Introduction

Cercospora Leaf Spot (CLS) is one of the most important and widespread fungal diseases of sugar beet. Severe losses occur if inoculum overwinters near fields planted to susceptible varieties and the crop canopy experiences long periods of leaf wetness accompanied by warm temperatures. Economic loss results from reduced root weight, reduced extractable sugar yield, increased loss to molasses during extraction, and reduced safe-storage times. For each 1% increase in disease severity present at the end of the season, there is an estimated 0.3% to 0.5% decrease in profit.

Symptoms: Lesions initially occur on older leaves and then progress to younger leaves. Lesions are 1/8 inch in diameter at maturity and appear light-colored to dark tan, with brown to purple margins. Severely affected leaves yellow, wither, and die, and remain attached to the plant. Yellowing and rapid leaf death is due to toxins produced by the fungus. Lesions also form on petioles and will appear elongated rather than circular. A diagnostic feature of CLS is the presence of tiny black dots (stromata) that form near the center of older lesions. Stromata are visible with a hand lens and, during periods of high moisture, will appear fuzzy due to the presence of abundant conidia. Sunken, circular lesions have also been described on sugar beet crowns not covered by soil.

Causal Agent: Cercospora beticola produces conidiophores (spore-producing structures) that grow out of stromata. Conidiophores produce conidia (spores) that are generally needle-shaped (2-3 X 36-107 μm), colorless, and have three to 14 cross-walls. Conidial morphology will vary greatly with environmental conditions. Although considerable genetic variability exists in the fungus population, there is no known sexual stage of the fungus.

Disease Cycle: Stromata formed in mature lesions are resistant to drying and enable the fungus to survive in plant residue from season to season. When moisture is sufficient, new conidia are formed on stromata. Conidia subsequently spread and infect new host leaves. Most spread occurs via wind and rain-splash. Fungus survival also may occur via conidia carried in residue and on seed. Weed hosts such as lambs quarter, pigweed, mallow and bindweed also may be sources of inoculum. Table beet, sugar beet, Swiss chard, most wild Beta species, spinach, and species of Atriplex, Cycloloma, Chenopodium, and possibly, Amaranthus, are hosts of C. beticola.
Severe losses occur if inoculum overwinters near fields planted to susceptible varieties and the crop canopy experiences long periods of leaf wetness accompanied by warm temperatures. Optimum conditions are 77 to 95°F (25-35°C) with night temperatures above 61°F (16°C), and a relative humidity of 90 to 95%. Infection is greatly reduced, or does not occur, at temperatures less than 59°F (15°C) or during periods of less than 11 hours of leaf wetness. The time between infection and spore production is seven to 21 days. This long incubation period may result in large differences between “Total Disease” and the amount of “Visible Disease” observed in the field during crop scouting. Therefore, considerable infection may have already occurred in the field even though plants appear healthy.

**Disease Management:** Susceptible varieties should not be planted within 100 yd of last year’s infected crop, to prevent dispersal of conidia from last year’s residue into the new crop. Tillage buries infected sugar beet residue and decreases inoculum carryover. Rotations of three years to non-host crops also will significantly reduce inoculum carryover. Resistant varieties may perform well under conditions of mild to moderate disease pressure. CLS will progress more slowly on resistant varieties and this will reduce, but may not totally eliminate, the need for supplemental fungicide application. Information on varietal resistance is available from sugar company reports and reports of variety trials conducted in the various production regions. The need for fungicide is based on varietal susceptibility, the availability of inoculum, and the presence of conditions favorable for disease development. It is important to monitor environmental conditions that determine when periods favorable for infection occur and to apply fungicide based on these “forecasts.” The most effective fungicide programs will have the first application made shortly before the onset of visible disease. Although foliar fungicides will not totally suppress CLS development, they will delay the onset of disease and, once disease develops, also will slow the rate of disease spread within the plant canopy.

**Fungicide Resistance Management:** The CLS fungus is known to develop resistance or insensitivity to certain fungicides following repeated exposure to those fungicides in the field. Practical resistance occurs when the fungus population becomes sufficiently insensitive to the fungicide so that the fungicide no longer is effective as a disease management tool. Practical resistance may develop suddenly or may slowly develop. Fungicides at greatest risk for developing resistant fungus populations are those that have very specific modes of action or have “single-site” activity. Because fungicide-resistant CLS fungus populations are developing in the High Plains, it is essential to follow fungicide resistance management programs to delay or prevent the development of practical resistance in our sugar beet fields.

The fungicide resistance management guidelines listed below also include those developed by working groups of the Fungicide Resistance Action Committee (FRAC).

1. Use the multiple and integrated disease management practices listed above to reduce overall disease intensity and overall reliance on fungicide for disease suppression. If there is less disease intensity, there will be less selection pressure placed on the fungus population by the fungicide.
2. Utilize multiple fungicide chemistries having different modes of action for disease management, either by applying them as tank-mixes or by alternating fungicide chemistries during sequential foliar applications. An effective fungicide partner is a fungicide that has a separate mode of action and also would provide satisfactory disease suppression when used alone. Additional specific recommendations are:

   a. **Benzimidazole Group:** This is the group of fungicides that contain as their active ingredient benomyl, carbendazim, thiabendazole, thiophanate or thiophanate-methyl. In addition to recommendations listed above, FRAC states that both mixtures and alternations with non-benzimidazole fungicide partners are acceptable methods for preventing and managing resistance to benzimidazoles. For high risk pathogens, tank-mixtures are preferred to alternations.

   b. **Strobilurin Type Action and Resistance (STAR) Group:** Members of the STAR group include the fungicides azoxystrobin, kresoxim-methyl, trifloxystrobin and famoxadone. Famoxadone has a mode of action similar to strobilurins and, thus, has the same recommendations for resistance management as do the strobilurins. Fungicides in this group have only recently been introduced for use in the High Plains. Recommendations are:

      i. Apply STAR fungicides at the labeled rate. Do not reduce the rate when making applications in combination with, or in alternation with, companion fungicides.

      ii. STAR fungicides should not exceed 33% (1 spray in 3) of the total number of fungicide applications made to each crop, whether applied solo or in mixtures with fungicide partners, even if the partner has a mode of action different from the STAR group.

      iii. Apply STAR fungicides preventatively (not curatively).

      iv. Apply STAR fungicides in alternation with compounds from a different (non-STAR) cross-resistance group.

Fungicide resistance management is becoming more critical in the High Plains as CLS inoculum becomes established, disease more prevalent, and fungicide use more common. Based on grower experiences in other production areas, several of our most effective CLS fungicides are at risk for development of practical resistance in the High Plains. Therefore, integrated approaches to disease management coupled with fungicide resistance management strategies will help preserve the efficacy and useful life of fungicides available to growers for CLS suppression in the High Plains.

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