1998

G98-1348 Cercospora Leaf Spot of Sugar Beet

Eric D. Kerr
University of Nebraska - Lincoln

Albert Weiss
University of Nebraska - Lincoln, aweiss1@unl.edu

G98-1348-A

NebGuide

Published by Cooperative Extension, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln

Cercospora Leaf Spot of Sugar Beet

This NebGuide describes the symptoms, factors favoring infection, prediction and control measures for Cercospora leaf spot of sugar beet.

Eric D. Kerr, Extension Plant Pathologist
Albert Weiss, Extension Agricultural Climatologist

Cercospora leaf spot, caused by the fungus *Cercospora beticola*, is the most serious leaf disease of sugar beet in western Nebraska. This disease has significantly reduced root and sugar yield in several production areas in the North Platte River Valley and was a major reason for the shift of sugar beet production from eastern Nebraska to other regions in the 1960s. Many vegetable and field crops and a wide range of weed species can serve as hosts for this fungus.

Symptoms

Symptoms initially occur on older leaves and then progress to younger leaves. The symptoms are leaf spots that are about 1/8 inch in diameter with ash-colored centers and purple to brown borders. These leaf spots are distinguished from other sugar beet diseases by black spore-bearing structures (sporophores) in the centers of the spots (*Figure 1*). Bacterial leaf spot symptoms are similar but lack black dots in their centers. The sporophores are easily seen as black dots with the aid of a hand lens. During moist periods, the black dots will be covered with colorless fuzzy masses of spores. As the disease progresses, numerous individual spots coalesce to form large areas of dead tissue (*Figure 2*). Under environmental conditions favorable for disease development (to be discussed later), severely infected older leaves wither and die. Newer leaves develop in the top of the crown, increasing its length. When the old leaves fall off, the scars formed on the crown produce a pineapple-like appearance.

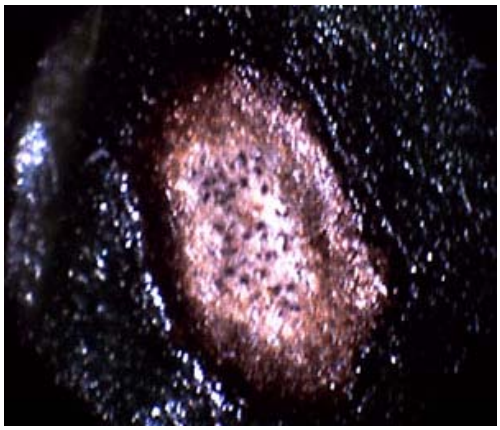

Figure 1.Leaf spots showing diagnostic black clumps of fungus sporophores and dark border. (Photo courtesy of North Dakota State University.)

Severely diseased plants can be seen at a distance when dead or dying leaves appear above the plant canopy (*Figure 3*). The disease is unevenly distributed throughout a field, usually being more severe in protected areas adjacent to windbreaks formed by trees or taller crops.

Factors Favoring Leaf Spot

Infection and development of epidemics of Cercospora leaf spot depend on the presence of susceptible varieties, adequate inoculum, and long periods of leaf wetness accompanied by warm temperatures in the crop canopy. This sequence must appear in the proper order for infection and development. If there is a susceptible variety and adequate inoculum, but temperatures are too cold or warm or there is no moisture on the leaf surfaces, infection cannot occur. Since leaf wetness is not routinely measured, relative humidity above 90 percent is sometimes used as an indicator. Generally in western Nebraska, temperatures at night (when leaves are usually wet) are near the lower limits favoring infection. On the other hand, long hours of leaf wetness that favor infection occur frequently. There is very little infection and disease development below 60°F or during periods of less than 11 hours of leaf wetness. In general, greater spore germination and leaf infection occurs when night temperatures are above 60°F and day temperatures are 80-90°F.

Figure 2.Severely infected sugar beet leaves with large necrotic areas.

Initial inoculum potential depends upon the survival of the fungus spores and stromata (masses of mycelia-fungus body) from the previous year's infected crop residue. Weeds such as lamb's quarter and pigweed, also may be a source of inoculum. New spores, produced under humid conditions on surviving stromata, are carried by wind or splashing rain to nearby sugar beet leaves where germination and infection can occur. Under favorable environmental conditions the inoculum level continues to increase with each infection cycle.

Figure 3.Death of older sugar beet leaves in a severely infected crop.

During the warm mid-summer, the life cycle of this disease may be completed in 10 days. Leaf spots form about five to seven days after infection. For several days spores are produced in the center of the leaf spot. Since infection occurs several days before the leaf spots are observed, the total infection present during wet weather is greater than what is visible for up to seven days.

