SUGARBEET DISEASE MANAGEMENT

I. Seedling and Root Diseases

Aphanomyces typically causes postmergence damping-off, and seedlings are very susceptible when they are 2-3 weeks old especially when soils are wet and warm. Tachigaren (hymexazol) is highly effective against Pythium at lower rates and Aphanomyces at higher rates. Tachigaren persists for only 3-4 weeks and will provide protection only for the emerging seedling; it does not provide full-season protection from Aphanomyces. Commercial seed treaters apply Tachigaren to sugarbeet seeds. Tachigaren can be used at 20 to 30 grams per unit (100,000) of seed on minimum buildup pelleted seed, or 45 to 90 grams per unit of seed on standard pelleted seed. Rates greater than 45 gram of Tachigaren per unit of seed may cause phytotoxicity. Use rate of 20 to 30 grams of Tachigaren is recommended on fields with light to medium disease pressure. Growers with medium disease pressure, however, should be cautioned that use of 20 or 30 gram rate may be inadequate when soil is warm after a heavy rainfall or when these conditions are prolonged within 3 weeks after planting. Use rate of 45 grams of Tachigaren is recommended for fields with heavy disease pressure. For season-long management of Aphanomyces, the best approach is to apply Tachigaren to varieties with partial resistance to Aphanomyces. The sugar factory by-product "waste lime" at 10 Tons/Acre is very effective against Aphanomyces. Early planting and good drainage may also help reduce early season losses from Aphanomyces seedling disease. An Aphanomyces soil test should be done to determine if the soil is infested with Aphanomyces, and the level of infection.

Rhizoctonia can cause both pre- and post-mergence damping-off of the seedlings when the soils are warm and moist. In severely infested fields, plant resistant varieties early, avoid "hilling" soil on sugarbeet crowns, increase the length of rotation, and rotate with non-host crops. Kabina ST (Penthiopyrad) or Vibrance (Sedaxane) seed treatment will provide

early season protection for about 4-5 weeks. Systiva was labeled for use as a seed treatment but there is limited research with this product. Products such as Rizolex (Toclofosmethyl) provide some level of protection. Other products may be labeled but does not provide effective control of *R. solani*. Quadris and generics such as Aframe and Satori (azoxystrobin) and Headline (pyraclostrobin) applied in-furrow will provide early season control. Rhizoctonia may also be controlled by applying Quadris, Priaxor (fluxapyroxad + pyraclostrobin) or Proline (prothiconazole) in a 7 inch band before infection occurs, or when the average soil temperature at the 4" depth is about 60° to 62° F. These fungicides provide better protection when application is done just prior to ¼" or ½" rainfall. Fields with a history of severe disease may need a second post application in warm and wet conditions for season long control.

Rhizomania (Crazy Root) is caused by *beet necrotic yellow vein virus* (BNYVV) that is transmitted by the soilborne protozoan vector, *Polmyxa betae.* The vector can survive in soil or root debris. High soil moisture and warm temperature will favor the vector to transmit BNYVV into plants as they infect roots. Rhizomania is characterized by stunted taproots with masses of hairy lateral roots giving them a bearded appearance. The root is often constricted and the vascular tissues become discolored. The leaves, with elongated petioles become fluorescent-yellow in color, similar to nitrogen deficiency symptoms. Rhizomania may be managed by early planting of approved resistant varieties early in well drained fields on a 3-4 year rotation. Select varieties with high resistance levels for areas with known history of severe Rhizomania. Recent research shows that new strains of this virus are developing that may overcome the existing resistance in the current cultivars.

Fusarium yellows and Fusarium yellowing decline are typically caused by the fungus, *Fusarium oxysporum* f. sp. b*Betae* and *F. secorum*, respectively. Fusarium yellows/yellowing decline may cause seedling death or poor growth and even death of older plants. Symptoms first appear on older leaves as chlorosis (yellowing) between the larger veins. As

the disease progresses, younger leaves also become chlorotic, and the older, symptomatic leaves become necrotic. Occasionally, only half a leaf is chlorotic or necrotic (a symptom more typical of Verticillium wilt, which also was recently identified on sugarbeet in this region). Entire leaves eventually die but remain attached to the plant and collapse in a heap around the crown.

