MANAGEMENT OF CERCOSPORA LEAF SPOT

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Cercospora leaf spot caused by the fungus *Cercospora beticola,* is a serious problem for sugarbeet producers and processors in Montana. Losses in research plots over the past 7 years have ranged from 1-3 tons per acre and 0.5-1.5% lower sugar. Greater levels of impurities and sugar loss to molasses have been common where this disease is uncontrolled. In addition, where Cercospora was not well-controlled storage pile deterioration was more rapid. Losses are caused by loss of photosynthetic leaf area and toxicity from toxins produced by the Cercospora fungus. Over the past 7 years a well-timed fungicide program increased income by $100-350 per acre as the result of spending $30-70 for fungicide plus application (Tables 3and 4). Disease incidence and losses have been greatest in the Sidney factory district, however, in the last two years the disease has caused significant losses in most areas in the Billings factory district. Disease loss is dependent on presence of inoculum, favorable weather for sporulation and infection and the time of initiation of the epidemic. The onset of the epidemic in the Sidney area has ranged from July1 –July 20 over the past 7 years with disease severity as measured by the Area Under the Disease Progress Curve varying from a high of 312 to a low of 16.7 (the higher the number the more the level of disease).

Development of this disease requires overwintered inoculum in the form of infected leaves and petioles from last years crop or infected weeds. Weed hosts include; winged pigweed, lambsquarter, pigweed, mallow, wild buckwheat and common unicorn flower. Spores are spread by winds and splashing rain, with wind transport generally less than 100-150 yards. Sporulation and infection are generally favored by warm (80-90EF) conditions where relative humidity in the leaf canopy are greater than 90% for more than 10-12 hours. Infection and sporulation can occur at lower temperatures but require longer periods of relative humidity above 90% for infections to occur. The optimum conditions for spore production are 86EF and 12 hours of relative humidity above 90%. The optimum conditions for infection are 76EF and 100% relative humidity for 8 hours.

As a rule of thumb night temperatures above 60 EF are required for significant sporulation and infection. The disease cycle is shown in Figure A. The data in Table 1 developed by Shane and Teng at the University of Minnesota, illustrates the interaction of temperature and relative humidity. This data is used in the Cercospora Leaf Spot Prediction Model operated by both Western and Holly Sugar Companies. This model has been shown to be highly effective in 4 years of use in Montana.

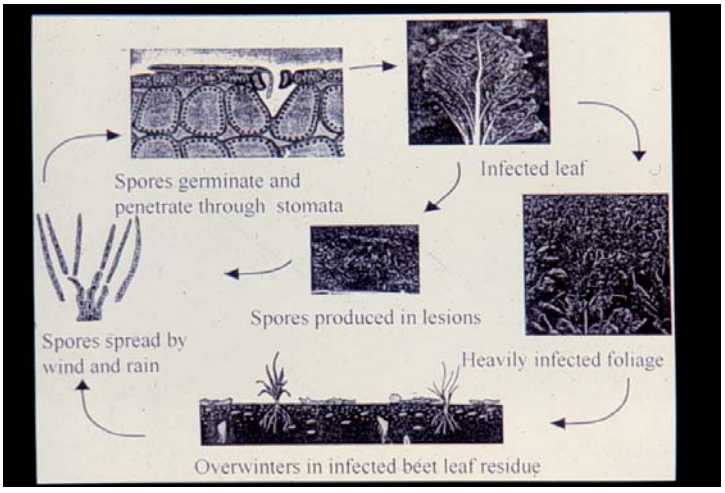

Figure A. Cercospora leaf spot disease cycle.

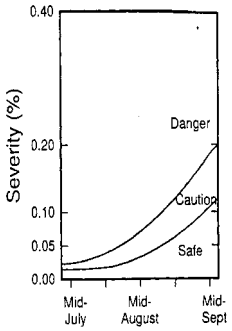

Figure B. Action Zones for Cercospora leaf spot control of sugarbeet based on disease severity and time of season

DISEASE PREDICTION

The Cercospora leaf spot model developed by researchers at the University of Minnesota in the early 1980s has proven to be helpful in identifying infection periods in Minnesota, North Dakota and Montana. This model has two integrally related components: percent disease severity as shown in Figure B and daily infection values as shown in Table 1. The weather data for use in Table 1 comes from temperature and humidity monitoring equipment placed in the canopy of a sugarbeet field. Several types of equipment are available from Gemplers (1 800 382-8473- www.gemplers.com). The most economical are the Hobo Temperature and humidity monitors. These require the Boxcar Pro version 4.0 software and the Hobo Shuttle to down-load your monitor(s) and transfer the information to your computer.