Predicting Cercospora Leaf Spot

A simple scheme to predict the potential for infection and development of Cercospora leaf spot based on favorable meteorological conditions is illustrated in *Table I*. This scheme assumes that a susceptible host and sufficient inoculum are present. Based on hours of leaf wetness (or high relative humidity--above 90 percent) and the temperature during this period, a daily infection value (DIV) is determined. If the two-day sum of the DIV's is seven or greater, there is a strong potential for infection and further leaf spot development. If this sum is less than six, there is little likelihood of infection. A sum of six is borderline and the crop should be monitored closely for increased infection potential or disease severity.

The following example illustrates how to use *Table I*. Assume that on Day 1 there were 13 hours of leaf wetness and the mean temperature during this period was 63°F. On Day 2, there were 15 hours of leaf wetness with a mean temperature of 65°F. The DIV for Day 1 was three while on Day 2 it was four. The sum for these two days is seven.

If there were no symptoms on leaves, then this DIV sum indicates that careful scouting is required. If symptoms are present, consider a fungicide application.

If on Day 3, there were 12 hours of leaf wetness and the temperature during this period was 62°F, then the DIV sum for Days 2 and 3 is 4 + 0 = 4, and no action would be necessary.

Table I. Daily infection values based on number of hours of high relative humidity (> 90 percent) or leaf wetness and concurrent average temperature during this period.

Hours	*Daily infection values*											
24	1	2	4	5	5	6	6	6	6	6	6	6
23	1	2	3	4	5	6	6	6	6	6	6	6
22	1	1	3	4	5	6	6	6	6	6	6	6

21	0	1	2	4	4	5	5	5	5	5	6	6
20	0	1	2	3	4	5	5	5	5	5	5	5
19	0	0	1	3	4	5	5	5	5	5	5	5
18	0	0	1	2	3	4	4	4	4	4	4	5
17	0	0	1	2	3	4	4	4	4	4	4	4
16	0	0	0	2	3	4	4	4	4	4	4	4
15	0	0	0	1	3	4	4	4	4	4	4	4
14	0	0	0	1	3	3	3	3	3	3	3	4
13	0	0	0	0	3	3	3	3	3	3	3	3
12	0	0	0	0	2	3	3	3	3	3	3	3
11	0	0	0	0	2	3	3	3	3	3	3	3
10	0	0	0	0	2	2	2	2	2	2	2	3
9	0	0	0	0	2	2	2	2	2	2	2	2
8	0	0	0	0	1	2	2	2	2	2	2	2
7	0	0	0	0	1	2	2	2	2	2	2	2
6	0	0	0	0	0	1	1	1	1	1	1	1
5	0	0	0	0	0	1	1	1	1	1	1	1
4	0	0	0	0	0	1	1	1	1	1	1	1
3	0	0	0	0	0	0	0	0	0	0	0	1
2	0	0	0	0	0	0	0	0	0	0	0	0
	59	60	61	62	63	64	65	66	67	68	69	70
Average temperature (F) during periods of leaf wetness or high relative humidity												

Data in *Table I* were initially developed for the sugar beet growing regions of North Dakota and Minnesota. This prediction scheme was successfully evaluated in a three-year trial in western Nebraska.

The data needed to use this prediction scheme can be obtained from a hygrothermograph (*Figure 4*), or an automated weather station (*Figure 4*) placed in a representative location. DIV's should be determined daily to facilitate timely application of fungicide.

Figure 4.Weather instruments used for determination of DIV's in a sugar beet crop: (a) hygrothermograph and (b) automated weather station.

Control

Resistant Varieties

Several leaf spot-resistant varieties are available and can significantly reduce yield losses. The disease progresses slowly on resistant varieties and may not develop severe symptoms even under favorable environmental conditions. Information on variety susceptibility is available in sugar company reports on variety trials and from seed company representatives. Some of the most susceptible varieties may have high yield potential in the absence of leaf spot, but fungicidal control will be necessary for satisfactory yields with severe leaf spot.

Chemical Control

Fungicidal sprays may be necessary in fields where inoculum has carried over from the previous year, susceptible or moderately resistant varieties are grown, and environmental conditions are favorable for infection. In western Nebraska, the first symptoms of Cercospora leaf spot are usually observed in late July or early August. Leaf spots may appear within five days after initial infection. Infections may already be established before the first spots are observed. Once symptoms appear, it is important that environmental conditions be monitored daily to detect periods favorable for infection. The disease may progress rapidly and fungicides should be applied immediately after favorable conditions are detected. Where susceptible varieties are grown in fields with a history of severe Cercospora leaf spot disease, the first preventive fungicide could be applied a few days before symptoms usually appear. Further applications should follow when environmental monitoring indicates a need.

Table II. Systemic and protectant fungicides registered for use on sugar beet for control of Cercospora leaf spot.