There are no external root symptoms associated with Fusarium yellows/yellowing decline. A transverse section through the root shows a grayish brown vascular discoloration. Infection of mature plants may not cause death, but the disease causes significant reduction in root yield and recoverable sucrose. In storage, quality of infected roots may deteriorate more rapidly compared to non-infected roots. The disease is favored by high soil temperatures. Fields that are waterlogged, or with poor soil structure provide favorable conditions for infection. Crop rotation may reduce inoculum buildup in the soil but this practice is unreliable because the pathogens havea wide host range and chlamydospores survive for many years. Use approved Fusarium resistant varieties to manage this disease. See circular PP-1247 for more information on Fusarium yellows of sugarbeet.

II. Leaf Spots

There are various leaf spot diseases of sugarbeet. Cercospora leaf spot, caused by *Cercospora beticola* is the most common and destructive disease in this area. The severity of Cercospora varies from year to year depending on weather conditions, inoculum potential, and varietal resistance. Cercospora can cause losses in susceptible varieties through reduced tonnage, reduced sucrose content, increased impurities and poorer storage after harvest when the beets are in piles. Bacterial leaf spot generally does not cause economic damage. Bacterial leaf spot may develop in wet weather; no fungicide is registered for its control. See Circular PP-1244 for a comparison of Cercospora and Bacterial leaf spots in sugarbeet.

Leafspot Management. Management of Cercospora requires an integrated approach which includes early incorporation of infected debris, crop rotation, use of varieties that are less susceptible, disease scouting, timely application of fungicide, adherence to appropriate application intervals and more frequent applications when disease conditions are favorable. Avoid planting next to last year's sugarbeet. This is especially important if last year's fields had high levels of Cercospora. In high risk situations, select approved varieties that are less susceptible than the average. Begin checking for Cercospora in late June or early July after row closure, making sure to check near last year's fields or shelter belts. The first fungicide application should occur when conditions first favor disease or at disease onset.

If the first application is late, control will be difficult all season, even if shorter than normal application intervals are used once applications start. When conditions favor disease, or disease is already prevalent, fungicide applications must be more frequent than when disease pressure is low.

Resistance and Tolerance to Fungicides. The terms "resistance" and "tolerance" are often used interchangeably. However, in the following discussion they are used with specific different meanings. Resistance is used to indicate that the Cercospora fungus is unaffected by a level of fungicide that previously prevented growth in the laboratory. Tolerance is used to indicate that growth of the Cercospora fungus is reduced in the laboratory by a level of fungicide that previously prevented growth in the laboratory. Resistant isolates of Cercospora are not controlled by field applications of a fungicide. If tolerant strains are present, a reduced level of control will occur.

The systemic fungicide thiophanate methyl (benzimidazole) has federal registration for Cercospora control, and is

in the benzimidazole class of fungicides. Thiophanate methyl can be used in a tank mix with TPTH, but only once in a season. The tank mix should be used as the first or second fungicide application.

Benzimidazole resistant isolates grow normally in the laboratory in the presence of 5 ppm (part per million) of benzimidazole fungicide. Sensitive isolates do not grow at all in the presence of 5 ppm of benzimidazole fungicide. Some isolates of the Cercospora fungus have been found that were resistant to the benzimidazole class of fungicide and tolerant to TPTH.

Strains of Cercospora with tolerance to TPTH were confirmed for the first time in southern Minnesota and the southern Red River Valley in 1994. Tolerance was detected in fields where control was not as good as expected. Such tolerance is difficult to distinguish from inadequate application technique or a late start in application. Tolerance is best defined as an ability of the fungus to grow in the laboratory in the presence of TPTH at 0.2 ppm or at 1 ppm. Sensitive strains do not grow at all when subjected to these levels of TPTH, but tolerant strains grow at a reduced rate compared to growth in the absence of TPTH. Effective fungicides from different classes should be alternated to delay the development of tolerant or resistant strains of the pathogen.