Losses are determined by the time of infection and infection intensity as shown in Figure B. In early to mid July an average of less than 1 leaf spot per leaf should trigger a spray program, whereas by August 1, 1-5 leaf spots per leaf will be needed and by mid August more than 5 leaf spots per leaf will be needed to justify fungicide application. In general, if disease levels are more than 75 leaf spots per leaf (3 % leaf coverage) at harvest, significant economic loss has occurred. The attached leaf spot severity assessment key (Figure B.) can be used to assess disease levels in the field. Growers and fieldmen should scout fields to determine the need for fungicide application. **Over the past 7 years research has shown that a timely first spray is critical to control and while season long protection is needed the first spray is the most important in determining the efficacy of a spray program.** Generally poor control is due to growers waiting too long to spray, exceeding the recommended spray intervals or using lower than labeled rates. Theses factors and failure to rotated fungicide classes are sure ways to encourage fungicide resistance.

Initial scouting should be done in fields bordering last years sugarbeet fields since the fungus survives between beet crops in undecayed infected leaves and the spores blow in the wind, commonly less than 100 yards. Because of the requirement for high humidity for infection and sporulation, disease development will often start in areas where plants dry slowly such as areas protected from the wind or near water. Field borders and these areas should be scouted first to identify initial infections. Following initial detection the entire field should be scouted weekly to determine the level of infection and the potential need for fungicide application. The drawing in Figure B and the table on the back are useful in field scouting to determine severity.

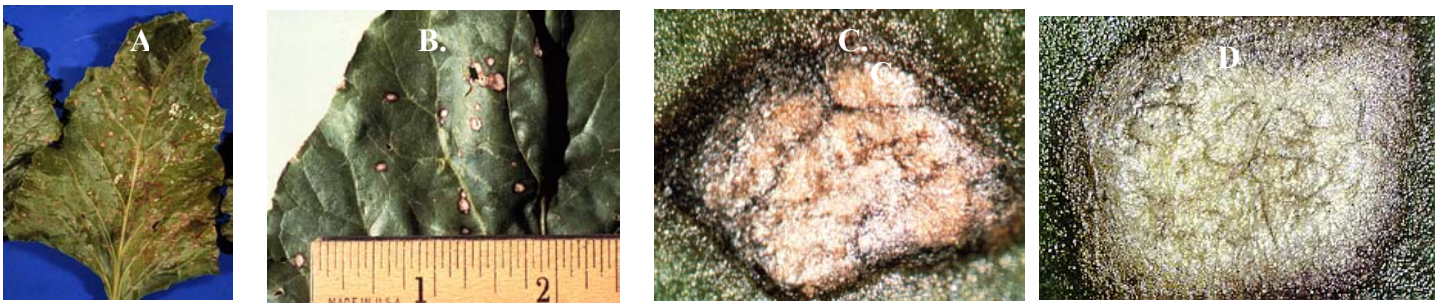

Figure C. Cercospora leaf spot symptoms: A. whole leaf with infection at approximately 3%. B. Close up of lesions. C. Close up showing black fungal stroma that characterize Cercospora leaf spot. D. Bacterial leaf spot-note tan margin-translucent when held up to light.

Cercospora leaf spots are generally less than 1/4 inch in diameter (Figure C-B) and are surrounded by a brown to purple margin with the center of the spot being tan-gray with small black spots (spore producing structures) (Figure C-C). Bacterial leaf spot (Figure C-D) can appear similar but don=t have the dark margin and the black spore producing structures in the center of the lesion

and are translucent when held up to light. Remember to consider the weather for the past week since infections take approximately 10-14 days to become visible. If conditions have been favorable for disease development and disease intensity is near the threshold levels above, sprays should be initiated. The systemic fungicides (Topsin M, Eminent, Gem and Quadris) available for use will not cure infections more than 0-72 hours old and protective fungicides such as Super Tin, Agri Tin, or Penncozeb) will only protect leaves from infection.

FUNGICIDES

Several fungicides are labeled for use on sugarbeets (Table 2.) and their selection will depend on whether the beet tops are to be fed and prior fungicide use. **Only tops treated with Topsin M, Penncozeb, Manex, Eminent, Gem or Quadris or copper (eg. Champ, Kocide) can legally be fed.** Our research has shown that copper is less than 50% as effective as the other fungicides. Copper or EBDC (ethylenebisdithiocarbamate) products should be applied on a 7-10 day spray interval and the other fungicides on a 14 day spray schedule. These spray intervals should be carefully observed since new growth will need to be protected and the fungicides do break down. Typically a new ring of leaves are developed each week during July and August. Generally no more than 1-4 sprays are required in Montana because cool night temperatures generally slow disease development sufficiently in September. However, with the warm Septembers of 1997 and 1998, an additional application would have been justified in early September, thus a 5th application would have been justified in some areas.

Table 2. Fungicides registered for use for Cercospora leaf spot in Montana for 2002.

