# INTEGRATED MANAGEMENT OF CERCOSPORA LEAF SPOT FOR WESTERN NORTH DAKOTA AND MONTANA

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Management of Cercospora leaf spot (CLS) is of major importance to both growers and processors. This disease will reduce both percent sugar, tons per acre and storage life and will increase impurities and sugar loss to molasses. Management practices for CLS include: crop rotation, use of resistant varieties, disease prediction models and fungicides (Windels et.al., 1997). Historically, resistant varieties (low KWS scores) have produced lower economic returns than susceptible varieties treated with an appropriate fungicide program (Jacobsen et. al., 1996, 1997, 1999). However, the use of moderately resistant varieties (KWS scores of 5.0-5.5) is now widely accepted in many production areas because yield potential of these varieties are now competitive with susceptible varieties when sprayed with fungicides. The full potential for use of these varieties has not been fully appraised since research to date has only examined their use with fungicide programs starting at disease onset with repeated applications on a 10-14 day schedule and ending 30 days or so before harvest. Over the past two years we have studied the potential to integrate the Minnesota prediction system with reduced fungicide usage on varieties with different levels of resistance. Data from the 1999 study that showed that moderately resistant (KWS=5.3) or resistant varieties (KWS=4.4) could achieve the same level of disease control under light disease pressure with 1-2 fewer sprays than susceptible varieties (KWS=6.0)(Jacobsen et. al., 1999) while achieving similar yields.

This year we had two different types of studies on Cercospora leaf spot. These were the standard fungicide efficacy screening trial where new and standard fungicides were evaluated and a trial where integration of fungicide, resistant varieties and the Minnesota predictive model were compared. The onset of disease was approximately July 12 and disease development thereafter was the lowest in the past six years owing primarily to very low night time relative humidity. Based on the Minnesota predictive model there were three major infection periods suggesting the need for three fungicide applications. However, full implementation of the model using scouting to ascertain percent leaf area infected would have limited suggested sprays to two or three. Another factor is the location of the two trials. The fungicide efficacy trial was located under the linear pivot in an area not planted to sugarbeets for previous three years while the trial involving variety resistance was planted adjacent to last years study and was planted to beets in 1998. This is shown in the Area Under the Disease Progress Curve (AUDPC) which measures the intensity of the Cercospora epidemic-1.67 for the fungicide efficacy trial and 12.99 for the variety resistance trial for the same variety- Beta 2185. This is a demonstration of the power of crop rotation in controlling Cercospora leaf spot.

## Cercospora Fungicide Efficacy Trial

Data for the fungicide efficacy trial are found in Table 1. In this trial all treatments reduced the AUDPC equally. This includes the use of Bac J used preventatively. This use was based on recent research showing the mode of action for this bacterium is induction of systemic resistance genes in the sugarbeet plant so that it defends itself against the Cercospora leaf spot pathogen. Several treatments significantly increased the percent sugar even though there was no significant increase in extractable sucrose yield per acre. This would have been anticipated based on the AUDPC information showing very low disease intensity. In studies on fungicide resistance on isolates from fungicide efficacy tests and random field isolates since 1996, we have found increasing resistance to the benzimidazole fungicides (Benlate, Topsin M), to the DMI fungicides (Tilt, Eminent), the strobilurin fungicides (Quadris, Flint, BAS 500) and tolerance to TPTH (Super Tin, AgriTin). In data from 1999 isolates benzimidazole resistance is now 5.7% of isolates from the Sidney factory district. Tolerance to the DMI fungicides was not detected in 1999 but was in the range of 2.3-2.8% in 1997and 1998 samples. While tolerance/resistance to the strobilurin fungicides was not found in earlier years, 7.8% of isolates were resistant to 10 ppm of azoxystrobin (Quadris). It is not yet known if these isolates are cross resistant to Flint or BAS 500, although in Europe with other fungi resistance is generally to all members of the strobilurin class of fungicides.

