. Typical complete reflectance curve as measured by leaf clip sensor attached to Ocean Optics spectroradiometer. Note decreasing signal to noise at extreme edges of sensor's range of sensitivity.

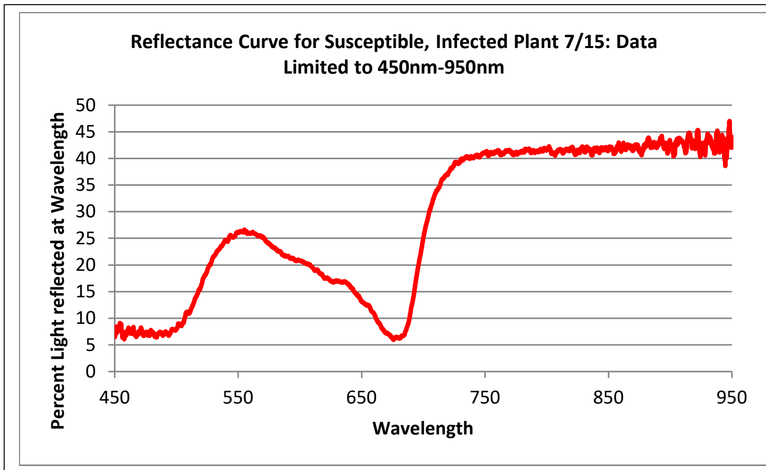


Figure 2. Typical spectral reflectance curve as measured by leaf clip sensor attached to Ocean Optics spectroradiometer, data has been limited to wavelengths between 450nm=-950nm.

A multiple correlation incorporating date and variety was used to assess the disease ratings of 12 plants per plot at each date (40 plots X 12 plants = 480 plants per sample date) with all 500 analyzed wavelengths (450nm-950nm) (a total of 240,000 wavelengths associated with disease ratings were assessed at each sample date). The resulting correlations were assessed for association to RCRR disease rating using AIC, AIC's were plotted against assessed wavelength for all dates (fig 3) (resulting in a total of 1,680,000 wavelengths associated with disease ratings – this multiple regression will stress computing limits!). The lowest AIC value on the AIC vs Wavelengths graph is considered to be the most important (i.e. in our case, the wavelengths most closely associated with RCRR infection).

It is important to note that the AIC is not a statistic and therefore cannot be directly compared, its units depend on the value of the coefficients in the association analysis and on the number of parameters in the model being assessed. To compare AIC values of wavelengths to assess which wavelengths was most closely associated with RCRR infection, a Relative Likelihood analysis was conducted (fig 4).

There is increasing variation in AIC values above 750 nm, this reflects the variation in reflectance values found in that range; there was no clear association of reflection of NIR above 750 and RCRR infection. The lowest AIC values appear just below 700nm (the range between red and NIR wavelengths). The relative Likelihood analysis indicates that, in our data, the wavelengths most closely associated with RCRR infection occur in a narrow band of approximately 20nm, centered around 689nm. The next highest peak occurred at 698 nm (although this may actually be a part of the 689 narrow bandwidth. Most sources consider these values to be technically red wavelengths, although some sources

**AIC = -2*LN(ʎ) + (2*P)**
Where:
ʎ = metric of association (coefficient) and
P = # parameters in the model

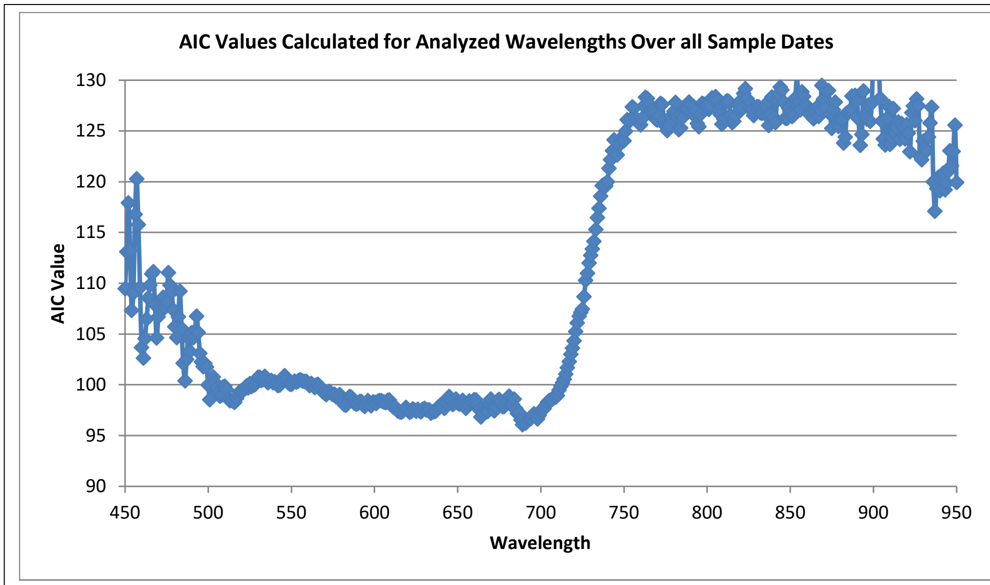


Figure 3. Akaike Information Criteria (AIC) values calculated for analyzed wavelengths over all sample dates. The lowest AIC value is considered the most influential in the relationship (i.e. the wavelengths most closely associated with RCRR infection).

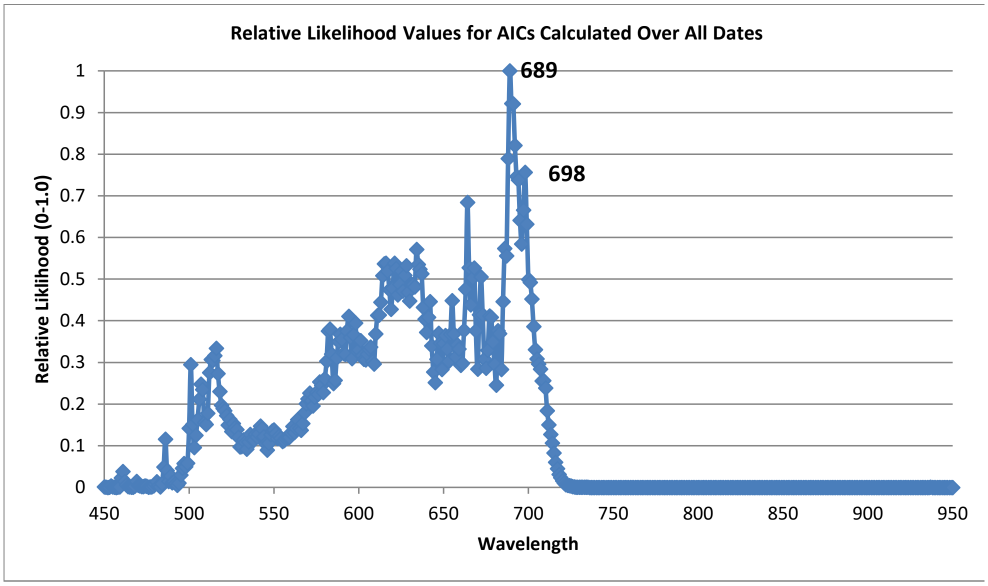


Figure 4. Relative Likelihood results for AICs calculated for all wavelengths and disease ratings over all dates. The wavelengths most closely associated with RCRR infection in our data are 689 (surrounded by a narrow bandwidth or ~20nm) and 698. An additional series of wavelengths well in the red wavelength range also show high relative likelihoods of being associated with RCRR infection.

place them in the low near-infrared. In either case, this range of wavelengths where red and NIR abut, sometimes inaccurately called the 'Red Edge', is an area where stress reactions in plants often affect the leaf's ability to reflect solar energy. So these results are not surprising. In addition to the narrow band around 689, there are several groups of wavelengths in the range of red wavelengths that show high relative likelihood of being associated with RCRR infection (582nm-602nm, 615nm-634nm, and a very narrow band between 663nm-665nm). Results from aerial imagery from VIS/NIR multi-sensor arrays and Forward Looking Infrared (FLIR) thermal cameras (e.g. fig 5) from all dates are still being analyzed. Results from these sensors will be combined with the reflection data to refine the ability to remotely sense Rhizoctonia Crown and Root Rot.

**Conclusions**:

In 2017, we found that RCRR does significantly affect the reflection characteristics of infected plants. The data in this study indicates that the most effective wavelengths to assess RCRR infection are a 20nm band centered around 689nm with additional narrow bands of wavelengths in other areas of the red wavelengths. These wavelengths may provide the best potential for the development of RCRR sensors, although additional data from aerial VIS/NIR and thermal imagery may provide significant improvement.

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We thank Jeff Nielsen, Hal Mickelson, Josie Dillon, and student workers Tim Cymbaluk, Brandon Kasprick, and Muira MacRae; the University of Minnesota, Northwest Research and Outreach Center, Crookston for providing land, equipment and other facilities.

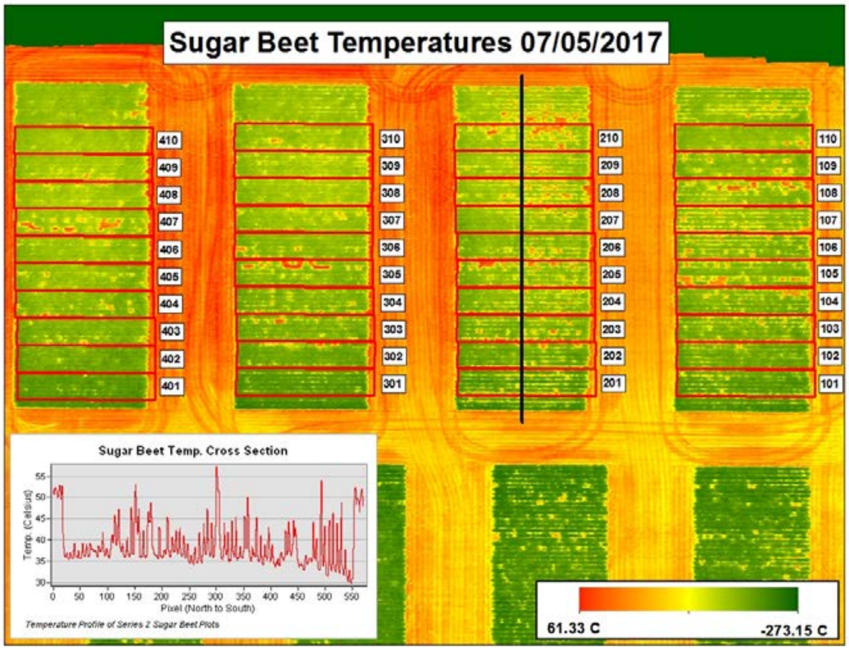


Figure 5. Example of Forward Looking Infrared (FLIR) image or research plots 7/05/2017. Analyses of FLIR imagery is still ongoing; addition of canopy temperatures estimated from these data is anticipated to increase predictive accuracy of identification of RCRR infection.

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**COMPARISON OF POSTEMERGENCE FUNGICIDES FOR CONTROL OF RHIZOCTONIA CROWN AND ROOT ROT OF SUGARBEET**

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Rhizoctonia crown and root rot (RCRR) caused by the soilborne fungus *Rhizoctonia solani* AG 2-2 is a common problem in the sugarbeet growing areas of Minnesota and North Dakota. The disease can cause damping-off on seedlings and infect older roots throughout the growing season. Warm (65°F+) soil combined with excess moisture conditions favor infection and disease development. Control methods include rotating with non-host (cereal) crops such as wheat, sowing partially resistant varieties, and the use of seed treatment, in-furrow, and/or postemergence fungicides. Several options are available to sugarbeet growers for control of Rhizoctonia, including some newly registered products. Data is needed to compare new fungicides alongside established postemergence fungicides.

**OBJECTIVES**

A field trial inoculated with *R. solani* AG 2-2 was established to evaluate postemergence application of several registered and other fungicides for control of Rhizoctonia crown and root rot and effect on sugarbeet yield and quality.

**MATERIALS AND METHODS**

The trial was established at the University of Minnesota, Northwest Research and Outreach Center, Crookston on a Hegne-Fargo complex soil. Prior to planting, soil was infested with *R. solani* AG 2-2-infested whole barley broadcast at 35 kg ha$^{-1}$ and incorporated with a Rau seedbed finisher. The trial was sown with the moderately susceptible cultivar 'Crystal 101RR' in six-row plots (22-inch row spacing) on May 8 at 4.5-inch seed spacing. Seed treatments included standard rates of Apron + Thiram, Tachigaren (45 g product/unit), and Kabina ST (14 g a.i./unit). Counter 20G (8 lb/A) was applied at planting for control of root maggot. Glyphosate (4.5 lb product ae/gallon) was applied on June 5 (22 oz A$^{-1}$) and 21 (28 oz A$^{-1}$), and July 5 (32 oz A$^{-1}$) for control of weeds. Treatments were assigned to plots (6 rows wide, 25 ft long) arranged in a randomized block design with four replicates. Postemergence fungicides were applied June 16 in a 7-inch band using 10 gallons of water/A with the exception of a broadcast application of the 14 fl oz A$^{-1}$ rate of Quadris. Fungicides, active ingredients, and rates are summarized in Table 1, including 17.6 fl oz A$^{-1}$ AZteroid (azoxystrobin), 10 and 14 fl oz A$^{-1}$ Quadris (azoxystrobin), 7 fl oz A$^{-1}$ Topguard EQ (azoxystrobin + flutriafol), 6.7 fl oz A$^{-1}$ Priaxor (fluxapyroxad + pyraclostrobin) plus 0.25% non-ionic surfactant (NIS), and 5.7 fl oz A$^{-1}$ Proline (prothioconazole) plus 0.125% NIS by volume. Plants were inoculated 3 days after fungicide treatments by applying *R. solani*-infested ground barley inoculum (23 g/25 ft of row) over each of the center four rows by hand. Following inoculation, plots were cultivated and loosened soil was hand-raked into crowns to create a favorable environment for infection with *R. solani*. A no-fungicide, inoculated control was also included. Stand counts were taken on June 9, 19, and 26.

**Table 1.** Product names, active ingredients, and rates used in a field trial evaluating postemergence fungicides for control of *Rhizoctonia solani* AG 2-2 on sugarbeet. Standard rates of Apron + Thiram, 45 g product/unit Tachigaren, and 14 g a.i./unit Kabina were on all seed. Fungicides were applied June 16 in a 7-inch band or broadcast using 10 gallons of water/A.

| Product | Active ingredient | Product rate | Active ingredient rate | Application |
|---|---|---|---|---|
| Untreated control | - | - | - | - |
| AZteroid | Azoxystrobin | 17.6 fl oz A$^{-1}$ | 103 g A$^{-1}$ | Band |
| Quadris | Azoxystrobin | 10 fl oz A$^{-1}$ | 73 g A$^{-1}$ | Band |
| Quadris | Azoxystrobin | 14 fl oz A$^{-1}$ | 103 g A$^{-1}$ | Band |
| Quadris | Azoxystrobin | 14 fl oz A$^{-1}$ | 103 g A$^{-1}$ | Broadcast |
| Topguard EQ[Z] | Azoxystrobin + Flutriafol | 7 fl oz A$^{-1}$ | 61 + 45 g A$^{-1}$ | Band |
| Priaxor + NIS (0.25%) | Pyraclostrobin + Fluxapyroxad | 6.7 fl oz A$^{-1}$ | 66 + 33 g A$^{-1}$ | Band |
| Proline + NIS (0.125%) | Prothioconazole | 5.7 fl oz A$^{-1}$ | 81 g A$^{-1}$ | Band |

[Z] Topguard EQ is registered in sugar beet only for use on foliar diseases

Cercospora leaf spot was controlled by Supertin + Topsin M (6 + 10 oz product in 19 gallons of water A$^{-1}$) applied with 8002 flat fan nozzles at 100 psi on July 25 and Inspire (7 oz product in 19 gallons of water A$^{-1}$) on August 8. The trial was harvested on October 4 and data were collected for number of harvested roots, yield, and quality. The number of harvested roots and baseline stand counts at the time of inoculation (June 19) were used to calculate percent stand loss. Twenty roots per plot also were arbitrarily selected and rated for severity of RCRR using a 0 to 7 scale (0 = healthy root, 7 = root completely rotted and foliage dead). Disease incidence was reported as the percent of rated roots with a root rot rating of > 2.

Data were subjected to analysis of variance using SAS Proc GLM (SAS Institute, Cary, NC). Means were separated by Fisher's Protected Least Significant Difference ($P$ = 0.05).

## RESULTS AND DISCUSSION

Harvest data is summarized in Table 2. Moderate rainfall in June (3.41 inches) resulted in adequate disease pressure for some infection, but low rainfall in July and August (1.42 and 0.77 inch, respectively) slowed development of disease. Percent stand loss, RCRR rating and incidence, and root and sucrose yields were significantly different ($P$ = 0.05) among treatments (Table 2). Percent stand loss and RCRR ratings and incidence were lower for all postemergence fungicides compared to the untreated control (Table 2). Among fungicide treatments, root and sucrose yields were highest for Topguard EQ, lowest for Priaxor, and intermediate for AZteroid, Quadris treatments, and Proline (Table 2). Percent sucrose and sucrose per ton were highest for the band applications of Quadris and Proline, lowest for the untreated control and Priaxor, and intermediate for AZteroid, broadcast Quadris and Topguard EQ (Table 2).

Stand loss in the untreated control was 66%, while RCRR rating and incidence averaged 3.7 and 75%, respectively, indicating a fairly high level of disease, despite dry soil conditions throughout July and August. Yet all postemergence fungicides provided significant control of RCRR and increased root and sucrose yield compared to the untreated control. In this trial, the broadcast application of Quadris and band application of Proline performed similarly to the band applications of Quadris. In past trials, these treatments have given mixed results. This trial was inoculated both prior to planting and at the time of fungicide application. Properly timed postemergence fungicides have good potential for decreasing RCRR and increasing root and sucrose yield.

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**Table 2.** Effect of postemergence fungicides on percent stand loss, RCRR ratings and incidence, and root and sucrose yields in a sugar beet field trial inoculated with *Rhizoctonia solani* AG 2-2.

| Treatment[V] | Percent stand loss[WX] | RCRR[W] (0-7)[Y] | RCRR[W] % Incidence[Z] | Yield[W] T/A | Sucrose[W] % | Sucrose[W] lb/ton | Sucrose[W] lb recov./A |
|---|---|---|---|---|---|---|---|
| Untreated control | 66 a | 3.7 a | 75 a | 23.2 c | 16.9 c | 314 b | 7324 c |
| AZteroid @ 17.6 fl oz $A^{-1}$ | 22 b | 0.7 b | 15 b | 33.6 ab | 17.6 ab | 330 ab | 11084 ab |
| Quadris @ 10 fl oz $A^{-1}$ | 15 b | 0.9 b | 16 b | 33.5 ab | 17.9 a | 336 a | 11272 a |
| Quadris @ 14 fl oz $A^{-1}$ | 27 b | 1.2 b | 25 b | 31.9 ab | 17.7 a | 334 a | 10659 ab |
| Quadris @ 14 fl oz $A^{-1}$ broadcast | 14 b | 1.1 b | 21 b | 33.4 ab | 17.4 abc | 327 ab | 10944 ab |
| Topguard EQ @ 7 fl oz $A^{-1}$ | 23 b | 1.1 b | 20 b | 35.5 a | 17.5 abc | 330 ab | 11715 a |
| Priaxor @ 6.7 fl oz $A^{-1}$ + NIS (0.25%) | 25 b | 1.5 b | 26 b | 31.0 b | 16.9 bc | 316 b | 9809 b |
| Proline @ 5.7 fl oz $A^{-1}$ + NIS (0.125%) | 25 b | 1.6 b | 33 b | 32.7 ab | 17.9 a | 336 a | 11013 ab |
| ANOVA $P$-value | 0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0297 | 0.0460 | 0.0001 |
| LSD ($P$ = 0.05)[W] | 17.6 | 0.92 | 18.4 | 3.86 | 0.68 | 15.4 | 1451 |

[V] Postemergence fungicide applications were made on June 16 using 10 gallons of water/A in a 7-inch band except where noted as broadcast; prior to planting, soil was infested with *R. solani* AG 2-2-infested whole barley broadcast at 35 kg $ha^{-1}$ and incorporated with a Rau seedbed finisher; plots were inoculated again on June 16 (after fungicide applications) by applying *R. solani*-infested ground barley inoculum (23 g/25 ft of row) over each of the center four rows by hand, followed by cultivation and hand-raking to move some soil into the crowns.

[W] For each column, numbers followed by the same letter are not significantly different according to Fisher's Protected Least Significant Difference (LSD); NS = not significantly different

[X] Percent stand loss = percent of stand present at the time of inoculation that died by harvest;

[Y] RCRR = Rhizoctonia crown and root rot; 0-7 scale, 0 = root clean, no disease, 7 = root completely rotted and plant dead

[Z] RCRR = Rhizoctonia crown and root rot; percent of roots with rating > 2

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We thank Jeff Nielsen, Hal Mickelson, and student workers Tim Cymbaluk, Brandon Kasprick, and Muira MacRae; the University of Minnesota, Northwest Research and Outreach Center, Crookston for providing land, equipment and other facilities; Crystal Beet Seed for providing seed; BASF, Bayer, FMC Agricultural Solutions, Syngenta, and Vive Crop Protection for fungicide samples; and American Crystal Sugar Company Quality Laboratory, East Grand Forks, MN for quality analyses.

**EVALUATION OF AT-PLANTING FUNGICIDE TREATMENTS FOR CONTROL OF *RHIZOCTONIA SOLANI* ON SUGARBEET**

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Rhizoctonia damping-off and crown and root rot (RCRR) caused by *Rhizoctonia solani* AG 2-2 have been the most common root diseases on sugarbeet in Minnesota and North Dakota for several years (1-2, 4-5, 8). Disease can occur throughout the growing season and reduce plant stand, root yield, and quality. Warm and wet soil conditions favor infection. Disease management options include rotating with non-host crops (cereals), planting partially resistant varieties, planting early when soil temperatures are cool, improving soil drainage, and applying fungicides as seed treatments, in-furrow (IF), and/or postemergence. An integrated management strategy should take advantage of multiple control options to reduce Rhizoctonia crown and root rot.

## OBJECTIVES

A field trial was established to evaluate various at-planting fungicide treatments (seed treatment and in-furrow) for 1) control of early-season damping-off and RCRR and 2) effect on yield and quality of sugarbeet.

## MATERIALS AND METHODS

The trial was established at the University of Minnesota, Northwest Research and Outreach Center (NWROC), Crookston. Field plots were fertilized for optimal yield and quality. A moderately susceptible variety (Crystal 101RR) with a 2-year average Rhizoctonia rating of 4.7 was used (9). A randomized complete block design with four replications was used. Seed treatments and rates are summarized in Table 1 and were applied by Germains Seed Technology, Fargo, ND. In-furrow fungicides (Table 1) were applied down the drip tube in 6 gallons total volume $A^{-1}$. The untreated control included no seed or in-furrow fungicide treatment at planting. Prior to planting, soil was infested with *R. solani* AG 2-2-infested whole barley broadcast at 35 kg $ha^{-1}$ and incorporated with a Rau seedbed finisher. The trial was sown in six-row plots (22-inch row spacing, 25-ft rows) on May 11 at 4.5-inch seed spacing. Counter 20G (8 lb $A^{-1}$) was applied at planting for control of sugarbeet root maggot and 3 gallons $A^{-1}$ starter fertilizer (10-34-0) was applied across all treatment combinations. Glyphosate (4.5 lb product ae/gallon) was applied on June 5 (22 oz $A^{-1}$) and 21 (28 oz $A^{-1}$), and July 5 (32 oz $A^{-1}$) for control of weeds. Cercospora leaf spot was controlled by Supertin + Topsin M (6 + 10 oz product in 19 gallons of water $A^{-1}$) applied with 8002 flat fan nozzles at 100 psi on July 25 and Inspire (7 oz product in 19 gallons of water $A^{-1}$) on August 8.

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**Table 1.** Application type, product names, active ingredients, and rates of fungicides used at planting in a field trial for control of *Rhizoctonia solani* AG 2-2 on sugarbeet. Standard rates of Apron + Thiram and 45 g/unit Tachigaren were on all seed. In-furrow fungicides were applied down the drip tube in a total volume of 6 gal/A.

| Application | Product | Active ingredient | Rate[Z] |
|---|---|---|---|
| None | - | - | - |
| Seed | Kabina ST | Penthiopyrad | 14 g a.i./unit seed |
| Seed | Metlock Suite + Kabina ST | Metcon + Rizo + Penthio | 0.21 + 0.5 + 7 g a.i./unit seed |
| Seed | Systiva | Fluxapyroxad | 5 g a.i./unit seed |
| Seed | Vibrance | Sedaxane | 1.5 g a.i./unit seed |
| In-furrow | AZteroid | Azoxystrobin | 11.9 fl oz product $A^{-1}$ |
| In-furrow | Quadris | Azoxystrobin | 10.0 fl oz product $A^{-1}$ |
| In-furrow | Xanthion | Pyraclostrobin + | 9.0 fl oz product $A^{-1}$ |
| | | Bacillus amyloliquefaciens | 1.8 fl oz product $A^{-1}$ |

[Z] 11.9 fl oz AZteroid and 10 fl oz Quadris contain 0.15 and 0.16 lb azoxystrobin, respectively

Stand counts were done beginning 2 weeks after planting through 9 weeks after planting. The trial was harvested on October 5. Data were collected for number of harvested roots, yield, and quality. Twenty roots per plot also were arbitrarily selected and rated for severity of RCRR using a 0 to 7 scale (0 = healthy root, 7 = root completely rotted and foliage dead). Disease incidence was reported as the percent of rated roots with a root rot rating of > 2. Data were subjected to analysis of variance using SAS Proc GLM (SAS Institute, Cary, NC). Treatment means were separated using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance.

## RESULTS AND DISCUSSION

There were significant differences among treatments for plant stands at 2 through 9 weeks after planting (Fig. 1). At 2 weeks after planting, Systiva seed treatment had higher stand than the untreated control (Fig. 1). From 3 to 7 weeks after planting, all seed treatments resulted in significantly higher plant stand than the untreated control (Fig. 1). At 9 weeks after planting, only Metlock Suite + Kabina and Systiva were significantly higher in plant stand than the untreated control (Fig. 1). In-furrow fungicides resulted in stands similar to the untreated control throughout the first 9 weeks after planting (Fig. 1). For all stand counts, mean plant stand for seed treatments was significantly higher than the mean plant stand for in-furrow fungicides according to orthogonal contrasts ($P = 0.05$). It is not unusual for stand establishment to be reduced for in-furrow fungicides compared to seed treatments. Soil moisture and temperature were lower than normal at the NWROC during the period of emergence. Rainfall at the NWROC was just 0.94 inch during the month of May compared to a 30-year average of 3.04 inches for May. Average four-inch bare soil temperatures at the NWROC were 52.4 °F and 61.9 °F for the months of May and June, respectively. Average four-inch soil temperature did not cross 65 °F until July 4.

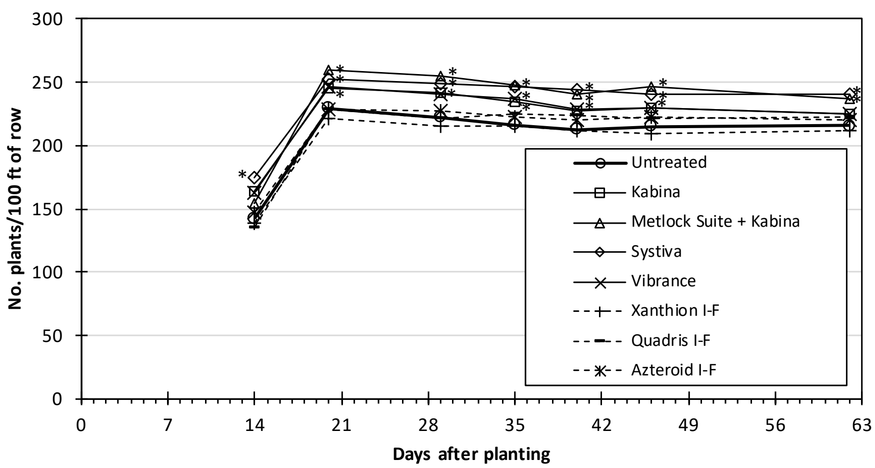


**Fig. 1.** Emergence and stand establishment for seed treatment (solid lines) and in-furrow (I-F, dotted lines) fungicides in a sugarbeet field trial infested with *Rhizoctonia solani* AG 2-2. For each stand count date, symbols marked with an asterisk represent stands significantly (P = 0.05) higher than the untreated control (bold solid line).

**Table 2.** Effects of at-planting (seed treatment or in-furrow) fungicide treatments on Rhizoctonia crown and root rot and sugarbeet yield and quality in a Rhizoctonia-infested field trial at the University of Minnesota, Northwest Research and Outreach Center, Crookston.

Sucrose[X]

| Treatment | No. harv. Roots/100 ft.[X] | RCRR (0-7)[XY] | RCRR % incidence[XZ] | Yield[X] | % | lb ton$^{-1}$ | lb A$^{-1}$ |
|---|---|---|---|---|---|---|---|
| Untreated control | 174 | 1.2 | 24 | 30.2 | 17.8 | 337 | 10170 |
| Kabina ST | 193 | 0.7 | 15 | 31.9 | 18.0 | 340 | 10844 |
| Met. Suite + 7 g Kabina | 200 | 1.3 | 25 | 31.3 | 17.7 | 333 | 10430 |
| Systiva | 205 | 1.1 | 21 | 33.9 | 18.0 | 339 | 11494 |
| Vibrance | 183 | 1.5 | 28 | 29.4 | 18.0 | 341 | 10063 |
| AZteroid in-furrow | 193 | 0.6 | 14 | 33.8 | 18.3 | 349 | 11767 |
| Quadris in-furrow | 191 | 0.9 | 15 | 31.7 | 17.8 | 337 | 10681 |
| Xanthion in-furrow | 189 | 0.8 | 15 | 31.9 | 18.1 | 342 | 10947 |
| ANOVA P-value | 0.2138 | 0.2437 | 0.3962 | 0.3233 | 0.8594 | 0.6769 | 0.2532 |
| LSD ($P$ = 0.05)[X] | NS | NS | NS | NS | NS | NS | NS |
| **Contrast analysis Seed vs in-furrow** | | | | | | | |
| Mean of Seed trts. | 195 | 1.1 | 22 | 31.6 | 17.9 | 339 | 10708 |
| Mean of In-furrow trts. | 191 | 0.7 | 15 | 32.4 | 18.0 | 343 | 11132 |
| P-value | 0.4391 | 0.0706 | 0.0771 | 0.3635 | 0.5758 | 0.3726 | 0.2261 |

[X] Values represent mean of 4 plots, NS = not significantly different
[Y] RCRR = Rhizoctonia crown and root rot; 0-7 scale, 0 = root clean, no disease, 7 = root completely rotted and plant dead
[Z] RCRR = Rhizoctonia crown and root rot; percent of roots with rating > 2

Soil moisture remained low throughout the growing season, resulting in low Rhizoctonia disease pressure in this trial. Total rainfall for the four months of May to August was 6.54 inches in 2017 compared to a 30-year average of 12.88 for the same four months. As a result, there were no significant differences among treatments for Rhizoctonia crown and root rot or yield and quality parameters (Table 2). Root rot ratings were low for all treatments with means ranging from 0.6 to 1.2 on the 0-7 scale (Table 2), reflecting the low disease pressure from *R. solani*. Disease incidence, reported as the percent of roots with a disease rating >2 ranged from 14 to 28% (Table 2). Root and sucrose yields were good for all treatments with root yields ranging from 29.4 to 33.8 ton A$^{-1}$ and sucrose ranging from 17.7 to 18.3%. Lack of significant differences at harvest in 2017 is in contrast with typical years with higher disease pressure, where in-furrow fungicides typically result in lower root rot ratings and higher yields at harvest compared to seed treatments (6-7).

**ACKNOWLEDGEMENTS**

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**USING POST FUNGICIDE APPLICATION AND SEED TREATMENTS FOR CONTROL OF RHIZOCTONIA SOLANI**

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Rhizoctonia root and crown rot, caused by *Rhizoctonia solani* Kühn, is currently the most devastating soil borne disease of sugarbeet (*Beta vulgaris* L.) in North Dakota and Minnesota. In the bi-state area, *R. solani* anastomosis group (AG) 1, AG-2-2, AG-4 and AG-5 cause damping off and AG-2-2 causes root and crown rot of sugarbeet (Windels and Nabben 1989). *R. solani* survives as thickened hyphae and sclerotia in organic material and is endemic in soils where sugarbeet is grown. *R. solani* has a wide host range including broad leaf crops and weeds (Anderson 1982; Nelson et al. 2002). Crop rotations of three or more years with small grains planted before sugarbeet is recommended to reduce disease incidence (Windels and Lamey 1998). In fields with a history of high disease severity, growers may plant varieties that are more resistant but with significantly lower yield potential compered to more susceptible varieties (Panella and Ruppel 1996). Research showed that timely application of azoxystrobin provided effective disease control but not when applied after infection or after symptoms were observed (Brantner and Windels, 2002; Jacobsen et al. 2002). Fungicidal seed treatments were developed and commercialized starting in 2013 to provide early season protection from *R. solani*.

The objective of this research was to evaluate the fungicidal seed treatments with and without a post-application fungicide their effectiveness at controlling *R. solani* and impact on yield and quality in sugarbeet.

## MATERIALS AND METHODS

A field trial was conducted at Hickson, ND in 2017. The site was inoculated on 28 April with *R. solani* AG 2-2 IIIB grown on barley. Inoculum was broadcast using a three-point mounted rotary/spinner type spreader calibrated to deliver 58 lbs/A of inoculum. The inoculum was incorporated with a Konskilde field cultivator to about the two-inch depth before planting. The experimental design was a randomized complete block with four replicates. Field plots comprised of six 25-foot long rows spaced 22 inches apart. Plots were planted to stand on 3 May with a known susceptible variety. Seeds were treated with Tachigaren at 45 g/kg seed to provide early season protection against *Aphanomyces cochlioides*, and Poncho Beta to provide early season insect control. Counter 20G was also applied at 9 lb/A at planting to control insect pests. Weeds were controlled on 1 and 13 June 10 July. Fungicides were sprayed to control Cercospora leaf spot on 24 July and 2 August.

The fungicides treatments and rates of fungicide used are listed in Table 1. Different commercial seed treatments were used alone and with a post fungicide applied in a 7-inch band application. The band-applications were made on 12 June at the eight leaf stage using 17 gal of spray solution/A.

Stand counts were taken during the season and at harvest. The middle two-rows of plots were harvested on 11 September and weights were recorded. Samples (12-15 roots) from each plot, not including roots on the ends of plots, were analyzed for quality at American Crystal Sugar Company tare laboratory at East Grand Forks, MN. The data analysis was performed with the ANOVA procedure of the Agriculture Research Manager, version 8 software package (Gylling Data Management Inc., Brookings, South Dakota, 2010). The least significant difference (LSD) test was used to compare treatments when the F-test for treatments was significant.

## RESULTS AND DISCUSSIONS

Dry conditions after planting resulted in delayed emergence. The first significant rainfall was 22 days after planting on May 25 and again on May 30. Plant stand was very variable in all treatments and counts taken on June 7 indicated variable stands but no significant differences among treatments. Seedling damping-off was not observed in June, probably because the dry conditions were not favorable for disease development. Rainfall on July 11 (2.84'') and 19 (0.52'') resulted in conditions more favorable for infection by *R. solani*. Typical symptoms of Rhizoctonia root rot including leaf wilting, yellowing, followed by death of leaves and then entire plants were observed starting in August. It should be noted that infection was not uniform in plots.

In the non-diseased conditions which prevailed early in the growing season, there were no significant differences in plant stand among seed treatments. At harvest, plant stand, although not statistically significantly, were lower in treatments which had only fungicide seed treatment(s) or no seed treatment compared to treatments with a post fungicide application Quadris application at the 8-leaf stage. The environmental conditions and visual symptoms on infected pants indicated that there was some *R. solani* infection later in the growing season. It was likely that post application of Quadris provided some protection of plants from the later season Rhizoctonia root rot and the trend for higher plant stand, tonnage, sucrose concentration and recoverable sucrose. Overall dry conditions with favorable growing degree days along with adequate soil moisture resulted in relatively high tonnage, sucrose concentration and recoverable sucrose in all treatments, including the non-treated check. The benefits of using Quadris was best demonstrated where the fungicide was used only as a post application compared to the treatment using no fungicidal seed and post treatments (non-treated check). Since it is not known what environmental conditions will prevail during the growing season, and that none of the recommended fungicides are curative (that is, will not control *R. solani* after symptoms are observed), the prophylactic use of seed treatments and a post fungicide application when plants are at the 4- to 8-leaf stage should provide effective protection from *R. solani*.

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**Table 1. Effect of seed treatments and post fungicide application for control of Rhizoctonia root rot on sugarbeet at Hickson, ND in 2017**

| Product and Rate in fl oz/A | 19 June Stand Count | 9 August Stand Count | 11 September Stand Count | 11 September Yield | 11 September Sucrose concentration | 11 September Recoverable sucrose |
|---|---|---|---|---|---|---|
| | **beets/100'** | **beets/100'** | **beets/100'** | **Ton/A** | **%** | **lb/A** |
| Untreated | 207 | 188 | 144 | 30.7 | 17.7 | 9,799 |
| Kabina 14g | 207 | 193 | 149 | 32.3 | 17.2 | 9,832 |
| Vibrance | 214 | 199 | 148 | 32.0 | 17.5 | 10,041 |
| Metlock + Rizolex + Kabina 7g | 207 | 199 | 149 | 32.5 | 17.0 | 9,809 |
| Quadris 9.2 fl oz | 193 | 204 | 162 | 35.7 | 17.8 | 11,426 |
| Kabina 14g **fb** Quadris 9.2 fl oz | 202 | 211 | 167 | 32.1 | 17.7 | 10,223 |
| Vibrance **fb** Quadris 9.2 fl oz | 209 | 205 | 164 | 32.3 | 17.7 | 10,332 |
| Metlock + Rizolex + Kabina 7g **fb** Quadris 9.2 fl oz | 215 | 229 | 171 | 34.9 | 17.4 | 10,922 |
| **LSD (P=0.10)** | **12** | **20** | **NS** | **3.6** | **0.67** | **1095** |

*Treatment applied POST on 2 June.

**SEED TREATMENT AND INFURROW FUNGICIDES FOR RHIZOCTONIA CONTROL**

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Rhizoctonia root and crown rot, caused by *Rhizoctonia solani* Kühn, is currently the most devastating soil borne disease of sugarbeet (*Beta vulgaris* L.) in North Dakota and Minnesota. In the bi-state area, *R. solani* anastomosis group (AG) 1, AG-2-2, AG-4 and AG-5 cause damping off and AG-2-2 causes root and crown rot of sugarbeet (Windels and Nabben 1989). *R. solani* survives as thickened hyphae and sclerotia in organic material and is endemic in soils where sugarbeet is grown. *R. solani* has a wide host range including broad leaf crops and weeds (Anderson 1982; Nelson et al. 2002). Crop rotations of three or more years with small grains planted before sugarbeet is recommended to reduce disease incidence (Windels and Lamey 1998). In fields with a history of high disease severity, growers may plant varieties that are more resistant but with significantly lower yield potential compared to more susceptible varieties (Panella and Ruppel 1996). Research showed that timely application of azoxystrobin provided effective disease control but not when applied after infection or after symptoms were observed (Brantner and Windels, 2002; Jacobsen et al. 2002). Fungicidal seed treatments were developed and commercialized starting in 2013 to provide early season protection from *R. solani* and to facilitate the practice of using a liquid starter fertilizer at planting and speed-up the rate of planting. It will be useful to know whether seed treatments are compatible with in-furrow fungicides when needed for areas with high disease pressure, whether seed treatments provide season long disease protection, and whether multiple post-fungicide applications provide better disease control compared to one post-application at the 4-leaf stage.

The objective of this research was to determine whether seed treatments are compatible with in-furrow fungicides when needed for areas with high disease pressure, whether seed treatments provide season long disease protection, and whether multiple post-fungicide applications provide better disease control compared to one post-application at the 4-leaf stage.

## MATERIALS AND METHODS

A field trial was conducted at Hickson, ND in 2017. The site was inoculated on 28 April with *R. solani* AG 2-2 IIIB grown on barley. Inoculum was broadcast using a three-point mounted rotary/spinner type spreader calibrated to deliver 58 lbs/A of inoculum. The inoculum was incorporated with a Konskilde field cultivator to about the two-inch depth before planting. The experimental design was a randomized complete block with four replicates. Field plots comprised of six 25-foot long rows spaced 22 inches apart. Plots were planted to stand on 3 May with a Rhiaxoctonia susceptible variety. Seeds were treated with Tachigaren at 45 g/kg seed to provide early season protection against *Aphanomyces cochlioides*, and Poncho Beta. Counter 20G was also applied at 9 lb/A at planting to control insect pests. Weeds were controlled on 1 and 13 June and 10 July. Fungicides were sprayed to control Cercospora Leaf Spot on 24 July and 2 August.

The fungicides and rates used are listed in Table 1. Treatments were applied as an in-furrow application. The in-furrow applications were made on 3 May (at planting) using 7.1 gal of spray solution/A.

Stand counts were taken during the season and at harvest. The middle two-rows of plots were harvested on 11 September and weights were recorded. Samples (12-15 roots) from each plot, not including roots on the ends of plots, were analyzed for quality at American Crystal Sugar Company tare laboratory at East Grand Forks, MN. The data analysis was performed with the ANOVA procedure of the Agriculture Research Manager, version 8 software package (Gylling Data Management Inc., Brookings, South Dakota, 2010). The least significant difference (LSD) test was used to compare treatments when the F-test for treatments was significant.

## RESULTS AND DISCUSSIONS

The first significant rainfall was 20 days after planting on May 25 and again on May 30. Emergence was non-uniform and occurred over a wide range of dates resulting in plant stand ranging from 158 to 182 on June 7 and 165 to 193 on June 23; however, there were no significant differences in plant stand among treatments on June 23 nor at harvest. It should be noted that dry conditions at and after planting were not favorable for infection and disease development by *R. solani* and Rhizoctonia damping-off was not observed. Later in the season, after mid-July, Rhizoctonia root rot symptoms and death of plants in some treatments were observed. There were no significant differences in tonnage nor in sucrose concentration among treatments. There were significant differences in sugar loss to molasses which resulted in significant differences in recoverable sucrose among treatments. The seed treatments which had no post-fungicide applications all had lower tonnage compared to the same seed treatments with post-fungicide applications. Likewise, the check with no seed treatment also had lower tonnage than the non-treated seed with a post-fungicide application. Since Rhizoctonia root rot was observed later in the season, it is likely that the post fungicide applications provided better disease protection in those treatments leading to higher recoverable sucrose. In this trial, the seed treatments used alone did not result in as high recoverable sucrose per acre as seed treatments with post-application fungicides, or treatments with post-application fungicides. It was safe to use seed treatments with in-furrow fungicides. Based on the field data, it will be useful for growers to continue to use fungicide seed treatments to provide protection in years when conditions are favorable for Rhizoctonia damping-off. However, seed treatments do not provide season long protection against R. solani, so post-fungicide applications will still be necessary. In this trial, two post-fungicide applications (at the 4-6 and at the 8-10 leaf stages) resulted in the highest recoverable sucrose per acre. Research will continue to determine the best time and number of post fungicide applications for effective control of R. solani and highest recoverable sucrose

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**Table 1. Effect of fungicides from in-furrow applications and seed treatments on Rhizoctonia root rot at Hickson, ND in 2017**

| Product and Rate in fl oz/A | Application dates | 12 June Stand Count | 11 Sept Stand Count | 11 Sept Yield | 11 Sept Sucrose concentration | 11 Sept SLM | 11 Sept Recoverable sucrose |
|---|---|---|---|---|---|---|---|
| | | beets/100’ | beets/100’ | Ton/A | % | % | lb/A |
| Untreated | - | 205 | 179 | 31.0 | 17.7 | 1.66 | 9,871 |
| Kabina | Seed trt | 200 | 162 | 32.6 | 17.6 | 1.70 | 10,385 |
| Vibrance | Seed trt | 210 | 164 | 31.3 | 17.9 | 1.61 | 10,205 |
| Metlock + Rizolex + Kabina | Seed trt | 214 | 174 | 33.5 | 17.9 | 1.57 | 10,920 |
| Systiva | Seed trt | 202 | 175 | 30.5 | 18.0 | 1.65 | 9,947 |
| Kabina/ Quadris 9.2 fl oz | Seed trt/ 12 June | 197 | 195 | 31.1 | 18.3 | 1.61 | 10,357 |
| Vibrance/ Quadris 9.2 fl oz | Seed trt/ 12 June | 212 | 166 | 32.2 | 17.7 | 1.59 | 10,333 |
| Metlock + Rizolex + Kabina/ Quadris 9.2 fl oz | Seed trt/ 12 June | 206 | 190 | 32.0 | 17.9 | 1.65 | 10,349 |
| Systiva/ Quadris 9.2 fl oz | Seed trt/ 12 June | 211 | 165 | 33.5 | 17.9 | 1.60 | 10,947 |
| Kabina/ Quadris 9.2 fl oz/ Proline 5.7 fl oz + NIS 0.125% v/v | Seed trt/ 12 June/ 20 June | 212 | 189 | 33.1 | 17.6 | 1.58 | 10,614 |
| Vibrance/ Quadris 9.2 fl oz/ Proline 5.7 fl oz + NIS 0.125% v/v | Seed trt/ 12 June/ 20 June | 216 | 193 | 31.8 | 18.1 | 1.62 | 10,476 |
| Metlock + Rizolex + Kabina/ Quadris 9.2 fl oz/ Proline 5.6 fl oz + NIS 0.125 % v/v | Seed trt/ 12 June/ 20 June | 216 | 189 | 34.5 | 17.7 | 1.67 | 11,020 |
| Systiva/ Quadris 9.2 fl oz/ Proline 5.7 fl oz + NIS 0.125% v/v | Seed trt/ 12 June/ 20 June | 216 | 192 | 32.2 | 18.1 | 1.59 | 10,578 |
| Quadris 9.2 fl oz | 12 June | 207 | 173 | 31.5 | 17.9 | 1.66 | 10,192 |
| Quadris 9.2 fl oz/ Proline 5.6 fl oz + NIS 0.125% v/v | 12 June/ 20 June | 212 | 164 | 31.7 | 18.2 | 1.55 | 10,538 |
| Quadris 9.2 fl oz IF | 3 May | 218 | 193 | 33.4 | 17.9 | 1.73 | 10,749 |
| Quadris 9.2 fl oz IF/ Proline 5.7 fl oz + 0.125% v/v | 3 May/ 12 June | 217 | 184 | 32.3 | 17.9 | 1.59 | 10,524 |
| Quadris 9.2 fl oz IF/ Proline 5.7 fl oz + 0.125% v/v/ Priaxor 6.7 fl oz | 3 May/ 12 June/ 20 June | 204 | 168 | 35.3 | 17.6 | 1.69 | 11,215 |
| Kabina +Quadris 9.2 fl oz IF | Seed trt/ 3 May | 209 | 161 | 30.4 | 17.6 | 1.59 | 9,778 |
| Vibrance + Quadris 9.2 fl oz IF | Seed trt/ 3 May | 195 | 179 | 31.9 | 17.8 | 1.66 | 10,223 |
| Metlock + Rizolex + Kabina + Quadris 9.2 fl oz IF | Seed trt/ 3 May | 199 | 167 | 27.8 | 18.2 | 1.64 | 9,172 |
| Systiva + Quadris 9.2 fl oz | Seed trt/ 3 May | 213 | 175 | 32.1 | 18.3 | 1.66 | 10,679 |
| Kabina + Quadris 9.2 fl oz IF/ Proline 5.7 fl oz + NIS 0.125% v/v | Seed trt/ 3 May/ 12 June | 205 | 187 | 30.0 | 18.5 | 1.58 | 10,126 |
| Vibrance + Quadris 9.2 fl oz IF/ Proline 5.7 fl oz + NIS 0.125% v/v | Seed trt/ 3 May/ 12 June | 181 | 170 | 33.0 | 18.2 | 1.55 | 10,993 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Metlock + Rizolex + Kabina + Quadris 9.2 fl oz IF/ Proline 5.7 fl oz + NIS 0.125% v/v | Seed trt/ 3 May/ 12 June | 198 | 163 | 32.2 | 18.3 | 1.63 | 10,682 |
| Systiva + Quadris 9.2 fl oz/ Proline 5.7 fl oz + NIS 0.125% v/v | Seed trt/ 3 May/ 12 June | 207 | 169 | 32.4 | 17.9 | 1.68 | 10,419 |
| **LSD (P=0.10)** | **-** | **15** | **NS** | **NS** | **NS** | **NS** | **NS** |

# SENSITIVITY OF *CERCOSPORA BETICOLA* TO FOLIAR FUNGICIDES IN 2017

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Leaf spot, caused by the fungus *Cercospora beticola*, is an endemic disease of sugarbeet produced in the Northern Great Plains area of North Dakota and Minnesota that reduces both yield and sucrose content. The disease is controlled by crop rotation, resistant varieties and timely fungicide applications. *Cercospora* leaf spot usually appears in the last half of the growing season, and multiple fungicide applications are necessary for disease management. Fungicides are used at high label rates and are alternated for best efficacy, but in recent years, mixtures are becoming more common. The most frequently used fungicides are Tin (triphenyl tin hydroxide), Topsin (thiophanate methyl), Eminent (tetraconazole), Proline (prothioconazole), Inspire (difenoconazole) and Headline (pyraclostrobin). In 2017, most of the DMI and QoI fungicides were applied as mixtures with either mancozeb or copper and Topsin is usually applied as a tank mix with Tin.

Like many other fungi, *C. beticola* has the ability to become less sensitive (resistant) to the fungicides used to control them after repeated exposure, and increased disease losses can result. Because both *C. beticola* and the fungicides used for management have histories of fungicide resistance in our production areas and other production areas in the US, Europe and Chile, it is important to monitor our *C. beticola* population for changes in sensitivity to the fungicides in order to achieve maximum disease control. We have monitored fungicide sensitivity of field isolates of *C. beticola* collected from fields representing the sugarbeet production area of the Red River Valley region to the commonly used fungicides in our area annually since 2003. In 2017, extensive sensitivity monitoring was conducted for Tin, Eminent, Inspire, Proline and Headline.

## OBJECTIVES

1) Monitor changes in sensitivity of *Cercospora beticola* isolates to Tin (fentin hydroxide)

2) Monitor changes in sensitivity of *Cercospora beticola* isolates to Topsin (thiophanate methyl)

3) Monitor changes in sensitivity of *Cercospora beticola* to three triazole (DMI) fungicides: Eminent (tetraconazole) and Inspire (difenoconazole) and Proline (prothioconazole)

4) Test *Cercospora beticola* isolates for the presence of the G143A mutation that confers resistance to Headline (pyraclostrobin) fungicide

5) Distribute results of sensitivity monitoring in a timely manner to the sugarbeet industry in order to make fungicide recommendations for disease management and fungicide resistance management for Cercospora leaf spot disease in our region.

## METHODS AND MATERIALS

In 2017, with financial support of the Sugarbeet Research and Extension Board of MN and ND, we tested 1105 *C. beticola* field isolates collected from throughout the sugarbeet production regions of ND and MN for sensitivity testing to Tin, Eminent, Inspire, Proline and Headline. For this report we use the commercial name of the fungicides, but all testing was conducted using the technical grade active ingredient of each fungicide, not the formulated commercial fungicide. The term µg/ml is equivalent to ppm.

Sugarbeet leaves with Cercospora leaf spot (CLS) were collected from commercial sugarbeet fields by agronomists from American Crystal Sugar Company, Minn-Dak Farmers Cooperative and Southern Minnesota Beet Sugar Cooperative representing all production areas in ND and MN. Leaves were delivered to our lab, and processed quickly to insure viability of spores. From each field sample, *C. beticola* spores were collected from a minimum of five spots per leaf from five leaves and mixed to make a composite of approximately 2500 spores. A subsample of the spore composite was transferred to a Petri plates containing water agar amended with Tin at 1 ug/ml. Germination of 100 spores on Tin amended water agar plates were counted 16 hours later and percent germination calculated. Germinated spores are considered resistant. Sensitivity to Topsin is tested alternate years and was not tested in 2017.

For triazole fungicide sensitivity testing, a radial growth procedure is used. A single spore subculture from the spore composite was grown on water agar medium amended with serial ten-fold dilutions of each technical grade triazole fungicide from 0.01 – 10.0 ppm. A separate test was conducted for each triazole fungicide. After 15 days, inhibition of radial growth was measured, and compared to the growth of *C. beticola* on non-amended water agar medium. This data was used to calculate an $EC_{50}$ value for each isolate; $EC_{50}$ is a standardized method of measuring fungicide resistance and is calculated by comparing the concentration of fungicide that reduces radial growth of *C. beticola* by 50% compared to the growth on non-amended media. Higher $EC_{50}$ values mean reduced sensitivity to the fungicide. An RF (resistance factor) was calculated by dividing the $EC_{50}$ value by the baseline value so fungicides can be directly compared.

For Headline resistance testing we use a PCR based molecular procedure to test for the presence of a specific mutation in *C. beticola* that imparts resistance to Headline. This procedure detects a specific mutation, G143A, which results in complete resistance to Headline. DNA is extracted from the remaining spore composite and tested by real-time PCR using primers specific for the G143A mutation. The test enables us to estimate the percentage of spores with the G143A mutation in each sample. Each sample tested contains approximately 2500-5000 spores and the DNA from this spore pool will test for the G143A mutation from each spore. The spore germination test we previously used only tested one spore per five spot/five leaf sample. The PCR test is also more sensitive and requires less interpretation than the previously used spore germination test. The PCR test will estimate the incidence of resistance in the population of spores tested, and give a better indication of Headline resistance in a field.

**RESULTS AND DISCUSSION**

CLS in 2017 was common but much less severe in than in 2016, and CLS in general was well managed by the fungicide programs that were used. The majority of the CLS samples were delivered to our lab at the end of the season in late September and early October. Almost all samples arrived in excellent condition and delivered as fresh samples. Field samples (n=1105) representing all production areas and factory districts were tested for sensitivity to five fungicides: tin, tetraconazole (Eminent), difenoconazole (the most active part of Inspire), prothioconazole (Proline) and pyraclostrobin (Headline). Three additional DMI, one SDHI ande one QoI fungicides not registered in the US for CLS were tested for activity against *C. beticola* in lab trials. One new DMI and one new QoI appeared to have good activity against *C. beticola.*

**TIN.** Tolerance (resistance) to Tin was first reported in 1994 at concentrations of 1-2 µg/ml. At these levels, disease control in the field is reduced. The incidence of fields with isolates resistant to Tin at 1.0 µg/ml increased between 1997 and 1999, but the incidence of fields with resistant isolates has been declining since the introduction of additional fungicides for resistance management, including Eminent in 1999, Gem in 2002 and Headline in 2003. In 1998, the percentage of fields with isolates resistant to Tin at 1.0 µg/ml was 64.6%, and declined to less than 10% from 2002 to 2010. From 2011 to 2014 there was an increase in the number of fields with resistance **(Figure 1),** and from 2015 to 2017, the incidence of fields with isolates resistant to Tin increased from 38.5% to 97% (**Figure 1**). The severity of resistance (as expressed as germination rate of spores from fields with resistant isolates) ranged from 1 to 100%, with the average germination rate ranging from 16 to 28% during the five year period of 2012 to 2017 **(Figure 2)**. The incidence of fields with tin resistance increased in all factory districts, with the lowest incidence in the Drayton, East Grand Forks and Hillsboro factory districts (**Figure. 3**). The low severity of resistance (<30%) may be the reason that tine is still an effective fungicide for managing CLS despite widespread incidence of resistance to tin.

**TOPSIN**. Resistance to Topsin has been present in our area since 1999, and is also common and widespread in European Union production areas. Resistance has historically been >70% but has declined below that level in six of the past twelve years. Topsin resistance, in sugarbeet and other crops, tends to decline when it is not used, but reappears quickly when it is again used in the field. In 2014, the percentage of fields with isolates resistant to Topsin at 5 µg/ml was 73.5% and in 2016 increased to 86.0% (data not shown). The incidence of resistance as measured by germination rate of spores from fields with resistant isolates ranged from 1 to 100%, with the average germination rate of 25%. Most applications of Topsin are as tank mixtures with Tin, which seems to be an effective management practice. Sensitivity to Topsin is measured in alternate years and was not tested in 2017.

**DMI (triazoles).** Sensitivity of *C. beticola* isolates to the DMI fungicides Eminent and Inspire, as measured by Resistance Factor values(RF), only doubled from 2007 to 2010, with average RF values <3 (RF values are the calculated $EC_{50}$ values divided by the baseline values). From 2011 to 2014, RF values of both Eminent and Inspire increased to 54.5 and 68.3 respectively (**Figure 4**). Surprisingly, in 2015 there was a 29% and 69% decline to in RF values to Eminent and Inspire respectively across all factory districts to average RF values of 39.0 and 21 (**Figure 4).** In 2016, the RF value of Eminent declined slightly and increased slightly for Inspire across all factory districts **(Figure 4)**. In 2017, RF values for both Eminent and Inspire increased **(Figure 4)**, ranging from 27.1 in the Moorhead district to 57.0 in the Hillsboro district **(Figure 5)**.

The RF values of *C. beticola* isolates to Proline from 2016 to 2017 were 6.5 and 9.1 respectively, much lower than either Eminent or Inspire RF values **(Figure 4),** and was observed in every factory district **(Figure 5).** Proline has become more widely used for managing CLS in recent years.

The resistance to the triazole fungicides we see in US isolates of *C. beticola* is due to overexpression of Cyp51 enzyme, and not due to a specific genetic mutation, so it will be difficult to develop a PCR assay for this group of fungicides. In companion studies we have conducted, higher levels of resistance to triazole fungicides are present in *C. beticola* isolates collected from Italy and France than found in the RRV production area. We do not know if the he reduction in RF values indicates a fitness penalty or not, but it will continue to be important to monitor resistance to triazole fungicides in the RRV region due to their widespread use. We are testing other DMI fungicides in our lab for their activity against *C. beticola*, but unfortunately, most of them are not registered for CLS management.

**HEADLINE.** Beginning in 2012, a PCR based molecular procedure was used to test for the presence of the G143A mutation in *C. beticola* using the remainder of the composite spore sample containing approximately 2500-5000 spores. The presence of this mutation indicates absolute resistance to Headline. The results are placed in five categories based on an estimate of the percentage of spores with the G143A mutation: S = no spores with G143A; S/r = <50 of the spores with G143A; S/R = equal number of spores with G143A; R/s >50% of the spores with G143A; and R = all spores with G143A**.** The G143A mutation was first detected in the RRV production area in 2012 and incidence of this mutation has increased in the population of isolates we test every year since then. Resistance to Headline in 2017 was similar to 2016. Across all factory districts in 2017, 10.9% of the isolates collected had all spores without the G143A mutation; the G143A mutation was found in 89.1% of the samples, and 64.2% of the samples had >50 of the spores with the G143A mutation (**Figure 6**). Samples with an R rating (all spores resistant) increased from 40.0% to 55.8% **(Figure 6).** Resistance (R) was detected in all factory districts ranging 45.6% in the East Grand Forks district to 70.3% in the Moorhead district (**Figure 7)**. Samples with S (all spores sensitive) ranged from 3,0% in the SMBSC district to 10.9% in the Moorhead district. Based on this data, the QoI fungicides Headline and Gem will likely not control CLS and will not be widely used in the near future. Although this is a stable mutation, we will continue to partially monitor for resistance to Headline in the RRV production area, particularly because Headline is often the only fungicide used, and is used annually even in the absence of disease. We do not know if there is a fitness penalty associated with the G143A mutation, but based on observation in MI and Italy, Austria and Serbia, where QoI resistance due to the G143A mutation is widespread. it appears that isolates with the G143A mutation are stable and can survive and increase in the population.

An increasing concern is the development of *C. beticola* isolates with resistance (reduced sensitivity) to more than one fungicide. Of the isolates tested in 2017:

25.9% were resistant to Eminent > 1ppm
47.1% were resistant to Inspire > 1ppm
97% were resistant to tin >1 ppm
89.1% were resistant to Headline
27.7% were resistant to tin plus a DMI
14.0% were resistant to tin plus Headline plus a DMI

In 2016, 14.4% of the isolates tested were resistant to tin plus a DMI plus Headline.

Previously we conducted a greenhouse trial to determine if isolates of *C. beticola* with high levels of resistance results in decreased disease control by field application rates of Eminent compared with isolates sensitive to Eminent. Results of this work showed that the break point for causing more disease was the $EC_{50}$ value of >1 µg/ml. At this value, there was significantly more disease when the field rate of Eminent was used. This trial was conducted using a CLS susceptible variety. We repeated this study using a CLS resistant variety to see if the break point results were the same or not. The break point for disease loss for a CLS resistant variety increased to the $EC_{50}$ value of 10 µg/ml. After this level of resistance, there was a significant loss in disease control. This study suggests that variety resistance increases the level *of C. beticola* isolated resistance necessary for disease loss five-fold. A solid recommendation for CLS management will be to use varieties with good CLS resistance, and to find higher levels of resistance in future years. The use of varieties with increased levels of resistance will be important to manage CLs in future years and breeding for CLS resistance should be encouraged. Differences in aggressiveness among isolates may account for inconsistency of data and should be considered during resistance breeding. Measuring disease loss due to fungicide resistance is difficult, and additional work is necessary to confirm and document the results of these preliminary trials with CLS and Eminent resistant to *C. beticola*.

**SUMMARY**

1. Resistance to Tin at 1.0 µg/ml almost disappeared in our region from 2003-2010, but has increased since 2011, probably due to increased use. In 2017, isolates from 97% of the fields samples had some resistance to tin (incidence), with a mean germination rate of 28% (severity). Tin resistance was found in all factory districts.

2. Topsin was not tested in 2017.

3. Resistance to both Eminent and Inspire, as measured by RF values, increase slightly in 2017 in all factory districts. The RF values for Proline were much lower that either Eminent or Inspire.

4. The incidence of isolates with the G143A mutation that results in resistance to Headline remained about the same in 2017 as it was in 2016 across all factory districts. Approximately 90% of the fields sampled have some level of resistance to Headline, and approximately 50% of the fields sampled have >50% of the spores resistant to Headline. These findings may limit the effective use of Headline for CLS management in future years.

5. The incidence of *C. beticola* isolates with resistance to multiple fungicides is a concern. About 14 % of our isolates have resistance to five fungicides.

6. *C. beticola* isolates with resistance caused more disease (leaf spots) than sensitive plants treated with Eminent at the field rate in greenhouse trials, and isolates with resistance can cause as much or disease than the sensitive isolates in plants not treated with Eminent. There is a difference between CLS susceptible and resistant varieties disease loss based on isolate resistance to Eminent. The $EC_{50}$ value break point for significant disease loss for a susceptible variety is 1.0 µg/ml for the susceptible varieties compared to a break point of 10.0 µg/ml for a resistant variety

7. We recommend continuing disease control recommendations currently in place including fungicide rotation, using high label rate of fungicides, mixtures with mancozeb or copper, scouting at end of the season to decide the necessity of a late application, using fungicide resistance maps for fungicide selection, using a resistant variety, spray intervals of 14 days, and applying fungicides to insure maximum coverage. It appears that early fungicide applications in 2017 helped manage CLS and early applications should continue in 2018. Improved disease control may be possible with improvements in fungicide coverage using proper spray nozzles and spray parameters such as ground speed, timing and gallonage.

Figure 1. Incidence of fields with *C. beticola* resistant to Tin at 1.0 µg/ml as measured by spore germination collected in ND and MN from 1998 to 2017

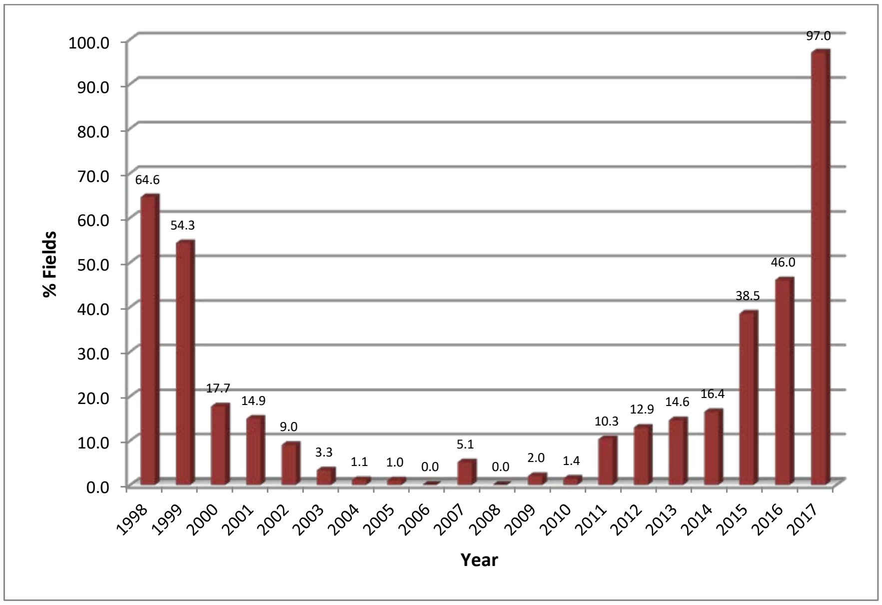


Figure 2. Incidence and severity of Tin resistance in *C. beticola* isolates collected from sugarbeet fields in ND and MN from 2003 to 2017

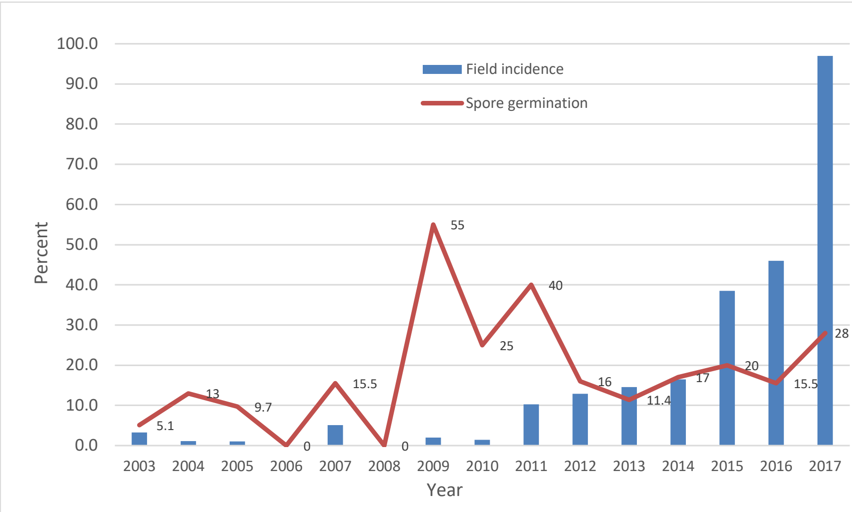



Figure. 3. Incidence of fields with *C. beticola* isolates collected in ND and MN resistant to Tin from 2013 to 2017 by factory district

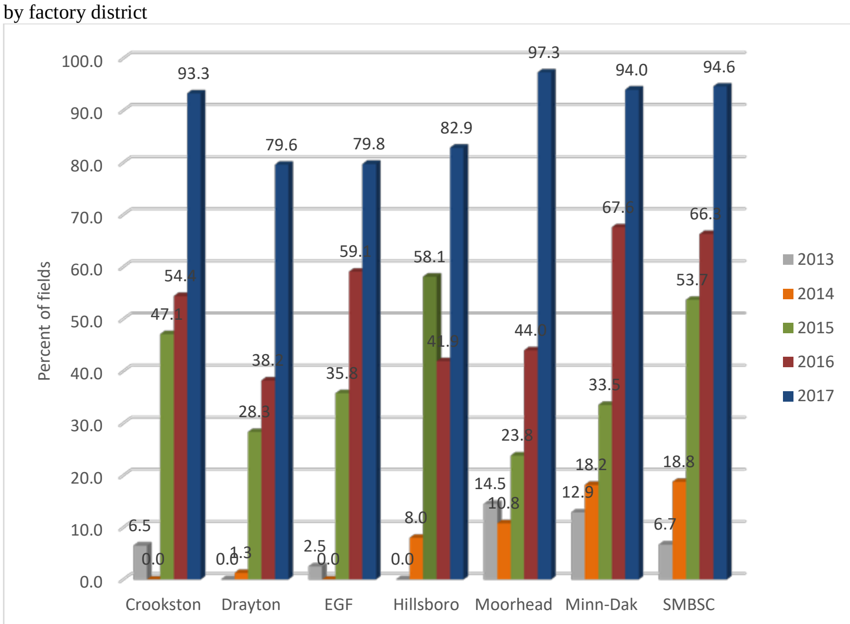


Figure 4. Resistance Factor values of *C. beticola* isolates collected in ND and MN from 2007-2017 to Eminent (tetraconazole), Inspire (difenoconazole) and Proline (prothioconazole)

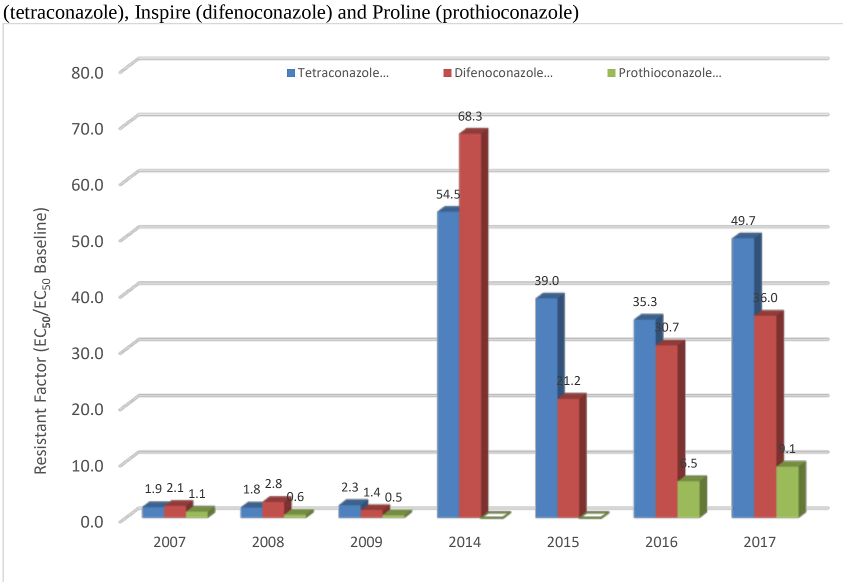



Figure 5. Sensitivity of *C. beticola* isolates collected in 2017 to Eminent, Inspire and Proline by factory district as expressed by Resistance Factor values

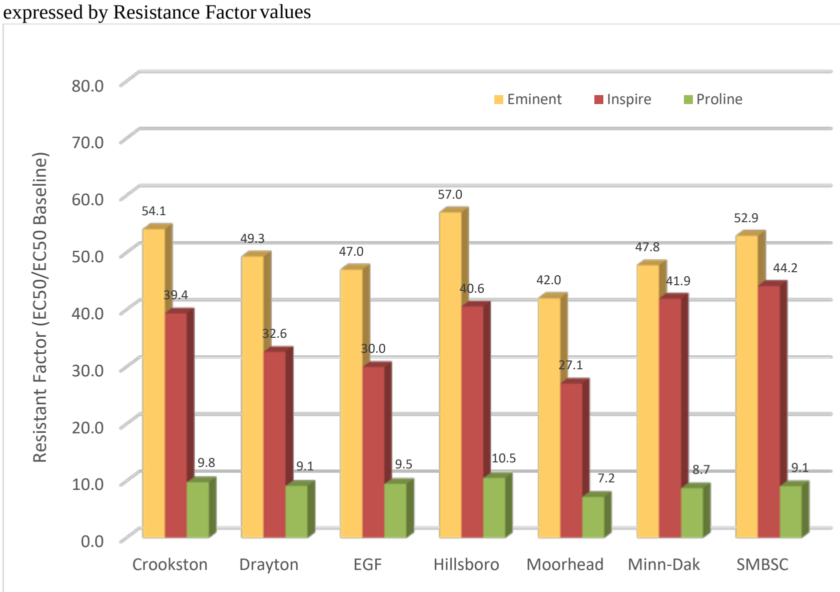


Figure 6. Sensitivity of *C. beticola* isolates collected in ND and MN to Headline from 2012 to 2017 as expressed by the percentage of spores with G143A mutation

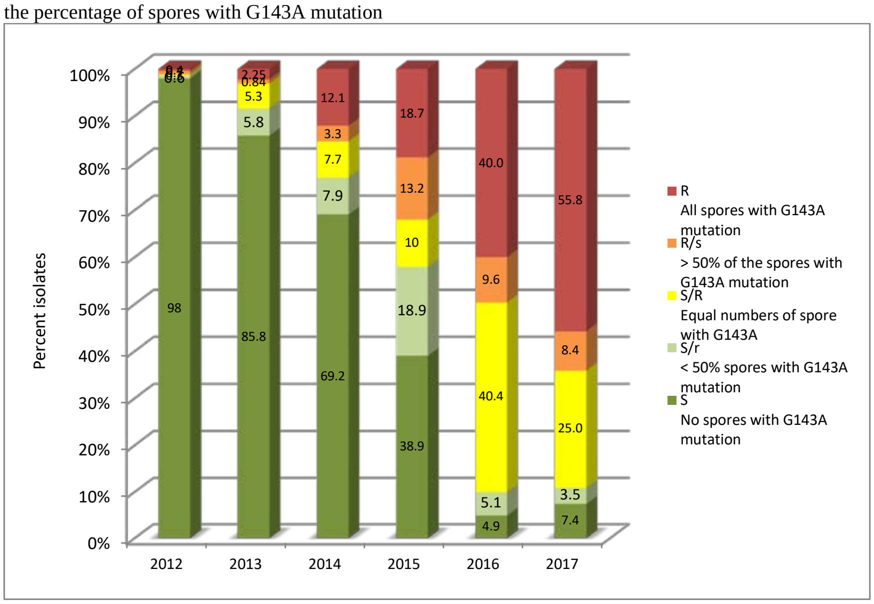
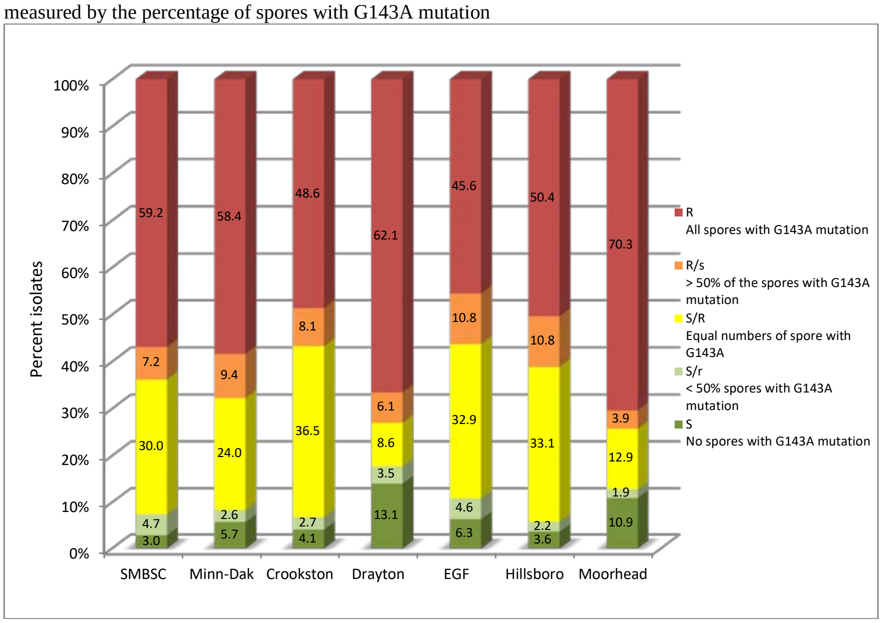



Figure 7. Sensitivity of *C. beticola* isolates collected in ND and MN in 2016 to Headline by factory district as measured by the percentage of spores with G143A mutation



**EFFICACY OF FUNGICIDES FOR CONTROLLING CERCOSPORA LEAF SPOT ON SUGARBEET**

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Cercospora leaf spot (CLS), caused by the fungus *Cercospora beticola* Sacc., is the most economically damaging foliar disease of sugarbeet in Minnesota and North Dakota. The disease reduces root yield and sucrose concentration and increases impurity concentrations resulting in reduced extractable sucrose and higher processing losses (Smith and Ruppel, 1973; Khan and Smith, 2005). Roots of diseased plants do not store well in storage piles that are processed in a 7 to 9 month period in North Dakota and Minnesota (Smith and Ruppel, 1973). Cercospora leaf spot is managed by integrating the use of tolerant varieties, reducing inoculum by crop rotation and tillage, and fungicide applications (Khan et al; 2007). It is difficult to combine high levels of Cercospora leaf spot resistance with high recoverable sucrose in sugarbeet (Smith and Campbell, 1996). Consequently, commercial varieties generally have only moderate levels of resistance and require fungicide applications to obtain acceptable levels of protection against Cercospora leaf spot (Miller et al., 1994) under moderate and high disease severity.

The objective of this research was to evaluate the efficacy of fungicides used in rotation to control Cercospora leaf spot on sugarbeet.

