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Cercospora Leafspot of Sugarbeet

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Figure 1. Cercospora leafspot.

Figure 2. Leafspots coalescing and killing large areas of leaf tissue.

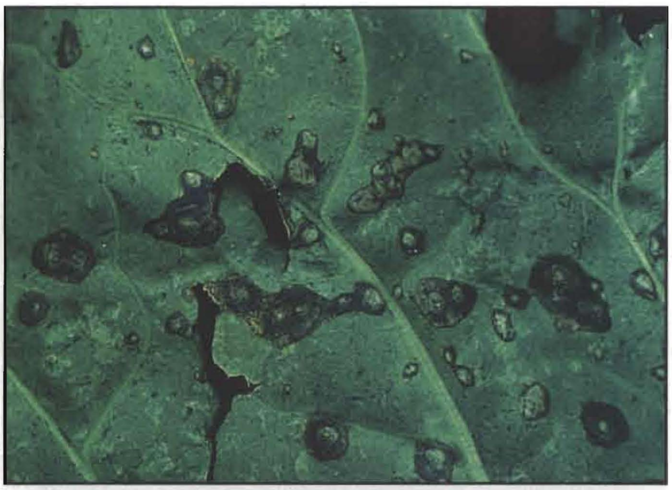

Figure 3. Bacterial leafspot. This is sometimes confused with Cercospora leafspot.

Cercospora leafspot, caused by the fungus *Cercospora beticola,* is the most serious disease of sugarbeets in eastern North Dakota and Minnesota. This disease can cause reduced tonnage and sucrose and increased impurities. Losses of 30 percent in recoverable sucrose are fairly common under moderate disease conditions. Roots of affected plants do not store as well in the pile as roots of healthy plants.

Many of the currently grown high-yielding sugarbeet varieties are susceptible or moderately susceptible to Cercospora. The epidemic of the 1980 and 1981 growing seasons was favored by optimum weather conditions and the very susceptible varieties grown at that time. The epidemic of the 1995 growing season was again favored by optimum weather conditions, frequent rainfall that washed fungicide off the leaves, and the widespread (southern Minnesota and the southern Red River Valley) presence of strains of Cercospora with tolerance to the tin fungicides.

Symptoms

Cercospora infection of the sugarbeet leaf produces circular spots about 1/8 inch (occasionally 3/16 inch) in diameter with ash gray centers and dark brown to reddish purple brown borders (Figure 1). During warm, rainy, humid weather, the spots may coalesce and kill entire leaves, particularly on susceptible varieties (Figure 2). In humid weather, these coalescing spots may be covered with areas of steel blue to light bluish-purple fuzz. These are masses of spores of the Cercospora fungus. Severely diseased leaves wither and die, resulting in severe defoliation. The disease begins on the older leaves and progresses to the younger leaves. Diseased leaves usually remain attached to the crown of the plant.

Bacterial leafspot can be confused with Cercospora leafspot. The symptoms of bacterial leafspot (Figure 3)

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frequently develop during cool rainy weather but may occur intermixed with Cercospora leafspot. Bacterial leafspot often appears on leaves a week or two earlier than Cercospora leafspsot but can be present throughout the season. Bacterial leafspot produces irregular-shaped to circular spots that are 3/16 to 1/4 inch in diameter. They have dark gray centers (Cercospora has light gray centers) with very dark to almost black borders. In areas where bacterial leafspots coalesce, portions of the leaf tend to tear, producing a ragged leaf (see Figure 3).

To distinguish Cercospora leafspot from bacterial leafspot, examine the spots with a hand lens. The gray centers of Cercospora leafspots usually will have tiny black dots in them (Figure 4), or if there is profuse spore production, the centers will have a fuzzy blue-gray appearance (Figure 2). There are no black dots or blue-gray fuzz (fungal spore mass) in the centers of bacterial leafspots (Figure 5).