Product	*Rate/acre*	*Preharvest interval (days)*
Systemic fungicides		
Benlate Fungicide 50 WP (User possession of supplemental label required for application)	6-8 oz	21
Topsin M 70 W	8-10 oz	21
Topsin M WSB 70 WP	8-10 oz	21
Protective fungicides		
Super Tin 80 WP	2.5-5 oz	21
Protex	1-1.8 qt	21
Manex	1.2-1.6 qt	14
Manzate 200 DF	1.5-2.0 lbs	14
Maneb 75 DF	1.5-2.0 lbs	14
Maneb 80 WP	1.5-2.0 lbs	14
Dithane DF	1.5-2.0 lbs	14
Dithane F-45	1.2-1.6 lbs	14
Dithane M-45	1.5-2.0 lbs	14
Penncozeb	1.5-2.0 lbs	14
Penncozeb DF	1.5-2.0 lbs	14
Maneb Plus Zinc F4	1.5-2.0 lbs	14
ManKocide	2.66-6.66 lbs	14
Kocide 2000	1.5-3.75 lbs	0
Kocide 101	2-5 lbs	0

Kocide LF	2.67-6.67 lbs	0
Kocide DF	2-5 lbs	0
Basicop	4 lbs	0
This list of fungicides is supplied with the understanding that there is no guarantee of effectiveness by the University of Nebraska, nor discrimination intended for any products not listed, and no endorsement for those listed.		

Many fungicides are registered for control of Cercospora leaf spot on sugar beet (*Table II*). They are listed as protectant and systemic fungicides. The systemic fungicides used for Cercospora leaf spot are all in a class of benzimidazole products. They include Benlate and Topsin M. They provide somewhat longer periods of protection than protectant fungicides and once absorbed into the leaves, they are not washed off by rain. Their greatest disadvantage is that Cercospora develops resistance to this type of fungicide. When the fungus develops resistance to one fungicide, it also is resistant to the other. Do not use systemic fungicides alone. They should always be used in combination or tank mixed with a protective fungicide to minimize the risk of the fungus developing resistance to them. For example, they can be used as a tank-mix with triphenyltin hydroxide (Super Tin) but limit this to one or two times per season. Perhaps the best use of systemics is before the disease becomes active, then follow with a protective fungicide when conditions are favorable for infection.

The principle of protective fungicides is to disrupt the natural sequence of infection. These fungicides act on the leaf surface to kill the newly germinated spores. Application timing is important with the first application several days prior to usual observation of initial leaf spot symptoms. It is important that the fungicide be allowed to dry on leaf surfaces. If washed off by rain, it will not be effective, but once dried, the fungicide is not easily washed off.

Super Tin has been a very effective protectant fungicide when used at full rate for the first application followed by another application after 14 days. However, in the last few years, strains of Cercospora with tolerance (not resistance) have developed and are becoming more widespread in the Red River Valley and southern Minnesota. In Nebraska, tolerance to Super Tin has not been observed but, nevertheless, "tolerance management" practices should help delay tolerance development. One strategy would be to use a tank mix of Super Tin at 3.75 oz rate with 1.5 lbs of a mancozeb product (or with Benlate or Topsin M at 3/8 pound) for the first application. Use no more than one application with Benlate or Topsin M in the tank-mix. With mancozeb in a tank-mix the application interval should be no more than 10 days.

Another strategy would be to use a mancozeb product for the first application followed within a week to 10 days by Super Tin and mancozeb in a tank-mix. The first application of mancozeb should be applied early--when disease levels are very low.

Since Super Tin, Benlate, and Topsin M have a 21-day preharvest interval, late season protection may be obtained with mancozeb and maneb fungicides with a 14-day waiting period or with copper fungicides with no preharvest waiting period.

For aerial application, use at least five gallons of spray mix per acre from a boom height of 6-10 feet above the crop. For ground application, apply the fungicide in at least 40 gallons of water per acre with at least 150 psi. Use a spreader sticker for maximum effectiveness.

Cultural Practices

Cultivation and rotation can reduce carryover inoculum. Rotation is a viable tool but is limited in western Nebraska because there are few crops to rotate with sugar beets. At least a three-year rotation is needed to reduce carryover from a severely diseased crop. Tillage reduces inoculum level by burying sugar beet residue and reducing spore dispersal into the new crop. Susceptible sugar beet varieties should not be planted within 100 yards of last year's severely infected crop to minimize spore dispersal into the new crop.

File G1348 under PLANT DISEASES
C-39, Field Crops, 1,500 printed
Issued March 1998

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Elbert C. Dickey, Director of Cooperative Extension, University of Nebraska, Institute of Agriculture and Natural Resources.