## MATERIALS AND METHODS

A field trial was conducted at Foxhome, MN in 2017. The experimental design was a randomized complete block with four replicates. Field plots comprised of six 30-feet long rows spaced 22 inches apart. Plots were planted on 5 May with a variety susceptible to Cercospora Leaf Spot. Seeds were treated with Tachigaren (45 g/kg seed), Kabina 14g and Nipsit Inside. Seed spacing within the row was 4.7 inches. Weeds were controlled with two herbicide applications on 1 June and 19 June. Quadris was applied on 24 May and 6 June to control *Rhizoctonia solani*. Plots were inoculated on 29 June with *C. beticola* inoculum.

Fungicide spray treatments were applied with a $CO_2$ pressurized 4-nozzle boom sprayer with 11002 TT TwinJet nozzles calibrated to deliver 17 gpa of solution at 60 p.s.i pressure to the middle four rows of plots. All fungicide treatments were initiated on 19 July. Most treatments included four fungicide applications on 19 July, 31 July, 21 August and 6 September. One treatment received applications on a shorter interval and had application dates of 19 July, 31 July, 7 August, 21 August and 6 September. Treatments were applied at rates indicated in Table 1.

Cercospora leaf spot severity was rated on the leaf spot assessment scale of 1 to 10 (Jones and Windels, 1991). A rating of 1 indicated the presence of 1- 5 spots/leaf or 0.1% disease severity and a rating of 10 indicated 50% or higher disease severity. Cercospora leaf spot severity was assessed five times during the season. The rating performed on 16 September is reported.

Plots were defoliated mechanically and harvested using a mechanical harvester on 20 September. The middle two rows of each plot were harvested and weighed for root yield. Twelve to 15 representative roots from each plot, not including roots on the ends of the plot, were analyzed for quality at the American Crystal Sugar Company Quality Tare Laboratory, Moorhead, MN. The data analysis was performed with the ANOVA procedure of the Agriculture Research Manager, version 8 software package (Gylling Data Management Inc., Brookings, South Dakota, 2010). The least significant difference (LSD) test was used to compare treatments when the F-test for treatments was significant.

## RESULTS AND DISCUSSIONS

Environmental conditions (especially moisture in the form of rainfall) were not favorable for rapid development of *C. beticola* after inoculation on 29 June and first symptoms at very low incidence were not visible until mid-July. On 11 August, CLS rating for the non-treated check was 4.2, still below the CLS rating (6.0) at which economic losses typically occur. Rainfall events during the week of 13 through 19 of August resulted in favorable conditions for rapid disease development as indicated by a CLS rating of 9.3 for the non-treated check on 24 August, followed by loss of mature leaves and re-growth of new leaves in the first week of September.
The CLS population was resistant to QoI fungicides and had the G143A mutation. CLS was effectively controlled when mixtures with different modes of action used individually at full or ¾ the recommended rates were used, and

when applications were made at 14 day and 10 to 12 day intervals. It was not possible to apply treatments scheduled for 14 July because of wet field conditions, resulting to a later application date on 21 August. The non-treated check had significantly higher CLS ratings compared to the fungicide treatments (Table 1). The fungicide treatments provided effective control of CLS which resulted in significantly higher sugar concentration, recoverable sucrose per acre, and recoverable sucrose per ton of sugarbeet compared to the non-treated check.

This research indicated that fungicides should be applied starting promptly at first symptoms of CLS and continued during the season once environmental conditions are favorable for disease development since our field have a high pathogen population. Each application should comprise of at least two modes of action, and when necessary such as during periods of regular rainfall, spray interval should be reduced from 14 to 10 to 12 days. In this trial, fungicide application was discontinued in early September to facilitate harvesting in mid- to late-September.

General comments for Cercospora leaf spot control in growers' fields in North Dakota and Minnesota where inoculum levels will probably be high in 2018 and CLS tolerant (KWS ratings of 5.2 and less) varieties are grown:

1. The first fungicide application should be made when disease symptoms are first observed (which entails scouting after row closure). If the first application is late, control will be difficult all season.
2. Subsequent applications should be made when symptoms are present and environmental conditions (2 consecutive days DIV obtained at http://ndawn.ndsu.nodak.edu) are favorable (DIV $\geq$7) for disease development.
3. Use mixtures of fungicides that are effective at controlling Cercospora leaf spot in an alternation program.
4. Use the recommended rates of fungicides to control Cercospora leaf spot.
5. During periods of regular rainfall, shorten application interval from 14 days to 10 to 12 days; use aerial applicators during periods when wet field conditions prevent the use of ground rigs.
6. Limit or avoid using fungicides to which the pathogen population has become resistant or less sensitive.
7. Only one application of a benzimidazole fungicide (such as Topsin M 4.5F) in combination with a protectant fungicide (such as SuperTin). The use of TPTH mixed with a QoI or DMI fungicides will increase the effectiveness of the QoIs and DMIs.
8. Limiting the use of Qoi's (strobilurins) to one application for control of QoI sensitive populations of *C. beticola* will prolong the effectiveness of these fungicides. Limit the total number of DMI fungicides to 50% or less of the total number of fungicide applications in a season for CLS.
9. Use high volumes of water (15 to 20 gpa for ground-rigs and 3 to 5 gpa for aerial application) with fungicides for effective disease control.
10. Mix, mix, Mix! Try to alternate mixtures with different modes of action for controlling CLS and managing fungicide resistance.

The following fungicides in several classes of chemistry are registered for use in sugarbeet:

| **Strobilurins** | **Sterol Inhibitors** | **Ethylenebisdithiocarbamate (EBDC)** |
|---|---|---|
| Headline/Pyrac | Eminent/Minerva | Penncozeb |
| Gem | Inspire XT | Manzate |
| Quadris | Proline | Mancozeb |
| Priaxor | Minerva Duo | Maneb |
| | Enable | |
| | Topguard | |

| **Benzimidazole** | **TriphenylTin Hydroxide (TPTH)** | **Copper** |
|---|---|---|
| Topsin | SuperTin | Kocide |
| | AgriTin | Badge |
| | | Champion |

**Table 1. Effect of fungicides on Cercospora leaf spot control and sugarbeet yield and quality at Foxhome, MN in 2017.**

| Treatment and rate/A | CLS* | Root yield | Sucrose concentration | Recoverable sucrose | | Returns** |
|---|---|---|---|---|---|---|
| | 1-10 | Ton/A | % | lb/Ton | lb/A | $/A |
| Inspire XT 5.3 fl oz + Topsin 7.6 fl oz/ Super Tin 6 fl oz + Manzate 1.2 qt/ Minerva Duo 16 fl oz/ Super Tin 6 fl oz + Manzate 1.2 qt/ Proline 3.8 fl oz + NIS 0.125 %v/v + Manzate 1.2 qt*** | 4.3 | 36.48 | 17.63 | 331.6 | 12,085 | 1,449.47 |
| Minerva Duo 16 fl oz/ Super Tin 6 fl oz + Manzate 1.2 qt/ Priaxor 6 fl oz + Manzate 1.2 qt/ Inspire XT 5.3 fl oz + Manzate 1.2 qt | 4.8 | 34.93 | 18.05 | 338.2 | 11,774 | 1,448.65 |
| Inspire XT 7 fl oz + Topsin 10 fl oz/ Super Tin 8 fl oz + Manzate 1.6 qt/ Minerva Duo 16 fl oz/ Super Tin 8 fl oz + Manzate 1.6 qt | 4.8 | 34.38 | 17.53 | 329.2 | 11,309 | 1,349.46 |
| Inspire XT 5.3 fl oz + Manzate 1.2 qt/ Super Tin 6 fl oz + Manzate 1.2 qt/ Minerva Duo 16 fl oz/ Super Tin 6 fl oz + Manzate 1.2 qt | 5.0 | 34.68 | 17.38 | 325.5 | 11,271 | 1,338.25 |
| Inspire XT 5.3 fl oz + Super Tin 6 fl oz/ Super Tin 6 fl oz + Manzate 1.2 qt/ Priaxor 6 fl oz + Manzate 1.2 qt/ Minerva Duo 12 fl oz + Manzate 1.2 qt | 4.8 | 33.00 | 17.65 | 331.5 | 10,923 | 1,305.95 |
| Manzate 1.2 qt + Topsin 7.6 fl oz/ Inspire XT 5.3 fl oz + Super Tin 6 fl oz/ Priaxor 6 fl oz + Super Tin 6 fl oz/ Minerva Duo 16 fl oz | 5.5 | 33.85 | 17.45 | 325.5 | 11,015 | 1,298.22 |
| Inspire XT 5.3 fl oz + Topsin 7.6 fl oz/ Super Tin 6 fl oz + Manzate 1.2 qt/ Minerva Duo 16 fl oz/ Super Tin 6 fl oz + Manzate 1.2 qt | 5.5 | 32.60 | 17.43 | 328.6 | 10,704 | 1,288.07 |
| Super Tin 6 fl oz + Topsin 7.6 fl oz/ Inspire XT 5.3 fl oz + Badge 3 pt/ Super Tin 6 fl oz + Manzate 1.2 qt/ Minerva Duo 12 fl oz + Badge 3 pt | 5.3 | 34.28 | 17.43 | 327.7 | 11,218 | 1,278.67 |
| Super Tin 6 fl oz + Manzate 1.2 qt + Topsin 7.6 fl oz/ Inspire XT 5.3 fl oz + Manzate 1.2 qt/ Super Tin 6 fl oz + Manzate 1.2 qt | 5.3 | 35.23 | 16.83 | 312.2 | 10,957 | 1,245.46 |
| Inspire XT 5.3 fl oz + Manzate 1.2 qt/ Super Tin 6 fl oz + Manzate 1.2 qt/ Priaxor 6 fl oz + Super Tin 6 fl oz/ Proline 3.8 fl oz + NIS 0.125 % v/v + Manzate 1.2 qt | 5.3 | 33.15 | 17.33 | 323.6 | 10,716 | 1,238.33 |
| Super Tin 6 fl oz + Manzate 1.2 qt + Topsin 7.6 fl oz/ Inspire XT 5.3 fl oz + Manzate 1.2 qt/ Super Tin 6 fl oz + Manzate 1.2 qt/ Priaxor 6 fl oz + Super Tin 6 fl oz | 5.0 | 34.18 | 17.18 | 318.6 | 10,853 | 1,235.36 |
| Super Tin 6 fl oz + Topsin 7.6 fl oz/ Inspire XT 7 fl oz/ Priaxor 8 fl oz/ Super Tin 8 fl oz | 5.8 | 33.95 | 16.95 | 315.1 | 10,692 | 1,220.30 |
| Inspire XT 7 fl oz + Manzate 1.6 qt/ Manzate 1.6 qt/ Proline 5 fl oz + NIS 0.125 %v/v + Topsin 10 fl oz/ Manzate 1.6 qt | 5.5 | 34.58 | 16.95 | 315.0 | 10,900 | 1,219.74 |
| Super Tin 8 fl oz + Topsin 10 fl oz/ Inspire XT 7 fl oz + Manzate 1.6 qt/ Super Tin 8 fl oz + Manzate 1.6 qt/ Minerva Duo 16 fl oz | 4.8 | 34.63 | 17.00 | 313.9 | 10,847 | 1,206.47 |
| Super Tin 8 fl oz + Topsin 10 fl oz/ Inspire XT 7 fl oz + Badge 4 pt/ Super Tin 8 fl oz + Manzate 1.6 qt/ Minerva Duo 16 fl oz + Badge 1.6 qt | 4.8 | 34.70 | 17.66 | 329.8 | 11,439 | 1,154.38 |
| Super Tin 6 fl oz + Manzate 1.2 qt + Topsin 7.6 fl oz/ Inspire XT 5.3 fl oz + Manzate 1.2 qt | 5.3 | 34.03 | 16.86 | 314.3 | 10,696 | 1,122.37 |
| Untreated Check | 10.0 | 29.90 | 15.13 | 277.0 | 8,289 | 831.06 |
| **LSD (P=0.05)** | **0.75** | **3.68** | **0.69** | **17.18** | **1,160** | **225.93** |

*Cercospora leaf spot measured on 1-10 scale (1 = 1- 5 spots/leaf or 0.1% severity and 10 = 50% severity) on 8 September.
**Returns based on American Crystal payment system and subtracting fungicide costs and application.
***Treatment applied on 10-12 day interval.

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## PLANT-PARASITIC NEMATODES ON SUGARBEET IN NORTH DAKOTA AND MINNESOTA

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### INTRODUCTION AND OBJECTIVES

Plant-parasitic nematodes are one of the important groups of pests on sugarbeet. The sugarbeet cyst nematode (*Heterodera schachtii*) is a major pest affecting sugarbeet production in the world (Khan et al. 2016a). This nematode was identified to be the major cause of "beet weariness" which was responsible for the closure of many sugarbeet processing factories in Germany (Harveson and Jackson 2008). Sugarbeet cyst nematode (SBCN) was first discovered in the U. S. in Utah in 1895 and has spread to at least 17 states (Stewart et al. 2014). In 2012 the SBCN was first reported officially in the Yellowstone Valley of western North Dakota (Nelson et al. 2012). Sugarbeet production in Utah and Washington has been terminated largely due to heavy infestations of SBCN which has made growing of sugarbeet unprofitable. In Michigan, this nematode significantly lowered sugarbeet yield and quality, and the estimate of the annual economic loss caused by SBCN to the Michigan Sugar Cooperative is about 5-10 million dollars (Stewart et al. 2014).

Apart from the SBCN, several other nematodes such as stubby root, sting, needle, spiral, sheath, stem and bulb, root knot, false root not, and potato rot nematodes have been reported as pests on sugarbeet in California, Idaho, Colorado, and other parts of the world. However, they are not known to be a factor for sugarbeet production in North Dakota and Minnesota. Infection with plant-parasitic nematodes often enhances infection by *Rhizoctonia* and other root disease pathogens, which increases the overall effect of the nematode damage.

In June 2015, we received approximately 50 samples from the agriculturists at American Crystal Sugar Company and other extension people. Some of the samples looked like injury from stubby root nematode, needle nematode, or sting nematode. In general these plants were stunted compared to the rest of the field and the roots had very short necrotic lateral roots. Some of the samples were pulled from "sand syndrome" fields in certain areas of the Red River Valley. Six groups of plant-parasitic nematodes were detected including soybean cyst nematode, stubby-root, root-lesion, pin, spiral, and stunt nematodes. In one field with sand syndrome, stubby root nematodes were detected from the area of small and stunted plants but were not detected in the area with healthy plants, which led to the first detection of the stubby root nematode *Paratrichodorus allius* on sugar beet in Minnesota (Yan et al. 2016, Khan et al. 2016b). However, the information on incidence, distribution and species of the plant-parasitic nematodes across North Dakota and Minnesota is limited. The host range of northern-grown crops to the stubby root nematode and effect of the vermiform plant-parasitic nematodes on sugar beet plant growth and crop yield are also not known.

The objectives of this research were to 1) conduct a survey of sugarbeet fields in North Dakota and Minnesota to determine the incidence, abundance and distribution of cyst nematodes and vermiform plant-parasitic nematodes; 2) determine the effect of vermiform plant-parasitic nematodes on plant growth of five sugarbeet cultivars commonly grown in ND and MN; 3) determine the host range of stubby root nematode (*P. allius*), especially for those crops such as wheat, corn, barley, soybean, and sunflower grown in rotation with sugar beet; and 4) evaluate sugarbeet varieties in ND and MN for resistance to *P. allius*.

### MATERIALS AND METHODS

Soil and root samples were collected three times once during spring, once in late summer, and once during harvest from sugarbeet fields in the Red River Valley of ND and MN. We worked in collaboration with sugar beet company representatives, sugarbeet producers and extension personnel to identify fields which might be infested with SBCN. Fields with poor sugarbeet growth possibly due to plant-parasitic nematodes were targeted for sampling. A total of 109 soil samples were collected from sugarbeet fields in eight counties in ND, four counties in MN, and one county in Montana. A soil sample consisted of 15-20 soil cores each in 2.5 cm in diameter by 30 cm deep.

Standard laboratory protocols were used in our lab for extracting nematodes from all of the samples and plant-parasitic nematodes including cyst nematodes and vermiform plant-parasitic nematodes were quantified using microscopy. Molecular procedures were optimized and utilized to differentiate SBCN from soybean cyst nematode that were found in sugarbeet fields (Ye 2012). Economically important vermiform plant-parasitic nematodes or nematode pathogens in high densities were attempted to be identified to species using molecular and morphological methods. A panel of nematode control species were requested and obtained from the USDA-ARS Nematology Laboratory in Beltsville MD.

Vermiform plant-parasitic nematode populations were extracted from soil from a naturally infested field to evaluate their effects on plant growth of five sugarbeet cultivars (BTS 8337, Crystal M375, BTS 80RR52, Maribo MA305, BTS 73MNRP). The nematode inoculum were used to inoculate sugarbeet plants under controlled conditions in the greenhouse. At harvest, plants are assessed for emergence rate, plant height, shoot dry weight, root dry weight, and final nematode density. The nematode reproductive factor will be determined by dividing the final nematode population by the initial population inoculated into each pot.

Hosting abilities of sugarbeet and rotational crops to the stubby root nematode will be determined. Northern-grown crops, including wheat, corn, soybean, barley, and sunflower, which are commonly grown in rotation with sugarbeet were evaluated as hosts for the stubby root nematode. Seven sugarbeet cultivars and five rotational crops were included; sugarbeet cultivars: BTS 8337, Crystal M375, BTS 80RR52, BTS 73MNRP, BTS 82RR28, Maribo MA305 and BTS 8500; wheat cultivars: Faller, Glenn, Elgin, Barlow and Brenan; corn cultivars: DK 43-46, DK 43-48, DK 44-13, 1392VT2P and LR9487VT2PRIB; soybean cultivars: Sheyenne, Barnes, HO9X7, SB-88O7N and LS-1335NRR2X; barley: Quest and ND-Genesis; and sunflower: Croplan 306 and Mycogen 8N270. A sugarbeet cultivar (BTS 73MNRP) with resistance/tolerance to sugarbeet cyst nematode were included in evaluation for resistance to stubby root nematode.

**RESULTS AND DISCUSSIONS**

In 2017, soil samples (109) were collected from sugarbeet fields in 8 counties (73 samples from Richland, Walsh, Pembina, Grand Forks, Cass, Traill, Benson, Williams) in ND, 4 counties (34 samples from Clay, Norman, Carver, Aitkin) in MN, and one county (2 samples from Richland) in Montana. Nine groups of plant-parasitic nematodes were detected including cyst nematode, stubby-root, root-lesion, pin, spiral, stunt, dagger, ring and lance nematodes. Thirty-eight soil samples (35%) were infested with stunt nematodes ranging from 20 to 620/100 cc of soil (Table 1, Figure 1). Thirty-five soil samples (32%) contained pin nematodes from 15 to 500/100 cc of soil. Twenty-six soil samples (24%) had spiral nematodes at 15 - 720/100 cc of soil, 11 soil samples (10%) had stubby root nematodes at 15 - 100/100 cc of soil, four samples had root-lesion nematodes at 20 - 60/100cc soil, one sample (1%) had ring nematode at 23/100cc soil, one sample (1%) had dagger nematode at 20/100cc soil, and one sample (1%) had lance nematode at 20/100cc soil (Table 1, Figure 1). Twenty soil samples (18%) were found to have cyst nematodes at 100-8,560/100 cc of soil. The average population densities of these nine groups of plant-parasitic nematodes were calculated, ranging from 20 to 1,196 (Table 1).

Soybean cyst nematode was first detected in ND in 2003 and in MN in 1978 (Bradley et al. 2004, Porter and Chen 2005). Infestation of soybean cyst nematode has spread to many soybean fields in which soybean is a rotational crop of sugarbeet. The soybean cyst nematode and the SBCN have very similar morphology and distinction between them is difficult and time consuming based on morphology using microscopic methods. Molecular procedures were optimized and utilized to identify the cyst nematodes to the species level. The cyst nematodes in nine soil samples were tested using species-specific PCR assays and DNA sequencing. Seven of the samples from ND and MN showed PCR bands specific for soybean cyst nematode using soybean cyst nematode-specific primers but did not produce amplification using sugarbeet cyst nematode-specific PCR primers, indicating these cyst nematodes were soybean cyst nematode but not sugarbeet cyst nematode. Two of the samples from Montana close to the border of ND showed PCR bands specific for sugarbeet cyst nematode using sugarbeet cyst nematode-specific primers but did not produce amplification using soybean cyst nematode-specific primers, indicating these cyst nematodes were sugarbeet cyst nematode. DNA sequencing results confirmed that the samples from ND and MN sugarbeet fields are soybean cyst nematode and the samples from MT sugarbeet fields are sugarbeet cyst nematode.

Likewise, the stubby root nematode we found was identified as *Paratrichodorus allius* using species-specific PCR. This confirms the presence of the stubby root nematode *P. allius* in sugarbeet fields in ND and MN. To determine the species identity of other plant-parasitic nematodes, PCR products from these samples were purified and sequenced. The root-lesion nematode in two samples was identified as *Pratylenchus neglectus*. The spiral nematode in one sample was identified as *Helicotylenchus pseudorobustus*, and pin nematode in one sample was determined as *Paratylenchus nanus*. The stunt nematodes in three samples were identified as a new species that haven't been reported in any literature. More work is needed to further validate the species identity of these plant-parasitic nematodes.

On September 15, 2017, one composite soil sample with 67 stubby root nematodes/100 cc soil along with 160 pin, 160 stunt and 220 spiral nematodes, collected from a field (Cavalier, ND) with a history of "sand syndrome", was used to inoculate seven varieties of sugarbeet, five varieties of each of wheat, corn and soybean crops, and two varieties of each of barley and sunflower. Each of these entries plus one unplanted control were planted in 5 replicates. This set of experiments was harvested on December 22, 2017 and the nematodes are being extracted, identified and counted to determine the resistance reactions of the sugarbeet varieties and hosting abilities of the crop species and varieties.

A soil sample was collected from a field infested with stubby root nematodes. This field (Cavalier, ND) has a history of "sand syndrome". Stubby root nematodes with other vermiform nematodes were extracted from 138 subsamples of the soil for obtaining enough inoculum. The soil was pasteurized to plant the five sugarbeet varieties for determining the effect of nematodes on plant growth by comparing to the plants inoculated with the vermiform nematodes extracted. Two sets of experiments were set up on November 1, 2017 and November 27, 2017, and will be harvested in February.

Table 1. The population densities of plant-parasitic nematodes in 100 cc of soil from 109 soil samples collected from sugarbeet fields.

| Nematode Common Name | Nematode Scientific Name | Lowest Density | Highest Density | Average Density |
|---|---|---|---|---|
| Spiral | *Helicotylechus* | 15 | 720 | 133 |
| Stunt | *Tylenchorhynchus* | 20 | 620 | 83 |
| Pin | *Paratylenchus* | 15 | 500 | 104 |
| Lesion | *Pratylenchus* | 20 | 60 | 40 |
| Dagger | *Xiphinema* | 20 | 20 | 20 |
| Stubby root | *Paratrichodorous* | 15 | 100 | 36 |
| Cyst nematode | *Heterodera* | 100 | 8,560 | 1,196 |
| Ring | *Mesocriconema* | 23 | 23 | 23 |
| Lance | *Hoplolaimus* | 20 | 20 | 20 |

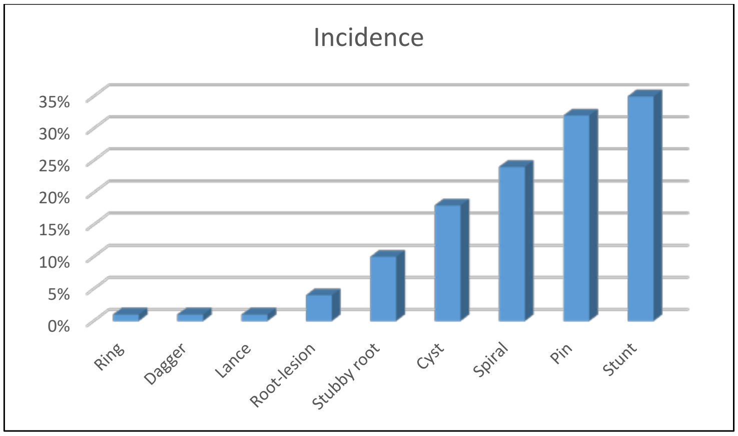


Figure 1. The occurrence frequency (incidence) of plant-parasitic nematodes in 109 soil samples collected from sugarbeet fields.

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# SCREENING OF SUGAR BEET GERMPLASM FOR RESISTANCE TO FUSARIUM YELLOWING DECLINE

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*Fusarium* spp. can lead to significant economic losses for sugar beet growers throughout the United States production region by causing reductions in yield from several associated diseases (Campbell, Fugate, and Niehaus 2011;Hanson and Hill 2004;Hanson and Jacobsen 2009;Stewart 1931) including Fusarium yellows (Stewart 1931) and Fusarium tip root (Harveson and Rush 1998;Martyn et al. 1989). In 2008, a new sugar beet disease was found in the Red River Valley of MN and ND which caused *Fusarium* yellows-like symptoms but turned out to be more aggressive than Fusarium yellows (Rivera et al. 2008). Symptoms differed from the traditional Fusarium yellows by causing discoloration of petiole vascular elements as well as seedling infection and rapid death of plants earlier in the season. Subsequent studies confirmed that the causal agent of this disease was different from any previously described *Fusarium* species and was therefore named *F. secorum* and the disease it causes as Fusarium yellowing decline (Secor et al. 2014).

*F. secorum* was shown to belong to the *Fusarium fujikuroi* species complex whereas Fusarium yellows is primarily caused by *Fusarium oxysporum* f. sp. *betae* (Ruppel 1991;Snyder and Hansen 1940) but can be caused by other *Fusarium* spp. including *F. acuminatum*, *F. avenaceaum*, *F. solani,* and *F. moniliforme* (Hanson and Hill 2004). Currently, the most effective management strategy for the more common Fusarium yellows is through the use of resistant cultivars and crop rotations with non-hosts (Harveson, Hanson, and Hein 2009) with several sugar beet germplasm being reported to have some resistance (Hanson et al. 2009). However it is unknown if the resistance found in sugar beet to the more common Fusarium yellows will provide any protection against the emerging Fusarium yellowing decline. Therefore this project proposes to screen multiple sugar beet germplasm for resistance against *F. secorum* which causes Fusarium yellowing decline.

**Objectives:**

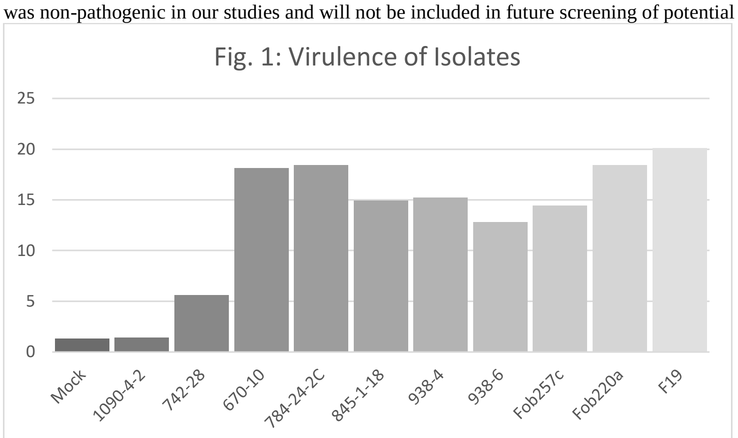
**Objective 1:** Screen select USDA-ARS, Fort Collins Sugar beet breeding program sugar beet germplasm with known resistance for Fusarium yellows for resistance to Fusarium yellowing decline caused by *F. secorum.* (in progress)

**Materials and Methods**

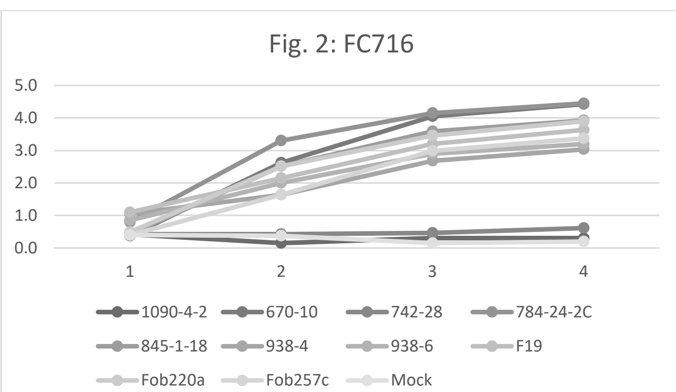
**Plant treatment(s).** Fifteen sugar beet lines/germplasm will be provided by the breeding program of Dr. Leonard Panella, USDA-ARS, Fort Collins, CO. Additionally, three sugar beet germplasm (Monohikori; FC716; and USH20) will be included as Fusarium yellows susceptible controls. Additional sugar beet lines provided by commercial sugar beet seed companies will be included as requested through lifetime of project. Experiments will be performed as previously described by Secor et al. (2014). Briefly, sugar beet seed will be planted into 6.5cm black plastic “conetainers” using pasteurized potting soil supplemented with Osmocote 14-14-14 slow release fertilizer (Scotts, Marysville, OH). Plants will be grown in a greenhouse with an average daytime temperature of 24°C and average nighttime temperature of 18°C and a 16h photoperiod for 4 weeks. Ten plants will be used for each treatment and will be performed using an augmented split block experimental design (Federer 2005). Briefly, germplasm will be randomly assigned to one of multiple “sets” of inoculations which will be based on the final number of sugar beet germplasm and *F. secorum* isolates. “Sets” will then represent the blocking for the statistical analysis for this experiment. Each inoculation “set” will then be used for two inoculation dates (experiments). At each inoculation date, two replicates will be performed where each isolate is inoculated to a block of five sugar beet plants per germplasm and replicate two times. Statistical analyses will be conducted using SAS Proc Glimmix (SAS Institute, version 9.2, Cary, NC, USA) and the best linear unbiased estimates (Blups) compared to the respective negative and positive controls.

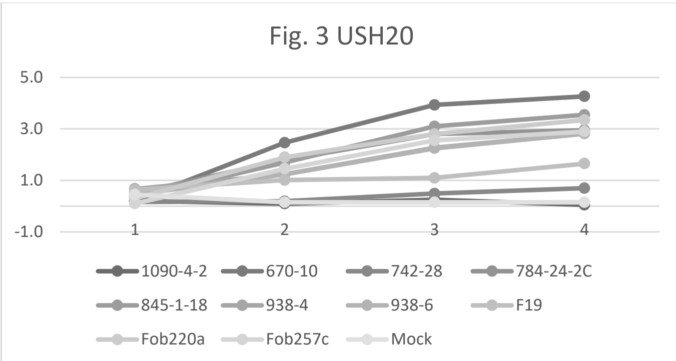
***Fusarium secorum* inoculations.** At inoculation, sugar beet plants that are at 4weeks after planting will be inoculated by dipping the root into a spore suspension of $1x10^5$ conidia $ml^{-1}$ for 2-8 min without agitation (Burlakoti et al. 2012;Secor et al. 2014). Plants will be inoculated with multiple isolates of *F. secorum* including the wild type *F. secorum* (670-10; Secor et al. 2014) and which represent the diversity of the pathogen population throughout the Red River Valley. *F. oxysporum* f. sp. *betae* isolate “F19” will be used as a known positive control for Fusarium yellows and distilled water as the negative control. Treated plants will be maintained in the greenhouse and evaluated for Fusarium yellowing decline symptoms on a weekly basis for 4 weeks after inoculation. Fusarium yellowing decline symptoms will be evaluated using a modified 0-5 Fusarium yellows disease severity rating (Hanson et al. 2009).

**Results and Discussion.** We were interested in two primary questions 1) Is there a variation in virulence of the *F. secorum* population and 2) Do sugar beet lines and/or cultivars differ in severity of Fusarium yellowing decline. In preliminary experiments, we determined that the *F. secorum* varies in virulence to sugar beet and that this is influenced by variety (Fig. 1). *F. oxysporum* isolates F19 and Fob220a and *F. secorum* isolates 670-10 and 784-24-2C are highly virulent, and mostly end up completely killing the sugar beet plants after 4weeks. *F. secorum* isolates 845-1-18, 938-4, and 938-6 and *F. oxysporum* Fob257c are moderately virulent. One *F. secorum* isolate 742-28, is weakly virulent only causing minor symptoms and is dependent on the cultivar in question. One isolate, 1090-4-2 was non-pathogenic in our studies and will not be included in future screening of potential resistant varieties.




Preliminary results have also indicated that sugar beet cultivars did react differently to the *F. secorum* isolates with some lines having more severe disease symptoms than others. In general, the most susceptible cultivar in these tests was VDH46177 and the least susceptible variety was USH20. Symptoms associated with *F. secorum* such as the half leaf yellowing also appeared to be associated with the cultivar being tested rather than based on isolate however, this trait was not specifically recorded. In future experiments we will record these observations for each isolate by genotype interaction. In general, each cultivar reacted differently to the isolates inoculated. For example, on sugar beet line FC716 all isolates tested caused generally the same amount of disease (Fig. 2) whereas on other lines such as USH20, a clear difference in the susceptibility to some isolates was observed (Fig. 3).






In conclusion, it appears that the *F. secorum* population varies in virulence to sugar beet but that this is similar to the variation that we see for Fusarium yellows caused by *F. oxysporum.* Likewise, there are differences in susceptibility of sugar beet and therefore it is important to screen for both *F. secorum* and *F. oxysporum* populations for each sugar beet production region. Testing for resistance to *F. secorum* was proposed for FY18-19 and findings will be reported in the future.

**METABOLOMIC ANALYSIS FOR IDENTIFICATION OF BIOLOGICAL FUNCTIONS ASSOCIATED WITH INFECTION BY AND RESISTANCE TO *BEET NECROTIC YELLOW VEIN VIRUS* IN SUGARBEET**

William M. Wintermantel, Kimberly Webb, Naveet Kaur and Corey Broeckling

**Background:**

Rhizomania, caused by *Beet necrotic yellow vein virus* (BNYVV), is one of the most economically important diseases affecting sugarbeet, and is widely distributed in most sugarbeet growing areas of the world. Fields remain infested with BNYVV indefinitely in *P. betae* cystosori that can remain dormant up to 25 years. Rotation to non-host crops or lengthening rotations is ineffective at reducing disease incidence, and to date the only viable means of control has been natural host-plant resistance. The *Rz1* source of resistance was introduced widely to commercial sugarbeet in the 1990s, and for several years has effectively controlled the virus. However, this resistance does not completely eliminate virus replication, but rather suppresses it to low levels compared to what one would find in a susceptible variety. The low level of replication in *Rz1* sugarbeet, has led to the emergence of new variants that overcome or "break" the resistance, since the main forms of the virus that can replicate in *Rz1* varieties are those few variants that have the ability to replicate in the presence of *Rz1*. In the early 2000s an *Rz1* resistance-breaking variant emerged in the Imperial Valley of California (Liu et al., 2005; Rush et al., 2006), and subsequent studies identified the presence of limited numbers of isolated resistance-breaking (RB) variants from most American production regions (Liu and Lewellen, 2007). RB isolates are increasingly affecting production throughout the US industry, and this can be expected to continue.

In addition to the well-known *Rz1* gene, several additional sources of genetic resistance to BNYVV have been identified, and they hold promise. Although these additional genes are being incorporated into sugarbeet varieties, the inability of any of these genes to completely eliminate BNYVV replication leaves all known resistance genes prone to eventual breakdown, even when the genes are "stacked" or combined in order to enhance resistance and make it more difficult for RB strains to establish in plants. It is critically important that rhizomania be studied to allow it to remain under control, and new advances in research approaches create the opportunity for completely new strategies for control of pathogens. This proposal uses one of those new approaches, metabolome analysis, to enhance knowledge of what happens in sugarbeet during infection, as well as to learn how resistance changes the sugarbeet plant to reduce virus accumulation and prevent symptom development. The result of this project will clarify information gained using other technologies and lead to new strategies to enhance and stabilize known forms of resistance. The information generated should also lead to new screening methods that can be applied for identification of varieties with enhanced resistance, as well as for the identification of new approaches to protect sugarbeet from rhizomania.

The different sources of resistance to BNYVV map to different chromosomal positions and although some may be allelic to one other, others appear to be distinct (Scholten et al., 1997; 1999; Gidner et al., 2005). Furthermore, several minor genes may contribute to enhanced resistance (Gidner et al., 2005), although further characterization of how this works is necessary. With the introduction of Roundup-Ready sugarbeets a few years ago, we may begin to see new opportunities for the application of biotechnology-based resistance at least in the US and Canada. Furthermore, the sequencing of the sugarbeet genome and the aggressive development of genetic markers creates additional opportunities for selective breeding that can target development and selection of sugarbeet with specific and unique traits that may lead to enhanced resistance as we learn more about how BNYVV infects sugarbeet and overcomes known sources of resistance. Finally, the emergence of new gene editing technologies may also lead to the ability to specifically target individual genes for up-or down-regulation that may enhance pathogen resistance or yield related traits.

With these things in mind, we recently completed studies evaluating resistant and susceptible sugarbeet using proteomics methods in order to gain an understanding of what BNYVV does at the cellular level to allow it to infect and cause disease in sugarbeet. These studies led to new knowledge on how BNYVV infection and virus resistance alter protein expression associated with infection and resistance in sugarbeet. (Larson et al., 2008; Webb et al., 2014 & 2015). Others have used different strategies to identify other protein interactions that may contribute to infection (Thiel and Varrelmann, 2009). Recent studies have begun to examine how gene activity (transcriptomics) is influenced by BNYVV infection (Fan et al., 2014; 2015). All of this information is informative on its own, but studies on gene expression (RNA and protein) only provide part of the picture. By utilizing a metabolomics approach, we can complement knowledge of gene expression provided through previous studies, and obtain a more complete picture of what is happening during BNYVV infection and resistance.

Metabolomics provides an analytic tool that enables the qualitative and quantitative profiling of metabolites in a biological system and serves as a link between the plant genotype and phenotypic (visible or obvious) responses (Fiehn et al., 2000; Heuberger et al., 2014). A better understanding of plant metabolism in response to different biotic stresses (including pathogen infections) facilitates a better understanding of plant physiology which is crucial for the development of future applications in plant breeding, biotechnology, and crop protection (Aliferis and Jabaji, 2012a). Metabolomic profiling was previously used in sugar beet to complement proteomic studies characterizing the response of carbohydrate metabolism and the TCA cycle to iron deficiency (Rellan-Alvarez et al., 2010). Aliferis and Jabaji (2012b) have described the metabolome of potato in response to infection with *R. solani* AG 3; however, to date there have been no known reported studies on the effects of plant pathogens on the metabolome of sugar beet. Additionally, metabolomic approaches have been utilized in characterizing compounds found in *R. solani* that are directly important to the fungus during critical life stages as well as characterizing the metabolites found in fungal exudates which may contain clues to secreted effectors (Aliferis and Jabaji, 2010a,b). Application of this technology to BNYVV in sugarbeet should lead to the identification of compounds necessary for both infection and resistance.

The information provided though our studies have the potential to lead to a new era in management of BNYVV. By utilizing knowledge of how the virus infects sugarbeet, combined with increasing knowledge of the sugarbeet genome and a growing number of molecular markers, it should be possible to enhance performance of existing resistance genes through selective, marker based breeding practices (Laurent et al., 2007). This could include selection for sugarbeet varieties enhanced for specific metabolites, as well as identifying new ways to reduce or even prevent BNYVV from infecting sugarbeet through targeted breeding directed at enhancing or manipulating specific biological pathways within the plant through specific gene editing approaches.

**Objectives:**

1. Compare the metabolome of a near isogenic line of susceptible (*rz1*) sugarbeet with those of sugarbeet with each of two resistance genes against BNYVV (*Rz1* and *Rz2*) at specific time points in the infection process.

2. Identify important compounds/cellular chemicals that may be critical to BNYVV infection of susceptible sugarbeet and for suppression of BNYVV in resistant sugarbeet.

3. Compare results with existing knowledge of RNA and protein expression changes associated with infection and resistance from previous studies to identify targets for interference and potential resistance.

**Summary of Project to Date:**

Three sugarbeet lines with closely related genetic backgrounds (near isogenic lines) from the ARS-Salinas sugarbeet breeding program (developed by Lewellen and Richardson) were used in seedling grow-out experiments; one with the *Rz1* resistance gene (C79-1), another with the *Rz2* resistance gene (C79-3), and one susceptible to BNYVV (C37). All three lines share the same genetic background and differ by the type of Rz gene they carry. Soil containing a well established isolate of BNYVV pathotype A (source collected from USDA-ARS, Spence Field in Salinas in 2006) was mixed with equal parts sterile builders sand and placed into new Styrofoam cups. Parallel studies were performed with an *Rz1* resistance breaking strain of BNYVV (Imperial Valley, CA - Rockwood 158 RB isolate), as well as with virus-free (healthy) soil. For each sugar beet variety, 50 seeds were planted per cup, with two cups per treatment, and grown in a growth chamber at 24ºC with 16-hour days and approximately 220 uM $m^{-1}s^{-2}$ light until 3 weeks after sowing. At each time point, seedlings from each cup was handled independently for each treatment to assure good infection of each sample/treatment. Foliar and root portions of the plant were separated at the crown and lyophilized (freeze dried), then stored at -80 until further analysis. Root samples from each plot were tested by RT-PCR to confirm BNYVV infection prior to use in metabolome analysis, and remaining roots from the same samples were used for metabolite extractions.

Roots from all three experiments were freeze-dried and stored at -80C so that metabolites could be extracted from all samples at the same time. Upon completion of the last replication, dried root samples were pulverized in liquid nitrogen and sent to the Core Laboratory at Colorado State University (CSU) in Ft. Collins, CO for methanol extraction of metabolites. Metabolome analysis was completed at CSU during the fall, and results of analyses provided to USDA-ARS in late November 2017.

Overall 746 metabolites were found and these were annotated to known compounds or to unknown compounds with a specified mass. These metabolites were examined in all possible combinations of treatments to look for statistically different levels of expression among treatments, including patterns of expression indicating how traditional or RB-BNYVV influence resistant and susceptible sugarbeet during infection, as well as for identification of "interesting" compounds that may play an important role in rhizomania disease development. Metabolite levels were compared among treatments using a 95 percent confidence interval to distinguish compounds with statistically different levels of expression among treatments. Results demonstrated the most important difference in metabolite levels was between healthy sugarbeet plants and sugarbeet plants infected with BNYVV. Results also demonstrated differences between traditional BNYVV and RB-BNYVV. Overall, comparative studies indicated 32% of differences in metabolite levels among treatments were based on the presence or absence of BNYVV (Fig. 1). In contrast, only 3% of variation among treatments could be explained by differences in sugarbeet variety (i.e. the different resistance genes) (Fig. 2). Essentially, results indicate most metabolic differences are caused by the BNYVV infection, and are not influenced much by the presence or absence of either resistance gene. This contrasts with what was observed with our recent proteomics analysis of similar sugarbeet near isogenic lines, in which differences that occurred were influenced by both virus strain and the resistance genes.

In our previous proteomics analysis comparing BNYVV infection of Rz1 and Rz2 sugarbeet with susceptible sugarbeet, we identified a number proteins with differential expression not only between RB- and traditional strains of BNYVV, but also between sugarbeet genotypes (Rz1, Rz2, and susceptible). Results of those studies demonstrated that abundance of select proteins in sugarbeet is significantly altered based on the presence or absence of the two resistance genes (Webb et al., 2015), whereas in the current metabolomics study very limited (3%) differences in the metabolome were determined by the presence or absence of rhizomania resistance genes.

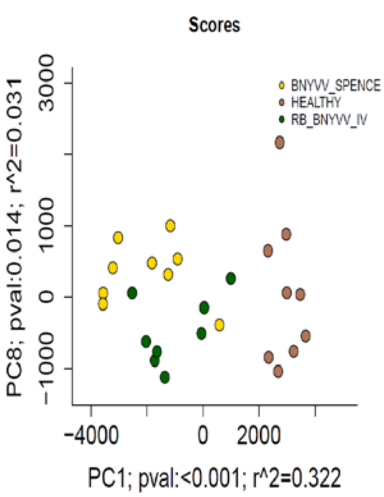



**Figure 1.** Principle component analysis plot generated from 27 samples derived from 9 treatments showing clear separation by virus type. Yellow: BNYVV-Spence (traditional/wild type BNYVV), Green: BNYVV-IV (Rz1 Resistance breaking BNYVV), Red: Healthy (virus-free sugarbeet).

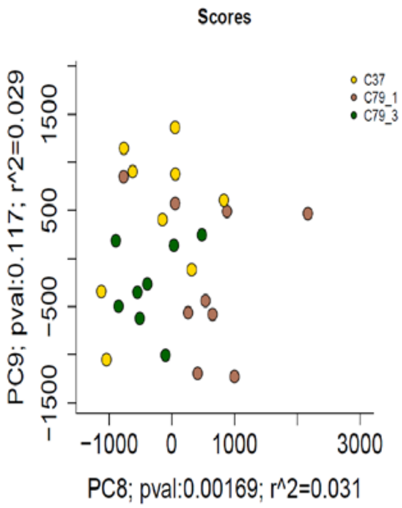



**Figure 2**. Principle component analysis plot generated from 27 samples derived from 9 treatments showing little separation by sugarbeet genotype (resistance gene or not). Yellow: C37 (susceptible sugarbeet [rz1rz2]), Red: C79-1 (Rz1 resistant sugarbeet [Rz1rz2]), Green: C79-3 (Rz2 resistant sugarbeet [rz1Rz2]).

Continuing studies are focusing on identification of specific compounds that differ among treatments. Although these detailed studies are just beginning, some interesting results have already been identified, including compound $C_{40}H_{107}N_{17}OS_4$ (Fig. 3). This compound had low expression in the absence of virus in both susceptible (rz1rz2) and resistant varieties (both Rz1 and Rz2), but higher expression with virus infection when either traditional or Rz1-resistance-breaking BNYVV strains were present. In general, the expression of this compound mimics what would be "expected" in a traditional gene-for-gene type of resistance. The highest expression of compound $C_{40}H_{107}N_{17}OS_4$ was observed in the susceptible line (C37) with the traditional BNYVV strain (Spence), but expression differences were also significant with the RB BNYVV strain (which we believe is generally less fit overall than traditional BNYVV based on its performance in field situations). The fact that this compound is expressed at elevated levels in all varieties indicates its expression is a response to infection, but not necessarily associated with ability of the plant to resist infection (no strong differential effect with resistant beets).

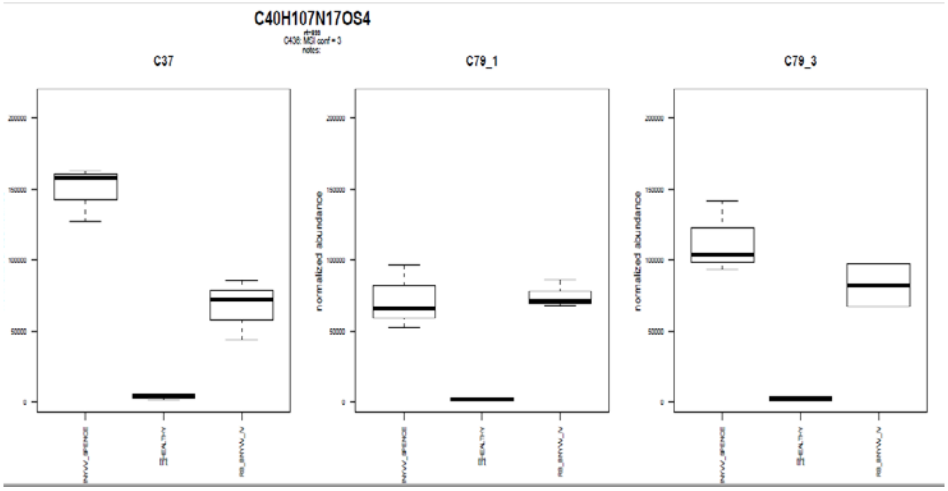



**Figure 3.** Abundance of compound $C_{40}H_{107}N_{17}OS_4$. C37 = susceptible sugarbeet (rz1rz2), C79-1 = Rz1 resistant sugarbeet (Rz1rz2), C79-3 = Rz2 resistant sugarbeet (rz1Rz2).

**Further Research:**

Although we have not requested additional funding for this project we will be continuing data analysis and interpretation of results. Through characterization of differential abundance of compounds and identification of these compounds, we expect to improve our knowledge of what is happening biochemically in sugarbeet during BNYVV infection and development of rhizomania disease. We will also examine results of this metabolome analysis in comparison to to those of our previous studies on proteomics (Larson et al., 2008; Webb et al., 2014, 2015), and studies by others on gene expression and protein interactions (Fan et al., 2014, 2015; Thiel and Varrelmann, 2009). This should allow us to begin to piece together how BNYVV causes disease in plants by determining changes that occur in infected vs. healthy sugarbeet. Ultimately we anticipate gaining insight into how resistance genes are able to suppress BNYVV levels by identifying differences in biochemicals produced (this study) along with changes in gene expression (previous studies). This information will be useful toward application of marker-based selection of traits that may enhance performance of resistance genes, as well as for identification of targets for use of new biotechnology-based methods that should lead to novel methods to prevent rhizomania disease in sugarbeet.

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**Budget Justification:** Funds for general laboratory supplies, as well as kits and reagents necessary for metabolite extraction, and other metabolome analyses were provided through a combination of BSDF funds and USDA-ARS in-house funds (Not SBREB) during 2016. These charges were covered with 2016 funds. Plant growth work at Salinas is nearly completed, and all samples will be sent for analysis once the current and final experiment is completed this month (Dec. 2016).

A GS-11 USDA-ARS postdoctoral research associate (Dr. Navneet Kaur, ARS Salinas) will conduct data analysis, with guidance and assistance from Drs. Broekling (CSU) and Webb (USDA) in Ft. Collins. Dr. Kaur's salary for sample preparation and research on this project was provided by SBREB in 2016. We are only requesting $6,000 from SBREB in 2017 to support Dr. Kaur's salary (additional salary funds were requested from BSDF). Dr. Kaur cannot be paid with USDA in-house funds due to her nationality (India). Therefore we are requesting limited funds from BSDF to assist with Dr. Kaur's salary to finish out the project involving data analysis and interpretation of results. An existing agreement is in place between USDA-ARS and BSDF to utilize BSDF funds for ARS salaries.

| **Budget**: | **USDA** | **BSDF** | **SBREB** |
|---|---|---|---|
| Labor | $25,000 | $10,000 | $6,000 |
| Equipment (over $250.00) | $0 | $0 | $0 |
| Supplies | $800 | $0 | $0 |
| Service (metabolomics analysis) | $9,000 | $0 | $0 |
| Travel | $0 | $0 | $0 |
| TOTALS: | $34,800 | $10,000 | $6,000 |

# SUGARBEET VARIETIES / QUALITY TESTING

NOTES

## RESULTS OF AMERICAN CRYSTAL SUGAR COMPANY'S 2017 CODED OFFICIAL VARIETY TRIALS

William S. Niehaus, Official Trial Manager
American Crystal Sugar Company
Moorhead, Minnesota

American Crystal Sugar Company's (ACSC) coded Official Variety Trials (OVT) are designed to provide an unbiased evaluation of the genetic potential of sugarbeet variety entries under several different environments. The two-year average of these evaluations then are used to establish a list of approved varieties which ensures the use of high quality, productive varieties to maximize returns for growers and the cooperative as a whole.

This report presents data from the 2017 American Crystal OVTs and describes the procedures and cultural practices involved in the trials.

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|---|---|
| 1 | ACSC approved varieties for 2017 |
| 2 | Multi-year performance of approved varieties (all locations combined) |
| 3 | Performance of ACSC Aphanomyces specialty varieties |
| 4 | Performance data of approved conventional varieties (all locations combined) |
| 5 | Disease ratings for ACSC tested varieties (multiple diseases) |
| 6 | Official trial sites, cooperators, plant and harvest dates, soil types and disease notes |
| 7 | Seed treatments applied to seed used in the OVTs |
| 8-18 | 2017 Roundup Ready variety trials and combined trials |
| 19-25 | 2017 Conventional variety trials and combined trials |
| 26-29 | Approval calculations for ACSC market |
| 30 | Aphanomyces disease nursery ratings |
| 31 | Cercospora disease nursery ratings |
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| 33 | Fusarium disease nursery ratings |
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### ***Procedures and Cultural Practices***

Sugarbeet official variety testing was conducted the ACSC growing region areas of the Red River Valley by ACSC personnel at the Technical Services Center.

All entries were assigned a code number by KayJay Ag Services. The seed then was sent to ACSC Technical Services Center at Moorhead for official testing.

Thirteen official yield trial sites were planted in the ACSC area with eleven harvested. Plant-to-stand trials (4.5 inch spacing) were used to evaluate the commercial, experimental and conventional varieties. Seed companies had the option of treating seed with Tachigaren, insecticide and a Rhizoctonia seed treatment fungicide. The treatments used on the seed planted in the official variety yield trials can be found in table 7.

Ten ACSC sites were used for variety approval calculations (Felton, Georgetown, Hendrum, Hillsboro, Climax, Grand Forks, Scandia, St. Thomas, Stephen and Bathgate). One site was abandoned due to erratic emergence (Casselton) and two were abandoned due to soil compaction (Humboldt and Argyle). Rhizoctonia was less prevalent in 2017 yet showed an increase from 2016 in yield trials. Based upon susceptible plot observations, root aphids had only a slight effect on varieties in 2017.

Plots were planted crosswise (90°) to the cooperators' normal farming operations, where possible. Plot row lengths for all official trials were maintained at 44 feet with about 39 feet harvested. All trials had two or four-row plots planted in four or six replications. Planting was performed with a 12-row SRES vacuum planter. The GPS controlled planter gave good single seed spacing which facilitated emergence counting. Emergence counts were taken on 24 feet of each plot. Multiple seedlings were counted as a single plant if they emerged less than one inch apart. The stands in all yield trials were refined by removing doubles (multiple seedlings less than 1.5 inch apart) by hand but were not further reduced.

Roundup Powermax with Event and full rates of fungicides were applied using a pickup sprayer driven down the alleys. Hand weeding was used where necessary. The micro rate program was used on conventional trials. All yield trials were treated with Quadris in a band during the 2 leaf (9 oz) and 6-10 leaf stage (14 oz) for Rhizoctonia control. Treatments used for Cercospora control in 2017 included Inspire XT/Penncozeb, Agritin/Incognito, Penncozeb, and Headline/Agritin. Ground spraying was conducted by ACSC technical staff.

Roundup Ready (RR) varieties with commercial seed were planted in four-row, six replication trials. The RR experimental entries were planted in smaller two-row, four replication trials. Two applications of Roundup were made in the 4-6 (32 oz) and 8-12 (22 oz) leaf stages.

ACSC Conventional OVT's were reinstated in 2016 and repeated again in 2017. Approval was based on one year of data with eighteen varieties approved for 2018 sales. Three conventional varieties were previously approved and have data from the 2012 Sugarbeet Research and Extension Report.

All plot rows were measured for total length after approximately 2.5 feet at each end were removed at the end of August, with skips greater than 60 inches being measured for adjustment purposes. Harvest was performed with two modified four-row harvesters (4310 and 4310A John Deere). All harvested beets of each plot were used for yield determination while one sample (approx 25 lbs) for sugar and impurity analysis was obtained from each plot. Quality analysis was performed at the ACSC Technical Services quality lab in Moorhead.

Varieties were planted in disease nurseries in North Dakota, Minnesota and Michigan to evaluate varieties for disease tolerance.

The ACSC official variety trial program attempts to utilize multiple disease nurseries adjusting the Cercospora, Aphanomyces, Rhizoctonia and Fusarium nursery data each year to provide consistency to the disease ratings. In 2017, the disease ratings for Aphanomyces (Shakopee) and Rhizoctonia (Michigan) were limited to a single location due to lack of disease pressure in the RRV. Consider reviewing all available disease ratings when evaluating variety performance.

***Acknowledgements***

Thanks to the beet seed companies for their participation in the official variety testing program and to all grower-cooperators, agricultural, and beet seed staff for their assistance. Special thanks are extended to Dr. Mohamed Khan for Cercospora nursery infection, Dr. Albert Sims for hosting a Rhizoctonia nursery, Randy Nelson for RRV disease ratings, USDA staff in Michigan for Cercospora and Rhizoctonia nursery ratings. The Betaseed staff for Aphanomyces and Cercospora ratings in the Shakopee area, and Kay Jay Ag Services for sampling and coding all variety entries.

## Table 1. Varieties Meeting ACSC Approval Criteria for the 2018 Sugarbeet Crop ++

| **Roundup Ready ®** | Full Market | Aph Spec | Rhc Spec | High Rzm |
|---|---|---|---|---|
| BTS 80RR52 | Yes | Aph | | Hi Rzm |
| BTS 8337 | Yes | Aph | | Hi Rzm |
| BTS 8363 | Yes | | | Hi Rzm |
| BTS 8500 | Yes | Aph | | Hi Rzm |
| BTS 8512 | Yes | Aph | | Hi Rzm |
| BTS 8524 | Yes | Aph | | Hi Rzm |
| BTS 8572 | Yes | Aph | | Hi Rzm |
| BTS 8606 | New | | | Hi Rzm |
| BTS 8629 | New | | | Hi Rzm |
| Crystal 093RR | Yes | Aph | | Hi Rzm |
| Crystal 101RR | Yes | Aph | | Hi Rzm |
| Crystal 246RR | Yes | | | Hi Rzm |
| Crystal 247RR | Yes | | | Hi Rzm |
| Crystal 355RR | Yes | Aph | Rhc | Hi Rzm |
| Crystal 467RR | Yes | Aph | | Hi Rzm |
| Crystal 572RR | Yes | | | Hi Rzm |
| Crystal 573RR | Yes | Aph | | Hi Rzm |
| Crystal 574RR | Yes | Aph | | Hi Rzm |
| Crystal 578RR | Yes | | | Hi Rzm |
| Crystal 684RR | New | Aph | | Hi Rzm |
| Crystal 986RR | Yes | Aph | | Rzm |
| Hilleshög 4302RR | Yes | Aph+ | Rhc | Rzm |
| Hilleshög 4448RR | Yes | | | Rzm |
| Hilleshög 9528RR | Yes | Aph | | Hi Rzm |
| Hilleshög 9707 | No | Aph | | Hi Rzm |
| Hilleshög 9708 | Yes | | | Hi Rzm |
| Hilleshög 9895 | No | Aph | | Hi Rzm |
| Maribo 109 | Yes | Aph | Rhc | Hi Rzm |
| Maribo 305 | Yes | | | Rzm |
| Maribo 502 | No | Aph | | Hi Rzm |
| Maribo 504 | Yes | | | Hi Rzm |
| Maribo 611 | No | Aph | | Hi Rzm |
| Seedex Avalanche (858) | Yes | Aph | | Hi Rzm |
| Seedex Canyon RR(844TT) | Yes | Aph | | Hi Rzm |
| Seedex Cruze RR(846) | Yes | Aph | | Rzm |
| Seedex Marathon (856) | Yes | | | Hi Rzm |
| Seedex Winchester RR | Yes | Aph | | Rzm |
| Seedex RR1861 | New | | | Hi Rzm |
| Seedex RR1863 | New | Aph | | Hi Rzm |
| SESVdh RR244TT | Yes | | | Hi Rzm |
| SESVdh RR265 | New | | | Hi Rzm |
| SESVdh RR266 | New | | | Hi Rzm |
| SESVdh RR268 | New | Aph | | Hi Rzm |
| SESVdh RR333 | Yes | Aph | | Hi Rzm |
| SESVdh RR351 | Yes | Aph | | Hi Rzm |

| **Conventional** | Full Market | High Rzm |
|---|---|---|
| BETA EXP 687 | Yes | Hi Rzm |
| BETA EXP 698 | Yes | Hi Rzm |
| BETA EXP 747 | New | Hi Rzm |
| BETA EXP 758 | New | Hi Rzm |
| Crystal R761 | Yes | Hi Rzm |
| Crystal 620 | Yes | Hi Rzm |
| Crystal 622 | Yes | Hi Rzm |
| Crystal 735 | New | Hi Rzm |
| Crystal 737 | New | Hi Rzm |
| Hilleshög 3035Rz | Yes | Rzm |
| Hilleshög 9891Rz | Yes | Rzm |
| Maribo MA615Rz | Yes | Rzm |
| Maribo MA720Rz | New | Hi Rzm |
| Seedex Deuce (SX0873TT) | Yes | Hi Rzm |
| Seedex 8869 | Yes | Hi Rzm |
| SESVdh 48611 | Yes | Hi Rzm |
| SESVdh 48777 | New | Hi Rzm |
| Strube 13722 | New | Rzm |

**Roundup Ready sugarbeets are subject to the ACSC RRSB Bolter Destruction Policy** Created 10/31/2017

**?reviously approved varieties not meeting current approval standards may be sold in 2018.**

undup Ready ® is a registered trademark of Monsanto Company.

h Spec = variety meets Aphanomyces specialty requirements

c Spec = variety meets Rhizoctonia specialty requirements

Rzm = may perform better under severe Rzm.

w = newly approved

**ıen updating 2017, Remember that BTS80RR52 2016 was the first year of No Rhc approval. Variety should still remain on the Approval variety if grown for one mo**

Table 2. Performance Data of RR Varieties During 2015, 2016, 2017 Growing Seasons (All Locations Combined) +++

| | Yrs | Rev/Ton ++ | | | | | Rev/Acre ++ | | | | | Rec/Ton | | Rec/Acre | | Sugar | | Yield | | Molasses | | Emerg | | Bolter / Ac | | CR + | | Aph Root+ | | Rhizoc+ | | Fusarium+ | | Rzm+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variety @ | Com | 17 | 2 Yr | 2Y% | 3Yr# | 3Y% | 17 | 2 Yr | 2Y% | 3Yr# | 3Yr% | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | |
| # locations | | 10 | 19 | | 29 | | 10 | 19 | | 29 | | 10 | 19 | 10 | 19 | 10 | 19 | 10 | 19 | 10 | 19 | 10 | 19 | 10 | 19 | 3 | 6 | 1 | 3 | 1 | 5 | 2 | 4 | |
| **Previous Approved** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BTS 80RR52 | 6 | 52.79 | 52.12 | 100 | 52.82 | 100 | 1699 | 1830 | 102 | 1787 | 103 | 334 | 326 | 10789 | 11432 | 17.94 | 17.45 | 32.4 | 35.3 | 1.22 | 1.17 | 78 | 75 | 5 | 2 | 4.37 | 4.33 | 4.4 | 4.2 | 4.1 | 4.3 | 2.7 | 2.7 | Hi |
| BTS 8337 | 3 | 57.43 | 55.76 | 107 | 56.99 | 108 | 1842 | 1860 | 104 | 1825 | 105 | 350 | 337 | 11209 | 11247 | 18.55 | 17.96 | 32.1 | 33.4 | 1.08 | 1.10 | 76 | 72 | 5 | 2 | 4.36 | 4.49 | 3.8 | 3.5 | 4.3 | 4.2 | 3.8 | 3.9 | Hi |
| BTS 8363 | 3 | 51.14 | 50.20 | 97 | 50.68 | 96 | 1770 | 1854 | 104 | 1813 | 104 | 329 | 319 | 11391 | 11777 | 17.53 | 17.03 | 34.7 | 37.0 | 1.09 | 1.06 | 78 | 76 | 0 | 0 | 4.10 | 4.21 | 4.6 | 4.8 | 4.9 | 4.6 | 3.5 | 3.3 | Hi |
| BTS 8500 | 1 | 53.24 | 51.10 | 98 | 51.62 | 98 | 1862 | 1914 | 107 | 1855 | 107 | 336 | 322 | 11741 | 12068 | 17.90 | 17.22 | 35.0 | 37.6 | 1.11 | 1.10 | 76 | 76 | 0 | 0 | 4.29 | 4.41 | 4.5 | 4.4 | 4.6 | 4.5 | 2.1 | 2.0 | Hi |
| BTS 8512 | 1 | 54.51 | 52.80 | 102 | 53.37 | 101 | 1749 | 1833 | 103 | 1793 | 103 | 340 | 328 | 10921 | 11380 | 18.08 | 17.48 | 32.2 | 34.8 | 1.08 | 1.08 | 79 | 77 | 14 | 7 | 3.69 | 3.86 | 3.8 | 4.0 | 4.3 | 4.4 | 3.0 | 2.8 | Hi |
| BTS 8524 | 1 | 51.51 | 49.79 | 96 | 50.15 | 95 | 1796 | 1875 | 105 | 1831 | 105 | 330 | 318 | 11506 | 11961 | 17.64 | 17.03 | 34.9 | 37.7 | 1.14 | 1.14 | 79 | 79 | 5 | 2 | 4.38 | 4.56 | 4.5 | 4.2 | 4.4 | 4.3 | 3.2 | 3.3 | Hi |
| BTS 8572 | 1 | 56.57 | 54.96 | 106 | 55.68 | 106 | 1817 | 1865 | 104 | 1816 | 105 | 347 | 335 | 11147 | 11365 | 18.41 | 17.81 | 32.2 | 34.0 | 1.07 | 1.05 | 78 | 77 | 0 | 0 | 4.14 | 4.27 | 3.8 | 4.1 | 4.3 | 4.4 | 2.5 | 2.4 | Hi |
| Crystal 093RR | 6 | 57.65 | 54.91 | 106 | 55.51 | 105 | 1866 | 1904 | 107 | 1850 | 106 | 350 | 335 | 11339 | 11603 | 18.60 | 17.84 | 32.4 | 34.8 | 1.08 | 1.10 | 76 | 74 | 0 | 0 | 4.49 | 4.72 | 4.4 | 4.4 | 4.5 | 4.4 | 3.5 | 3.4 | Hi |
| Crystal 101RR | 6 | 51.29 | 49.71 | 96 | 50.79 | 96 | 1718 | 1784 | 100 | 1728 | 99 | 329 | 318 | 11040 | 11400 | 17.66 | 17.10 | 33.6 | 36.0 | 1.20 | 1.22 | 77 | 73 | 0 | 0 | 4.57 | 4.58 | 3.9 | 3.7 | 4.8 | 4.8 | 2.7 | 2.6 | Hi |
| Crystal 246RR | 4 | 52.05 | 49.94 | 96 | 50.68 | 96 | 1775 | 1810 | 101 | 1774 | 102 | 332 | 319 | 11322 | 11534 | 17.67 | 17.01 | 34.2 | 36.3 | 1.09 | 1.09 | 74 | 75 | 0 | 0 | 4.63 | 4.72 | 5.1 | 5.0 | 4.2 | 4.3 | 3.2 | 3.2 | Hi |
| Crystal 247RR | 4 | 53.09 | 51.91 | 100 | 52.76 | 100 | 1832 | 1923 | 108 | 1886 | 109 | 335 | 325 | 11575 | 12031 | 17.79 | 17.28 | 34.6 | 37.1 | 1.03 | 1.04 | 76 | 72 | 18 | 9 | 4.55 | 4.60 | 5.4 | 5.1 | 4.5 | 4.4 | 3.0 | 2.9 | Hi |
| Crystal 355RR | 2 | 54.56 | 53.87 | 104 | 54.20 | 103 | 1711 | 1829 | 102 | 1761 | 101 | 340 | 331 | 10689 | 11243 | 18.16 | 17.70 | 31.5 | 34.0 | 1.15 | 1.14 | 75 | 76 | 0 | 0 | 4.36 | 4.48 | 4.8 | 4.7 | 4.1 | 4.0 | 2.8 | 2.7 | Hi |
| Crystal 467RR | 1 | 51.56 | 49.09 | 94 | 50.11 | 95 | 1804 | 1825 | 102 | 1805 | 104 | 330 | 316 | 11588 | 11754 | 17.63 | 16.91 | 35.2 | 37.4 | 1.12 | 1.14 | 80 | 75 | 0 | 0 | 4.46 | 4.57 | 4.0 | 4.0 | 4.5 | 4.4 | 2.0 | 1.9 | Hi |
| Crystal 572RR | 1 | 58.99 | 56.37 | 108 | 56.67 | 108 | 1891 | 1937 | 108 | 1866 | 107 | 355 | 340 | 11379 | 11673 | 18.74 | 18.01 | 32.1 | 34.5 | 1.01 | 1.02 | 81 | 79 | 0 | 0 | 4.27 | 4.42 | 4.7 | 4.7 | 4.5 | 4.3 | 2.6 | 2.2 | Hi |
| Crystal 573RR | NC | 55.66 | 54.22 | 104 | 54.82 | 104 | 1785 | 1877 | 105 | 1837 | 106 | 344 | 333 | 11039 | 11512 | 18.28 | 17.71 | 32.1 | 34.7 | 1.08 | 1.07 | 75 | 74 | 0 | 0 | 4.15 | 4.25 | 3.8 | 4.0 | 4.6 | 4.6 | 3.1 | 3.3 | Hi |
| Crystal 574RR | 1 | 52.84 | 50.76 | 98 | 51.24 | 97 | 1875 | 1973 | 110 | 1915 | 110 | 334 | 321 | 11851 | 12453 | 17.79 | 17.14 | 35.4 | 38.8 | 1.08 | 1.09 | 79 | 79 | 0 | 0 | 4.35 | 4.43 | 4.7 | 4.2 | 4.2 | 4.3 | 2.2 | 2.0 | Hi |
| Crystal 578RR | NC | 54.05 | 52.68 | 101 | 53.46 | 101 | 1899 | 1958 | 110 | 1904 | 110 | 338 | 328 | 11908 | 12160 | 18.00 | 17.43 | 35.3 | 37.2 | 1.07 | 1.05 | 80 | 78 | 0 | 0 | 4.91 | 4.89 | 4.6 | 4.5 | 4.4 | 4.4 | 2.4 | 2.2 | Hi |
| Crystal 986RR | 6 | 54.89 | 53.48 | 103 | 54.13 | 103 | 1776 | 1836 | 103 | 1772 | 102 | 341 | 330 | 11008 | 11298 | 18.09 | 17.51 | 32.2 | 34.2 | 1.03 | 1.01 | 78 | 77 | 0 | 0 | 4.77 | 4.76 | 4.1 | 4.2 | 4.4 | 4.4 | 4.7 | 4.8 | Rzm |
| Hilleshög HIL9707 | 1 | 49.79 | 48.85 | 94 | 50.46 | 96 | 1692 | 1716 | 96 | 1661 | 96 | 324 | 315 | 11020 | 11042 | 17.35 | 16.86 | 34.0 | 35.1 | 1.14 | 1.13 | 72 | 66 | 5 | 2 | 4.96 | 4.74 | 4.7 | 4.3 | 4.4 | 4.4 | 4.1 | 4.5 | Hi |
| Hilleshög HIL9708 | NC | 54.11 | 52.09 | 100 | 53.34 | 101 | 1640 | 1749 | 98 | 1730 | 100 | 339 | 326 | 10290 | 10933 | 18.02 | 17.34 | 30.4 | 33.7 | 1.07 | 1.06 | 74 | 76 | 9 | 5 | 4.61 | 4.68 | 5.9 | 5.4 | 4.2 | 4.2 | 4.6 | 4.4 | Hi |
| Hilleshög 4302RR | 4 | 52.73 | 52.18 | 100 | 53.06 | 101 | 1597 | 1699 | 95 | 1674 | 96 | 334 | 326 | 10093 | 10582 | 17.75 | 17.33 | 30.1 | 32.5 | 1.05 | 1.04 | 65 | 65 | 0 | 0 | 3.93 | 4.03 | 6.7 | 5.6 | 3.6 | 3.6 | 5.1 | 5.1 | Rzm |
| Hilleshög 4448RR | 4 | 53.93 | 51.47 | 99 | 53.10 | 101 | 1829 | 1851 | 104 | 1840 | 106 | 338 | 324 | 11456 | 11617 | 17.97 | 17.24 | 33.9 | 35.9 | 1.06 | 1.06 | 70 | 67 | 5 | 2 | 5.28 | 5.24 | 6.3 | 5.1 | 4.6 | 4.6 | 5.3 | 5.3 | Rzm |
| Hilleshög 9528RR | 3 | 54.35 | 53.26 | 102 | 54.10 | 103 | 1785 | 1884 | 106 | 1843 | 106 | 339 | 329 | 11154 | 11637 | 18.02 | 17.51 | 32.9 | 35.4 | 1.05 | 1.05 | 74 | 71 | 5 | 2 | 4.99 | 4.86 | 5.6 | 4.7 | 4.2 | 4.2 | 4.2 | 4.4 | Hi |
| Maribo 109 | 2 | 56.86 | 56.60 | 109 | 57.45 | 109 | 1569 | 1729 | 97 | 1675 | 96 | 348 | 340 | 9579 | 10365 | 18.43 | 18.03 | 27.5 | 30.5 | 1.06 | 1.04 | 67 | 68 | 0 | 5 | 4.14 | 4.14 | 5.1 | 4.7 | 3.6 | 3.7 | 4.2 | 4.4 | Hi |
| Maribo 305 | 2 | 52.03 | 50.29 | 97 | 50.67 | 96 | 1731 | 1752 | 98 | 1713 | 99 | 332 | 320 | 11018 | 11121 | 17.60 | 17.00 | 33.2 | 34.8 | 1.02 | 1.02 | 67 | 65 | 0 | 0 | 4.98 | 4.85 | 5.7 | 5.0 | 4.6 | 4.5 | 5.9 | 5.9 | Rzm |
| Maribo MA502 | 1 | 51.46 | 49.31 | 95 | 50.47 | 96 | 1642 | 1733 | 97 | 1716 | 99 | 330 | 316 | 10539 | 11124 | 17.66 | 17.00 | 32.0 | 35.4 | 1.17 | 1.20 | 74 | 72 | 68 | 34 | 5.01 | 4.90 | 3.5 | 3.3 | 4.8 | 4.8 | 3.0 | 2.5 | Hi |
| Maribo MA504 | NC | 52.70 | 50.34 | 97 | 51.66 | 98 | 1830 | 1879 | 105 | 1875 | 108 | 334 | 320 | 11632 | 11946 | 17.77 | 17.07 | 34.9 | 37.5 | 1.07 | 1.08 | 77 | 75 | 0 | 0 | 5.50 | 5.27 | 6.2 | 5.4 | 4.4 | 4.5 | 4.5 | 4.6 | Hi |
| SV RR244TT | 2 | 52.93 | 52.31 | 101 | 52.78 | 100 | 1796 | 1837 | 103 | 1787 | 103 | 335 | 326 | 11339 | 11427 | 17.79 | 17.36 | 33.8 | 35.0 | 1.05 | 1.05 | 72 | 69 | 5 | 2 | 4.85 | 4.65 | 4.9 | 4.9 | 4.5 | 4.5 | 3.7 | 3.9 | Hi |
| SV RR333 | 2 | 54.21 | 53.06 | 102 | 53.63 | 102 | 1823 | 1887 | 106 | 1849 | 106 | 339 | 329 | 11399 | 11670 | 17.98 | 17.46 | 33.7 | 35.6 | 1.04 | 1.03 | 72 | 71 | 0 | 0 | 4.84 | 4.84 | 5.0 | 4.8 | 4.4 | 4.4 | 5.3 | 5.1 | Hi |
| SV RR351 | 1 | 53.73 | 52.02 | 100 | 53.06 | 101 | 1783 | 1877 | 105 | 1792 | 103 | 337 | 325 | 11196 | 11723 | 17.91 | 17.30 | 33.2 | 36.1 | 1.05 | 1.04 | 74 | 73 | 0 | 0 | 4.41 | 4.46 | 4.2 | 4.3 | 4.2 | 4.2 | 5.0 | 4.9 | Hi |
| SX Avalanche RR(858) | 1 | 55.22 | 53.89 | 104 | 54.90 | 104 | 1690 | 1803 | 101 | 1761 | 101 | 342 | 331 | 10472 | 11077 | 18.13 | 17.58 | 30.6 | 33.5 | 1.02 | 1.00 | 72 | 72 | 9 | 5 | 4.64 | 4.69 | 4.0 | 4.2 | 4.3 | 4.4 | 5.8 | 5.6 | Hi |
| SX Canyon RR | 2 | 55.26 | 53.44 | 103 | 53.37 | 101 | 1829 | 1878 | 105 | 1812 | 104 | 342 | 330 | 11330 | 11574 | 18.15 | 17.51 | 33.1 | 35.1 | 1.03 | 1.02 | 71 | 71 | 0 | 0 | 4.92 | 4.84 | 4.3 | 4.3 | 4.5 | 4.5 | 5.1 | 5.2 | Hi |
| SX Cruze RR | 2 | 48.01 | 47.03 | 90 | 48.53 | 92 | 1696 | 1704 | 95 | 1683 | 97 | 318 | 309 | 11272 | 11197 | 17.05 | 16.56 | 35.5 | 36.3 | 1.13 | 1.11 | 77 | 74 | 5 | 2 | 5.37 | 5.01 | 4.8 | 4.1 | 4.4 | 4.5 | 4.0 | 3.4 | Rzm |
| SX Marathon RR(856) | 1 | 54.66 | 52.81 | 102 | 53.90 | 102 | 1812 | 1925 | 108 | 1894 | 109 | 340 | 328 | 11296 | 11948 | 18.04 | 17.43 | 33.2 | 36.6 | 1.02 | 1.04 | 72 | 72 | 5 | 2 | 4.54 | 4.49 | 4.5 | 4.5 | 4.4 | 4.4 | 4.8 | 4.9 | Hi |
| SX Winchester RR | 3 | 51.84 | 52.22 | 100 | 53.49 | 101 | 1580 | 1706 | 96 | 1664 | 96 | 331 | 326 | 10087 | 10615 | 17.59 | 17.29 | 30.5 | 32.6 | 1.04 | 1.01 | 66 | 67 | 5 | 2 | 4.07 | 4.02 | 4.4 | 4.1 | 4.5 | 4.6 | 4.6 | 4.4 | Rzm |
| **Newly Approved** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BTS 8606 | NC | 54.65 | 53.10 | 102 | -- | -- | 1882 | 1941 | 109 | -- | -- | 340 | 329 | 11739 | 12018 | 18.13 | 17.54 | 34.6 | 36.6 | 1.09 | 1.08 | 79 | 75 | 0 | 0 | 4.73 | 4.92 | 4.9 | 4.8 | 5.0 | 4.7 | 2.8 | 2.7 | Hi |
| BTS 8629 | NC | 52.38 | 50.48 | 97 | -- | -- | 1884 | 1920 | 108 | -- | -- | 333 | 320 | 11986 | 12153 | 17.72 | 17.08 | 36.1 | 38.0 | 1.08 | 1.07 | 81 | 80 | 0 | 5 | 4.29 | 4.44 | 4.7 | 4.4 | 4.2 | 4.0 | 4.2 | 4.1 | Hi |
| Crystal 684RR | NC | 52.65 | 50.72 | 98 | -- | -- | 1899 | 2005 | 112 | -- | -- | 334 | 321 | 12057 | 12684 | 17.81 | 17.18 | 36.2 | 39.7 | 1.12 | 1.13 | 80 | 79 | 0 | 0 | 4.34 | 4.45 | 4.3 | 4.0 | 4.6 | 4.5 | 2.0 | 1.9 | Hi |
| Hilleshög HIL9895 | NC | 50.46 | 50.46 | 97 | -- | -- | 1547 | 1710 | 96 | -- | -- | 326 | 320 | 10024 | 10827 | 17.48 | 17.18 | 30.8 | 33.9 | 1.17 | 1.18 | 73 | 72 | 41 | 25 | 4.84 | 4.67 | 4.4 | 4.0 | 4.3 | 4.4 | 4.1 | 3.3 | Hi |
| Maribo MA611 | NC | 50.37 | 50.32 | 97 | -- | -- | 1542 | 1654 | 93 | -- | -- | 326 | 319 | 10000 | 10495 | 17.45 | 17.14 | 30.8 | 32.9 | 1.16 | 1.16 | 75 | 76 | 9 | 5 | 5.03 | 4.75 | 4.0 | 4.0 | 4.4 | 4.5 | 3.8 | 2.9 | Hi |
| SV RR265 | NC | 53.56 | 52.21 | 100 | -- | -- | 1836 | 1908 | 107 | -- | -- | 337 | 326 | 11584 | 11915 | 17.89 | 17.35 | 34.5 | 36.7 | 1.04 | 1.04 | 74 | 73 | 0 | 0 | 5.19 | 5.09 | 5.4 | 4.9 | 4.4 | 4.4 | 5.3 | 5.3 | Hi |
| SV RR266 | NC | 53.86 | 52.70 | 101 | -- | -- | 1814 | 1893 | 106 | -- | -- | 338 | 328 | 11405 | 11760 | 17.94 | 17.41 | 33.9 | 36.0 | 1.03 | 1.01 | 68 | 71 | 0 | 5 | 4.61 | 4.67 | 5.6 | 5.1 | 4.4 | 4.3 | 5.6 | 5.4 | Hi |
| SV RR268 | NC | 54.83 | 53.43 | 103 | -- | -- | 1802 | 1878 | 105 | -- | -- | 341 | 330 | 11245 | 11602 | 18.08 | 17.53 | 33.1 | 35.2 | 1.02 | 1.01 | 75 | 74 | 0 | 0 | 5.06 | 5.10 | 4.7 | 4.4 | 4.6 | 4.6 | 5.0 | 5.1 | Hi |
| SX RR1861 | NC | 53.14 | 52.18 | 100 | -- | -- | 1748 | 1857 | 104 | -- | -- | 335 | 326 | 11055 | 11594 | 17.81 | 17.34 | 33.0 | 35.7 | 1.03 | 1.03 | 76 | 74 | 0 | 0 | 4.74 | 4.63 | 5.7 | 5.1 | 4.5 | 4.5 | 5.0 | 4.9 | Hi |
| SX RR1863 | NC | 55.21 | 54.29 | 104 | -- | -- | 1773 | 1889 | 106 | -- | -- | 342 | 333 | 11008 | 11565 | 18.13 | 17.65 | 32.2 | 34.8 | 1.01 | 1.00 | 67 | 71 | 0 | 0 | 4.08 | 4.21 | 4.9 | 4.2 | 4.2 | 4.4 | 6.0 | 5.9 | Hi |
| Benchmark var. mean | | 52.84 | 51.97 | | 52.71 | | 1681 | 1785 | | 1737 | | 334 | 325 | 10653 | 11164 | 17.88 | 17.39 | 31.9 | 34.4 | 1.16 | 1.14 | 74 | 72 | | | | | | | | | | | |

# 3 Yr is mean of 3 years data, 3 Y% is 3-Yr mean as % of benchmark varieties. 2 Yr is mean of 2 years data, 2 Y% is 2-Yr mean as % of benchmark varieties.
+ Aph ratings from RRV & Shakopee (res.<4.4, susc>5.5). CR from Randolph MN, Foxhome MN & Michigan (res.<4.4, susc>5.5). Fusarium from RRV (res.<3.0, susc>5.0). Rhizoc. from Mhd, NWROC & Mich (res.<3.8, susc>5). Hi may perform better under severe Rzm.
++2017 Revenue estimate based on a $48.49 beet payment (5-yr ave) at 17.5% crop with a 1.5% loss to molasses. 2016 Revenue estimate based on a $52.44 beet payment and 2015 Revenue estimates based on a $54.96 beet payment. Revenue does not consider hauling or production costs.
+++ Sites include Casselton, Averill, Perley, Halstad, Hillsboro, Climax, Scandia, Grand Forks, Alvarado, St Thomas in 2015.
+++ Sites include Casselton, Averill, Ada, Hillsboro, Fisher, Crookston, Grand Forks, St Thomas, Stephen in 2016.
+++ Sites include Felton, Georgetown, Hillsboro, Climax, Grand Forks, Stephen, Scandia, St. Thomas, Hendrum, Bathgate in 2017.
-- indicates data not available.
Bolters /Ac are based upon a plant stand of 45,000.
Emergence is % of planted seeds producing a four leaf beet.