Ramularia leaf spot may also be confused with Cercospora leaf spot. Ramularia leaf spots develop light brown centers with dark brown or reddish brown borders. The spots are slightly larger than Cercospora, about 3/16–1/4 inch in diameter. Ramularia leaf spots have a more irregular to angular appearance. In moist weather, masses of spores form tiny white dots in the centers of the spots or may even form a silver gray to white fuzzy surface — this contrasts sharply with Cercospora. Ramularia is favored by cooler weather than Cercospora.

Alternaria leaf spot may be confused with Cercospora leaf spot. Generally Alternaria attacks only yellowed leaf tissue. Spots may be 1/8 to 3/8 inch in diameter or slightly larger. Spots are roughly circular, dark brown to black, often with a target pattern of concentric rings and a dark brown to black fuzzy growth of spores. Alternaria leaf spot usually first develops near the leaf margins, then the spots spread and coalesce and occupy much of the leaf area between the main veins.

Ramularia and Alternaria rarely cause enough damage to warrant control by fungicides. Bacterial leafspot is rarely of economic concern and is not controlled by fungicides.

Survival and Spread

The most common source of the Cercospora fungus is infected beet debris in the field. The fungus and spores survive over winter on this debris. The Cercospora spores are spread by wind, water (irrigation and rain), and insects. The fungus also can be carried on the seed, although this is usually of minor importance. The fungus may infect some common weeds such as redroot pigweed, lambsquarters, mallow, and bindweed, but there is little evidence that these weeds are important in the disease cycle.

Cercospora leafspot develops rapidly in warm, humid and rainy weather. The Cercospora spores are produced most readily at temperatures of 68-79 degrees Fahrenheit and relative humidities (RH) of 90-100 percent. Spores do not form at temperatures less than 50 F. Optimal spore germination and infection occur when the temperature is 75-77 F and the RH is 100 percent for at least 8 ½ hours. In general, day temperatures of 80-90 F and night temperatures above 60 F favor disease development. Under favorable conditions, leafspot symptoms may occur in as few as five days after infection, with more spores produced in another five days.

Management

■ Cultural Practices

Since the Cercospora fungus overwinters on infected beet leaves, crop rotation is important. A three-year rotation is minimal for reducing carryover of the fungus. Since plant debris and spores can be blown some distance, beets should not be planted nearer than 100 yards from a field that was in beets last year. This is especially important in cases where last year's beets were severely diseased. Burying beet refuse by tillage helps reduce inoculum survival and dispersal. Fall tillage is most effective for reducing Cercospora populations but may increase the severity of soil erosion during open winters.

Figure 4. Single Cercospora leafspot magnified 15 times to show the black fruiting bodies.

Figure 5. Single bacterial leafspot magnified 15 times. Note absence of fruiting bodies.

■ Varieties

There are great differences in varietal susceptibility to Cercospora leafspot. The disease develops slowly and seldom becomes severe on some varieties, but it develops rapidly and can cause total defoliation on others. Current performance of approved varieties requires at least a moderate level of resistance to Cercospora leafspot. Information on the susceptibility of varieties to Cercospora is available in the Minnesota and North Dakota *Sugarbeet Research and Extension Reports,* published annually. The published yield data, however, do not come from the same plots as the disease data, so no direct correlations can be made between yield and disease from this data.

■ Fungicides

Currently registered fungicides are of two types: protectant fungicides and systemic fungicides.

Protectant fungicides act on the leaf surface to **prevent** infection; they do not "cure" established infections. It takes five or more days from the time of infection before leafspots appear. If a protectant fungicide is applied immediately after a rainy, humid period, infections will already be established and it may be too late to prevent development of leafspots several days later. Late application may result in claims that "the fungicide didn't work" or "the fungicide wasn't applied correctly."

It is essential that protectant fungicides be on the leaf **before** rainy or humid weather occurs. The application must be made early enough to allow spray droplets to dry before rains begin. The fungicide is not as easily washed off after it dries.

