Chapter 10: Diseases of Sunflower

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July 2021

Phoma Black Stem *(Phoma macdonaldii)*

Phoma black stem is widespread disease throughout sunflower fields in South Dakota. Yield losses are considered rare but can occur in high disease pressure and are more common if the fungal pathogen is transmitted into the stem by sunflower stem weevils *(Apion occidentale)*.

Biology: The causal fungus, *P. macdonaldii*, survives on infested crop residue. Phoma black stem can be observed at any time on the sunflower plants during the growing season when environmental conditions are favorable, such as rainfall, humid conditions, and moderate temperatures (60 to 75°F).

Symptoms: Disease symptoms include chlorosis and necrosis in leaf veins and/or petiole and jet-black colored lesions on the stem of the plant, specifically at the base of the petiole. The lesions on the stem have definite borders and appear shiny (Fig. 10.1). Lesions are generally superficial and do not severely damage the pith or cause lodging (Fig. 10.2).

Figure 10.1. Phoma black stem lesions on the stem of the sunflower plant (Photo: Samuel Markell, NDSU).

Figure 10.2. Phoma black stem lesions do not cause wilting or lodging of sunflower plants (Photo: Samuel Markell, NDSU).

Management: Phoma black stem can be managed by crop rotation and avoiding planting near a field with crop residue from previously cropped to sunflowers. Foliar fungicides may be applied and can be efficacious but may not be economically viable.

Phomopsis Stem Canker (*Diaporthe helianthi, D. gulyae,* species of *Diaporthe*)

Phomopsis stem canker is an economically important stem disease of sunflower in South Dakota. However, the disease prevalence varies among years and locations. Yield losses greater than 40% have been observed in severely affected fields.

Biology: The causal fungus (or fungi) overwinters on infested crop residues. Phomopsis stem canker is favored by wet weather, high humidity (~90%) and moderate temperatures (68 to 77°F).

Symptoms: Disease symptoms include brown-colored lesions on the leaves (Fig. 10.3), which spread into the petiole and stem. The lesions on the stem begin as a small, brown-colored spot that can become large and tan-to-light brown colored (Fig. 10.4) over time. These stem lesions are often and commonly six inches or more in length, and larger than lesions caused by Phoma black stem. Phomopsis stem canker can cause extensive degradation of the pith, becoming soft and mushy enabling the stems to be easily crushed by light to moderate thumb pressure. Infected plants will then lodge easily, resulting in severe loss at harvest.

Figure 10.3. Phomopsis stem canker lesion observed on the leaf (Photo: Febina Mathew, SDSU).

Figure10.4. Phomopsis stem canker lesion observed on the stem (Photo: Febina Mathew, SDSU).

Management: Phomopsis stem canker can be managed by rotating with non-hosts (e.g., wheat, corn), eliminating crop residue, controlling volunteer and wild sunflowers (that are hosts) and avoid planting near fields that were affected in the previous season. Commercial hybrids with partial resistance are available. Application of foliar fungicides at R1 growth stage (when miniature floral head is formed on the plant) may help mitigate Phomopsis stem canker, but the efficacy may also be affected by prevailing weather conditions and disease pressure.

Sunflower Rust *(Puccinia helianthi)*

Rust is an important foliar disease of sunflower in South Dakota, but the disease severity varies among fields, based on time of infection and disease progress influenced by environmental conditions. Yield losses up to approximately 80% have been reported from rust in the neighboring state of North Dakota.

Biology: The rust fungus is very specific to sunflower and can overwinter (as teliospores) on residues of wild, volunteer or commercial sunflower even during the harshest South Dakota winter. When rust overwinters, the first visible signs and symptoms of rust can occur in vegetative growth stages as small (¼ inch or less) circular orange bumps (pycnia; Fig. 10.5) on the top sides of leaves. On the underside of the leaf will be a small cluster of orange cups (Aecia; Fig. 10.6). These structures are relatively uncommon and rarely observed. Rust most frequently appears in reproductive growth stages, and when small cinnamon-brown pustules (uredia) appear on leaves (Fig. 10.7).

Figure 10.5. Circular, orange-colored bumps (pycnia) produced by the sunflower rust pathogen on the leaf (Photo: Samuel Markell, NDSU).