Created 10/30/2017

Table 3. Performance Data of RR Aphanomyces Specialty Varieties - Under Aphanomyces Conditions (Relative to Susceptible Checks) approved for 2018 Growing Season +++

| | Years | Rev/Ton | | | Rev/Acre | | | Rec/Ton | | Rec/Acre | | Sugar | | Yield | | CR Rating + | | Aph Root + | | | Rhizoctonia + | | Fusarium + | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variety | Comm | 2017 | 2016 | %Sus | 2017 | 2016 | %Sus | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 17 | 16 | 17 | 16 | 2 Yr | 17 | 16 | 17 | 16 |
| # of locations | | 0 | 2 | 2 | 0 | 2 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 0 | 2 | 3 | 3 | 1 | 2 | 3 | 1 | 4 | 2 | 2 |
| **Previously Approved** | | | | | | | | | | | | | | | | | | | | | | | | |
| BTS 80RR52 | 6 | -- | 47.73 | 99 | -- | 1406 | 137 | -- | 305.0 | -- | 8994 | -- | 16.32 | -- | 29.5 | 4.37 | 4.28 | 4.4 | 4.1 | 4.2 | 4.1 | 4.4 | 2.7 | 2.8 |
| BTS 8337 | 3 | -- | 49.32 | 102 | -- | 1372 | 134 | -- | 310.0 | -- | 8626 | -- | 16.59 | -- | 27.9 | 4.36 | 4.62 | 3.8 | 3.3 | 3.5 | 4.3 | 4.1 | 3.8 | 4.0 |
| BTS 8500 | 1 | -- | 44.32 | 92 | -- | 1328 | 130 | -- | 293.9 | -- | 8817 | -- | 15.79 | -- | 30.1 | 4.29 | 4.54 | 4.5 | 4.2 | 4.4 | 4.6 | 4.4 | 2.1 | 1.9 |
| BTS 8512 | 1 | -- | 45.42 | 94 | -- | 1291 | 126 | -- | 297.6 | -- | 8488 | -- | 15.97 | -- | 28.6 | 3.69 | 4.04 | 3.8 | 4.2 | 4.0 | 4.3 | 4.4 | 3.0 | 2.7 |
| BTS 8524 | 1 | -- | 44.53 | 92 | -- | 1417 | 138 | -- | 294.6 | -- | 9385 | -- | 15.85 | -- | 31.9 | 4.38 | 4.74 | 4.5 | 3.9 | 4.2 | 4.4 | 4.2 | 3.2 | 3.4 |
| BTS 8572 | 1 | -- | 49.62 | 103 | -- | 1285 | 125 | -- | 311.6 | -- | 8094 | -- | 16.59 | -- | 26.1 | 4.14 | 4.41 | 3.8 | 4.5 | 4.1 | 4.3 | 4.5 | 2.5 | 2.2 |
| Crystal 093RR | 6 | -- | 49.26 | 102 | -- | 1380 | 135 | -- | 309.9 | -- | 8685 | -- | 16.61 | -- | 28.1 | 4.49 | 4.95 | 4.4 | 4.3 | 4.4 | 4.5 | 4.4 | 3.5 | 3.4 |
| Crystal 101RR | 6 | -- | 42.78 | 89 | -- | 1332 | 130 | -- | 289.2 | -- | 9012 | -- | 15.70 | -- | 31.2 | 4.57 | 4.59 | 3.9 | 3.4 | 3.7 | 4.8 | 4.8 | 2.7 | 2.4 |
| Crystal 355RR | 2 | -- | 49.37 | 102 | -- | 1278 | 125 | -- | 310.2 | -- | 8071 | -- | 16.58 | -- | 26.1 | 4.36 | 4.60 | 4.8 | 4.5 | 4.7 | 4.1 | 4.0 | 2.8 | 2.7 |
| Crystal 467RR | 1 | -- | 42.00 | 87 | -- | 1244 | 121 | -- | 286.1 | -- | 8510 | -- | 15.48 | -- | 29.9 | 4.46 | 4.69 | 4.0 | 4.0 | 4.0 | 4.5 | 4.3 | 2.0 | 1.8 |
| Crystal 573RR | NC | -- | 48.78 | 101 | -- | 1303 | 127 | -- | 308.8 | -- | 8294 | -- | 16.51 | -- | 27.0 | 4.15 | 4.35 | 3.8 | 4.1 | 4.0 | 4.6 | 4.5 | 3.1 | 3.5 |
| Crystal 574RR | 1 | -- | 44.17 | 92 | -- | 1361 | 133 | -- | 293.4 | -- | 9003 | -- | 15.76 | -- | 30.5 | 4.35 | 4.51 | 4.7 | 3.7 | 4.2 | 4.2 | 4.5 | 2.2 | 1.8 |
| Crystal 986RR | 6 | -- | 49.30 | 102 | -- | 1428 | 139 | -- | 310.0 | -- | 8981 | -- | 16.53 | -- | 29.0 | 4.77 | 4.75 | 4.1 | 4.4 | 4.2 | 4.4 | 4.4 | 4.7 | 4.9 |
| Hilleshög HIL9707 | 1 | -- | 44.36 | 92 | -- | 1256 | 123 | -- | 294.0 | -- | 8345 | -- | 15.78 | -- | 28.4 | 4.96 | 4.53 | 4.7 | 4.0 | 4.3 | 4.4 | 4.4 | 4.1 | 4.9 |
| Hilleshög 4302RR | 4 | -- | 47.43 | 98 | -- | 1096 | 107 | -- | 304.0 | -- | 6975 | -- | 16.25 | -- | 22.9 | 3.93 | 4.13 | 6.7 | 4.6 | 5.6 | 3.6 | 3.7 | 5.1 | 5.1 |
| Hilleshög 9528RR | 3 | -- | 48.08 | 100 | -- | 1379 | 134 | -- | 306.1 | -- | 8772 | -- | 16.38 | -- | 28.6 | 4.99 | 4.73 | 5.6 | 3.8 | 4.7 | 4.2 | 4.2 | 4.2 | 4.5 |
| Maribo 109 | 2 | -- | 51.46 | 107 | -- | 1180 | 115 | -- | 316.9 | -- | 7271 | -- | 16.91 | -- | 23.0 | 4.14 | 4.14 | 5.1 | 4.3 | 4.7 | 3.6 | 3.7 | 4.2 | 4.5 |
| Maribo MA502 | 1 | -- | 44.36 | 92 | -- | 1350 | 132 | -- | 294.0 | -- | 8945 | -- | 15.88 | -- | 30.4 | 5.01 | 4.79 | 3.5 | 3.1 | 3.3 | 4.8 | 4.7 | 3.0 | 1.9 |
| SV RR333 | 2 | -- | 46.56 | 97 | -- | 1241 | 121 | -- | 301.2 | -- | 8010 | -- | 16.08 | -- | 26.5 | 4.84 | 4.85 | 5.0 | 4.7 | 4.8 | 4.4 | 4.4 | 5.3 | 4.8 |
| SV RR351 | 1 | -- | 46.82 | 97 | -- | 1386 | 135 | -- | 302.2 | -- | 8971 | -- | 16.16 | -- | 29.7 | 4.41 | 4.50 | 4.2 | 4.4 | 4.3 | 4.2 | 4.2 | 5.0 | 4.8 |
| SX Avalanche RR(858) | 1 | -- | 48.30 | 100 | -- | 1330 | 130 | -- | 307.2 | -- | 8473 | -- | 16.37 | -- | 27.6 | 4.64 | 4.74 | 4.0 | 4.4 | 4.2 | 4.3 | 4.5 | 5.8 | 5.4 |
| SX Canyon RR | 2 | -- | 44.98 | 93 | -- | 1201 | 117 | -- | 296.2 | -- | 7852 | -- | 15.86 | -- | 26.3 | 4.92 | 4.76 | 4.3 | 4.3 | 4.3 | 4.5 | 4.4 | 5.1 | 5.3 |
| SX Cruze RR | 2 | -- | 42.40 | 88 | -- | 1321 | 129 | -- | 288.0 | -- | 8957 | -- | 15.51 | -- | 31.0 | 5.37 | 4.65 | 4.8 | 3.4 | 4.1 | 4.4 | 4.7 | 4.0 | 2.8 |
| SX Winchester RR | 3 | -- | 47.53 | 99 | -- | 1311 | 128 | -- | 304.3 | -- | 8395 | -- | 16.23 | -- | 27.6 | 4.07 | 3.97 | 4.4 | 3.9 | 4.1 | 4.5 | 4.6 | 4.6 | 4.1 |
| **Newly Approved** | | | | | | | | | | | | | | | | | | | | | | | | |
| Crystal 684RR | NC | -- | 44.83 | 93 | -- | 1517 | 148 | -- | 295.6 | -- | 9986 | -- | 15.89 | -- | 33.7 | 4.34 | 4.57 | 4.3 | 3.7 | 4.0 | 4.6 | 4.4 | 2.0 | 1.8 |
| Hilleshög HIL9895 | NC | -- | 46.60 | 97 | -- | 1344 | 131 | -- | 301.5 | -- | 8726 | -- | 16.20 | -- | 29.0 | 4.84 | 4.49 | 4.4 | 3.6 | 4.0 | 4.3 | 4.6 | 4.1 | 2.4 |
| Maribo MA611 | NC | -- | 48.38 | 100 | -- | 1278 | 125 | -- | 307.5 | -- | 8119 | -- | 16.50 | -- | 26.4 | 5.03 | 4.47 | 4.0 | 3.9 | 4.0 | 4.4 | 4.6 | 3.8 | 2.0 |
| SX RR1863 | NC | -- | 50.16 | 104 | -- | 1349 | 132 | -- | 313.4 | -- | 8434 | -- | 16.62 | -- | 26.9 | 4.08 | 4.35 | 4.9 | 3.6 | 4.2 | 4.2 | 4.5 | 6.0 | 5.8 |
| SV RR268 | NC | -- | 48.64 | 101 | -- | 1306 | 127 | -- | 308.4 | -- | 8262 | -- | 16.40 | -- | 26.7 | 5.06 | 5.13 | 4.7 | 4.0 | 4.4 | 4.6 | 4.7 | 5.0 | 5.2 |
| Aph Susc Checks | | -- | 48.17 | | -- | 1025 | | -- | 306.8 | -- | 6529 | -- | 16.49 | -- | 21.3 | | | | | | | | | |
| Mean of Aph Specialty Varieties | | -- | 46.81 | | -- | 1320 | | -- | 302.1 | -- | 8533 | -- | 16.18 | -- | 28.3 | | | | | | | | | |

%Susc = % of susceptible varieties.

+ Aph ratings from RRV & Shakopee (res.<4.4, susc>5.5). CR from Randolph MN, Foxhome MN & Michigan (res.<4.4, susc>5.5). Fusarium from RRV (res.<3.0, susc>5.0). Rhizoc. from Mhd, NWROC & Mich (res.<3.8, susc>5). Hi may perform better under severe Rzm.

++ 2016 Revenue estimates based on a $52.44 beet payment at 17.5% sugar and 1.5% loss to molasses. Revenue does not consider hauling or production costs.

+++ 2016 Data from Perley and Cavalier.

++++Lack of Aphanomyces pressure at any of the OVT sites prevented collection of Aphanomyces Yield Data for 2017.

Table 4. Performance Data of Conventional Varieties During 2016 and 2017 Growing Seasons (All Locations Combined)+++

| | Yrs | Rev/Ton ++ | | | Rev/Acre ++ | | | Rec/Ton | | Rec/Acre | | Sugar | | Yield | | Molasses | | Emerg | | Bolter / Ac | | CR + | | Aph Root+ | | Rhizoc + | | Fus+ | | Rzm+ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variety | Com | 17 | 2 Yr | 2Y% | 17 | 2 Yr | 2Y% | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | 17 | 2 Yr | |
| # locations | | 6 | 11 | | 6 | 11 | | 6 | 11 | 6 | 11 | 6 | 11 | 6 | 11 | 6 | 11 | 6 | 11 | 6 | 11 | 3 | 6 | 1 | 3 | 4 | 6 | 2 | 4 | |
| **Previous Approved** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BETA EXP 687 | NC | 56.11 | 54.82 | 121 | 1633 | 1781 | 116 | 345 | 334 | 10123 | 10894 | 18.47 | 17.94 | 29.6 | 32.8 | 1.22 | 1.22 | 72 | 73 | 0 | 0 | 3.99 | 4.07 | 4.3 | 4.6 | 4.2 | 4.2 | 3.5 | 3.5 | Hi |
| BETA EXP 698 | NC | 53.21 | 52.37 | 116 | 1615 | 1786 | 116 | 336 | 326 | 10304 | 11185 | 17.92 | 17.45 | 31.1 | 34.6 | 1.14 | 1.14 | 76 | 73 | 0 | 0 | 4.18 | 4.23 | 3.6 | 3.7 | 4.5 | 4.4 | 3.1 | 2.9 | Hi |
| Crystal 620 | NC | 53.96 | 53.05 | 117 | 1706 | 1825 | 119 | 338 | 329 | 10783 | 11322 | 18.05 | 17.56 | 32.2 | 34.6 | 1.15 | 1.13 | 69 | 70 | 0 | 0 | 4.14 | 4.17 | 4.1 | 4.2 | 4.4 | 4.5 | 2.8 | 2.8 | Hi |
| Crystal 622 | NC | 54.64 | 54.57 | 120 | 1532 | 1665 | 108 | 340 | 333 | 9650 | 10228 | 18.26 | 17.89 | 28.7 | 30.9 | 1.25 | 1.22 | 66 | 66 | 0 | 0 | 3.72 | 3.84 | 4.0 | 4.2 | 4.5 | 4.3 | 3.5 | 3.6 | Hi |
| Crystal R761 | 8 | 51.12 | 50.18 | 111 | 1691 | 1749 | 114 | 329 | 319 | 10896 | 11128 | 17.72 | 17.25 | 33.2 | 35.0 | 1.28 | 1.28 | 74 | 72 | 0 | 0 | 4.93 | 4.96 | 4.0 | 3.8 | 4.5 | 4.6 | 3.2 | 3.2 | Hi |
| Hilleshög 3035Rz | 11 | 54.33 | 54.57 | 120 | 1457 | 1617 | 105 | 339 | 333 | 9182 | 9906 | 18.17 | 17.84 | 27.3 | 29.9 | 1.21 | 1.18 | 80 | 79 | 18 | 77 | 4.42 | 4.47 | 5.2 | 4.8 | 4.1 | 4.0 | 3.7 | 3.7 | Rzm |
| Hilleshög 9891Rz | NC | 54.95 | 53.90 | 119 | 1481 | 1585 | 103 | 341 | 331 | 9268 | 9781 | 18.26 | 17.77 | 27.4 | 29.7 | 1.19 | 1.20 | 77 | 77 | 0 | 0 | 4.13 | 4.27 | 4.9 | 4.7 | 4.5 | 4.3 | 3.7 | 3.7 | Rzm |
| Maribo MA615Rz | NC | 51.71 | 51.79 | 114 | 1586 | 1778 | 116 | 331 | 324 | 10191 | 11127 | 17.80 | 17.42 | 31.0 | 34.5 | 1.27 | 1.20 | 80 | 76 | 0 | 0 | 4.81 | 4.92 | 5.3 | 5.0 | 4.7 | 4.6 | 4.7 | 4.9 | Rzm |
| Seedex 8869 | NC | 54.07 | 53.32 | 118 | 1741 | 1874 | 122 | 338 | 329 | 10942 | 11585 | 18.02 | 17.53 | 32.5 | 35.3 | 1.09 | 1.06 | 75 | 77 | 0 | 0 | 5.21 | 4.99 | 5.0 | 4.8 | 4.4 | 4.5 | 3.5 | 3.2 | Hi |
| Seedex Deuce | NC | 53.90 | 53.65 | 118 | 1790 | 1882 | 122 | 338 | 330 | 11246 | 11584 | 18.00 | 17.58 | 33.4 | 35.1 | 1.10 | 1.05 | 75 | 75 | 18 | 18 | 4.76 | 4.72 | 6.0 | 5.9 | 4.4 | 4.5 | 4.5 | 4.6 | Hi |
| SV 48611 | NC | 55.52 | 54.71 | 121 | 1669 | 1793 | 117 | 343 | 334 | 10325 | 10925 | 18.30 | 17.83 | 30.1 | 32.8 | 1.13 | 1.13 | 69 | 68 | 0 | 0 | 5.28 | 5.06 | 4.2 | 4.4 | 4.3 | 4.5 | 5.7 | 5.5 | Hi |
| **Newly Approved** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BETA EXP 747 | NC | 52.59 | -- | -- | 1652 | -- | -- | 334 | -- | 10556 | -- | 17.83 | -- | 31.9 | -- | 1.15 | -- | 75 | -- | 0 | 0 | 4.40 | -- | 3.6 | -- | 3.9 | -- | 4.6 | -- | Hi |
| BETA EXP 758 | NC | 53.88 | -- | -- | 1638 | -- | -- | 338 | -- | 10331 | -- | 18.02 | -- | 30.8 | -- | 1.13 | -- | 78 | -- | 0 | 0 | 4.52 | -- | 3.3 | -- | 4.3 | -- | 3.9 | -- | Hi |
| Crystal 735 | NC | 58.13 | -- | -- | 1616 | -- | -- | 352 | -- | 9832 | -- | 18.69 | -- | 28.1 | -- | 1.09 | -- | 68 | -- | 0 | 0 | 4.44 | -- | 3.9 | -- | 4.6 | -- | 3.6 | -- | Hi |
| Crystal 737 | NC | 53.57 | -- | -- | 1555 | -- | -- | 337 | -- | 9878 | -- | 18.09 | -- | 29.7 | -- | 1.25 | -- | 69 | -- | 0 | 0 | 3.92 | -- | 2.2 | -- | 4.2 | -- | 3.5 | -- | Rzm |
| Maribo MA720Rz | NC | 55.19 | -- | -- | 1586 | -- | -- | 342 | -- | 9919 | -- | 18.23 | -- | 29.3 | -- | 1.13 | -- | 84 | -- | 0 | 0 | 4.54 | -- | 5.2 | -- | 4.5 | -- | 3.3 | -- | Hi |
| SV 48777 | NC | 57.39 | -- | -- | 1701 | -- | -- | 349 | -- | 10409 | -- | 18.49 | -- | 30.0 | -- | 1.02 | -- | 72 | -- | 0 | 0 | 4.76 | -- | 4.2 | -- | 4.6 | -- | 4.0 | -- | Hi |
| Strube 13722 | NC | 50.40 | -- | -- | 1696 | -- | -- | 326 | -- | 11043 | -- | 17.46 | -- | 34.0 | -- | 1.15 | -- | 79 | -- | 0 | 0 | 4.06 | -- | 7.5 | -- | 4.7 | -- | 6.6 | -- | Rzm |
| Benchmark var. mean | | 52.84 | 51.50 | | 1681 | 1760 | | 334 | 324 | 10653 | 11056 | 17.88 | 17.32 | 31.9 | 34.3 | 1.16 | 1.14 | 74 | 71 | | | | | | | | | | | |

Emergence is % of planted seeds producing a four leaf beet.
+ Aph ratings from Shakopee (res<4.4, susc>5.5). CR from Randolph MN, Foxhome MN & Michigan (res<4.5, susc>5.2). Fusarium from RRV (res<3.0, susc>5.0). Rhizoc. from Mhd, NWROC & Mich (res<3.8, susc>5). Hi may perform better under severe Rzm.
++ 2017 Revenue estimate based on a $48.49 beet payment (5-yr ave) at 17.5% sugar and 1.5% loss to molasses. 2016 Revenue estimate based on a $52.44 beet payment. Revenue does not consider hauling or production costs.
+++ Sites include Casselton, Ada, Crookston, Grand Forks, St. Thomas in 2016.
+++ Sites include Casselton, Hendrum, Grand Forks, Scandia, St. Thomas, Humbolt in 2017.
Bolters /Ac are based upon a plant stand of 45,000.
-- data not available.

Created 10/31/2017

Table 5. Official Trial Disease Nurseries 2015 - 2017 (Varieties tested in 2017)

Cercospora, Aphanomyces, Rhizoctonia, Fusarium & Rhizomania

| | | < 4.5 CR > 5.2 | | | | | < 4.4 Aph > 5.5 | | | | | < 3.82 Rhizoctonia > 5.0 | | | | | < 3.0 Fusarium > 5.0 | | | | | High Rzm |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 17 | 16 | 15 | 2 Yr | 3 Yr | 17 | 16 | 15 | 2 Yr | 3 Yr | 17 | 16 | 15 | 2 Yr | 3 Yr | 17 | 16 | 15 | 2 Yr | 3 Yr | |
| Code | Variety | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | Mean | |
| | **ACSC Commercial** | | | | | | | | | | | | | | | | | | | | | |
| 529 | BTS 80RR52 | 4.37 | 4.28 | 4.11 | 4.33 | 4.26 | 4.36 | 4.11 | 3.24 | 4.23 | 3.90 | 4.14 | 4.41 | 3.95 | 4.27 | 4.17 | 2.69 | 2.81 | 2.83 | 2.75 | 2.77 | Hi Rzm |
| 545 | BTS 8337 | 4.36 | 4.62 | 4.49 | 4.49 | 4.49 | 3.78 | 3.26 | 2.55 | 3.52 | 3.19 | 4.30 | 4.08 | 3.87 | 4.19 | 4.08 | 3.83 | 4.01 | 3.72 | 3.92 | 3.85 | Hi Rzm |
| 562 | BTS 8363 | 4.10 | 4.33 | 3.83 | 4.21 | 4.09 | 4.60 | 4.93 | 4.77 | 4.76 | 4.76 | 4.85 | 4.34 | 4.12 | 4.59 | 4.44 | 3.49 | 3.11 | 2.85 | 3.30 | 3.15 | Hi Rzm |
| 513 | BTS 8500 | 4.29 | 4.54 | 4.45 | 4.41 | 4.43 | 4.52 | 4.22 | 3.54 | 4.37 | 4.09 | 4.57 | 4.43 | 4.19 | 4.50 | 4.40 | 2.14 | 1.90 | 2.41 | 2.02 | 2.15 | Hi Rzm |
| 533 | BTS 8512 | 3.69 | 4.04 | 4.12 | 3.86 | 3.95 | 3.78 | 4.17 | 3.91 | 3.97 | 3.95 | 4.28 | 4.44 | 4.28 | 4.36 | 4.33 | 2.96 | 2.71 | 2.70 | 2.83 | 2.79 | Hi Rzm |
| 550 | BTS 8524 | 4.38 | 4.74 | 4.40 | 4.56 | 4.51 | 4.49 | 3.89 | 3.33 | 4.19 | 3.90 | 4.41 | 4.20 | 4.14 | 4.31 | 4.25 | 3.24 | 3.38 | 2.88 | 3.31 | 3.17 | Hi Rzm |
| 570 | BTS 8572 | 4.14 | 4.41 | 4.60 | 4.27 | 4.38 | 3.76 | 4.46 | 4.05 | 4.11 | 4.09 | 4.32 | 4.54 | 3.85 | 4.43 | 4.24 | 2.54 | 2.23 | 2.54 | 2.39 | 2.44 | Hi Rzm |
| 549 | Crystal 093RR | 4.49 | 4.95 | 4.76 | 4.72 | 4.73 | 4.43 | 4.32 | 3.86 | 4.38 | 4.21 | 4.50 | 4.37 | 3.96 | 4.44 | 4.28 | 3.48 | 3.35 | 3.22 | 3.42 | 3.35 | Hi Rzm |
| 551 | Crystal 101RR | 4.57 | 4.59 | 4.65 | 4.58 | 4.60 | 3.92 | 3.42 | 3.31 | 3.67 | 3.55 | 4.78 | 4.78 | 4.64 | 4.78 | 4.73 | 2.72 | 2.40 | 2.64 | 2.56 | 2.59 | Hi Rzm |
| 507 | Crystal 246RR | 4.63 | 4.81 | 4.49 | 4.72 | 4.64 | 5.13 | 4.85 | 4.99 | 4.99 | 4.99 | 4.23 | 4.32 | 4.19 | 4.28 | 4.25 | 3.24 | 3.10 | 3.00 | 3.17 | 3.11 | Hi Rzm |
| 560 | Crystal 247RR | 4.55 | 4.65 | 4.19 | 4.60 | 4.47 | 5.35 | 4.77 | 4.94 | 5.06 | 5.02 | 4.49 | 4.32 | 4.33 | 4.40 | 4.38 | 3.00 | 2.80 | 2.51 | 2.90 | 2.77 | Hi Rzm |
| 565 | Crystal 355RR | 4.36 | 4.60 | 4.43 | 4.48 | 4.46 | 4.84 | 4.46 | 3.26 | 4.65 | 4.19 | 4.09 | 3.96 | NE | 4.02 | NE | 2.76 | 2.65 | NE | 2.71 | NE | Hi Rzm |
| 523 | Crystal 467RR | 4.46 | 4.69 | 4.34 | 4.57 | 4.49 | 3.96 | 4.04 | 3.55 | 4.00 | 3.85 | 4.47 | 4.26 | 3.97 | 4.37 | 4.23 | 1.98 | 1.84 | 2.46 | 1.91 | 2.09 | Hi Rzm |
| 503 | Crystal 572RR | 4.27 | 4.57 | 4.65 | 4.42 | 4.50 | 4.69 | 4.74 | 4.33 | 4.71 | 4.59 | 4.47 | 4.21 | 3.89 | 4.34 | 4.19 | 2.64 | 1.82 | 2.36 | 2.23 | 2.27 | Hi Rzm |
| 544 | Crystal 574RR | 4.35 | 4.51 | 4.30 | 4.43 | 4.39 | 4.72 | 3.69 | 2.93 | 4.21 | 3.78 | 4.16 | 4.47 | 4.16 | 4.31 | 4.26 | 2.23 | 1.82 | 2.00 | 2.02 | 2.02 | Hi Rzm |
| 532 | Crystal 986RR | 4.77 | 4.75 | 4.97 | 4.76 | 4.83 | 4.09 | 4.41 | 3.87 | 4.25 | 4.12 | 4.39 | 4.38 | 4.06 | 4.38 | 4.28 | 4.73 | 4.86 | 3.89 | 4.79 | 4.49 | Hi Rzm |
| 505 | Hilleshög 4302RR | 3.93 | 4.13 | 4.13 | 4.03 | 4.06 | 6.66 | 4.63 | 4.02 | 5.65 | 5.10 | 3.60 | 3.65 | 3.70 | 3.63 | 3.65 | 5.09 | 5.09 | 4.05 | 5.09 | 4.74 | Rzm |
| 542 | Hilleshög 4448RR | 5.28 | 5.21 | 5.29 | 5.24 | 5.26 | 6.29 | 3.90 | 2.80 | 5.09 | 4.33 | 4.63 | 4.51 | 3.92 | 4.57 | 4.35 | 5.35 | 5.26 | NE | 5.30 | NE | Rzm |
| 531 | Hilleshög 9528RR | 4.99 | 4.73 | 5.16 | 4.86 | 4.96 | 5.63 | 3.77 | 2.97 | 4.70 | 4.12 | 4.21 | 4.21 | 4.10 | 4.21 | 4.18 | 4.25 | 4.52 | 4.00 | 4.39 | 4.26 | Hi Rzm |
| 559 | Hilleshög HIL9707 | 4.96 | 4.53 | 4.60 | 4.74 | 4.70 | 4.70 | 3.99 | 3.52 | 4.34 | 4.07 | 4.43 | 4.40 | 4.21 | 4.41 | 4.35 | 4.09 | 4.88 | 3.68 | 4.49 | 4.22 | Hi Rzm |
| 556 | Maribo 109 | 4.14 | 4.14 | 4.56 | 4.14 | 4.28 | 5.06 | 4.27 | 3.54 | 4.66 | 4.29 | 3.63 | 3.69 | 3.67 | 3.66 | 3.66 | 4.23 | 4.50 | 3.58 | 4.37 | 4.11 | Hi Rzm |
| 539 | Maribo 305 | 4.98 | 4.72 | 4.76 | 4.85 | 4.82 | 5.67 | 4.42 | 4.76 | 5.05 | 4.95 | 4.60 | 4.40 | 3.83 | 4.50 | 4.28 | 5.89 | 5.89 | 5.02 | 5.89 | 5.60 | Rzm |
| 526 | Maribo MA502 | 5.01 | 4.79 | 5.04 | 4.90 | 4.95 | 3.53 | 3.06 | 2.93 | 3.29 | 3.17 | 4.78 | 4.73 | 4.14 | 4.76 | 4.55 | 3.02 | 1.92 | 2.33 | 2.47 | 2.42 | Hi Rzm |
| 537 | SX Avalanche RR(858) | 4.64 | 4.74 | 4.15 | 4.69 | 4.51 | 4.00 | 4.44 | 3.40 | 4.22 | 3.95 | 4.29 | 4.52 | 4.21 | 4.40 | 4.34 | 5.75 | 5.38 | 5.12 | 5.57 | 5.42 | Rzm |
| 548 | SX Canyon RR | 4.92 | 4.76 | 4.02 | 4.84 | 4.56 | 4.33 | 4.28 | 3.59 | 4.31 | 4.07 | 4.51 | 4.40 | 4.22 | 4.45 | 4.38 | 5.12 | 5.26 | 3.85 | 5.19 | 4.74 | Rzm |
| 535 | SX Cruze RR | 5.37 | 4.65 | 4.57 | 5.01 | 4.87 | 4.79 | 3.41 | 4.14 | 4.10 | 4.11 | 4.39 | 4.69 | 4.18 | 4.54 | 4.42 | 3.98 | 2.80 | NE | 3.39 | NE | Rzm |
| 519 | SX Marathon RR(856) | 4.54 | 4.44 | 5.37 | 4.49 | 4.78 | 4.52 | 4.38 | 4.53 | 4.45 | 4.48 | 4.40 | 4.47 | 4.16 | 4.43 | 4.34 | 4.84 | 4.90 | 4.87 | 4.87 | 4.87 | Rzm |
| 575 | SX Winchester RR | 4.07 | 3.97 | 3.67 | 4.02 | 3.90 | 4.36 | 3.85 | 3.07 | 4.11 | 3.76 | 4.47 | 4.63 | 4.28 | 4.55 | 4.46 | 4.64 | 4.11 | 3.95 | 4.38 | 4.23 | Rzm |
| 564 | SV RR244TT | 4.85 | 4.46 | 4.17 | 4.65 | 4.49 | 4.91 | 4.97 | 4.23 | 4.94 | 4.70 | 4.50 | 4.45 | 4.18 | 4.48 | 4.38 | 3.74 | 4.14 | 3.86 | 3.94 | 3.91 | Hi Rzm |
| 541 | SV RR333 | 4.84 | 4.85 | 4.54 | 4.84 | 4.74 | 4.99 | 4.71 | 3.46 | 4.85 | 4.39 | 4.44 | 4.44 | 4.11 | 4.44 | 4.33 | 5.35 | 4.84 | NE | 5.09 | NE | Hi Rzm |
| 573 | SV RR351 | 4.41 | 4.50 | 4.62 | 4.46 | 4.51 | 4.18 | 4.38 | 3.53 | 4.28 | 4.03 | 4.25 | 4.17 | NE | 4.21 | NE | 4.96 | 4.75 | NE | 4.86 | NE | Hi Rzm |
| | **ACSC Experimental** | | | | | | | | | | | | | | | | | | | | | |
| 509 | BTS 8606 | 4.73 | 5.12 | -- | 4.92 | -- | 4.91 | 4.60 | -- | 4.75 | -- | 5.00 | 4.48 | -- | 4.74 | -- | 2.81 | 2.69 | -- | 2.75 | -- | Hi Rzm |
| 525 | BTS 8629 | 4.29 | 4.59 | -- | 4.44 | -- | 4.68 | 4.14 | -- | 4.41 | -- | 4.21 | 3.73 | -- | 3.97 | -- | 4.20 | 4.04 | -- | 4.12 | -- | Hi Rzm |
| 577 | BTS 8735 | 4.22 | -- | -- | -- | -- | 4.74 | -- | -- | -- | -- | 4.38 | -- | -- | -- | -- | 3.93 | -- | -- | -- | -- | Hi Rzm |
| 506 | BTS 8742 | 4.36 | -- | -- | -- | -- | 5.02 | -- | -- | -- | -- | 4.23 | -- | -- | -- | -- | 2.59 | -- | -- | -- | -- | Hi Rzm |
| 536 | BTS 8749 | 4.05 | -- | -- | -- | -- | 3.53 | -- | -- | -- | -- | 3.95 | -- | -- | -- | -- | 3.28 | -- | -- | -- | -- | Hi Rzm |
| 540 | BTS 8756 | 4.01 | -- | -- | -- | -- | 5.23 | -- | -- | -- | -- | 4.34 | -- | -- | -- | -- | 2.67 | -- | -- | -- | -- | Hi Rzm |
| 521 | BTS 8767 | 4.16 | -- | -- | -- | -- | 4.80 | -- | -- | -- | -- | 4.75 | -- | -- | -- | -- | 2.71 | -- | -- | -- | -- | Hi Rzm |
| 518 | BTS 8770 | 4.30 | -- | -- | -- | -- | 4.97 | -- | -- | -- | -- | 4.57 | -- | -- | -- | -- | 2.82 | -- | -- | -- | -- | Hi Rzm |
| 567 | BTS 8784 | 3.65 | -- | -- | -- | -- | 4.59 | -- | -- | -- | -- | 4.64 | -- | -- | -- | -- | 2.63 | -- | -- | -- | -- | Hi Rzm |
| 502 | BTS 8787 | 4.03 | -- | -- | -- | -- | 4.71 | -- | -- | -- | -- | 4.31 | -- | -- | -- | -- | 2.50 | -- | -- | -- | -- | Hi Rzm |
| 512 | BTS 8798 | 4.30 | -- | -- | -- | -- | 4.92 | -- | -- | -- | -- | 4.52 | -- | -- | -- | -- | 3.37 | -- | -- | -- | -- | Hi Rzm |
| 554 | Crystal 573RR | 4.15 | 4.35 | 4.15 | 4.25 | 4.22 | 3.84 | 4.06 | 3.69 | 3.95 | 3.86 | 4.57 | 4.55 | 4.25 | 4.56 | 4.45 | 3.10 | 3.49 | 3.02 | 3.29 | 3.20 | Hi Rzm |
| 571 | Crystal 578RR | 4.91 | 4.87 | 4.93 | 4.89 | 4.91 | 4.56 | 4.44 | 4.52 | 4.50 | 4.51 | 4.40 | 4.32 | 4.03 | 4.36 | 4.25 | 2.41 | 1.99 | 2.42 | 2.20 | 2.27 | Hi Rzm |
| 510 | Crystal 684RR | 4.34 | 4.57 | -- | 4.45 | -- | 4.31 | 3.74 | -- | 4.02 | -- | 4.57 | 4.41 | -- | 4.49 | -- | 2.01 | 1.76 | -- | 1.89 | -- | Hi Rzm |
| 547 | Crystal 792RR | 3.94 | -- | -- | -- | -- | 4.73 | -- | -- | -- | -- | 3.88 | -- | -- | -- | -- | 2.81 | -- | -- | -- | -- | Hi Rzm |
| 557 | Crystal 793RR | 3.93 | -- | -- | -- | -- | 3.02 | -- | -- | -- | -- | 4.26 | -- | -- | -- | -- | 2.95 | -- | -- | -- | -- | Hi Rzm |
| 534 | Crystal 794RR | 4.92 | -- | -- | -- | -- | 4.65 | -- | -- | -- | -- | 4.15 | -- | -- | -- | -- | 2.45 | -- | -- | -- | -- | Hi Rzm |
| 522 | Crystal 795RR | 4.39 | -- | -- | -- | -- | 4.40 | -- | -- | -- | -- | 3.94 | -- | -- | -- | -- | 2.66 | -- | -- | -- | -- | Hi Rzm |
| 553 | Crystal 796RR | 4.85 | -- | -- | -- | -- | 3.11 | -- | -- | -- | -- | 4.23 | -- | -- | -- | -- | 2.34 | -- | -- | -- | -- | Hi Rzm |
| 528 | Crystal 797RR | 4.17 | -- | -- | -- | -- | 5.21 | -- | -- | -- | -- | 4.26 | -- | -- | -- | -- | 3.18 | -- | -- | -- | -- | Hi Rzm |
| 576 | Hilleshög HIL9708 | 4.61 | 4.74 | 5.04 | 4.68 | 4.80 | 5.94 | 4.82 | 4.69 | 5.38 | 5.15 | 4.21 | 4.28 | 4.04 | 4.25 | 4.18 | 4.61 | 4.29 | 3.69 | 4.45 | 4.20 | Hi Rzm |
| 561 | Hilleshög HIL9895 | 4.84 | 4.49 | -- | 4.67 | -- | 4.39 | 3.65 | -- | 4.02 | -- | 4.34 | 4.56 | -- | 4.45 | -- | 4.15 | 2.40 | -- | 3.27 | -- | Hi Rzm |
| 566 | Hilleshög HIL9920 | 4.89 | -- | -- | -- | -- | 4.94 | -- | -- | -- | -- | 4.48 | -- | -- | -- | -- | 5.92 | -- | -- | -- | -- | Hi Rzm |
| 563 | Hilleshög HIL9921 | 4.47 | -- | -- | -- | -- | 5.41 | -- | -- | -- | -- | 3.85 | -- | -- | -- | -- | 4.66 | -- | -- | -- | -- | Hi Rzm |
| 504 | Hilleshög HIL9922 | 4.02 | -- | -- | -- | -- | 5.79 | -- | -- | -- | -- | 4.39 | -- | -- | -- | -- | 4.49 | -- | -- | -- | -- | Hi Rzm |
| 543 | Hilleshög HIL9923 | 4.81 | -- | -- | -- | -- | 5.06 | -- | -- | -- | -- | 4.58 | -- | -- | -- | -- | 5.29 | -- | -- | -- | -- | Hi Rzm |
| 517 | Hilleshög HIL9924 | 4.09 | -- | -- | -- | -- | 5.37 | -- | -- | -- | -- | 4.62 | -- | -- | -- | -- | 4.58 | -- | -- | -- | -- | Hi Rzm |
| 514 | Maribo MA504 | 5.50 | 5.04 | 5.25 | 5.27 | 5.26 | 6.20 | 4.54 | 4.60 | 5.37 | 5.11 | 4.37 | 4.58 | 3.98 | 4.47 | 4.31 | 4.52 | 4.60 | 4.11 | 4.56 | 4.41 | Hi Rzm |
| 568 | Maribo MA611 | 5.03 | 4.47 | -- | 4.75 | -- | 4.00 | 3.94 | -- | 3.97 | -- | 4.44 | 4.63 | -- | 4.53 | -- | 3.78 | 1.96 | -- | 2.87 | -- | Hi Rzm |
| 574 | Maribo MA717 | 4.85 | -- | -- | -- | -- | 5.31 | -- | -- | -- | -- | 4.28 | -- | -- | -- | -- | 4.95 | -- | -- | -- | -- | Rzm |
| 530 | Maribo MA718 | 4.39 | -- | -- | -- | -- | 4.46 | -- | -- | -- | -- | 4.13 | -- | -- | -- | -- | 4.61 | -- | -- | -- | -- | Rzm |
| 538 | Maribo MA719 | 4.41 | -- | -- | -- | -- | 4.75 | -- | -- | -- | -- | 4.28 | -- | -- | -- | -- | 5.76 | -- | -- | -- | -- | Rzm |

| | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 558 | SX RR1861 | 4.74 | 4.52 | -- | 4.63 | -- | 5.71 | 4.40 | -- | 5.05 | -- | 4.50 | 4.59 | -- | 4.55 | -- | 5.05 | 4.75 | -- | 4.90 | -- | Hi Rzm |
| 527 | SX RR1863 | 4.08 | 4.35 | -- | 4.21 | -- | 4.88 | 3.55 | -- | 4.21 | -- | 4.23 | 4.54 | -- | 4.39 | -- | 6.04 | 5.80 | -- | 5.92 | -- | Hi Rzm |
| 516 | SX RR1875 | 4.06 | -- | -- | -- | -- | 4.13 | -- | -- | -- | -- | 4.34 | -- | -- | -- | -- | 3.57 | -- | -- | -- | -- | Hi Rzm |
| 520 | SX RR1876 | 4.31 | -- | -- | -- | -- | 4.73 | -- | -- | -- | -- | 4.42 | -- | -- | -- | -- | 3.85 | -- | -- | -- | -- | Hi Rzm |
| 569 | SX RR1877 | 4.62 | -- | -- | -- | -- | 3.84 | -- | -- | -- | -- | 4.42 | -- | -- | -- | -- | 4.21 | -- | -- | -- | -- | Hi Rzm |
| 552 | SX RR1878 | 4.71 | -- | -- | -- | -- | 5.54 | -- | -- | -- | -- | 4.31 | -- | -- | -- | -- | 5.03 | -- | -- | -- | -- | Hi Rzm |
| 524 | SX RR1879 | 4.88 | -- | -- | -- | -- | 4.18 | -- | -- | -- | -- | 4.36 | -- | -- | -- | -- | 4.64 | -- | -- | -- | -- | Hi Rzm |
| 511 | SV RR265 | 5.19 | 5.00 | -- | 5.09 | -- | 5.35 | 4.54 | -- | 4.95 | -- | 4.42 | 4.44 | -- | 4.43 | -- | 5.32 | 5.26 | -- | 5.29 | -- | Hi Rzm |
| 555 | SV RR266 | 4.61 | 4.74 | -- | 4.67 | -- | 5.64 | 4.62 | -- | 5.13 | -- | 4.39 | 4.20 | -- | 4.30 | -- | 5.64 | 5.18 | -- | 5.41 | -- | Hi Rzm |
| 572 | SV RR268 | 5.06 | 5.13 | -- | 5.10 | -- | 4.71 | 4.00 | -- | 4.36 | -- | 4.57 | 4.70 | -- | 4.63 | -- | 5.01 | 5.20 | -- | 5.11 | -- | Hi Rzm |
| 515 | SV RR371 | 4.59 | -- | -- | -- | -- | 4.55 | -- | -- | -- | -- | 4.31 | -- | -- | -- | -- | 4.91 | -- | -- | -- | -- | Hi Rzm |
| 501 | SV RR372 | 4.23 | -- | -- | -- | -- | 4.42 | -- | -- | -- | -- | 4.47 | -- | -- | -- | -- | 4.19 | -- | -- | -- | -- | Hi Rzm |
| 508 | SV RR373 | 4.31 | -- | -- | -- | -- | 4.93 | -- | -- | -- | -- | 4.38 | -- | -- | -- | -- | 5.17 | -- | -- | -- | -- | Hi Rzm |
| 578 | SV RR374 | 4.71 | -- | -- | -- | -- | 5.20 | -- | -- | -- | -- | 4.30 | -- | -- | -- | -- | 4.44 | -- | -- | -- | -- | Hi Rzm |
| 546 | SV RR375 | 5.08 | -- | -- | -- | -- | 4.54 | -- | -- | -- | -- | 4.25 | -- | -- | -- | -- | 5.44 | -- | -- | -- | -- | Hi Rzm |
| | **ACSC Conventional** | | | | | | | | | | | | | | | | | | | | | |
| 807 | BETA EXP 687 | 3.99 | 4.14 | -- | 4.07 | -- | 4.30 | 4.88 | -- | 4.59 | -- | 4.20 | 4.16 | -- | 4.18 | -- | 3.51 | 3.41 | -- | 3.46 | -- | Hi Rzm |
| 808 | BETA EXP 698 | 4.18 | 4.27 | -- | 4.23 | -- | 3.62 | 3.69 | -- | 3.65 | -- | 4.45 | 4.35 | -- | 4.40 | -- | 3.06 | 2.74 | -- | 2.90 | -- | Hi Rzm |
| 810 | BETA EXP 747 | 4.40 | -- | -- | -- | -- | 3.60 | -- | -- | -- | -- | 3.93 | -- | -- | -- | -- | 4.58 | -- | -- | -- | -- | Hi Rzm |
| 817 | BETA EXP 758 | 4.52 | -- | -- | -- | -- | 3.29 | -- | -- | -- | -- | 4.31 | -- | -- | -- | -- | 3.91 | -- | -- | -- | -- | Hi Rzm |
| 811 | Crystal 620 | 4.14 | 4.19 | -- | 4.17 | -- | 4.09 | 4.28 | -- | 4.18 | -- | 4.37 | 4.54 | -- | 4.45 | -- | 2.79 | 2.73 | -- | 2.76 | -- | Hi Rzm |
| 801 | Crystal 622 | 3.72 | 3.96 | -- | 3.84 | -- | 4.05 | 4.36 | -- | 4.20 | -- | 4.49 | 4.14 | -- | 4.31 | -- | 3.53 | 3.57 | -- | 3.55 | -- | Hi Rzm |
| 814 | Crystal 735 | 4.44 | -- | -- | -- | -- | 3.93 | -- | -- | -- | -- | 4.61 | -- | -- | -- | -- | 3.62 | -- | -- | -- | -- | Hi Rzm |
| 806 | Crystal 737 | 3.92 | -- | -- | -- | -- | 2.25 | -- | -- | -- | -- | 4.25 | -- | -- | -- | -- | 3.52 | -- | -- | -- | -- | Hi Rzm |
| 819 | Crystal R761 | 4.93 | 4.99 | -- | 4.96 | -- | 4.01 | 3.57 | -- | 3.79 | -- | 4.54 | 4.57 | -- | 4.55 | -- | 3.23 | 3.25 | -- | 3.24 | -- | Hi Rzm |
| 805 | Hilleshög 3035Rz | 4.42 | 4.53 | -- | 4.47 | -- | 5.18 | 4.40 | -- | 4.79 | -- | 4.07 | 3.93 | -- | 4.00 | -- | 3.70 | 3.65 | -- | 3.67 | -- | Rzm |
| 812 | Hilleshög 9891Rz | 4.13 | 4.42 | -- | 4.27 | -- | 4.89 | 4.45 | -- | 4.67 | -- | 4.46 | 4.22 | -- | 4.34 | -- | 3.66 | 3.76 | -- | 3.71 | -- | Rzm |
| 818 | Maribo MA615Rz | 4.81 | 5.04 | -- | 4.92 | -- | 5.30 | 4.80 | -- | 5.05 | -- | 4.73 | 4.54 | -- | 4.63 | -- | 4.72 | 5.11 | -- | 4.92 | -- | Rzm |
| 816 | Maribo MA720Rz | 4.54 | -- | -- | -- | -- | 5.15 | -- | -- | -- | -- | 4.55 | -- | -- | -- | -- | 3.31 | -- | -- | -- | -- | Rzm |
| 809 | Seedex 8869 | 5.21 | 4.76 | -- | 4.99 | -- | 4.99 | 4.70 | -- | 4.85 | -- | 4.40 | 4.67 | -- | 4.53 | -- | 3.53 | 2.92 | -- | 3.23 | -- | Rzm |
| 802 | Seedex Deuce | 4.76 | 4.68 | -- | 4.72 | -- | 6.04 | 5.70 | -- | 5.87 | -- | 4.39 | 4.66 | -- | 4.52 | -- | 4.54 | 4.68 | -- | 4.61 | -- | Rzm |
| 815 | SV 48611 | 5.28 | 4.85 | -- | 5.06 | -- | 4.25 | 4.47 | -- | 4.36 | -- | 4.35 | 4.66 | -- | 4.50 | -- | 5.74 | 5.24 | -- | 5.49 | -- | Hi Rzm |
| 803 | SV 48777 | 4.76 | -- | -- | -- | -- | 4.20 | -- | -- | -- | -- | 4.59 | -- | -- | -- | -- | 3.96 | -- | -- | -- | -- | Rzm |
| 813 | Strube 12720 | 5.65 | -- | -- | -- | -- | 8.11 | -- | -- | -- | -- | 4.59 | -- | -- | -- | -- | 5.60 | -- | -- | -- | -- | Rzm |
| 804 | Strube 13722 | 4.06 | -- | -- | -- | -- | 7.54 | -- | -- | -- | -- | 4.73 | -- | -- | -- | -- | 6.63 | -- | -- | -- | -- | Rzm |

CR ratings on a scale of 1-9.
Aph root ratings on a scale of 1-9.
Rhizoctonia ratings on a scale of 1-7.
Fusarium ratings on a scale of 1-9.
NE indicates variety was not entered into disease nursery.
Hi Rzm = may perform better under severe Rzm.

Created 11/8/2017

Table 6. Planting & Harvest Dates, Previous Crop and Disease Levels for 2017 ACSC Official Trial Sites *

| | District / | | Planting | Harvest | Preceeding | | Diseases Present @ | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Location | Trial Type | Cooperator | Date | Date | Crop | Soil Type | Aph | Rhc | Rzm | Fus | Maggot | Rt Aphid | Comments |
| Casselton ND | Mhd/Hlb | Todd Weber | 5/1 | 9/8 | Barley | Medium/Light | N | N | N | N | N | N | Late emergence, Conv Harvested Only |
| Felton MN | Mhd/Hlb | Menholt Farms | 4/22 | 10/19 | Wheat | Medium/Light | N | N | N | N | N | N | Uniform |
| Georgetown MN | Mhd/Hlb | Hoff Farms | 5/9 | 10/18 | Soybeans | Medium | L | L | N | N | N | N | AP in NE |
| Hendrum MN | EGF/Crk | Mark Maring | 4/17 | 10/15 | Wheat | Medium | N | L-M | L-M | N | N | N | Uniform Very little disease |
| Hillsboro ND | Mhd/Hlb | Cotton Farms | 4/22 | 10/16 | Wheat | Medium | N | L | L-M | N | N | L | Some Weak Stands |
| Climax MN | EGF/Crk | Curt Knutson | 5/10 | 10/13 | Wheat | Medium | L | M | L | N | L | L | Nursery Abandoned |
| Grand Forks ND | EGF/Crk | Drees Farming Association | 5/5 | 10/10 | Wheat | Medium/Light | L | M | L | N | N | N | Slight water stunting. Some weaker stand |
| Scandia MN | EGF/Crk | Dennis Deboer | 5/2 | 9/13 | Wheat | Medium | L-M | L | M | N | N | N | Some Weak Stands |
| Stephen MN | EGF/Crk | Hvidsten Farms | 5/4 | 10/6 | Wheat | Medium/Light | N | L | L | N | L | N | Uniform Canopy, Some Wilting in August |
| Argyle MN | EGF/Crk | Brent Riopelle | 5/3 | Abandon | Wheat | Medium/Heavy | L | M | M | NA | NA | L | Abandoned |
| St Thomas ND | Dtn | Kennelly Farms | 5/8 | 9/30 | Wheat | Medium/Light | L | L | L | N | N | N | Gappy due to Hail Damage |
| Humboldt MN | Dtn | Weise Farms | 5/6 | 10/5 | Wheat | Medium/Heavy | L | L | L | N | N | N | Conv Harvested Only |
| Bathgate ND | Dtn | Shady Bend Farms | 5/7 | 10/1 | Wheat | Medium/Heavy | L-M | M | N | L | L | L | Shorter Yellow Canopy |
| Mhd Rhc-S | Rhc Nurs | Jon Hickel | 5/11 | Abandon | Soybeans | Medium/Heavy | L | V | N | L | N | N | |
| Mhd Rhc-E | Rhc Nurs | Jon Hickel | 5/11 | Abandon | Soybeans | Medium/Heavy | L | L-M | N | L | N | N | |
| Mhd Rhc-W | Rhc Nurs | Jon Hickel | 5/11 | Abandon | Soybeans | Medium/Heavy | L | L-M | N | L-M | N | N | |
| NWROC Rhc | Rhc Nurs | Albert Sims | 5/10 | 8/30 | Soybeans | Medium | N | L-M | N | N | N | N | |
| BSDF Rhc | Rhc Nurs | Mitch McGrath | 5/11 | 8/16 | NA | NA | NA | NA | NA | NA | NA | NA | |
| Mhd SE Fus | Fusarium | Ernie Oberg | 5/11 | 7/18 | Soybeans | Medium | NA | L | N | V | NA | NA | |
| Mhd Fus | Fusarium | Kevin Nelson | 5/12 | 7/20 | Soybeans | Medium | NA | N | N | V | NA | NA | |
| Shakopee MN | Aph Nurs | Patrick O'Boyle | 5/9 | 8/30 | NA | NA | NA | NA | NA | NA | NA | NA | |
| Longmont CO | RA Nurs | Eric Runkle | 4/20 | 10/10 | NA | NA | NA | NA | NA | NA | NA | NA | |
| Foxhome CR | Cercospora | Kevin Etzler | 5/9 | 8/29 | Wheat | Medium | NA | L-M | NA | L | NA | NA | |
| BSDF CR | CR Nurs | Mitch McGrath | 5/11 | 8/30 | NA | NA | NA | NA | NA | NA | NA | NA | |
| Randolph MN CR | Cercospora | Patrick O'Boyle | 5/5 | 8/9 | NA | Medium/Light | NA | NA | NA | NA | NA | NA | |

* Fertilizer applied in accordance to cooperative recommendations.

@ Disease notes for Aph., Rhizoc., Rhizomania, Fusarium, Root Maggot and Root Aphids were based upon visual evaluations (N=none, L=light, M=moderate, V=severe, NA=not observed)

Created 10-31-2017

Table 7. Seed Treatments Used on Varieties in ACSC Official Trials in 2017

| Variety | Years in Trial | Years ** Comm. | Fungicide (Rhizoctonia) | Insecticide Spring Tails & Maggots | Tachigaren Rate (Aphanomyces) | Priming (Emergence) | Fungicide (Damping Off) |
|---|---|---|---|---|---|---|---|
| **ACSC Commercial** | | | | | | | |
| BTS 80RR52 | 8 | 6 | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8337 | 5 | 3 | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8363 | 5 | 3 | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8500 | 3 | 1 | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8512 | 3 | 1 | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8524 | 3 | 1 | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8572 | 3 | 1 | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| Crystal 093RR | 8 | 6 | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 101RR | 7 | 6 | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 246RR | 6 | 4 | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 247RR | 6 | 4 | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 355RR | 5 | 2 | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 467RR | 4 | 1 | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 572RR | 3 | 1 | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 574RR | 3 | 1 | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 986RR | 9 | 6 | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Hilleshög 4302RR | 7 | 4 | Vibrance | Cruiser Maxx | 0 | XBEET | Apron XL Maxim |
| Hilleshög 4448RR | 6 | 4 | Vibrance | Cruiser Maxx | 0 | XBEET | Apron XL Maxim |
| Hilleshög 9528RR | 5 | 3 | Vibrance | Cruiser Maxx | 0 | XBEET | Apron XL Maxim |
| Hilleshög HIL9707 | 3 | 1 | Vibrance | Cruiser Maxx | 45 | XBEET | Apron XL Maxim |
| Maribo 109 | 4 | 2 | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Maribo 305 | 5 | 2 | Vibrance | Cruiser Maxx | 20 | XBEET | Apron XL Maxim |
| Maribo MA502 | 3 | 1 | Vibrance | Cruiser Maxx | 20 | XBEET | Apron XL Maxim |
| SX Avalanche RR(858) | 3 | 1 | Metlock/Rizolex/Kabina 7g | NipsIt | 20 | XBEET | Sebring Thiram |
| SX Canyon RR | 4 | 2 | Metlock/Rizolex/Kabina 7g | NipsIt | 20 | XBEET | Sebring Thiram |
| SX Cruze RR | 4 | 2 | Metlock/Rizolex/Kabina 7g | NipsIt | 20 | XBEET | Sebring Thiram |
| SX Marathon RR(856) | 3 | 1 | Metlock/Rizolex/Kabina 7g | NipsIt | 20 | XBEET | Sebring Thiram |
| SX Winchester RR | 5 | 3 | Metlock/Rizolex/Kabina 7g | NipsIt | 20 | XBEET | Sebring Thiram |
| SV RR244TT | 4 | 2 | Metlock/Rizolex/Kabina 7g | NipsIt | 20 | XBEET | Sebring Thiram |
| SV RR333 | 5 | 2 | Metlock/Rizolex/Kabina 7g | NipsIt | 20 | XBEET | Sebring Thiram |
| SV RR351 | 3 | 1 | Metlock/Rizolex/Kabina 7g | NipsIt | 20 | XBEET | Sebring Thiram |
| **ACSC Experimental** | | | | | | | |
| BTS 8606 | 2 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8629 | 2 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8735 | 1 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8742 | 1 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8749 | 1 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8756 | 1 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8767 | 1 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8770 | 1 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8784 | 1 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8787 | 1 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BTS 8798 | 1 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| Crystal 573RR | 3 | NC | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 578RR | 3 | NC | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 684RR | 2 | NC | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 792RR | 1 | NC | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 793RR | 1 | NC | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 794RR | 1 | NC | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 795RR | 1 | NC | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 796RR | 1 | NC | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 797RR | 1 | NC | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Hilleshög HIL9708 | 3 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Hilleshög HIL9895 | 2 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Hilleshög HIL9920 | 1 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Hilleshög HIL9921 | 1 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Hilleshög HIL9922 | 1 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Hilleshög HIL9923 | 1 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Hilleshög HIL9924 | 1 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Maribo MA504 | 3 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Maribo MA611 | 2 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Maribo MA717 | 1 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Maribo MA718 | 1 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Maribo MA719 | 1 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| SX RR1861 | 2 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SX RR1863 | 2 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SX RR1875 | 1 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SX RR1876 | 1 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SX RR1877 | 1 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SX RR1878 | 1 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SX RR1879 | 1 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SV RR265 | 2 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SV RR266 | 2 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SV RR268 | 2 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SV RR371 | 1 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SV RR372 | 1 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SV RR373 | 1 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SV RR374 | 1 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SV RR375 | 1 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Conventional** | | | | | | | | |
| BETA EXP 687 | 2 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BETA EXP 698 | 2 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BETA EXP 747 | 1 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| BETA EXP 758 | 1 | NC | Systiva | Poncho Beta | 35 | Ultipro | Allegiance Thiram |
| Crystal 620 | 2 | NC | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 622 | 2 | NC | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 735 | 1 | NC | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal 737 | 1 | NC | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Crystal R761 | 11 | 8 | Kabina 14g | Poncho Beta | 45 | XBEET | Allegiance Thiram |
| Hilleshög 3035Rz | 13 | 11 | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Hilleshög 9891Rz | 2 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Maribo MA615Rz | 2 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Maribo MA720Rz | 1 | NC | Vibrance | Cruiser Maxx | 20 | NA | Apron XL Maxim |
| Seedex 8869 | 2 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| Seedex Deuce | 10 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SV 48611 | 2 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| SV 48777 | 1 | NC | Kabina 14g | NipsIt | 20 | NA | Sebring Thiram |
| Strube 12720 | 1 | NC | NA | Poncho Beta | 14 | 3D Plus | Thiram |
| Strube 13722 | 1 | NC | NA | Poncho Beta | 14 | 3D Plus | Thiram |

NA indicates no treatment applied in this category.

Created 11/9/2017

## Table 8. 2017 Performance of All RR Varieties - ACSC Official Trial

10 sites

| Variety @ | Code | Rec/T lbs. | Rec/T %Bnch | Rec/A lbs. | Rec/A %Bnch | Loss Mol % | Rev/T $ ++ | Rev/T %Bnch | Rev/A $ ++ | Rev/A %Bnch | Sugar % | Yield T/A | Na ppm | K ppm | AmN ppm | Bolter per Ac | Emerg. % | Tare % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Commercial Trial** | | | | | | | | | | | | | | | | | | |
| BTS 80RR52 | 103 | 334.2 | 100 | 10789 | 101 | 1.22 | 52.79 | 100 | 1699 | 101 | 17.94 | 32.39 | 206 | 1650 | 432 | 5 | 78.2 | 5.5 |
| BTS 8337 | 116 | 349.5 | 105 | 11209 | 105 | 1.08 | 57.43 | 109 | 1842 | 110 | 18.55 | 32.08 | 174 | 1574 | 352 | 5 | 76.0 | 6.3 |
| BTS 8363 | 130 | 328.7 | 98 | 11391 | 107 | 1.09 | 51.14 | 97 | 1770 | 105 | 17.53 | 34.70 | 214 | 1555 | 354 | 0 | 77.9 | 5.9 |
| BTS 8500 | 119 | 335.7 | 100 | 11741 | 110 | 1.11 | 53.24 | 101 | 1862 | 111 | 17.90 | 34.98 | 192 | 1606 | 366 | 0 | 76.2 | 5.5 |
| BTS 8512 | 109 | 339.9 | 102 | 10921 | 103 | 1.08 | 54.51 | 103 | 1749 | 104 | 18.08 | 32.19 | 182 | 1557 | 359 | 14 | 79.5 | 5.5 |
| BTS 8524 | 101 | 330.0 | 99 | 11506 | 108 | 1.14 | 51.51 | 97 | 1796 | 107 | 17.64 | 34.88 | 197 | 1697 | 362 | 5 | 78.7 | 6.1 |
| BTS 8572 | 111 | 346.7 | 104 | 11147 | 105 | 1.07 | 56.57 | 107 | 1817 | 108 | 18.41 | 32.19 | 159 | 1501 | 377 | 0 | 77.6 | 6.0 |
| Crystal 093RR | 115 | 350.3 | 105 | 11339 | 106 | 1.08 | 57.65 | 109 | 1866 | 111 | 18.60 | 32.40 | 153 | 1575 | 366 | 0 | 76.4 | 5.8 |
| Crystal 101RR | 107 | 329.3 | 98 | 11040 | 104 | 1.20 | 51.29 | 97 | 1718 | 102 | 17.66 | 33.57 | 238 | 1768 | 376 | 0 | 76.9 | 5.7 |
| Crystal 246RR | 108 | 331.7 | 99 | 11322 | 106 | 1.09 | 52.05 | 99 | 1775 | 106 | 17.67 | 34.16 | 226 | 1553 | 349 | 0 | 74.3 | 6.2 |
| Crystal 247RR | 131 | 335.2 | 100 | 11575 | 109 | 1.03 | 53.09 | 100 | 1832 | 109 | 17.79 | 34.57 | 202 | 1568 | 305 | 18 | 76.1 | 5.7 |
| Crystal 355RR | 104 | 340.0 | 102 | 10689 | 100 | 1.15 | 54.56 | 103 | 1711 | 102 | 18.16 | 31.53 | 195 | 1601 | 400 | 0 | 75.1 | 6.3 |
| Crystal 467RR | 129 | 330.1 | 99 | 11588 | 109 | 1.12 | 51.56 | 98 | 1804 | 107 | 17.63 | 35.22 | 256 | 1647 | 338 | 0 | 79.6 | 5.7 |
| Crystal 572RR | 126 | 354.7 | 106 | 11379 | 107 | 1.01 | 58.99 | 112 | 1891 | 112 | 18.74 | 32.12 | 148 | 1456 | 341 | 0 | 81.5 | 6.5 |
| Crystal 574RR | 110 | 334.4 | 100 | 11851 | 111 | 1.08 | 52.84 | 100 | 1875 | 112 | 17.79 | 35.41 | 175 | 1587 | 346 | 0 | 79.5 | 5.2 |
| Crystal 986RR | 128 | 341.1 | 102 | 11008 | 103 | 1.03 | 54.89 | 104 | 1776 | 106 | 18.09 | 32.18 | 210 | 1440 | 339 | 0 | 78.4 | 6.2 |
| Hilleshög 4302RR | 105 | 334.0 | 100 | 10093 | 95 | 1.05 | 52.73 | 100 | 1597 | 95 | 17.75 | 30.13 | 223 | 1584 | 310 | 0 | 65.2 | 6.2 |
| Hilleshög 4448RR | 112 | 338.0 | 101 | 11456 | 108 | 1.06 | 53.93 | 102 | 1829 | 109 | 17.97 | 33.89 | 191 | 1516 | 351 | 5 | 69.8 | 5.1 |
| Hilleshög 9528RR | 123 | 339.3 | 101 | 11154 | 105 | 1.05 | 54.35 | 103 | 1785 | 106 | 18.02 | 32.88 | 193 | 1512 | 343 | 5 | 74.1 | 5.4 |
| Hilleshög HIL9707 | 114 | 324.3 | 97 | 11020 | 103 | 1.14 | 49.79 | 94 | 1692 | 101 | 17.35 | 33.98 | 226 | 1598 | 375 | 5 | 71.8 | 5.7 |
| Maribo 109 | 122 | 347.6 | 104 | 9579 | 90 | 1.06 | 56.86 | 108 | 1569 | 93 | 18.43 | 27.50 | 184 | 1495 | 355 | 0 | 67.5 | 5.8 |
| Maribo 305 | 106 | 331.7 | 99 | 11018 | 103 | 1.02 | 52.03 | 98 | 1731 | 103 | 17.60 | 33.15 | 194 | 1457 | 333 | 0 | 66.8 | 5.0 |
| Maribo MA502 | 121 | 329.8 | 99 | 10539 | 99 | 1.17 | 51.46 | 97 | 1642 | 98 | 17.66 | 32.02 | 257 | 1672 | 370 | 68 | 73.6 | 5.7 |
| SX Avalanche RR(858) | 127 | 342.2 | 102 | 10472 | 98 | 1.02 | 55.22 | 104 | 1690 | 101 | 18.13 | 30.60 | 200 | 1526 | 310 | 9 | 71.6 | 6.3 |
| SX Canyon RR | 118 | 342.4 | 102 | 11330 | 106 | 1.03 | 55.26 | 105 | 1829 | 109 | 18.15 | 33.11 | 171 | 1534 | 331 | 0 | 71.4 | 5.8 |
| SX Cruze RR | 117 | 318.4 | 95 | 11272 | 106 | 1.13 | 48.01 | 91 | 1696 | 101 | 17.05 | 35.47 | 202 | 1564 | 388 | 5 | 76.8 | 5.7 |
| SX Marathon RR(856) | 102 | 340.4 | 102 | 11296 | 106 | 1.02 | 54.66 | 103 | 1812 | 108 | 18.04 | 33.22 | 170 | 1534 | 323 | 5 | 71.7 | 6.1 |
| SX Winchester RR | 125 | 331.1 | 99 | 10087 | 95 | 1.04 | 51.84 | 98 | 1580 | 94 | 17.59 | 30.46 | 195 | 1566 | 320 | 5 | 65.7 | 5.8 |
| SV RR244TT | 120 | 334.7 | 100 | 11339 | 106 | 1.05 | 52.93 | 100 | 1796 | 107 | 17.79 | 33.83 | 178 | 1577 | 331 | 5 | 71.9 | 5.7 |
| SV RR333 | 124 | 338.9 | 101 | 11399 | 107 | 1.04 | 54.21 | 103 | 1823 | 108 | 17.98 | 33.65 | 178 | 1556 | 325 | 0 | 72.4 | 5.8 |
| SV RR351 | 113 | 337.3 | 101 | 11196 | 105 | 1.05 | 53.73 | 102 | 1783 | 106 | 17.91 | 33.19 | 185 | 1549 | 332 | 0 | 73.9 | 5.8 |
| RR Filler #01s | 132 | 330.8 | 99 | 11182 | 105 | 1.19 | 51.76 | 98 | 1747 | 104 | 17.73 | 33.86 | 234 | 1738 | 375 | 0 | 78.6 | 6.0 |
| RR Filler #01v | 133 | 330.2 | 99 | 11242 | 106 | 1.20 | 51.58 | 98 | 1754 | 104 | 17.71 | 34.10 | 234 | 1753 | 376 | 0 | 78.0 | 5.6 |
| **Experimental Trial (Comm status)** | | | | | | | | | | | | | | | | | | |
| BTS 8606 | 242 | 340.5 | 102 | 11739 | 110 | 1.09 | 54.65 | 103 | 1882 | 112 | 18.13 | 34.57 | 207 | 1576 | 356 | 0 | 78.9 | 4.8 |
| BTS 8629 | 224 | 332.8 | 100 | 11986 | 113 | 1.08 | 52.38 | 99 | 1884 | 112 | 17.72 | 36.12 | 215 | 1450 | 377 | 0 | 81.2 | 4.1 |
| BTS 8735 | 234 | 335.7 | 100 | 11581 | 109 | 1.05 | 53.23 | 101 | 1836 | 109 | 17.84 | 34.49 | 199 | 1421 | 364 | 0 | 79.2 | 3.8 |
| BTS 8742 | 207 | 333.4 | 100 | 10461 | 98 | 1.23 | 52.55 | 99 | 1646 | 98 | 17.89 | 31.40 | 210 | 1624 | 443 | 0 | 76.4 | 4.7 |
| BTS 8749 | 202 | 337.7 | 101 | 10812 | 101 | 1.14 | 53.82 | 102 | 1719 | 102 | 18.04 | 32.11 | 203 | 1629 | 381 | 9 | 77.3 | 4.9 |
| BTS 8756 | 241 | 338.4 | 101 | 10818 | 102 | 1.25 | 54.06 | 102 | 1724 | 103 | 18.16 | 32.02 | 202 | 1698 | 443 | 0 | 81.6 | 5.0 |
| BTS 8767 | 235 | 339.2 | 101 | 11755 | 110 | 1.08 | 54.27 | 103 | 1878 | 112 | 18.05 | 34.75 | 203 | 1590 | 342 | 0 | 81.4 | 5.0 |
| BTS 8770 | 247 | 337.4 | 101 | 11328 | 106 | 1.07 | 53.72 | 102 | 1801 | 107 | 17.95 | 33.62 | 211 | 1609 | 325 | 9 | 73.2 | 4.4 |
| BTS 8784 | 236 | 351.4 | 105 | 10874 | 102 | 1.04 | 57.86 | 109 | 1787 | 106 | 18.62 | 31.00 | 160 | 1451 | 359 | 0 | 77.3 | 4.4 |
| BTS 8787 | 219 | 331.5 | 99 | 11071 | 104 | 1.09 | 52.00 | 98 | 1733 | 103 | 17.68 | 33.45 | 198 | 1583 | 351 | 0 | 73.4 | 4.5 |
| BTS 8798 | 223 | 338.8 | 101 | 10627 | 100 | 1.07 | 54.16 | 103 | 1695 | 101 | 18.03 | 31.42 | 166 | 1485 | 377 | 0 | 80.1 | 5.1 |
| Crystal 573RR | 225 | 343.9 | 103 | 11039 | 104 | 1.08 | 55.66 | 105 | 1785 | 106 | 18.28 | 32.14 | 176 | 1511 | 368 | 0 | 75.0 | 4.4 |
| Crystal 578RR | 220 | 338.4 | 101 | 11908 | 112 | 1.07 | 54.05 | 102 | 1899 | 113 | 18.00 | 35.28 | 206 | 1579 | 335 | 0 | 80.1 | 4.6 |
| Crystal 684RR | 239 | 333.7 | 100 | 12057 | 113 | 1.12 | 52.65 | 100 | 1899 | 113 | 17.81 | 36.22 | 216 | 1658 | 354 | 0 | 80.0 | 4.9 |
| Crystal 792RR | 218 | 344.0 | 103 | 11139 | 105 | 1.05 | 55.67 | 105 | 1799 | 107 | 18.26 | 32.45 | 161 | 1485 | 367 | 0 | 77.6 | 4.2 |
| Crystal 793RR | 246 | 347.5 | 104 | 11636 | 109 | 1.00 | 56.69 | 107 | 1896 | 113 | 18.39 | 33.52 | 172 | 1441 | 329 | 18 | 78.0 | 4.8 |
| Crystal 794RR | 208 | 333.8 | 100 | 11629 | 109 | 1.09 | 52.66 | 100 | 1835 | 109 | 17.79 | 34.82 | 206 | 1534 | 368 | 0 | 70.7 | 4.1 |
| Crystal 795RR | 215 | 340.1 | 102 | 10685 | 100 | 1.13 | 54.53 | 103 | 1708 | 102 | 18.14 | 31.53 | 191 | 1557 | 395 | 0 | 75.7 | 4.6 |
| Crystal 796RR | 238 | 337.0 | 101 | 12237 | 115 | 1.07 | 53.63 | 101 | 1950 | 116 | 17.93 | 36.27 | 190 | 1570 | 342 | 0 | 80.0 | 5.0 |
| Crystal 797RR | 201 | 330.1 | 99 | 11595 | 109 | 1.11 | 51.58 | 98 | 1809 | 108 | 17.63 | 35.22 | 233 | 1660 | 339 | 9 | 69.6 | 4.1 |
| Hilleshög HIL9708 | 222 | 338.6 | 101 | 10290 | 97 | 1.07 | 54.11 | 102 | 1640 | 98 | 18.02 | 30.41 | 214 | 1493 | 364 | 9 | 74.3 | 3.7 |
| Hilleshög HIL9895 | 209 | 326.3 | 98 | 10024 | 94 | 1.17 | 50.46 | 95 | 1547 | 92 | 17.48 | 30.84 | 223 | 1604 | 400 | 41 | 73.1 | 4.3 |
| Hilleshög HIL9920 | 203 | 347.2 | 104 | 10968 | 103 | 1.02 | 56.61 | 107 | 1785 | 106 | 18.40 | 31.64 | 190 | 1574 | 304 | 9 | 74.1 | 4.4 |
| Hilleshög HIL9921 | 204 | 345.2 | 103 | 9779 | 92 | 1.08 | 56.04 | 106 | 1585 | 94 | 18.35 | 28.35 | 206 | 1481 | 368 | 0 | 76.5 | 4.2 |
| Hilleshög HIL9922 | 231 | 325.4 | 97 | 10144 | 95 | 1.18 | 50.19 | 95 | 1560 | 93 | 17.44 | 31.26 | 215 | 1627 | 403 | 68 | 78.0 | 4.8 |
| Hilleshög HIL9923 | 243 | 337.5 | 101 | 9412 | 88 | 1.24 | 53.77 | 102 | 1497 | 89 | 18.11 | 27.92 | 248 | 1644 | 441 | 0 | 62.1 | 3.8 |
| Hilleshög HIL9924 | 237 | 335.0 | 100 | 9186 | 86 | 1.27 | 53.00 | 100 | 1455 | 87 | 18.02 | 27.42 | 219 | 1622 | 482 | 0 | 57.5 | 4.6 |
| Maribo MA504 | 229 | 333.9 | 100 | 11632 | 109 | 1.07 | 52.70 | 100 | 1830 | 109 | 17.77 | 34.93 | 210 | 1502 | 357 | 0 | 76.9 | 3.4 |
| Maribo MA611 | 245 | 325.9 | 97 | 10000 | 94 | 1.16 | 50.37 | 95 | 1542 | 92 | 17.45 | 30.75 | 225 | 1623 | 378 | 9 | 75.3 | 3.9 |
| Maribo MA717 | 232 | 342.0 | 102 | 10828 | 102 | 1.08 | 55.10 | 104 | 1742 | 104 | 18.19 | 31.68 | 185 | 1505 | 372 | 0 | 74.8 | 4.0 |
| Maribo MA718 | 221 | 330.0 | 99 | 9489 | 89 | 1.20 | 51.56 | 98 | 1476 | 88 | 17.68 | 28.89 | 282 | 1720 | 370 | 0 | 63.9 | 4.3 |
| Maribo MA719 | 213 | 337.1 | 101 | 10181 | 96 | 1.25 | 53.64 | 102 | 1617 | 96 | 18.09 | 30.27 | 227 | 1675 | 446 | 59 | 67.4 | 3.4 |
| SX RR1861 | 233 | 335.3 | 100 | 11055 | 104 | 1.03 | 53.14 | 101 | 1748 | 104 | 17.81 | 33.04 | 179 | 1545 | 322 | 0 | 76.0 | 4.6 |
| SX RR1863 | 244 | 342.4 | 102 | 11008 | 103 | 1.01 | 55.21 | 104 | 1773 | 105 | 18.13 | 32.18 | 180 | 1545 | 301 | 0 | 66.6 | 4.3 |
| SX RR1875 | 210 | 341.6 | 102 | 9977 | 94 | 1.00 | 54.96 | 104 | 1605 | 95 | 18.09 | 29.24 | 185 | 1498 | 307 | 32 | 77.0 | 5.3 |
| SX RR1876 | 228 | 332.6 | 99 | 10794 | 101 | 1.06 | 52.31 | 99 | 1694 | 101 | 17.69 | 32.53 | 179 | 1553 | 341 | 0 | 68.5 | 3.9 |
| SX RR1877 | 227 | 330.0 | 99 | 10449 | 98 | 1.25 | 51.56 | 98 | 1626 | 97 | 17.74 | 31.79 | 228 | 1697 | 434 | 0 | 72.0 | 3.7 |
| SX RR1878 | 206 | 335.6 | 100 | 11097 | 104 | 1.03 | 53.22 | 101 | 1756 | 104 | 17.82 | 33.11 | 177 | 1541 | 326 | 0 | 71.5 | 4.4 |
| SX RR1879 | 205 | 338.5 | 101 | 11092 | 104 | 1.04 | 54.07 | 102 | 1770 | 105 | 17.98 | 32.79 | 187 | 1533 | 328 | 0 | 75.6 | 4.1 |
| SV RR265 | 240 | 336.8 | 101 | 11584 | 109 | 1.04 | 53.56 | 101 | 1836 | 109 | 17.89 | 34.52 | 176 | 1544 | 328 | 0 | 74.1 | 4.7 |
| SV RR266 | 216 | 337.9 | 101 | 11405 | 107 | 1.03 | 53.86 | 102 | 1814 | 108 | 17.94 | 33.86 | 181 | 1544 | 324 | 0 | 68.2 | 4.3 |
| SV RR268 | 226 | 341.1 | 102 | 11245 | 106 | 1.02 | 54.83 | 104 | 1802 | 107 | 18.08 | 33.06 | 176 | 1556 | 313 | 0 | 75.1 | 4.3 |
| SV RR371 | 212 | 339.0 | 101 | 11476 | 108 | 1.03 | 54.21 | 103 | 1833 | 109 | 17.99 | 33.88 | 171 | 1536 | 320 | 0 | 76.4 | 4.6 |
| SV RR372 | 217 | 332.7 | 100 | 10960 | 103 | 1.04 | 52.35 | 99 | 1723 | 103 | 17.68 | 32.97 | 177 | 1520 | 335 | 0 | 72.9 | 4.6 |
| SV RR373 | 230 | 331.8 | 99 | 10305 | 97 | 1.08 | 52.08 | 99 | 1613 | 96 | 17.68 | 31.13 | 186 | 1594 | 348 | 0 | 65.9 | 4.6 |
| SV RR374 | 214 | 337.2 | 101 | 11173 | 105 | 1.04 | 53.68 | 102 | 1776 | 106 | 17.92 | 33.17 | 187 | 1518 | 338 | 9 | 77.0 | 4.8 |
| SV RR375 | 211 | 342.4 | 102 | 11189 | 105 | 1.05 | 55.21 | 104 | 1802 | 107 | 18.19 | 32.72 | 173 | 1584 | 334 | 9 | 67.9 | 3.9 |
| AP CHK MOD RES RR#4 | 248 | 333.5 | 100 | 11425 | 107 | 1.05 | 52.58 | 99 | 1796 | 107 | 17.73 | 34.38 | 220 | 1581 | 317 | 0 | 71.6 | 4.4 |
| AP CHK SUS HYB#3 | 249 | 343.6 | 103 | 10379 | 97 | 1.10 | 55.54 | 105 | 1675 | 100 | 18.29 | 30.27 | 235 | 1586 | 350 | 0 | 72.1 | 4.9 |
| Crystal 355RR(Check) | 250 | 337.1 | 101 | 10878 | 102 | 1.17 | 53.65 | 102 | 1727 | 103 | 18.03 | 32.34 | 205 | 1623 | 403 | 0 | 76.3 | 5.5 |
| BTS 80RR52(Check) | 251 | 336.3 | 101 | 10945 | 103 | 1.18 | 53.41 | 101 | 1738 | 103 | 18.00 | 32.54 | 188 | 1632 | 409 | 0 | 77.0 | 5.4 |
| Crystal 101RR (Check) | 252 | 333.0 | 100 | 11311 | 106 | 1.21 | 52.45 | 99 | 1781 | 106 | 17.86 | 33.99 | 227 | 1780 | 377 | 0 | 76.6 | 3.9 |
| Hilleshög 4302RR (Check) | 253 | 331.1 | 99 | 9476 | 89 | 1.07 | 51.87 | 98 | 1478 | 88 | 17.63 | 28.75 | 242 | 1568 | 330 | 0 | 65.2 | 4.6 |
| RR Filler #05 | 254 | 332.0 | 99 | 9158 | 86 | 1.25 | 52.15 | 99 | 1435 | 85 | 17.84 | 27.63 | 289 | 1662 | 426 | 0 | 69.8 | 5.7 |
| | | | | | | | | | | | | | | | | | | |
| Comm Benchmark Mean | | 334.4 | | 10653 | | 1.16 | 52.84 | | 1681 | | 17.88 | 31.91 | 215 | 1651 | 380 | | 73.8 | 4.8 |
| Comm Trial Mean | | 336.4 | | 11096 | | 1.09 | 53.47 | | 1762 | | 17.91 | 33.02 | 198 | 1578 | 352 | | 74.6 | 5.8 |
| Coeff. of Var. (%) | | 2.8 | | 5.4 | | 8.5 | 5.3 | | 6.9 | | 2.4 | 4.9 | 22 | 5.0 | 15 | | 8.0 | 28.8 |
| Mean LSD (0.05) | | 4.9 | | 442 | | 0.05 | 1.49 | | 83 | | 0.23 | 1.20 | 25 | 40 | 28 | | 3.4 | 0.6 |
| Mean LSD (0.01) | | 6.5 | | 582 | | 0.06 | 1.96 | | 109 | | 0.30 | 1.58 | 33 | 52 | 37 | | 4.5 | 0.8 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** | ** |