Fungicide	Class	Product Rate Per acre	Preharvest Interval-days	Reentry (hr.)	Top feeding allowed
Topsin-M	Benzimidazole systemic	½ lb	21	12	yes
Eminent	Sterol inhibitor-systemic	13 oz	14	24	yes
Gem	Strobilurin systemic	6-7 oz	21	12	yes
Quadris	Strobilurin systemic	6.2-15.4 oz. (most data 9.2)	0	4	yes
TPTH SuperTin/AgriTin	Organo metal protectant	5 oz limit 15oz/yr	SuperTin-7 AgriTin-21	48	NO
Penncozeb	EBDC protectant	1.5-2 lb	14	24	yes
Manex	EBDC protectant	1.2-1.6 qt	14	24	yes
Mancozeb-Manex II, Dithane M/F-45, Manzate 75DF	EBDC protectant	1.5-2.0 lb	14	24	no
Maneb-Maneb 80/75DF	EBDC protectant	1.5-2.0	14	24	NO

Applications of Topsin M, Eminent or the strobilurins used alone should be limited to no more than 1 application per season to minimize the potential for fungicide resistant isolates of Cercospora to develop. If these fungicides are used in more than 1 application, they should be mixed with another fungicide or used in an alternate spray program with other fungicides. We did not detect Benlate or Topsin resistant isolates in surveys in 1993-1997, however in 2001, >60% of isolates were resistant to the benzimidazole class in the Sidney factory district and < 10% resistant in the Western factory district. Resistance to the benzimidazole fungicide (Benlate and Topsin M) is

common in other sugar beet production areas in the U.S.A. where these products were used without a good fungicide resistance management program. We have not found any resistance to Eminent or the strobilurin fungicides (Gem, Quadris, Headline) but have found tolerance to 1-10 ppm in a small percentage of isolates. Where these fungicides have been used outside of a good resistance management program these fungicides are nearly useless because of resistance. Generally, Eminent, Topsin M, Gem or Quadris should be used only in the first spray and other materials used in subsequent sprays. The reason to use these systemic fungicides in the first spray is that they have 24-72 hour kickback activity. That is to say that these materials can eradicate infections 24-72 hours old. Tin tolerant isolates are common in Minnesota and North Dakota (Red River Valley) and we have detected tolerance up to 5 ppm in Montana, however we do not feel this is a major problem here although the 5 oz. rate outperformed the 3.75 oz rate since1999. **The main key to preventing fungicide resistance is to use a different class of fungicides in each application-never do subsequent sprays with the same class of fungicides-see Table 2 for information on fungicide classes.** If poor control is seen with any fungicide please send leaves with leaf spots to the Plant Disease Clinic here at MSU.

Good control will require both proper timing and good coverage. Aerial applications should use a MINIMUM of 5 gallons of water per acre. Ground applications should use 20 gallons of water/acre and spray pressures of 40-100 psi. Follow labels regarding the use of surfactants or spreader-stickers.

RESISTANT VARIETIES

In our trials over the past three years we have found that even those varieties with relatively high levels of resistance (low KWS scores) respond to fungicide treatments and that economically growers should chose high yield potential varieties and invest in a good spray program. In general, varieties with KWS scores less than 5 are also resistant to yield. In plots at Sidney in 1999-2001 varieties with a KWS score of 5.3 or less had the same level of disease control and yield with 2-3 sprays compared to varieties with a KWS score of 6.3 where 4 sprays were needed to achieve maximum economic yield. Data for 2001 are given in Table 3.

Table 3. Integration of variety resistance to Cercospora leaf spot, fungicides, fungicide application number and the biological control Bac J for Management of Cercospora leaf spot of sugarbeet

Treatment	Beta 2185 KWS = 6.3		HH 111 KWS = 5.3		HM 7054 KWS =4.3	
	AUDPC (4)	Sugar lbs per A	AUDPC	Sugar lbs. per A	AUDPC	Sugar lbs. per A
unsprayed	58.3	7425	48.6	8022	35.6	8084
4 sprays (1)	29.1	8768	24.8	8719	17.7	8463
3 sprays (2)	31.9	8059	30.9	8845	16.6	8390
2 sprays (3)	30.8	7836	30.1	8711	16.2	8343
Eminent + Bac J onset + Bac J 14, 28, and 42 days	27.7	9161	23.8	8776	18.9	8552
Flsd 0.05	4.36	849	4.36	849	4.36	849

FLSD 0.05 for AUDPC =4.4, for Sugar /A=584 lbs

(1) Mean of spray at disease onset plus 14. 28 and 42 days and Minnesota predictive model since they were the same. First spray at disease onset =Eminent @ 13 oz./A, second spray=Benlate @ 0.5lb/A, third and fourth spray =SuperTin @ 5.0 oz/A

(2) First spray at disease onset=Eminent @ 13 oz./A, second spray=Benlate @ 0.5lb/A, third spray =SuperTin @ 5.0 oz/A.
(3) First spray at disease onset=Eminent @ 13 oz./A, second spray=Benlate @ 0.5lb/A
(4) AUDPC = Area under the disease progress curve.