In the past it was common to use a preventive spray program, particularly on highly susceptible varieties. The varieties currently available (1996) are less susceptible than many of the varieties grown in 1980 and 1981 and an explosive development of leafspot is less likely. With currently available varieties, a combination of careful scouting for leafspot and use of the Cercospora prediction model can provide proper timing of fungicide treatments.

The key to use of the model is early detection of the disease, monitoring of disease levels, and monitoring of weather to determine the daily infection values. Information on daily infection values is available through a network of weather monitoring equipment. Some of the weather stations are managed by the sugar cooperatives, but the majority are part of the North Dakota Agricultural Weather Network (NDAWN).

A complete discussion of the use of the model is presented in a separate publication entitled *A Management Model for Cercospora Leaf Spot of Sugarbeets.*

If growers wish to monitor their own fields, a hygrothermograph can be purchased to monitor temperature and humidity and the data used to calculate daily infection values. The cost of the hygrothermograph can be repaid by eliminating a single fungicide application.

Protectant fungicides registered for Cercospora control include mancozeb, maneb, triphenyl tin hydroxide (Super Tin), maneb plus triphenyl tin hydroxide, and copper fungicides. A spreader-sticker should be added to the spray tank to improve coverage and retention of wettable powder formulations of mancozeb and maneb.

Research data developed in the past decade indicated that Super Tin was slightly more effective than the other protectants and is retained well on the foliage even after repeated rains.

Beginning in late 1994, however, the Cercospora fungus was found to have developed tolerance to Super Tin in a few selected fields in southern Minnesota and the southern Red River Valley. A survey in 1995 showed that tolerance was widespread in southern Minnesota, fairly widespread in the southern Red River Valley, and present in a few fields farther north in the Red River Valley (Figure 6). Tolerance is best defined as the ability of the fungus to grow at reduced rates in the presence of Super Tin compared to the growth rate without Super Tin. Sensitive strains do not grow in the presence of the same rate of Super Tin.

Systemic fungicides are absorbed by the leaf. Those currently registered for Cercospora control include Benlate and Topsin M. These fungicides are related and belong to the benzimidazole class of fungicides. Cercospora strains resistant to benzimidazole fungicides were detected in 1981 in the Renville factory district of Minnesota and since that time have become widespread across the entire sugarbeet growing areas of Minnesota and eastern North Dakota.

Strains of Cercospora with resistance to the benzimidazole fungicides were still present in 1995. Resistant strains grow in the laboratory in the presence of 5 ppm of benzimidazole fungicide just as vigorously as they would if no benzimidazole fungicide were present. Sensitive strains do not grow at all in the presence of 5 ppm of benzimidazole fungicide. In 1995 some strains of the Cercospora fungus were found that were resistant to the benzimidazole fungicides **and** tolerant to Super Tin.

Benzimidazole fungicides should **never** be used alone in Minnesota or North Dakota because of the high prevalence of resistant strains. **Once resistant strains are established in an area, they persist for many years.**

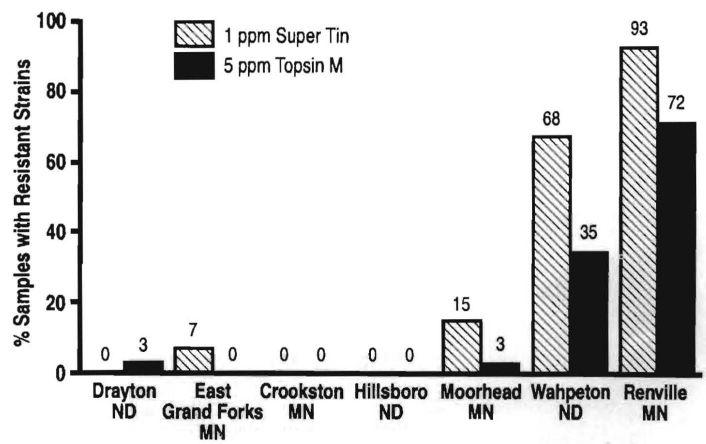

Figure 6. Prevalence of Super Tin tolerance and Topsin M resistance, 1995.