Bolters per acre are based upon 45,000 plants per acre. Trial # = 17ACSExp10

* 2017 Data from 10 sites

@ Experimental trial data adjusted to commercial status. Statistics are from commercial trial. Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs. Created 10/31/2017

## Table 9. 2017 Performance of All RR Varieties - ACSC Official Trial

### Felton MN

| Variety @ | Code | Rec/T lbs. | Rec/T %Bnch | Rec/A lbs. | Rec/A %Bnch | Loss Mol % | Rev/T $ ++ | Rev/T %Bnch | Rev/A $ ++ | Rev/A %Bnch | Sugar % | Yield T/A | Na ppm | K ppm | AmN ppm | Bolter per Ac | Emerg. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Commercial Trial** | | | | | | | | | | | | | | | | | |
| BTS 80RR52 | 103 | 298.0 | 98 | 11136 | 102 | 1.95 | 41.82 | 95 | 1578 | 100 | 16.83 | 37.05 | 552 | 1779 | 842 | 0 | 58.3 |
| BTS 8337 | 116 | 340.1 | 111 | 12185 | 111 | 1.51 | 54.57 | 124 | 1953 | 123 | 18.55 | 35.96 | 305 | 1598 | 626 | 0 | 60.8 |
| BTS 8363 | 130 | 306.9 | 100 | 12019 | 110 | 1.67 | 44.51 | 101 | 1746 | 110 | 17.02 | 39.03 | 483 | 1698 | 669 | 0 | 64.6 |
| BTS 8500 | 119 | 325.8 | 107 | 12953 | 118 | 1.58 | 50.23 | 114 | 1994 | 126 | 17.87 | 39.89 | 357 | 1618 | 658 | 0 | 65.3 |
| BTS 8512 | 109 | 321.8 | 105 | 11792 | 108 | 1.49 | 49.03 | 111 | 1791 | 113 | 17.61 | 36.59 | 351 | 1565 | 602 | 32 | 60.4 |
| BTS 8524 | 101 | 315.0 | 103 | 12812 | 117 | 1.58 | 46.98 | 107 | 1913 | 121 | 17.35 | 40.62 | 407 | 1728 | 614 | 0 | 63.8 |
| BTS 8572 | 111 | 329.4 | 108 | 11975 | 109 | 1.55 | 51.35 | 116 | 1874 | 118 | 17.98 | 36.28 | 286 | 1557 | 685 | 0 | 62.2 |
| Crystal 093RR | 115 | 329.8 | 108 | 12237 | 112 | 1.49 | 51.46 | 117 | 1907 | 120 | 18.03 | 37.21 | 319 | 1625 | 597 | 0 | 57.8 |
| Crystal 101RR | 107 | 303.5 | 99 | 11549 | 106 | 1.69 | 43.51 | 99 | 1655 | 104 | 16.87 | 38.23 | 456 | 1816 | 659 | 0 | 64.0 |
| Crystal 246RR | 108 | 315.0 | 103 | 12362 | 113 | 1.65 | 46.99 | 107 | 1849 | 117 | 17.39 | 39.13 | 491 | 1629 | 664 | 0 | 57.9 |
| Crystal 247RR | 131 | 322.1 | 105 | 12591 | 115 | 1.44 | 49.12 | 111 | 1924 | 121 | 17.56 | 38.88 | 418 | 1661 | 524 | 32 | 65.9 |
| Crystal 355RR | 104 | 312.1 | 102 | 11247 | 103 | 1.70 | 46.10 | 105 | 1667 | 105 | 17.28 | 35.84 | 478 | 1650 | 708 | 0 | 59.9 |
| Crystal 467RR | 129 | 308.6 | 101 | 12418 | 113 | 1.60 | 45.04 | 102 | 1818 | 115 | 16.99 | 40.06 | 533 | 1677 | 607 | 0 | 68.9 |
| Crystal 572RR | 126 | 339.4 | 111 | 12424 | 114 | 1.39 | 54.37 | 123 | 1994 | 126 | 18.39 | 36.46 | 266 | 1439 | 595 | 0 | 72.8 |
| Crystal 574RR | 110 | 325.0 | 106 | 12873 | 118 | 1.53 | 50.00 | 113 | 1982 | 125 | 17.78 | 39.86 | 331 | 1612 | 626 | 0 | 68.6 |
| Crystal 986RR | 128 | 307.4 | 101 | 11073 | 101 | 1.54 | 44.67 | 101 | 1617 | 102 | 16.92 | 35.65 | 455 | 1446 | 644 | 0 | 61.8 |
| Hilleshög 4302RR | 105 | 308.5 | 101 | 9842 | 90 | 1.57 | 45.00 | 102 | 1442 | 91 | 16.99 | 31.73 | 492 | 1696 | 589 | 0 | 45.2 |
| Hilleshög 4448RR | 112 | 312.5 | 102 | 12012 | 110 | 1.38 | 46.22 | 105 | 1779 | 112 | 17.03 | 38.28 | 387 | 1531 | 530 | 0 | 50.3 |
| Hilleshög 9528RR | 123 | 314.9 | 103 | 12138 | 111 | 1.48 | 46.94 | 106 | 1813 | 114 | 17.20 | 38.59 | 392 | 1489 | 608 | 0 | 63.5 |
| Hilleshög HIL9707 | 114 | 300.7 | 98 | 11587 | 106 | 1.65 | 42.66 | 97 | 1655 | 104 | 16.65 | 38.37 | 437 | 1650 | 687 | 0 | 58.9 |
| Maribo 109 | 122 | 328.3 | 107 | 10166 | 93 | 1.50 | 51.01 | 116 | 1574 | 99 | 17.93 | 31.25 | 392 | 1455 | 627 | 0 | 49.6 |
| Maribo 305 | 106 | 301.5 | 99 | 11335 | 104 | 1.45 | 42.89 | 97 | 1617 | 102 | 16.51 | 37.68 | 424 | 1449 | 581 | 0 | 51.7 |
| Maribo MA502 | 121 | 303.5 | 99 | 11253 | 103 | 1.68 | 43.48 | 99 | 1617 | 102 | 16.81 | 37.07 | 552 | 1707 | 644 | 0 | 64.1 |
| SX Avalanche RR(858) | 127 | 324.2 | 106 | 11058 | 101 | 1.50 | 49.76 | 113 | 1699 | 107 | 17.71 | 34.03 | 410 | 1578 | 587 | 0 | 58.1 |
| SX Canyon RR | 118 | 311.3 | 102 | 11569 | 106 | 1.62 | 45.86 | 104 | 1707 | 108 | 17.24 | 37.06 | 373 | 1565 | 703 | 0 | 53.4 |
| SX Cruze RR | 117 | 293.3 | 96 | 11905 | 109 | 1.78 | 40.41 | 92 | 1651 | 104 | 16.43 | 40.28 | 444 | 1647 | 773 | 0 | 60.2 |
| SX Marathon RR(856) | 102 | 325.7 | 107 | 11876 | 109 | 1.39 | 50.22 | 114 | 1833 | 116 | 17.66 | 36.30 | 288 | 1610 | 551 | 0 | 59.4 |
| SX Winchester RR | 125 | 307.6 | 101 | 10074 | 92 | 1.59 | 44.73 | 101 | 1452 | 92 | 17.00 | 33.03 | 427 | 1656 | 624 | 0 | 51.1 |
| SV RR244TT | 120 | 319.4 | 105 | 11780 | 108 | 1.46 | 48.30 | 110 | 1776 | 112 | 17.44 | 37.01 | 336 | 1631 | 567 | 0 | 60.3 |
| SV RR333 | 124 | 319.4 | 105 | 11868 | 108 | 1.53 | 48.32 | 110 | 1795 | 113 | 17.49 | 37.07 | 356 | 1633 | 619 | 0 | 58.2 |
| SV RR351 | 113 | 319.0 | 104 | 11716 | 107 | 1.53 | 48.19 | 109 | 1778 | 112 | 17.44 | 36.61 | 350 | 1618 | 623 | 0 | 59.2 |
| RR Filler #01s | 132 | 307.3 | 101 | 12007 | 110 | 1.64 | 44.64 | 101 | 1749 | 110 | 17.01 | 38.95 | 441 | 1747 | 636 | 0 | 66.2 |
| RR Filler #01v | 133 | 302.8 | 99 | 11523 | 105 | 1.73 | 43.28 | 98 | 1653 | 104 | 16.88 | 37.92 | 494 | 1724 | 706 | 0 | 59.5 |
| **Experimental Trial (Comm status)** | | | | | | | | | | | | | | | | | |
| BTS 8606 | 242 | 308.6 | 101 | 11660 | 107 | 1.83 | 44.94 | 102 | 1701 | 107 | 17.20 | 37.91 | 562 | 1684 | 780 | 0 | 70.4 |
| BTS 8629 | 224 | 306.8 | 100 | 12344 | 113 | 1.83 | 44.46 | 101 | 1799 | 113 | 17.12 | 40.15 | 575 | 1513 | 849 | 0 | 72.1 |
| BTS 8735 | 234 | 311.4 | 102 | 11728 | 107 | 1.72 | 45.70 | 104 | 1729 | 109 | 17.28 | 37.42 | 499 | 1555 | 742 | 0 | 68.9 |
| BTS 8742 | 207 | 303.7 | 99 | 11411 | 104 | 1.78 | 43.60 | 99 | 1641 | 103 | 16.93 | 37.63 | 529 | 1546 | 803 | 0 | 70.6 |
| BTS 8749 | 202 | 307.7 | 101 | 11004 | 101 | 1.85 | 44.68 | 101 | 1609 | 101 | 17.20 | 35.36 | 536 | 1745 | 778 | 0 | 73.4 |
| BTS 8756 | 241 | 302.8 | 99 | 10842 | 99 | 2.12 | 43.36 | 98 | 1549 | 98 | 17.11 | 35.90 | 523 | 1775 | 1013 | 0 | 72.5 |
| BTS 8767 | 235 | 310.7 | 102 | 11603 | 106 | 1.78 | 45.50 | 103 | 1697 | 107 | 17.29 | 37.41 | 505 | 1711 | 753 | 0 | 68.6 |
| BTS 8770 | 247 | 309.3 | 101 | 11770 | 108 | 1.64 | 45.12 | 102 | 1722 | 109 | 17.12 | 37.95 | 506 | 1642 | 641 | 0 | 69.8 |
| BTS 8784 | 236 | 320.6 | 105 | 11359 | 104 | 1.54 | 48.22 | 109 | 1708 | 108 | 17.64 | 35.36 | 383 | 1537 | 639 | 0 | 66.8 |
| BTS 8787 | 219 | 311.2 | 102 | 11853 | 108 | 1.54 | 45.66 | 104 | 1747 | 110 | 17.16 | 37.90 | 414 | 1640 | 587 | 0 | 67.3 |
| BTS 8798 | 223 | 316.7 | 104 | 11294 | 103 | 1.62 | 47.15 | 107 | 1671 | 105 | 17.49 | 36.04 | 361 | 1565 | 699 | 0 | 75.0 |
| Crystal 573RR | 225 | 319.2 | 104 | 11375 | 104 | 1.53 | 47.85 | 108 | 1711 | 108 | 17.56 | 35.47 | 362 | 1512 | 642 | 0 | 68.5 |
| Crystal 578RR | 220 | 312.1 | 102 | 11446 | 105 | 1.64 | 45.90 | 104 | 1689 | 107 | 17.26 | 36.43 | 439 | 1665 | 652 | 0 | 69.1 |
| Crystal 684RR | 239 | 304.2 | 100 | 12620 | 115 | 1.57 | 43.74 | 99 | 1827 | 115 | 16.82 | 41.08 | 477 | 1663 | 583 | 0 | 80.8 |
| Crystal 792RR | 218 | 321.8 | 105 | 11337 | 104 | 1.43 | 48.56 | 110 | 1704 | 107 | 17.61 | 35.76 | 294 | 1472 | 606 | 0 | 72.1 |
| Crystal 793RR | 246 | 324.6 | 106 | 12103 | 111 | 1.42 | 49.31 | 112 | 1842 | 116 | 17.75 | 37.29 | 364 | 1374 | 603 | 0 | 72.3 |
| Crystal 794RR | 208 | 311.9 | 102 | 11980 | 109 | 1.58 | 45.86 | 104 | 1757 | 111 | 17.22 | 38.58 | 485 | 1614 | 604 | 0 | 54.5 |
| Crystal 795RR | 215 | 306.2 | 100 | 10998 | 100 | 1.83 | 44.28 | 100 | 1598 | 101 | 17.09 | 35.78 | 489 | 1594 | 846 | 0 | 66.5 |
| Crystal 796RR | 238 | 312.9 | 102 | 12477 | 114 | 1.64 | 46.11 | 105 | 1846 | 116 | 17.30 | 39.79 | 442 | 1602 | 678 | 0 | 67.8 |
| Crystal 797RR | 201 | 294.4 | 96 | 11842 | 108 | 1.87 | 41.06 | 93 | 1669 | 105 | 16.51 | 39.58 | 611 | 1761 | 761 | 0 | 57.1 |
| Hilleshög HIL9708 | 222 | 307.1 | 101 | 10134 | 93 | 1.69 | 44.51 | 101 | 1468 | 93 | 17.06 | 32.92 | 490 | 1560 | 739 | 0 | 67.5 |
| Hilleshög HIL9895 | 209 | 291.7 | 95 | 10106 | 92 | 1.87 | 40.35 | 91 | 1405 | 89 | 16.37 | 34.72 | 574 | 1650 | 831 | 95 | 64.4 |
| Hilleshög HIL9920 | 203 | 319.0 | 104 | 11027 | 101 | 1.58 | 47.80 | 108 | 1648 | 104 | 17.58 | 34.95 | 449 | 1666 | 609 | 0 | 69.7 |
| Hilleshög HIL9921 | 204 | 317.0 | 104 | 10546 | 96 | 1.56 | 47.23 | 107 | 1567 | 99 | 17.43 | 33.76 | 508 | 1516 | 618 | 0 | 73.6 |
| Hilleshög HIL9922 | 231 | 290.4 | 95 | 10514 | 96 | 1.85 | 39.97 | 91 | 1449 | 91 | 16.29 | 36.12 | 471 | 1650 | 841 | 0 | 69.3 |
| Hilleshög HIL9923 | 243 | 307.8 | 101 | 9722 | 89 | 2.00 | 44.72 | 101 | 1405 | 89 | 17.28 | 31.98 | 616 | 1766 | 894 | 0 | 41.4 |
| Hilleshög HIL9924 | 237 | 306.6 | 100 | 10123 | 93 | 2.04 | 44.41 | 101 | 1471 | 93 | 17.25 | 32.84 | 543 | 1713 | 970 | 0 | 36.4 |
| Maribo MA504 | 229 | 301.4 | 99 | 11828 | 108 | 1.66 | 42.98 | 97 | 1675 | 106 | 16.71 | 39.80 | 505 | 1535 | 715 | 0 | 63.0 |
| Maribo MA611 | 245 | 291.3 | 95 | 9843 | 90 | 1.85 | 40.21 | 91 | 1362 | 86 | 16.34 | 33.64 | 613 | 1745 | 765 | 0 | 64.5 |
| Maribo MA717 | 232 | 310.5 | 102 | 10832 | 99 | 1.76 | 45.46 | 103 | 1589 | 100 | 17.26 | 34.58 | 453 | 1562 | 798 | 0 | 67.8 |
| Maribo MA718 | 221 | 292.2 | 96 | 9572 | 87 | 2.03 | 40.46 | 92 | 1328 | 84 | 16.49 | 32.76 | 796 | 1916 | 793 | 0 | 52.2 |
| Maribo MA719 | 213 | 307.0 | 100 | 10574 | 97 | 1.96 | 44.51 | 101 | 1524 | 96 | 17.21 | 34.89 | 507 | 1804 | 876 | 0 | 43.3 |
| SX RR1861 | 233 | 304.3 | 100 | 11087 | 101 | 1.62 | 43.76 | 99 | 1601 | 101 | 16.85 | 36.33 | 419 | 1645 | 658 | 0 | 64.4 |
| SX RR1863 | 244 | 314.4 | 103 | 10928 | 100 | 1.47 | 46.51 | 105 | 1614 | 102 | 17.25 | 34.92 | 411 | 1579 | 555 | 0 | 61.6 |
| SX RR1875 | 210 | 319.3 | 105 | 10186 | 93 | 1.43 | 47.88 | 109 | 1529 | 96 | 17.50 | 31.90 | 344 | 1536 | 560 | 0 | 65.8 |
| SX RR1876 | 228 | 296.2 | 97 | 11113 | 102 | 1.83 | 41.55 | 94 | 1572 | 99 | 16.56 | 37.22 | 457 | 1683 | 804 | 0 | 60.2 |
| SX RR1877 | 227 | 302.4 | 99 | 11257 | 103 | 1.89 | 43.24 | 98 | 1608 | 101 | 16.94 | 37.38 | 569 | 1749 | 818 | 0 | 60.5 |
| SX RR1878 | 206 | 311.9 | 102 | 11456 | 105 | 1.49 | 45.85 | 104 | 1686 | 106 | 17.15 | 36.49 | 402 | 1579 | 568 | 0 | 61.6 |
| SX RR1879 | 205 | 308.4 | 101 | 10838 | 99 | 1.66 | 44.89 | 102 | 1576 | 99 | 17.10 | 35.09 | 431 | 1660 | 684 | 0 | 64.2 |
| SV RR265 | 240 | 304.6 | 100 | 12158 | 111 | 1.68 | 43.86 | 99 | 1758 | 111 | 16.89 | 39.67 | 457 | 1680 | 676 | 0 | 73.6 |
| SV RR266 | 216 | 302.8 | 99 | 11608 | 106 | 1.64 | 43.37 | 98 | 1666 | 105 | 16.81 | 38.14 | 457 | 1658 | 657 | 0 | 55.9 |
| SV RR268 | 226 | 304.5 | 100 | 11472 | 105 | 1.68 | 43.83 | 99 | 1659 | 105 | 16.92 | 37.39 | 430 | 1724 | 686 | 0 | 65.5 |
| SV RR371 | 212 | 312.7 | 102 | 11455 | 105 | 1.51 | 46.08 | 104 | 1692 | 107 | 17.22 | 36.42 | 362 | 1535 | 622 | 0 | 70.3 |
| SV RR372 | 217 | 304.3 | 100 | 10714 | 98 | 1.70 | 43.77 | 99 | 1550 | 98 | 16.92 | 35.07 | 379 | 1581 | 771 | 0 | 71.0 |
| SV RR373 | 230 | 306.6 | 100 | 10799 | 99 | 1.58 | 44.41 | 101 | 1563 | 99 | 16.96 | 35.07 | 366 | 1636 | 644 | 0 | 54.1 |
| SV RR374 | 214 | 313.7 | 103 | 11455 | 105 | 1.49 | 46.33 | 105 | 1702 | 107 | 17.25 | 36.21 | 377 | 1565 | 588 | 0 | 69.1 |
| SV RR375 | 211 | 321.3 | 105 | 11936 | 109 | 1.45 | 48.41 | 110 | 1798 | 113 | 17.62 | 37.24 | 344 | 1683 | 529 | 95 | 58.5 |
| AP CHK MOD RES RR#4 | 248 | 301.9 | 99 | 11765 | 108 | 1.73 | 43.12 | 98 | 1684 | 106 | 16.79 | 39.20 | 626 | 1744 | 664 | 0 | 59.8 |
| AP CHK SUS HYB#3 | 249 | 309.5 | 101 | 10026 | 92 | 1.60 | 45.18 | 102 | 1469 | 93 | 17.08 | 32.71 | 528 | 1511 | 653 | 0 | 59.0 |
| Crystal 355RR(Check) | 250 | 310.2 | 102 | 11251 | 103 | 1.76 | 45.39 | 103 | 1649 | 104 | 17.25 | 36.39 | 473 | 1691 | 753 | 0 | 66.0 |
| BTS 80RR52(Check) | 251 | 307.2 | 101 | 11747 | 107 | 1.74 | 44.58 | 101 | 1711 | 108 | 17.11 | 37.90 | 437 | 1743 | 734 | 0 | 65.2 |
| Crystal 101RR (Check) | 252 | 307.8 | 101 | 11705 | 107 | 1.68 | 44.71 | 101 | 1707 | 108 | 17.07 | 37.82 | 453 | 1813 | 627 | 0 | 69.7 |
| Hilleshög 4302RR (Check) | 253 | 296.9 | 97 | 9071 | 83 | 1.73 | 41.75 | 95 | 1276 | 80 | 16.54 | 30.74 | 614 | 1693 | 683 | 0 | 41.7 |
| RR Filler #05 | 254 | 299.9 | 98 | 9312 | 85 | 1.99 | 42.59 | 97 | 1317 | 83 | 16.88 | 31.02 | 715 | 1666 | 881 | 0 | 55.6 |
| | | | | | | | | | | | | | | | | | |
| Comm Benchmark Mean | | 305.5 | | 10944 | | 1.73 | 44.11 | | 1586 | | 16.99 | 35.71 | 494 | 1735 | 699 | | 60.6 |
| Comm Trial Mean | | 315.1 | | 11738 | | 1.57 | 47.02 | | 1753 | | 17.33 | 37.21 | 409 | 1621 | 636 | | 60.1 |
| Coeff. of Var. (%) | | 3.5 | | 5.1 | | 9.6 | 7.1 | | 7.8 | | 2.7 | 4.0 | 18 | 5.7 | 15 | | 11.0 |
| Mean LSD (0.05) | | 14.8 | | 810 | | 0.21 | 4.47 | | 186 | | 0.61 | 1.97 | 99 | 122 | 128 | | 8.5 |
| Mean LSD (0.01) | | 19.5 | | 1071 | | 0.27 | 5.91 | | 246 | | 0.81 | 2.60 | 131 | 162 | 169 | | 11.2 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

Bolters per acre are based upon 45,000 plants per acre. Trial # = 178302

@ Experimental trial data adjusted to commercial status. Statistics are from commercial trial. Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs. Created 10/31/2017

## Table 10. 2017 Performance of All RR Varieties - ACSC Official Trial

### Georgetown MN

| Code | Rec/T lbs. | Rec/T %Bnch | Rec/A lbs. | Rec/A %Bnch | Loss Mol % | Rev/T $ ++ | Rev/T %Bnch | Rev/A $ ++ | Rev/A %Bnch | Sugar % | Yield T/A | Na ppm | K ppm | AmN ppm | Bolter per Ac | Emerg. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 103 | 349.4 | 100 | 11554 | 102 | 1.07 | 57.40 | 101 | 1903 | 103 | 18.55 | 33.00 | 121 | 1682 | 341 | 0 | 89.7 |
| 116 | 356.5 | 102 | 11522 | 102 | 1.03 | 59.55 | 104 | 1916 | 104 | 18.86 | 32.45 | 128 | 1666 | 312 | 0 | 90.8 |
| 130 | 343.2 | 99 | 12044 | 107 | 0.94 | 55.53 | 97 | 1941 | 105 | 18.10 | 35.23 | 130 | 1555 | 266 | 0 | 92.4 |
| 119 | 347.5 | 100 | 12424 | 110 | 1.02 | 56.83 | 100 | 2038 | 110 | 18.40 | 35.86 | 132 | 1669 | 301 | 0 | 94.4 |
| 109 | 352.6 | 101 | 11322 | 100 | 0.97 | 58.37 | 102 | 1869 | 101 | 18.59 | 32.14 | 116 | 1607 | 283 | 63 | 89.9 |
| 101 | 344.8 | 99 | 12365 | 110 | 1.03 | 56.01 | 98 | 2013 | 109 | 18.28 | 35.92 | 156 | 1718 | 285 | 0 | 92.9 |
| 111 | 354.7 | 102 | 11421 | 101 | 0.99 | 59.00 | 104 | 1893 | 102 | 18.71 | 32.20 | 122 | 1502 | 323 | 0 | 88.4 |
| 115 | 362.2 | 104 | 11434 | 101 | 1.06 | 61.27 | 107 | 1943 | 105 | 19.18 | 31.51 | 122 | 1664 | 333 | 0 | 89.3 |
| 107 | 347.9 | 100 | 11842 | 105 | 1.11 | 56.93 | 100 | 1941 | 105 | 18.50 | 34.07 | 168 | 1845 | 307 | 0 | 91.4 |
| 108 | 344.5 | 99 | 12215 | 108 | 1.02 | 55.91 | 98 | 1987 | 108 | 18.25 | 35.22 | 162 | 1582 | 312 | 0 | 89.5 |
| 131 | 347.7 | 100 | 12745 | 113 | 0.94 | 56.88 | 100 | 2083 | 113 | 18.33 | 36.61 | 120 | 1600 | 264 | 0 | 88.8 |
| 104 | 347.9 | 100 | 11035 | 98 | 1.09 | 56.95 | 100 | 1800 | 97 | 18.48 | 31.85 | 128 | 1675 | 352 | 0 | 92.3 |
| 129 | 346.3 | 99 | 12099 | 107 | 1.02 | 56.44 | 99 | 1971 | 107 | 18.32 | 34.94 | 140 | 1698 | 286 | 0 | 91.6 |
| 126 | 364.3 | 105 | 11309 | 100 | 1.01 | 61.91 | 109 | 1918 | 104 | 19.24 | 31.23 | 128 | 1620 | 308 | 0 | 92.5 |
| 110 | 345.9 | 99 | 12657 | 112 | 1.01 | 56.34 | 99 | 2063 | 112 | 18.30 | 36.55 | 138 | 1685 | 282 | 0 | 89.5 |
| 128 | 353.9 | 102 | 11582 | 103 | 0.97 | 58.75 | 103 | 1924 | 104 | 18.66 | 32.82 | 162 | 1509 | 290 | 0 | 92.9 |
| 105 | 347.2 | 100 | 10693 | 95 | 0.94 | 56.71 | 99 | 1746 | 95 | 18.29 | 30.86 | 149 | 1643 | 242 | 0 | 83.4 |
| 112 | 356.2 | 102 | 12467 | 111 | 0.95 | 59.44 | 104 | 2085 | 113 | 18.76 | 34.89 | 132 | 1536 | 281 | 32 | 89.3 |
| 123 | 353.2 | 101 | 11768 | 104 | 0.94 | 58.55 | 103 | 1958 | 106 | 18.60 | 33.18 | 131 | 1541 | 270 | 0 | 84.2 |
| 114 | 340.6 | 98 | 12329 | 109 | 1.05 | 54.72 | 96 | 1986 | 107 | 18.08 | 36.11 | 165 | 1696 | 307 | 0 | 91.3 |
| 122 | 360.8 | 104 | 10953 | 97 | 1.01 | 60.85 | 107 | 1850 | 100 | 19.06 | 30.14 | 128 | 1541 | 328 | 0 | 87.8 |
| 106 | 347.2 | 100 | 12014 | 106 | 1.02 | 56.71 | 99 | 1953 | 106 | 18.38 | 34.77 | 168 | 1474 | 337 | 0 | 86.1 |
| 121 | 348.3 | 100 | 10953 | 97 | 1.10 | 57.05 | 100 | 1797 | 97 | 18.52 | 31.51 | 164 | 1732 | 333 | 0 | 87.4 |
| 127 | 357.1 | 103 | 11035 | 98 | 0.98 | 59.72 | 105 | 1839 | 100 | 18.82 | 31.08 | 143 | 1621 | 275 | 63 | 86.6 |
| 118 | 359.7 | 103 | 11895 | 105 | 0.98 | 60.51 | 106 | 1992 | 108 | 18.95 | 33.11 | 117 | 1649 | 278 | 0 | 87.8 |
| 117 | 333.2 | 96 | 11542 | 102 | 1.05 | 52.48 | 92 | 1815 | 98 | 17.71 | 34.70 | 126 | 1620 | 338 | 0 | 90.8 |
| 102 | 361.1 | 104 | 11765 | 104 | 0.98 | 60.93 | 107 | 1983 | 107 | 19.03 | 32.57 | 126 | 1610 | 282 | 0 | 91.8 |
| 125 | 347.2 | 100 | 11202 | 99 | 0.94 | 56.73 | 100 | 1823 | 99 | 18.30 | 32.37 | 121 | 1621 | 257 | 32 | 85.3 |
| 120 | 350.5 | 101 | 11955 | 106 | 1.04 | 57.73 | 101 | 1968 | 107 | 18.56 | 34.10 | 129 | 1649 | 321 | 0 | 88.4 |
| 124 | 355.9 | 102 | 11978 | 106 | 0.92 | 59.37 | 104 | 2001 | 108 | 18.72 | 33.51 | 111 | 1603 | 249 | 0 | 91.6 |
| 113 | 351.2 | 101 | 11472 | 102 | 1.03 | 57.95 | 102 | 1902 | 103 | 18.60 | 32.72 | 143 | 1603 | 318 | 0 | 89.2 |
| 132 | 343.2 | 99 | 11211 | 99 | 1.14 | 55.53 | 97 | 1803 | 98 | 18.30 | 32.77 | 182 | 1810 | 338 | 0 | 93.8 |
| 133 | 341.3 | 98 | 12048 | 107 | 1.13 | 54.94 | 96 | 1927 | 104 | 18.19 | 35.37 | 185 | 1801 | 330 | 0 | 92.2 |
| **status)** | | | | | | | | | | | | | | | | |
| 242 | 355.8 | 102 | 11822 | 105 | 0.96 | 59.31 | 104 | 1970 | 107 | 18.76 | 33.27 | 131 | 1601 | 279 | 0 | 89.2 |
| 224 | 343.8 | 99 | 12811 | 114 | 0.99 | 55.68 | 98 | 2075 | 112 | 18.18 | 37.34 | 143 | 1441 | 337 | 0 | 96.6 |
| 234 | 347.5 | 100 | 13070 | 116 | 0.92 | 56.81 | 100 | 2139 | 116 | 18.30 | 37.64 | 117 | 1453 | 294 | 0 | 95.6 |
| 207 | 347.7 | 100 | 10853 | 96 | 1.10 | 56.84 | 100 | 1770 | 96 | 18.48 | 31.35 | 125 | 1676 | 360 | 0 | 91.8 |
| 202 | 344.5 | 99 | 11186 | 99 | 1.03 | 55.91 | 98 | 1814 | 98 | 18.26 | 32.56 | 155 | 1635 | 315 | 0 | 88.5 |
| 241 | 350.9 | 101 | 11264 | 100 | 1.14 | 57.83 | 101 | 1858 | 101 | 18.69 | 32.12 | 144 | 1812 | 358 | 0 | 95.5 |
| 235 | 363.5 | 104 | 12271 | 109 | 0.91 | 61.64 | 108 | 2082 | 113 | 19.10 | 33.79 | 139 | 1526 | 254 | 0 | 88.0 |
| 247 | 348.8 | 100 | 12565 | 111 | 0.95 | 57.22 | 100 | 2060 | 112 | 18.39 | 36.09 | 136 | 1567 | 274 | 0 | 88.1 |
| 236 | 359.1 | 103 | 11309 | 100 | 0.99 | 60.30 | 106 | 1901 | 103 | 18.96 | 31.54 | 130 | 1599 | 312 | 0 | 94.1 |
| 219 | 327.1 | 94 | 11591 | 103 | 0.91 | 50.68 | 89 | 1794 | 97 | 17.26 | 35.53 | 135 | 1551 | 247 | 0 | 87.7 |
| 223 | 350.3 | 101 | 11050 | 98 | 0.96 | 57.66 | 101 | 1819 | 98 | 18.48 | 31.58 | 137 | 1562 | 283 | 0 | 95.3 |
| 225 | 359.8 | 103 | 11935 | 106 | 1.00 | 60.51 | 106 | 2008 | 109 | 18.98 | 33.22 | 134 | 1575 | 304 | 0 | 93.9 |
| 220 | 357.2 | 103 | 12635 | 112 | 0.90 | 59.72 | 105 | 2113 | 114 | 18.76 | 35.43 | 158 | 1527 | 239 | 0 | 92.7 |
| 239 | 354.5 | 102 | 13245 | 117 | 0.99 | 58.91 | 103 | 2201 | 119 | 18.73 | 37.47 | 151 | 1737 | 270 | 0 | 93.6 |
| 218 | 354.3 | 102 | 11743 | 104 | 1.00 | 58.87 | 103 | 1950 | 106 | 18.72 | 33.23 | 126 | 1505 | 331 | 0 | 89.6 |
| 246 | 358.2 | 103 | 12495 | 111 | 0.97 | 60.03 | 105 | 2094 | 113 | 18.88 | 34.94 | 135 | 1444 | 320 | 0 | 91.7 |
| 208 | 342.2 | 98 | 11941 | 106 | 1.02 | 55.22 | 97 | 1927 | 104 | 18.12 | 34.96 | 174 | 1493 | 333 | 0 | 93.4 |
| 215 | 347.6 | 100 | 11185 | 99 | 1.05 | 56.82 | 100 | 1828 | 99 | 18.42 | 32.27 | 126 | 1592 | 347 | 0 | 93.7 |
| 238 | 352.7 | 101 | 12775 | 113 | 0.94 | 58.38 | 102 | 2117 | 115 | 18.58 | 36.22 | 144 | 1563 | 265 | 0 | 95.0 |
| 201 | 336.4 | 97 | 12051 | 107 | 1.01 | 53.48 | 94 | 1913 | 104 | 17.84 | 35.95 | 156 | 1736 | 276 | 0 | 81.1 |
| 222 | 352.0 | 101 | 11740 | 104 | 0.94 | 58.15 | 102 | 1940 | 105 | 18.55 | 33.40 | 160 | 1441 | 294 | 0 | 92.8 |
| 209 | 354.3 | 102 | 10964 | 97 | 1.07 | 58.85 | 103 | 1821 | 99 | 18.79 | 31.02 | 143 | 1560 | 367 | 0 | 89.3 |
| 203 | 360.5 | 104 | 11557 | 102 | 0.98 | 60.70 | 106 | 1945 | 105 | 19.01 | 32.16 | 142 | 1709 | 258 | 0 | 92.8 |
| 204 | 364.0 | 105 | 10942 | 97 | 0.96 | 61.78 | 108 | 1855 | 100 | 19.16 | 30.16 | 147 | 1560 | 283 | 0 | 91.3 |
| 231 | 341.0 | 98 | 10710 | 95 | 1.27 | 54.85 | 96 | 1724 | 93 | 18.32 | 31.45 | 188 | 1711 | 471 | 0 | 95.8 |
| 243 | 349.6 | 100 | 10935 | 97 | 1.16 | 57.44 | 101 | 1800 | 97 | 18.64 | 31.28 | 199 | 1702 | 379 | 0 | 85.4 |
| 237 | 348.4 | 100 | 9906 | 88 | 1.19 | 57.09 | 100 | 1623 | 88 | 18.62 | 28.48 | 161 | 1710 | 416 | 0 | 74.4 |
| 229 | 349.2 | 100 | 12500 | 111 | 1.02 | 57.35 | 101 | 2049 | 111 | 18.49 | 35.91 | 155 | 1545 | 333 | 0 | 96.0 |
| 245 | 347.4 | 100 | 10398 | 92 | 1.00 | 56.76 | 100 | 1701 | 92 | 18.37 | 29.96 | 123 | 1588 | 311 | 0 | 93.9 |
| 232 | 352.5 | 101 | 11890 | 105 | 1.08 | 58.31 | 102 | 1969 | 107 | 18.72 | 33.75 | 187 | 1554 | 369 | 0 | 84.6 |
| 221 | 351.3 | 101 | 10802 | 96 | 1.04 | 57.97 | 102 | 1781 | 96 | 18.61 | 30.81 | 162 | 1738 | 292 | 0 | 81.7 |
| 213 | 354.8 | 102 | 11128 | 99 | 1.14 | 59.01 | 104 | 1849 | 100 | 18.89 | 31.42 | 176 | 1756 | 357 | 0 | 87.8 |
| 233 | 356.1 | 102 | 11972 | 106 | 0.91 | 59.40 | 104 | 1997 | 108 | 18.72 | 33.70 | 123 | 1575 | 246 | 0 | 95.7 |
| 244 | 359.2 | 103 | 11810 | 105 | 0.88 | 60.31 | 106 | 1982 | 107 | 18.85 | 32.95 | 136 | 1575 | 221 | 0 | 85.9 |
| 210 | 349.1 | 100 | 11044 | 98 | 0.93 | 57.32 | 101 | 1815 | 98 | 18.40 | 31.63 | 154 | 1603 | 247 | 0 | 93.6 |
| 228 | 347.1 | 100 | 11659 | 103 | 0.94 | 56.67 | 99 | 1904 | 103 | 18.30 | 33.67 | 140 | 1573 | 270 | 0 | 89.8 |
| 227 | 345.1 | 99 | 11501 | 102 | 1.12 | 56.06 | 98 | 1869 | 101 | 18.38 | 33.39 | 142 | 1786 | 350 | 0 | 90.2 |
| 206 | 348.0 | 100 | 12511 | 111 | 0.96 | 56.94 | 100 | 2049 | 111 | 18.37 | 35.98 | 129 | 1572 | 291 | 0 | 97.0 |
| 205 | 354.2 | 102 | 12700 | 113 | 0.95 | 58.83 | 103 | 2109 | 114 | 18.66 | 35.93 | 133 | 1590 | 266 | 0 | 90.6 |
| 240 | 357.6 | 103 | 11828 | 105 | 0.95 | 59.85 | 105 | 1981 | 107 | 18.83 | 33.12 | 111 | 1605 | 269 | 0 | 93.3 |
| 216 | 355.0 | 102 | 12197 | 108 | 1.04 | 59.06 | 104 | 2029 | 110 | 18.79 | 34.42 | 148 | 1708 | 301 | 0 | 92.3 |
| 226 | 357.5 | 103 | 11851 | 105 | 0.97 | 59.81 | 105 | 1983 | 107 | 18.86 | 33.19 | 143 | 1584 | 284 | 0 | 96.8 |
| 212 | 361.2 | 104 | 12088 | 107 | 0.97 | 60.93 | 107 | 2039 | 110 | 19.03 | 33.51 | 126 | 1599 | 277 | 0 | 94.6 |
| 217 | 347.5 | 100 | 11772 | 104 | 0.94 | 56.80 | 100 | 1927 | 104 | 18.32 | 33.89 | 140 | 1550 | 274 | 0 | 88.6 |

## Table 11. 2017 Performance of All RR Varieties - ACSC Official Trial

### Hendrum MN

| Variety @ | Code | Rec/T lbs. | Rec/T %Bnch | Rec/A lbs. | Rec/A %Bnch | Loss Mol % | Rev/T $ ++ | Rev/T %Bnch | Rev/A $ ++ | Rev/A %Bnch | Sugar % | Yield T/A | Na ppm | K ppm | AmN ppm | Bolter per Ac | Emerg. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Commercial Trial** | | | | | | | | | | | | | | | | | |
| BTS 80RR52 | 103 | 329.0 | 100 | 11362 | 102 | 1.24 | 51.23 | 100 | 1762 | 102 | 17.69 | 34.63 | 168 | 1540 | 487 | 0 | 72.9 |
| BTS 8337 | 116 | 342.8 | 104 | 11353 | 102 | 1.02 | 55.39 | 108 | 1836 | 107 | 18.16 | 33.21 | 138 | 1422 | 363 | 32 | 67.7 |
| BTS 8363 | 130 | 323.7 | 98 | 11969 | 108 | 1.04 | 49.62 | 97 | 1832 | 106 | 17.23 | 36.97 | 168 | 1403 | 374 | 0 | 68.5 |
| BTS 8500 | 119 | 334.0 | 102 | 12307 | 111 | 1.01 | 52.72 | 103 | 1939 | 113 | 17.70 | 36.79 | 140 | 1434 | 352 | 0 | 62.6 |
| BTS 8512 | 109 | 337.6 | 103 | 11595 | 105 | 1.03 | 53.82 | 105 | 1846 | 107 | 17.90 | 34.39 | 144 | 1380 | 379 | 0 | 75.8 |
| BTS 8524 | 101 | 322.3 | 98 | 12590 | 114 | 1.16 | 49.20 | 96 | 1919 | 111 | 17.26 | 39.11 | 153 | 1617 | 411 | 0 | 71.5 |
| BTS 8572 | 111 | 339.5 | 103 | 11642 | 105 | 1.10 | 54.40 | 106 | 1864 | 108 | 18.08 | 34.29 | 144 | 1424 | 423 | 0 | 71.4 |
| Crystal 093RR | 115 | 343.2 | 104 | 11318 | 102 | 1.11 | 55.52 | 108 | 1833 | 106 | 18.28 | 33.00 | 123 | 1463 | 428 | 0 | 72.2 |
| Crystal 101RR | 107 | 325.1 | 99 | 11347 | 102 | 1.21 | 50.02 | 98 | 1747 | 101 | 17.47 | 34.94 | 201 | 1608 | 436 | 0 | 70.3 |
| Crystal 246RR | 108 | 327.6 | 100 | 12345 | 111 | 1.00 | 50.79 | 99 | 1913 | 111 | 17.38 | 37.71 | 171 | 1385 | 346 | 0 | 68.2 |
| Crystal 247RR | 131 | 326.4 | 99 | 12461 | 112 | 1.02 | 50.44 | 99 | 1923 | 112 | 17.33 | 38.18 | 166 | 1482 | 333 | 0 | 68.7 |
| Crystal 355RR | 104 | 330.9 | 101 | 11048 | 100 | 1.14 | 51.79 | 101 | 1725 | 100 | 17.68 | 33.42 | 145 | 1499 | 431 | 0 | 61.0 |
| Crystal 467RR | 129 | 321.6 | 98 | 11800 | 106 | 1.08 | 48.97 | 96 | 1794 | 104 | 17.16 | 36.74 | 198 | 1540 | 354 | 0 | 75.5 |
| Crystal 572RR | 126 | 343.4 | 104 | 11653 | 105 | 0.98 | 55.56 | 109 | 1885 | 109 | 18.14 | 33.94 | 129 | 1346 | 356 | 0 | 78.6 |
| Crystal 574RR | 110 | 326.7 | 99 | 12505 | 113 | 1.03 | 50.52 | 99 | 1930 | 112 | 17.36 | 38.31 | 135 | 1432 | 365 | 0 | 70.5 |
| Crystal 986RR | 128 | 344.5 | 105 | 11434 | 103 | 0.98 | 55.92 | 109 | 1854 | 108 | 18.22 | 33.18 | 155 | 1263 | 369 | 0 | 74.9 |
| Hilleshög 4302RR | 105 | 330.6 | 101 | 10607 | 96 | 0.96 | 51.69 | 101 | 1659 | 96 | 17.49 | 32.03 | 169 | 1421 | 309 | 0 | 55.2 |
| Hilleshög 4448RR | 112 | 341.2 | 104 | 12251 | 110 | 1.05 | 54.91 | 107 | 1973 | 114 | 18.11 | 36.00 | 152 | 1321 | 409 | 32 | 67.1 |
| Hilleshög 9528RR | 123 | 340.2 | 103 | 11559 | 104 | 1.01 | 54.59 | 107 | 1857 | 108 | 18.02 | 34.03 | 156 | 1332 | 368 | 0 | 65.6 |
| Hilleshög HIL9707 | 114 | 326.0 | 99 | 11997 | 108 | 1.08 | 50.30 | 98 | 1846 | 107 | 17.38 | 36.87 | 159 | 1453 | 390 | 0 | 69.5 |
| Maribo 109 | 122 | 348.1 | 106 | 10104 | 91 | 0.95 | 57.01 | 111 | 1658 | 96 | 18.36 | 29.06 | 134 | 1322 | 340 | 0 | 55.9 |
| Maribo 305 | 106 | 329.9 | 100 | 11944 | 108 | 0.99 | 51.50 | 101 | 1866 | 108 | 17.47 | 36.20 | 144 | 1301 | 366 | 0 | 54.3 |
| Maribo MA502 | 121 | 336.7 | 102 | 11257 | 101 | 1.09 | 53.55 | 105 | 1792 | 104 | 17.92 | 33.39 | 172 | 1510 | 383 | 32 | 62.3 |
| SX Avalanche RR(858) | 127 | 335.0 | 102 | 10300 | 93 | 0.96 | 53.03 | 104 | 1632 | 95 | 17.71 | 30.74 | 183 | 1432 | 300 | 0 | 56.9 |
| SX Canyon RR | 118 | 339.5 | 103 | 11764 | 106 | 0.98 | 54.41 | 106 | 1888 | 110 | 17.95 | 34.60 | 131 | 1413 | 337 | 0 | 61.0 |
| SX Cruze RR | 117 | 317.2 | 96 | 11559 | 104 | 1.05 | 47.64 | 93 | 1735 | 101 | 16.91 | 36.42 | 131 | 1388 | 396 | 0 | 64.8 |
| SX Marathon RR(856) | 102 | 336.4 | 102 | 11556 | 104 | 0.96 | 53.45 | 104 | 1837 | 107 | 17.79 | 34.39 | 143 | 1393 | 324 | 0 | 67.1 |
| SX Winchester RR | 125 | 322.4 | 98 | 10091 | 91 | 0.94 | 49.22 | 96 | 1541 | 89 | 17.07 | 31.30 | 154 | 1363 | 315 | 0 | 51.8 |
| SV RR244TT | 120 | 331.7 | 101 | 11906 | 107 | 0.94 | 52.05 | 102 | 1870 | 109 | 17.53 | 35.82 | 115 | 1405 | 316 | 32 | 68.8 |
| SV RR333 | 124 | 336.9 | 102 | 11520 | 104 | 1.05 | 53.60 | 105 | 1829 | 106 | 17.90 | 34.26 | 160 | 1430 | 372 | 0 | 63.7 |
| SV RR351 | 113 | 340.7 | 104 | 11589 | 104 | 0.93 | 54.76 | 107 | 1866 | 108 | 17.97 | 33.93 | 119 | 1400 | 310 | 0 | 63.6 |
| RR Filler #01s | 132 | 319.8 | 97 | 11455 | 103 | 1.23 | 48.44 | 95 | 1734 | 101 | 17.22 | 35.83 | 202 | 1637 | 444 | 0 | 71.0 |
| RR Filler #01v | 133 | 325.6 | 99 | 11333 | 102 | 1.14 | 50.20 | 98 | 1746 | 101 | 17.43 | 34.86 | 173 | 1604 | 392 | 0 | 71.0 |
| **Experimental Trial (Comm status)** | | | | | | | | | | | | | | | | | |
| BTS 8606 | 242 | 336.0 | 102 | 12185 | 110 | 1.06 | 53.26 | 104 | 1927 | 112 | 17.86 | 36.33 | 185 | 1401 | 369 | 0 | 70.4 |
| BTS 8629 | 224 | 327.5 | 100 | 12596 | 114 | 1.07 | 50.79 | 99 | 1947 | 113 | 17.46 | 38.71 | 184 | 1310 | 411 | 0 | 80.6 |
| BTS 8735 | 234 | 331.0 | 101 | 13054 | 118 | 1.01 | 51.82 | 101 | 2038 | 118 | 17.57 | 39.62 | 164 | 1258 | 383 | 0 | 71.7 |
| BTS 8742 | 207 | 325.0 | 99 | 10608 | 96 | 1.24 | 50.06 | 98 | 1626 | 94 | 17.49 | 32.67 | 179 | 1565 | 477 | 0 | 62.9 |
| BTS 8749 | 202 | 326.2 | 99 | 10949 | 99 | 1.15 | 50.37 | 98 | 1697 | 98 | 17.49 | 33.51 | 163 | 1506 | 431 | 0 | 71.2 |
| BTS 8756 | 241 | 331.7 | 101 | 10836 | 98 | 1.22 | 51.99 | 102 | 1692 | 98 | 17.80 | 32.75 | 147 | 1543 | 473 | 0 | 75.1 |
| BTS 8767 | 235 | 335.2 | 102 | 12746 | 115 | 0.98 | 53.02 | 104 | 2013 | 117 | 17.77 | 38.14 | 158 | 1378 | 340 | 0 | 80.5 |
| BTS 8770 | 247 | 328.4 | 100 | 12133 | 109 | 1.03 | 51.03 | 100 | 1886 | 109 | 17.48 | 36.97 | 183 | 1428 | 348 | 95 | 63.5 |
| BTS 8784 | 236 | 342.1 | 104 | 11235 | 101 | 1.07 | 55.04 | 108 | 1806 | 105 | 18.19 | 32.83 | 140 | 1289 | 442 | 0 | 75.0 |
| BTS 8787 | 219 | 331.3 | 101 | 11837 | 107 | 1.03 | 51.91 | 101 | 1845 | 107 | 17.60 | 35.97 | 158 | 1420 | 359 | 0 | 54.9 |
| BTS 8798 | 223 | 327.7 | 100 | 11059 | 100 | 1.08 | 50.85 | 99 | 1708 | 99 | 17.46 | 33.71 | 180 | 1385 | 397 | 0 | 66.9 |
| Crystal 573RR | 225 | 335.0 | 102 | 11119 | 100 | 1.14 | 52.99 | 104 | 1759 | 102 | 17.90 | 33.21 | 179 | 1401 | 443 | 0 | 71.5 |
| Crystal 578RR | 220 | 329.8 | 100 | 13060 | 118 | 1.05 | 51.44 | 100 | 2035 | 118 | 17.55 | 39.59 | 161 | 1466 | 358 | 0 | 72.2 |
| Crystal 684RR | 239 | 330.0 | 100 | 12435 | 112 | 1.13 | 51.49 | 101 | 1938 | 112 | 17.63 | 37.88 | 179 | 1514 | 406 | 0 | 79.1 |
| Crystal 792RR | 218 | 336.8 | 102 | 11717 | 106 | 1.05 | 53.52 | 105 | 1863 | 108 | 17.91 | 34.85 | 136 | 1413 | 390 | 0 | 68.4 |
| Crystal 793RR | 246 | 342.5 | 104 | 12135 | 109 | 0.89 | 55.17 | 108 | 1944 | 113 | 18.02 | 35.52 | 137 | 1272 | 306 | 0 | 76.8 |
| Crystal 794RR | 208 | 328.2 | 100 | 12186 | 110 | 1.10 | 50.98 | 100 | 1884 | 109 | 17.50 | 37.33 | 207 | 1430 | 401 | 0 | 57.8 |
| Crystal 795RR | 215 | 328.3 | 100 | 10968 | 99 | 1.22 | 51.02 | 100 | 1702 | 99 | 17.64 | 33.53 | 179 | 1469 | 484 | 0 | 68.1 |
| Crystal 796RR | 238 | 325.8 | 99 | 12767 | 115 | 1.07 | 50.26 | 98 | 1980 | 115 | 17.40 | 39.15 | 166 | 1421 | 394 | 0 | 65.7 |
| Crystal 797RR | 201 | 325.4 | 99 | 11968 | 108 | 1.02 | 50.16 | 98 | 1837 | 107 | 17.30 | 36.98 | 197 | 1428 | 328 | 95 | 58.7 |
| Hilleshög HIL9708 | 222 | 331.4 | 101 | 10529 | 95 | 1.04 | 51.93 | 101 | 1641 | 95 | 17.60 | 31.83 | 182 | 1369 | 369 | 0 | 68.4 |
| Hilleshög HIL9895 | 209 | 321.3 | 98 | 10165 | 92 | 1.10 | 48.94 | 96 | 1547 | 90 | 17.16 | 31.73 | 155 | 1407 | 415 | 0 | 69.2 |
| Hilleshög HIL9920 | 203 | 340.7 | 104 | 10765 | 97 | 1.04 | 54.65 | 107 | 1725 | 100 | 18.09 | 31.74 | 158 | 1455 | 351 | 0 | 64.8 |
| Hilleshög HIL9921 | 204 | 339.3 | 103 | 10113 | 91 | 1.10 | 54.23 | 106 | 1615 | 94 | 18.09 | 29.99 | 178 | 1316 | 438 | 0 | 75.2 |
| Hilleshög HIL9922 | 231 | 323.2 | 98 | 10516 | 95 | 1.12 | 49.49 | 97 | 1604 | 93 | 17.28 | 32.61 | 150 | 1478 | 424 | 0 | 64.1 |
| Hilleshög HIL9923 | 243 | 334.3 | 102 | 10349 | 93 | 1.20 | 52.77 | 103 | 1633 | 95 | 17.91 | 30.88 | 183 | 1537 | 451 | 0 | 55.8 |
| Hilleshög HIL9924 | 237 | 336.4 | 102 | 9299 | 84 | 1.27 | 53.38 | 104 | 1473 | 85 | 18.08 | 27.51 | 173 | 1516 | 516 | 0 | 44.1 |
| Maribo MA504 | 229 | 329.3 | 100 | 12433 | 112 | 1.05 | 51.30 | 100 | 1924 | 112 | 17.51 | 37.99 | 178 | 1334 | 385 | 0 | 70.6 |
| Maribo MA611 | 245 | 324.4 | 99 | 10535 | 95 | 1.16 | 49.86 | 97 | 1611 | 93 | 17.38 | 32.68 | 186 | 1494 | 436 | 95 | 61.3 |
| Maribo MA717 | 232 | 333.4 | 101 | 11605 | 105 | 1.09 | 52.48 | 103 | 1823 | 106 | 17.77 | 34.96 | 179 | 1370 | 409 | 0 | 70.5 |
| Maribo MA718 | 221 | 323.6 | 98 | 10404 | 94 | 1.11 | 49.62 | 97 | 1602 | 93 | 17.33 | 32.15 | 230 | 1602 | 353 | 0 | 56.2 |
| Maribo MA719 | 213 | 338.5 | 103 | 10750 | 97 | 1.17 | 54.01 | 106 | 1715 | 99 | 18.11 | 31.62 | 178 | 1545 | 440 | 0 | 56.9 |
| SX RR1861 | 233 | 333.4 | 101 | 11042 | 100 | 1.09 | 52.49 | 103 | 1735 | 101 | 17.77 | 33.21 | 129 | 1432 | 409 | 0 | 59.4 |
| SX RR1863 | 244 | 337.2 | 103 | 11055 | 100 | 0.91 | 53.62 | 105 | 1751 | 102 | 17.78 | 32.93 | 149 | 1388 | 271 | 0 | 48.4 |
| SX RR1875 | 210 | 339.0 | 103 | 10941 | 99 | 0.98 | 54.13 | 106 | 1743 | 101 | 17.94 | 32.38 | 146 | 1366 | 343 | 0 | 69.0 |
| SX RR1876 | 228 | 329.0 | 100 | 10890 | 98 | 0.98 | 51.20 | 100 | 1695 | 98 | 17.46 | 32.98 | 154 | 1390 | 341 | 0 | 52.5 |
| SX RR1877 | 227 | 330.4 | 100 | 10424 | 94 | 1.20 | 51.63 | 101 | 1628 | 94 | 17.74 | 31.59 | 182 | 1504 | 461 | 0 | 61.6 |
| SX RR1878 | 206 | 332.5 | 101 | 10886 | 98 | 0.94 | 52.22 | 102 | 1700 | 99 | 17.57 | 33.02 | 142 | 1408 | 305 | 0 | 59.1 |
| SX RR1879 | 205 | 335.3 | 102 | 11165 | 101 | 0.97 | 53.06 | 104 | 1761 | 102 | 17.77 | 33.53 | 160 | 1358 | 340 | 0 | 63.6 |
| SV RR265 | 240 | 331.5 | 101 | 11522 | 104 | 0.95 | 51.95 | 102 | 1804 | 105 | 17.56 | 34.71 | 146 | 1412 | 318 | 0 | 61.7 |
| SV RR266 | 216 | 338.5 | 103 | 10977 | 99 | 0.98 | 53.98 | 105 | 1743 | 101 | 17.91 | 32.45 | 143 | 1410 | 339 | 0 | 50.7 |
| SV RR268 | 226 | 334.0 | 102 | 11222 | 101 | 0.94 | 52.69 | 103 | 1768 | 103 | 17.67 | 33.61 | 147 | 1403 | 307 | 0 | 65.7 |
| SV RR371 | 212 | 332.9 | 101 | 11027 | 99 | 1.03 | 52.35 | 102 | 1733 | 101 | 17.70 | 33.16 | 143 | 1480 | 351 | 0 | 66.9 |
| SV RR372 | 217 | 332.1 | 101 | 11416 | 103 | 1.01 | 52.10 | 102 | 1786 | 104 | 17.61 | 34.41 | 153 | 1406 | 345 | 0 | 67.3 |
| SV RR373 | 230 | 329.5 | 100 | 10333 | 93 | 1.08 | 51.35 | 100 | 1605 | 93 | 17.56 | 31.27 | 176 | 1480 | 373 | 0 | 57.6 |
| SV RR374 | 214 | 327.8 | 100 | 11545 | 104 | 0.99 | 50.85 | 99 | 1793 | 104 | 17.42 | 35.17 | 152 | 1369 | 354 | 0 | 71.7 |
| SV RR375 | 211 | 334.1 | 102 | 11117 | 100 | 1.12 | 52.71 | 103 | 1752 | 102 | 17.85 | 33.44 | 159 | 1504 | 409 | 0 | 56.4 |
| AP CHK MOD RES RR#4 | 248 | 330.0 | 100 | 11653 | 105 | 1.03 | 51.48 | 101 | 1808 | 105 | 17.51 | 35.40 | 185 | 1393 | 365 | 0 | 57.5 |
| AP CHK SUS HYB#3 | 249 | 342.2 | 104 | 10651 | 96 | 1.07 | 55.08 | 108 | 1706 | 99 | 18.16 | 31.10 | 184 | 1374 | 387 | 0 | 57.6 |
| Crystal 355RR(Check) | 250 | 331.0 | 101 | 11708 | 106 | 1.22 | 51.81 | 101 | 1825 | 106 | 17.75 | 35.37 | 177 | 1521 | 470 | 0 | 71.1 |
| BTS 80RR52(Check) | 251 | 331.3 | 101 | 11525 | 104 | 1.14 | 51.90 | 101 | 1801 | 104 | 17.71 | 34.79 | 132 | 1510 | 438 | 0 | 64.4 |
| Crystal 101RR (Check) | 252 | 327.2 | 99 | 11023 | 99 | 1.21 | 50.67 | 99 | 1710 | 99 | 17.57 | 33.76 | 178 | 1630 | 433 | 0 | 69.8 |
| Hilleshög 4302RR (Check) | 253 | 326.1 | 99 | 10108 | 91 | 0.98 | 50.36 | 98 | 1557 | 90 | 17.30 | 31.10 | 196 | 1407 | 321 | 0 | 52.7 |
| RR Filler #05 | 254 | 331.1 | 101 | 9129 | 82 | 1.25 | 51.84 | 101 | 1429 | 83 | 17.81 | 27.45 | 226 | 1565 | 478 | 0 | 66.9 |
| | | | | | | | | | | | | | | | | | |
| Comm Benchmark Mean | | 328.9 | | 11091 | | 1.14 | 51.18 | | 1723 | | 17.58 | 33.76 | 171 | 1517 | 416 | | 64.5 |
| Comm Trial Mean | | 332.6 | | 11561 | | 1.04 | 52.31 | | 1816 | | 17.68 | 34.80 | 154 | 1435 | 372 | | 66.7 |
| Coeff. of Var. (%) | | 2.6 | | 4.0 | | 7.1 | 5.0 | | 5.7 | | 2.3 | 3.6 | 16 | 4.3 | 13 | | 10.0 |
| Mean LSD (0.05) | | 11.1 | | 612 | | 0.10 | 3.37 | | 134 | | 0.51 | 1.64 | 31 | 75 | 62 | | 8.3 |
| Mean LSD (0.01) | | 14.7 | | 808 | | 0.13 | 4.46 | | 177 | | 0.67 | 2.17 | 41 | 98 | 81 | | 11.0 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

Bolters per acre are based upon 45,000 plants per acre. Trial # = 178304

@ Experimental trial data adjusted to commercial status. Statistics are from commercial trial. Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs. Created 10/31/2017