## Cercospora Variety Resistance Trial

Data for the 2000 trial are presented in Tables 2, 3, and 4. In this trial three varieties differing in their KWS scores (0-9 with 9 being most susceptible and 0 being immune) were examined for their response to varying numbers of fungicide applications. The purpose of this trial was to determine whether based on yield of extractable sucrose, growers could use varieties with moderate levels of resistance and reduced fungicide applications and achieve the same profitability. Historically, varieties with moderate to high resistance to Cercospora leaf spot have not been as profitable as susceptible varieties with a good fungicide spray program. In addition, this trial incorporated a spray schedule based on infection periods calculated by the Minnesota prediction model.

The low AUDPC scores and severity on September 12 (< 3.0% leaf area infected) suggested that except for the susceptible variety Beta 2185 there would be no economic yield effects. There were however statistically significant differences between varieties and spray programs in AUDPC. To achieve optimal disease control on Beta 2185 (KWS=6.3) required 3-4 sprays, on the moderately susceptible HH111 (KWS=5.3) only two sprays were required and on the highly resistant HM 7054 only one spray was required to achieve the same level of disease. Thus under low disease pressure the choice of a moderately resistant or resistant variety with reduced fungicide application would be statistically more profitable than the susceptible variety. It is important to note that the unsprayed plots were not walked in and thus did not have leaf damage associated with workers applying fungicides. It is also interesting that use of fungicide application based on the predictive model provided disease control equal to the calendar spray model that suggested the need for 4 sprays. Figure1 show the disease progress curves from August 18 to September 12 for the three varieties with no fungicide applied, 1 application, 2 applications and 3 applications. These figures show clear differences in the disease progress curves for varieties with no fungicide and 1 or 2 fungicide applications but not with 3 applications. For the most resistant variety HM 7054 there is no difference in the disease progress curve between 2 and 3 sprays. When data was analyzed across all treatments (Tables 3 and 4) there were significant variety and variety X spray number effects on AUDPC and percent sugar with Beta 2185 > HH111> HM7054.

Table 1. Results of 2000 Sugarbeet Cercospora Fungicide Efficacy Trial at the Eastern Agricultural Research Center-Sidney, MT

| Treatment | | AUDPC[2] | % sucrose | sucrose/acre |
|---|---|---|---|---|
| 1. | untreated | 1.67 | 17.1 | 10999 |
| 2. | Bac J preventive | 0.15 | 17.6 | 10943 |
| 3. | Eminent 13 oz alternated with SuperTin 5 oz. | 0.47 | 17.7 | 10875 |
| 4. | Eminent 13 oz alternated with BAS 500 0.15 lb ai. | 0.13 | 17.7 | 11295 |
| 5. | Eminent 13 oz alternated with Flint 3 oz. | 0.10 | 18.4 | 11076 |
| 6. | Stratego 10 oz alternated with SuperTin 5 oz | 0.18 | 17.5 | 11237 |
| 7. | Stratego 14 oz alternated with SuperTin 5 oz | 0.15 | 18.1 | 11266 |
| 8. | Eminent 13 oz/Benlate 0.5 lb (1)<br>SuperTin 5 oz/Penncozeb 2 lb | 0.19 | 18.0 | 10895 |
| 9. | Benlate 0.5 lb/Eminent 13 oz<br>Benlate0.5 lb+Penncozeb 1.5 lb/<br>Eminent 13 oz | 0.12 | 18.3 | 10957 |
| 10. | Eminent 13 oz/Topsin M 0.5 lb./<br>Dithane DF 2.0 lb/Eminent 13 oz. | 0.43 | 17.9 | 11298 |
| 11. | Eminent 13 oz + Bac J | 0.16 | 16.7 | 10419 |
| 12. | BAS 500 0.15 lb ai. +1%Agridex | 0.14 | 17.9 | 11145 |
| 13. | BAS 500 0.15 lb. ai.+ Bac J | 0.22 | 17.7 | 11079 |
| 14. | Flint 3 oz + Bac J | 0.13 | 18.0 | 11216 |
| 15. | Flint 3 oz alternated with Benlate 0.5 lb. | 0.12 | 17.9 | 11792 |
| 16. | Stratego 10 oz alternated with Benlate 0.5 lb. | 0.12 | 18.3 | 11782 |
| 17. | Benlate 0.5 lb. alternated with Flint 3 oz | 0.18 | 18.2 | 11461 |
| 18. | metaconazole 0.1 lb. ai | 0.13 | 17.7 | 11671 |
| 19. | metaconazole 0.075 lb. ai. | 0.14 | 17.7 | 11499 |
| 20. | Benlate 0.5 lb +Bac J/<br>Eminent 13 oz + Bac J/<br>Bac J/ Bac J | 0.40 | 18.1 | 10931 |
| | FLSD 0.05 | 0.58 | 1.1 | ns |