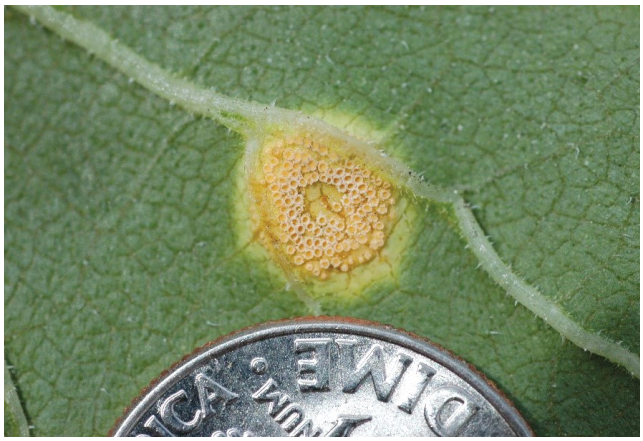

Figure 10.6. Orange colored cups (aecia) produced by the sunflower rust pathogen on the leaf (Photo: Samuel Markell, NDSU).

Figure 10.7. Cinnamon-brown colored pustules (uredia) produced by the sunflower rust pathogen on the leaf (Photo: Samuel Markell, NDSU).

Symptoms: Pustules may be surrounded by a yellow halo and will be filled with cinnamon-brown spores that easily rub off leaving a dusty streak of urediniospores. Spores can be dispersed by wind for miles. Rust is favored by long periods of leaf wetness (fog, dew) and air temperatures between 55 and 85°F.

Management: The disease is best managed by using integrated management practices, which include removal of overwintering hosts (such as wild and volunteer sunflowers), avoiding planting sunflower adjacent to a field with infested crop residue, selecting commercial hybrids with rust resistance, removing infested residue (by plowing, disking, etc.), and applying a foliar fungicide if needed. While considering foliar fungicide applications, it is critical to scout sunflower fields for rust. A foliar fungicide is likely beneficial if 1% rust severity is observed on the four uppermost-fully-expanded leaves at or before bloom (growth stage R5). Fungicides applied at R6 or after are not likely to be beneficial. In cases where rust has overwintered, observed in vegetative growth stages, and conducive conditions for disease development persist, an earlier application may be beneficial.

Sclerotinia Wilt/Basal stalk rot, Sclerotinia Mid-Stem Rot and Sclerotinia Head Rot *(Sclerotinia sclerotiorum)*

The causal fungal pathogen, *S. sclerotiorum*, causes three different diseases on sunflower - Sclerotinia wilt/Basal stalk rot, Sclerotinia mid-stem rot and Sclerotinia head rot. The fungus has a large host range (~350 plant species), known to cause “white mold” in all broadleaf crops and weed species. Among the three diseases, Sclerotinia head rot is most prevalent in the Northern Great Plains. Sclerotinia wilt/Basal stalk rot and Sclerotinia mid-stem rot may be common in Northern Great Plains, but these are generally more common in the Central High Plains and Southern Great Plains. Yield losses between 10 and 70% have been documented.

Biology: The fungus survives as irregularly shaped black structures (sclerotia) in the soil and plant residues, that resemble rat droppings. Sclerotia can persist for several years in the soil. For Sclerotinia wilt/Basal stalk rot, sclerotia can germinate to produce mycelium, which infects the lateral roots of the plants. For Sclerotinia mid-stem rot and Sclerotinia head rot, sclerotia can germinate to form small structures resembling mushrooms (apothecia) that produce and release spores (ascopores). The ascospores can move by rain splash and for several miles by wind. These spores, upon availability of free moisture, infect the senescing plant tissue and flower petals, initiating new infections and disease.

Symptoms:

Sclerotinia wilt/Basal stalk rot. Disease symptoms include a tan to light brown colored lesion, often at the soil line, which may girdle the stem over time. Dense, white-colored growth of the fungus may be observed on the stem lesion (Fig. 10.8). The affected plants can wilt and/or lodge as they enter reproductive growth stages of crop development. Additionally, these affected plants may occur singly or in clusters within rows.

Figure 10.8. Tan-colored lesions of Sclerotinia wilt/Basal stalk rot at the base of the sunflower plant (Photo: Samuel Markell, NDSU).

Sclerotinia mid-stem rot. The causal fungus produces a tan-colored, water-soaked lesion on the stem of the plants, primarily around the petiole. These lesions will enlarge over time and will eventually girdle and shred the stem (Fig. 10.9). Sclerotia can be visible within or on the exterior of the sunflower, however, they are observed towards the end of the growing season.