## Table 12. 2017 Performance of All RR Varieties - ACSC Official Trial

### Hillsboro ND

| Variety @ | Code | Rec/T lbs. | Rec/T %Bnch | Rec/A lbs. | Rec/A %Bnch | Loss Mol % | Rev/T $ ++ | Rev/T %Bnch | Rev/A $ ++ | Rev/A %Bnch | Sugar % | Yield T/A | Na ppm | K ppm | AmN ppm | Bolter per Ac | Emerg. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Commercial Trial** | | | | | | | | | | | | | | | | | |
| BTS 80RR52 | 103 | 356.4 | 99 | 13386 | 101 | 1.26 | 59.53 | 99 | 2234 | 101 | 19.09 | 37.68 | 131 | 1790 | 454 | 32 | 77.6 |
| BTS 8337 | 116 | 368.6 | 103 | 13793 | 105 | 1.05 | 63.22 | 105 | 2371 | 107 | 19.51 | 37.45 | 114 | 1662 | 335 | 0 | 79.5 |
| BTS 8363 | 130 | 359.5 | 100 | 14098 | 107 | 1.01 | 60.46 | 100 | 2352 | 106 | 18.98 | 39.64 | 108 | 1596 | 324 | 0 | 71.4 |
| BTS 8500 | 119 | 355.0 | 99 | 14164 | 107 | 1.14 | 59.08 | 98 | 2361 | 107 | 18.88 | 39.74 | 140 | 1681 | 385 | 0 | 73.7 |
| BTS 8512 | 109 | 355.7 | 99 | 12773 | 97 | 1.07 | 59.30 | 99 | 2136 | 96 | 18.85 | 35.66 | 103 | 1614 | 363 | 0 | 76.5 |
| BTS 8524 | 101 | 349.0 | 97 | 13794 | 105 | 1.17 | 57.28 | 95 | 2260 | 102 | 18.62 | 39.65 | 129 | 1806 | 382 | 0 | 75.2 |
| BTS 8572 | 111 | 367.9 | 103 | 13654 | 104 | 1.07 | 62.99 | 105 | 2334 | 105 | 19.47 | 37.25 | 108 | 1638 | 360 | 0 | 75.2 |
| Crystal 093RR | 115 | 372.7 | 104 | 13505 | 102 | 1.16 | 64.45 | 107 | 2337 | 106 | 19.80 | 36.14 | 128 | 1707 | 400 | 0 | 80.8 |
| Crystal 101RR | 107 | 349.0 | 97 | 13275 | 101 | 1.26 | 57.29 | 95 | 2172 | 98 | 18.71 | 38.12 | 138 | 1986 | 398 | 0 | 78.2 |
| Crystal 246RR | 108 | 354.9 | 99 | 13525 | 103 | 1.02 | 59.07 | 98 | 2252 | 102 | 18.77 | 38.15 | 135 | 1626 | 310 | 0 | 74.8 |
| Crystal 247RR | 131 | 369.0 | 103 | 13898 | 105 | 1.02 | 63.32 | 105 | 2385 | 108 | 19.47 | 37.70 | 144 | 1674 | 291 | 126 | 74.5 |
| Crystal 355RR | 104 | 367.9 | 103 | 13561 | 103 | 1.16 | 63.01 | 105 | 2330 | 105 | 19.57 | 36.67 | 114 | 1741 | 400 | 0 | 77.5 |
| Crystal 467RR | 129 | 353.6 | 99 | 14147 | 107 | 1.12 | 58.66 | 97 | 2339 | 106 | 18.80 | 40.16 | 141 | 1815 | 334 | 0 | 78.1 |
| Crystal 572RR | 126 | 375.6 | 105 | 13453 | 102 | 1.06 | 65.32 | 109 | 2338 | 106 | 19.84 | 35.94 | 95 | 1625 | 356 | 0 | 79.2 |
| Crystal 574RR | 110 | 357.7 | 100 | 14353 | 109 | 1.08 | 59.90 | 100 | 2403 | 109 | 18.96 | 40.17 | 114 | 1672 | 350 | 0 | 75.8 |
| Crystal 986RR | 128 | 379.2 | 106 | 13843 | 105 | 1.02 | 66.43 | 110 | 2416 | 109 | 19.97 | 36.64 | 118 | 1540 | 340 | 0 | 75.3 |
| Hilleshög 4302RR | 105 | 361.1 | 101 | 12542 | 95 | 1.08 | 60.93 | 101 | 2122 | 96 | 19.14 | 34.57 | 143 | 1786 | 312 | 0 | 53.2 |
| Hilleshög 4448RR | 112 | 360.0 | 100 | 13334 | 101 | 1.17 | 60.61 | 101 | 2252 | 102 | 19.17 | 36.81 | 120 | 1635 | 429 | 0 | 64.2 |
| Hilleshög 9528RR | 123 | 362.7 | 101 | 13311 | 101 | 1.10 | 61.42 | 102 | 2262 | 102 | 19.22 | 36.39 | 126 | 1710 | 351 | 0 | 69.1 |
| Hilleshög HIL9707 | 114 | 343.1 | 96 | 11863 | 90 | 1.26 | 55.48 | 92 | 1913 | 86 | 18.42 | 34.95 | 185 | 1795 | 432 | 0 | 52.1 |
| Maribo 109 | 122 | 365.1 | 102 | 11059 | 84 | 1.19 | 62.13 | 103 | 1889 | 85 | 19.44 | 30.17 | 129 | 1659 | 435 | 0 | 56.4 |
| Maribo 305 | 106 | 353.9 | 99 | 12738 | 97 | 1.05 | 58.75 | 98 | 2116 | 96 | 18.73 | 35.91 | 124 | 1559 | 356 | 0 | 59.8 |
| Maribo MA502 | 121 | 348.4 | 97 | 12558 | 95 | 1.29 | 57.08 | 95 | 2061 | 93 | 18.72 | 36.02 | 156 | 1914 | 437 | 639 | 64.6 |
| SX Avalanche RR(858) | 127 | 366.4 | 102 | 12841 | 97 | 0.96 | 62.53 | 104 | 2200 | 99 | 19.29 | 34.90 | 112 | 1597 | 282 | 0 | 66.5 |
| SX Canyon RR | 118 | 362.6 | 101 | 13325 | 101 | 1.06 | 61.38 | 102 | 2254 | 102 | 19.19 | 36.79 | 118 | 1684 | 331 | 0 | 68.6 |
| SX Cruze RR | 117 | 333.2 | 93 | 13302 | 101 | 1.15 | 52.48 | 87 | 2094 | 95 | 17.81 | 40.00 | 130 | 1693 | 392 | 0 | 71.2 |
| SX Marathon RR(856) | 102 | 364.8 | 102 | 13317 | 101 | 1.03 | 62.05 | 103 | 2269 | 102 | 19.28 | 36.51 | 110 | 1633 | 325 | 0 | 65.8 |
| SX Winchester RR | 125 | 356.4 | 99 | 12170 | 92 | 1.05 | 59.52 | 99 | 2027 | 92 | 18.86 | 34.22 | 128 | 1686 | 316 | 0 | 59.9 |
| SV RR244TT | 120 | 361.0 | 101 | 13564 | 103 | 1.07 | 60.89 | 101 | 2292 | 103 | 19.13 | 37.32 | 97 | 1719 | 341 | 0 | 67.2 |
| SV RR333 | 124 | 361.3 | 101 | 13712 | 104 | 1.05 | 61.00 | 101 | 2306 | 104 | 19.12 | 38.06 | 109 | 1650 | 339 | 0 | 66.7 |
| SV RR351 | 113 | 358.3 | 100 | 13727 | 104 | 1.13 | 60.09 | 100 | 2301 | 104 | 19.03 | 38.28 | 133 | 1735 | 364 | 0 | 66.5 |
| RR Filler #01s | 132 | 359.8 | 100 | 13954 | 106 | 1.21 | 60.54 | 101 | 2344 | 106 | 19.19 | 38.93 | 132 | 1892 | 385 | 0 | 77.5 |
| RR Filler #01v | 133 | 346.9 | 97 | 13284 | 101 | 1.26 | 56.64 | 94 | 2166 | 98 | 18.61 | 38.35 | 179 | 1957 | 394 | 0 | 79.3 |
| **Experimental Trial (Comm status)** | | | | | | | | | | | | | | | | | |
| BTS 8606 | 242 | 370.7 | 103 | 15760 | 119 | 1.04 | 63.81 | 106 | 2710 | 122 | 19.58 | 42.49 | 101 | 1663 | 323 | 0 | 75.3 |
| BTS 8629 | 224 | 362.0 | 101 | 15145 | 115 | 1.06 | 61.20 | 102 | 2559 | 116 | 19.16 | 41.84 | 131 | 1522 | 364 | 0 | 74.2 |
| BTS 8735 | 234 | 368.0 | 103 | 15603 | 118 | 1.01 | 62.97 | 105 | 2666 | 120 | 19.42 | 42.49 | 107 | 1495 | 341 | 0 | 79.1 |
| BTS 8742 | 207 | 351.9 | 98 | 13067 | 99 | 1.37 | 58.19 | 97 | 2148 | 97 | 18.98 | 37.35 | 116 | 1873 | 524 | 0 | 74.7 |
| BTS 8749 | 202 | 363.4 | 101 | 13685 | 104 | 1.14 | 61.60 | 102 | 2306 | 104 | 19.33 | 37.91 | 103 | 1761 | 383 | 0 | 70.3 |
| BTS 8756 | 241 | 362.8 | 101 | 13509 | 102 | 1.22 | 61.45 | 102 | 2275 | 103 | 19.38 | 37.53 | 100 | 1838 | 426 | 0 | 76.2 |
| BTS 8767 | 235 | 373.5 | 104 | 15618 | 118 | 1.05 | 64.64 | 107 | 2699 | 122 | 19.74 | 41.76 | 102 | 1709 | 324 | 0 | 80.5 |
| BTS 8770 | 247 | 367.5 | 102 | 15537 | 118 | 1.01 | 62.84 | 104 | 2650 | 120 | 19.41 | 42.38 | 104 | 1719 | 291 | 0 | 69.7 |
| BTS 8784 | 236 | 373.8 | 104 | 14296 | 108 | 1.04 | 64.72 | 108 | 2470 | 112 | 19.74 | 38.39 | 89 | 1529 | 367 | 0 | 73.8 |
| BTS 8787 | 219 | 361.0 | 101 | 14727 | 112 | 1.13 | 60.92 | 101 | 2478 | 112 | 19.20 | 40.87 | 112 | 1784 | 365 | 0 | 71.7 |
| BTS 8798 | 223 | 366.2 | 102 | 14194 | 108 | 1.06 | 62.46 | 104 | 2411 | 109 | 19.39 | 38.92 | 81 | 1587 | 368 | 0 | 76.7 |
| Crystal 573RR | 225 | 368.3 | 103 | 14881 | 113 | 1.15 | 63.06 | 105 | 2542 | 115 | 19.57 | 40.48 | 102 | 1721 | 396 | 0 | 75.1 |
| Crystal 578RR | 220 | 368.4 | 103 | 15986 | 121 | 1.03 | 63.09 | 105 | 2728 | 123 | 19.48 | 43.52 | 114 | 1685 | 310 | 0 | 79.1 |
| Crystal 684RR | 239 | 359.1 | 100 | 15049 | 114 | 1.08 | 60.35 | 100 | 2532 | 114 | 19.04 | 41.92 | 115 | 1728 | 340 | 0 | 71.3 |
| Crystal 792RR | 218 | 368.0 | 103 | 14213 | 108 | 1.06 | 62.99 | 105 | 2426 | 110 | 19.47 | 38.84 | 88 | 1607 | 359 | 0 | 80.5 |
| Crystal 793RR | 246 | 365.5 | 102 | 15055 | 114 | 1.08 | 62.25 | 103 | 2555 | 115 | 19.38 | 41.31 | 120 | 1598 | 368 | 95 | 75.1 |
| Crystal 794RR | 208 | 355.4 | 99 | 14750 | 112 | 1.18 | 59.26 | 98 | 2457 | 111 | 18.97 | 41.50 | 130 | 1713 | 418 | 0 | 65.7 |
| Crystal 795RR | 215 | 362.5 | 101 | 14247 | 108 | 1.12 | 61.35 | 102 | 2408 | 109 | 19.24 | 39.40 | 102 | 1702 | 379 | 0 | 79.3 |
| Crystal 796RR | 238 | 367.6 | 103 | 15358 | 116 | 1.03 | 62.84 | 104 | 2618 | 118 | 19.43 | 41.91 | 98 | 1730 | 302 | 0 | 81.6 |
| Crystal 797RR | 201 | 360.0 | 100 | 15579 | 118 | 1.06 | 60.63 | 101 | 2612 | 118 | 19.09 | 43.40 | 108 | 1779 | 309 | 0 | 66.5 |
| Hilleshög HIL9708 | 222 | 362.6 | 101 | 13181 | 100 | 1.10 | 61.37 | 102 | 2220 | 100 | 19.24 | 36.65 | 126 | 1627 | 373 | 0 | 68.8 |
| Hilleshög HIL9895 | 209 | 349.2 | 97 | 12490 | 95 | 1.30 | 57.41 | 95 | 2052 | 93 | 18.75 | 35.83 | 132 | 1799 | 477 | 0 | 59.7 |
| Hilleshög HIL9920 | 203 | 377.6 | 105 | 14614 | 111 | 1.03 | 65.85 | 109 | 2539 | 115 | 19.94 | 38.90 | 102 | 1727 | 302 | 0 | 68.8 |
| Hilleshög HIL9921 | 204 | 370.0 | 103 | 12201 | 92 | 1.14 | 63.58 | 106 | 2090 | 94 | 19.66 | 33.15 | 112 | 1628 | 408 | 0 | 71.4 |
| Hilleshög HIL9922 | 231 | 352.4 | 98 | 12529 | 95 | 1.18 | 58.36 | 97 | 2061 | 93 | 18.82 | 35.79 | 118 | 1765 | 403 | 675 | 67.9 |
| Hilleshög HIL9923 | 243 | 365.8 | 102 | 12255 | 93 | 1.30 | 62.34 | 104 | 2081 | 94 | 19.59 | 33.71 | 137 | 1731 | 491 | 0 | 62.7 |
| Hilleshög HIL9924 | 237 | 367.2 | 102 | 12317 | 93 | 1.23 | 62.74 | 104 | 2100 | 95 | 19.60 | 33.64 | 111 | 1745 | 450 | 0 | 50.2 |
| Maribo MA504 | 229 | 363.2 | 101 | 15013 | 114 | 1.10 | 61.57 | 102 | 2534 | 114 | 19.27 | 41.66 | 117 | 1643 | 373 | 0 | 72.3 |
| Maribo MA611 | 245 | 348.2 | 97 | 12546 | 95 | 1.24 | 57.11 | 95 | 2063 | 93 | 18.65 | 35.85 | 140 | 1829 | 426 | 0 | 68.3 |
| Maribo MA717 | 232 | 363.4 | 101 | 13081 | 99 | 1.16 | 61.60 | 102 | 2211 | 100 | 19.33 | 36.25 | 112 | 1643 | 424 | 0 | 65.4 |
| Maribo MA718 | 221 | 358.7 | 100 | 11964 | 91 | 1.14 | 60.22 | 100 | 2007 | 91 | 19.08 | 33.43 | 146 | 1812 | 346 | 0 | 54.5 |
| Maribo MA719 | 213 | 363.5 | 101 | 12494 | 95 | 1.23 | 61.63 | 102 | 2116 | 96 | 19.42 | 34.44 | 104 | 1790 | 446 | 576 | 67.5 |
| SX RR1861 | 233 | 355.1 | 99 | 14491 | 110 | 1.05 | 59.14 | 98 | 2409 | 109 | 18.81 | 40.95 | 99 | 1645 | 340 | 0 | 71.0 |
| SX RR1863 | 244 | 371.1 | 103 | 14268 | 108 | 0.97 | 63.91 | 106 | 2449 | 111 | 19.56 | 38.58 | 85 | 1634 | 292 | 0 | 64.0 |
| SX RR1875 | 210 | 372.6 | 104 | 13747 | 104 | 1.02 | 64.35 | 107 | 2375 | 107 | 19.67 | 36.82 | 108 | 1637 | 317 | 293 | 73.2 |
| SX RR1876 | 228 | 357.6 | 100 | 13849 | 105 | 1.08 | 59.89 | 100 | 2314 | 104 | 18.97 | 38.85 | 95 | 1632 | 367 | 0 | 69.2 |
| SX RR1877 | 227 | 348.4 | 97 | 13528 | 103 | 1.39 | 57.17 | 95 | 2208 | 100 | 18.81 | 39.11 | 131 | 1923 | 519 | 0 | 63.7 |
| SX RR1878 | 206 | 365.1 | 102 | 13582 | 103 | 0.99 | 62.12 | 103 | 2302 | 104 | 19.26 | 37.43 | 86 | 1648 | 293 | 0 | 66.9 |
| SX RR1879 | 205 | 369.1 | 103 | 14521 | 110 | 0.99 | 63.32 | 105 | 2483 | 112 | 19.46 | 39.53 | 87 | 1619 | 299 | 0 | 74.6 |
| SV RR265 | 240 | 360.5 | 101 | 13891 | 105 | 1.05 | 60.77 | 101 | 2335 | 105 | 19.08 | 38.81 | 90 | 1662 | 336 | 0 | 63.4 |
| SV RR266 | 216 | 359.4 | 100 | 15073 | 114 | 1.02 | 60.43 | 100 | 2533 | 114 | 19.00 | 41.94 | 96 | 1618 | 326 | 0 | 62.2 |
| SV RR268 | 226 | 366.3 | 102 | 14770 | 112 | 1.03 | 62.48 | 104 | 2513 | 113 | 19.37 | 40.38 | 93 | 1667 | 323 | 0 | 76.4 |
| SV RR371 | 212 | 364.9 | 102 | 14578 | 111 | 1.06 | 62.07 | 103 | 2479 | 112 | 19.32 | 39.93 | 102 | 1666 | 344 | 0 | 70.5 |
| SV RR372 | 217 | 361.6 | 101 | 14780 | 112 | 0.99 | 61.10 | 102 | 2495 | 113 | 19.09 | 40.86 | 92 | 1590 | 309 | 0 | 64.5 |
| SV RR373 | 230 | 355.3 | 99 | 13034 | 99 | 1.13 | 59.18 | 98 | 2165 | 98 | 18.91 | 36.82 | 96 | 1722 | 389 | 0 | 54.5 |
| SV RR374 | 214 | 351.8 | 98 | 14464 | 110 | 1.10 | 58.17 | 97 | 2387 | 108 | 18.69 | 41.21 | 126 | 1651 | 364 | 0 | 73.7 |
| SV RR375 | 211 | 365.7 | 102 | 13789 | 105 | 1.05 | 62.32 | 104 | 2346 | 106 | 19.34 | 37.71 | 99 | 1677 | 331 | 0 | 67.4 |
| AP CHK MOD RES RR#4 | 248 | 361.8 | 101 | 16096 | 122 | 0.99 | 61.14 | 102 | 2712 | 122 | 19.11 | 44.67 | 107 | 1689 | 280 | 0 | 73.8 |
| AP CHK SUS HYB#3 | 249 | 367.8 | 103 | 13783 | 104 | 1.22 | 62.92 | 105 | 2355 | 106 | 19.62 | 37.60 | 123 | 1846 | 415 | 0 | 69.1 |
| Crystal 355RR(Check) | 250 | 359.8 | 100 | 14176 | 107 | 1.14 | 60.55 | 101 | 2383 | 108 | 19.13 | 39.50 | 122 | 1722 | 385 | 0 | 75.3 |
| BTS 80RR52(Check) | 251 | 364.0 | 101 | 14730 | 112 | 1.18 | 61.80 | 103 | 2493 | 113 | 19.41 | 40.45 | 116 | 1771 | 411 | 0 | 77.6 |
| Crystal 101RR (Check) | 252 | 356.5 | 99 | 14565 | 110 | 1.27 | 59.58 | 99 | 2423 | 109 | 19.11 | 41.08 | 132 | 2004 | 399 | 0 | 71.6 |
| Hilleshög 4302RR (Check) | 253 | 354.1 | 99 | 9292 | 70 | 1.17 | 58.84 | 98 | 1559 | 70 | 18.86 | 26.02 | 156 | 1806 | 369 | 0 | 42.5 |
| RR Filler #05 | 254 | 358.4 | 100 | 12399 | 94 | 1.27 | 60.14 | 100 | 2075 | 94 | 19.19 | 34.70 | 185 | 1761 | 446 | 0 | 66.5 |
| | | | | | | | | | | | | | | | | | |
| Comm Benchmark Mean | | 358.6 | | 13191 | | 1.19 | 60.19 | | 2215 | | 19.13 | 36.76 | 132 | 1826 | 391 | | 66.7 |
| Comm Trial Mean | | 359.3 | | 13328 | | 1.12 | 60.39 | | 2239 | | 19.08 | 37.12 | 127 | 1711 | 364 | | 70.7 |
| Coeff. of Var. (%) | | 2.9 | | 5.2 | | 7.9 | 5.2 | | 6.6 | | 2.6 | 4.5 | 19 | 5.3 | 14 | | 7.9 |
| Mean LSD (0.05) | | 12.5 | | 869 | | 0.11 | 3.79 | | 180 | | 0.60 | 2.18 | 31 | 113 | 63 | | 7.1 |
| Mean LSD (0.01) | | 16.5 | | 1147 | | 0.15 | 5.01 | | 238 | | 0.79 | 2.88 | 41 | 149 | 84 | | 9.4 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

Bolters per acre are based upon 45,000 plants per acre. Trial # = 178305

@ Experimental trial data adjusted to commercial status. Statistics are from commercial trial. Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs. Created 10/31/2017

## Table 13. 2017 Performance of All RR Varieties - ACSC Official Trial

### Climax MN

| Variety @ | Code | Rec/T lbs. | Rec/T %Bnch | Rec/A lbs. | Rec/A %Bnch | Loss Mol % | Rev/T $ ++ | Rev/T %Bnch | Rev/A $ ++ | Rev/A %Bnch | Sugar % | Yield T/A | Na ppm | K ppm | AmN ppm | Bolter per Ac | Emerg. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Commercial Trial** | | | | | | | | | | | | | | | | | |
| BTS 80RR52 | 103 | 335.5 | 102 | 9304 | 100 | 1.01 | 53.17 | 104 | 1473 | 102 | 17.78 | 27.80 | 109 | 1437 | 363 | 0 | 90.6 |
| BTS 8337 | 116 | 350.5 | 107 | 10245 | 110 | 1.04 | 57.73 | 113 | 1688 | 117 | 18.56 | 29.19 | 114 | 1407 | 389 | 0 | 85.7 |
| BTS 8363 | 130 | 330.7 | 101 | 9615 | 103 | 0.95 | 51.73 | 101 | 1507 | 105 | 17.49 | 29.05 | 118 | 1351 | 334 | 0 | 84.9 |
| BTS 8500 | 119 | 330.9 | 101 | 10891 | 117 | 1.02 | 51.79 | 102 | 1705 | 118 | 17.56 | 32.90 | 118 | 1484 | 349 | 0 | 89.4 |
| BTS 8512 | 109 | 336.8 | 103 | 9910 | 107 | 0.97 | 53.57 | 105 | 1578 | 109 | 17.82 | 29.42 | 122 | 1362 | 348 | 32 | 88.3 |
| BTS 8524 | 101 | 320.6 | 98 | 9790 | 105 | 1.12 | 48.68 | 95 | 1480 | 103 | 17.14 | 30.64 | 131 | 1552 | 407 | 32 | 87.9 |
| BTS 8572 | 111 | 347.7 | 106 | 10141 | 109 | 0.96 | 56.87 | 112 | 1657 | 115 | 18.33 | 29.22 | 104 | 1364 | 341 | 0 | 86.9 |
| Crystal 093RR | 115 | 337.8 | 103 | 10270 | 111 | 0.96 | 53.87 | 106 | 1637 | 114 | 17.85 | 30.47 | 110 | 1404 | 331 | 0 | 83.2 |
| Crystal 101RR | 107 | 322.8 | 98 | 9965 | 107 | 1.08 | 49.34 | 97 | 1524 | 106 | 17.23 | 30.87 | 143 | 1573 | 367 | 0 | 86.3 |
| Crystal 246RR | 108 | 332.8 | 101 | 8974 | 97 | 0.98 | 52.35 | 103 | 1413 | 98 | 17.62 | 26.96 | 135 | 1387 | 341 | 0 | 83.0 |
| Crystal 247RR | 131 | 329.8 | 100 | 10090 | 109 | 0.94 | 51.45 | 101 | 1573 | 109 | 17.43 | 30.60 | 131 | 1368 | 318 | 0 | 85.2 |
| Crystal 355RR | 104 | 337.5 | 103 | 9765 | 105 | 1.07 | 53.79 | 106 | 1550 | 108 | 17.94 | 29.10 | 118 | 1479 | 393 | 0 | 88.4 |
| Crystal 467RR | 129 | 326.7 | 100 | 9973 | 107 | 1.01 | 50.52 | 99 | 1540 | 107 | 17.33 | 30.57 | 147 | 1457 | 342 | 0 | 92.5 |
| Crystal 572RR | 126 | 348.4 | 106 | 10547 | 114 | 0.92 | 57.09 | 112 | 1726 | 120 | 18.35 | 30.35 | 98 | 1280 | 340 | 0 | 90.2 |
| Crystal 574RR | 110 | 325.1 | 99 | 10850 | 117 | 1.00 | 50.04 | 98 | 1665 | 116 | 17.24 | 33.42 | 111 | 1436 | 352 | 0 | 89.3 |
| Crystal 986RR | 128 | 307.1 | 94 | 7275 | 78 | 0.90 | 44.60 | 87 | 1060 | 74 | 16.26 | 23.61 | 172 | 1324 | 283 | 0 | 86.8 |
| Hilleshög 4302RR | 105 | 317.2 | 97 | 8134 | 88 | 0.94 | 47.64 | 93 | 1218 | 85 | 16.79 | 25.71 | 166 | 1396 | 297 | 0 | 77.2 |
| Hilleshög 4448RR | 112 | 320.6 | 98 | 8699 | 94 | 0.90 | 48.69 | 95 | 1324 | 92 | 16.94 | 27.08 | 123 | 1356 | 297 | 0 | 77.2 |
| Hilleshög 9528RR | 123 | 326.2 | 99 | 9517 | 102 | 0.87 | 50.36 | 99 | 1465 | 102 | 17.17 | 29.23 | 120 | 1320 | 279 | 0 | 81.6 |
| Hilleshög HIL9707 | 114 | 310.6 | 95 | 8371 | 90 | 0.94 | 45.65 | 90 | 1228 | 85 | 16.47 | 27.01 | 161 | 1378 | 303 | 0 | 86.4 |
| Maribo 109 | 122 | 335.9 | 102 | 7871 | 85 | 0.87 | 53.32 | 105 | 1249 | 87 | 17.67 | 23.43 | 119 | 1320 | 283 | 0 | 80.4 |
| Maribo 305 | 106 | 312.7 | 95 | 8361 | 90 | 0.89 | 46.27 | 91 | 1237 | 86 | 16.52 | 26.69 | 127 | 1309 | 294 | 0 | 80.8 |
| Maribo MA502 | 121 | 318.2 | 97 | 8196 | 88 | 0.95 | 47.96 | 94 | 1236 | 86 | 16.88 | 25.75 | 145 | 1471 | 295 | 0 | 82.4 |
| SX Avalanche RR(858) | 127 | 333.8 | 102 | 8715 | 94 | 0.94 | 52.67 | 103 | 1376 | 95 | 17.63 | 26.09 | 120 | 1393 | 316 | 32 | 83.7 |
| SX Canyon RR | 118 | 336.5 | 103 | 10135 | 109 | 0.91 | 53.48 | 105 | 1612 | 112 | 17.74 | 30.07 | 110 | 1357 | 305 | 0 | 84.0 |
| SX Cruze RR | 117 | 318.3 | 97 | 9981 | 107 | 1.03 | 47.97 | 94 | 1502 | 104 | 16.94 | 31.43 | 128 | 1432 | 373 | 0 | 86.0 |
| SX Marathon RR(856) | 102 | 337.0 | 103 | 10467 | 113 | 0.92 | 53.63 | 105 | 1662 | 115 | 17.76 | 31.12 | 114 | 1334 | 316 | 0 | 82.5 |
| SX Winchester RR | 125 | 317.1 | 97 | 8110 | 87 | 0.89 | 47.63 | 93 | 1218 | 85 | 16.75 | 25.55 | 118 | 1400 | 277 | 0 | 79.4 |
| SV RR244TT | 120 | 330.8 | 101 | 10167 | 109 | 0.97 | 51.75 | 102 | 1588 | 110 | 17.51 | 30.81 | 124 | 1389 | 337 | 0 | 84.3 |
| SV RR333 | 124 | 341.5 | 104 | 10049 | 108 | 0.86 | 54.99 | 108 | 1619 | 112 | 17.94 | 29.39 | 99 | 1330 | 277 | 0 | 86.3 |
| SV RR351 | 113 | 325.8 | 99 | 10007 | 108 | 0.89 | 50.24 | 99 | 1542 | 107 | 17.18 | 30.76 | 120 | 1316 | 296 | 0 | 86.3 |
| RR Filler #01s | 132 | 324.4 | 99 | 9896 | 107 | 1.10 | 49.84 | 98 | 1524 | 106 | 17.33 | 30.47 | 141 | 1551 | 385 | 0 | 89.7 |
| RR Filler #01v | 133 | 322.0 | 98 | 10126 | 109 | 1.10 | 49.09 | 96 | 1545 | 107 | 17.20 | 31.44 | 140 | 1570 | 382 | 0 | 89.5 |
| **Experimental Trial (Comm status)** | | | | | | | | | | | | | | | | | |
| BTS 8606 | 242 | 337.0 | 103 | 9393 | 101 | 0.90 | 53.62 | 105 | 1491 | 103 | 17.76 | 27.91 | 118 | 1348 | 299 | 0 | 87.6 |
| BTS 8629 | 224 | 337.7 | 103 | 11158 | 120 | 0.94 | 53.84 | 106 | 1779 | 123 | 17.84 | 33.13 | 116 | 1306 | 346 | 0 | 93.0 |
| BTS 8735 | 234 | 337.7 | 103 | 9268 | 100 | 0.92 | 53.83 | 106 | 1469 | 102 | 17.80 | 27.68 | 128 | 1285 | 326 | 0 | 91.6 |
| BTS 8742 | 207 | 334.4 | 102 | 8983 | 97 | 1.02 | 52.82 | 104 | 1412 | 98 | 17.73 | 26.84 | 129 | 1447 | 359 | 0 | 90.5 |
| BTS 8749 | 202 | 338.0 | 103 | 9798 | 105 | 1.04 | 53.91 | 106 | 1560 | 108 | 17.94 | 29.02 | 133 | 1426 | 378 | 0 | 86.4 |
| BTS 8756 | 241 | 343.3 | 105 | 9656 | 104 | 1.01 | 55.49 | 109 | 1563 | 108 | 18.18 | 28.15 | 106 | 1515 | 347 | 0 | 91.5 |
| BTS 8767 | 235 | 335.7 | 102 | 10123 | 109 | 0.89 | 53.20 | 104 | 1601 | 111 | 17.67 | 30.33 | 125 | 1376 | 286 | 0 | 86.9 |
| BTS 8770 | 247 | 339.0 | 103 | 9744 | 105 | 0.91 | 54.21 | 106 | 1557 | 108 | 17.87 | 28.80 | 116 | 1401 | 295 | 0 | 88.5 |
| BTS 8784 | 236 | 348.5 | 106 | 9535 | 103 | 0.95 | 57.06 | 112 | 1561 | 108 | 18.40 | 27.22 | 101 | 1353 | 345 | 0 | 87.9 |
| BTS 8787 | 219 | 335.2 | 102 | 9528 | 103 | 0.99 | 53.07 | 104 | 1500 | 104 | 17.73 | 28.64 | 120 | 1450 | 333 | 0 | 83.5 |
| BTS 8798 | 223 | 330.4 | 101 | 9249 | 100 | 1.06 | 51.64 | 101 | 1448 | 100 | 17.59 | 27.90 | 134 | 1406 | 403 | 0 | 92.1 |
| Crystal 573RR | 225 | 340.8 | 104 | 9962 | 107 | 0.92 | 54.73 | 107 | 1599 | 111 | 17.97 | 29.31 | 112 | 1344 | 318 | 0 | 84.9 |
| Crystal 578RR | 220 | 335.3 | 102 | 9576 | 103 | 0.99 | 53.11 | 104 | 1507 | 105 | 17.74 | 28.73 | 124 | 1403 | 346 | 0 | 86.3 |
| Crystal 684RR | 239 | 336.2 | 102 | 10959 | 118 | 1.00 | 53.35 | 105 | 1724 | 120 | 17.78 | 32.88 | 121 | 1443 | 339 | 0 | 87.4 |
| Crystal 792RR | 218 | 336.0 | 102 | 10093 | 109 | 1.05 | 53.29 | 105 | 1603 | 111 | 17.84 | 29.83 | 120 | 1475 | 377 | 0 | 87.9 |
| Crystal 793RR | 246 | 350.3 | 107 | 9961 | 107 | 0.87 | 57.57 | 113 | 1632 | 113 | 18.39 | 28.49 | 99 | 1304 | 292 | 0 | 84.4 |
| Crystal 794RR | 208 | 328.5 | 100 | 9815 | 106 | 1.05 | 51.05 | 100 | 1529 | 106 | 17.48 | 29.84 | 138 | 1474 | 376 | 0 | 86.0 |
| Crystal 795RR | 215 | 339.7 | 103 | 9458 | 102 | 0.99 | 54.41 | 107 | 1506 | 105 | 17.96 | 28.13 | 120 | 1399 | 350 | 0 | 88.2 |
| Crystal 796RR | 238 | 330.2 | 101 | 10691 | 115 | 0.94 | 51.59 | 101 | 1668 | 116 | 17.47 | 32.51 | 115 | 1344 | 335 | 0 | 88.8 |
| Crystal 797RR | 201 | 334.1 | 102 | 10330 | 111 | 1.03 | 52.74 | 103 | 1609 | 112 | 17.70 | 31.47 | 151 | 1462 | 350 | 0 | 84.2 |
| Hilleshög HIL9708 | 222 | 327.6 | 100 | 7828 | 84 | 0.85 | 50.81 | 100 | 1213 | 84 | 17.24 | 24.01 | 124 | 1256 | 282 | 0 | 86.9 |
| Hilleshög HIL9895 | 209 | 324.8 | 99 | 7886 | 85 | 0.91 | 49.95 | 98 | 1213 | 84 | 17.15 | 24.35 | 128 | 1450 | 276 | 0 | 83.7 |
| Hilleshög HIL9920 | 203 | 337.8 | 103 | 8533 | 92 | 0.84 | 53.86 | 106 | 1357 | 94 | 17.73 | 25.20 | 126 | 1348 | 251 | 0 | 83.7 |
| Hilleshög HIL9921 | 204 | 333.8 | 102 | 7833 | 84 | 0.93 | 52.64 | 103 | 1229 | 85 | 17.63 | 23.26 | 131 | 1350 | 325 | 0 | 75.5 |
| Hilleshög HIL9922 | 231 | 320.4 | 98 | 7931 | 85 | 0.90 | 48.66 | 95 | 1206 | 84 | 16.93 | 24.75 | 115 | 1378 | 292 | 0 | 90.9 |
| Hilleshög HIL9923 | 243 | 332.9 | 101 | 6900 | 74 | 1.06 | 52.40 | 103 | 1085 | 75 | 17.70 | 20.84 | 161 | 1531 | 358 | 0 | 76.0 |
| Hilleshög HIL9924 | 237 | 319.4 | 97 | 7058 | 76 | 1.11 | 48.37 | 95 | 1063 | 74 | 17.07 | 22.25 | 146 | 1481 | 413 | 0 | 75.0 |
| Maribo MA504 | 229 | 322.5 | 98 | 8073 | 87 | 0.88 | 49.27 | 97 | 1234 | 86 | 17.01 | 24.87 | 133 | 1344 | 279 | 0 | 87.8 |
| Maribo MA611 | 245 | 311.8 | 95 | 7337 | 79 | 0.98 | 46.08 | 90 | 1081 | 75 | 16.56 | 23.65 | 139 | 1481 | 310 | 0 | 83.8 |
| Maribo MA717 | 232 | 333.8 | 102 | 8168 | 88 | 0.88 | 52.64 | 103 | 1284 | 89 | 17.57 | 24.64 | 111 | 1354 | 278 | 0 | 84.7 |
| Maribo MA718 | 221 | 322.6 | 98 | 7464 | 80 | 1.07 | 49.28 | 97 | 1128 | 78 | 17.17 | 23.30 | 185 | 1488 | 363 | 0 | 72.6 |
| Maribo MA719 | 213 | 326.8 | 100 | 7028 | 76 | 1.08 | 50.56 | 99 | 1093 | 76 | 17.43 | 21.51 | 136 | 1593 | 370 | 0 | 84.6 |
| SX RR1861 | 233 | 337.1 | 103 | 9841 | 106 | 0.89 | 53.65 | 105 | 1563 | 108 | 17.75 | 29.26 | 109 | 1297 | 311 | 0 | 92.0 |
| SX RR1863 | 244 | 326.6 | 99 | 8797 | 95 | 0.89 | 50.52 | 99 | 1355 | 94 | 17.23 | 26.88 | 126 | 1366 | 282 | 0 | 78.9 |
| SX RR1875 | 210 | 333.1 | 101 | 8046 | 87 | 0.85 | 52.43 | 103 | 1270 | 88 | 17.52 | 24.25 | 113 | 1308 | 270 | 0 | 91.4 |
| SX RR1876 | 228 | 331.1 | 101 | 10327 | 111 | 1.02 | 51.85 | 102 | 1604 | 111 | 17.56 | 31.47 | 129 | 1448 | 355 | 0 | 82.7 |
| SX RR1877 | 227 | 328.5 | 100 | 9152 | 98 | 1.11 | 51.05 | 100 | 1415 | 98 | 17.53 | 28.02 | 136 | 1542 | 406 | 0 | 85.6 |
| SX RR1878 | 206 | 326.4 | 99 | 9807 | 106 | 0.97 | 50.43 | 99 | 1508 | 105 | 17.28 | 30.25 | 120 | 1393 | 335 | 0 | 80.6 |
| SX RR1879 | 205 | 333.0 | 101 | 9357 | 101 | 0.90 | 52.42 | 103 | 1468 | 102 | 17.56 | 28.10 | 115 | 1338 | 304 | 0 | 89.8 |
| SV RR265 | 240 | 337.0 | 103 | 10432 | 112 | 0.92 | 53.63 | 105 | 1651 | 115 | 17.77 | 31.14 | 106 | 1342 | 313 | 0 | 78.8 |
| SV RR266 | 216 | 339.9 | 104 | 10887 | 117 | 0.87 | 54.47 | 107 | 1749 | 121 | 17.88 | 32.07 | 100 | 1303 | 295 | 0 | 89.0 |
| SV RR268 | 226 | 337.0 | 103 | 9610 | 103 | 0.88 | 53.61 | 105 | 1522 | 106 | 17.72 | 28.72 | 112 | 1324 | 284 | 0 | 87.9 |
| SV RR371 | 212 | 336.9 | 103 | 9778 | 105 | 0.88 | 53.59 | 105 | 1556 | 108 | 17.73 | 29.29 | 102 | 1310 | 297 | 0 | 89.1 |
| SV RR372 | 217 | 324.3 | 99 | 9300 | 100 | 0.99 | 49.82 | 98 | 1424 | 99 | 17.19 | 28.88 | 111 | 1384 | 354 | 0 | 86.3 |
| SV RR373 | 230 | 324.4 | 99 | 8911 | 96 | 0.94 | 49.85 | 98 | 1368 | 95 | 17.17 | 27.53 | 112 | 1444 | 311 | 0 | 83.7 |
| SV RR374 | 214 | 336.3 | 102 | 9398 | 101 | 0.95 | 53.38 | 105 | 1482 | 103 | 17.76 | 28.14 | 115 | 1372 | 337 | 0 | 88.2 |
| SV RR375 | 211 | 348.8 | 106 | 10294 | 111 | 0.89 | 57.14 | 112 | 1692 | 117 | 18.36 | 29.55 | 99 | 1329 | 308 | 0 | 82.2 |
| AP CHK MOD RES RR#4 | 248 | 340.1 | 104 | 9635 | 104 | 0.87 | 54.54 | 107 | 1543 | 107 | 17.88 | 28.52 | 117 | 1306 | 288 | 0 | 85.6 |
| AP CHK SUS HYB#3 | 249 | 334.8 | 102 | 8014 | 86 | 0.92 | 52.95 | 104 | 1261 | 87 | 17.66 | 23.97 | 143 | 1399 | 298 | 0 | 86.9 |
| Crystal 355RR(Check) | 250 | 331.5 | 101 | 9606 | 103 | 1.11 | 51.97 | 102 | 1496 | 104 | 17.67 | 29.13 | 144 | 1491 | 412 | 0 | 88.2 |
| BTS 80RR52(Check) | 251 | 332.7 | 101 | 9118 | 98 | 1.01 | 52.32 | 103 | 1439 | 100 | 17.65 | 27.45 | 115 | 1427 | 359 | 0 | 86.2 |
| Crystal 101RR (Check) | 252 | 327.5 | 100 | 10003 | 108 | 1.07 | 50.75 | 100 | 1550 | 108 | 17.45 | 30.60 | 127 | 1618 | 357 | 0 | 86.5 |
| Hilleshög 4302RR (Check) | 253 | 321.3 | 98 | 8441 | 91 | 0.91 | 48.90 | 96 | 1280 | 89 | 16.97 | 26.29 | 151 | 1349 | 292 | 0 | 76.2 |
| RR Filler #05 | 254 | 311.4 | 95 | 6325 | 68 | 1.05 | 45.98 | 90 | 930 | 65 | 16.61 | 20.39 | 173 | 1511 | 350 | 0 | 76.2 |
| Comm Benchmark Mean | | 328.3 | | 9292 | | 1.03 | 50.99 | | 1441 | | 17.44 | 28.37 | 134 | 1471 | 355 | | 84.3 |
| Comm Trial Mean | | 328.8 | | 9527 | | 0.97 | 51.14 | | 1482 | | 17.40 | 28.98 | 126 | 1403 | 331 | | 85.3 |
| Coeff. of Var. (%) | | 2.7 | | 6.0 | | 7.8 | 5.2 | | 7.3 | | 2.3 | 5.7 | 18 | 5.4 | 13 | | 6.4 |
| Mean LSD (0.05) | | 11.4 | | 730 | | 0.09 | 3.46 | | 137 | | 0.52 | 2.13 | 27 | 90 | 54 | | 6.6 |
| Mean LSD (0.01) | | 15.1 | | 964 | | 0.12 | 4.57 | | 180 | | 0.68 | 2.81 | 36 | 119 | 71 | | 8.7 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

Bolters per acre are based upon 45,000 plants per acre. Trial # = 178306

@ Experimental trial data adjusted to commercial status. Statistics are from commercial trial. Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs. Created 10/31/2017

## Table 14. 2017 Performance of All RR Varieties - ACSC Official Trial

### Grand Forks ND

| Variety @ | Code | Rec/T lbs. | Rec/T %Bnch | Rec/A lbs. | Rec/A %Bnch | Loss Mol % | Rev/T $ ++ | Rev/T %Bnch | Rev/A $ ++ | Rev/A %Bnch | Sugar % | Yield T/A | Na ppm | K ppm | AmN ppm | Bolter per Ac | Emerg. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Commercial Trial** | | | | | | | | | | | | | | | | | |
| BTS 80RR52 | 103 | 352.4 | 99 | 11374 | 97 | 0.90 | 58.29 | 98 | 1882 | 97 | 18.52 | 32.31 | 129 | 1547 | 239 | 0 | 76.6 |
| BTS 8337 | 116 | 357.2 | 100 | 11258 | 96 | 0.87 | 59.77 | 100 | 1881 | 96 | 18.73 | 31.54 | 130 | 1523 | 219 | 0 | 77.4 |
| BTS 8363 | 130 | 348.0 | 98 | 12320 | 106 | 0.80 | 56.98 | 96 | 2017 | 103 | 18.20 | 35.39 | 122 | 1449 | 191 | 0 | 78.9 |
| BTS 8500 | 119 | 351.0 | 98 | 12258 | 105 | 0.87 | 57.88 | 97 | 2020 | 104 | 18.41 | 34.87 | 128 | 1531 | 218 | 0 | 76.6 |
| BTS 8512 | 109 | 359.7 | 101 | 11280 | 97 | 0.86 | 60.50 | 102 | 1900 | 97 | 18.85 | 31.31 | 122 | 1529 | 220 | 0 | 78.7 |
| BTS 8524 | 101 | 352.2 | 99 | 12535 | 107 | 0.85 | 58.23 | 98 | 2073 | 106 | 18.46 | 35.62 | 139 | 1570 | 196 | 0 | 74.7 |
| BTS 8572 | 111 | 363.7 | 102 | 11765 | 101 | 0.82 | 61.72 | 104 | 1996 | 102 | 19.01 | 32.44 | 117 | 1467 | 205 | 0 | 82.3 |
| Crystal 093RR | 115 | 373.2 | 105 | 11780 | 101 | 0.87 | 64.61 | 108 | 2039 | 105 | 19.53 | 31.56 | 110 | 1516 | 234 | 0 | 78.4 |
| Crystal 101RR | 107 | 359.5 | 101 | 12368 | 106 | 0.86 | 60.46 | 101 | 2079 | 107 | 18.84 | 34.46 | 139 | 1613 | 186 | 0 | 78.4 |
| Crystal 246RR | 108 | 355.0 | 100 | 12385 | 106 | 0.79 | 59.09 | 99 | 2060 | 106 | 18.54 | 34.96 | 137 | 1451 | 175 | 0 | 70.3 |
| Crystal 247RR | 131 | 357.4 | 100 | 12135 | 104 | 0.71 | 59.82 | 100 | 2031 | 104 | 18.58 | 34.04 | 115 | 1343 | 153 | 0 | 75.0 |
| Crystal 355RR | 104 | 360.8 | 101 | 11601 | 99 | 0.85 | 60.85 | 102 | 1955 | 100 | 18.90 | 32.19 | 121 | 1490 | 223 | 0 | 75.0 |
| Crystal 467RR | 129 | 346.5 | 97 | 12144 | 104 | 0.83 | 56.51 | 95 | 1986 | 102 | 18.16 | 35.06 | 139 | 1541 | 186 | 0 | 80.2 |
| Crystal 572RR | 126 | 370.3 | 104 | 12471 | 107 | 0.80 | 63.73 | 107 | 2147 | 110 | 19.31 | 33.57 | 114 | 1429 | 198 | 0 | 81.8 |
| Crystal 574RR | 110 | 351.3 | 98 | 12300 | 105 | 0.85 | 57.96 | 97 | 2029 | 104 | 18.42 | 35.04 | 125 | 1560 | 203 | 0 | 80.0 |
| Crystal 986RR | 128 | 355.5 | 100 | 12439 | 107 | 0.80 | 59.24 | 99 | 2074 | 106 | 18.58 | 34.94 | 139 | 1390 | 205 | 0 | 79.2 |
| Hilleshög 4302RR | 105 | 353.9 | 99 | 11353 | 97 | 0.82 | 58.77 | 99 | 1884 | 97 | 18.52 | 32.03 | 138 | 1462 | 198 | 0 | 69.0 |
| Hilleshög 4448RR | 112 | 361.3 | 101 | 12812 | 110 | 0.82 | 61.00 | 102 | 2157 | 111 | 18.89 | 35.56 | 118 | 1487 | 202 | 0 | 70.8 |
| Hilleshög 9528RR | 123 | 346.9 | 97 | 11762 | 101 | 0.84 | 56.65 | 95 | 1922 | 99 | 18.19 | 33.88 | 139 | 1491 | 207 | 0 | 78.4 |
| Hilleshög HIL9707 | 114 | 341.6 | 96 | 12190 | 104 | 0.82 | 55.03 | 92 | 1956 | 100 | 17.89 | 35.79 | 138 | 1469 | 192 | 32 | 79.2 |
| Maribo 109 | 122 | 371.8 | 104 | 10296 | 88 | 0.83 | 64.16 | 108 | 1770 | 91 | 19.41 | 27.82 | 129 | 1480 | 200 | 0 | 72.9 |
| Maribo 305 | 106 | 352.8 | 99 | 12554 | 108 | 0.81 | 58.42 | 98 | 2074 | 106 | 18.44 | 35.65 | 128 | 1417 | 201 | 0 | 64.3 |
| Maribo MA502 | 121 | 346.9 | 97 | 11785 | 101 | 0.91 | 56.64 | 95 | 1924 | 99 | 18.26 | 33.93 | 173 | 1608 | 218 | 0 | 77.3 |
| SX Avalanche RR(858) | 127 | 352.7 | 99 | 11753 | 101 | 0.84 | 58.40 | 98 | 1943 | 100 | 18.47 | 33.34 | 155 | 1407 | 222 | 0 | 72.4 |
| SX Canyon RR | 118 | 362.8 | 102 | 12704 | 109 | 0.75 | 61.45 | 103 | 2157 | 111 | 18.89 | 34.98 | 106 | 1396 | 170 | 0 | 73.2 |
| SX Cruze RR | 117 | 331.3 | 93 | 12154 | 104 | 0.86 | 51.91 | 87 | 1907 | 98 | 17.42 | 36.66 | 129 | 1550 | 207 | 0 | 77.9 |
| SX Marathon RR(856) | 102 | 349.7 | 98 | 12295 | 105 | 0.79 | 57.48 | 96 | 2021 | 104 | 18.28 | 35.14 | 113 | 1467 | 186 | 0 | 69.0 |
| SX Winchester RR | 125 | 350.2 | 98 | 11362 | 97 | 0.83 | 57.63 | 97 | 1868 | 96 | 18.34 | 32.50 | 127 | 1565 | 187 | 0 | 66.7 |
| SV RR244TT | 120 | 352.1 | 99 | 12859 | 110 | 0.78 | 58.21 | 98 | 2128 | 109 | 18.38 | 36.48 | 115 | 1453 | 176 | 0 | 70.8 |
| SV RR333 | 124 | 354.5 | 99 | 12282 | 105 | 0.79 | 58.92 | 99 | 2042 | 105 | 18.51 | 34.64 | 122 | 1485 | 174 | 0 | 74.5 |
| SV RR351 | 113 | 355.6 | 100 | 12283 | 105 | 0.80 | 59.28 | 99 | 2049 | 105 | 18.58 | 34.44 | 113 | 1488 | 183 | 0 | 74.5 |
| RR Filler #01s | 132 | 354.7 | 99 | 12122 | 104 | 0.85 | 59.00 | 99 | 2013 | 103 | 18.59 | 34.20 | 144 | 1616 | 179 | 0 | 77.1 |
| RR Filler #01v | 133 | 351.2 | 98 | 12082 | 103 | 0.87 | 57.93 | 97 | 1991 | 102 | 18.43 | 34.46 | 149 | 1610 | 191 | 0 | 77.9 |
| **Experimental Trial (Comm status)** | | | | | | | | | | | | | | | | | |
| BTS 8606 | 242 | 365.6 | 103 | 12597 | 108 | 0.78 | 62.28 | 105 | 2139 | 110 | 19.07 | 34.62 | 118 | 1450 | 176 | 0 | 74.6 |
| BTS 8629 | 224 | 353.0 | 99 | 12078 | 103 | 0.77 | 58.47 | 98 | 1993 | 102 | 18.42 | 34.39 | 144 | 1333 | 193 | 0 | 80.2 |
| BTS 8735 | 234 | 358.3 | 100 | 12238 | 105 | 0.72 | 60.08 | 101 | 2054 | 105 | 18.65 | 34.19 | 119 | 1231 | 190 | 0 | 74.4 |
| BTS 8742 | 207 | 353.6 | 99 | 11489 | 98 | 0.92 | 58.66 | 98 | 1915 | 98 | 18.60 | 32.33 | 142 | 1503 | 261 | 0 | 76.9 |
| BTS 8749 | 202 | 362.5 | 102 | 11449 | 98 | 0.84 | 61.35 | 103 | 1937 | 99 | 18.97 | 31.57 | 120 | 1493 | 215 | 0 | 80.1 |
| BTS 8756 | 241 | 360.9 | 101 | 11965 | 102 | 0.95 | 60.84 | 102 | 2016 | 103 | 18.98 | 33.09 | 139 | 1593 | 264 | 0 | 78.9 |
| BTS 8767 | 235 | 346.0 | 97 | 11987 | 103 | 0.88 | 56.39 | 95 | 1958 | 100 | 18.18 | 34.61 | 152 | 1545 | 212 | 0 | 82.8 |
| BTS 8770 | 247 | 356.3 | 100 | 12474 | 107 | 0.80 | 59.50 | 100 | 2084 | 107 | 18.62 | 34.86 | 125 | 1473 | 184 | 0 | 71.4 |
| BTS 8784 | 236 | 377.9 | 106 | 11675 | 100 | 0.75 | 65.94 | 111 | 2041 | 105 | 19.65 | 30.83 | 99 | 1319 | 196 | 0 | 77.6 |
| BTS 8787 | 219 | 359.1 | 101 | 11492 | 98 | 0.80 | 60.33 | 101 | 1936 | 99 | 18.77 | 31.95 | 123 | 1436 | 199 | 0 | 76.5 |
| BTS 8798 | 223 | 363.6 | 102 | 11725 | 100 | 0.78 | 61.68 | 103 | 1977 | 101 | 18.95 | 32.43 | 108 | 1320 | 217 | 0 | 81.6 |
| Crystal 573RR | 225 | 364.6 | 102 | 12361 | 106 | 0.78 | 61.96 | 104 | 2101 | 108 | 19.01 | 33.92 | 113 | 1341 | 213 | 0 | 75.4 |
| Crystal 578RR | 220 | 357.5 | 100 | 12755 | 109 | 0.82 | 59.85 | 100 | 2128 | 109 | 18.71 | 35.81 | 132 | 1494 | 192 | 0 | 78.1 |
| Crystal 684RR | 239 | 352.9 | 99 | 13397 | 115 | 0.87 | 58.45 | 98 | 2211 | 113 | 18.51 | 38.12 | 146 | 1528 | 215 | 0 | 76.3 |
| Crystal 792RR | 218 | 357.0 | 100 | 11890 | 102 | 0.81 | 59.71 | 100 | 1986 | 102 | 18.67 | 33.40 | 127 | 1361 | 228 | 0 | 82.5 |
| Crystal 793RR | 246 | 365.5 | 102 | 12885 | 110 | 0.75 | 62.25 | 104 | 2191 | 112 | 19.03 | 35.26 | 122 | 1310 | 194 | 0 | 79.9 |
| Crystal 794RR | 208 | 355.6 | 100 | 13006 | 111 | 0.79 | 59.29 | 99 | 2167 | 111 | 18.59 | 36.63 | 135 | 1389 | 200 | 0 | 72.0 |
| Crystal 795RR | 215 | 362.5 | 102 | 11255 | 96 | 0.88 | 61.35 | 103 | 1901 | 97 | 19.00 | 31.17 | 115 | 1456 | 252 | 0 | 74.3 |
| Crystal 796RR | 238 | 364.4 | 102 | 13710 | 117 | 0.80 | 61.91 | 104 | 2307 | 118 | 19.02 | 38.04 | 123 | 1454 | 194 | 0 | 81.6 |
| Crystal 797RR | 201 | 354.2 | 99 | 12478 | 107 | 0.82 | 58.83 | 99 | 2075 | 106 | 18.54 | 35.32 | 135 | 1567 | 170 | 0 | 68.3 |
| Hilleshög HIL9708 | 222 | 355.8 | 100 | 11704 | 100 | 0.84 | 59.36 | 100 | 1952 | 100 | 18.64 | 32.84 | 140 | 1524 | 200 | 95 | 78.1 |
| Hilleshög HIL9895 | 209 | 348.6 | 98 | 11809 | 101 | 0.84 | 57.19 | 96 | 1930 | 99 | 18.27 | 33.99 | 135 | 1521 | 200 | 0 | 80.0 |
| Hilleshög HIL9920 | 203 | 368.3 | 103 | 11285 | 97 | 0.80 | 63.09 | 106 | 1926 | 99 | 19.23 | 30.81 | 155 | 1417 | 190 | 0 | 68.5 |
| Hilleshög HIL9921 | 204 | 367.8 | 103 | 10899 | 93 | 0.85 | 62.90 | 106 | 1858 | 95 | 19.24 | 29.62 | 138 | 1411 | 240 | 0 | 78.2 |
| Hilleshög HIL9922 | 231 | 350.3 | 98 | 11344 | 97 | 0.83 | 57.68 | 97 | 1874 | 96 | 18.36 | 32.16 | 132 | 1518 | 197 | 0 | 80.4 |
| Hilleshög HIL9923 | 243 | 353.5 | 99 | 10108 | 87 | 0.93 | 58.63 | 98 | 1674 | 86 | 18.60 | 28.75 | 174 | 1483 | 264 | 0 | 60.8 |
| Hilleshög HIL9924 | 237 | 358.1 | 100 | 10064 | 86 | 0.91 | 60.02 | 101 | 1683 | 86 | 18.81 | 28.18 | 124 | 1473 | 266 | 0 | 54.4 |
| Maribo MA504 | 229 | 345.5 | 97 | 13333 | 114 | 0.81 | 56.25 | 94 | 2165 | 111 | 18.09 | 38.74 | 133 | 1422 | 209 | 0 | 85.5 |
| Maribo MA611 | 245 | 347.7 | 97 | 11597 | 99 | 0.82 | 56.92 | 96 | 1896 | 97 | 18.21 | 33.30 | 126 | 1514 | 194 | 0 | 81.0 |
| Maribo MA717 | 232 | 366.0 | 103 | 12128 | 104 | 0.87 | 62.38 | 105 | 2062 | 106 | 19.16 | 33.14 | 127 | 1492 | 224 | 0 | 75.9 |
| Maribo MA718 | 221 | 361.3 | 101 | 10594 | 91 | 0.83 | 60.98 | 102 | 1783 | 91 | 18.90 | 29.35 | 127 | 1563 | 186 | 0 | 67.4 |
| Maribo MA719 | 213 | 353.1 | 99 | 11744 | 101 | 0.94 | 58.51 | 98 | 1945 | 100 | 18.59 | 33.27 | 159 | 1500 | 269 | 0 | 67.4 |
| SX RR1861 | 233 | 353.2 | 99 | 12204 | 105 | 0.79 | 58.55 | 98 | 2010 | 103 | 18.45 | 34.76 | 138 | 1437 | 184 | 0 | 79.0 |
| SX RR1863 | 244 | 362.0 | 102 | 12334 | 106 | 0.82 | 61.20 | 103 | 2082 | 107 | 18.93 | 34.22 | 118 | 1483 | 205 | 0 | 74.8 |
| SX RR1875 | 210 | 358.2 | 100 | 11106 | 95 | 0.81 | 60.06 | 101 | 1862 | 95 | 18.73 | 31.00 | 128 | 1480 | 189 | 0 | 78.7 |
| SX RR1876 | 228 | 350.4 | 98 | 11996 | 103 | 0.78 | 57.71 | 97 | 1976 | 101 | 18.31 | 34.21 | 117 | 1461 | 178 | 0 | 70.8 |
| SX RR1877 | 227 | 347.2 | 97 | 11132 | 95 | 0.88 | 56.76 | 95 | 1812 | 93 | 18.23 | 32.23 | 126 | 1557 | 220 | 0 | 77.1 |
| SX RR1878 | 206 | 347.8 | 98 | 12204 | 105 | 0.78 | 56.94 | 96 | 1987 | 102 | 18.17 | 35.18 | 114 | 1424 | 190 | 0 | 73.4 |
| SX RR1879 | 205 | 359.9 | 101 | 12717 | 109 | 0.80 | 60.56 | 102 | 2143 | 110 | 18.81 | 35.32 | 109 | 1463 | 191 | 0 | 70.8 |
| SV RR265 | 240 | 355.4 | 100 | 13171 | 113 | 0.78 | 59.22 | 99 | 2198 | 113 | 18.56 | 37.02 | 118 | 1411 | 185 | 0 | 79.5 |
| SV RR266 | 216 | 358.7 | 101 | 12131 | 104 | 0.75 | 60.21 | 101 | 2031 | 104 | 18.69 | 33.96 | 105 | 1386 | 177 | 0 | 65.6 |
| SV RR268 | 226 | 363.5 | 102 | 12599 | 108 | 0.79 | 61.66 | 103 | 2127 | 109 | 18.97 | 34.73 | 115 | 1438 | 187 | 0 | 74.0 |
| SV RR371 | 212 | 349.7 | 98 | 13002 | 111 | 0.81 | 57.51 | 97 | 2136 | 110 | 18.30 | 37.26 | 140 | 1430 | 196 | 0 | 75.5 |
| SV RR372 | 217 | 348.2 | 98 | 12397 | 106 | 0.75 | 57.03 | 96 | 2035 | 104 | 18.16 | 35.53 | 106 | 1397 | 170 | 0 | 65.6 |
| SV RR373 | 230 | 352.1 | 99 | 11305 | 97 | 0.79 | 58.23 | 98 | 1865 | 96 | 18.40 | 32.17 | 107 | 1450 | 188 | 0 | 71.9 |
| SV RR374 | 214 | 365.4 | 102 | 12519 | 107 | 0.76 | 62.20 | 104 | 2130 | 109 | 19.04 | 34.16 | 116 | 1389 | 182 | 0 | 82.1 |
| SV RR375 | 211 | 358.0 | 100 | 12458 | 107 | 0.79 | 60.00 | 101 | 2084 | 107 | 18.70 | 34.86 | 124 | 1413 | 198 | 0 | 64.6 |
| AP CHK MOD RES RR#4 | 248 | 356.9 | 100 | 11684 | 100 | 0.73 | 59.65 | 100 | 1946 | 100 | 18.58 | 32.81 | 124 | 1400 | 151 | 0 | 67.3 |
| AP CHK SUS HYB#3 | 249 | 359.6 | 101 | 12042 | 103 | 0.88 | 60.48 | 101 | 2023 | 104 | 18.86 | 33.44 | 154 | 1500 | 221 | 0 | 77.7 |
| Crystal 355RR(Check) | 250 | 356.8 | 100 | 12104 | 104 | 0.88 | 59.64 | 100 | 2031 | 104 | 18.73 | 33.75 | 134 | 1486 | 237 | 0 | 74.8 |
| BTS 80RR52(Check) | 251 | 356.8 | 100 | 11742 | 101 | 0.90 | 59.64 | 100 | 1963 | 101 | 18.74 | 32.89 | 128 | 1526 | 243 | 0 | 79.8 |
| Crystal 101RR (Check) | 252 | 359.1 | 101 | 12501 | 107 | 0.88 | 60.33 | 101 | 2096 | 108 | 18.85 | 35.05 | 142 | 1659 | 188 | 0 | 68.8 |
| Hilleshög 4302RR (Check) | 253 | 353.9 | 99 | 10348 | 89 | 0.78 | 58.76 | 99 | 1710 | 88 | 18.47 | 29.30 | 123 | 1441 | 179 | 0 | 76.5 |
| RR Filler #05 | 254 | 354.2 | 99 | 10187 | 87 | 0.89 | 58.84 | 99 | 1682 | 86 | 18.59 | 28.99 | 175 | 1585 | 198 | 0 | 71.5 |
| Comm Benchmark Mean | | 356.7 | | 11674 | | 0.86 | 59.59 | | 1950 | | 18.70 | 32.75 | 132 | 1528 | 211 | | 75.0 |
| Comm Trial Mean | | 354.7 | | 12032 | | 0.83 | 58.99 | | 1999 | | 18.56 | 33.96 | 129 | 1497 | 198 | | 75.4 |
| Coeff. of Var. (%) | | 2.4 | | 5.1 | | 6.1 | 4.4 | | 6.1 | | 2.2 | 4.9 | 14 | 5.1 | 12 | | 7.6 |
| Mean LSD (0.05) | | 10.9 | | 773 | | 0.06 | 3.31 | | 151 | | 0.52 | 2.14 | 23 | 98 | 31 | | 6.5 |
| Mean LSD (0.01) | | 14.4 | | 1020 | | 0.08 | 4.37 | | 199 | | 0.69 | 2.83 | 30 | 129 | 41 | | 8.6 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

Bolters per acre are based upon 45,000 plants per acre. Trial # = 178307

@ Experimental trial data adjusted to commercial status. Statistics are from commercial trial. Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs. Created 10/31/2017

## Table 15. 2017 Performance of All RR Varieties - ACSC Official Trial

### Scandia MN

| Variety @ | Code | Rec/T lbs. | Rec/T %Bnch | Rec/A lbs. | Rec/A %Bnch | Loss Mol % | Rev/T $ ++ | Rev/T %Bnch | Rev/A $ ++ | Rev/A %Bnch | Sugar % | Yield T/A | Na ppm | K ppm | AmN ppm | Bolter per Ac | Emerg. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Commercial Trial** | | | | | | | | | | | | | | | | | |
| BTS 80RR52 | 103 | 344.9 | 102 | 9843 | 110 | 1.35 | 56.03 | 104 | 1597 | 112 | 18.59 | 28.66 | 191 | 1657 | 535 | 0 | 70.2 |
| BTS 8337 | 116 | 351.7 | 104 | 10028 | 112 | 1.31 | 58.08 | 108 | 1652 | 116 | 18.90 | 28.68 | 231 | 1626 | 503 | 0 | 58.2 |
| BTS 8363 | 130 | 323.8 | 96 | 9612 | 107 | 1.38 | 49.65 | 92 | 1478 | 103 | 17.58 | 29.62 | 293 | 1711 | 512 | 0 | 67.1 |
| BTS 8500 | 119 | 332.7 | 99 | 10247 | 114 | 1.30 | 52.33 | 97 | 1614 | 113 | 17.92 | 30.76 | 237 | 1642 | 478 | 0 | 63.3 |
| BTS 8512 | 109 | 336.9 | 100 | 9737 | 109 | 1.30 | 53.60 | 100 | 1553 | 109 | 18.14 | 28.91 | 240 | 1597 | 493 | 0 | 74.2 |
| BTS 8524 | 101 | 322.3 | 96 | 9334 | 104 | 1.41 | 49.20 | 92 | 1429 | 100 | 17.53 | 28.85 | 256 | 1747 | 536 | 32 | 69.6 |
| BTS 8572 | 111 | 349.0 | 103 | 9485 | 106 | 1.26 | 57.28 | 107 | 1558 | 109 | 18.72 | 27.15 | 183 | 1569 | 494 | 0 | 70.4 |
| Crystal 093RR | 115 | 348.2 | 103 | 9779 | 109 | 1.21 | 57.03 | 106 | 1601 | 112 | 18.63 | 28.13 | 156 | 1605 | 460 | 0 | 61.8 |
| Crystal 101RR | 107 | 323.8 | 96 | 8243 | 92 | 1.48 | 49.65 | 92 | 1262 | 88 | 17.66 | 25.40 | 330 | 1818 | 541 | 0 | 59.2 |
| Crystal 246RR | 108 | 326.8 | 97 | 9909 | 110 | 1.32 | 50.56 | 94 | 1519 | 106 | 17.66 | 30.56 | 282 | 1644 | 481 | 0 | 63.8 |
| Crystal 247RR | 131 | 335.4 | 99 | 9686 | 108 | 1.27 | 53.16 | 99 | 1534 | 107 | 18.04 | 28.97 | 256 | 1693 | 440 | 0 | 61.8 |
| Crystal 355RR | 104 | 344.4 | 102 | 9890 | 110 | 1.36 | 55.88 | 104 | 1600 | 112 | 18.58 | 28.80 | 259 | 1684 | 514 | 0 | 69.3 |
| Crystal 467RR | 129 | 333.9 | 99 | 10310 | 115 | 1.40 | 52.70 | 98 | 1633 | 114 | 18.09 | 30.91 | 328 | 1756 | 493 | 0 | 64.3 |
| Crystal 572RR | 126 | 355.1 | 105 | 9702 | 108 | 1.15 | 59.12 | 110 | 1606 | 112 | 18.91 | 27.41 | 178 | 1533 | 421 | 0 | 69.1 |
| Crystal 574RR | 110 | 323.5 | 96 | 9744 | 109 | 1.31 | 49.56 | 92 | 1496 | 105 | 17.48 | 30.07 | 250 | 1683 | 469 | 0 | 68.8 |
| Crystal 986RR | 128 | 345.6 | 102 | 9852 | 110 | 1.19 | 56.24 | 105 | 1595 | 112 | 18.47 | 28.64 | 248 | 1483 | 438 | 0 | 68.6 |
| Hilleshög 4302RR | 105 | 336.2 | 100 | 7920 | 88 | 1.25 | 53.41 | 99 | 1262 | 88 | 18.07 | 23.32 | 277 | 1659 | 433 | 0 | 46.3 |
| Hilleshög 4448RR | 112 | 337.4 | 100 | 9718 | 108 | 1.28 | 53.77 | 100 | 1541 | 108 | 18.15 | 29.00 | 245 | 1587 | 483 | 0 | 56.4 |
| Hilleshög 9528RR | 123 | 343.2 | 102 | 9796 | 109 | 1.33 | 55.53 | 103 | 1580 | 110 | 18.49 | 28.53 | 243 | 1603 | 517 | 0 | 60.0 |
| Hilleshög HIL9707 | 114 | 311.5 | 92 | 8228 | 92 | 1.58 | 45.91 | 85 | 1216 | 85 | 17.16 | 26.37 | 336 | 1809 | 618 | 0 | 36.1 |
| Maribo 109 | 122 | 339.8 | 101 | 7682 | 86 | 1.34 | 54.48 | 101 | 1232 | 86 | 18.33 | 22.48 | 253 | 1598 | 524 | 0 | 42.4 |
| Maribo 305 | 106 | 337.2 | 100 | 9494 | 106 | 1.19 | 53.71 | 100 | 1515 | 106 | 18.05 | 28.12 | 230 | 1518 | 431 | 0 | 55.3 |
| Maribo MA502 | 121 | 334.4 | 99 | 9176 | 102 | 1.45 | 52.86 | 98 | 1452 | 102 | 18.17 | 27.49 | 331 | 1739 | 537 | 0 | 63.7 |
| SX Avalanche RR(858) | 127 | 346.3 | 103 | 8593 | 96 | 1.23 | 56.45 | 105 | 1405 | 98 | 18.54 | 24.62 | 273 | 1626 | 417 | 0 | 62.6 |
| SX Canyon RR | 118 | 346.1 | 103 | 9169 | 102 | 1.26 | 56.40 | 105 | 1493 | 104 | 18.57 | 26.65 | 220 | 1677 | 455 | 0 | 58.6 |
| SX Cruze RR | 117 | 318.3 | 94 | 9867 | 110 | 1.40 | 47.97 | 89 | 1487 | 104 | 17.31 | 31.13 | 287 | 1594 | 551 | 0 | 64.8 |
| SX Marathon RR(856) | 102 | 336.5 | 100 | 8900 | 99 | 1.27 | 53.48 | 100 | 1414 | 99 | 18.09 | 26.47 | 231 | 1613 | 467 | 32 | 54.1 |
| SX Winchester RR | 125 | 324.2 | 96 | 8547 | 95 | 1.29 | 49.76 | 93 | 1309 | 92 | 17.50 | 26.36 | 271 | 1594 | 476 | 0 | 48.9 |
| SV RR244TT | 120 | 324.5 | 96 | 8971 | 100 | 1.38 | 49.84 | 93 | 1381 | 97 | 17.60 | 27.52 | 244 | 1705 | 528 | 0 | 52.1 |
| SV RR333 | 124 | 331.6 | 98 | 9258 | 103 | 1.25 | 52.01 | 97 | 1448 | 101 | 17.83 | 27.97 | 222 | 1634 | 453 | 0 | 57.7 |
| SV RR351 | 113 | 343.9 | 102 | 9324 | 104 | 1.18 | 55.73 | 104 | 1508 | 105 | 18.37 | 27.14 | 206 | 1604 | 409 | 0 | 57.8 |
| RR Filler #01s | 132 | 330.4 | 98 | 9087 | 101 | 1.45 | 51.65 | 96 | 1419 | 99 | 17.96 | 27.51 | 285 | 1838 | 526 | 0 | 67.2 |
| RR Filler #01v | 133 | 330.4 | 98 | 9113 | 102 | 1.50 | 51.65 | 96 | 1423 | 99 | 18.03 | 27.67 | 288 | 1894 | 555 | 0 | 66.0 |
| **Experimental Trial (Comm status)** | | | | | | | | | | | | | | | | | |
| BTS 8606 | 242 | 334.9 | 99 | 10428 | 116 | 1.34 | 53.06 | 99 | 1628 | 114 | 18.10 | 31.68 | 294 | 1653 | 516 | 0 | 69.9 |
| BTS 8629 | 224 | 325.4 | 96 | 10310 | 115 | 1.28 | 50.30 | 94 | 1578 | 110 | 17.55 | 31.45 | 256 | 1541 | 500 | 0 | 72.3 |
| BTS 8735 | 234 | 322.7 | 96 | 9987 | 111 | 1.21 | 49.50 | 92 | 1536 | 107 | 17.35 | 30.59 | 228 | 1442 | 477 | 0 | 62.1 |
| BTS 8742 | 207 | 328.7 | 97 | 9558 | 107 | 1.47 | 51.23 | 95 | 1501 | 105 | 17.90 | 28.66 | 263 | 1732 | 588 | 0 | 74.2 |
| BTS 8749 | 202 | 346.2 | 103 | 9542 | 106 | 1.28 | 56.29 | 105 | 1569 | 110 | 18.61 | 27.02 | 200 | 1598 | 506 | 0 | 72.3 |
| BTS 8756 | 241 | 334.6 | 99 | 9635 | 107 | 1.47 | 52.94 | 99 | 1515 | 106 | 18.18 | 28.87 | 265 | 1754 | 577 | 0 | 74.6 |
| BTS 8767 | 235 | 334.4 | 99 | 10126 | 113 | 1.33 | 52.88 | 98 | 1610 | 113 | 18.05 | 29.86 | 283 | 1707 | 474 | 0 | 66.8 |
| BTS 8770 | 247 | 340.7 | 101 | 8716 | 97 | 1.25 | 54.73 | 102 | 1382 | 97 | 18.29 | 25.75 | 263 | 1732 | 426 | 0 | 51.6 |
| BTS 8784 | 236 | 348.1 | 103 | 9355 | 104 | 1.19 | 56.86 | 106 | 1530 | 107 | 18.61 | 26.93 | 218 | 1499 | 452 | 0 | 62.9 |
| BTS 8787 | 219 | 315.6 | 94 | 9455 | 105 | 1.30 | 47.44 | 88 | 1437 | 100 | 17.09 | 29.28 | 249 | 1624 | 483 | 0 | 60.2 |
| BTS 8798 | 223 | 339.5 | 101 | 8856 | 99 | 1.28 | 54.39 | 101 | 1404 | 98 | 18.25 | 26.07 | 193 | 1503 | 529 | 0 | 68.0 |
| Crystal 573RR | 225 | 341.5 | 101 | 8956 | 100 | 1.32 | 54.95 | 102 | 1453 | 102 | 18.41 | 26.15 | 218 | 1603 | 523 | 0 | 59.0 |
| Crystal 578RR | 220 | 341.4 | 101 | 10035 | 112 | 1.23 | 54.94 | 102 | 1607 | 112 | 18.32 | 29.65 | 254 | 1656 | 434 | 0 | 71.1 |
| Crystal 684RR | 239 | 317.7 | 94 | 9871 | 110 | 1.38 | 48.04 | 89 | 1522 | 106 | 17.27 | 30.62 | 295 | 1756 | 492 | 0 | 61.7 |
| Crystal 792RR | 218 | 341.8 | 101 | 9187 | 102 | 1.20 | 55.03 | 102 | 1481 | 104 | 18.30 | 26.76 | 202 | 1500 | 457 | 0 | 62.5 |
| Crystal 793RR | 246 | 339.6 | 101 | 9330 | 104 | 1.25 | 54.39 | 101 | 1517 | 106 | 18.24 | 26.76 | 248 | 1549 | 463 | 0 | 66.8 |
| Crystal 794RR | 208 | 320.6 | 95 | 9588 | 107 | 1.22 | 48.90 | 91 | 1467 | 103 | 17.26 | 29.53 | 225 | 1533 | 464 | 0 | 53.9 |
| Crystal 795RR | 215 | 345.3 | 102 | 8858 | 99 | 1.29 | 56.06 | 104 | 1449 | 101 | 18.58 | 25.49 | 225 | 1647 | 485 | 0 | 67.2 |
| Crystal 796RR | 238 | 319.4 | 95 | 9667 | 108 | 1.28 | 48.52 | 90 | 1480 | 104 | 17.26 | 29.90 | 243 | 1650 | 473 | 0 | 67.2 |
| Crystal 797RR | 201 | 330.2 | 98 | 9731 | 108 | 1.29 | 51.67 | 96 | 1505 | 105 | 17.79 | 29.40 | 267 | 1703 | 454 | 0 | 55.5 |
| Hilleshög HIL9708 | 222 | 346.5 | 103 | 7915 | 88 | 1.21 | 56.40 | 105 | 1285 | 90 | 18.55 | 22.76 | 235 | 1559 | 459 | 0 | 61.3 |
| Hilleshög HIL9895 | 209 | 327.3 | 97 | 8339 | 93 | 1.35 | 50.83 | 95 | 1287 | 90 | 17.72 | 25.59 | 296 | 1652 | 506 | 95 | 61.7 |
| Hilleshög HIL9920 | 203 | 343.6 | 102 | 9498 | 106 | 1.13 | 55.55 | 103 | 1533 | 107 | 18.32 | 27.41 | 222 | 1528 | 394 | 95 | 63.3 |
| Hilleshög HIL9921 | 204 | 332.2 | 98 | 8711 | 97 | 1.28 | 52.26 | 97 | 1361 | 95 | 17.90 | 26.43 | 293 | 1504 | 496 | 0 | 69.5 |
| Hilleshög HIL9922 | 231 | 317.9 | 94 | 8353 | 93 | 1.44 | 48.13 | 90 | 1274 | 89 | 17.34 | 26.06 | 296 | 1697 | 555 | 0 | 65.8 |
| Hilleshög HIL9923 | 243 | 333.2 | 99 | 7036 | 78 | 1.59 | 52.55 | 98 | 1120 | 78 | 18.23 | 20.55 | 325 | 1765 | 635 | 0 | 48.4 |
| Hilleshög HIL9924 | 237 | 334.1 | 99 | 8175 | 91 | 1.47 | 52.80 | 98 | 1293 | 90 | 18.17 | 24.31 | 248 | 1651 | 616 | 0 | 55.9 |
| Maribo MA504 | 229 | 335.3 | 99 | 9661 | 108 | 1.24 | 53.17 | 99 | 1529 | 107 | 18.01 | 28.56 | 247 | 1610 | 452 | 0 | 65.6 |
| Maribo MA611 | 245 | 323.6 | 96 | 8964 | 100 | 1.35 | 49.77 | 93 | 1389 | 97 | 17.54 | 27.27 | 257 | 1620 | 529 | 0 | 64.1 |
| Maribo MA717 | 232 | 338.9 | 100 | 9300 | 104 | 1.23 | 54.22 | 101 | 1477 | 103 | 18.17 | 27.15 | 206 | 1529 | 479 | 0 | 62.9 |
| Maribo MA718 | 221 | 333.9 | 99 | 7570 | 84 | 1.33 | 52.76 | 98 | 1192 | 83 | 18.03 | 22.40 | 290 | 1799 | 462 | 0 | 53.9 |
| Maribo MA719 | 213 | 337.7 | 100 | 9076 | 101 | 1.50 | 53.86 | 100 | 1430 | 100 | 18.37 | 27.04 | 280 | 1718 | 591 | 0 | 57.0 |
| SX RR1861 | 233 | 335.6 | 99 | 9027 | 101 | 1.19 | 53.26 | 99 | 1444 | 101 | 17.99 | 26.58 | 207 | 1641 | 419 | 0 | 57.0 |
| SX RR1863 | 244 | 340.2 | 101 | 9120 | 102 | 1.18 | 54.56 | 102 | 1462 | 102 | 18.20 | 26.76 | 208 | 1610 | 419 | 0 | 63.3 |
| SX RR1875 | 210 | 340.5 | 101 | 7125 | 79 | 1.16 | 54.65 | 102 | 1137 | 80 | 18.19 | 20.94 | 244 | 1524 | 406 | 0 | 59.4 |
| SX RR1876 | 228 | 333.9 | 99 | 8889 | 99 | 1.21 | 52.76 | 98 | 1390 | 97 | 17.91 | 26.63 | 202 | 1561 | 455 | 0 | 51.6 |
| SX RR1877 | 227 | 332.8 | 99 | 7566 | 84 | 1.44 | 52.41 | 98 | 1200 | 84 | 18.08 | 22.22 | 270 | 1684 | 579 | 0 | 52.3 |
| SX RR1878 | 206 | 334.3 | 99 | 8818 | 98 | 1.28 | 52.86 | 98 | 1399 | 98 | 18.01 | 26.26 | 213 | 1653 | 485 | 0 | 52.3 |
| SX RR1879 | 205 | 332.3 | 99 | 8762 | 98 | 1.26 | 52.29 | 97 | 1386 | 97 | 17.89 | 26.35 | 274 | 1616 | 455 | 0 | 68.8 |
| SV RR265 | 240 | 336.8 | 100 | 9182 | 102 | 1.25 | 53.57 | 100 | 1453 | 102 | 18.10 | 27.54 | 206 | 1650 | 464 | 0 | 61.7 |
| SV RR266 | 216 | 336.8 | 100 | 9202 | 103 | 1.21 | 53.59 | 100 | 1453 | 102 | 18.07 | 27.72 | 244 | 1665 | 419 | 0 | 55.5 |
| SV RR268 | 226 | 342.1 | 101 | 8754 | 98 | 1.13 | 55.12 | 103 | 1394 | 97 | 18.25 | 25.83 | 220 | 1627 | 379 | 0 | 57.4 |
| SV RR371 | 212 | 335.5 | 99 | 9850 | 110 | 1.11 | 53.23 | 99 | 1566 | 109 | 17.91 | 29.16 | 206 | 1552 | 377 | 0 | 58.6 |
| SV RR372 | 217 | 326.7 | 97 | 8499 | 95 | 1.20 | 50.66 | 94 | 1316 | 92 | 17.55 | 25.78 | 261 | 1589 | 413 | 0 | 65.6 |
| SV RR373 | 230 | 333.5 | 99 | 7693 | 86 | 1.21 | 52.65 | 98 | 1196 | 84 | 17.89 | 22.99 | 216 | 1671 | 428 | 0 | 46.5 |
| SV RR374 | 214 | 333.1 | 99 | 8917 | 99 | 1.23 | 52.52 | 98 | 1416 | 99 | 17.91 | 26.37 | 272 | 1565 | 453 | 0 | 56.3 |
| SV RR375 | 211 | 334.8 | 99 | 8322 | 93 | 1.34 | 53.00 | 99 | 1321 | 92 | 18.10 | 24.83 | 233 | 1733 | 505 | 0 | 48.8 |
| AP CHK MOD RES RR#4 | 248 | 326.1 | 97 | 9710 | 108 | 1.30 | 50.49 | 94 | 1500 | 105 | 17.62 | 29.91 | 280 | 1691 | 469 | 0 | 50.4 |
| AP CHK SUS HYB#3 | 249 | 344.9 | 102 | 8308 | 93 | 1.25 | 55.94 | 104 | 1351 | 94 | 18.51 | 23.69 | 310 | 1603 | 443 | 0 | 65.6 |
| Crystal 355RR(Check) | 250 | 344.1 | 102 | 9444 | 105 | 1.24 | 55.70 | 104 | 1533 | 107 | 18.45 | 27.15 | 202 | 1640 | 448 | 0 | 63.7 |
| BTS 80RR52(Check) | 251 | 338.6 | 100 | 9280 | 103 | 1.44 | 54.12 | 101 | 1489 | 104 | 18.37 | 27.41 | 238 | 1735 | 562 | 0 | 74.2 |
| Crystal 101RR (Check) | 252 | 340.9 | 101 | 9218 | 103 | 1.45 | 54.78 | 102 | 1474 | 103 | 18.49 | 27.40 | 268 | 1839 | 543 | 0 | 66.8 |
| Hilleshög 4302RR (Check) | 253 | 325.7 | 97 | 7954 | 89 | 1.31 | 50.37 | 94 | 1225 | 86 | 17.59 | 24.21 | 348 | 1605 | 470 | 0 | 48.4 |
| RR Filler #05 | 254 | 341.8 | 101 | 8296 | 92 | 1.32 | 55.03 | 102 | 1336 | 93 | 18.41 | 24.18 | 278 | 1667 | 491 | 0 | 55.1 |
| Comm Benchmark Mean | | 337.3 | | 8974 | | 1.36 | 53.74 | | 1430 | | 18.23 | 26.55 | 264 | 1705 | 506 | | 63.3 |
| Comm Trial Mean | | 335.5 | | 9341 | | 1.32 | 53.17 | | 1479 | | 18.09 | 27.87 | 253 | 1659 | 491 | | 60.9 |
| Coeff. of Var. (%) | | 3.0 | | 6.6 | | 8.7 | 5.7 | | 8.4 | | 2.5 | 5.7 | 19 | 4.9 | 14 | | 13.7 |
| Mean LSD (0.05) | | 13.2 | | 796 | | 0.15 | 3.98 | | 159 | | 0.59 | 2.09 | 63 | 102 | 89 | | 10.1 |
| Mean LSD (0.01) | | 17.4 | | 1051 | | 0.20 | 5.26 | | 209 | | 0.78 | 2.76 | 83 | 134 | 118 | | 13.4 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

