AT-PLANT LIQUID INSECTICIDES TO CONTROL WIREWORMS AND SUGARBEET ROOT MAGGOT LARVAE IN SUGARBEET

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Introduction:

The sugarbeet root maggot (SBRM), *Tetanops myopaeformis* (Röder), is an annual threat to sugarbeet production in the Red River Valley (RRV) of North Dakota and Minnesota. Its persistence in certain areas of the RRV growing area provides a strong impetus for sugarbeet producers to annually protect their sugarbeet fields with a prophylactic application of an at-plant soil insecticide, usually in the form of granules. At-plant insecticide applications are also common in much of the remainder of the RRV to protect sugarbeet from losses associated with other soil insect pests such as white grubs, springtails, and wireworms. Thus, a high percentage of fields receive insecticide treatment at planting time, and most infestations of these insects are controlled successfully without even being undetected. Little is known, however, regarding the frequency or severity of these infestations, or the efficacy of various insecticides for controlling wireworms. Comprehensive information regarding the efficacy of at-plant liquids in SBRM control programs is also lacking. In recent years, the development of at-plant liquid insecticide application technology has led to abandonment of granular insecticides by some growers. Additionally, granular application devices are no longer included as standard equipment on most new sugarbeet planters, and the added expense is tempting to forego. Therefore, liquid at-plant soil insecticide materials require thorough screening to determine their potential value in sugarbeet insect pest management systems throughout the RRV production area.

This experiment was designed to achieve the following: 1) compare conventional granular planting-time soil insecticides with experimental liquid insecticides for efficacy in controlling root maggot larvae; and 2) assess the performance of at-plant liquids and granular insecticides against wireworms; and 3) determine the impact 10-34-0 starter fertilizer on performance of MustangMax and Regent insecticides.

Materials and Methods:

This experiment was planted on May 18, 2006. The seed variety used was Van der Have 46519. Liquid insecticides were either applied as in-furrow or T-band applications. In-furrow treatments were applied directly into the open seed furrow by turning the nozzle so all of the finished spray went into the furrow. T-band applications involved applying a 5-inch swath over the open seed furrow. Teejet 8001E nozzles were used to apply water-based spray solutions, and Teejet 11001 nozzles were used for the fertilizer-based (10-34-0) spray solutions. Counter 15G was included as a standard, and controls in the experiment included both an untreated check and a fertilizer-only (10-34-0) control. All liquid applications were made using a delivery rate of 5 GPA.

To determine the relative ability of treatments to protect roots from SBRM infestations, sugarbeet root maggot feeding injury was assessed on ten roots in each plot (i.e., five from each of the outer 2 rows) on August 2 using the 0 to 9 scale of Campbell et al. (2000). Treatment performance was also assessed on the basis of sugarbeet yield. This experiment was harvested on September 28. Immediately before harvest, a commercial-grade mechanical defoliator was used to remove all foliage from each plot. All beets from the center 2 rows of each plot were lifted by using a mechanical harvester and weighed in the field using a harvester-mounted digital scale. A representative subsample of 12-16 beets was collected from each plot and sent to the American Crystal Sugar Company Tare Laboratory (East Grand Forks, MN) for analysis of sugar content and quality.

All data from root maggot damage ratings and harvest samples were subjected to analysis of variance (ANOVA) using the general linear models (GLM) procedure (SAS Institute, 1999), and 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 means are presented in Table 1. The average root injury rating of 6.43 for the untreated check indicated the presence of a moderately high SBRM infestation for this trial. Counter 15G treatments tended to provide the best protection of roots from sugarbeet root maggot feeding injury. Treatments that performed as well as Counter with respect to root maggot control included the tank mixture of Lorsban 75WG+Mustang and all three remaining Lorsban 75WG treatments. Moderate levels of protection from root maggot feeding injury were observed with the Mustang+10-34-0 starter fertilizer and the Mustang-only treatment. Although not significant, a slight trend indicated that the 10-34-0 impeded performance of Regent. Treatments that failed to provide a significant reduction in root maggot feeding injury compared to the untreated check included Asana+10-34-0, Regent (with and without 10-34-0), and the fertilizer control.