(1) / separates spray applications.
(2) AUDPC=Area Under the Disease Progress Curve

Spray dates: BAC J preventive: 6/26/00 + 7/12, 7/26, 8/09, 8/23
All others: 7/12, 7/26, 8/09, 8/23

Sprayed –4 of 6 rows with $CO_2$ boom sprayer with 4 Spraying Systems 8002vs nozzles@30psi=16 gallon/Acre

Variety: Beta 2185

AUDPC rating dates: 7/12, 8/15, 8/23, 9/11

Harvest: 9/20/00

Table 2. Results of 0-4 fungicide applications to sugarbeet varieties differing in resistance to Cercospora leaf spot and a comparison to use of the Minnesota prediction model (Program spray)

BETA 2185-KWS=6.3

| Treatment | AUDPC | % sucrose | extractable sucrose lb./A |
|---|---|---|---|
| not sprayed | 12.99 | 18.12 | 7345 |
| 1 spray | 2.97 | 17.98 | 8077 |
| 2 sprays | 2.19 | 18.31 | 8249 |
| 3 sprays | 1.43 | 18.08 | 8327 |
| 4 sprays | 0.29 | 17.92 | 9228 |
| program –based (3) | 0.74 | 18.03 | 8249 |
| FLSD 0.05 | 2.04 | ns | 1909 |

HH 111-KWS=5.3

| Treatment | AUDPC | % sucrose | extractable sucrose lb./A |
|---|---|---|---|
| not sprayed | 6.75 | 18.12 | 9679 |
| 1 spray | 1.18 | 17.84 | 8332 |
| 2 sprays | 0.24 | 17.82 | 8878 |
| 3 sprays | 0.13 | 17.84 | 7753 |
| 4 sprays | 0.06 | 17.92 | 7011 |
| program –based (3) | 0.28 | 17.91 | 8240 |
| FLSD 0.05 | 2.48 | ns | ns |

HM7054-KWS=4.3

| Treatment | AUDPC | % sucrose | extractable sucrose lb./A |
|---|---|---|---|
| not sprayed | 7.13 | 18.0 | 8277 |
| 1 spray | 1.61 | 17.76 | 8114 |
| 2 sprays | 2.35 | 17.22 | 8058 |
| 3 sprays | 0.29 | 17.98 | 8280 |
| 4 sprays | 0.18 | 17.51 | 8309 |
| program –based (3) | 0.51 | 17.61 | 7894 |
| FLSD 0.05 | 2.68 | ns | ns |

First spray applied 7/12 (Eminent 13 0z/A); Second spray 7/26 (Benlate 0.5 lb./A); Third spray 8/09 (Super Tin 5 oz/A); Fourth spray 8/23 (Super Tin 5 oz/A).

ns= not statistically significant.

Table 3. Effect of Variety on AUPDC, % sucrose and yield of extractable sucrose per acre.

| Variety-KWS score | AUPDC | % sucrose | sucrose lb./A |
|---|---|---|---|
| Beta 2185 – 6.3 | 3.4 A | 18.07 A | 8246 A |
| HH 111 –5.3 | 2.0 B | 17.68 B | 8155 A |
| HM 7054 -4.3 | 1.4 B | 17.91 A | 8315 A |