Bolters per acre are based upon 45,000 plants per acre. Trial # = 178308

@ Experimental trial data adjusted to commercial status. Statistics are from commercial trial. Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs. Created 10/31/2017

## Table 16. 2017 Performance of All RR Varieties - ACSC Official Trial

### Stephen MN

| Variety @ | Code | Rec/T lbs. | Rec/T %Bnch | Rec/A lbs. | Rec/A %Bnch | Loss Mol % | Rev/T $ ++ | Rev/T %Bnch | Rev/A $ ++ | Rev/A %Bnch | Sugar % | Yield T/A | Na ppm | K ppm | AmN ppm | Bolter per Ac | Emerg. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Commercial Trial** | | | | | | | | | | | | | | | | | |
| BTS 80RR52 | 103 | 317.1 | 100 | 11965 | 104 | 1.28 | 47.62 | 99 | 1799 | 104 | 17.14 | 37.68 | 270 | 1677 | 446 | 0 | 74.0 |
| BTS 8337 | 116 | 335.0 | 105 | 11955 | 104 | 1.13 | 53.02 | 110 | 1898 | 109 | 17.87 | 35.56 | 273 | 1608 | 349 | 0 | 69.8 |
| BTS 8363 | 130 | 308.6 | 97 | 12386 | 107 | 1.13 | 45.05 | 94 | 1808 | 104 | 16.56 | 39.98 | 294 | 1585 | 350 | 0 | 74.5 |
| BTS 8500 | 119 | 315.1 | 99 | 11956 | 104 | 1.27 | 47.02 | 98 | 1793 | 103 | 17.00 | 37.91 | 292 | 1690 | 421 | 0 | 66.4 |
| BTS 8512 | 109 | 322.2 | 101 | 11539 | 100 | 1.28 | 49.17 | 102 | 1759 | 101 | 17.39 | 35.88 | 290 | 1686 | 433 | 0 | 74.0 |
| BTS 8524 | 101 | 316.3 | 99 | 11814 | 102 | 1.14 | 47.39 | 99 | 1769 | 102 | 16.96 | 37.43 | 244 | 1695 | 346 | 0 | 74.0 |
| BTS 8572 | 111 | 337.0 | 106 | 11989 | 104 | 1.16 | 53.65 | 112 | 1903 | 110 | 18.03 | 35.72 | 190 | 1483 | 439 | 0 | 71.9 |
| Crystal 093RR | 115 | 342.2 | 107 | 11992 | 104 | 1.10 | 55.21 | 115 | 1929 | 111 | 18.22 | 35.26 | 171 | 1555 | 381 | 0 | 72.1 |
| Crystal 101RR | 107 | 309.1 | 97 | 11554 | 100 | 1.25 | 45.19 | 94 | 1678 | 97 | 16.71 | 37.63 | 338 | 1797 | 366 | 0 | 69.5 |
| Crystal 246RR | 108 | 312.8 | 98 | 12029 | 104 | 1.22 | 46.33 | 96 | 1784 | 103 | 16.84 | 38.45 | 338 | 1638 | 387 | 0 | 67.2 |
| Crystal 247RR | 131 | 319.2 | 100 | 12945 | 112 | 1.05 | 48.24 | 100 | 1945 | 112 | 17.03 | 40.66 | 248 | 1598 | 302 | 0 | 72.9 |
| Crystal 355RR | 104 | 330.5 | 104 | 11825 | 102 | 1.14 | 51.66 | 108 | 1846 | 106 | 17.66 | 35.92 | 218 | 1540 | 392 | 0 | 63.3 |
| Crystal 467RR | 129 | 313.1 | 98 | 12786 | 111 | 1.22 | 46.41 | 97 | 1887 | 109 | 16.88 | 40.95 | 370 | 1653 | 371 | 0 | 70.1 |
| Crystal 572RR | 126 | 340.3 | 107 | 12457 | 108 | 1.08 | 54.63 | 114 | 2002 | 115 | 18.09 | 36.53 | 188 | 1387 | 401 | 0 | 73.4 |
| Crystal 574RR | 110 | 328.6 | 103 | 12633 | 109 | 1.10 | 51.09 | 106 | 1963 | 113 | 17.54 | 38.40 | 204 | 1574 | 365 | 0 | 74.7 |
| Crystal 986RR | 128 | 335.7 | 105 | 12149 | 105 | 1.03 | 53.25 | 111 | 1926 | 111 | 17.82 | 36.17 | 221 | 1401 | 346 | 0 | 73.2 |
| Hilleshög 4302RR | 105 | 317.3 | 100 | 10814 | 94 | 1.10 | 47.67 | 99 | 1624 | 94 | 16.97 | 33.99 | 311 | 1623 | 308 | 0 | 64.6 |
| Hilleshög 4448RR | 112 | 326.4 | 102 | 11548 | 100 | 1.20 | 50.42 | 105 | 1780 | 102 | 17.51 | 35.66 | 282 | 1544 | 411 | 0 | 63.0 |
| Hilleshög 9528RR | 123 | 326.9 | 103 | 10890 | 94 | 1.17 | 50.58 | 105 | 1682 | 97 | 17.51 | 33.37 | 267 | 1559 | 396 | 0 | 70.8 |
| Hilleshög HIL9707 | 114 | 317.9 | 100 | 12537 | 109 | 1.03 | 47.87 | 100 | 1879 | 108 | 16.93 | 39.56 | 235 | 1509 | 316 | 0 | 71.1 |
| Maribo 109 | 122 | 337.0 | 106 | 9997 | 87 | 1.08 | 53.65 | 112 | 1592 | 92 | 17.93 | 29.58 | 220 | 1505 | 353 | 0 | 65.6 |
| Maribo 305 | 106 | 323.5 | 102 | 10678 | 93 | 1.01 | 49.56 | 103 | 1631 | 94 | 17.19 | 33.07 | 230 | 1483 | 304 | 0 | 59.1 |
| Maribo MA502 | 121 | 311.2 | 98 | 10595 | 92 | 1.19 | 45.82 | 95 | 1553 | 89 | 16.75 | 34.16 | 333 | 1690 | 353 | 0 | 67.2 |
| SX Avalanche RR(858) | 127 | 323.9 | 102 | 11350 | 98 | 1.07 | 49.67 | 103 | 1737 | 100 | 17.27 | 35.13 | 280 | 1554 | 318 | 0 | 65.6 |
| SX Canyon RR | 118 | 339.0 | 106 | 12206 | 106 | 1.01 | 54.24 | 113 | 1949 | 112 | 17.95 | 36.23 | 177 | 1484 | 324 | 0 | 64.8 |
| SX Cruze RR | 117 | 304.0 | 95 | 11855 | 103 | 1.09 | 43.64 | 91 | 1694 | 98 | 16.30 | 39.09 | 244 | 1571 | 341 | 0 | 77.4 |
| SX Marathon RR(856) | 102 | 325.0 | 102 | 11969 | 104 | 1.12 | 49.99 | 104 | 1834 | 106 | 17.37 | 37.06 | 218 | 1565 | 367 | 0 | 67.7 |
| SX Winchester RR | 125 | 321.5 | 101 | 10882 | 94 | 1.07 | 48.95 | 102 | 1657 | 95 | 17.14 | 33.74 | 218 | 1608 | 320 | 0 | 55.7 |
| SV RR244TT | 120 | 316.7 | 99 | 11773 | 102 | 1.14 | 47.49 | 99 | 1769 | 102 | 16.97 | 37.19 | 253 | 1626 | 356 | 0 | 64.6 |
| SV RR333 | 124 | 315.9 | 99 | 12112 | 105 | 1.16 | 47.24 | 98 | 1812 | 104 | 16.94 | 38.37 | 265 | 1646 | 363 | 0 | 63.8 |
| SV RR351 | 113 | 318.4 | 100 | 11851 | 103 | 1.17 | 48.02 | 100 | 1788 | 103 | 17.08 | 37.17 | 264 | 1630 | 375 | 0 | 70.8 |
| RR Filler #01s | 132 | 305.5 | 96 | 11657 | 101 | 1.30 | 44.09 | 92 | 1679 | 97 | 16.58 | 38.14 | 372 | 1762 | 400 | 0 | 72.4 |
| RR Filler #01v | 133 | 320.2 | 101 | 11889 | 103 | 1.19 | 48.56 | 101 | 1800 | 104 | 17.20 | 37.19 | 281 | 1792 | 342 | 0 | 72.1 |
| **Experimental Trial (Comm status)** | | | | | | | | | | | | | | | | | |
| BTS 8606 | 242 | 335.7 | 105 | 13015 | 113 | 1.08 | 53.13 | 111 | 2051 | 118 | 17.94 | 38.86 | 208 | 1597 | 351 | 0 | 78.5 |
| BTS 8629 | 224 | 321.2 | 101 | 13070 | 113 | 1.10 | 48.84 | 102 | 1976 | 114 | 17.19 | 41.03 | 267 | 1468 | 371 | 0 | 75.0 |
| BTS 8735 | 234 | 321.5 | 101 | 12463 | 108 | 1.15 | 48.90 | 102 | 1883 | 108 | 17.25 | 39.15 | 282 | 1475 | 397 | 0 | 81.3 |
| BTS 8742 | 207 | 325.6 | 102 | 10991 | 95 | 1.20 | 50.14 | 104 | 1681 | 97 | 17.54 | 34.02 | 232 | 1582 | 418 | 0 | 71.1 |
| BTS 8749 | 202 | 328.9 | 103 | 11428 | 99 | 1.19 | 51.11 | 106 | 1773 | 102 | 17.64 | 34.73 | 254 | 1698 | 381 | 95 | 73.0 |
| BTS 8756 | 241 | 327.5 | 103 | 11933 | 103 | 1.19 | 50.71 | 106 | 1836 | 106 | 17.61 | 36.74 | 225 | 1705 | 388 | 0 | 79.7 |
| BTS 8767 | 235 | 331.0 | 104 | 12768 | 111 | 1.14 | 51.74 | 108 | 1978 | 114 | 17.67 | 38.90 | 246 | 1623 | 356 | 0 | 82.8 |
| BTS 8770 | 247 | 326.9 | 103 | 11935 | 103 | 1.12 | 50.52 | 105 | 1832 | 106 | 17.48 | 36.85 | 274 | 1674 | 333 | 0 | 68.0 |
| BTS 8784 | 236 | 344.4 | 108 | 11467 | 99 | 1.04 | 55.72 | 116 | 1845 | 106 | 18.29 | 33.72 | 185 | 1415 | 364 | 0 | 78.5 |
| BTS 8787 | 219 | 318.9 | 100 | 11402 | 99 | 1.16 | 48.17 | 100 | 1717 | 99 | 17.11 | 35.88 | 248 | 1625 | 370 | 0 | 73.8 |
| BTS 8798 | 223 | 327.0 | 103 | 10814 | 94 | 1.08 | 50.56 | 105 | 1651 | 95 | 17.48 | 33.52 | 198 | 1495 | 367 | 0 | 77.0 |
| Crystal 573RR | 225 | 327.6 | 103 | 11619 | 101 | 1.11 | 50.73 | 106 | 1788 | 103 | 17.48 | 35.64 | 233 | 1513 | 370 | 0 | 65.6 |
| Crystal 578RR | 220 | 325.1 | 102 | 13422 | 116 | 1.14 | 49.99 | 104 | 2052 | 118 | 17.37 | 41.58 | 256 | 1634 | 351 | 0 | 77.0 |
| Crystal 684RR | 239 | 326.1 | 102 | 12696 | 110 | 1.22 | 50.27 | 105 | 1947 | 112 | 17.55 | 39.25 | 253 | 1743 | 395 | 0 | 77.4 |
| Crystal 792RR | 218 | 336.1 | 106 | 12143 | 105 | 1.05 | 53.23 | 111 | 1911 | 110 | 17.87 | 36.46 | 179 | 1426 | 369 | 0 | 72.3 |
| Crystal 793RR | 246 | 336.9 | 106 | 12357 | 107 | 0.98 | 53.50 | 111 | 1959 | 113 | 17.83 | 36.85 | 185 | 1491 | 296 | 0 | 69.5 |
| Crystal 794RR | 208 | 334.7 | 105 | 12475 | 108 | 1.07 | 52.84 | 110 | 1960 | 113 | 17.86 | 37.39 | 205 | 1523 | 348 | 0 | 68.4 |
| Crystal 795RR | 215 | 328.3 | 103 | 11423 | 99 | 1.12 | 50.95 | 106 | 1772 | 102 | 17.56 | 34.89 | 245 | 1479 | 381 | 0 | 62.1 |
| Crystal 796RR | 238 | 329.7 | 104 | 13349 | 116 | 1.09 | 51.35 | 107 | 2068 | 119 | 17.62 | 40.69 | 204 | 1618 | 344 | 0 | 77.7 |
| Crystal 797RR | 201 | 314.9 | 99 | 12564 | 109 | 1.14 | 46.98 | 98 | 1858 | 107 | 16.96 | 40.20 | 322 | 1693 | 325 | 0 | 66.4 |
| Hilleshög HIL9708 | 222 | 323.0 | 101 | 10732 | 93 | 1.27 | 49.39 | 103 | 1639 | 94 | 17.42 | 33.41 | 323 | 1583 | 440 | 0 | 65.6 |
| Hilleshög HIL9895 | 209 | 307.0 | 96 | 10408 | 90 | 1.37 | 44.63 | 93 | 1509 | 87 | 16.68 | 33.90 | 313 | 1642 | 500 | 95 | 66.0 |
| Hilleshög HIL9920 | 203 | 334.3 | 105 | 12466 | 108 | 1.03 | 52.73 | 110 | 1960 | 113 | 17.73 | 37.58 | 209 | 1523 | 319 | 0 | 71.1 |
| Hilleshög HIL9921 | 204 | 340.6 | 107 | 9500 | 82 | 1.03 | 54.58 | 114 | 1517 | 87 | 18.03 | 28.14 | 226 | 1427 | 331 | 0 | 68.4 |
| Hilleshög HIL9922 | 231 | 311.1 | 98 | 11103 | 96 | 1.20 | 45.84 | 95 | 1632 | 94 | 16.78 | 35.76 | 272 | 1703 | 378 | 0 | 75.0 |
| Hilleshög HIL9923 | 243 | 328.8 | 103 | 9493 | 82 | 1.12 | 51.10 | 106 | 1458 | 84 | 17.62 | 29.28 | 263 | 1564 | 364 | 0 | 58.2 |
| Hilleshög HIL9924 | 237 | 313.2 | 98 | 9689 | 84 | 1.39 | 46.46 | 97 | 1429 | 82 | 17.05 | 31.10 | 276 | 1636 | 531 | 0 | 47.7 |
| Maribo MA504 | 229 | 329.3 | 103 | 12510 | 108 | 1.20 | 51.22 | 107 | 1936 | 111 | 17.66 | 38.32 | 275 | 1554 | 408 | 0 | 66.8 |
| Maribo MA611 | 245 | 317.1 | 100 | 11138 | 97 | 1.21 | 47.62 | 99 | 1658 | 95 | 17.07 | 35.46 | 284 | 1663 | 390 | 0 | 67.2 |
| Maribo MA717 | 232 | 332.6 | 104 | 11139 | 97 | 1.04 | 52.23 | 109 | 1743 | 100 | 17.69 | 33.89 | 203 | 1519 | 324 | 0 | 71.5 |
| Maribo MA718 | 221 | 309.8 | 97 | 10019 | 87 | 1.33 | 45.47 | 95 | 1465 | 84 | 16.81 | 32.48 | 432 | 1749 | 417 | 0 | 59.8 |
| Maribo MA719 | 213 | 324.9 | 102 | 10445 | 91 | 1.37 | 49.95 | 104 | 1596 | 92 | 17.67 | 32.39 | 315 | 1654 | 495 | 0 | 54.3 |
| SX RR1861 | 233 | 322.8 | 101 | 11780 | 102 | 0.95 | 49.31 | 103 | 1793 | 103 | 17.08 | 36.79 | 184 | 1569 | 256 | 0 | 73.1 |
| SX RR1863 | 244 | 335.0 | 105 | 11612 | 101 | 1.06 | 52.92 | 110 | 1831 | 105 | 17.81 | 34.89 | 205 | 1584 | 329 | 0 | 48.8 |
| SX RR1875 | 210 | 334.3 | 105 | 10405 | 90 | 0.98 | 52.71 | 110 | 1634 | 94 | 17.71 | 31.23 | 203 | 1477 | 296 | 0 | 68.0 |
| SX RR1876 | 228 | 325.7 | 102 | 11539 | 100 | 0.98 | 50.17 | 104 | 1760 | 101 | 17.29 | 35.87 | 195 | 1592 | 273 | 0 | 64.1 |
| SX RR1877 | 227 | 308.6 | 97 | 11437 | 99 | 1.40 | 45.10 | 94 | 1670 | 96 | 16.86 | 37.01 | 354 | 1812 | 472 | 0 | 66.4 |
| SX RR1878 | 206 | 326.9 | 103 | 11725 | 102 | 1.12 | 50.54 | 105 | 1797 | 103 | 17.50 | 36.31 | 246 | 1584 | 360 | 0 | 62.9 |
| SX RR1879 | 205 | 326.5 | 102 | 11131 | 96 | 1.05 | 50.40 | 105 | 1701 | 98 | 17.42 | 34.49 | 215 | 1582 | 323 | 0 | 71.9 |
| SV RR265 | 240 | 323.6 | 102 | 12640 | 110 | 1.05 | 49.56 | 103 | 1924 | 111 | 17.24 | 39.37 | 208 | 1592 | 320 | 0 | 64.5 |
| SV RR266 | 216 | 327.2 | 103 | 11927 | 103 | 1.01 | 50.64 | 105 | 1840 | 106 | 17.34 | 36.83 | 195 | 1540 | 307 | 0 | 56.6 |
| SV RR268 | 226 | 331.5 | 104 | 12012 | 104 | 1.00 | 51.89 | 108 | 1862 | 107 | 17.57 | 36.82 | 191 | 1612 | 289 | 0 | 69.5 |
| SV RR371 | 212 | 326.0 | 102 | 11838 | 103 | 1.02 | 50.24 | 105 | 1810 | 104 | 17.36 | 36.71 | 187 | 1638 | 299 | 0 | 68.0 |
| SV RR372 | 217 | 325.7 | 102 | 10872 | 94 | 1.01 | 50.16 | 104 | 1668 | 96 | 17.32 | 33.48 | 204 | 1558 | 303 | 0 | 60.2 |
| SV RR373 | 230 | 319.3 | 100 | 11545 | 100 | 1.15 | 48.27 | 100 | 1744 | 100 | 17.13 | 36.10 | 244 | 1680 | 353 | 0 | 60.9 |
| SV RR374 | 214 | 318.4 | 100 | 11877 | 103 | 1.19 | 48.00 | 100 | 1793 | 103 | 17.07 | 37.25 | 227 | 1621 | 400 | 95 | 72.3 |
| SV RR375 | 211 | 329.1 | 103 | 11764 | 102 | 1.08 | 51.18 | 107 | 1822 | 105 | 17.58 | 35.86 | 182 | 1667 | 335 | 0 | 59.8 |
| AP CHK MOD RES RR#4 | 248 | 320.8 | 101 | 13423 | 116 | 1.10 | 48.70 | 101 | 2027 | 117 | 17.11 | 42.22 | 279 | 1596 | 329 | 0 | 72.7 |
| AP CHK SUS HYB#3 | 249 | 344.5 | 108 | 11552 | 100 | 1.18 | 55.74 | 116 | 1854 | 107 | 18.41 | 33.88 | 283 | 1616 | 382 | 0 | 62.9 |
| Crystal 355RR(Check) | 250 | 321.3 | 101 | 11448 | 99 | 1.21 | 48.84 | 102 | 1744 | 100 | 17.26 | 35.53 | 285 | 1540 | 420 | 0 | 69.1 |
| BTS 80RR52(Check) | 251 | 324.0 | 102 | 12302 | 107 | 1.18 | 49.66 | 103 | 1874 | 108 | 17.36 | 38.11 | 244 | 1624 | 389 | 0 | 69.5 |
| Crystal 101RR (Check) | 252 | 307.7 | 97 | 11920 | 103 | 1.31 | 44.82 | 93 | 1727 | 99 | 16.77 | 38.89 | 322 | 1873 | 403 | 0 | 71.1 |
| Hilleshög 4302RR (Check) | 253 | 321.1 | 101 | 10488 | 91 | 1.07 | 48.81 | 102 | 1601 | 92 | 17.09 | 32.69 | 286 | 1600 | 300 | 0 | 61.3 |
| RR Filler #05 | 254 | 314.3 | 99 | 9733 | 84 | 1.47 | 46.78 | 97 | 1429 | 82 | 17.25 | 31.45 | 428 | 1746 | 511 | 0 | 67.6 |
| | | | | | | | | | | | | | | | | | |
| Comm Benchmark Mean | | 318.5 | | 11540 | | 1.19 | 48.04 | | 1737 | | 17.12 | 36.31 | 284 | 1659 | 378 | | 67.8 |
| Comm Trial Mean | | 322.2 | | 11775 | | 1.14 | 49.16 | | 1792 | | 17.25 | 36.63 | 261 | 1598 | 365 | | 69.0 |
| Coeff. of Var. (%) | | 3.1 | | 5.0 | | 9.1 | 6.1 | | 6.8 | | 2.6 | 4.7 | 23 | 5.5 | 15 | | 8.7 |
| Mean LSD (0.05) | | 12.9 | | 744 | | 0.14 | 3.92 | | 155 | | 0.58 | 2.27 | 77 | 113 | 75 | | 6.8 |
| Mean LSD (0.01) | | 17.1 | | 983 | | 0.18 | 5.18 | | 204 | | 0.76 | 2.99 | 102 | 150 | 99 | | 9.0 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

Bolters per acre are based upon 45,000 plants per acre. Trial # = 178309

@ Experimental trial data adjusted to commercial status. Statistics are from commercial trial. Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs. Created 10/31/2017

Table 17. 2017 Performance of All RR Varieties - ACSC Official Trial

St Thomas ND

| Variety @ | Code | Rec/T lbs. | Rec/T %Bnch | Rec/A lbs. | Rec/A %Bnch | Loss Mol % | Rev/T $ ++ | Rev/T %Bnch | Rev/A $ ++ | Rev/A %Bnch | Sugar % | Yield T/A | Na ppm | K ppm | AmN ppm | Bolter per Ac | Emerg. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Commercial Trial** | | | | | | | | | | | | | | | | | |
| BTS 80RR52 | 103 | 306.3 | 100 | 9516 | 103 | 1.16 | 44.35 | 99 | 1378 | 103 | 16.47 | 31.05 | 245 | 1656 | 369 | 0 | 77.3 |
| BTS 8337 | 116 | 326.6 | 106 | 9537 | 103 | 0.97 | 50.50 | 113 | 1474 | 110 | 17.30 | 29.23 | 185 | 1602 | 259 | 0 | 72.0 |
| BTS 8363 | 130 | 296.9 | 97 | 9682 | 105 | 1.04 | 41.49 | 93 | 1350 | 101 | 15.88 | 32.66 | 272 | 1546 | 294 | 0 | 78.8 |
| BTS 8500 | 119 | 306.1 | 100 | 9832 | 107 | 1.03 | 44.28 | 99 | 1424 | 106 | 16.34 | 32.12 | 238 | 1654 | 274 | 0 | 74.7 |
| BTS 8512 | 109 | 311.0 | 101 | 9640 | 105 | 0.98 | 45.76 | 103 | 1419 | 106 | 16.53 | 31.00 | 215 | 1563 | 266 | 0 | 79.0 |
| BTS 8524 | 101 | 305.2 | 99 | 9637 | 105 | 0.96 | 44.00 | 99 | 1389 | 104 | 16.22 | 31.59 | 200 | 1720 | 215 | 0 | 79.6 |
| BTS 8572 | 111 | 319.0 | 104 | 9937 | 108 | 1.00 | 48.20 | 108 | 1498 | 112 | 16.95 | 31.22 | 191 | 1475 | 317 | 0 | 73.3 |
| Crystal 093RR | 115 | 326.0 | 106 | 10368 | 112 | 1.01 | 50.32 | 113 | 1598 | 119 | 17.30 | 31.84 | 162 | 1653 | 281 | 0 | 72.3 |
| Crystal 101RR | 107 | 301.9 | 98 | 9498 | 103 | 1.08 | 43.01 | 96 | 1353 | 101 | 16.18 | 31.46 | 276 | 1805 | 256 | 0 | 75.4 |
| Crystal 246RR | 108 | 299.2 | 97 | 9393 | 102 | 1.01 | 42.18 | 95 | 1324 | 99 | 15.96 | 31.38 | 265 | 1610 | 258 | 0 | 72.6 |
| Crystal 247RR | 131 | 298.4 | 97 | 9627 | 104 | 0.98 | 41.96 | 94 | 1352 | 101 | 15.90 | 32.31 | 276 | 1578 | 239 | 0 | 71.7 |
| Crystal 355RR | 104 | 307.9 | 100 | 9176 | 100 | 1.11 | 44.83 | 101 | 1334 | 100 | 16.51 | 29.84 | 237 | 1598 | 352 | 0 | 68.4 |
| Crystal 467RR | 129 | 303.0 | 99 | 10560 | 115 | 1.02 | 43.34 | 97 | 1509 | 113 | 16.17 | 34.89 | 350 | 1599 | 239 | 0 | 77.9 |
| Crystal 572RR | 126 | 336.5 | 110 | 9867 | 107 | 0.88 | 53.49 | 120 | 1568 | 117 | 17.71 | 29.32 | 159 | 1414 | 252 | 0 | 79.9 |
| Crystal 574RR | 110 | 303.2 | 99 | 9988 | 108 | 0.98 | 43.41 | 97 | 1429 | 107 | 16.14 | 32.96 | 205 | 1603 | 257 | 0 | 79.1 |
| Crystal 986RR | 128 | 314.0 | 102 | 9841 | 107 | 1.00 | 46.68 | 105 | 1464 | 109 | 16.70 | 31.34 | 270 | 1490 | 280 | 0 | 72.0 |
| Hilleshög 4302RR | 105 | 312.3 | 102 | 8678 | 94 | 0.94 | 46.17 | 104 | 1285 | 96 | 16.56 | 27.75 | 257 | 1499 | 239 | 0 | 65.8 |
| Hilleshög 4448RR | 112 | 314.0 | 102 | 10202 | 111 | 0.96 | 46.67 | 105 | 1515 | 113 | 16.67 | 32.54 | 203 | 1545 | 259 | 0 | 66.4 |
| Hilleshög 9528RR | 123 | 320.4 | 104 | 9585 | 104 | 0.96 | 48.60 | 109 | 1449 | 108 | 16.97 | 30.01 | 207 | 1484 | 270 | 0 | 71.5 |
| Hilleshög HIL9707 | 114 | 306.8 | 100 | 10029 | 109 | 1.02 | 44.51 | 100 | 1453 | 109 | 16.37 | 32.73 | 277 | 1483 | 295 | 0 | 75.8 |
| Maribo 109 | 122 | 322.5 | 105 | 8074 | 88 | 0.92 | 49.24 | 110 | 1235 | 92 | 17.04 | 25.00 | 190 | 1478 | 254 | 0 | 69.2 |
| Maribo 305 | 106 | 303.4 | 99 | 9282 | 101 | 0.99 | 43.45 | 97 | 1332 | 100 | 16.16 | 30.56 | 209 | 1591 | 270 | 0 | 60.6 |
| Maribo MA502 | 121 | 301.6 | 98 | 9820 | 107 | 1.04 | 42.93 | 96 | 1397 | 104 | 16.13 | 32.58 | 320 | 1613 | 265 | 0 | 71.5 |
| SX Avalanche RR(858) | 127 | 319.5 | 104 | 9279 | 101 | 0.89 | 48.35 | 108 | 1403 | 105 | 16.87 | 29.08 | 195 | 1502 | 217 | 0 | 70.7 |
| SX Canyon RR | 118 | 307.4 | 100 | 9589 | 104 | 0.96 | 44.67 | 100 | 1391 | 104 | 16.33 | 31.24 | 224 | 1558 | 251 | 0 | 66.0 |
| SX Cruze RR | 117 | 292.2 | 95 | 9975 | 108 | 1.04 | 40.07 | 90 | 1364 | 102 | 15.64 | 34.20 | 264 | 1564 | 291 | 0 | 81.9 |
| SX Marathon RR(856) | 102 | 308.3 | 100 | 10066 | 109 | 0.94 | 44.96 | 101 | 1470 | 110 | 16.36 | 32.60 | 218 | 1541 | 242 | 0 | 67.9 |
| SX Winchester RR | 125 | 304.4 | 99 | 8570 | 93 | 0.97 | 43.77 | 98 | 1231 | 92 | 16.19 | 28.17 | 249 | 1574 | 242 | 0 | 61.5 |
| SV RR244TT | 120 | 307.9 | 100 | 9396 | 102 | 0.98 | 44.83 | 101 | 1369 | 102 | 16.37 | 30.50 | 218 | 1618 | 245 | 0 | 66.9 |
| SV RR333 | 124 | 310.4 | 101 | 9882 | 107 | 0.97 | 45.57 | 102 | 1452 | 109 | 16.48 | 31.78 | 204 | 1575 | 257 | 0 | 67.3 |
| SV RR351 | 113 | 307.5 | 100 | 9590 | 104 | 0.97 | 44.72 | 100 | 1393 | 104 | 16.34 | 31.19 | 230 | 1552 | 256 | 0 | 72.6 |
| RR Filler #01s | 132 | 305.3 | 99 | 9754 | 106 | 1.08 | 44.05 | 99 | 1404 | 105 | 16.35 | 32.00 | 279 | 1744 | 274 | 0 | 73.1 |
| RR Filler #01v | 133 | 302.9 | 99 | 9836 | 107 | 1.13 | 43.31 | 97 | 1404 | 105 | 16.28 | 32.52 | 294 | 1811 | 291 | 0 | 73.7 |
| **Experimental Trial (Comm status)** | | | | | | | | | | | | | | | | | |
| BTS 8606 | 242 | 301.0 | 98 | 10022 | 109 | 1.11 | 42.77 | 96 | 1425 | 107 | 16.16 | 33.25 | 281 | 1678 | 310 | 0 | 80.3 |
| BTS 8629 | 224 | 304.4 | 99 | 10108 | 110 | 1.01 | 43.80 | 98 | 1459 | 109 | 16.24 | 33.08 | 262 | 1503 | 281 | 0 | 80.8 |
| BTS 8735 | 234 | 307.1 | 100 | 9017 | 98 | 1.02 | 44.62 | 100 | 1302 | 97 | 16.40 | 29.41 | 233 | 1493 | 319 | 0 | 72.7 |
| BTS 8742 | 207 | 310.5 | 101 | 8851 | 96 | 1.15 | 45.58 | 102 | 1297 | 97 | 16.66 | 28.45 | 268 | 1665 | 362 | 0 | 62.4 |
| BTS 8749 | 202 | 305.3 | 99 | 10144 | 110 | 1.06 | 44.05 | 99 | 1463 | 109 | 16.34 | 33.22 | 260 | 1721 | 281 | 0 | 68.5 |
| BTS 8756 | 241 | 313.8 | 102 | 8911 | 97 | 1.18 | 46.59 | 104 | 1314 | 98 | 16.87 | 28.57 | 254 | 1665 | 377 | 0 | 78.1 |
| BTS 8767 | 235 | 310.6 | 101 | 11021 | 120 | 1.03 | 45.63 | 102 | 1623 | 121 | 16.58 | 35.34 | 229 | 1646 | 282 | 0 | 84.3 |
| BTS 8770 | 247 | 304.2 | 99 | 9306 | 101 | 1.10 | 43.73 | 98 | 1330 | 99 | 16.31 | 30.68 | 290 | 1759 | 285 | 0 | 71.7 |
| BTS 8784 | 236 | 329.5 | 107 | 9371 | 102 | 0.97 | 51.25 | 115 | 1457 | 109 | 17.46 | 28.47 | 155 | 1476 | 303 | 0 | 71.4 |
| BTS 8787 | 219 | 304.8 | 99 | 9810 | 106 | 1.06 | 43.89 | 98 | 1413 | 106 | 16.31 | 32.20 | 260 | 1666 | 296 | 0 | 66.8 |
| BTS 8798 | 223 | 313.4 | 102 | 9759 | 106 | 0.95 | 46.48 | 104 | 1445 | 108 | 16.63 | 31.16 | 165 | 1486 | 282 | 0 | 76.1 |
| Crystal 573RR | 225 | 315.6 | 103 | 9714 | 105 | 0.97 | 47.12 | 106 | 1446 | 108 | 16.76 | 30.73 | 194 | 1514 | 278 | 0 | 66.8 |
| Crystal 578RR | 220 | 302.2 | 98 | 10312 | 112 | 1.10 | 43.16 | 97 | 1477 | 110 | 16.22 | 34.00 | 276 | 1659 | 312 | 0 | 78.9 |
| Crystal 684RR | 239 | 302.8 | 99 | 10555 | 115 | 1.11 | 43.33 | 97 | 1506 | 113 | 16.25 | 34.97 | 281 | 1698 | 304 | 0 | 75.8 |
| Crystal 792RR | 218 | 322.7 | 105 | 9730 | 106 | 0.98 | 49.24 | 110 | 1481 | 111 | 17.14 | 30.22 | 168 | 1513 | 300 | 0 | 76.4 |
| Crystal 793RR | 246 | 329.0 | 107 | 10087 | 109 | 0.94 | 51.11 | 115 | 1565 | 117 | 17.41 | 30.77 | 181 | 1452 | 265 | 0 | 68.4 |
| Crystal 794RR | 208 | 310.0 | 101 | 10473 | 114 | 1.01 | 45.45 | 102 | 1539 | 115 | 16.53 | 33.65 | 253 | 1576 | 273 | 0 | 64.1 |
| Crystal 795RR | 215 | 316.0 | 103 | 9524 | 103 | 1.04 | 47.22 | 106 | 1422 | 106 | 16.85 | 30.13 | 220 | 1632 | 297 | 0 | 68.6 |
| Crystal 796RR | 238 | 311.2 | 101 | 10972 | 119 | 1.01 | 45.78 | 103 | 1625 | 121 | 16.59 | 34.94 | 238 | 1694 | 252 | 0 | 79.5 |
| Crystal 797RR | 201 | 303.9 | 99 | 9322 | 101 | 1.10 | 43.64 | 98 | 1339 | 100 | 16.29 | 30.72 | 296 | 1735 | 285 | 0 | 66.5 |
| Hilleshög HIL9708 | 222 | 319.2 | 104 | 9195 | 100 | 0.97 | 48.18 | 108 | 1384 | 103 | 16.94 | 28.94 | 226 | 1461 | 288 | 0 | 62.0 |
| Hilleshög HIL9895 | 209 | 302.1 | 98 | 9542 | 104 | 0.99 | 43.11 | 97 | 1360 | 102 | 16.11 | 31.54 | 233 | 1601 | 256 | 0 | 67.4 |
| Hilleshög HIL9920 | 203 | 324.1 | 106 | 10065 | 109 | 1.00 | 49.64 | 111 | 1538 | 115 | 17.23 | 31.10 | 235 | 1767 | 230 | 0 | 66.0 |
| Hilleshög HIL9921 | 204 | 319.2 | 104 | 8292 | 90 | 0.99 | 48.19 | 108 | 1244 | 93 | 16.97 | 26.05 | 222 | 1493 | 297 | 0 | 71.8 |
| Hilleshög HIL9922 | 231 | 299.7 | 98 | 9848 | 107 | 1.09 | 42.38 | 95 | 1395 | 104 | 16.07 | 32.79 | 259 | 1693 | 295 | 0 | 78.4 |
| Hilleshög HIL9923 | 243 | 310.1 | 101 | 8199 | 89 | 1.19 | 45.47 | 102 | 1202 | 90 | 16.69 | 26.49 | 294 | 1652 | 376 | 0 | 56.5 |
| Hilleshög HIL9924 | 237 | 302.2 | 98 | 6541 | 71 | 1.22 | 43.14 | 97 | 921 | 69 | 16.34 | 21.72 | 281 | 1684 | 408 | 0 | 50.2 |
| Maribo MA504 | 229 | 308.4 | 100 | 10501 | 114 | 0.87 | 44.99 | 101 | 1536 | 115 | 16.31 | 33.89 | 210 | 1474 | 215 | 0 | 68.6 |
| Maribo MA611 | 245 | 299.7 | 98 | 9137 | 99 | 1.05 | 42.39 | 95 | 1288 | 96 | 16.04 | 30.68 | 273 | 1600 | 286 | 0 | 75.5 |
| Maribo MA717 | 232 | 320.2 | 104 | 9161 | 99 | 0.99 | 48.48 | 109 | 1388 | 104 | 17.01 | 28.66 | 202 | 1452 | 310 | 0 | 71.4 |
| Maribo MA718 | 221 | 295.7 | 96 | 8616 | 93 | 1.18 | 41.20 | 92 | 1201 | 90 | 15.95 | 29.16 | 347 | 1706 | 337 | 0 | 53.9 |
| Maribo MA719 | 213 | 315.4 | 103 | 9579 | 104 | 1.17 | 47.04 | 105 | 1430 | 107 | 16.93 | 30.39 | 258 | 1713 | 360 | 0 | 58.4 |
| SX RR1861 | 233 | 306.7 | 100 | 9630 | 104 | 0.96 | 44.46 | 100 | 1398 | 105 | 16.30 | 31.33 | 192 | 1661 | 240 | 0 | 69.5 |
| SX RR1863 | 244 | 315.6 | 103 | 9486 | 103 | 1.00 | 47.09 | 106 | 1417 | 106 | 16.79 | 30.02 | 238 | 1586 | 255 | 0 | 52.0 |
| SX RR1875 | 210 | 314.0 | 102 | 8715 | 95 | 0.96 | 46.64 | 105 | 1295 | 97 | 16.67 | 27.72 | 215 | 1514 | 267 | 0 | 73.9 |
| SX RR1876 | 228 | 305.8 | 100 | 8574 | 93 | 1.01 | 44.20 | 99 | 1241 | 93 | 16.31 | 27.95 | 218 | 1547 | 291 | 0 | 55.0 |
| SX RR1877 | 227 | 298.8 | 97 | 9260 | 100 | 1.13 | 42.14 | 95 | 1300 | 97 | 16.07 | 31.03 | 267 | 1723 | 321 | 0 | 63.8 |
| SX RR1878 | 206 | 301.4 | 98 | 9266 | 101 | 1.00 | 42.88 | 96 | 1317 | 98 | 16.08 | 30.77 | 221 | 1571 | 282 | 0 | 65.0 |
| SX RR1879 | 205 | 308.8 | 101 | 9455 | 103 | 0.98 | 45.11 | 101 | 1368 | 102 | 16.43 | 30.95 | 235 | 1490 | 265 | 0 | 71.8 |
| SV RR265 | 240 | 309.0 | 101 | 10287 | 112 | 0.98 | 45.17 | 101 | 1498 | 112 | 16.44 | 33.44 | 201 | 1512 | 273 | 0 | 68.6 |
| SV RR266 | 216 | 305.1 | 99 | 9405 | 102 | 1.04 | 43.99 | 99 | 1350 | 101 | 16.30 | 31.02 | 233 | 1566 | 296 | 0 | 62.3 |
| SV RR268 | 226 | 313.7 | 102 | 10076 | 109 | 0.99 | 46.55 | 104 | 1497 | 112 | 16.68 | 32.11 | 221 | 1628 | 258 | 0 | 65.8 |
| SV RR371 | 212 | 314.9 | 103 | 10603 | 115 | 0.93 | 46.91 | 105 | 1577 | 118 | 16.68 | 33.72 | 202 | 1589 | 220 | 0 | 71.0 |
| SV RR372 | 217 | 311.6 | 101 | 10132 | 110 | 0.97 | 45.92 | 103 | 1495 | 112 | 16.57 | 32.47 | 179 | 1585 | 272 | 0 | 62.0 |
| SV RR373 | 230 | 301.6 | 98 | 9509 | 103 | 1.05 | 42.93 | 96 | 1365 | 102 | 16.13 | 31.30 | 230 | 1640 | 307 | 0 | 62.4 |
| SV RR374 | 214 | 305.5 | 99 | 9877 | 107 | 1.01 | 44.12 | 99 | 1427 | 107 | 16.30 | 32.25 | 239 | 1588 | 279 | 0 | 73.0 |
| SV RR375 | 211 | 312.2 | 102 | 9454 | 103 | 1.02 | 46.10 | 103 | 1394 | 104 | 16.63 | 30.36 | 235 | 1594 | 277 | 0 | 63.6 |
| AP CHK MOD RES RR#4 | 248 | 307.3 | 100 | 9394 | 102 | 1.02 | 44.65 | 100 | 1363 | 102 | 16.40 | 30.64 | 266 | 1725 | 243 | 0 | 70.6 |
| AP CHK SUS HYB#3 | 249 | 316.9 | 103 | 9279 | 101 | 1.08 | 47.47 | 106 | 1389 | 104 | 16.92 | 29.28 | 312 | 1745 | 255 | 0 | 60.2 |
| Crystal 355RR(Check) | 250 | 312.1 | 102 | 9502 | 103 | 1.11 | 46.06 | 103 | 1402 | 105 | 16.71 | 30.38 | 239 | 1669 | 327 | 0 | 64.3 |
| BTS 80RR52(Check) | 251 | 310.8 | 101 | 9011 | 98 | 1.09 | 45.68 | 102 | 1321 | 99 | 16.62 | 29.11 | 211 | 1595 | 338 | 0 | 76.2 |
| Crystal 101RR (Check) | 252 | 306.2 | 100 | 9812 | 106 | 1.04 | 44.32 | 99 | 1425 | 107 | 16.36 | 32.03 | 277 | 1716 | 254 | 0 | 74.5 |
| Hilleshög 4302RR (Check) | 253 | 299.4 | 97 | 8543 | 93 | 1.05 | 42.30 | 95 | 1203 | 90 | 16.02 | 28.58 | 287 | 1578 | 297 | 0 | 67.2 |
| RR Filler #05 | 254 | 304.0 | 99 | 8657 | 94 | 1.23 | 43.69 | 98 | 1242 | 93 | 16.43 | 28.49 | 409 | 1741 | 354 | 0 | 59.1 |
| Comm Benchmark Mean | | 307.1 | | 9217 | | 1.07 | 44.59 | | 1338 | | 16.43 | 30.03 | 254 | 1640 | 304 | | 70.5 |
| Comm Trial Mean | | 309.3 | | 9627 | | 1.00 | 45.26 | | 1406 | | 16.47 | 31.17 | 236 | 1585 | 267 | | 72.3 |
| Coeff. of Var. (%) | | 3.0 | | 5.5 | | 9.1 | 6.2 | | 7.3 | | 2.5 | 5.4 | 24 | 5.0 | 18 | | 7.9 |
| Mean LSD (0.05) | | 11.9 | | 690 | | 0.12 | 3.61 | | 132 | | 0.52 | 2.19 | 71 | 101 | 63 | | 7.3 |
| Mean LSD (0.01) | | 15.8 | | 912 | | 0.15 | 4.77 | | 175 | | 0.69 | 2.89 | 94 | 133 | 83 | | 9.7 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

Bolters per acre are based upon 45,000 plants per acre. Trial # = 178311

@ Experimental trial data adjusted to commercial status. Statistics are from commercial trial. Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs. Created 10/31/2017

## Table 18. 2017 Performance of All RR Varieties - ACSC Official Trial

### Bathgate ND

| Variety @ | Code | Rec/T lbs. | Rec/T %Bnch | Rec/A lbs. | Rec/A %Bnch | Loss Mol % | Rev/T $ ++ | Rev/T %Bnch | Rev/A $ ++ | Rev/A %Bnch | Sugar % | Yield T/A | Na ppm | K ppm | AmN ppm | Bolter per Ac | Emerg. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Commercial Trial** | | | | | | | | | | | | | | | | | |
| BTS 80RR52 | 103 | 357.2 | 100 | 8690 | 92 | 0.96 | 59.77 | 100 | 1454 | 93 | 18.82 | 24.35 | 142 | 1725 | 233 | 0 | 95.4 |
| BTS 8337 | 116 | 365.4 | 102 | 10117 | 107 | 0.87 | 62.22 | 104 | 1726 | 110 | 19.13 | 27.72 | 132 | 1657 | 186 | 0 | 97.5 |
| BTS 8363 | 130 | 346.8 | 97 | 10163 | 108 | 0.89 | 56.62 | 95 | 1654 | 105 | 18.23 | 29.35 | 151 | 1666 | 198 | 0 | 97.7 |
| BTS 8500 | 119 | 355.6 | 100 | 10477 | 111 | 0.90 | 59.26 | 99 | 1752 | 112 | 18.68 | 29.37 | 142 | 1664 | 207 | 0 | 97.0 |
| BTS 8512 | 109 | 360.2 | 101 | 9697 | 103 | 0.91 | 60.65 | 102 | 1636 | 104 | 18.92 | 26.79 | 133 | 1660 | 213 | 0 | 97.8 |
| BTS 8524 | 101 | 348.8 | 98 | 10381 | 110 | 0.94 | 57.21 | 96 | 1714 | 109 | 18.38 | 29.53 | 156 | 1806 | 196 | 0 | 98.8 |
| BTS 8572 | 111 | 360.5 | 101 | 9419 | 100 | 0.86 | 60.77 | 102 | 1589 | 101 | 18.88 | 26.06 | 136 | 1542 | 203 | 0 | 94.5 |
| Crystal 093RR | 115 | 363.2 | 102 | 10585 | 112 | 0.89 | 61.56 | 103 | 1805 | 115 | 19.05 | 28.95 | 125 | 1572 | 226 | 0 | 96.2 |
| Crystal 101RR | 107 | 348.9 | 98 | 10592 | 113 | 0.98 | 57.23 | 96 | 1733 | 110 | 18.42 | 30.50 | 191 | 1829 | 204 | 0 | 96.4 |
| Crystal 246RR | 108 | 349.5 | 98 | 10093 | 107 | 0.86 | 57.41 | 96 | 1656 | 106 | 18.33 | 28.92 | 157 | 1574 | 190 | 0 | 95.8 |
| Crystal 247RR | 131 | 346.7 | 97 | 9605 | 102 | 0.86 | 56.58 | 95 | 1572 | 100 | 18.20 | 27.57 | 151 | 1677 | 171 | 32 | 95.2 |
| Crystal 355RR | 104 | 362.4 | 102 | 7872 | 84 | 0.94 | 61.34 | 103 | 1327 | 85 | 19.07 | 21.85 | 142 | 1665 | 235 | 0 | 95.9 |
| Crystal 467RR | 129 | 349.8 | 98 | 9703 | 103 | 0.91 | 57.51 | 96 | 1587 | 101 | 18.40 | 27.87 | 208 | 1719 | 177 | 0 | 95.7 |
| Crystal 572RR | 126 | 374.4 | 105 | 9922 | 105 | 0.81 | 64.96 | 109 | 1718 | 110 | 19.53 | 26.56 | 121 | 1488 | 190 | 0 | 98.3 |
| Crystal 574RR | 110 | 358.4 | 100 | 10388 | 110 | 0.90 | 60.12 | 101 | 1737 | 111 | 18.82 | 29.11 | 138 | 1630 | 212 | 0 | 96.1 |
| Crystal 986RR | 128 | 365.8 | 103 | 10692 | 114 | 0.84 | 62.36 | 105 | 1832 | 117 | 19.13 | 29.08 | 153 | 1521 | 197 | 0 | 98.1 |
| Hilleshög 4302RR | 105 | 358.5 | 100 | 10492 | 111 | 0.86 | 60.16 | 101 | 1760 | 112 | 18.78 | 29.31 | 137 | 1657 | 178 | 0 | 93.1 |
| Hilleshög 4448RR | 112 | 350.4 | 98 | 11531 | 123 | 0.86 | 57.70 | 97 | 1898 | 121 | 18.38 | 32.86 | 148 | 1601 | 192 | 0 | 94.8 |
| Hilleshög 9528RR | 123 | 357.2 | 100 | 11312 | 120 | 0.86 | 59.75 | 100 | 1895 | 121 | 18.72 | 31.67 | 148 | 1584 | 186 | 32 | 96.3 |
| Hilleshög HIL9707 | 114 | 347.1 | 97 | 11076 | 118 | 0.91 | 56.70 | 95 | 1809 | 115 | 18.27 | 31.91 | 156 | 1710 | 197 | 0 | 96.7 |
| Maribo 109 | 122 | 366.0 | 103 | 9431 | 100 | 0.90 | 62.41 | 105 | 1607 | 102 | 19.20 | 25.81 | 148 | 1580 | 225 | 0 | 93.3 |
| Maribo 305 | 106 | 355.0 | 100 | 11777 | 125 | 0.80 | 59.08 | 99 | 1957 | 125 | 18.55 | 33.22 | 143 | 1469 | 181 | 0 | 96.1 |
| Maribo MA502 | 121 | 353.7 | 99 | 9869 | 105 | 0.93 | 58.70 | 98 | 1624 | 104 | 18.62 | 28.21 | 197 | 1735 | 193 | 0 | 94.9 |
| SX Avalanche RR(858) | 127 | 363.1 | 102 | 9740 | 103 | 0.83 | 61.55 | 103 | 1651 | 105 | 18.98 | 26.81 | 135 | 1564 | 177 | 0 | 93.4 |
| SX Canyon RR | 118 | 355.5 | 100 | 10787 | 115 | 0.81 | 59.23 | 99 | 1799 | 115 | 18.58 | 30.28 | 133 | 1535 | 169 | 0 | 95.5 |
| SX Cruze RR | 117 | 342.3 | 96 | 10614 | 113 | 0.89 | 55.25 | 93 | 1712 | 109 | 18.00 | 30.98 | 144 | 1580 | 216 | 32 | 93.2 |
| SX Marathon RR(856) | 102 | 361.6 | 101 | 10903 | 116 | 0.82 | 61.10 | 102 | 1844 | 118 | 18.90 | 30.13 | 142 | 1555 | 168 | 0 | 93.9 |
| SX Winchester RR | 125 | 357.5 | 100 | 9729 | 103 | 0.89 | 59.86 | 100 | 1624 | 104 | 18.77 | 27.26 | 136 | 1615 | 211 | 0 | 95.1 |
| SV RR244TT | 120 | 352.5 | 99 | 10968 | 117 | 0.84 | 58.34 | 98 | 1810 | 115 | 18.47 | 31.21 | 149 | 1603 | 170 | 0 | 95.7 |
| SV RR333 | 124 | 362.1 | 101 | 11322 | 120 | 0.83 | 61.24 | 103 | 1909 | 122 | 18.93 | 31.37 | 130 | 1588 | 176 | 0 | 95.3 |
| SV RR351 | 113 | 355.5 | 100 | 10591 | 113 | 0.86 | 59.24 | 99 | 1762 | 112 | 18.63 | 29.92 | 165 | 1562 | 189 | 0 | 97.6 |
| RR Filler #01s | 132 | 355.6 | 100 | 10528 | 112 | 0.91 | 59.27 | 99 | 1752 | 112 | 18.68 | 29.69 | 165 | 1773 | 175 | 0 | 97.7 |
| RR Filler #01v | 133 | 356.8 | 100 | 11083 | 118 | 0.91 | 59.62 | 100 | 1856 | 118 | 18.75 | 30.98 | 160 | 1759 | 181 | 0 | 98.3 |
| **Experimental Trial (Comm status)** | | | | | | | | | | | | | | | | | |
| BTS 8606 | 242 | 363.0 | 102 | 10652 | 113 | 0.87 | 61.49 | 103 | 1790 | 114 | 19.02 | 29.65 | 140 | 1684 | 168 | 0 | 85.9 |
| BTS 8629 | 224 | 346.0 | 97 | 9958 | 106 | 0.82 | 56.42 | 95 | 1611 | 103 | 18.13 | 29.02 | 131 | 1566 | 171 | 0 | 91.2 |
| BTS 8735 | 234 | 352.5 | 99 | 9481 | 101 | 0.85 | 58.37 | 98 | 1569 | 100 | 18.49 | 27.00 | 147 | 1560 | 193 | 0 | 94.4 |
| BTS 8742 | 207 | 356.6 | 100 | 8502 | 90 | 0.95 | 59.56 | 100 | 1407 | 90 | 18.76 | 24.07 | 140 | 1716 | 225 | 0 | 98.1 |
| BTS 8749 | 202 | 350.9 | 98 | 8916 | 95 | 0.92 | 57.89 | 97 | 1465 | 93 | 18.47 | 25.64 | 151 | 1776 | 183 | 0 | 93.7 |
| BTS 8756 | 241 | 361.4 | 101 | 9315 | 99 | 1.00 | 61.03 | 102 | 1567 | 100 | 19.07 | 26.03 | 161 | 1800 | 233 | 0 | 93.9 |
| BTS 8767 | 235 | 346.7 | 97 | 9241 | 98 | 0.87 | 56.63 | 95 | 1485 | 95 | 18.21 | 27.33 | 133 | 1732 | 166 | 0 | 94.9 |
| BTS 8770 | 247 | 353.4 | 99 | 9071 | 96 | 0.88 | 58.64 | 98 | 1504 | 96 | 18.57 | 25.83 | 129 | 1758 | 165 | 0 | 90.6 |
| BTS 8784 | 236 | 367.2 | 103 | 8910 | 95 | 0.86 | 62.72 | 105 | 1507 | 96 | 19.22 | 24.51 | 141 | 1565 | 196 | 0 | 90.8 |
| BTS 8787 | 219 | 350.5 | 98 | 9278 | 99 | 0.97 | 57.76 | 97 | 1523 | 97 | 18.49 | 26.61 | 157 | 1698 | 248 | 0 | 88.5 |
| BTS 8798 | 223 | 354.9 | 99 | 8040 | 85 | 0.85 | 59.06 | 99 | 1324 | 84 | 18.60 | 23.15 | 118 | 1586 | 191 | 0 | 94.2 |
| Crystal 573RR | 225 | 355.4 | 100 | 8501 | 90 | 0.85 | 59.22 | 99 | 1399 | 89 | 18.62 | 24.15 | 124 | 1583 | 188 | 0 | 89.6 |
| Crystal 578RR | 220 | 353.3 | 99 | 9700 | 103 | 0.84 | 58.61 | 98 | 1583 | 101 | 18.52 | 28.02 | 142 | 1652 | 160 | 0 | 90.8 |
| Crystal 684RR | 239 | 345.8 | 97 | 9622 | 102 | 0.97 | 56.36 | 95 | 1577 | 101 | 18.26 | 27.72 | 155 | 1797 | 215 | 0 | 90.1 |
| Crystal 792RR | 218 | 361.1 | 101 | 9161 | 97 | 0.93 | 60.90 | 102 | 1539 | 98 | 18.98 | 25.58 | 169 | 1616 | 228 | 0 | 89.6 |
| Crystal 793RR | 246 | 359.2 | 101 | 9689 | 103 | 0.86 | 60.36 | 101 | 1623 | 103 | 18.83 | 27.29 | 137 | 1638 | 183 | 126 | 94.1 |
| Crystal 794RR | 208 | 355.8 | 100 | 10392 | 110 | 0.89 | 59.34 | 100 | 1721 | 110 | 18.68 | 29.51 | 132 | 1645 | 202 | 0 | 91.6 |
| Crystal 795RR | 215 | 364.0 | 102 | 8773 | 93 | 0.89 | 61.78 | 104 | 1471 | 94 | 19.08 | 24.53 | 134 | 1610 | 209 | 0 | 91.8 |
| Crystal 796RR | 238 | 356.4 | 100 | 10312 | 110 | 0.86 | 59.51 | 100 | 1725 | 110 | 18.69 | 29.15 | 137 | 1661 | 173 | 0 | 93.8 |
| Crystal 797RR | 201 | 353.3 | 99 | 10060 | 107 | 0.87 | 58.62 | 98 | 1661 | 106 | 18.54 | 28.64 | 141 | 1772 | 147 | 0 | 84.2 |
| Hilleshög HIL9708 | 222 | 364.8 | 102 | 9972 | 106 | 0.88 | 62.01 | 104 | 1689 | 108 | 19.12 | 27.39 | 149 | 1596 | 200 | 0 | 92.4 |
| Hilleshög HIL9895 | 209 | 333.9 | 94 | 8429 | 90 | 0.96 | 52.82 | 89 | 1312 | 84 | 17.65 | 25.95 | 161 | 1796 | 205 | 126 | 93.6 |
| Hilleshög HIL9920 | 203 | 368.4 | 103 | 10002 | 106 | 0.87 | 63.08 | 106 | 1695 | 108 | 19.27 | 27.46 | 137 | 1638 | 184 | 0 | 88.7 |
| Hilleshög HIL9921 | 204 | 368.9 | 103 | 8655 | 92 | 0.93 | 63.24 | 106 | 1481 | 94 | 19.37 | 23.57 | 137 | 1667 | 223 | 0 | 92.2 |
| Hilleshög HIL9922 | 231 | 349.3 | 98 | 8906 | 95 | 0.91 | 57.42 | 96 | 1449 | 92 | 18.38 | 25.78 | 164 | 1680 | 198 | 0 | 91.4 |
| Hilleshög HIL9923 | 243 | 359.4 | 101 | 9019 | 96 | 0.94 | 60.41 | 101 | 1499 | 96 | 18.92 | 25.54 | 168 | 1721 | 214 | 0 | 81.7 |
| Hilleshög HIL9924 | 237 | 363.9 | 102 | 8381 | 89 | 0.97 | 61.74 | 104 | 1404 | 90 | 19.16 | 23.48 | 183 | 1625 | 253 | 0 | 82.4 |
| Maribo MA504 | 229 | 355.0 | 100 | 10574 | 112 | 0.89 | 59.12 | 99 | 1737 | 111 | 18.63 | 30.20 | 185 | 1598 | 192 | 0 | 95.9 |
| Maribo MA611 | 245 | 349.9 | 98 | 8822 | 94 | 0.89 | 57.59 | 97 | 1443 | 92 | 18.40 | 25.57 | 153 | 1734 | 175 | 0 | 93.6 |
| Maribo MA717 | 232 | 372.1 | 104 | 10611 | 113 | 0.86 | 64.20 | 108 | 1810 | 115 | 19.45 | 28.86 | 138 | 1603 | 181 | 0 | 89.1 |
| Maribo MA718 | 221 | 347.5 | 97 | 8134 | 86 | 0.96 | 56.87 | 95 | 1328 | 85 | 18.34 | 23.50 | 182 | 1852 | 187 | 0 | 89.2 |
| Maribo MA719 | 213 | 346.1 | 97 | 8862 | 94 | 0.97 | 56.46 | 95 | 1438 | 92 | 18.27 | 25.84 | 187 | 1724 | 231 | 0 | 93.9 |
| SX RR1861 | 233 | 348.8 | 98 | 9182 | 98 | 0.92 | 57.26 | 96 | 1474 | 94 | 18.35 | 27.03 | 211 | 1601 | 206 | 0 | 96.6 |
| SX RR1863 | 244 | 360.3 | 101 | 10603 | 113 | 0.86 | 60.68 | 102 | 1771 | 113 | 18.88 | 29.78 | 161 | 1658 | 168 | 0 | 84.9 |
| SX RR1875 | 210 | 353.4 | 99 | 8578 | 91 | 0.82 | 58.64 | 98 | 1407 | 90 | 18.50 | 24.94 | 156 | 1522 | 174 | 0 | 97.8 |
| SX RR1876 | 228 | 348.5 | 98 | 8824 | 94 | 0.85 | 57.17 | 96 | 1432 | 91 | 18.27 | 25.70 | 130 | 1663 | 163 | 0 | 88.4 |
| SX RR1877 | 227 | 356.6 | 100 | 9370 | 100 | 0.89 | 59.57 | 100 | 1563 | 100 | 18.71 | 26.32 | 124 | 1721 | 186 | 0 | 95.7 |
| SX RR1878 | 206 | 360.0 | 101 | 10467 | 111 | 0.84 | 60.60 | 102 | 1751 | 112 | 18.85 | 29.39 | 145 | 1648 | 162 | 0 | 92.0 |
| SX RR1879 | 205 | 358.8 | 101 | 10317 | 110 | 0.82 | 60.22 | 101 | 1711 | 109 | 18.75 | 29.01 | 132 | 1596 | 160 | 0 | 97.9 |
| SV RR265 | 240 | 348.0 | 98 | 10324 | 110 | 0.88 | 57.03 | 96 | 1695 | 108 | 18.27 | 29.57 | 179 | 1548 | 198 | 0 | 94.6 |
| SV RR266 | 216 | 352.4 | 99 | 10155 | 108 | 0.84 | 58.35 | 98 | 1669 | 106 | 18.48 | 29.22 | 129 | 1620 | 173 | 0 | 94.4 |
| SV RR268 | 226 | 362.9 | 102 | 9846 | 105 | 0.80 | 61.46 | 103 | 1657 | 106 | 18.96 | 27.51 | 134 | 1522 | 160 | 0 | 94.7 |
| SV RR371 | 212 | 357.2 | 100 | 10403 | 111 | 0.79 | 59.78 | 100 | 1729 | 110 | 18.66 | 29.45 | 118 | 1524 | 159 | 0 | 94.0 |
| SV RR372 | 217 | 346.3 | 97 | 10128 | 108 | 0.85 | 56.50 | 95 | 1635 | 104 | 18.15 | 29.61 | 167 | 1545 | 180 | 0 | 95.1 |
| SV RR373 | 230 | 348.2 | 98 | 9220 | 98 | 0.85 | 57.10 | 96 | 1492 | 95 | 18.26 | 26.93 | 144 | 1640 | 166 | 0 | 79.6 |
| SV RR374 | 214 | 362.6 | 102 | 10297 | 109 | 0.83 | 61.37 | 103 | 1710 | 109 | 18.96 | 29.26 | 130 | 1535 | 185 | 0 | 94.5 |
| SV RR375 | 211 | 356.6 | 100 | 10376 | 110 | 0.87 | 59.57 | 100 | 1715 | 109 | 18.70 | 29.66 | 134 | 1680 | 181 | 0 | 94.7 |
| AP CHK MOD RES RR#4 | 248 | 349.7 | 98 | 9026 | 96 | 0.85 | 57.51 | 96 | 1481 | 94 | 18.32 | 25.84 | 149 | 1638 | 166 | 0 | 91.3 |
| AP CHK SUS HYB#3 | 249 | 365.9 | 103 | 9315 | 99 | 0.88 | 62.35 | 105 | 1584 | 101 | 19.18 | 25.69 | 143 | 1755 | 164 | 0 | 90.6 |
| Crystal 355RR(Check) | 250 | 355.8 | 100 | 8633 | 92 | 0.96 | 59.35 | 100 | 1445 | 92 | 18.76 | 24.05 | 142 | 1713 | 243 | 0 | 94.4 |
| BTS 80RR52(Check) | 251 | 353.7 | 99 | 8568 | 91 | 0.96 | 58.72 | 98 | 1417 | 90 | 18.64 | 24.38 | 143 | 1734 | 232 | 0 | 92.0 |
| Crystal 101RR (Check) | 252 | 357.9 | 100 | 10855 | 115 | 0.94 | 59.96 | 101 | 1809 | 115 | 18.83 | 30.66 | 168 | 1817 | 184 | 0 | 91.4 |
| Hilleshög 4302RR (Check) | 253 | 359.6 | 101 | 9591 | 102 | 0.87 | 60.46 | 101 | 1602 | 102 | 18.85 | 26.92 | 159 | 1612 | 190 | 0 | 89.8 |
| RR Filler #05 | 254 | 354.9 | 99 | 7613 | 81 | 0.94 | 59.06 | 99 | 1250 | 80 | 18.69 | 21.74 | 161 | 1835 | 184 | 0 | 92.2 |
| Comm Benchmark Mean | | 356.8 | | 9412 | | 0.94 | 59.63 | | 1569 | | 18.77 | 26.50 | 153 | 1719 | 212 | | 91.9 |
| Comm Trial Mean | | 356.5 | | 10308 | | 0.88 | 59.54 | | 1720 | | 18.70 | 28.95 | 149 | 1632 | 195 | | 96.0 |
| Coeff. of Var. (%) | | 2.4 | | 6.4 | | 6.0 | 4.4 | | 7.0 | | 2.2 | 6.5 | 21 | 4.1 | 13 | | 3.2 |
| Mean LSD (0.05) | | 9.9 | | 841 | | 0.06 | 3.01 | | 152 | | 0.47 | 2.40 | 36 | 81 | 30 | | 3.7 |
| Mean LSD (0.01) | | 13.1 | | 1111 | | 0.08 | 3.97 | | 201 | | 0.62 | 3.17 | 47 | 107 | 40 | | 4.9 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ns |

Bolters per acre are based upon 45,000 plants per acre. Trial # = 178313

@ Experimental trial data adjusted to commercial status. Statistics are from commercial trial. Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs. Created 10/31/2017

Table 19. 2017 Performance of Conventional Varieties - ACSC Official Trials
6 sites - All Characters

| *Unadjusted<br>Variety @ | Code | Rec/T<br>lbs. | Rec/T<br>%Mean | Rec/A<br>lbs. | Rec/A<br>%Mean | Loss<br>Mol % | Rev/T<br>$ ++ | Rev/T<br>%Mean | Rev/A<br>$ ++ | Rev/A<br>%Mean | Sugar<br>% | Yield<br>T/A | Na<br>ppm | K<br>ppm | AmN<br>ppm | Bolter<br>/Ac | Emerg.<br>% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BETA EXP 687 | 807 | 345.1 | 102 | 10123 | 100 | 1.22 | 56.11 | 104 | 1633 | 102 | 18.47 | 29.59 | 175 | 1690 | 431 | 0 | 72.4 |
| BETA EXP 698 | 808 | 335.6 | 99 | 10304 | 101 | 1.14 | 53.21 | 99 | 1615 | 101 | 17.92 | 31.10 | 213 | 1659 | 363 | 0 | 75.9 |
| BETA EXP 747 | 810 | 333.5 | 99 | 10556 | 104 | 1.15 | 52.59 | 98 | 1652 | 103 | 17.83 | 31.91 | 241 | 1510 | 405 | 0 | 74.8 |
| BETA EXP 758 | 817 | 337.8 | 100 | 10331 | 102 | 1.13 | 53.88 | 100 | 1638 | 102 | 18.02 | 30.79 | 206 | 1655 | 358 | 0 | 78.1 |
| Crystal 620 | 811 | 338.1 | 100 | 10783 | 106 | 1.15 | 53.96 | 100 | 1706 | 106 | 18.05 | 32.19 | 189 | 1600 | 401 | 0 | 69.4 |
| Crystal 622 | 801 | 340.3 | 101 | 9650 | 95 | 1.25 | 54.64 | 102 | 1532 | 95 | 18.26 | 28.72 | 201 | 1681 | 444 | 0 | 66.4 |
| Crystal 735 | 814 | 351.8 | 104 | 9832 | 97 | 1.09 | 58.13 | 108 | 1616 | 101 | 18.69 | 28.12 | 159 | 1535 | 382 | 0 | 67.8 |
| Crystal 737 | 806 | 336.8 | 100 | 9878 | 97 | 1.25 | 53.57 | 100 | 1555 | 97 | 18.09 | 29.65 | 240 | 1680 | 436 | 0 | 69.4 |
| Crystal R761 | 819 | 328.7 | 97 | 10896 | 107 | 1.28 | 51.12 | 95 | 1691 | 105 | 17.72 | 33.22 | 247 | 1813 | 422 | 0 | 74.1 |
| Hilleshög 3035Rz | 805 | 339.3 | 101 | 9182 | 90 | 1.21 | 54.33 | 101 | 1457 | 91 | 18.17 | 27.34 | 202 | 1625 | 429 | 18 | 80.4 |
| Hilleshög 9891Rz | 812 | 341.3 | 101 | 9268 | 91 | 1.19 | 54.95 | 102 | 1481 | 92 | 18.26 | 27.37 | 178 | 1637 | 425 | 0 | 76.6 |
| Maribo MA615Rz | 818 | 330.6 | 98 | 10191 | 100 | 1.27 | 51.71 | 96 | 1586 | 99 | 17.80 | 30.98 | 271 | 1709 | 430 | 0 | 80.0 |
| Maribo MA720Rz | 816 | 342.1 | 101 | 9919 | 98 | 1.13 | 55.19 | 103 | 1586 | 99 | 18.23 | 29.26 | 199 | 1558 | 390 | 0 | 83.6 |
| Seedex 8869 | 809 | 338.4 | 100 | 10942 | 108 | 1.09 | 54.07 | 101 | 1741 | 108 | 18.02 | 32.49 | 197 | 1669 | 333 | 0 | 74.7 |
| Seedex Deuce | 802 | 337.9 | 100 | 11246 | 111 | 1.10 | 53.90 | 100 | 1790 | 111 | 18.00 | 33.36 | 207 | 1692 | 329 | 18 | 74.8 |
| Strube 12720 | 813 | 329.5 | 98 | 11314 | 111 | 1.11 | 51.36 | 96 | 1753 | 109 | 17.58 | 34.56 | 226 | 1687 | 328 | 0 | 75.0 |
| Strube 13722 | 804 | 326.3 | 97 | 11043 | 109 | 1.15 | 50.40 | 94 | 1696 | 106 | 17.46 | 34.04 | 230 | 1777 | 333 | 0 | 79.2 |
| SV 48611 | 815 | 343.2 | 102 | 10325 | 102 | 1.13 | 55.52 | 103 | 1669 | 104 | 18.30 | 30.12 | 191 | 1598 | 383 | 0 | 68.9 |
| SV 48777 | 803 | 349.4 | 104 | 10409 | 103 | 1.02 | 57.39 | 107 | 1701 | 106 | 18.49 | 29.98 | 171 | 1627 | 296 | 0 | 72.0 |
| Crystal 355RR(Check) | 820 | 338.5 | 100 | 9880 | 97 | 1.24 | 54.10 | 101 | 1563 | 97 | 18.17 | 29.50 | 197 | 1680 | 444 | 0 | 75.5 |
| BTS 80RR52(Check) | 821 | 334.1 | 99 | 10171 | 100 | 1.24 | 52.77 | 98 | 1590 | 99 | 17.95 | 30.77 | 194 | 1685 | 443 | 0 | 77.6 |
| Crystal 101RR (Check) | 822 | 330.5 | 98 | 10855 | 107 | 1.28 | 51.68 | 96 | 1689 | 105 | 17.81 | 33.02 | 256 | 1780 | 426 | 0 | 73.1 |
| Hilleshög 4302RR (Check | 823 | 336.3 | 100 | 9167 | 90 | 1.12 | 53.43 | 99 | 1446 | 90 | 17.94 | 27.45 | 233 | 1636 | 350 | 18 | 60.6 |
| Maribo Ultramono(Filler) | 824 | 330.6 | 98 | 7431 | 73 | 1.28 | 51.72 | 96 | 1152 | 72 | 17.81 | 22.69 | 293 | 1769 | 411 | 0 | 61.2 |
| | | | | | | | | | | | | | | | | | |
| Benchmark Mean | | 334.9 | | 10018 | | 1.22 | 53.00 | | 1572 | | 17.97 | 30.19 | 220 | 1695 | 416 | | 71.7 |
| Trial Mean | | 337.3 | | 10154 | | 1.18 | 53.74 | | 1606 | | 18.04 | 30.34 | 213 | 1665 | 391 | | 73.4 |
| Coeff. of Var. (%) | | 2.4 | | 6.5 | | 7.2 | 4.5 | | 7.3 | | 2.1 | 6.5 | 18.5 | 4.7 | 13.5 | | 9.9 |
| Mean LSD (0.05) | | 7.2 | | 718 | | 0.08 | 2.18 | | 128 | | 0.34 | 2.06 | 35 | 59 | 50 | | 5.7 |
| Mean LSD (0.01) | | 9.5 | | 949 | | 0.10 | 2.89 | | 169 | | 0.45 | 2.72 | 46 | 77 | 66 | | 7.5 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

*Actual data output without adjustment factor.
%Mean = percentage of trial mean.
@ Some varieties not approved for sale. Refer to approval list for approval status.
++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs.

Created 11/01/2017
Trial # = 17ACSCnv

## Table 20. 2017 Performance of Conventional Varieties - ACSC Official Trials

### Casselton ND - All Characters

| *Unadjusted<br>Variety @ | Code | Rec/T<br>lbs. | Rec/T<br>%Mean | Rec/A<br>lbs. | Rec/A<br>%Mean | Loss<br>Mol % | Rev/T<br>$ ++ | Rev/T<br>%Mean | Rev/A<br>$ ++ | Rev/A<br>%Mean | Sugar<br>% | Yield<br>T/A | Na<br>ppm | K<br>ppm | AmN<br>ppm | Bolter<br>/Ac | Emerg.<br>% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BETA EXP 687 | 807 | 349.9 | 102 | 8737 | 108 | 1.54 | 57.53 | 103 | 1438 | 110 | 19.02 | 24.91 | 157 | 2105 | 576 | 0 | 73.3 |
| BETA EXP 698 | 808 | 351.0 | 102 | 7696 | 95 | 1.30 | 57.89 | 104 | 1273 | 97 | 18.84 | 21.83 | 175 | 2071 | 399 | 0 | 82.8 |
| BETA EXP 747 | 810 | 343.3 | 100 | 8004 | 99 | 1.33 | 55.53 | 99 | 1297 | 99 | 18.50 | 23.28 | 183 | 1999 | 435 | 0 | 75.9 |
| BETA EXP 758 | 817 | 344.2 | 100 | 7397 | 92 | 1.49 | 55.81 | 100 | 1198 | 92 | 18.71 | 21.50 | 199 | 2109 | 519 | 0 | 74.7 |
| Crystal 620 | 811 | 348.5 | 101 | 8412 | 104 | 1.42 | 57.13 | 102 | 1378 | 105 | 18.84 | 24.16 | 161 | 2018 | 506 | 0 | 64.6 |
| Crystal 622 | 801 | 355.8 | 103 | 8361 | 104 | 1.43 | 59.34 | 106 | 1396 | 107 | 19.23 | 23.49 | 145 | 2071 | 512 | 0 | 69.4 |
| Crystal 735 | 814 | 356.0 | 103 | 7362 | 91 | 1.32 | 59.40 | 106 | 1226 | 94 | 19.12 | 20.70 | 135 | 1910 | 468 | 0 | 67.5 |
| Crystal 737 | 806 | 348.9 | 101 | 8279 | 103 | 1.38 | 57.25 | 103 | 1358 | 104 | 18.83 | 23.76 | 196 | 2117 | 433 | 0 | 73.3 |
| Crystal R761 | 819 | 327.2 | 95 | 8294 | 103 | 1.53 | 50.66 | 91 | 1288 | 98 | 17.88 | 25.26 | 215 | 2242 | 514 | 0 | 74.5 |
| Hilleshög 3035Rz | 805 | 345.6 | 100 | 7217 | 89 | 1.45 | 56.23 | 101 | 1177 | 90 | 18.72 | 20.88 | 166 | 2080 | 508 | 0 | 75.5 |
| Hilleshög 9891Rz | 812 | 343.8 | 100 | 7857 | 97 | 1.39 | 55.71 | 100 | 1273 | 97 | 18.59 | 22.85 | 160 | 2043 | 479 | 0 | 73.3 |
| Maribo MA615Rz | 818 | 328.9 | 96 | 7698 | 95 | 1.60 | 51.19 | 92 | 1200 | 92 | 18.04 | 23.35 | 240 | 2210 | 565 | 0 | 82.9 |
| Maribo MA720Rz | 816 | 354.0 | 103 | 7915 | 98 | 1.32 | 58.79 | 105 | 1312 | 100 | 19.04 | 22.43 | 144 | 1996 | 445 | 0 | 81.2 |
| Seedex 8869 | 809 | 344.7 | 100 | 9405 | 116 | 1.44 | 55.96 | 100 | 1527 | 117 | 18.68 | 27.30 | 168 | 2184 | 477 | 0 | 78.7 |
| Seedex Deuce | 802 | 341.3 | 99 | 8644 | 107 | 1.40 | 54.93 | 98 | 1392 | 106 | 18.47 | 25.31 | 159 | 2205 | 441 | 0 | 77.3 |
| Strube 12720 | 813 | 335.6 | 98 | 8936 | 111 | 1.44 | 53.20 | 95 | 1421 | 109 | 18.21 | 26.53 | 172 | 2152 | 475 | 0 | 72.8 |
| Strube 13722 | 804 | 340.4 | 99 | 10491 | 130 | 1.37 | 54.66 | 98 | 1685 | 129 | 18.38 | 30.81 | 170 | 2198 | 416 | 0 | 70.6 |
| SV 48611 | 815 | 349.5 | 102 | 8355 | 103 | 1.36 | 57.43 | 103 | 1372 | 105 | 18.84 | 23.89 | 140 | 2047 | 462 | 0 | 71.8 |
| SV 48777 | 803 | 352.1 | 102 | 8521 | 106 | 1.24 | 58.21 | 104 | 1407 | 107 | 18.83 | 24.20 | 154 | 2092 | 347 | 0 | 68.1 |
| Crystal 355RR(Check) | 820 | 352.9 | 103 | 7070 | 88 | 1.37 | 58.46 | 105 | 1174 | 90 | 19.01 | 19.98 | 162 | 2076 | 456 | 0 | 72.2 |
| BTS 80RR52(Check) | 821 | 343.2 | 100 | 7596 | 94 | 1.50 | 55.53 | 99 | 1228 | 94 | 18.67 | 22.15 | 159 | 2182 | 527 | 0 | 73.0 |
| Crystal 101RR (Check) | 822 | 323.6 | 94 | 8275 | 102 | 1.62 | 49.58 | 89 | 1266 | 97 | 17.82 | 25.60 | 230 | 2270 | 570 | 0 | 72.3 |
| Hilleshög 4302RR (Checl | 823 | 341.0 | 99 | 6938 | 86 | 1.34 | 54.85 | 98 | 1112 | 85 | 18.41 | 20.48 | 177 | 2086 | 421 | 0 | 52.5 |
| Maribo Ultramono(Filler) | 824 | 340.3 | 99 | 6319 | 78 | 1.57 | 54.63 | 98 | 1013 | 77 | 18.58 | 18.62 | 260 | 2152 | 546 | 0 | 54.1 |
| | | | | | | | | | | | | | | | | | |
| Benchmark Mean | | 340.2 | | 7470 | | 1.46 | 54.61 | | 1195 | | 18.48 | 22.05 | 182 | 2154 | 494 | | 67.5 |
| Trial Mean | | 344.2 | | 8074 | | 1.42 | 55.83 | | 1309 | | 18.64 | 23.47 | 176 | 2109 | 479 | | 72.2 |
| Coeff. of Var. (%) | | 2.1 | | 6.2 | | 5.7 | 4.0 | | 6.9 | | 1.8 | 5.9 | 12.5 | 2.3 | 11.3 | | 7.9 |
| Mean LSD (0.05) | | 11.2 | | 795 | | 0.12 | 3.40 | | 144 | | 0.51 | 2.20 | 31 | 75 | 82 | | 8.3 |
| Mean LSD (0.01) | | 14.9 | | 1059 | | 0.16 | 4.52 | | 192 | | 0.68 | 2.93 | 41 | 99 | 110 | | 11.0 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

*Actual data output without adjustment factor.