Table 1. *Feeding injury* in sugarbeet treated with planting-time granular or liquid insecticides to control the sugarbeet root maggot, St. Thomas, ND, 2006

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb ai/ac)	Root injury (0-9)
Counter 15G	B	10 lb	1.5	2.40 d
Counter 15G	B	11.9 lb	1.8	2.55 d
Counter 15G	M	11.9 lb	1.8	2.55 d
Lorsban 75WG + Mustang Max 0.8EC	5" TB	0.89 lb 2.5 fl oz	0.67 0.015	3.03 d
Lorsban 75WG	5" TB	1.33 lb	1.0	3.10 d
Lorsban 75WG	IF	1.33 lb	1.0	3.15 d
Lorsban 75WG	5" TB	0.89 lb	0.67	3.70 cd
MustangMax 0.8EC + 10-34-0 fert.	IF	4 fl oz	0.025	4.60 bc
Mustang 0.8EC	IF	4 fl oz	0.025	4.68 bc
Asana 0.66EC + 10-34-0 fert.	IF	9.6 fl oz	0.05	5.15 ab

Regent 4SC	IF	4.16 fl oz	0.13	5.28 ab
10-34-0 fert.	IF	----		5.78 ab
Regent 4SC + 10-34-0 fert.	IF	4.16 fl oz	0.13	6.28 a
Check	--	----		6.43 a
LSD (0.05)				1.41

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD).
[a]B = Band; M = Modified in-furrow; TB = T-band over open seed furrow; IF = Directly into seed furrow

Stand counts, which were used as an indicator of protection from losses associated with wireworm injury, appear in Table 2. Data revealed that MustangMax performed well against wireworms in this trial. Excellent stand protection was also observed with both banded and modified in-furrow applications of Counter 15G, and no impacts of rate or placement were observed with the insecticide. One interesting result was that plots treated with MustangMax in a 10-34-0 fertilizer solution had significantly less (35% less) surviving plants than those that received Mustang in a water-based spray solution. Poor protection from wireworm-associated stand loss was also observed with the Asana+10-34-0 treatment. It is unlikely that these stand losses were attributable to phytotoxic effects from the starter fertilizer because there was no significant difference between the fertilizer control and the untreated check.

Yield data for this experiment are presented in Table 3. The combined negative impacts of sugarbeet root maggot and wireworms on these plots make it difficult to interpret which insect had the greatest effect on yield parameters; however, these conditions provided a unique opportunity to better understand the potential for major yield loss in situations where both insects infest and cause crop injury in the same sugarbeet field. In addition, this infestation allowed for performance comparisons to identify effective control programs for managing such scenarios. All insecticide treatments except Regent, Asana+10-34-0, and Regent +10-34-0 resulted in significant increases in recoverable sucrose and root yields compared to the untreated in this study. Counter-treated plots produced root yield increases of 10.9 to 13.6 tons per acre and revenue benefits of $311 to $388 per acre above those from the untreated check. Lorsban 75WG treatments also performed well in relation to yield parameters. The 5-inch T-band of Lorsban 75WG, applied at 0.89 lb product/ac, yielded 2,850 lb more recoverable sucrose than the untreated check. The difference was a 59% yield increase over no insecticide. Although not significant, the water-based spray of MustangMax yielded an average of 2.4 tons per acre more than the MustangMax+10-34-0 treatment.

Table 2. *Stand counts* in sugarbeet treated with planting-time granular or liquid insecticides to control wireworms and sugarbeet root maggot larvae, St. Thomas, ND, 2006

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb ai/ac)	Stand count (plants / 100 ft)
Mustang 0.8EC	IF	4 fl oz	0.025	108 a
Counter 15G	B	11.9 lb	1.8	108 a