A new class of systemic fungicides known as sterol inhibitors is being investigated for Cercospora control. Most sterol inhibitors are at least locally systemic; that is, they are absorbed by the leaf and distributed within the leaf. Others are more fully systemic, but most do not move into new foliage formed after the fungicide is applied. Some of the sterol inhibitors may have curative properties for Cercospora control. Currently (1996), none of these fungicides is registered, but some may be in the future. Check for current recommendations, and **do not** use any of these fungicides before they are registered.

Resistance Management. The 1995 growing season changed the way Cercospora must be managed. Growers must use practices that help manage resistance to the benzimidazole fungicides and tolerance to Super Tin. Several options are available.

Plant varieties with slightly lower Cercospora ratings. Use of more tolerant varieties is especially important when planting next to a field that had Cercospora problems the previous year, or if planting in an area surrounded by trees, which results in conditions favorable to Cercospora.

Rotate the fungicides used. This is of little value in the case of the benzimidazole fungicides, since benzimidazole resistant strains persist for long periods in the environment. It is more effective with Super Tin, because the tolerant strains do not compete well with the sensitive strains in the absence of Super Tin. Use of mancozeb early in the season or late in the season, after the full complement of tin has been used, are strategies that could help reduce Super Tin-tolerant populations of Cercopsora.

Use tank mixes of different classes of fungicides. The best performing registered tank mixes in 1995 were Super Tin + Topsin M. Since strains of Cercospora with double resistance have been found, and since there is evidence that these strains may build up quickly when tank mixes of these products are used, these tank mixes must be used sparingly, once or at most twice in a season.

Spraying Fungicides. Once the Cercospora prediction model or scouting report indicates that fungicide spraying should begin, it should be continued as long as the weather favors disease development. This can be determined by following the daily infection values for the nearest weather observation site. Recommended rates and application intervals are stated on fungicide labels. When weather favors rapid disease buildup or when growing highly susceptible varieties, the **interval** between applications should approach the shortest ones indicated on the label, and the amount of fungicide used should approach the maximum label **rate.**

It is necessary to shorten the spray interval when conditions favor disease or when disease is already prevalent in order to protect new foliage. No currently registered fungicide can cure established infections. When disease is building up rapidly, many spores of the Cercospora fungus are present, and if shorter spray intervals are not used, newly emerged foliage will be infected before the next application of fungicide occurs.

In the case of the tin fungicides it was not usually necessary or desirable to exceed 70 percent of maximum label rate. In areas where Super Tin tolerance is present, it may be desirable to use either the middle rate in a tank mix with an unrelated fungicide, or to use the maximum rate (and fewer applications).

Growers who do not use the Cercospora prediction model and/or scouting may need to use a preventive spraying program or else begin spraying at the first sign of disease in the field or growing area. Although preventive spraying can eliminate or reduce disease losses, it may result in use of more sprays than are necessary. Use of the prediction model and scouting can avoid unnecessary spraying.

Data from other states, as well as from trials in North Dakota and Minnesota, indicate that ground spraying will give as good or slightly better control than aerial application. Pressures for ground application should be 100-150 psi. At least 20 gallons of water should be applied per acre.

For aerial application, at least 5 gallons per acre should be applied. Swath width should be equal to the wingspan of the aircraft or slightly more (up to 10 percent). Swath width for all fungicides should be the same as for desiccant herbicides. Hollow cone nozzles with D-6 to D-10 orifices and 46 or 56 cores are recommended. The boom should be 6-10 feet above the crop.

Photo credits:

Figure 1,2 - H. A. Lamey
Figure 3 - W. M. Bugbee
Figure 4, 5 - C. E. Windels
Figure 6 - data of W. M. Bugbee

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