C. beticola was confirmed to be resistant to QoI fungicides especially pyraclostrobin which is found in Headline and Priaxor. Populations resistant to QoI fungicides have the G143A mutation and are not controlled when these fungicides are applied which may lead to field failures.

Managing Cercospora Leaf Spot with Fungicides. In areas where the *C. beticola* population is sensitive to QoI fungicides, the fungicides, Headline, Priaxor, Gem (QoIs), Proline, Inspire XT, Eminent/Minerva/Minerva Duo, Topguard (triazoles), TPTH, and mixtures of TPTH and Topsin, TPTH or Topsin in mixtures with the triazoles or QoIs used in a rotation program, will effectively control Cercospora leaf spot. Since *C. beticola*, under favorable conditions, develops resistance very rapidly to QoI fungicides, it is recommended to mix QoI fungicides always with a protectant for control of CLS. In mixtures, individual fungicides should be used at least at 0.75 to 0.80 times their labeled full rates or at full rates.

In 2016, *C. beticola* populations resistant to QoI fungicides were found throughout the sugarbeet production area. Growers should not use QoI fungicides to manage populations with known QoI resistance. Mixtures of fungicides, such as TPTH and triazoles, TPTH + Topsin, TPTH + EBDCs, with different modes of action should be used in a rotation program to manage CLS in areas with known QoI resistance. Varieties with higher CLS tolerance should also be used.

The first fungicide used for Cercospora control in 2017 should not be the same fungicide, or a fungicide from the same class of chemistry as the last fungicide application in 2016.

If aerial application is made, make sure that areas around power lines and trees are side-dressed by use of ground equipment. Aerial applicators should use a minimum of 5 gal water/A; 7-10 gal/A gives better coverage. Improperly sprayed areas become focal points for Cercospora spread. Best results with ground equipment are obtained by using high pressure (100 psi) and high volume (20 gal/A) of water.

Pre-harvest Intervals (PHI). Fungicides may be needed well into September to control Cercospora in some years; stopping application of fungicides before this time may result in late-season damage that can reduce tonnage, sucrose and quality. Do not allow the PHI to be an excuse for missing an application late in the season. It may be preferable to spray a field but leave the headland and a strip (or strips) in the middle untreated, thereby allowing pre-pile harvest in untreated areas.

Application Intervals. Generally, the application interval for most of the fungicides recommended is 14 days. However, EBDCs may be required at 7 to 10 day intervals.

Variety Selection and Cercospora Management. There are differences in Cercospora susceptibility among approved varieties. Cercospora may be somewhat easier to manage on varieties with higher than average tolerance to Cercospora. Conversely, varieties which are more susceptible than the average may need extra fungicide applications in years that are highly favorable for Cercospora. Use of more tolerant varieties can be an important part of an integrated disease management plan.

Powdery Mildew Control: The triazoles, QoIs, and sulfur fungicides will provide effective control. See circular PP-967 for more information on powdery mildew.

FOLIAR SPRAYS - LEAFSPOTS

Fungicide and Estimated Cost	Label Rate	Harvest Restrictions (PHI)	Remarks/ Restrictions
QoIs Azoxystrobin Quadris $/A = 23.91-41.17	9.0 -15.5 fl oz/A	May be applied up to harvest (0 d PHI). Re-entry interval (REI) – 4hr	Always alternate with a non- QoI fungicide. Effective for 14 days
Pyraclostrobin Headline $/A = 21.09 – 28.13	9-12 fl oz/A	7 d PHI REI – 4hr	Always alternate with a non- QoI fungicide. Effective for 14 days
Priaxor $/A= 22.27-29.69	6-8 fl oz/A	7 d PHI ; REI – 12hr	Alternate with non-SDHI and non-QoI fungicide
Trifloxystrobin Gem $/A= 26.95	3.5 fl oz/a	21 d PHI REI – 12hr	Always alternate with a non-QoI fungicide.
Triazoles Eminent/Minerva $/A = 16.05	13 fl oz/A	14 d PHI REI – 12hr	Always alternate with a non-triazole fungicide
Inspire XT $/A = 17.12	7 fl oz/A	21 d PHI REI – 12hr	Always alternate with a non-triazole
Proline $/A = 16.80	5 fl oz/A	7 d PHI REI – 48hr	Alternate with a non-triazole fungicide.
Topguard	10-14 fl oz/A	21 d PHI	Alternate with non-triazoles.
Minerva Duo	16 fl oz/a	14 d PHI; REI-48hr	Alternate with – non-triazole fungicide