Counter 15G	B	10 lb	1.5	106 a
Counter 15G	M	11.9 lb	1.8	105 a
Lorsban 75WG	5” TB	0.89 lb	0.67	97 ab
Lorsban 75WG	IF	1.33 lb	1.0	84 abc
Regent 4SC	IF	4.16 fl oz	0.13	80 a-d
Regent 4SC + 10-34-0 fert.	IF	4.16 fl oz	0.13	75 a-d
MustangMax 0.8EC + 10-34-0 fert.	IF	4 fl oz	0.025	70 bcd
Lorsban 75WG + Mustang Max 0.8EC	5” TB	0.89 lb 2.5 fl oz	0.67 0.015	70 bcd
Lorsban 75WG	5” TB	1.33 lb	1.0	67 bcd
Asana 0.66EC + 10-34-0 fert.	IF	9.6 fl oz	0.05	55 cd
Check	--	----		51 cd
10-34-0 fert.	IF	----		46 d
LSD (0.05)				34

Means within a column sharing a letter are not significantly (*P* = 0.05) different from each other (Fisher’s Protected LSD).
[a]B = Band; M = Modified in-furrow; TB = T-band over open seed furrow; IF = Directly into seed furrow

Table 3. *Yield parameters* from sugarbeet treated with planting-time granular or liquid insecticides to control wireworms and sugarbeet root maggot larvae, St. Thomas, ND, 2006

Treatment/form.	Placement[a]	Rate (product/ac)	Rate (lb ai/ac)	Recoverable sucrose (lb/ac)	Root yield (T/ac)	Sucrose (%)	Gross return ($/ac)
Counter 15G	B	10 lb	1.5	8634 a	32.3 a	15.13 ab	823
Counter 15G	M	11.9 lb	1.8	8324 ab	30.3 ab	15.35 a	827
Counter 15G	B	11.9 lb	1.8	7863 abc	29.6abc	15.08 ab	746
Lorsban 75WG	5” TB	0.89 lb	0.67	7681 abc	28.2bcd	15.28 ab	756
Lorsban 75WG	IF	1.33 lb	1.0	7447 bc	28.0bcd	15.10 ab	705
Lorsban 75WG	5” TB	1.33 lb	1.0	7165 cd	26.4cde	15.28 ab	700
Mustang 0.8EC	IF	4 fl oz	0.025	6871 cde	25.4def	15.18 ab	667
Lorsban 75WG + Mustang Max 0.8EC	5” TB	0.89 lb 2.5 fl oz	0.67 0.015	6288 def	24.7d-g	14.55 bc	554

MustangMax 0.8EC + 10-34-0 fert.	IF	4 fl oz	0.025	5920 ef	23.0efg	14.55 bc	531
Regent 4SC	IF	4.16 fl oz	0.13	5887 efg	22.3fgh	14.98 ab	552
Asana 0.66EC + 10-34-0 fert.	IF	9.6 fl oz	0.05	5570 fg	22.7efg	14.15 c	460
Regent 4SC + 10-34-0 fert.	IF	4.16 fl oz	0.13	5436 fg	21.1ghi	14.65 abc	491
Check	--	----	----	4831 gh	18.7 hi	14.68 abc	435
10-34-0 fert.	IF	----	----	4311 h	17.4 i	14.15 c	362
LSD (0.05)				1081	3.8	0.79	

Means within a column sharing a letter are not significantly (*P* = 0.05) different from each other (Fisher's Protected LSD).
[a]B = Band; M = Modified in-furrow; TB = T-band over open seed furrow; IF = Directly into seed furrow

These results demonstrate the potential for major sugarbeet yield losses from combined infestations of these pests, especially in the absence of effective control materials. The findings reported here also provide useful information for growers to design effective control strategies based on the relative risks of wireworms and sugarbeet root maggot damage to their production systems. Counter 15G, the standard in this trial, provided excellent protection from both pests and this demonstrated through root injury ratings, plant stand assessments, and yield comparisons. Lorsban 75WG also appeared to be effective at managing the wireworm/root maggot complex that developed in this field site. Further study should be carried out to determine the safety of Lorsban 75WG under other environmental conditions and on different soil types. Additional research is needed to ascertain the reason for slight trends in reduced performance by some of the insecticides when applied in the starter fertilizer solution.

References 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. Sugarbeet Res. 37: 57–69.

SAS Institute. 1999. SAS/STAT user's guide for personal computers, version 8.0. SAS Institute, Inc., Cary, NC.