%Mean = percentage of trial mean.

@ Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs.

Created 10/31/2017

Trial # = 178201

## Table 21. 2017 Performance of Conventional Varieties - ACSC Official Trials

### Hendrum MN - All Characters

| *Unadjusted<br>Variety @ | Code | Rec/T<br>lbs. | Rec/T<br>%Mean | Rec/A<br>lbs. | Rec/A<br>%Mean | Loss<br>Mol % | Rev/T<br>$ ++ | Rev/T<br>%Mean | Rev/A<br>$ ++ | Rev/A<br>%Mean | Sugar<br>% | Yield<br>T/A | Na<br>ppm | K<br>ppm | AmN<br>ppm | Bolter<br>/Ac | Emerg.<br>% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BETA EXP 687 | 807 | 324.4 | 101 | 11587 | 102 | 1.31 | 49.82 | 101 | 1780 | 103 | 17.54 | 35.74 | 188 | 1414 | 573 | 0 | 62.2 |
| BETA EXP 698 | 808 | 317.6 | 99 | 11707 | 103 | 1.29 | 47.77 | 97 | 1757 | 102 | 17.17 | 36.96 | 274 | 1325 | 546 | 0 | 62.8 |
| BETA EXP 747 | 810 | 317.0 | 98 | 11787 | 104 | 1.34 | 47.59 | 97 | 1770 | 102 | 17.20 | 37.18 | 312 | 1202 | 602 | 0 | 57.9 |
| BETA EXP 758 | 817 | 320.9 | 100 | 11893 | 105 | 1.19 | 48.76 | 99 | 1816 | 105 | 17.24 | 36.89 | 195 | 1383 | 482 | 0 | 73.9 |
| Crystal 620 | 811 | 320.1 | 99 | 11628 | 102 | 1.30 | 48.52 | 99 | 1762 | 102 | 17.32 | 36.40 | 222 | 1335 | 577 | 0 | 56.6 |
| Crystal 622 | 801 | 319.7 | 99 | 10612 | 93 | 1.37 | 48.40 | 99 | 1599 | 92 | 17.34 | 33.34 | 209 | 1380 | 618 | 0 | 59.2 |
| Crystal 735 | 814 | 339.2 | 105 | 10440 | 92 | 1.27 | 54.31 | 111 | 1671 | 97 | 18.24 | 30.81 | 200 | 1328 | 560 | 0 | 56.7 |
| Crystal 737 | 806 | 312.4 | 97 | 10862 | 96 | 1.41 | 46.19 | 94 | 1598 | 92 | 17.03 | 34.95 | 340 | 1316 | 617 | 0 | 60.1 |
| Crystal R761 | 819 | 320.4 | 100 | 11495 | 101 | 1.36 | 48.61 | 99 | 1746 | 101 | 17.38 | 35.82 | 253 | 1496 | 567 | 0 | 64.6 |
| Hilleshög 3035Rz | 805 | 323.1 | 100 | 10186 | 90 | 1.40 | 49.43 | 101 | 1562 | 90 | 17.56 | 31.49 | 229 | 1354 | 640 | 95 | 77.9 |
| Hilleshög 9891Rz | 812 | 327.1 | 102 | 10120 | 89 | 1.32 | 50.65 | 103 | 1566 | 91 | 17.68 | 31.01 | 181 | 1346 | 599 | 0 | 74.6 |
| Maribo MA615Rz | 818 | 316.0 | 98 | 11507 | 101 | 1.31 | 47.28 | 96 | 1718 | 99 | 17.11 | 36.44 | 319 | 1365 | 533 | 0 | 79.6 |
| Maribo MA720Rz | 816 | 322.0 | 100 | 10803 | 95 | 1.20 | 49.09 | 100 | 1649 | 95 | 17.30 | 33.51 | 246 | 1178 | 527 | 0 | 87.8 |
| Seedex 8869 | 809 | 333.3 | 104 | 12467 | 110 | 1.11 | 52.51 | 107 | 1960 | 113 | 17.76 | 37.45 | 189 | 1306 | 440 | 0 | 74.4 |
| Seedex Deuce | 802 | 332.9 | 103 | 12261 | 108 | 1.12 | 52.39 | 107 | 1933 | 112 | 17.77 | 36.78 | 180 | 1402 | 431 | 0 | 74.9 |
| Strube 12720 | 813 | 313.7 | 97 | 12729 | 112 | 1.20 | 46.59 | 95 | 1889 | 109 | 16.89 | 40.56 | 287 | 1461 | 440 | 0 | 75.1 |
| Strube 13722 | 804 | 312.8 | 97 | 12459 | 110 | 1.25 | 46.30 | 94 | 1842 | 107 | 16.88 | 39.84 | 261 | 1521 | 467 | 0 | 80.7 |
| SV 48611 | 815 | 333.9 | 104 | 10676 | 94 | 1.24 | 52.69 | 107 | 1691 | 98 | 17.93 | 31.84 | 197 | 1315 | 537 | 0 | 67.8 |
| SV 48777 | 803 | 335.6 | 104 | 11728 | 103 | 1.07 | 53.22 | 108 | 1860 | 108 | 17.85 | 34.92 | 180 | 1376 | 396 | 0 | 75.8 |
| Crystal 355RR(Check) | 820 | 313.4 | 97 | 12059 | 106 | 1.44 | 46.50 | 95 | 1790 | 104 | 17.12 | 38.51 | 254 | 1406 | 651 | 0 | 72.6 |
| BTS 80RR52(Check) | 821 | 309.3 | 96 | 11950 | 105 | 1.49 | 45.26 | 92 | 1747 | 101 | 16.96 | 38.61 | 258 | 1364 | 695 | 0 | 74.2 |
| Crystal 101RR (Check) | 822 | 319.7 | 99 | 12145 | 107 | 1.41 | 48.40 | 99 | 1835 | 106 | 17.38 | 37.98 | 312 | 1497 | 581 | 0 | 73.4 |
| Hilleshög 4302RR (Checl | 823 | 320.6 | 100 | 10795 | 95 | 1.29 | 48.69 | 99 | 1636 | 95 | 17.32 | 33.69 | 274 | 1400 | 530 | 0 | 66.9 |
| Maribo Ultramono(Filler) | 824 | 322.1 | 100 | 8682 | 76 | 1.37 | 49.13 | 100 | 1327 | 77 | 17.48 | 26.95 | 321 | 1498 | 549 | 0 | 50.7 |
| Benchmark Mean | | 315.8 | | 11737 | | 1.41 | 47.21 | | 1752 | | 17.20 | 37.20 | 274 | 1417 | 614 | | 71.8 |
| Trial Mean | | 322.0 | | 11357 | | 1.30 | 49.09 | | 1729 | | 17.39 | 35.32 | 245 | 1374 | 548 | | 69.2 |
| Coeff. of Var. (%) | | 2.8 | | 5.7 | | 8.9 | 5.5 | | 6.5 | | 2.3 | 6.3 | 18.6 | 6.7 | 13.9 | | 15.7 |
| Mean LSD (0.05) | | 13.2 | | 966 | | 0.17 | 3.99 | | 169 | | 0.60 | 3.24 | 65 | 138 | 115 | | 16.2 |
| Mean LSD (0.01) | | 17.5 | | 1284 | | 0.23 | 5.31 | | 225 | | 0.79 | 4.30 | 86 | 183 | 152 | | 21.6 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

*Actual data output without adjustment factor.

%Mean = percentage of trial mean.

@ Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs.

Created 11/01/2017

Trial # = 178204

## Table 22. 2017 Performance of Conventional Varieties - ACSC Official Trials

### Grand Forks ND - All Characters

| ***Unadjusted** | | Rec/T | Rec/T | Rec/A | Rec/A | Loss | Rev/T | Rev/T | Rev/A | Rev/A | Sugar | Yield | Na | K | AmN | Bolter | Emerg. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variety @ | Code | lbs. | %Mean | lbs. | %Mean | Mol % | $ ++ | %Mean | $ ++ | %Mean | % | T/A | ppm | ppm | ppm | /Ac | % |
| BETA EXP 687 | 807 | 375.4 | 105 | 12865 | 101 | 0.89 | 65.28 | 109 | 2238 | 105 | 19.67 | 34.48 | 115 | 1607 | 218 | 0 | 71.0 |
| BETA EXP 698 | 808 | 359.9 | 101 | 13661 | 107 | 0.86 | 60.59 | 101 | 2295 | 107 | 18.84 | 37.78 | 137 | 1657 | 175 | 0 | 75.9 |
| BETA EXP 747 | 810 | 355.6 | 99 | 13165 | 103 | 0.76 | 59.27 | 99 | 2210 | 103 | 18.54 | 36.72 | 136 | 1369 | 179 | 0 | 78.5 |
| BETA EXP 758 | 817 | 358.3 | 100 | 13535 | 106 | 0.83 | 60.08 | 100 | 2277 | 107 | 18.76 | 37.94 | 136 | 1541 | 185 | 0 | 75.7 |
| Crystal 620 | 811 | 365.2 | 102 | 13266 | 104 | 0.78 | 62.17 | 104 | 2255 | 105 | 19.04 | 36.52 | 121 | 1467 | 170 | 0 | 73.9 |
| Crystal 622 | 801 | 367.2 | 103 | 12194 | 95 | 0.88 | 62.77 | 105 | 2089 | 98 | 19.24 | 33.08 | 122 | 1530 | 234 | 0 | 69.2 |
| Crystal 735 | 814 | 372.0 | 104 | 12857 | 100 | 0.77 | 64.22 | 107 | 2208 | 103 | 19.37 | 34.58 | 117 | 1419 | 182 | 0 | 68.8 |
| Crystal 737 | 806 | 358.3 | 100 | 12181 | 95 | 0.92 | 60.10 | 100 | 2045 | 96 | 18.83 | 33.84 | 148 | 1641 | 226 | 0 | 70.1 |
| Crystal R761 | 819 | 346.4 | 97 | 14029 | 110 | 0.90 | 56.50 | 94 | 2281 | 107 | 18.22 | 40.60 | 163 | 1667 | 194 | 0 | 78.4 |
| Hilleshög 3035Rz | 805 | 359.7 | 101 | 11074 | 87 | 0.82 | 60.52 | 101 | 1853 | 87 | 18.81 | 31.07 | 122 | 1544 | 180 | 0 | 85.9 |
| Hilleshög 9891Rz | 812 | 361.6 | 101 | 11123 | 87 | 0.84 | 61.08 | 102 | 1872 | 88 | 18.92 | 30.69 | 132 | 1544 | 197 | 0 | 80.9 |
| Maribo MA615Rz | 818 | 348.7 | 98 | 13330 | 104 | 0.92 | 57.20 | 96 | 2196 | 103 | 18.36 | 38.13 | 189 | 1615 | 216 | 0 | 78.2 |
| Maribo MA720Rz | 816 | 354.9 | 99 | 12595 | 98 | 0.86 | 59.07 | 99 | 2101 | 98 | 18.60 | 35.23 | 142 | 1569 | 199 | 0 | 87.9 |
| Seedex 8869 | 809 | 351.7 | 98 | 14304 | 112 | 0.80 | 58.10 | 97 | 2342 | 110 | 18.39 | 41.12 | 124 | 1511 | 170 | 0 | 74.0 |
| Seedex Deuce | 802 | 362.4 | 101 | 14788 | 116 | 0.80 | 61.33 | 102 | 2464 | 115 | 18.92 | 41.50 | 130 | 1530 | 163 | 0 | 79.5 |
| Strube 12720 | 813 | 344.6 | 96 | 13718 | 107 | 0.86 | 55.95 | 93 | 2227 | 104 | 18.09 | 39.91 | 167 | 1631 | 168 | 0 | 72.6 |
| Strube 13722 | 804 | 347.6 | 97 | 12814 | 100 | 0.87 | 56.86 | 95 | 2084 | 97 | 18.25 | 37.09 | 134 | 1706 | 172 | 0 | 77.4 |
| SV 48611 | 815 | 360.2 | 101 | 13690 | 107 | 0.77 | 60.65 | 101 | 2312 | 108 | 18.79 | 38.09 | 114 | 1414 | 182 | 0 | 69.0 |
| SV 48777 | 803 | 363.6 | 102 | 13258 | 104 | 0.81 | 61.68 | 103 | 2251 | 105 | 18.99 | 36.47 | 139 | 1434 | 196 | 0 | 70.8 |
| Crystal 355RR(Check) | 820 | 358.8 | 100 | 12341 | 96 | 0.90 | 60.24 | 101 | 2072 | 97 | 18.83 | 34.17 | 126 | 1599 | 229 | 0 | 77.4 |
| BTS 80RR52(Check) | 821 | 354.3 | 99 | 12491 | 98 | 0.89 | 58.88 | 98 | 2096 | 98 | 18.61 | 34.90 | 143 | 1547 | 232 | 0 | 71.0 |
| Crystal 101RR (Check) | 822 | 342.2 | 96 | 12925 | 101 | 0.93 | 55.21 | 92 | 2067 | 97 | 18.03 | 38.03 | 197 | 1628 | 214 | 0 | 70.6 |
| Hilleshög 4302RR (Checl | 823 | 353.4 | 99 | 11559 | 90 | 0.83 | 58.61 | 98 | 1924 | 90 | 18.50 | 32.69 | 163 | 1522 | 179 | 0 | 67.6 |
| Maribo Ultramono(Filler) | 824 | 359.5 | 101 | 9283 | 73 | 0.96 | 60.44 | 101 | 1567 | 73 | 18.94 | 25.82 | 169 | 1745 | 223 | 0 | 67.1 |
| Benchmark Mean | | 352.2 | | 12329 | | 0.89 | 58.24 | | 2040 | | 18.49 | 34.95 | 157 | 1574 | 214 | | 71.7 |
| Trial Mean | | 357.6 | | 12794 | | 0.85 | 59.87 | | 2138 | | 18.73 | 35.85 | 141 | 1560 | 195 | | 74.6 |
| Coeff. of Var. (%) | | 2.3 | | 6.3 | | 5.5 | 4.1 | | 7.0 | | 2.1 | 5.9 | 15.5 | 4.6 | 11.1 | | 8.9 |
| Mean LSD (0.05) | | 12.8 | | 1230 | | 0.07 | 3.87 | | 222 | | 0.60 | 3.36 | 33 | 111 | 34 | | 9.6 |
| Mean LSD (0.01) | | 17.0 | | 1636 | | 0.10 | 5.15 | | 294 | | 0.80 | 4.48 | 44 | 148 | 45 | | 12.8 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

*Actual data output without adjustment factor.

%Mean = percentage of trial mean.

@ Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs.

Created 11/01/2017

Trial # = 178207

## Table 23. 2017 Performance of Conventional Varieties - ACSC Official Trials

### Scandia MN - All Characters

| *Unadjusted Variety @ | Code | Rec/T lbs. | Rec/T %Mean | Rec/A lbs. | Rec/A %Mean | Loss Mol % | Rev/T $ ++ | Rev/T %Mean | Rev/A $ ++ | Rev/A %Mean | Sugar % | Yield T/A | Na ppm | K ppm | AmN ppm | Bolter /Ac | Emerg. % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BETA EXP 687 | 807 | 350.8 | 104 | 9906 | 103 | 1.34 | 57.81 | 107 | 1634 | 107 | 18.88 | 28.21 | 197 | 1727 | 504 | 0 | 64.2 |
| BETA EXP 698 | 808 | 321.0 | 95 | 9924 | 103 | 1.28 | 48.81 | 90 | 1530 | 100 | 17.35 | 30.71 | 245 | 1692 | 447 | 0 | 70.3 |
| BETA EXP 747 | 810 | 328.1 | 97 | 10398 | 108 | 1.29 | 50.94 | 94 | 1609 | 105 | 17.69 | 31.56 | 272 | 1510 | 501 | 0 | 70.0 |
| BETA EXP 758 | 817 | 345.3 | 102 | 9869 | 103 | 1.23 | 56.17 | 104 | 1599 | 104 | 18.50 | 28.81 | 224 | 1677 | 429 | 0 | 74.1 |
| Crystal 620 | 811 | 332.0 | 98 | 10323 | 108 | 1.23 | 52.14 | 96 | 1616 | 105 | 17.83 | 31.09 | 209 | 1625 | 444 | 0 | 63.6 |
| Crystal 622 | 801 | 345.1 | 102 | 9124 | 95 | 1.35 | 56.10 | 104 | 1490 | 97 | 18.62 | 26.38 | 219 | 1693 | 514 | 0 | 59.9 |
| Crystal 735 | 814 | 357.1 | 105 | 9498 | 99 | 1.20 | 59.71 | 110 | 1596 | 104 | 19.06 | 26.52 | 177 | 1579 | 450 | 0 | 61.8 |
| Crystal 737 | 806 | 347.4 | 103 | 9868 | 103 | 1.38 | 56.78 | 105 | 1593 | 104 | 18.73 | 28.66 | 244 | 1704 | 523 | 0 | 55.2 |
| Crystal R761 | 819 | 326.7 | 96 | 9976 | 104 | 1.54 | 50.51 | 93 | 1538 | 100 | 17.87 | 30.60 | 307 | 1894 | 571 | 0 | 62.1 |
| Hilleshög 3035Rz | 805 | 340.1 | 100 | 8351 | 87 | 1.52 | 54.59 | 101 | 1339 | 87 | 18.53 | 24.67 | 294 | 1710 | 620 | 0 | 70.8 |
| Hilleshög 9891Rz | 812 | 344.7 | 102 | 9163 | 95 | 1.48 | 55.96 | 103 | 1484 | 97 | 18.71 | 26.62 | 226 | 1726 | 606 | 0 | 60.8 |
| Maribo MA615Rz | 818 | 326.5 | 96 | 9398 | 98 | 1.47 | 50.47 | 93 | 1453 | 95 | 17.80 | 28.74 | 327 | 1718 | 562 | 0 | 68.2 |
| Maribo MA720Rz | 816 | 350.4 | 103 | 9400 | 98 | 1.31 | 57.71 | 107 | 1531 | 100 | 18.81 | 26.99 | 225 | 1575 | 518 | 0 | 70.5 |
| Seedex 8869 | 809 | 341.6 | 101 | 9668 | 101 | 1.20 | 55.02 | 102 | 1550 | 101 | 18.27 | 28.34 | 240 | 1707 | 388 | 0 | 55.5 |
| Seedex Deuce | 802 | 337.5 | 100 | 10238 | 107 | 1.26 | 53.79 | 99 | 1617 | 106 | 18.12 | 30.63 | 276 | 1703 | 422 | 95 | 51.3 |
| Strube 12720 | 813 | 330.5 | 98 | 10852 | 113 | 1.24 | 51.67 | 95 | 1675 | 109 | 17.75 | 33.16 | 287 | 1702 | 408 | 0 | 66.4 |
| Strube 13722 | 804 | 319.2 | 94 | 10529 | 110 | 1.21 | 48.24 | 89 | 1611 | 105 | 17.19 | 32.82 | 250 | 1780 | 376 | 0 | 74.9 |
| SV 48611 | 815 | 351.2 | 104 | 10650 | 111 | 1.30 | 57.93 | 107 | 1774 | 116 | 18.88 | 30.19 | 205 | 1698 | 473 | 0 | 54.3 |
| SV 48777 | 803 | 345.3 | 102 | 9278 | 97 | 1.12 | 56.14 | 104 | 1509 | 98 | 18.39 | 26.87 | 209 | 1628 | 356 | 0 | 61.9 |
| Crystal 355RR(Check) | 820 | 343.6 | 101 | 9538 | 99 | 1.35 | 55.64 | 103 | 1551 | 101 | 18.55 | 27.77 | 233 | 1716 | 506 | 0 | 66.4 |
| BTS 80RR52(Check) | 821 | 341.0 | 101 | 9948 | 104 | 1.31 | 54.86 | 101 | 1598 | 104 | 18.37 | 29.29 | 210 | 1707 | 490 | 0 | 74.7 |
| Crystal 101RR (Check) | 822 | 338.9 | 100 | 10585 | 110 | 1.52 | 54.22 | 100 | 1683 | 110 | 18.46 | 31.36 | 325 | 1895 | 558 | 0 | 65.9 |
| Hilleshög 4302RR (Checl | 823 | 346.5 | 102 | 7772 | 81 | 1.25 | 56.51 | 104 | 1258 | 82 | 18.57 | 22.50 | 286 | 1637 | 432 | 95 | 37.0 |
| Maribo Ultramono(Filler) | 824 | 319.6 | 94 | 6112 | 64 | 1.33 | 48.37 | 89 | 915 | 60 | 17.30 | 19.24 | 433 | 1716 | 419 | 0 | 58.2 |
| | | | | | | | | | | | | | | | | | |
| Benchmark Mean | | 342.5 | | 9461 | | 1.36 | 55.31 | | 1523 | | 18.49 | 27.73 | 263 | 1739 | 496 | | 61.0 |
| Trial Mean | | 338.8 | | 9599 | | 1.32 | 54.17 | | 1532 | | 18.26 | 28.41 | 255 | 1697 | 480 | | 63.3 |
| Coeff. of Var. (%) | | 2.7 | | 7.3 | | 7.5 | 5.0 | | 7.9 | | 2.3 | 7.6 | 19.1 | 4.2 | 12.3 | | 12.2 |
| Mean LSD (0.05) | | 13.9 | | 1011 | | 0.15 | 4.21 | | 171 | | 0.65 | 3.20 | 69 | 108 | 90 | | 11.3 |
| Mean LSD (0.01) | | 18.5 | | 1343 | | 0.20 | 5.60 | | 228 | | 0.86 | 4.25 | 91 | 144 | 120 | | 15.0 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

*Actual data output without adjustment factor.

%Mean = percentage of trial mean.

@ Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs.

Created 10/31/2017

Trial # = 178208

Table 24. 2017 Performance of Conventional Varieties - ACSC Official Trials

St Thomas ND - All Characters

| *Unadjusted<br>Variety @ | Code | Rec/T<br>lbs. | Rec/T<br>%Mean | Rec/A<br>lbs. | Rec/A<br>%Mean | Loss<br>Mol % | Rev/T<br>$ ++ | Rev/T<br>%Mean | Rev/A<br>$ ++ | Rev/A<br>%Mean | Sugar<br>% | Yield<br>T/A | Na<br>ppm | K<br>ppm | AmN<br>ppm | Bolter<br>/Ac | Emerg.<br>% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BETA EXP 687 | 807 | 291.4 | 101 | 9706 | 98 | 1.24 | 39.84 | 102 | 1324 | 99 | 15.80 | 33.51 | 268 | 1582 | 456 | 0 | 71.2 |
| BETA EXP 698 | 808 | 294.5 | 102 | 11083 | 112 | 1.15 | 40.78 | 104 | 1536 | 115 | 15.87 | 37.67 | 346 | 1572 | 353 | 0 | 69.6 |
| BETA EXP 747 | 810 | 284.0 | 98 | 10363 | 105 | 1.26 | 37.60 | 96 | 1382 | 103 | 15.48 | 36.27 | 454 | 1439 | 433 | 0 | 72.9 |
| BETA EXP 758 | 817 | 293.3 | 101 | 10091 | 102 | 1.13 | 40.39 | 103 | 1383 | 103 | 15.78 | 34.60 | 374 | 1573 | 320 | 0 | 76.8 |
| Crystal 620 | 811 | 286.7 | 99 | 10876 | 110 | 1.25 | 38.40 | 98 | 1451 | 108 | 15.58 | 38.08 | 327 | 1541 | 440 | 0 | 64.1 |
| Crystal 622 | 801 | 280.7 | 97 | 9685 | 98 | 1.37 | 36.58 | 93 | 1256 | 94 | 15.39 | 34.69 | 390 | 1617 | 485 | 0 | 56.8 |
| Crystal 735 | 814 | 307.9 | 106 | 10330 | 104 | 1.12 | 44.83 | 114 | 1506 | 112 | 16.54 | 33.38 | 251 | 1430 | 400 | 0 | 64.2 |
| Crystal 737 | 806 | 287.5 | 99 | 9781 | 99 | 1.37 | 38.65 | 98 | 1310 | 98 | 15.73 | 34.17 | 387 | 1557 | 504 | 0 | 64.1 |
| Crystal R761 | 819 | 284.2 | 98 | 10483 | 106 | 1.31 | 37.64 | 96 | 1390 | 104 | 15.53 | 36.80 | 408 | 1709 | 408 | 0 | 73.2 |
| Hilleshög 3035Rz | 805 | 295.3 | 102 | 10075 | 102 | 1.08 | 41.02 | 105 | 1402 | 105 | 15.84 | 34.21 | 296 | 1455 | 346 | 0 | 77.1 |
| Hilleshög 9891Rz | 812 | 295.8 | 102 | 9414 | 95 | 1.18 | 41.16 | 105 | 1307 | 97 | 15.97 | 31.78 | 299 | 1489 | 407 | 0 | 74.9 |
| Maribo MA615Rz | 818 | 288.6 | 100 | 9614 | 97 | 1.29 | 38.97 | 99 | 1287 | 96 | 15.72 | 33.54 | 403 | 1545 | 443 | 0 | 75.0 |
| Maribo MA720Rz | 816 | 297.0 | 103 | 10242 | 103 | 1.09 | 41.54 | 106 | 1433 | 107 | 15.92 | 34.62 | 316 | 1437 | 344 | 0 | 76.4 |
| Seedex 8869 | 809 | 287.7 | 99 | 10208 | 103 | 1.15 | 38.71 | 99 | 1378 | 103 | 15.54 | 35.32 | 363 | 1575 | 335 | 0 | 72.9 |
| Seedex Deuce | 802 | 282.5 | 98 | 10236 | 103 | 1.05 | 37.14 | 95 | 1350 | 101 | 15.17 | 36.22 | 386 | 1511 | 275 | 0 | 71.9 |
| Strube 12720 | 813 | 287.2 | 99 | 10825 | 109 | 0.99 | 38.57 | 98 | 1458 | 109 | 15.36 | 37.70 | 343 | 1449 | 265 | 0 | 68.4 |
| Strube 13722 | 804 | 274.4 | 95 | 9594 | 97 | 1.17 | 34.67 | 88 | 1211 | 90 | 14.90 | 34.93 | 445 | 1609 | 315 | 0 | 76.6 |
| SV 48611 | 815 | 290.4 | 100 | 8803 | 89 | 1.18 | 39.54 | 101 | 1187 | 89 | 15.72 | 30.34 | 357 | 1431 | 397 | 0 | 64.9 |
| SV 48777 | 803 | 314.0 | 109 | 10381 | 105 | 0.99 | 46.66 | 119 | 1540 | 115 | 16.68 | 33.06 | 249 | 1496 | 273 | 0 | 62.6 |
| Crystal 355RR(Check) | 820 | 288.5 | 100 | 9487 | 96 | 1.28 | 38.96 | 99 | 1284 | 96 | 15.70 | 32.88 | 294 | 1585 | 460 | 0 | 69.5 |
| BTS 80RR52(Check) | 821 | 289.5 | 100 | 9958 | 101 | 1.20 | 39.26 | 100 | 1343 | 100 | 15.67 | 34.53 | 297 | 1574 | 400 | 0 | 76.0 |
| Crystal 101RR (Check) | 822 | 289.0 | 100 | 10419 | 105 | 1.17 | 39.11 | 100 | 1411 | 105 | 15.63 | 35.90 | 365 | 1634 | 335 | 0 | 63.9 |
| Hilleshög 4302RR (Checl | 823 | 280.6 | 97 | 8270 | 84 | 1.11 | 36.57 | 93 | 1077 | 80 | 15.14 | 29.54 | 408 | 1518 | 304 | 0 | 57.3 |
| Maribo Ultramono(Filler) | 824 | 275.9 | 95 | 7752 | 78 | 1.34 | 35.14 | 90 | 989 | 74 | 15.15 | 27.96 | 450 | 1618 | 433 | 0 | 59.0 |
| | | | | | | | | | | | | | | | | | |
| Benchmark Mean | | 286.9 | | 9534 | | 1.19 | 38.48 | | 1279 | | 15.54 | 33.21 | 341 | 1578 | 375 | | 66.7 |
| Trial Mean | | 289.4 | | 9903 | | 1.19 | 39.24 | | 1341 | | 15.66 | 34.24 | 353 | 1539 | 380 | | 69.1 |
| Coeff. of Var. (%) | | 2.5 | | 5.6 | | 6.6 | 5.6 | | 6.8 | | 2.1 | 5.7 | 16.2 | 6.3 | 11.6 | | 8.7 |
| Mean LSD (0.05) | | 11.5 | | 845 | | 0.12 | 3.47 | | 142 | | 0.50 | 2.98 | 92 | 146 | 71 | | 8.8 |
| Mean LSD (0.01) | | 15.3 | | 1123 | | 0.17 | 4.62 | | 189 | | 0.66 | 3.97 | 122 | 194 | 94 | | 11.7 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

*Actual data output without adjustment factor.

%Mean = percentage of trial mean.

@ Some varieties not approved for sale. Refer to approval list for approval status.

++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs.

Created 10/31/2017

Trial # = 178211

## Table 25. 2017 Performance of Conventional Varieties - ACSC Official Trials

### Humboldt MN - All Characters

| *Unadjusted<br>Variety @ | Code | Rec/T<br>lbs. | Rec/T<br>%Mean | Rec/A<br>lbs. | Rec/A<br>%Mean | Loss<br>Mol % | Rev/T<br>$ ++ | Rev/T<br>%Mean | Rev/A<br>$ ++ | Rev/A<br>%Mean | Sugar<br>% | Yield<br>T/A | Na<br>ppm | K<br>ppm | AmN<br>ppm | Bolter<br>/Ac | Emerg.<br>% |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BETA EXP 687 | 807 | 377.8 | 102 | 7746 | 84 | 0.95 | 66.00 | 103 | 1367 | 86 | 19.84 | 20.22 | 100 | 1730 | 248 | 0 | 92.3 |
| BETA EXP 698 | 808 | 370.9 | 100 | 7566 | 82 | 0.93 | 63.91 | 99 | 1298 | 82 | 19.48 | 20.54 | 97 | 1644 | 251 | 0 | 93.6 |
| BETA EXP 747 | 810 | 372.2 | 100 | 9844 | 107 | 0.96 | 64.29 | 100 | 1710 | 108 | 19.56 | 26.22 | 104 | 1559 | 300 | 0 | 94.6 |
| BETA EXP 758 | 817 | 362.1 | 97 | 8780 | 96 | 0.87 | 61.23 | 95 | 1483 | 94 | 18.98 | 24.32 | 112 | 1646 | 202 | 0 | 92.9 |
| Crystal 620 | 811 | 374.6 | 101 | 10322 | 112 | 0.93 | 65.02 | 101 | 1792 | 113 | 19.66 | 27.54 | 99 | 1615 | 256 | 0 | 95.0 |
| Crystal 622 | 801 | 374.9 | 101 | 7968 | 87 | 1.02 | 65.12 | 101 | 1379 | 87 | 19.77 | 21.31 | 109 | 1795 | 272 | 0 | 84.3 |
| Crystal 735 | 814 | 376.6 | 101 | 8681 | 94 | 0.91 | 65.64 | 102 | 1515 | 96 | 19.74 | 22.99 | 101 | 1537 | 266 | 0 | 87.5 |
| Crystal 737 | 806 | 368.1 | 99 | 8327 | 91 | 1.04 | 63.07 | 98 | 1418 | 89 | 19.45 | 22.79 | 117 | 1722 | 297 | 0 | 94.9 |
| Crystal R761 | 819 | 368.1 | 99 | 11299 | 123 | 1.05 | 63.06 | 98 | 1932 | 122 | 19.46 | 30.78 | 115 | 1877 | 276 | 0 | 91.9 |
| Hilleshög 3035Rz | 805 | 371.0 | 100 | 7994 | 87 | 0.94 | 63.93 | 99 | 1378 | 87 | 19.48 | 21.55 | 102 | 1618 | 262 | 0 | 94.7 |
| Hilleshög 9891Rz | 812 | 375.1 | 101 | 8117 | 88 | 0.96 | 65.18 | 101 | 1398 | 88 | 19.72 | 21.89 | 100 | 1662 | 261 | 0 | 95.9 |
| Maribo MA615Rz | 818 | 376.6 | 101 | 9464 | 103 | 1.00 | 65.63 | 102 | 1654 | 104 | 19.83 | 25.09 | 114 | 1819 | 253 | 0 | 94.8 |
| Maribo MA720Rz | 816 | 376.2 | 101 | 8543 | 93 | 0.99 | 65.51 | 102 | 1482 | 94 | 19.80 | 22.80 | 134 | 1565 | 295 | 0 | 97.7 |
| Seedex 8869 | 809 | 372.6 | 100 | 9572 | 104 | 0.89 | 64.42 | 100 | 1655 | 104 | 19.52 | 25.71 | 97 | 1742 | 197 | 0 | 93.4 |
| Seedex Deuce | 802 | 371.1 | 100 | 11330 | 123 | 0.99 | 63.96 | 99 | 1949 | 123 | 19.55 | 30.64 | 110 | 1803 | 253 | 0 | 94.1 |
| Strube 12720 | 813 | 366.1 | 98 | 10569 | 115 | 0.91 | 62.44 | 97 | 1801 | 114 | 19.21 | 28.92 | 104 | 1735 | 209 | 0 | 95.2 |
| Strube 13722 | 804 | 363.2 | 98 | 10150 | 110 | 1.00 | 61.58 | 96 | 1725 | 109 | 19.16 | 27.90 | 108 | 1850 | 247 | 0 | 94.5 |
| SV 48611 | 815 | 372.9 | 100 | 9615 | 105 | 0.95 | 64.52 | 100 | 1662 | 105 | 19.60 | 25.88 | 103 | 1717 | 242 | 0 | 85.5 |
| SV 48777 | 803 | 385.7 | 104 | 9470 | 103 | 0.93 | 68.40 | 106 | 1675 | 106 | 20.22 | 24.59 | 103 | 1733 | 222 | 0 | 94.3 |
| Crystal 355RR(Check) | 820 | 375.4 | 101 | 9052 | 99 | 1.09 | 65.26 | 101 | 1565 | 99 | 19.86 | 24.24 | 101 | 1675 | 357 | 0 | 95.4 |
| BTS 80RR52(Check) | 821 | 367.9 | 99 | 8703 | 95 | 1.04 | 62.98 | 98 | 1491 | 94 | 19.44 | 23.68 | 110 | 1730 | 308 | 0 | 97.1 |
| Crystal 101RR (Check) | 822 | 372.1 | 100 | 11134 | 121 | 1.03 | 64.27 | 100 | 1917 | 121 | 19.63 | 30.01 | 107 | 1701 | 303 | 0 | 93.3 |
| Hilleshög 4302RR (Checl | 823 | 377.0 | 101 | 9890 | 108 | 0.88 | 65.75 | 102 | 1715 | 108 | 19.73 | 26.37 | 104 | 1643 | 214 | 0 | 84.4 |
| Maribo Ultramono(Filler) | 824 | 365.3 | 98 | 6395 | 70 | 1.09 | 62.22 | 97 | 1082 | 68 | 19.36 | 17.65 | 117 | 1900 | 297 | 0 | 77.9 |
| | | | | | | | | | | | | | | | | | |
| Benchmark Mean | | 373.1 | | 9695 | | 1.01 | 64.57 | | 1672 | | 19.67 | 26.08 | 106 | 1687 | 296 | | 92.5 |
| Trial Mean | | 372.2 | | 9189 | | 0.97 | 64.31 | | 1585 | | 19.58 | 24.74 | 107 | 1709 | 262 | | 92.3 |
| Coeff. of Var. (%) | | 1.8 | | 6.6 | | 7.0 | 3.1 | | 7.3 | | 1.6 | 6.0 | 12.0 | 4.7 | 18.4 | | 3.3 |
| Mean LSD (0.05) | | 11.3 | | 1143 | | 0.12 | 3.43 | | 217 | | 0.53 | 2.84 | 22 | 132 | 79 | | 5.4 |
| Mean LSD (0.01) | | 15.2 | | 1534 | | 0.16 | 4.59 | | 291 | | 0.70 | 3.81 | 29 | 176 | 106 | | 7.2 |
| Sig Lvl | | ** | | ** | | ** | ** | | ** | | ** | ** | ** | ** | ** | | ** |

*Actual data output without adjustment factor. Created 11/01/2017
%Mean = percentage of trial mean. Trial # = 178212
@ Some varieties not approved for sale. Refer to approval list for approval status.
++ Revenue estimates are based on a $48.49 beet payment at 17.5% sugar & 1.5% loss to molasses and does not consider hauling costs.

## Table 26. Calculation for Approval of Sugarbeet Varieties for ACSC Market for 2018

| | | Rec/Ton | | | | | Rev/Acre | | | | | R/T + | Cercospora Rating + | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Approval | | | | | % | | | | | % | $/A | | | | 2 Yr | 3 Yr |
| Variety | Status | | 2016 | 2017 | 2 Yr | Bench | | 2016 | 2017 | 2 Yr | Bench | Bench | 2015 | 2016 | 2017 | Mean | Mean |
| **Previously Approved (3 Yr)** | | | | | | | | | | | | | | | | | **<=5.40** |
| BTS 80RR52 | Approved | | 316.8 | 334.2 | 325.5 | 100.6 | | 1960 | 1699 | 1830 | 103.2 | 203.8 | 4.11 | 4.28 | 4.37 | | 4.26 |
| BTS 8337 | Approved | | 325.2 | 349.5 | 337.4 | 104.3 | | 1877 | 1842 | 1860 | 104.9 | 209.2 | 4.49 | 4.62 | 4.36 | | 4.49 |
| BTS 8363 | Approved | | 309.8 | 328.7 | 319.3 | 98.7 | | 1937 | 1770 | 1854 | 104.6 | 203.2 | 3.83 | 4.33 | 4.10 | | 4.09 |
| BTS 8500 | Approved | | 308.7 | 335.7 | 322.2 | 99.6 | | 1966 | 1862 | 1914 | 108.0 | 207.6 | 4.45 | 4.54 | 4.29 | | 4.43 |
| BTS 8512 | Approved | | 315.8 | 339.9 | 327.9 | 101.3 | | 1917 | 1749 | 1833 | 103.4 | 204.8 | 4.12 | 4.04 | 3.69 | | 3.95 |
| BTS 8524 | Approved | | 305.7 | 330.0 | 317.9 | 98.2 | | 1954 | 1796 | 1875 | 105.8 | 204.0 | 4.40 | 4.74 | 4.38 | | 4.51 |
| BTS 8572 | Approved | | 323.3 | 346.7 | 335.0 | 103.5 | | 1913 | 1817 | 1865 | 105.2 | 208.8 | 4.60 | 4.41 | 4.14 | | 4.38 |
| Crystal 093RR | Approved | | 319.1 | 350.3 | 334.7 | 103.5 | | 1942 | 1866 | 1904 | 107.4 | 210.9 | 4.76 | 4.95 | 4.49 | | 4.73 |
| Crystal 101RR | Approved | | 306.3 | 329.3 | 317.8 | 98.2 | | 1849 | 1718 | 1784 | 100.6 | 198.9 | 4.65 | 4.59 | 4.57 | | 4.60 |
| Crystal 246RR | Approved | | 305.3 | 331.7 | 318.5 | 98.4 | | 1845 | 1775 | 1810 | 102.1 | 200.6 | 4.49 | 4.81 | 4.63 | | 4.64 |
| Crystal 247RR | Approved | | 314.5 | 335.2 | 324.9 | 100.4 | | 2014 | 1832 | 1923 | 108.5 | 208.9 | 4.19 | 4.65 | 4.55 | | 4.47 |
| Crystal 355RR | Approved | | 322.3 | 340.0 | 331.2 | 102.4 | | 1947 | 1711 | 1829 | 103.2 | 205.5 | 4.43 | 4.60 | 4.36 | | 4.46 |
| Crystal 467RR | Approved | | 301.0 | 330.1 | 315.6 | 97.5 | | 1845 | 1804 | 1825 | 102.9 | 200.5 | 4.34 | 4.69 | 4.46 | | 4.49 |
| Crystal 572RR | Approved | | 324.7 | 354.7 | 339.7 | 105.0 | | 1982 | 1891 | 1937 | 109.3 | 214.3 | 4.65 | 4.57 | 4.27 | | 4.50 |
| Crystal 573RR | Approved | | 321.4 | 343.9 | 332.7 | 102.8 | | 1970 | 1785 | 1878 | 105.9 | 208.7 | 4.15 | 4.35 | 4.15 | | 4.22 |
| Crystal 574RR | Approved | | 307.8 | 334.4 | 321.1 | 99.3 | | 2070 | 1875 | 1973 | 111.3 | 210.5 | 4.30 | 4.51 | 4.35 | | 4.39 |
| Crystal 578RR | Approved | | 316.6 | 338.4 | 327.5 | 101.2 | | 2017 | 1899 | 1958 | 110.5 | 211.7 | 4.93 | 4.87 | 4.91 | | 4.91 |
| Crystal 986RR | Approved | | 318.8 | 341.1 | 330.0 | 102.0 | | 1895 | 1776 | 1836 | 103.6 | 205.5 | 4.97 | 4.75 | 4.77 | | 4.83 |
| Hilleshög HIL9708 | Approved | | 312.4 | 338.6 | 325.5 | 100.6 | | 1857 | 1640 | 1749 | 98.6 | 199.3 | 5.04 | 4.74 | 4.61 | | 4.80 |
| Hilleshög 4302RR | Approved | | 317.4 | 334.0 | 325.7 | 100.7 | | 1801 | 1597 | 1699 | 95.9 | 196.5 | 4.13 | 4.13 | 3.93 | | 4.06 |
| Hilleshög 4448RR | Approved | | 309.1 | 338.0 | 323.6 | 100.0 | | 1873 | 1829 | 1851 | 104.4 | 204.4 | 5.29 | 5.21 | 5.28 | | 5.26 |
| Hilleshög 9528RR | Approved | | 319.1 | 339.3 | 329.2 | 101.8 | | 1982 | 1785 | 1884 | 106.3 | 208.0 | 5.16 | 4.73 | 4.99 | | 4.96 |
| Maribo 109 | Approved | | 332.4 | 347.6 | 340.0 | 105.1 | | 1889 | 1569 | 1729 | 97.5 | 202.6 | 4.56 | 4.14 | 4.14 | | 4.28 |
| Maribo 305 | Approved | | 307.5 | 331.7 | 319.6 | 98.8 | | 1773 | 1731 | 1752 | 98.8 | 197.6 | 4.76 | 4.72 | 4.98 | | 4.82 |
| Maribo MA504 | Approved | | 305.5 | 333.9 | 319.7 | 98.8 | | 1929 | 1830 | 1880 | 106.0 | 204.9 | 5.25 | 5.04 | 5.50 | | 5.26 |
| SV RR244TT | Approved | | 317.6 | 334.7 | 326.2 | 100.8 | | 1877 | 1796 | 1837 | 103.6 | 204.4 | 4.17 | 4.46 | 4.85 | | 4.49 |
| SV RR333 | Approved | | 318.3 | 338.9 | 328.6 | 101.6 | | 1950 | 1823 | 1887 | 106.4 | 208.0 | 4.54 | 4.85 | 4.84 | | 4.74 |
| SV RR351 | Approved | | 313.2 | 337.3 | 325.3 | 100.5 | | 1971 | 1783 | 1877 | 105.9 | 206.4 | 4.62 | 4.50 | 4.41 | | 4.51 |
| SX Avalanche RR(858) | Approved | | 320.7 | 342.2 | 331.5 | 102.4 | | 1916 | 1690 | 1803 | 101.7 | 204.2 | 4.15 | 4.74 | 4.64 | | 4.51 |
| SX Canyon RR | Approved | | 317.4 | 342.4 | 329.9 | 102.0 | | 1926 | 1829 | 1878 | 105.9 | 207.9 | 4.02 | 4.76 | 4.92 | | 4.56 |
| SX Cruze RR | Approved | | 299.6 | 318.4 | 309.0 | 95.5 | | 1712 | 1696 | 1704 | 96.1 | 191.6 | 4.57 | 4.65 | 5.37 | | 4.87 |
| SX Marathon RR(856) | Approved | | 315.4 | 340.4 | 327.9 | 101.4 | | 2039 | 1812 | 1926 | 108.6 | 210.0 | 5.37 | 4.44 | 4.54 | | 4.78 |
| SX Winchester RR | Approved | | 320.5 | 331.1 | 325.8 | 100.7 | | 1831 | 1580 | 1706 | 96.2 | 196.9 | 3.67 | 3.97 | 4.07 | | 3.90 |
| **Candidates for Approval (2 Yr)** | | | | | | | | | | | | | | | | **<=5.20** | |
| BTS 8606 | Approved | | 317.3 | 340.5 | 328.9 | 101.7 | | 2000 | 1882 | 1941 | 109.5 | 211.2 | -- | 5.12 | 4.73 | 4.92 | -- |
| BTS 8629 | Approved | | 307.5 | 332.8 | 320.2 | 99.0 | | 1955 | 1884 | 1920 | 108.3 | 207.3 | -- | 4.59 | 4.29 | 4.44 | -- |
| Crystal 684RR | Approved | | 308.1 | 333.7 | 320.9 | 99.2 | | 2111 | 1899 | 2005 | 113.1 | 212.3 | -- | 4.57 | 4.34 | 4.45 | -- |
| Hilleshög HIL9707 | Not Approved | | 305.2 | 324.3 | 314.8 | 97.3 | | 1739 | 1692 | 1716 | 96.8 | 194.1 | 4.60 | 4.53 | 4.96 | 4.74 | 4.70 |
| Hilleshög HIL9895 | Not Approved | | 313.7 | 326.3 | 320.0 | 98.9 | | 1873 | 1547 | 1710 | 96.5 | 195.4 | -- | 4.49 | 4.84 | 4.67 | -- |
| Maribo MA502 | Not Approved | | 302.7 | 329.8 | 316.3 | 97.8 | | 1825 | 1642 | 1734 | 97.8 | 195.6 | 5.04 | 4.79 | 5.01 | 4.90 | 4.95 |
| Maribo MA611 | Not Approved | | 313.1 | 325.9 | 319.5 | 98.8 | | 1765 | 1542 | 1654 | 93.3 | 192.0 | -- | 4.47 | 5.03 | 4.75 | -- |
| SX RR1861 | Approved | | 316.2 | 335.3 | 325.8 | 100.7 | | 1966 | 1748 | 1857 | 104.8 | 205.5 | -- | 4.52 | 4.74 | 4.63 | -- |
| SX RR1863 | Approved | | 323.4 | 342.4 | 332.9 | 102.9 | | 2006 | 1773 | 1890 | 106.6 | 209.5 | -- | 4.35 | 4.08 | 4.21 | -- |
| SV RR265 | Approved | | 315.1 | 336.8 | 326.0 | 100.7 | | 1979 | 1836 | 1908 | 107.6 | 208.4 | -- | 5.00 | 5.19 | 5.09 | -- |
| SV RR266 | Approved | | 317.3 | 337.9 | 327.6 | 101.3 | | 1971 | 1814 | 1893 | 106.8 | 208.0 | -- | 4.74 | 4.61 | 4.67 | -- |
| SV RR268 | Approved | | 319.0 | 341.1 | 330.1 | 102.0 | | 1954 | 1802 | 1878 | 106.0 | 208.0 | -- | 5.13 | 5.06 | 5.10 | -- |
| **Benchmark Varieties** | | 2015 | 2016 | 2017 | | | 2015 | 2016 | 2017 | | | | | | | | |
| Crystal 875RR | Benchmark | 308.5 | | | | | 1490 | | | | | | | | | | |
| BTS 81RR17(Check) | Benchmark | 307.6 | 310.2 | | | | 1574 | 1845 | | | | | | | | | |
| BTS 80RR52 | Benchmark | 317.7 | 316.8 | 334.2 | | | 1701 | 1960 | 1699 | | | | | | | | |
| Hilleshög 4302RR | Benchmark | 319.5 | 317.4 | 334.0 | | | 1624 | 1801 | 1597 | | | | | | | | |
| Crystal 101RR | Benchmark | | 306.3 | 329.3 | | | | 1849 | 1718 | | | | | | | | |
| Crystal 355RR | Benchmark | | | 340.0 | | | | | 1711 | | | | | | | | |
| **Benchmark mean** | | 313.3 | 312.7 | 334.4 | 323.5 | | 1597 | 1864 | 1681 | 1773 | | | | | | | |

+ All Cercospora ratings 2015-2017 were adjusted to 1982 basis.

Variety approval criteria include: 1) 2 years of official trial data, 2) Cercospora rating must not exceed 5.20 (1982 adjusted data), 3a) R/T >= 100% of Bench or 3b) R/T >= 97% and R/T + $/A >= 202% of Bench. 3 yrs of data may be considered for initial approval.

Bench for 2017 added Crystal 355RR and dropped BTS 81RR17(Check).

Created 11-04-2017.

To maintain approval, the 3-year Cercospora rating must not exceed 5.40 (1982 adjusted data).

Table 27. Projected Calculation for Approval of Sugarbeet Varieties for ACSC Market

| Variety | Approval ^ Likely | Rec/Ton 2017 | Rec/Ton % Bench | Rev/Acre 2017 | Rev/Acre % Bench | R/T + $/A Bench | CR Rating ^^ 2017 |
|---|---|---|---|---|---|---|---|
| **Candidates for Retesting (1 Yr)** | | | | | | | |
| BTS 8735 | On Track | 335.7 | 100.4 | 1836 | 109.2 | 209.6 | 4.22 |
| BTS 8742 | Not On Track | 333.4 | 99.7 | 1646 | 97.9 | 197.6 | 4.36 |
| BTS 8749 | On Track | 337.7 | 101.0 | 1719 | 102.2 | 203.2 | 4.05 |
| BTS 8756 | On Track | 338.4 | 101.2 | 1724 | 102.5 | 203.7 | 4.01 |
| BTS 8767 | On Track | 339.2 | 101.4 | 1878 | 111.7 | 213.1 | 4.16 |
| BTS 8770 | On Track | 337.4 | 100.9 | 1801 | 107.1 | 208.0 | 4.30 |
| BTS 8784 | On Track | 351.4 | 105.1 | 1787 | 106.3 | 211.4 | 3.65 |
| BTS 8787 | On Track | 331.5 | 99.1 | 1733 | 103.1 | 202.2 | 4.03 |
| BTS 8798 | On Track | 338.8 | 101.3 | 1695 | 100.8 | 202.1 | 4.30 |
| Crystal 792RR | On Track | 344.0 | 102.9 | 1799 | 107.0 | 209.9 | 3.94 |
| Crystal 793RR | On Track | 347.5 | 103.9 | 1896 | 112.8 | 216.7 | 3.93 |
| Crystal 794RR | On Track | 333.8 | 99.8 | 1835 | 109.1 | 209.0 | 4.92 |
| Crystal 795RR | On Track | 340.1 | 101.7 | 1708 | 101.6 | 203.3 | 4.39 |
| Crystal 796RR | On Track | 337.0 | 100.8 | 1950 | 116.0 | 216.8 | 4.85 |
| Crystal 797RR | On Track | 330.1 | 98.7 | 1809 | 107.6 | 206.3 | 4.17 |
| Hilleshög HIL9920 | On Track | 347.2 | 103.8 | 1785 | 106.2 | 210.0 | 4.89 |
| Hilleshög HIL9921 | On Track | 345.2 | 103.2 | 1585 | 94.3 | 197.5 | 4.47 |
| Hilleshög HIL9922 | Not On Track | 325.4 | 97.3 | 1560 | 92.8 | 190.1 | 4.02 |
| Hilleshög HIL9923 | On Track | 337.5 | 100.9 | 1497 | 89.0 | 190.0 | 4.81 |
| Hilleshög HIL9924 | On Track | 335.0 | 100.2 | 1455 | 86.5 | 186.7 | 4.09 |
| Maribo MA717 | On Track | 342.0 | 102.3 | 1742 | 103.6 | 205.9 | 4.85 |
| Maribo MA718 | Not On Track | 330.0 | 98.7 | 1476 | 87.8 | 186.5 | 4.39 |
| Maribo MA719 | On Track | 337.1 | 100.8 | 1617 | 96.2 | 197.0 | 4.41 |
| SX RR1875 | On Track | 341.6 | 102.2 | 1605 | 95.5 | 197.6 | 4.06 |
| SX RR1876 | Not On Track | 332.6 | 99.5 | 1694 | 100.8 | 200.2 | 4.31 |
| SX RR1877 | Not On Track | 330.0 | 98.7 | 1626 | 96.7 | 195.4 | 4.62 |
| SX RR1878 | On Track | 335.6 | 100.4 | 1756 | 104.4 | 204.8 | 4.71 |
| SX RR1879 | On Track | 338.5 | 101.2 | 1770 | 105.3 | 206.5 | 4.88 |
| SV RR371 | On Track | 339.0 | 101.4 | 1833 | 109.0 | 210.4 | 4.59 |
| SV RR372 | On Track | 332.7 | 99.5 | 1723 | 102.5 | 202.0 | 4.23 |
| SV RR373 | Not On Track | 331.8 | 99.2 | 1613 | 95.9 | 195.2 | 4.31 |
| SV RR374 | On Track | 337.2 | 100.8 | 1776 | 105.6 | 206.5 | 4.71 |
| SV RR375 | Not On Track | 342.4 | 102.4 | 1802 | 107.2 | 209.6 | 5.08 |
| **Benchmark Varieties** | | | | | | | |
| BTS 80RR52 | | 334.2 | 99.9 | 1699 | 101.1 | | |
| Hilleshög 4302RR | | 334.0 | 99.9 | 1597 | 95.0 | | |
| Crystal 101RR | | 329.3 | 98.5 | 1718 | 102.2 | | |
| Crystal 355RR | | 340.0 | 101.7 | 1711 | 101.8 | | |
| Benchmark Mean | | 334.4 | | 1681 | | | |

^ = not on track for approval. On Track = data is tracking for potential approval.
^^ All Cercospora ratings 2017 were adjusted to 1982 basis.

Full market approval criteria include: 1) 2 years of official trial data, 2) Cercospora rating must not exceed 5.00 (1982 adjusted data),
3a) R/T >= 100% of Bench or 3b) R/T >= 97% and R/T + $/A equal to 202 of Bench.
Bench for 2017 added Crystal 355RR and dropped BTS 81RR17(Check). Created 11-04-2017.

Table 28. Calculation for Approval of Sugarbeet Varieties for ACSC Aphanomyces Specialty Market for 2018

| Trial | | Approval | Root Aph. Rating | | | | | Cercospora Rating + | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yrs | Variety | Status | 2015 | 2016 | 2017 | 2 Yr | 3 Yr | 2015 | 2016 | 2017 | 2 Yr | 3 Yr |
| | **Previously Approved (3 Yrs)** | | | | | | <=4.70 | | | | | <=5.40 |
| 8 | BTS 80RR52 | Approved | 3.24 | 4.11 | 4.36 | 4.24 | 3.90 | 4.11 | 4.28 | 4.37 | 4.33 | 4.25 |
| 5 | BTS 8337 | Approved | 2.55 | 3.26 | 3.78 | 3.52 | 3.20 | 4.49 | 4.62 | 4.36 | 4.49 | 4.49 |
| 3 | BTS 8500 | Approved | 3.54 | 4.22 | 4.52 | 4.37 | 4.09 | 4.45 | 4.54 | 4.29 | 4.42 | 4.43 |
| 3 | BTS 8512 | Approved | 3.91 | 4.17 | 3.78 | 3.98 | 3.95 | 4.12 | 4.04 | 3.69 | 3.87 | 3.95 |
| 3 | BTS 8524 | Approved | 3.33 | 3.89 | 4.49 | 4.19 | 3.90 | 4.40 | 4.74 | 4.38 | 4.56 | 4.51 |
| 3 | BTS 8572 | Approved | 4.05 | 4.46 | 3.76 | 4.11 | 4.09 | 4.60 | 4.41 | 4.14 | 4.28 | 4.38 |
| 8 | Crystal 093RR | Approved | 3.86 | 4.32 | 4.43 | 4.38 | 4.20 | 4.76 | 4.95 | 4.49 | 4.72 | 4.73 |
| 7 | Crystal 101RR | Approved | 3.31 | 3.42 | 3.92 | 3.67 | 3.55 | 4.65 | 4.59 | 4.57 | 4.58 | 4.60 |
| 5 | Crystal 355RR | Approved | 3.26 | 4.46 | 4.84 | 4.65 | 4.19 | 4.43 | 4.60 | 4.36 | 4.48 | 4.46 |
| 4 | Crystal 467RR | Approved | 3.55 | 4.04 | 3.96 | 4.00 | 3.85 | 4.34 | 4.69 | 4.46 | 4.58 | 4.50 |
| 3 | Crystal 573RR | Approved | 3.69 | 4.06 | 3.84 | 3.95 | 3.86 | 4.15 | 4.35 | 4.15 | 4.25 | 4.22 |
| 3 | Crystal 574RR | Approved | 2.93 | 3.69 | 4.72 | 4.21 | 3.78 | 4.30 | 4.51 | 4.35 | 4.43 | 4.39 |
| 9 | Crystal 986RR | Approved | 3.87 | 4.41 | 4.09 | 4.25 | 4.12 | 4.97 | 4.75 | 4.77 | 4.76 | 4.83 |
| 3 | Hilleshög HIL9707 | Approved | 3.52 | 3.99 | 4.70 | 4.35 | 4.07 | 4.60 | 4.53 | 4.96 | 4.75 | 4.70 |
| 7 | Hilleshög 4302RR | NO | 4.02 | 4.63 | 6.66 | 5.65 | 5.10 | 4.13 | 4.13 | 3.93 | 4.03 | 4.06 |
| 5 | Hilleshög 9528RR | Approved | 2.97 | 3.77 | 5.63 | 4.70 | 4.12 | 5.16 | 4.73 | 4.99 | 4.86 | 4.96 |
| 4 | Maribo 109 | Approved | 3.54 | 4.27 | 5.06 | 4.67 | 4.29 | 4.56 | 4.14 | 4.14 | 4.14 | 4.28 |
| 3 | Maribo MA502 | Approved | 2.93 | 3.06 | 3.53 | 3.30 | 3.17 | 5.04 | 4.79 | 5.01 | 4.90 | 4.95 |
| 5 | SV RR333 | Approved | 3.46 | 4.71 | 4.99 | 4.85 | 4.39 | 4.54 | 4.85 | 4.84 | 4.85 | 4.74 |
| 3 | SV RR351 | Approved | 3.53 | 4.38 | 4.18 | 4.28 | 4.03 | 4.62 | 4.50 | 4.41 | 4.46 | 4.51 |
| 3 | SX Avalanche RR(858) | Approved | 3.40 | 4.44 | 4.00 | 4.22 | 3.95 | 4.15 | 4.74 | 4.64 | 4.69 | 4.51 |
| 4 | SX Canyon RR | Approved | 3.59 | 4.28 | 4.33 | 4.31 | 4.07 | 4.02 | 4.76 | 4.92 | 4.84 | 4.57 |
| 4 | SX Cruze RR | Approved | 4.14 | 3.41 | 4.79 | 4.10 | 4.11 | 4.57 | 4.65 | 5.37 | 5.01 | 4.86 |
| 5 | SX Winchester RR | Approved | 3.07 | 3.85 | 4.36 | 4.11 | 3.76 | 3.67 | 3.97 | 4.07 | 4.02 | 3.90 |
| | **Candidates for Approval** | | | | | <=4.40 | | | | | | <=5.20 |
| 5 | BTS 8363 | NO | 4.77 | 4.93 | 4.60 | 4.77 | 4.77 | 3.83 | 4.33 | 4.10 | 4.22 | 4.09 |
| 2 | BTS 8606 | NO | -- | 4.60 | 4.91 | 4.76 | -- | | 5.12 | 4.73 | 4.93 | |
| 2 | BTS 8629 | NO | -- | 4.14 | 4.68 | 4.41 | -- | | 4.59 | 4.29 | 4.44 | |
| 6 | Crystal 246RR | NO | 4.99 | 4.85 | 5.13 | 4.99 | 4.99 | 4.49 | 4.81 | 4.63 | 4.72 | 4.64 |
| 6 | Crystal 247RR | NO | 4.94 | 4.77 | 5.35 | 5.06 | 5.02 | 4.19 | 4.65 | 4.55 | 4.60 | 4.46 |
| 3 | Crystal 572RR | NO | 4.33 | 4.74 | 4.69 | 4.72 | 4.59 | 4.65 | 4.57 | 4.27 | 4.42 | 4.50 |
| 3 | Crystal 578RR | NO | 4.52 | 4.44 | 4.56 | 4.50 | 4.51 | 4.93 | 4.87 | 4.91 | 4.89 | 4.90 |
| 2 | Crystal 684RR | Approved | -- | 3.74 | 4.31 | 4.03 | -- | -- | 4.57 | 4.34 | 4.46 | -- |
| 3 | Hilleshög HIL9708 | NO | 4.69 | 4.82 | 5.94 | 5.38 | 5.15 | 5.04 | 4.74 | 4.61 | 4.68 | 4.80 |
| 2 | Hilleshög HIL9895 | Approved | -- | 3.65 | 4.39 | 4.02 | -- | -- | 4.49 | 4.84 | 4.67 | -- |
| 6 | Hilleshög 4448RR | NO | 2.80 | 3.90 | 6.29 | 5.10 | 4.33 | 5.29 | 5.21 | 5.28 | 5.25 | 5.26 |
| 5 | Maribo 305 | NO | 4.76 | 4.42 | 5.67 | 5.05 | 4.95 | 4.76 | 4.72 | 4.98 | 4.85 | 4.82 |
| 3 | Maribo MA504 | NO | 4.60 | 4.54 | 6.20 | 5.37 | 5.11 | 5.25 | 5.04 | 5.50 | 5.27 | 5.26 |
| 2 | Maribo MA611 | Approved | -- | 3.94 | 4.00 | 3.97 | -- | -- | 4.47 | 5.03 | 4.75 | -- |
| 4 | SV RR244TT | NO | 4.23 | 4.97 | 4.91 | 4.94 | 4.70 | 4.17 | 4.46 | 4.85 | 4.66 | 4.49 |
| 2 | SV RR265 | NO | -- | 4.54 | 5.35 | 4.95 | -- | -- | 5.00 | 5.19 | 5.10 | -- |
| 2 | SV RR266 | NO | -- | 4.62 | 5.64 | 5.13 | -- | -- | 4.74 | 4.61 | 4.68 | -- |
| 2 | SV RR268 | Approved | -- | 4.00 | 4.71 | 4.36 | -- | -- | 5.13 | 5.06 | 5.10 | -- |
| 3 | SX Marathon RR(856) | NO | 4.53 | 4.38 | 4.52 | 4.45 | 4.48 | 5.37 | 4.44 | 4.54 | 4.49 | 4.78 |
| 2 | SX RR1861 | NO | -- | 4.40 | 5.71 | 5.06 | -- | -- | 4.52 | 4.74 | 4.63 | -- |
| 2 | SX RR1863 | Approved | -- | 3.55 | 4.88 | 4.22 | -- | -- | 4.35 | 4.08 | 4.22 | -- |
| | Approval Criteria new varieties | | | | | 4.40 | | | | | 5.20 | |
| | Criteria to Maintain Approval | | | | | | 4.70 | | | | | 5.40 |

+ All Cercospora ratings 2015-2017 were adjusted to 1982 basis.

Aphanomyces approval criteria include: 1) Cercospora rating must not exceed 5.20 (1982 adjusted data), 2) Aph root rating <= 4.40 after 2 years.
3 yrs of data may be considered for initial approval.

To maintain Aphanomyces approval criteria include: 1) Cercospora 3 year mean must not exceed 5.40, 2) Aph root rating <= 4.70 after 3 years.

Created 11/8/2017

Previously approved varieties not meeting current approval standards may be sold in 2018.

Table 29. Calculation for Approval of Sugarbeet Varieties for ACSC Rhizoctonia Specialty Market for 2018

| | Approval | Disease Index + | | | | | Cercospora Rating | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Variety | Status | 2015 | 2016 | 2017 | 2 Yr Mn | 3 Yr Mn | 2015 | 2016 | 2017 | 2 Yr Mn | 3 Yr Mn |
| **Previously Approved (3 Yr)** | | | | | | | | | | | |
| Crystal 355RR | Approved | NE | 3.96 | 4.09 | 4.03 | NE | 4.43 | 4.60 | 4.36 | 4.48 | 4.46 |
| Hilleshög 4302RR | Approved | 3.70 | 3.65 | 3.60 | 3.63 | 3.65 | 4.13 | 4.13 | 3.93 | 4.03 | 4.06 |
| Maribo 109 | Approved | 3.67 | 3.69 | 3.63 | 3.66 | 3.66 | 4.56 | 4.14 | 4.14 | 4.14 | 4.28 |
| **Candidates for Approval (2 Yr)** | | | | | | | | | | | |
| BTS 80RR52 | Not Approved | 3.95 | 4.41 | 4.14 | 4.28 | 4.17 | 4.11 | 4.28 | 4.37 | 4.33 | 4.25 |
| BTS 8337 | Not Approved | 3.87 | 4.08 | 4.30 | 4.19 | 4.08 | 4.49 | 4.62 | 4.36 | 4.49 | 4.49 |
| BTS 8363 | Not Approved | 4.12 | 4.34 | 4.85 | 4.60 | 4.44 | 3.83 | 4.33 | 4.10 | 4.22 | 4.09 |
| BTS 8500 | Not Approved | 4.19 | 4.43 | 4.57 | 4.50 | 4.40 | 4.45 | 4.54 | 4.29 | 4.42 | 4.43 |
| BTS 8512 | Not Approved | 4.28 | 4.44 | 4.28 | 4.36 | 4.33 | 4.12 | 4.04 | 3.69 | 3.87 | 3.95 |
| BTS 8524 | Not Approved | 4.14 | 4.20 | 4.41 | 4.31 | 4.25 | 4.40 | 4.74 | 4.38 | 4.56 | 4.51 |
| BTS 8572 | Not Approved | 3.85 | 4.54 | 4.32 | 4.43 | 4.24 | 4.60 | 4.41 | 4.14 | 4.28 | 4.38 |
| BTS 8606 | Not Approved | -- | 4.48 | 5.00 | 4.74 | -- | -- | 5.12 | 4.73 | 4.93 | -- |
| BTS 8629 | Not Approved | -- | 3.73 | 4.21 | 3.97 | -- | -- | 4.59 | 4.29 | 4.44 | -- |
| Crystal 093RR | Not Approved | 3.96 | 4.37 | 4.50 | 4.44 | 4.28 | 4.76 | 4.95 | 4.49 | 4.72 | 4.73 |
| Crystal 101RR | Not Approved | 4.64 | 4.78 | 4.78 | 4.78 | 4.73 | 4.65 | 4.59 | 4.57 | 4.58 | 4.60 |
| Crystal 246RR | Not Approved | 4.19 | 4.32 | 4.23 | 4.28 | 4.25 | 4.49 | 4.81 | 4.63 | 4.72 | 4.64 |
| Crystal 247RR | Not Approved | 4.33 | 4.32 | 4.49 | 4.41 | 4.38 | 4.19 | 4.65 | 4.55 | 4.60 | 4.46 |
| Crystal 467RR | Not Approved | 3.97 | 4.26 | 4.47 | 4.37 | 4.23 | 4.34 | 4.69 | 4.46 | 4.58 | 4.50 |
| Crystal 572RR | Not Approved | 3.89 | 4.21 | 4.47 | 4.34 | 4.19 | 4.65 | 4.57 | 4.27 | 4.42 | 4.50 |
| Crystal 573RR | Not Approved | 4.25 | 4.55 | 4.57 | 4.56 | 4.46 | 4.15 | 4.35 | 4.15 | 4.25 | 4.22 |
| Crystal 574RR | Not Approved | 4.16 | 4.47 | 4.16 | 4.32 | 4.26 | 4.30 | 4.51 | 4.35 | 4.43 | 4.39 |
| Crystal 578RR | Not Approved | 4.03 | 4.32 | 4.40 | 4.36 | 4.25 | 4.93 | 4.87 | 4.91 | 4.89 | 4.90 |
| Crystal 684RR | Not Approved | -- | 4.41 | 4.57 | 4.49 | -- | -- | 4.57 | 4.34 | 4.46 | -- |
| Crystal 986RR | Not Approved | 4.06 | 4.38 | 4.39 | 4.39 | 4.28 | 4.97 | 4.75 | 4.77 | 4.76 | 4.83 |
| Hilleshög 4448RR | Not Approved | 3.92 | 4.51 | 4.63 | 4.57 | 4.35 | 5.29 | 5.21 | 5.28 | 5.25 | 5.26 |
| Hilleshög 9528RR | Not Approved | 4.10 | 4.21 | 4.21 | 4.21 | 4.17 | 5.16 | 4.73 | 4.99 | 4.86 | 4.96 |
| Hilleshög HIL9707 | Not Approved | 4.21 | 4.40 | 4.43 | 4.42 | 4.35 | 4.60 | 4.53 | 4.96 | 4.75 | 4.70 |
| Hilleshög HIL9708 | Not Approved | 4.04 | 4.28 | 4.21 | 4.25 | 4.18 | 5.04 | 4.74 | 4.61 | 4.68 | 4.80 |
| Hilleshög HIL9895 | Not Approved | -- | 4.56 | 4.34 | 4.45 | -- | -- | 4.49 | 4.84 | 4.67 | -- |
| Maribo 305 | Not Approved | 3.83 | 4.40 | 4.60 | 4.50 | 4.28 | 4.76 | 4.72 | 4.98 | 4.85 | 4.82 |
| Maribo MA502 | Not Approved | 4.14 | 4.73 | 4.78 | 4.76 | 4.55 | 5.04 | 4.79 | 5.01 | 4.90 | 4.95 |
| Maribo MA504 | Not Approved | 3.98 | 4.58 | 4.37 | 4.48 | 4.31 | 5.25 | 5.04 | 5.50 | 5.27 | 5.26 |
| Maribo MA611 | Not Approved | -- | 4.63 | 4.44 | 4.54 | -- | -- | 4.47 | 5.03 | 4.75 | -- |
| SX Avalanche RR(858) | Not Approved | 4.21 | 4.52 | 4.29 | 4.41 | 4.34 | 4.15 | 4.74 | 4.64 | 4.69 | 4.51 |
| SX Canyon RR | Not Approved | 4.22 | 4.40 | 4.51 | 4.46 | 4.38 | 4.02 | 4.76 | 4.92 | 4.84 | 4.57 |
| SX Cruze RR | Not Approved | 4.18 | 4.69 | 4.39 | 4.54 | 4.42 | 4.57 | 4.65 | 5.37 | 5.01 | 4.86 |
| SX Marathon RR(856) | Not Approved | 4.16 | 4.47 | 4.40 | 4.44 | 4.34 | 5.37 | 4.44 | 4.54 | 4.49 | 4.78 |
| SX RR1861 | Not Approved | -- | 4.59 | 4.50 | 4.55 | -- | -- | 4.52 | 4.74 | 4.63 | -- |
| SX RR1863 | Not Approved | -- | 4.54 | 4.23 | 4.39 | -- | -- | 4.35 | 4.08 | 4.22 | -- |
| SX Winchester RR | Not Approved | 4.28 | 4.63 | 4.47 | 4.55 | 4.46 | 3.67 | 3.97 | 4.07 | 4.02 | 3.90 |
| SV RR244TT | Not Approved | 4.18 | 4.45 | 4.50 | 4.48 | 4.38 | 4.17 | 4.46 | 4.85 | 4.66 | 4.49 |
| SV RR265 | Not Approved | -- | 4.44 | 4.42 | 4.43 | -- | -- | 5.00 | 5.19 | 5.10 | -- |
| SV RR266 | Not Approved | -- | 4.20 | 4.39 | 4.30 | -- | -- | 4.74 | 4.61 | 4.68 | -- |
| SV RR268 | Not Approved | -- | 4.70 | 4.57 | 4.64 | -- | -- | 5.13 | 5.06 | 5.10 | -- |
| SV RR333 | Not Approved | 4.11 | 4.44 | 4.44 | 4.44 | 4.33 | 4.54 | 4.85 | 4.84 | 4.85 | 4.74 |
| SV RR351 | Not Approved | -- | 4.17 | 4.25 | 4.21 | -- | 4.62 | 4.50 | 4.41 | 4.46 | 4.51 |
| **Susceptible Checks** | | | | | | | | | | | |
| RH CK#08 CRYS539RR | | 4.65 | 4.84 | 4.74 | | | | | | | |
| RH CK#21 CRYS768RR | | -- | -- | 4.66 | | | | | | | |
| RH CK#24 BETA86RR88 | | 4.82 | -- | -- | | | | | | | |
| RH CK#25 HILL4043RR | | 4.35 | 4.76 | 4.51 | | | | | | | |
| RH CK#27 HILL4012RR | | 4.41 | -- | -- | | | | | | | |
| RH CK#28 CRYS658RR | | -- | 4.57 | -- | | | | | | | |
| RH CK#29 BETA87RR58 | | 4.77 | 4.67 | 4.79 | | | | | | | |
| RH CK#30 SES36711RR | | 4.91 | -- | -- | | | | | | | |
| RH CK#31 HILL4000RR | | 5.03 | 4.80 | 4.65 | | | | | | | |
| RH CK#34 BETA86RR66 | | 4.57 | -- | -- | | | | | | | |
| RH CK#35 SES36812RR | | 4.37 | 4.55 | 4.71 | | | | | | | |
| RH CK#36 BETA85RR02 | | 4.71 | -- | -- | | | | | | | |
| RH CK#37 SES36918RR | | 4.34 | 4.67 | -- | | | | | | | |
| RH CK#40 CRYS101RR | | 4.55 | 4.65 | 4.55 | | | | | | | |
| RH CK#45 BTS82RR33 | | -- | -- | 4.73 | | | | | | | |
| RH CK#47 SES36272RR | | -- | 4.50 | 4.62 | | | | | | | |
| RH CK#49 CRYS247RR | | -- | 4.38 | 4.65 | | | | | | | |
| Susceptible Hybrid Mean | | 4.62 | 4.64 | 4.66 | 4.65 | 4.64 | | | | **5.20** | **5.40** |
| Approval Criteria ++ | | 3.82 | 3.82 | 3.82 | **3.82** | **3.82** | | | | | |
| Disapproval Criteria | | | | | | **4.18** | | | | | |

Rhc and CR ratings were adjusted based upon check performance. Created 11/8/2017
+ Disease Index is based on a scale of 0 (healthy) to 7 (dead).
++ Candidates must have better tolerance than susc. check mean * 80%. To maintain approval, tolerance must be better than susc. check mean * 90%.
Previously approved varieties not meeting current approval standards may be sold in 2018.