FOLIAR SPRAYS – LEAF SPOTS

Fungicide And Estimated cost	Label Rate	Harvest Restrictions (PHI)	Remarks/Restrictions
Benzimidazole	0.5 lb/A	Do not apply within	Resistance to benzimidazole
Topsin M WSB		21 days of harvest	fungicides is common. Use
Thiophanate	0.4 lb/A	(21 d PHI).	only in a tank mix with a
Methyl 85 WDG			protectant
Topsin M4.5F	10 fl. oz/A	REI - 12 hr	Do not exceed 1 application/year.
$/A =3.46			See text.
EBDC's			
Mancozeb			
Manzate 75 DF	1.5-2 lb/A	Do not apply	Effective for about 7-10 days.
Dithane F-45/M45		within 14 days	Do not enter treated
Penncozeb DF	1.5-2 lb/A	of harvest	areas within 24 hours
		(14 d PHI).	without protective clothing
$/A =6.03-8.04		REI - 24 hr	

FOLIAR SPRAYS LEAFSPOT

Fungicide and Estimated Cost	Label Rate	Harvest Restrictions (PHI)	Remarks/Restrictions
Triphenyl Tin Hydroxide (TPTH)			Restricted use pesticide.
Super Tin 80WP $/A=4.43 - 5.91	3.75 -5 oz/A	Do not graze or feed beet tops to livestock. REI - 48 hr.7 d PHI	Use 5 oz/A rate for WP formulation. Do not enter treated fields within 48 hours of treating without protective clothing.
Agri Tin Super Tin 4L $/A=4.48 -5.97	6-8 fl oz/A		Do not exceed 15 oz/A of TPTH 80 WP or 24 fl oz/A of TPTH 4L per season. Ground application must be with closed

The following are registered fungicides used for controlling Cercospora leaf spot and their class of chemistry:

QoIs	**Sterol Inhibitors**	**Ethylenebisdithiocarbamates (EBDC)**
Gem	Eminent	Mancozeb
Headline/Priaxor	Enable	Penncozeb
Quadris	Minerva/Minerva Duo	
	Proline	
Benzimidazole	Inspire XT	**Triphenyltin Hydroxide (TPTH)**
Topsin M	Topguard	SuperTin
		AgriTin

PS: Products must be labeled before they can be used for controlling disease on sugarbeet.

Rhizoctonia Root Rot Control

Fungicide and Estimated Cost $/A	Label Rate/A	Harvest Restrictions (PHI)	Remarks/Restrictions
Quadris/Satori/Aframe $24.44- 37.98	9.2-14.3 fl oz	May be applied up to harvest (0-d PHI). Re-entry interval (REI) – 4hr	In-furrow applications for 22” rows; mixing with starter fertilizer not recommended
Headline $21.09-28.13	9-12 fl oz	7-d PHI	In-furrow application
Quadris/Satori/Aframe $24.44-44.09	9.2-16.6 fl oz	0-d PHI	7” band application in 22” rows before average soil temp at 4” depth reaches 65°F or 4-6 leaf stage when an effective seed treatment is used
Proline $19.15	5.7 fl oz NIS 0.125% v/v	May be applied to 7-d PHI	
Priaxor $29.69	6-8 fl oz	7-d PHI	