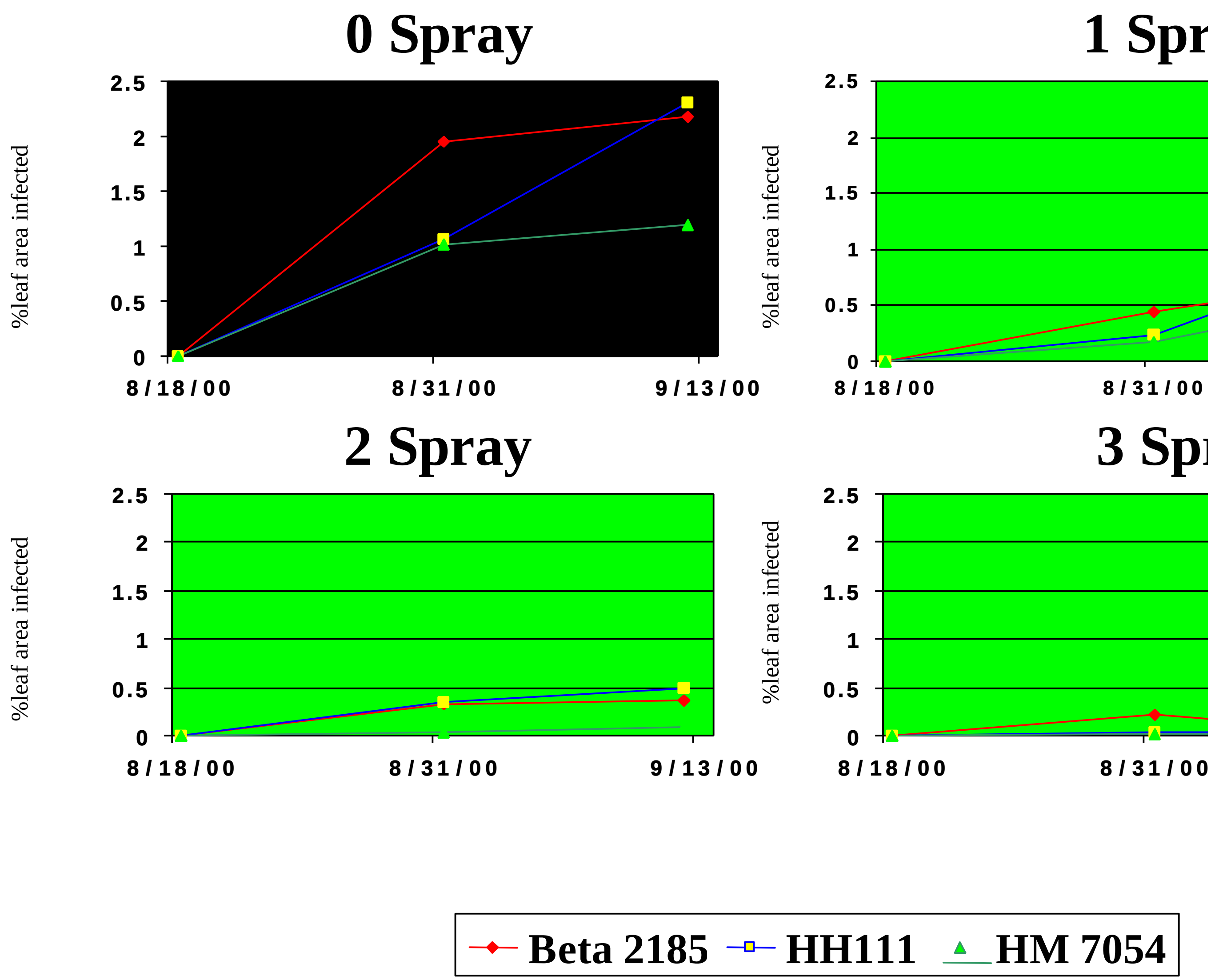
Values followed by the same letter do not differ at P=0.05

Table 4. Effect of number of sprays

| Number of sprays | AUDPC | % sucrose | sucrose lb./A |
|---|---|---|---|
| 0 | 8.96 A | 18.08 A | 8434 A |
| 1 | 1.92 B | 17.86 AB | 8174 A |
| 2 | 1.60 BC | 17.78 B | 8395 A |
| 3 | 0.62 BCD | 17.96 AB | 8120 A |
| 4 | 0.18 D | 17.79 B | 8182 A |
| Program =3 sprays | 0.51 CD | 17.85 AB | 8127 A |

Values followed by the same letter do not differ at P=0.05

Figure 1. Disease progress curves(% leaf area infected over time) for Cercospora leaf spot on Beta 2185 (KWS=6.3-susceptible), resistance) and HM 7054 (KWS=4.3-resistant) at Sidney, MT in 2000.



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