Table 30. 2017 Aphanomyces Ratings for Official Trial Entries
Betaseed Nursery - Shakopee, MN & ACSC - RRV

| | | | | Adjusted @ | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Chk | | | Shak | | | | | | Trial |
| @ | Code | Variety | 8/30 | 2017 | 2 Yr | 3 Yr | 2016^^ | 2015 ^^ | Yrs |
| | | | | 1 loc | 3loc | 5 loc | 2 loc | 2 loc | |
| | 529 | BTS 80RR52 | 4.36 | 4.36 | 4.23 | 3.90 | 4.11 | 3.24 | 8 |
| | 545 | BTS 8337 | 3.78 | 3.78 | 3.52 | 3.19 | 3.26 | 2.55 | 5 |
| | 562 | BTS 8363 | 4.60 | 4.60 | 4.76 | 4.76 | 4.93 | 4.77 | 5 |
| | 513 | BTS 8500 | 4.52 | 4.52 | 4.37 | 4.09 | 4.22 | 3.54 | 3 |
| | 533 | BTS 8512 | 3.78 | 3.78 | 3.97 | 3.95 | 4.17 | 3.91 | 3 |
| | 550 | BTS 8524 | 4.49 | 4.49 | 4.19 | 3.90 | 3.89 | 3.33 | 3 |
| | 570 | BTS 8572 | 3.76 | 3.76 | 4.11 | 4.09 | 4.46 | 4.05 | 3 |
| | 509 | BTS 8606 | 4.91 | 4.91 | 4.75 | -- | 4.60 | -- | 2 |
| | 525 | BTS 8629 | 4.68 | 4.68 | 4.41 | -- | 4.14 | -- | 2 |
| | 577 | BTS 8735 | 4.74 | 4.74 | -- | -- | -- | -- | 1 |
| | 506 | BTS 8742 | 5.02 | 5.02 | -- | -- | -- | -- | 1 |
| | 536 | BTS 8749 | 3.53 | 3.53 | -- | -- | -- | -- | 1 |
| | 540 | BTS 8756 | 5.23 | 5.23 | -- | -- | -- | -- | 1 |
| | 521 | BTS 8767 | 4.80 | 4.80 | -- | -- | -- | -- | 1 |
| | 518 | BTS 8770 | 4.97 | 4.97 | -- | -- | -- | -- | 1 |
| | 567 | BTS 8784 | 4.59 | 4.59 | -- | -- | -- | -- | 1 |
| | 502 | BTS 8787 | 4.71 | 4.71 | -- | -- | -- | -- | 1 |
| | 512 | BTS 8798 | 4.92 | 4.92 | -- | -- | -- | -- | 1 |
| | 549 | Crystal 093RR | 4.43 | 4.43 | 4.38 | 4.21 | 4.32 | 3.86 | 8 |
| | 551 | Crystal 101RR | 3.92 | 3.92 | 3.67 | 3.55 | 3.42 | 3.31 | 7 |
| | 507 | Crystal 246RR | 5.13 | 5.13 | 4.99 | 4.99 | 4.85 | 4.99 | 6 |
| | 560 | Crystal 247RR | 5.35 | 5.35 | 5.06 | 5.02 | 4.77 | 4.94 | 6 |
| | 565 | Crystal 355RR | 4.84 | 4.84 | 4.65 | 4.19 | 4.46 | 3.26 | 5 |
| | 523 | Crystal 467RR | 3.96 | 3.96 | 4.00 | 3.85 | 4.04 | 3.55 | 4 |
| | 503 | Crystal 572RR | 4.69 | 4.69 | 4.71 | 4.59 | 4.74 | 4.33 | 3 |
| | 554 | Crystal 573RR | 3.84 | 3.84 | 3.95 | 3.86 | 4.06 | 3.69 | 3 |
| | 544 | Crystal 574RR | 4.72 | 4.72 | 4.21 | 3.78 | 3.69 | 2.93 | 3 |
| | 571 | Crystal 578RR | 4.56 | 4.56 | 4.50 | 4.51 | 4.44 | 4.52 | 3 |
| | 510 | Crystal 684RR | 4.31 | 4.31 | 4.02 | -- | 3.74 | -- | 2 |
| | 547 | Crystal 792RR | 4.73 | 4.73 | -- | -- | -- | -- | 1 |
| | 557 | Crystal 793RR | 3.02 | 3.02 | -- | -- | -- | -- | 1 |
| | 534 | Crystal 794RR | 4.65 | 4.65 | -- | -- | -- | -- | 1 |
| | 522 | Crystal 795RR | 4.40 | 4.40 | -- | -- | -- | -- | 1 |
| | 553 | Crystal 796RR | 3.11 | 3.11 | -- | -- | -- | -- | 1 |
| | 528 | Crystal 797RR | 5.21 | 5.21 | -- | -- | -- | -- | 1 |
| | 532 | Crystal 986RR | 4.09 | 4.09 | 4.25 | 4.12 | 4.41 | 3.87 | 9 |
| | 559 | Hilleshög HIL9707 | 4.70 | 4.70 | 4.34 | 4.07 | 3.99 | 3.52 | 3 |
| | 576 | Hilleshög HIL9708 | 5.94 | 5.94 | 5.38 | 5.15 | 4.82 | 4.69 | 3 |
| | 561 | Hilleshög HIL9895 | 4.39 | 4.39 | 4.02 | -- | 3.65 | -- | 2 |
| | 566 | Hilleshög HIL9920 | 4.94 | 4.94 | -- | -- | -- | -- | 1 |
| | 563 | Hilleshög HIL9921 | 5.41 | 5.41 | -- | -- | -- | -- | 1 |
| | 504 | Hilleshög HIL9922 | 5.79 | 5.79 | -- | -- | -- | -- | 1 |
| | 543 | Hilleshög HIL9923 | 5.06 | 5.06 | -- | -- | -- | -- | 1 |
| | 517 | Hilleshög HIL9924 | 5.37 | 5.37 | -- | -- | -- | -- | 1 |
| | 505 | Hilleshög 4302RR | 6.66 | 6.66 | 5.65 | 5.10 | 4.63 | 4.02 | 7 |
| | 542 | Hilleshög 4448RR | 6.29 | 6.29 | 5.09 | 4.33 | 3.90 | 2.80 | 6 |
| | 531 | Hilleshög 9528RR | 5.63 | 5.63 | 4.70 | 4.12 | 3.77 | 2.97 | 5 |
| | 556 | Maribo 109 | 5.06 | 5.06 | 4.66 | 4.29 | 4.27 | 3.54 | 4 |
| | 539 | Maribo 305 | 5.67 | 5.67 | 5.05 | 4.95 | 4.42 | 4.76 | 5 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 526 | Maribo MA502 | 3.53 | 3.53 | 3.29 | 3.17 | 3.06 | 2.93 | 3 |
| | 514 | Maribo MA504 | 6.20 | 6.20 | 5.37 | 5.11 | 4.54 | 4.60 | 3 |
| | 568 | Maribo MA611 | 4.00 | 4.00 | 3.97 | -- | 3.94 | -- | 2 |
| | 574 | Maribo MA717 | 5.31 | 5.31 | -- | -- | -- | -- | 1 |
| | 530 | Maribo MA718 | 4.46 | 4.46 | -- | -- | -- | -- | 1 |
| | 538 | Maribo MA719 | 4.75 | 4.75 | -- | -- | -- | -- | 1 |
| | 564 | SV RR244TT | 4.91 | 4.91 | 4.94 | 4.70 | 4.97 | 4.23 | 4 |
| | 511 | SV RR265 | 5.35 | 5.35 | 4.95 | -- | 4.54 | -- | 2 |
| | 555 | SV RR266 | 5.64 | 5.64 | 5.13 | -- | 4.62 | -- | 2 |
| | 572 | SV RR268 | 4.71 | 4.71 | 4.36 | -- | 4.00 | -- | 2 |
| | 541 | SV RR333 | 4.99 | 4.99 | 4.85 | 4.39 | 4.71 | 3.46 | 5 |
| | 573 | SV RR351 | 4.18 | 4.18 | 4.28 | 4.03 | 4.38 | 3.53 | 3 |
| | 515 | SV RR371 | 4.55 | 4.55 | -- | -- | -- | -- | 1 |
| | 501 | SV RR372 | 4.42 | 4.42 | -- | -- | -- | -- | 1 |
| | 508 | SV RR373 | 4.93 | 4.93 | -- | -- | -- | -- | 1 |
| | 578 | SV RR374 | 5.20 | 5.20 | -- | -- | -- | -- | 1 |
| | 546 | SV RR375 | 4.54 | 4.54 | -- | -- | -- | -- | 1 |
| | 537 | SX Avalanche RR(858) | 4.00 | 4.00 | 4.22 | 3.95 | 4.44 | 3.40 | 3 |
| | 548 | SX Canyon RR | 4.33 | 4.33 | 4.31 | 4.07 | 4.28 | 3.59 | 4 |
| | 535 | SX Cruze RR | 4.79 | 4.79 | 4.10 | 4.11 | 3.41 | 4.14 | 4 |
| | 519 | SX Marathon RR(856) | 4.52 | 4.52 | 4.45 | 4.48 | 4.38 | 4.53 | 3 |
| | 558 | SX RR1861 | 5.71 | 5.71 | 5.05 | -- | 4.40 | -- | 2 |
| | 527 | SX RR1863 | 4.88 | 4.88 | 4.21 | -- | 3.55 | -- | 2 |
| | 516 | SX RR1875 | 4.13 | 4.13 | -- | -- | -- | -- | 1 |
| | 520 | SX RR1876 | 4.73 | 4.73 | -- | -- | -- | -- | 1 |
| | 569 | SX RR1877 | 3.84 | 3.84 | -- | -- | -- | -- | 1 |
| | 552 | SX RR1878 | 5.54 | 5.54 | -- | -- | -- | -- | 1 |
| | 524 | SX RR1879 | 4.18 | 4.18 | -- | -- | -- | -- | 1 |
| | 575 | SX Winchester RR | 4.36 | 4.36 | 4.11 | 3.76 | 3.85 | 3.07 | 5 |
| 1 | 1001 | AP Ck-32 CRYS981RR | 3.19 | 3.19 | 3.45 | 3.38 | 3.71 | 3.25 | 9 |
| 1 | 1002 | AP CK-33 CRYS768RR | 4.74 | 4.74 | 4.73 | 4.77 | 4.71 | 4.86 | 11 |
| 1 | 1003 | AP CK-34 HILL4000RR | 6.76 | 6.76 | 6.13 | 6.00 | 5.49 | 5.73 | 11 |
| 1 | 1004 | AP CK-35 BETA87RR58 | 4.86 | 4.86 | 5.03 | 5.29 | 5.20 | 5.79 | 11 |
| 1 | 1005 | AP CK-41 CRYS765RR | 6.01 | 6.01 | 5.91 | 6.19 | 5.81 | 6.73 | 7 |
| 1 | 1006 | AP CK-43 BTS80RR32 | 4.64 | 4.64 | 4.65 | 4.86 | 4.66 | 5.26 | 8 |
| 1 | 1007 | AP CK-44 SX VISION RR | 5.17 | 5.17 | 5.07 | 5.16 | 4.97 | 5.33 | 9 |
| 1 | 1008 | AP CK-45 CRYS986RR | 4.22 | 4.22 | 4.41 | 4.32 | 4.60 | 4.14 | 9 |
| 1 | 1009 | AP CK-47 CRYS101RR | 3.83 | 3.83 | 3.62 | 3.46 | 3.41 | 3.14 | 7 |
| 1 | 1010 | AP CK-49 BTS82RR33 | 6.29 | 6.29 | 5.96 | 6.00 | 5.63 | 6.09 | 6 |
| 1 | 1011 | AP CK-51 CRYS246RR | 4.65 | 4.65 | 4.77 | 4.84 | 4.89 | 4.99 | 6 |
| 1 | 1012 | AP CK-52 HILL4094RR | 4.58 | 4.58 | 4.74 | 4.69 | 4.90 | 4.60 | 10 |
| 1 | 1013 | AP CK-53 CRYS093RR | 4.19 | 4.19 | 4.37 | 4.20 | 4.55 | 3.86 | 8 |
| 1 | 1014 | AP CK-54 SES36273RR | 5.05 | 5.05 | 4.76 | 4.63 | 4.46 | 4.38 | 6 |
| 1 | 1015 | AP CK-55 CRYS247RR | 4.00 | 4.00 | 4.59 | 4.71 | 5.19 | 4.94 | 6 |
| | 1016 | AP CHK SUS HYB#3 | 4.99 | 4.99 | 5.34 | 5.90 | 5.70 | 7.03 | 11 |
| | 1017 | AP CHK MOD RES RR | 4.65 | 4.65 | 4.71 | 4.54 | 4.76 | 4.22 | 11 |
| | 1018 | AP CHK RES RR | 4.49 | 4.49 | 4.21 | 4.00 | 3.93 | 3.59 | 12 |
| | 1019 | AP CHK SUS HYB#3 | 5.40 | 5.40 | 5.55 | 6.04 | 5.70 | 7.03 | 11 |
| | 1020 | AP CHK SUS HYB#4 | 5.99 | 5.99 | 5.92 | 6.46 | 5.85 | 7.56 | 11 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1021 | AP CHK MOD RES RR#2 | 4.78 | 4.78 | 4.76 | 4.68 | 4.74 | 4.51 | 11 |
| | 1022 | AP CHK MOD RES RR#4 | 4.74 | 4.74 | 4.76 | 4.82 | 4.77 | 4.94 | 6 |
| | 1023 | AC CHK RES RR#3 | 3.23 | 3.23 | 3.13 | 2.88 | 3.02 | 2.38 | 10 |
| | 1024 | AP CHK SUS HYB#4 | 6.20 | 6.20 | 6.02 | 6.53 | 5.85 | 7.56 | 11 |
| | | **Conventional** | | | | | | | |
| | 919 | BETA EXP 687 | 4.30 | 4.30 | 4.59 | -- | 4.88 | -- | 2 |
| | 918 | BETA EXP 698 | 3.62 | 3.62 | 3.65 | -- | 3.69 | -- | 2 |
| | 905 | BETA EXP 747 | 3.60 | 3.60 | -- | -- | -- | -- | 1 |
| | 909 | BETA EXP 758 | 3.29 | 3.29 | -- | -- | -- | -- | 1 |
| | 901 | Crystal 620 | 4.09 | 4.09 | 4.18 | -- | 4.28 | -- | 2 |
| | 906 | Crystal 622 | 4.05 | 4.05 | 4.20 | -- | 4.36 | -- | 2 |
| | 913 | Crystal 735 | 3.93 | 3.93 | -- | -- | -- | -- | 1 |
| | 910 | Crystal 737 | 2.25 | 2.25 | -- | -- | -- | -- | 1 |
| | 902 | Crystal R761 | 4.01 | 4.01 | 3.79 | -- | 3.57 | -- | 11 |
| | 914 | Hilleshög 3035Rz | 5.18 | 5.18 | 4.79 | -- | 4.40 | -- | 13 |
| | 917 | Hilleshög 9891Rz | 4.89 | 4.89 | 4.67 | -- | 4.45 | -- | 2 |
| | 904 | Maribo MA615Rz | 5.30 | 5.30 | 5.05 | -- | 4.80 | -- | 2 |
| | 916 | Maribo MA720Rz | 5.15 | 5.15 | -- | -- | -- | -- | 1 |
| | 911 | Seedex 8869 | 4.99 | 4.99 | 4.85 | -- | 4.70 | -- | 2 |
| | 907 | Seedex Deuce | 6.04 | 6.04 | 5.87 | -- | 5.70 | -- | 10 |
| | 912 | Strube 12720 | 8.11 | 8.11 | -- | -- | -- | -- | 1 |
| | 908 | Strube 13722 | 7.54 | 7.54 | -- | -- | -- | -- | 1 |
| | 903 | SV 48611 | 4.25 | 4.25 | 4.36 | -- | 4.47 | -- | 2 |
| | 915 | SV 48777 | 4.20 | 4.20 | -- | -- | -- | -- | 1 |
| | 1001 | AP Ck-32 CRYS981RR | 2.93 | 2.93 | 3.32 | 3.30 | 3.71 | 3.25 | 9 |
| | 1003 | AP CK-34 HILL4000RR | 6.36 | 6.36 | 5.92 | 5.86 | 5.49 | 5.73 | 11 |
| | 1006 | AP CK-43 BTS80RR32 | 5.57 | 5.57 | 5.11 | 5.16 | 4.66 | 5.26 | 8 |
| | 1009 | AP CK-47 CRYS101RR | 3.01 | 3.01 | 3.21 | 3.19 | 3.41 | 3.14 | 7 |
| | 1011 | AP CK-51 CRYS246RR | 5.20 | 5.20 | 5.05 | 5.03 | 4.89 | 4.99 | 6 |
| | | | | | | | | | |
| | | Check Mean | 4.81 | 4.81 | | | | | |
| 15 | | Trial Mean | 4.75 | 4.75 | | | | | |
| | | Coeff. of Var. (%) | 24.9 | | | | | | |
| | | Mean LSD (0.05) | 1.44 | | | | | | |
| | | Mean LSD (0.01) | 1.90 | | | | | | |
| | | Sig Lvl | ** | | | | | | |
| | | Adjustment Factor | 1.11 | | | | | | |

@ 2017 Root Rating was taken in early fall (1=healthy, 9=severe damage). Created 11/3/2017

Ratings adjusted to 2003 basis. (2000-2002 Aph nurseries). Adjustment based on variety checks.

Table 31. 2017 Cercospora Ratings for ACSC Official Trial Entries
Betaseed (Randolph MN), BSDF (Frankenmuth MI) & NDSU (Foxhome MN)

| | | | | | | Adjusted to 1982 Basis @ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Chk | | | Beta | BSDF | Foxhome | | | | | | Trial |
| @ | Code | Variety | Avg | Avg | Avg | 2017 | 2 Yr | 3 Yr | 2016 | 2015 | Yrs |
| | | | 5 Dates+ | 5 Dates+ | 8 Dates+ | 3 loc | 6 loc | 9 loc | 3 loc | 3 loc | |
| | 529 | BTS 80RR52 | 3.59 | 5.40 | 4.13 | 4.37 | 4.33 | 4.26 | 4.28 | 4.11 | 8 |
| | 545 | BTS 8337 | 4.25 | 4.37 | 4.46 | 4.36 | 4.49 | 4.49 | 4.62 | 4.49 | 5 |
| | 562 | BTS 8363 | 3.96 | 4.48 | 3.87 | 4.10 | 4.21 | 4.09 | 4.33 | 3.83 | 5 |
| | 513 | BTS 8500 | 4.44 | 4.52 | 3.90 | 4.29 | 4.41 | 4.43 | 4.54 | 4.45 | 3 |
| | 533 | BTS 8512 | 2.99 | 4.29 | 3.79 | 3.69 | 3.86 | 3.95 | 4.04 | 4.12 | 3 |
| | 550 | BTS 8524 | 4.61 | 4.55 | 3.98 | 4.38 | 4.56 | 4.51 | 4.74 | 4.40 | 3 |
| | 570 | BTS 8572 | 3.51 | 4.46 | 4.45 | 4.14 | 4.27 | 4.38 | 4.41 | 4.60 | 3 |
| | 509 | BTS 8606 | 4.76 | 4.81 | 4.62 | 4.73 | 4.92 | -- | 5.12 | -- | 2 |
| | 525 | BTS 8629 | 4.18 | 4.46 | 4.22 | 4.29 | 4.44 | -- | 4.59 | -- | 2 |
| | 577 | BTS 8735 | 3.92 | 4.77 | 3.97 | 4.22 | -- | -- | -- | -- | 1 |
| | 506 | BTS 8742 | 3.73 | 4.65 | 4.71 | 4.36 | -- | -- | -- | -- | 1 |
| | 536 | BTS 8749 | 3.42 | 4.65 | 4.08 | 4.05 | -- | -- | -- | -- | 1 |
| | 540 | BTS 8756 | 3.27 | 4.65 | 4.12 | 4.01 | -- | -- | -- | -- | 1 |
| | 521 | BTS 8767 | 4.07 | 4.30 | 4.10 | 4.16 | -- | -- | -- | -- | 1 |
| | 518 | BTS 8770 | 4.18 | 4.96 | 3.77 | 4.30 | -- | -- | -- | -- | 1 |
| | 567 | BTS 8784 | 2.93 | 4.23 | 3.81 | 3.65 | -- | -- | -- | -- | 1 |
| | 502 | BTS 8787 | 3.66 | 4.60 | 3.84 | 4.03 | -- | -- | -- | -- | 1 |
| | 512 | BTS 8798 | 3.92 | 4.58 | 4.42 | 4.30 | -- | -- | -- | -- | 1 |
| | 549 | Crystal 093RR | 4.05 | 4.60 | 4.81 | 4.49 | 4.72 | 4.73 | 4.95 | 4.76 | 8 |
| | 551 | Crystal 101RR | 4.84 | 4.41 | 4.47 | 4.57 | 4.58 | 4.60 | 4.59 | 4.65 | 7 |
| | 507 | Crystal 246RR | 4.90 | 4.69 | 4.30 | 4.63 | 4.72 | 4.64 | 4.81 | 4.49 | 6 |
| | 560 | Crystal 247RR | 4.95 | 4.41 | 4.30 | 4.55 | 4.60 | 4.47 | 4.65 | 4.19 | 6 |
| | 565 | Crystal 355RR | 4.06 | 4.65 | 4.38 | 4.36 | 4.48 | 4.46 | 4.60 | 4.43 | 5 |
| | 523 | Crystal 467RR | 4.49 | 4.61 | 4.27 | 4.46 | 4.57 | 4.49 | 4.69 | 4.34 | 4 |
| | 503 | Crystal 572RR | 4.01 | 4.30 | 4.51 | 4.27 | 4.42 | 4.50 | 4.57 | 4.65 | 3 |
| | 554 | Crystal 573RR | 3.84 | 4.18 | 4.42 | 4.15 | 4.25 | 4.22 | 4.35 | 4.15 | 3 |
| | 544 | Crystal 574RR | 4.56 | 4.54 | 3.96 | 4.35 | 4.43 | 4.39 | 4.51 | 4.30 | 3 |
| | 571 | Crystal 578RR | 5.46 | 4.80 | 4.47 | 4.91 | 4.89 | 4.91 | 4.87 | 4.93 | 3 |
| | 510 | Crystal 684RR | 4.26 | 4.65 | 4.10 | 4.34 | 4.45 | -- | 4.57 | -- | 2 |
| | 547 | Crystal 792RR | 3.04 | 4.55 | 4.22 | 3.94 | -- | -- | -- | -- | 1 |
| | 557 | Crystal 793RR | 3.28 | 4.31 | 4.20 | 3.93 | -- | -- | -- | -- | 1 |
| | 534 | Crystal 794RR | 5.30 | 5.04 | 4.42 | 4.92 | -- | -- | -- | -- | 1 |
| | 522 | Crystal 795RR | 3.92 | 4.88 | 4.38 | 4.39 | -- | -- | -- | -- | 1 |
| | 553 | Crystal 796RR | 4.84 | 4.94 | 4.78 | 4.85 | -- | -- | -- | -- | 1 |
| | 528 | Crystal 797RR | 3.73 | 4.49 | 4.29 | 4.17 | -- | -- | -- | -- | 1 |
| | 532 | Crystal 986RR | 4.25 | 4.89 | 5.16 | 4.77 | 4.76 | 4.83 | 4.75 | 4.97 | 9 |
| | 559 | Hilleshög HIL9707 | 4.76 | 5.19 | 4.92 | 4.96 | 4.74 | 4.70 | 4.53 | 4.60 | 3 |
| | 576 | Hilleshög HIL9708 | 4.71 | 4.59 | 4.55 | 4.61 | 4.68 | 4.80 | 4.74 | 5.04 | 3 |
| | 561 | Hilleshög HIL9895 | 4.77 | 4.88 | 4.87 | 4.84 | 4.67 | -- | 4.49 | -- | 2 |
| | 566 | Hilleshög HIL9920 | 4.31 | 5.04 | 5.33 | 4.89 | -- | -- | -- | -- | 1 |
| | 563 | Hilleshög HIL9921 | 4.31 | 4.75 | 4.34 | 4.47 | -- | -- | -- | -- | 1 |
| | 504 | Hilleshög HIL9922 | 3.76 | 4.54 | 3.77 | 4.02 | -- | -- | -- | -- | 1 |
| | 543 | Hilleshög HIL9923 | 5.09 | 5.26 | 4.08 | 4.81 | -- | -- | -- | -- | 1 |
| | 517 | Hilleshög HIL9924 | 3.78 | 4.81 | 3.68 | 4.09 | -- | -- | -- | -- | 1 |
| | 505 | Hilleshög 4302RR | 3.63 | 4.11 | 4.04 | 3.93 | 4.03 | 4.06 | 4.13 | 4.13 | 7 |
| | 542 | Hilleshög 4448RR | 5.46 | 4.83 | 5.54 | 5.28 | 5.24 | 5.26 | 5.21 | 5.29 | 6 |
| | 531 | Hilleshög 9528RR | 5.13 | 5.01 | 4.83 | 4.99 | 4.86 | 4.96 | 4.73 | 5.16 | 5 |
| | 556 | Maribo 109 | 3.96 | 4.49 | 3.96 | 4.14 | 4.14 | 4.28 | 4.14 | 4.56 | 4 |
| | 539 | Maribo 305 | 4.77 | 5.39 | 4.77 | 4.98 | 4.85 | 4.82 | 4.72 | 4.76 | 5 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 526 | Maribo MA502 | 4.98 | 5.30 | 4.76 | | 5.01 | 4.90 | 4.95 | 4.79 | 5.04 | 3 |
| | 514 | Maribo MA504 | 5.07 | 5.76 | 5.66 | | 5.50 | 5.27 | 5.26 | 5.04 | 5.25 | 3 |
| | 568 | Maribo MA611 | 4.95 | 5.45 | 4.69 | | 5.03 | 4.75 | -- | 4.47 | -- | 2 |
| | 574 | Maribo MA717 | 4.65 | 4.84 | 5.05 | | 4.85 | -- | -- | -- | -- | 1 |
| | 530 | Maribo MA718 | 4.32 | 4.53 | 4.30 | | 4.39 | -- | -- | -- | -- | 1 |
| | 538 | Maribo MA719 | 4.13 | 5.14 | 3.96 | | 4.41 | -- | -- | -- | -- | 1 |
| | 564 | SV RR244TT | 5.10 | 4.48 | 4.95 | | 4.85 | 4.65 | 4.49 | 4.46 | 4.17 | 4 |
| | 511 | SV RR265 | 5.26 | 5.07 | 5.23 | | 5.19 | 5.09 | -- | 5.00 | -- | 2 |
| | 555 | SV RR266 | 4.35 | 5.01 | 4.48 | | 4.61 | 4.67 | -- | 4.74 | -- | 2 |
| | 572 | SV RR268 | 5.27 | 4.80 | 5.13 | | 5.06 | 5.10 | -- | 5.13 | -- | 2 |
| | 541 | SV RR333 | 4.65 | 5.07 | 4.79 | | 4.84 | 4.84 | 4.74 | 4.85 | 4.54 | 5 |
| | 573 | SV RR351 | 4.16 | 4.63 | 4.44 | | 4.41 | 4.46 | 4.51 | 4.50 | 4.62 | 3 |
| | 515 | SV RR371 | 3.73 | 5.25 | 4.79 | | 4.59 | -- | -- | -- | -- | 1 |
| | 501 | SV RR372 | 3.94 | 4.41 | 4.32 | | 4.23 | -- | -- | -- | -- | 1 |
| | 508 | SV RR373 | 3.83 | 4.65 | 4.45 | | 4.31 | -- | -- | -- | -- | 1 |
| | 578 | SV RR374 | 4.59 | 4.89 | 4.65 | | 4.71 | -- | -- | -- | -- | 1 |
| | 546 | SV RR375 | 5.10 | 5.21 | 4.91 | | 5.08 | -- | -- | -- | -- | 1 |
| | 537 | SX Avalanche RR(858) | 4.58 | 4.54 | 4.79 | | 4.64 | 4.69 | 4.51 | 4.74 | 4.15 | 3 |
| | 548 | SX Canyon RR | 4.22 | 5.84 | 4.69 | | 4.92 | 4.84 | 4.56 | 4.76 | 4.02 | 4 |
| | 535 | SX Cruze RR | 5.82 | 5.41 | 4.87 | | 5.37 | 5.01 | 4.87 | 4.65 | 4.57 | 4 |
| | 519 | SX Marathon RR(856) | 4.05 | 4.90 | 4.67 | | 4.54 | 4.49 | 4.78 | 4.44 | 5.37 | 3 |
| | 558 | SX RR1861 | 4.40 | 4.88 | 4.95 | | 4.74 | 4.63 | -- | 4.52 | -- | 2 |
| | 527 | SX RR1863 | 3.52 | 4.25 | 4.47 | | 4.08 | 4.21 | -- | 4.35 | -- | 2 |
| | 516 | SX RR1875 | 3.19 | 4.96 | 4.04 | | 4.06 | -- | -- | -- | -- | 1 |
| | 520 | SX RR1876 | 4.36 | 4.41 | 4.15 | | 4.31 | -- | -- | -- | -- | 1 |
| | 569 | SX RR1877 | 4.56 | 5.21 | 4.08 | | 4.62 | -- | -- | -- | -- | 1 |
| | 552 | SX RR1878 | 4.54 | 4.97 | 4.61 | | 4.71 | -- | -- | -- | -- | 1 |
| | 524 | SX RR1879 | 4.53 | 5.23 | 4.87 | | 4.88 | -- | -- | -- | -- | 1 |
| | 575 | SX Winchester RR | 3.42 | 4.75 | 4.03 | | 4.07 | 4.02 | 3.90 | 3.97 | 3.67 | 5 |
| 1 | 1101 | CR CK-19 CRYS539RR | 5.98 | 4.89 | 5.59 | | 5.49 | 5.39 | 5.37 | 5.30 | 5.31 | 13 |
| 1 | 1102 | CR CK-24 HILL4012RR | 5.06 | 4.87 | 5.47 | | 5.13 | 5.22 | 5.23 | 5.31 | 5.24 | 12 |
| 1 | 1103 | CR CK-28 HILL4010RR | 5.24 | 6.15 | 4.94 | | 5.44 | 5.44 | 5.36 | 5.43 | 5.20 | 12 |
| 1 | 1104 | CR CK-33 HILL4043RR | 5.33 | 5.18 | 5.13 | | 5.21 | 4.97 | 5.01 | 4.73 | 5.09 | 11 |
| 1 | 1105 | CR CK-34 HILL4000RR | 4.92 | 5.12 | 4.95 | | 5.00 | 4.88 | 4.80 | 4.77 | 4.64 | 11 |
| 1 | 1106 | CR CK-41 CRYS981RR | 5.30 | 4.56 | 4.84 | | 4.90 | 4.89 | 4.97 | 4.89 | 5.12 | 9 |
| 1 | 1107 | CR CK-42 CRYS985RR | 3.24 | 4.44 | 4.06 | | 3.91 | 4.07 | 4.20 | 4.23 | 4.45 | 9 |
| 1 | 1108 | CR CK-43 CRYS246RR | 4.70 | 4.95 | 4.67 | | 4.77 | 4.77 | 4.68 | 4.77 | 4.49 | 6 |
| 1 | 1109 | CR CK-44 BETA80RR32 | 5.51 | 4.42 | 4.88 | | 4.94 | 4.99 | 4.97 | 5.04 | 4.92 | 8 |
| 1 | 1110 | CR CK-45 HILL4448RR | 5.03 | 5.34 | 5.34 | | 5.24 | 5.12 | 5.18 | 5.00 | 5.29 | 6 |
| 1 | 1111 | CR CK-46 HILL4062RR | 3.90 | 4.25 | 4.18 | | 4.11 | 4.24 | 4.29 | 4.37 | 4.39 | 10 |
| 1 | 1112 | CR CK-47 HILL4094RR | 4.25 | 4.29 | 4.40 | | 4.31 | 4.30 | 4.30 | 4.28 | 4.30 | 10 |
| | 1113 | CR CK MOD SUS HYB#3 | 5.64 | 4.80 | 5.53 | | 5.32 | 5.33 | 5.24 | 5.33 | 5.05 | 13 |
| | 1114 | CR CK MOD SUS HYB#3 | 5.58 | 5.26 | 5.61 | | 5.49 | 5.41 | 5.29 | 5.33 | 5.05 | 13 |
| | 1115 | CR CK MOD RES HYB#4 | 3.23 | 4.95 | 4.71 | | 4.30 | 4.27 | 4.35 | 4.24 | 4.52 | 10 |
| | 1116 | CR CK MOD RES HYB#4 | 3.35 | 4.54 | 4.51 | | 4.13 | 4.19 | 4.30 | 4.24 | 4.52 | 10 |
| | 1117 | CR CK MOD SUS HYB#5 | 4.76 | 5.13 | 5.45 | | 5.11 | 5.04 | 5.10 | 4.97 | 5.21 | 11 |
| | | Conventional | | | | | | | | | | |
| | 919 | BETA EXP 687 | 3.58 | 4.05 | 4.35 | | 3.99 | 4.07 | -- | 4.14 | -- | 2 |
| | 918 | BETA EXP 698 | 4.52 | 3.87 | 4.14 | | 4.18 | 4.23 | -- | 4.27 | -- | 2 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 905 | BETA EXP 747 | 3.96 | 4.36 | 4.88 | | 4.40 | -- | -- | -- | -- | 1 |
| | 909 | BETA EXP 758 | 4.39 | 4.44 | 4.74 | | 4.52 | -- | -- | -- | -- | 1 |
| | 901 | Crystal 620 | 4.20 | 3.87 | 4.34 | | 4.14 | 4.17 | -- | 4.19 | -- | 2 |
| | 906 | Crystal 622 | 2.88 | 3.93 | 4.34 | | 3.72 | 3.84 | -- | 3.96 | -- | 2 |
| | 913 | Crystal 735 | 4.52 | 4.04 | 4.76 | | 4.44 | -- | -- | -- | -- | 1 |
| | 910 | Crystal 737 | 3.46 | 3.77 | 4.55 | | 3.92 | -- | -- | -- | -- | 1 |
| | 902 | Crystal R761 | 5.23 | 4.40 | 5.16 | | 4.93 | 4.96 | -- | 4.99 | -- | 11 |
| | 914 | Hilleshög 3035Rz | 4.12 | 4.23 | 4.93 | | 4.42 | 4.47 | -- | 4.53 | -- | 13 |
| | 917 | Hilleshög 9891Rz | 3.76 | 3.90 | 4.73 | | 4.13 | 4.27 | -- | 4.42 | -- | 2 |
| | 904 | Maribo MA615Rz | 4.92 | 4.71 | 4.80 | | 4.81 | 4.92 | -- | 5.04 | -- | 2 |
| | 916 | Maribo MA720Rz | 5.03 | 3.80 | 4.80 | | 4.54 | -- | -- | -- | -- | 1 |
| | 911 | Seedex 8869 | 5.63 | 4.33 | 5.67 | | 5.21 | 4.99 | -- | 4.76 | -- | 2 |
| | 907 | Seedex Deuce | 4.60 | 4.48 | 5.20 | | 4.76 | 4.72 | -- | 4.68 | -- | 10 |
| | 912 | Strube 12720 | 5.58 | 5.11 | 6.26 | | 5.65 | -- | -- | -- | -- | 1 |
| | 908 | Strube 13722 | 3.79 | 3.57 | 4.80 | | 4.06 | -- | -- | -- | -- | 1 |
| | 903 | SV 48611 | 5.95 | 4.30 | 5.59 | | 5.28 | 5.06 | -- | 4.85 | -- | 2 |
| | 915 | SV 48777 | 4.32 | 4.43 | 5.54 | | 4.76 | -- | -- | -- | -- | 1 |
| | 1101 | CR CK-19 CRYS539RR | 5.98 | 5.32 | 5.53 | | 5.61 | 5.45 | 5.41 | 5.30 | 5.31 | 13 |
| | 1106 | CR CK-41 CRYS981RR | 5.30 | 4.72 | 5.39 | | 5.14 | 5.01 | 5.05 | 4.89 | 5.12 | 9 |
| | 1107 | CR CK-42 CRYS985RR | 3.24 | 3.98 | 5.11 | | 4.11 | 4.17 | 4.27 | 4.23 | 4.45 | 9 |
| | 1109 | CR CK-44 BETA80RR32 | 5.51 | 4.26 | 4.92 | | 4.90 | 4.97 | 4.95 | 5.04 | 4.92 | 8 |
| | 1110 | CR CK-45 HILL4448RR | 5.03 | 5.38 | 5.39 | | 5.27 | 5.13 | 5.19 | 5.00 | 5.29 | 6 |
| | | | | | | | | | | | | |
| | | Check Mean | 4.77 | 4.89 | 4.96 | | 4.87 | | | | | |
| 12 | | Trial Mean | 4.38 | 4.80 | 4.54 | | 4.57 | | | | | |
| | | Coeff. of Var. (%) | 10.15 | 9.25 | 5.97 | | | | | | | |
| | | Mean LSD (0.05) | 0.55 | 0.59 | 0.32 | | | | | | | |
| | | Mean LSD (0.01) | 0.73 | 0.79 | 0.43 | | | | | | | |
| | | Sig Mrk | ** | ** | ** | | | | | | | |
| | | Adj Factor | 1.20 | 1.16 | 1.01 | | | | | | | |

Lower numbers indicate better Cercospora resistance (1-Ex,9=Poor).

@ Ratings adjusted to 1982 basis (5.5 equivalent in 1978-81 CR nurseries). Adjustment based on check varieties.

Chk = varieties used to adjust CR readings to 1982 basis. Ratings * (Adj. factor) = Adj Rating.

+ Average rating based upon multiple rating dates.

Created 11/3/2017

Tabel 32. 2017 Rhizoctonia Ratings for ACSC Official Trial Entries

Rhizoctonia Nursery - BSDF, NWROC & Two ACSC Sites

| Sus Chk ^ | Chk @ | Code | Variety | BSDF 8/24 | 2017 | 2 Yr | 3 Yr | 2016 | 2015 | Trial Yrs |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Adjusted @ | | | | | | |
| | | | | | 1 loc | 5 loc | 9 loc | 4 loc | 4 loc | |
| | | 529 | BTS 80RR52 | 4.14 | 4.14 | 4.27 | 4.17 | 4.41 | 3.95 | 8 |
| | | 545 | BTS 8337 | 4.30 | 4.30 | 4.19 | 4.08 | 4.08 | 3.87 | 5 |
| | | 562 | BTS 8363 | 4.85 | 4.85 | 4.59 | 4.44 | 4.34 | 4.12 | 5 |
| | | 513 | BTS 8500 | 4.57 | 4.57 | 4.50 | 4.40 | 4.43 | 4.19 | 3 |
| | | 533 | BTS 8512 | 4.28 | 4.28 | 4.36 | 4.33 | 4.44 | 4.28 | 3 |
| | | 550 | BTS 8524 | 4.41 | 4.41 | 4.31 | 4.25 | 4.20 | 4.14 | 3 |
| | | 570 | BTS 8572 | 4.32 | 4.32 | 4.43 | 4.24 | 4.54 | 3.85 | 3 |
| | | 509 | BTS 8606 | 5.00 | 5.00 | 4.74 | -- | 4.48 | -- | 2 |
| | | 525 | BTS 8629 | 4.21 | 4.21 | 3.97 | -- | 3.73 | -- | 2 |
| | | 577 | BTS 8735 | 4.38 | 4.38 | -- | -- | -- | -- | 1 |
| | | 506 | BTS 8742 | 4.23 | 4.23 | -- | -- | -- | -- | 1 |
| | | 536 | BTS 8749 | 3.95 | 3.95 | -- | -- | -- | -- | 1 |
| | | 540 | BTS 8756 | 4.34 | 4.34 | -- | -- | -- | -- | 1 |
| | | 521 | BTS 8767 | 4.75 | 4.75 | -- | -- | -- | -- | 1 |
| | | 518 | BTS 8770 | 4.57 | 4.57 | -- | -- | -- | -- | 1 |
| | | 567 | BTS 8784 | 4.64 | 4.64 | -- | -- | -- | -- | 1 |
| | | 502 | BTS 8787 | 4.31 | 4.31 | -- | -- | -- | -- | 1 |
| | | 512 | BTS 8798 | 4.52 | 4.52 | -- | -- | -- | -- | 1 |
| | | 549 | Crystal 093RR | 4.50 | 4.50 | 4.44 | 4.28 | 4.37 | 3.96 | 8 |
| | | 551 | Crystal 101RR | 4.78 | 4.78 | 4.78 | 4.73 | 4.78 | 4.64 | 7 |
| | | 507 | Crystal 246RR | 4.23 | 4.23 | 4.28 | 4.25 | 4.32 | 4.19 | 6 |
| | | 560 | Crystal 247RR | 4.49 | 4.49 | 4.40 | 4.38 | 4.32 | 4.33 | 6 |
| | | 565 | Crystal 355RR | 4.09 | 4.09 | 4.02 | -- | 3.96 | -- | 5 |
| | | 523 | Crystal 467RR | 4.47 | 4.47 | 4.37 | 4.23 | 4.26 | 3.97 | 4 |
| | | 503 | Crystal 572RR | 4.47 | 4.47 | 4.34 | 4.19 | 4.21 | 3.89 | 3 |
| | | 554 | Crystal 573RR | 4.57 | 4.57 | 4.56 | 4.45 | 4.55 | 4.25 | 3 |
| | | 544 | Crystal 574RR | 4.16 | 4.16 | 4.31 | 4.26 | 4.47 | 4.16 | 3 |
| | | 571 | Crystal 578RR | 4.40 | 4.40 | 4.36 | 4.25 | 4.32 | 4.03 | 3 |
| | | 510 | Crystal 684RR | 4.57 | 4.57 | 4.49 | -- | 4.41 | -- | 2 |
| | | 547 | Crystal 792RR | 3.88 | 3.88 | -- | -- | -- | -- | 1 |
| | | 557 | Crystal 793RR | 4.26 | 4.26 | -- | -- | -- | -- | 1 |
| | | 534 | Crystal 794RR | 4.15 | 4.15 | -- | -- | -- | -- | 1 |
| | | 522 | Crystal 795RR | 3.94 | 3.94 | -- | -- | -- | -- | 1 |
| | | 553 | Crystal 796RR | 4.23 | 4.23 | -- | -- | -- | -- | 1 |
| | | 528 | Crystal 797RR | 4.26 | 4.26 | -- | -- | -- | -- | 1 |
| | | 532 | Crystal 986RR | 4.39 | 4.39 | 4.38 | 4.28 | 4.38 | 4.06 | 9 |
| | | 559 | Hilleshög HIL9707 | 4.43 | 4.43 | 4.41 | 4.35 | 4.40 | 4.21 | 3 |
| | | 576 | Hilleshög HIL9708 | 4.21 | 4.21 | 4.25 | 4.18 | 4.28 | 4.04 | 3 |
| | | 561 | Hilleshög HIL9895 | 4.34 | 4.34 | 4.45 | -- | 4.56 | -- | 2 |
| | | 566 | Hilleshög HIL9920 | 4.48 | 4.48 | -- | -- | -- | -- | 1 |
| | | 563 | Hilleshög HIL9921 | 3.85 | 3.85 | -- | -- | -- | -- | 1 |
| | | 504 | Hilleshög HIL9922 | 4.39 | 4.39 | -- | -- | -- | -- | 1 |
| | | 543 | Hilleshög HIL9923 | 4.58 | 4.58 | -- | -- | -- | -- | 1 |
| | | 517 | Hilleshög HIL9924 | 4.62 | 4.62 | -- | -- | -- | -- | 1 |
| | | 505 | Hilleshög 4302RR | 3.60 | 3.60 | 3.63 | 3.65 | 3.65 | 3.70 | 7 |
| | | 542 | Hilleshög 4448RR | 4.63 | 4.63 | 4.57 | 4.35 | 4.51 | 3.92 | 6 |
| | | 531 | Hilleshög 9528RR | 4.21 | 4.21 | 4.21 | 4.18 | 4.21 | 4.10 | 5 |
| | | 556 | Maribo 109 | 3.63 | 3.63 | 3.66 | 3.66 | 3.69 | 3.67 | 4 |
| | | 539 | Maribo 305 | 4.60 | 4.60 | 4.50 | 4.28 | 4.40 | 3.83 | 5 |
| | | 526 | Maribo MA502 | 4.78 | 4.78 | 4.76 | 4.55 | 4.73 | 4.14 | 3 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 514 | Maribo MA504 | 4.37 | 4.37 | | 4.47 | 4.31 | 4.58 | 3.98 | 3 |
| | | 568 | Maribo MA611 | 4.44 | 4.44 | | 4.53 | -- | 4.63 | -- | 2 |
| | | 574 | Maribo MA717 | 4.28 | 4.28 | | -- | -- | -- | -- | 1 |
| | | 530 | Maribo MA718 | 4.13 | 4.13 | | -- | -- | -- | -- | 1 |
| | | 538 | Maribo MA719 | 4.28 | 4.28 | | -- | -- | -- | -- | 1 |
| | | 564 | SV RR244TT | 4.50 | 4.50 | | 4.48 | 4.38 | 4.45 | 4.18 | 4 |
| | | 511 | SV RR265 | 4.42 | 4.42 | | 4.43 | -- | 4.44 | -- | 2 |
| | | 555 | SV RR266 | 4.39 | 4.39 | | 4.30 | -- | 4.20 | -- | 2 |
| | | 572 | SV RR268 | 4.57 | 4.57 | | 4.63 | -- | 4.70 | -- | 2 |
| | | 541 | SV RR333 | 4.44 | 4.44 | | 4.44 | 4.33 | 4.44 | 4.11 | 5 |
| | | 573 | SV RR351 | 4.25 | 4.25 | | 4.21 | -- | 4.17 | -- | 3 |
| | | 515 | SV RR371 | 4.31 | 4.31 | | -- | -- | -- | -- | 1 |
| | | 501 | SV RR372 | 4.47 | 4.47 | | -- | -- | -- | -- | 1 |
| | | 508 | SV RR373 | 4.38 | 4.38 | | -- | -- | -- | -- | 1 |
| | | 578 | SV RR374 | 4.30 | 4.30 | | -- | -- | -- | -- | 1 |
| | | 546 | SV RR375 | 4.25 | 4.25 | | -- | -- | -- | -- | 1 |
| | | 537 | SX Avalanche RR(858) | 4.29 | 4.29 | | 4.40 | 4.34 | 4.52 | 4.21 | 3 |
| | | 548 | SX Canyon RR | 4.51 | 4.51 | | 4.45 | 4.38 | 4.40 | 4.22 | 4 |
| | | 535 | SX Cruze RR | 4.39 | 4.39 | | 4.54 | 4.42 | 4.69 | 4.18 | 4 |
| | | 519 | SX Marathon RR(856) | 4.40 | 4.40 | | 4.43 | 4.34 | 4.47 | 4.16 | 3 |
| | | 558 | SX RR1861 | 4.50 | 4.50 | | 4.55 | -- | 4.59 | -- | 2 |
| | | 527 | SX RR1863 | 4.23 | 4.23 | | 4.39 | -- | 4.54 | -- | 2 |
| | | 516 | SX RR1875 | 4.34 | 4.34 | | -- | -- | -- | -- | 1 |
| | | 520 | SX RR1876 | 4.42 | 4.42 | | -- | -- | -- | -- | 1 |
| | | 569 | SX RR1877 | 4.42 | 4.42 | | -- | -- | -- | -- | 1 |
| | | 552 | SX RR1878 | 4.31 | 4.31 | | -- | -- | -- | -- | 1 |
| | | 524 | SX RR1879 | 4.36 | 4.36 | | -- | -- | -- | -- | 1 |
| | | 575 | SX Winchester RR | 4.47 | 4.47 | | 4.55 | 4.46 | 4.63 | 4.28 | 5 |
| 1 | 1 | 1301 | RH CK#08 CRYS539RR | 4.74 | 4.74 | | 4.79 | 4.74 | 4.84 | 4.65 | 9 |
| | 1 | 1302 | RH CK#20 CRYS765RR | 4.31 | 4.31 | | 4.33 | 4.29 | 4.35 | 4.22 | 9 |
| | 1 | 1303 | RH CK#21 CRYS768RR | 4.66 | 4.66 | | 4.49 | 4.41 | 4.32 | 4.25 | 9 |
| 1 | 1 | 1304 | RH CK#25 HILL4043RR | 4.51 | 4.51 | | 4.63 | 4.54 | 4.76 | 4.35 | 9 |
| 1 | 1 | 1305 | RH CK#28 CRYS658RR | 4.36 | 4.36 | | 4.46 | 4.34 | 4.57 | 4.09 | 12 |
| 1 | 1 | 1306 | RH CK#29 BETA87RR58 | 4.79 | 4.79 | | 4.73 | 4.75 | 4.67 | 4.77 | 11 |
| 1 | 1 | 1307 | RH CK#31 HILL4000RR | 4.65 | 4.65 | | 4.72 | 4.83 | 4.80 | 5.03 | 11 |
| 1 | 1 | 1308 | RH CK#35 SES36812RR | 4.71 | 4.71 | | 4.63 | 4.54 | 4.55 | 4.37 | 10 |
| | 1 | 1309 | RH CK#36 BETA85RR02 | 4.10 | 4.10 | | 4.28 | 4.42 | 4.45 | 4.71 | 13 |
| 1 | 1 | 1310 | RH CK#37 SES36918RR | 4.43 | 4.43 | | 4.55 | 4.48 | 4.67 | 4.34 | 9 |
| 1 | 1 | 1311 | RH CK#40 CRYS101RR | 4.55 | 4.55 | | 4.60 | 4.58 | 4.65 | 4.55 | 7 |
| | 1 | 1312 | RH CK#45 BTS82RR33 | 4.73 | 4.73 | | 4.46 | 4.37 | 4.19 | 4.18 | 6 |
| 1 | 1 | 1313 | RH CK#47 SES36272RR | 4.62 | 4.62 | | 4.56 | 4.50 | 4.50 | 4.39 | 6 |
| | 1 | 1314 | RH CK#48 HILL4094RR | 3.80 | 3.80 | | 3.85 | 3.71 | 3.90 | 3.44 | 10 |
| 1 | 1 | 1315 | RH CK#49 CRYS247RR | 4.65 | 4.65 | | 4.51 | 4.45 | 4.38 | 4.33 | 6 |
| | | 1316 | RES RHC #1 | 3.62 | 3.62 | | 3.73 | 3.64 | 3.83 | 3.47 | 12 |
| | | 1317 | MOD RHC #6 | 4.68 | 4.68 | | 4.50 | 4.36 | 4.32 | 4.09 | 12 |
| | | 1318 | SUS RHC #3 | 4.32 | 4.32 | | 4.51 | 4.57 | 4.70 | 4.69 | 13 |
| | | 1319 | SUS RHC #9 | 4.43 | 4.43 | | 4.54 | 4.47 | 4.65 | 4.34 | 9 |
| | | 1320 | MOD RHC #5 | 4.34 | 4.34 | | 4.53 | 4.44 | 4.71 | 4.27 | 12 |
| | | 1321 | RES RHC #2 | 3.65 | 3.65 | | 3.83 | 3.78 | 4.01 | 3.68 | 10 |
| | | 1322 | SUS RHC #3 | 4.95 | 4.95 | | 4.85 | 4.79 | 4.74 | 4.69 | 13 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1323 | SUS RHC #9 | 4.51 | 4.51 | | 4.54 | 4.47 | 4.57 | 4.34 | 9 |
| | | 1324 | SUS RHC #10 | 4.28 | 4.28 | | 4.51 | 4.60 | 4.75 | 4.77 | 9 |
| | | | **Conventional** | | | | | | | | |
| | | 919 | BETA EXP 687 | 4.20 | 4.20 | | 4.18 | -- | 4.16 | -- | 2 |
| | | 918 | BETA EXP 698 | 4.45 | 4.45 | | 4.40 | -- | 4.35 | -- | 2 |
| | | 905 | BETA EXP 747 | 3.93 | 3.93 | | -- | -- | -- | -- | 1 |
| | | 909 | BETA EXP 758 | 4.31 | 4.31 | | -- | -- | -- | -- | 1 |
| | | 901 | Crystal 620 | 4.37 | 4.37 | | 4.45 | -- | 4.54 | -- | 2 |
| | | 906 | Crystal 622 | 4.49 | 4.49 | | 4.31 | -- | 4.14 | -- | 2 |
| | | 913 | Crystal 735 | 4.61 | 4.61 | | -- | -- | -- | -- | 1 |
| | | 910 | Crystal 737 | 4.25 | 4.25 | | -- | -- | -- | -- | 1 |
| | | 902 | Crystal R761 | 4.54 | 4.54 | | 4.55 | -- | 4.57 | -- | 11 |
| | | 914 | Hilleshög 3035Rz | 4.07 | 4.07 | | 4.00 | -- | 3.93 | -- | 13 |
| | | 917 | Hilleshög 9891Rz | 4.46 | 4.46 | | 4.34 | -- | 4.22 | -- | 2 |
| | | 904 | Maribo MA615Rz | 4.73 | 4.73 | | 4.63 | -- | 4.54 | -- | 2 |
| | | 916 | Maribo MA720Rz | 4.55 | 4.55 | | -- | -- | -- | -- | 1 |
| | | 911 | Seedex 8869 | 4.40 | 4.40 | | 4.53 | -- | 4.67 | -- | 2 |
| | | 907 | Seedex Deuce | 4.39 | 4.39 | | 4.52 | -- | 4.66 | -- | 10 |
| | | 912 | Strube 12720 | 4.59 | 4.59 | | -- | -- | -- | -- | 1 |
| | | 908 | Strube 13722 | 4.73 | 4.73 | | -- | -- | -- | -- | 1 |
| | | 903 | SV 48611 | 4.35 | 4.35 | | 4.50 | -- | 4.66 | -- | 2 |
| | | 915 | SV 48777 | 4.59 | 4.59 | | -- | -- | -- | -- | 1 |
| | | 1301 | RH CK#08 CRYS539RR | 4.74 | 4.74 | | 4.79 | 4.74 | 4.84 | 4.65 | 9 |
| | | 1303 | RH CK#21 CRYS768RR | 4.66 | 4.66 | | 4.49 | 4.41 | 4.32 | 4.25 | 9 |
| | | 1311 | RH CK#40 CRYS101RR | 4.55 | 4.55 | | 4.60 | 4.58 | 4.65 | 4.55 | 7 |
| | | 1314 | RH CK#48 HILL4094RR | 3.80 | 3.80 | | 3.85 | 3.71 | 3.90 | 3.44 | 10 |
| | | 1315 | RH CK#49 CRYS247RR | 4.65 | 4.65 | | 4.51 | 4.45 | 4.38 | 4.33 | 6 |
| | | | | | | | | | | | |
| | 15 | | Mean of Check Varieties | 4.51 | 4.51 | | 4.51 | 4.46 | 4.51 | 4.38 | |
| 10 | | | Mean of Susc Checks | 4.60 | 4.60 | | 4.62 | 4.58 | 4.64 | 4.49 | |
| | | | Trial Mean | 4.38 | | | | | | | |
| | | | Coeff. of Var. (%) | 7.0 | | | | | | | |
| | | | Mean LSD (0.05) | 0.43 | | | | | | | |
| | | | Mean LSD (0.01) | 0.56 | | | | | | | |
| | | | Sig Lvl | ** | | | | | | | |
| | | | Adjustment Factor | 0.72 | | | | | | | |
| | | | Approval Limit (80% of susc checks) | 5.08 | 3.68 | | 3.70 | 3.66 | 3.71 | 3.59 | |
| | | | | | | | | | | | |
| | | | @ Adjustment is based upon check varieties. | | | | | | | | |
| | | | Lower numbers indicate better tolerance (0=Ex, 7=Poor). | | | | | | | | |
| | | | ^ Approval criteria is based upon mean of 10 susc varieties (approval option 1) or 3.82 (approval option 2). | | | | | | | | |
| | | | | | | | | | Created 11/3/2017 | | |

Table 33. 2017 Fusarium Ratings for ACSC Official Trial Entries
Two Moorhead, MN Sites

| Chk @ | Code | Variety | N Mhd 4 Dates+ | S Mhd 4 Dates+ | Adjusted @ 2017 2 loc | 2 Yr 4 loc | 3 Yr 6 loc | 2016 2 loc | 2015 2 loc | Trial Yrs |
|---|---|---|---|---|---|---|---|---|---|---|
| | 529 | BTS 80RR52 | 2.61 | 2.77 | 2.69 | 2.75 | 2.77 | 2.81 | 2.83 | 8 |
| | 545 | BTS 8337 | 3.76 | 3.90 | 3.83 | 3.92 | 3.85 | 4.01 | 3.72 | 5 |
| | 562 | BTS 8363 | 3.45 | 3.54 | 3.49 | 3.30 | 3.15 | 3.11 | 2.85 | 5 |
| | 513 | BTS 8500 | 1.79 | 2.48 | 2.14 | 2.02 | 2.15 | 1.90 | 2.41 | 3 |
| | 533 | BTS 8512 | 2.89 | 3.02 | 2.96 | 2.83 | 2.79 | 2.71 | 2.70 | 3 |
| | 550 | BTS 8524 | 3.21 | 3.28 | 3.24 | 3.31 | 3.17 | 3.38 | 2.88 | 3 |
| | 570 | BTS 8572 | 2.07 | 3.02 | 2.54 | 2.39 | 2.44 | 2.23 | 2.54 | 3 |
| | 509 | BTS 8606 | 2.49 | 3.14 | 2.81 | 2.75 | -- | 2.69 | -- | 2 |
| | 525 | BTS 8629 | 4.15 | 4.26 | 4.20 | 4.12 | -- | 4.04 | -- | 2 |
| | 577 | BTS 8735 | 4.00 | 3.86 | 3.93 | -- | -- | -- | -- | 1 |
| | 506 | BTS 8742 | 2.21 | 2.98 | 2.59 | -- | -- | -- | -- | 1 |
| | 536 | BTS 8749 | 2.95 | 3.61 | 3.28 | -- | -- | -- | -- | 1 |
| | 540 | BTS 8756 | 2.36 | 2.99 | 2.67 | -- | -- | -- | -- | 1 |
| | 521 | BTS 8767 | 2.65 | 2.78 | 2.71 | -- | -- | -- | -- | 1 |
| | 518 | BTS 8770 | 2.39 | 3.24 | 2.82 | -- | -- | -- | -- | 1 |
| | 567 | BTS 8784 | 2.21 | 3.05 | 2.63 | -- | -- | -- | -- | 1 |
| | 502 | BTS 8787 | 1.98 | 3.02 | 2.50 | -- | -- | -- | -- | 1 |
| | 512 | BTS 8798 | 3.17 | 3.56 | 3.37 | -- | -- | -- | -- | 1 |
| | 549 | Crystal 093RR | 3.22 | 3.74 | 3.48 | 3.42 | 3.35 | 3.35 | 3.22 | 8 |
| | 551 | Crystal 101RR | 2.14 | 3.31 | 2.72 | 2.56 | 2.59 | 2.40 | 2.64 | 7 |
| | 507 | Crystal 246RR | 3.10 | 3.38 | 3.24 | 3.17 | 3.11 | 3.10 | 3.00 | 6 |
| | 560 | Crystal 247RR | 2.97 | 3.02 | 3.00 | 2.90 | 2.77 | 2.80 | 2.51 | 6 |
| | 565 | Crystal 355RR | 2.58 | 2.94 | 2.76 | 2.71 | NE | 2.65 | NE | 5 |
| | 523 | Crystal 467RR | 1.75 | 2.21 | 1.98 | 1.91 | 2.09 | 1.84 | 2.46 | 4 |
| | 503 | Crystal 572RR | 2.33 | 2.95 | 2.64 | 2.23 | 2.27 | 1.82 | 2.36 | 3 |
| | 554 | Crystal 573RR | 3.05 | 3.16 | 3.10 | 3.29 | 3.20 | 3.49 | 3.02 | 3 |
| | 544 | Crystal 574RR | 1.87 | 2.59 | 2.23 | 2.02 | 2.02 | 1.82 | 2.00 | 3 |
| | 571 | Crystal 578RR | 2.15 | 2.66 | 2.41 | 2.20 | 2.27 | 1.99 | 2.42 | 3 |
| | 510 | Crystal 684RR | 1.73 | 2.30 | 2.01 | 1.89 | -- | 1.76 | -- | 2 |
| | 547 | Crystal 792RR | 2.70 | 2.93 | 2.81 | -- | -- | -- | -- | 1 |
| | 557 | Crystal 793RR | 2.72 | 3.18 | 2.95 | -- | -- | -- | -- | 1 |
| | 534 | Crystal 794RR | 2.09 | 2.80 | 2.45 | -- | -- | -- | -- | 1 |
| | 522 | Crystal 795RR | 2.39 | 2.93 | 2.66 | -- | -- | -- | -- | 1 |
| | 553 | Crystal 796RR | 2.06 | 2.62 | 2.34 | -- | -- | -- | -- | 1 |
| | 528 | Crystal 797RR | 3.12 | 3.24 | 3.18 | -- | -- | -- | -- | 1 |
| | 532 | Crystal 986RR | 4.73 | 4.73 | 4.73 | 4.79 | 4.49 | 4.86 | 3.89 | 9 |
| | 559 | Hilleshög HIL9707 | 4.13 | 4.06 | 4.09 | 4.49 | 4.22 | 4.88 | 3.68 | 3 |
| | 576 | Hilleshög HIL9708 | 4.82 | 4.40 | 4.61 | 4.45 | 4.20 | 4.29 | 3.69 | 3 |
| | 561 | Hilleshög HIL9895 | 3.93 | 4.36 | 4.15 | 3.27 | -- | 2.40 | -- | 2 |
| | 566 | Hilleshög HIL9920 | 6.01 | 5.84 | 5.92 | -- | -- | -- | -- | 1 |
| | 563 | Hilleshög HIL9921 | 4.72 | 4.60 | 4.66 | -- | -- | -- | -- | 1 |
| | 504 | Hilleshög HIL9922 | 4.58 | 4.40 | 4.49 | -- | -- | -- | -- | 1 |
| | 543 | Hilleshög HIL9923 | 4.91 | 5.67 | 5.29 | -- | -- | -- | -- | 1 |
| | 517 | Hilleshög HIL9924 | 4.54 | 4.62 | 4.58 | -- | -- | -- | -- | 1 |
| | 505 | Hilleshög 4302RR | 4.99 | 5.19 | 5.09 | 5.09 | 4.74 | 5.09 | 4.05 | 7 |
| | 542 | Hilleshög 4448RR | 5.75 | 4.94 | 5.35 | 5.30 | NE | 5.26 | NE | 6 |
| | 531 | Hilleshög 9528RR | 4.52 | 3.97 | 4.25 | 4.39 | 4.26 | 4.52 | 4.00 | 5 |
| | 556 | Maribo 109 | 4.45 | 4.02 | 4.23 | 4.37 | 4.11 | 4.50 | 3.58 | 4 |
| | 539 | Maribo 305 | 5.91 | 5.86 | 5.89 | 5.89 | 5.60 | 5.89 | 5.02 | 5 |
| | 526 | Maribo MA502 | 2.70 | 3.34 | 3.02 | 2.47 | 2.42 | 1.92 | 2.33 | 3 |
| | 514 | Maribo MA504 | 4.62 | 4.43 | 4.52 | 4.56 | 4.41 | 4.60 | 4.11 | 3 |
| | 568 | Maribo MA611 | 3.58 | 3.97 | 3.78 | 2.87 | -- | 1.96 | -- | 2 |
| | 574 | Maribo MA717 | 5.10 | 4.80 | 4.95 | -- | -- | -- | -- | 1 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 530 | Maribo MA718 | 4.26 | 4.96 | | 4.61 | -- | -- | -- | -- | 1 |
| | 538 | Maribo MA719 | 6.36 | 5.16 | | 5.76 | -- | -- | -- | -- | 1 |
| | 564 | SV RR244TT | 3.85 | 3.62 | | 3.74 | 3.94 | 3.91 | 4.14 | 3.86 | 4 |
| | 511 | SV RR265 | 5.19 | 5.46 | | 5.32 | 5.29 | -- | 5.26 | -- | 2 |
| | 555 | SV RR266 | 6.14 | 5.14 | | 5.64 | 5.41 | -- | 5.18 | -- | 2 |
| | 572 | SV RR268 | 5.37 | 4.65 | | 5.01 | 5.11 | -- | 5.20 | -- | 2 |
| | 541 | SV RR333 | 5.66 | 5.03 | | 5.35 | 5.09 | NE | 4.84 | NE | 5 |
| | 573 | SV RR351 | 5.07 | 4.86 | | 4.96 | 4.86 | NE | 4.75 | NE | 3 |
| | 515 | SV RR371 | 4.92 | 4.90 | | 4.91 | -- | -- | -- | -- | 1 |
| | 501 | SV RR372 | 4.33 | 4.06 | | 4.19 | -- | -- | -- | -- | 1 |
| | 508 | SV RR373 | 5.64 | 4.70 | | 5.17 | -- | -- | -- | -- | 1 |
| | 578 | SV RR374 | 4.74 | 4.13 | | 4.44 | -- | -- | -- | -- | 1 |
| | 546 | SV RR375 | 5.64 | 5.25 | | 5.44 | -- | -- | -- | -- | 1 |
| | 537 | SX Avalanche RR(858) | 5.67 | 5.84 | | 5.75 | 5.57 | 5.42 | 5.38 | 5.12 | 3 |
| | 548 | SX Canyon RR | 5.21 | 5.04 | | 5.12 | 5.19 | 4.74 | 5.26 | 3.85 | 4 |
| | 535 | SX Cruze RR | 3.98 | 3.97 | | 3.98 | 3.39 | NE | 2.80 | NE | 4 |
| | 519 | SX Marathon RR(856) | 5.25 | 4.43 | | 4.84 | 4.87 | 4.87 | 4.90 | 4.87 | 3 |
| | 558 | SX RR1861 | 5.07 | 5.02 | | 5.05 | 4.90 | -- | 4.75 | -- | 2 |
| | 527 | SX RR1863 | 6.45 | 5.64 | | 6.04 | 5.92 | -- | 5.80 | -- | 2 |
| | 516 | SX RR1875 | 3.38 | 3.75 | | 3.57 | -- | -- | -- | -- | 1 |
| | 520 | SX RR1876 | 3.74 | 3.96 | | 3.85 | -- | -- | -- | -- | 1 |
| | 569 | SX RR1877 | 3.93 | 4.49 | | 4.21 | -- | -- | -- | -- | 1 |
| | 552 | SX RR1878 | 5.21 | 4.86 | | 5.03 | -- | -- | -- | -- | 1 |
| | 524 | SX RR1879 | 4.76 | 4.52 | | 4.64 | -- | -- | -- | -- | 1 |
| | 575 | SX Winchester RR | 4.62 | 4.67 | | 4.64 | 4.38 | 4.23 | 4.11 | 3.95 | 5 |
| 1 | 1201 | FS CK #07 CRYS658RR | 2.45 | 3.26 | | 2.85 | 2.76 | 2.73 | 2.66 | 2.67 | 12 |
| 1 | 1202 | FS CK #08 HILL4000RR | 6.50 | 6.68 | | 6.59 | 6.37 | 6.30 | 6.15 | 6.16 | 11 |
| 1 | 1203 | FS CK #09 HILL4010RR | 6.63 | 6.20 | | 6.41 | 6.42 | 6.40 | 6.42 | 6.35 | 12 |
| 1 | 1204 | FS CK #12 HILL4012RR | 6.28 | 5.49 | | 5.89 | 6.02 | 6.00 | 6.15 | 5.96 | 12 |
| 1 | 1205 | FS CK #13 HILL4043RR | 6.22 | 6.39 | | 6.31 | 6.18 | 6.12 | 6.05 | 6.01 | 11 |
| 1 | 1206 | FS CK #17 CRYS765RR | 3.90 | 4.13 | | 4.02 | 4.06 | 4.13 | 4.10 | 4.26 | 9 |
| 1 | 1207 | FS CK #18 CRYS768RR | 4.38 | 4.36 | | 4.37 | 4.38 | 4.29 | 4.40 | 4.09 | 9 |
| 1 | 1208 | FS CK #26 BETA87RR6 | 4.64 | 5.45 | | 5.05 | 4.78 | 4.70 | 4.51 | 4.53 | 8 |
| 1 | 1209 | FS CK #28 SES36918RI | 5.61 | 4.48 | | 5.04 | 5.09 | 5.14 | 5.13 | 5.25 | 9 |
| 1 | 1210 | FS CK #29 CRYS875RR | 4.68 | 4.86 | | 4.77 | 4.73 | 4.60 | 4.68 | 4.35 | 10 |
| | 1211 | FS CHK RES RR #1 | 2.73 | 2.73 | | 2.73 | 2.55 | 2.62 | 2.37 | 2.77 | 7 |
| | 1212 | FS CHK SUS RR #2 | 6.39 | 6.35 | | 6.37 | 6.25 | 6.34 | 6.12 | 6.53 | 7 |
| | 1213 | FS CHK MOD RR RES # | 4.55 | 4.15 | | 4.35 | 4.26 | 4.22 | 4.17 | 4.14 | 11 |
| | 1214 | FS CHK MOD RR SUS # | 4.64 | 4.59 | | 4.61 | 4.92 | 4.88 | 5.23 | 4.81 | 11 |
| | 1215 | FS CHK RES RR #2 | 1.97 | 2.82 | | 2.40 | 2.22 | 2.20 | 2.04 | 2.15 | 6 |
| | 1216 | FS CHK SUS RR #10 | 5.34 | 5.06 | | 5.20 | 5.29 | 5.23 | 5.38 | 5.11 | 4 |
| | 1217 | FS CHK SUS RR #10 | 5.66 | 5.19 | | 5.43 | 5.37 | 5.28 | 5.32 | 5.11 | 4 |
| | 1218 | FS CHK SUS RR #11 | 5.74 | 5.48 | | 5.61 | 5.75 | 5.51 | 5.89 | 5.02 | 5 |
| | | **Conventional** | | | | | | | | | |
| | 919 | BETA EXP 687 | 3.65 | 3.38 | | 3.51 | 3.46 | -- | 3.41 | -- | 2 |
| | 918 | BETA EXP 698 | 2.99 | 3.13 | | 3.06 | 2.90 | -- | 2.74 | -- | 2 |
| | 905 | BETA EXP 747 | 4.64 | 4.53 | | 4.58 | -- | -- | -- | -- | 1 |
| | 909 | BETA EXP 758 | 3.79 | 4.03 | | 3.91 | -- | -- | -- | -- | 1 |
| | 901 | Crystal 620 | 2.55 | 3.03 | | 2.79 | 2.76 | -- | 2.73 | -- | 2 |
| | 906 | Crystal 622 | 3.45 | 3.62 | | 3.53 | 3.55 | -- | 3.57 | -- | 2 |
| | 913 | Crystal 735 | 3.69 | 3.55 | | 3.62 | -- | -- | -- | -- | 1 |
| | 910 | Crystal 737 | 3.79 | 3.25 | | 3.52 | -- | -- | -- | -- | 1 |
| | 902 | Crystal R761 | 3.18 | 3.28 | | 3.23 | 3.24 | -- | 3.25 | -- | 11 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 914 | Hilleshög 3035Rz | 3.76 | 3.63 | | 3.70 | 3.67 | -- | 3.65 | -- | 13 |
| | 917 | Hilleshög 9891Rz | 3.71 | 3.60 | | 3.66 | 3.71 | -- | 3.76 | -- | 2 |
| | 904 | Maribo MA615Rz | 4.93 | 4.52 | | 4.72 | 4.92 | -- | 5.11 | -- | 2 |
| | 916 | Maribo MA720Rz | 3.44 | 3.17 | | 3.31 | -- | -- | -- | -- | 1 |
| | 911 | Seedex 8869 | 3.51 | 3.55 | | 3.53 | 3.23 | -- | 2.92 | -- | 2 |
| | 907 | Seedex Deuce | 4.53 | 4.56 | | 4.54 | 4.61 | -- | 4.68 | -- | 10 |
| | 912 | Strube 12720 | 5.49 | 5.71 | | 5.60 | -- | -- | -- | -- | 1 |
| | 908 | Strube 13722 | 6.23 | 7.02 | | 6.63 | -- | -- | -- | -- | 1 |
| | 903 | SV 48611 | 5.84 | 5.64 | | 5.74 | 5.49 | -- | 5.24 | -- | 2 |
| | 915 | SV 48777 | 3.90 | 4.03 | | 3.96 | -- | -- | -- | -- | 1 |
| | 1201 | FS CK #07 CRYS658RR | 3.01 | 2.99 | | 3.00 | 2.83 | 2.78 | 2.66 | 2.67 | 12 |
| | 1205 | FS CK #13 HILL4043RR | 6.04 | 6.17 | | 6.10 | 6.08 | 6.05 | 6.05 | 6.01 | 11 |
| | 1207 | FS CK #18 CRYS768RR | 4.23 | 4.20 | | 4.21 | 4.30 | 4.23 | 4.40 | 4.09 | 9 |
| | 1209 | FS CK #28 SES36918RI | 5.61 | 5.46 | | 5.54 | 5.33 | 5.30 | 5.13 | 5.25 | 9 |
| | 1210 | FS CK #29 CRYS875RR | 4.46 | 4.53 | | 4.50 | 4.59 | 4.51 | 4.68 | 4.35 | 10 |
| | | | | | | | | | | | |
| 10 | | Check Mean | 4.86 | 4.75 | | 4.81 | | | | | |
| | | Trial Mean | 4.06 | 4.14 | | 4.10 | | | | | |
| | | Coeff. of Var. (%) | 12.67 | 13.16 | | | | | | | |
| | | Mean LSD (0.05) | 0.70 | 0.70 | | | | | | | |
| | | Mean LSD (0.01) | 0.93 | 0.93 | | | | | | | |
| | | Sig Mrk | ** | ** | | | | | | | |
| | | Adj Factor | 0.9346 | 0.9505 | | | | | | | |
| | | | | | | | | | | | |
| | | @ Adjustment is based upon check varieties. | | | | | | | | | |
| | | + Average rating based upon multiple rating dates. Lower numbers indicate better tolerance (1=Ex, 9=Poor). | | | | | | | | | |
| | | NE indicates variety was not evaluated in disease nursery. | | | | | | | Created 11/3/2017 | | |

Table 34. Herbicides and Fungicides Applied to ACSC Official Trials

| | Herbicide/Insecticide | | | Fungicide | | |
|---|---|---|---|---|---|---|
| Location | Herbicide & Rate | Spray Dates | Method | Fungicide Used | Spray Dates | Method |
| Casselton | Conventional | 5/15,5/24,6/5 | Ground | Quadris | 5/31,6/20 | Ground |
| | | | | CR.1/CR.2/CR.3/CR.4 | 7/10,7/20,8/7,8/18 | Ground |
| Felton | RU1 | 6/5 | Ground | Quadris | 5/19,6/8 | Ground |
| | RU2 | 6/22 | Ground | CR.1/CR.2/CR.3/CR.4 | 7/10,7/20,8/1,8/21 | Ground |
| Georgetown | RU1 | 6/5 | Ground | Quadris | 6/1,6/23 | Ground |
| | RU2 | 6/22 | Ground | CR.2/CR.3/CR.4 | 7/14,7/25,8/15,8/21 | Ground |
| Hendrum | RU1 | 5/15*,5/26 | Ground | Quadris | 5/19,6/8 | Ground |
| | RU2 | 6/26 | Ground | CR.1/CR.2/CR.3/CR.4 | 7/10,7/20,8/1,8/18 | Ground |
| | Conventional | 5/15,5/26,6/5 | Ground | | | |
| Hillsboro | RU1 | 6/1 | Ground | Quadris | 5/19,6/8 | Ground |
| | RU2 | 6/20 | Ground | CR.1/CR.2/CR.3/CR.4 | 7/10,7/20,8/7,8/18 | Ground |
| Climax | RU1 | 6/5 | Ground | Quadris | 6/1,6/20 | Ground |
| | RU2 | 6/22 | Ground | CR.1/CR.2/CR.3/CR.4 | 7/14,7/25,8/15,8/21 | Ground |
| Grand Forks + # | RU1 | 5/24 | Ground | Quadris | 5/31,6/22 | Ground |
| | RU2 | 6/12,7/7 | Ground | CR.1/CR.2/CR.3 | 7/14,7/25,8/15 | Ground |
| | Conventional | 5/15,5/24,6/5 | Ground | | | |
| Scandia | RU1 | 6/5 | Ground | Quadris | 5/24,6/12 | Ground |
| | RU2 | 6/22 | Ground | CR.1/CR.2/CR.3 | 7/14,7/25,8/15 | Ground |
| | Conventional | 5/15,5/24,6/5 | Ground | | | |
| Stephen | RU1 | 5/26 | Ground | Quadris | 5/24,6/12 | Ground |
| | RU2 | 6/12 | Ground | CR.1/CR.2/CR.3 | 7/14,7/26,8/17 | Ground |
| | | | | | | |
| St. Thomas+# | RU1 | 6/1 | Ground | Quadris | 6/5,6/19 | Ground |
| | RU2 | 6/20 | Ground | CR.1/CR.2/CR.3 | 7/19,7/26,8/17 | Ground |
| | Conventional | 5/23,5/31,6/8 | Ground | | | |
| Humboldt | Conventional | 5/23,5/31,6/8 | Ground | Quadris | 6/6,6/16 | Ground |
| | | | | CR.1/CR.2/CR.3 | 7/18,7/26,8/17 | Ground |
| Bathgate# | RU1 | 6/1 | Ground | Quadris | 6/5,6/16 | Ground |
| | RU2 | 6/20 | Ground | CR.1/CR.2/CR.3 | 7/18,7/26,8/17 | Ground |

Ground applications complete by Technical Service personnel from ACSC.
RU1 = Roundup Powermax (32 oz./A), Event (1 gal./100 gal water).
RU1, *= Early application of 22oz to control cover crop.
RU2 = Roundup Powermax (22 oz./A), Event (1 gal./100 gal water).

Quadris=first application on 2 leaf beets, second on 4-8 leaf beets.
CR.1=Insire XT + Penncozeb
CR.2=Agritin + Incognito
CR.3=Penncozeb
CR.4=Headline + Agritin

+ Counter 20G applied at 9.0 lbs./A at Grand Forks & St Thomas. Thimet applied at Grand Forks & St Thomas near peak fly in early June.
# Warhawk 4E applied near peak root maggot fly in early June.