Figure 10.9. Shredding of stem of sunflower plants from Sclerotinia mid-stem rot (Photo: Samuel Markell, NDSU).

Sclerotinia head rot. Disease symptoms are observed as a soft, brown-colored lesion on the back of the sunflower head. The lesion will spread to cover a portion or the entire head, and at times, white growth of the fungus may appear on the face of the head. As the disease continues to develop, the head may completely shred and fall apart, resembling a white straw broom that can be seen from a distance (Fig. 10.10). Several sclerotia may be produced within the sunflower head with varying shape and size.

Figure. 10.10. Sclerotinia head rot on a sunflower plant (Photo: Samuel Markell, NDSU).

Management: Managing Sclerotinia wilt, Sclerotinia mid-stem rot and Sclerotinia head rot can be a challenge. Current options include rotating sunflower with non-hosts (e.g., wheat and corn), managing broadleaf weeds and crop volunteers that are hosts of *S. sclerotiorum*, and avoiding practices (excess nitrogen or high seeding rate) that can increase crop canopy density. Commercial hybrids with partial resistance are available that be planted in fields with history of white mold. At the time of this publication, foliar fungicides are not recommended as limited efficacy has been demonstrated. Microbial products may be available for biological control of *S. sclerotiorum*, but their efficacy data is currently lacking.

Other diseases of less importance in South Dakota

Bacterial leaf spot *(Pseudomonas syringae pv. helianthi)*

Bacterial leaf spot is now commonly recognized occurring in sunflower production throughout temperate growing regions worldwide but is seldom considered to be an economically significant problem. Symptoms of bacterial leaf spot are variable, depending upon cultivar and accompanying environmental conditions. Leaf lesions begin as small necrotic spots of varying size and shape. Initially the spots are water-soaked and angular later becoming necrotic. The lesions may also be surrounded by a yellow (chlorotic) halo (Fig. 10.11), which also can coalesce to form large chlorotic areas on affected leaves. As disease progresses, the leaf spots coalesce, dry up and die. As the disease is often found occurring primarily on leaves in the lower part of the canopy, it seldom causes yield reductions. Like many bacterial pathogens, it is spread by splashing rains and high winds, and can also infect plants naturally through open stomata on leaves and through wounds created by hail, sandblasting, or other forms of mechanical damage. No control measures are warranted or recommended due to the normally low degree of damage to affected plants.

Figure 10.11. Bacterial leaf spot on sunflower leaf (Photo: Robert Harveson, UNL).

Charcoal Rot *(Macrophomina phaseolina)*

Charcoal rot can cause yield loss of sunflower under hot and dry environments. In South Dakota, the disease is less common than other stem diseases, such as Phomopsis stem canker and Phoma black stem. Charcoal rot can develop during the reproductive growth stages of crop development and is favored by high temperature (>90°F) and low soil moisture. Disease symptoms include a gray-colored lesion on

the stem at the soil line (Fig. 10.12), and possibly premature senescing or lodging. The interior of the stem may be filled with dusty, black-colored microsclerotia (Fig. 10.13). Charcoal rot can be managed by rotating sunflower with non-hosts (e.g., wheat) and by avoiding drought stress through irrigation.

Figure 10.12. Charcoal rot of sunflower at the base of the stem (Photo: Robert Harveson, UNL).

Figure 10.13. Microsclerotia produced by the charcoal rot fungus inside the stem (Photo: Robert Harveson, UNL).

Downy Mildew *(Plasmopara halstedii)*

Downy mildew is infrequently observed in South Dakota. Yield loss from downy mildew depends on the disease incidence (number of diseased plants) and distribution of the affected plants. Root-initiated systemic infections occur early in the season when seeds are germinating, and plants are emerging. Infected plants are severely stunted (Fig. 10.14) and exhibit conspicuous chlorosis and yellowing between veins that may be confused with virus symptoms (Fig. 10.15). These types of infections are favored by cool and waterlogged soil conditions. The causal pathogen is a soilborne, fungal-like oomycete and can survive in soil for long periods of time and is specific to sunflower. Downy mildew can be managed by selecting hybrids with resistance to *P. halstedii* and fungicide seed treatments.

Figure 10.14. Sunflower plants stunted from downy mildew (Photo: Robert Harveson, UNL).

Figure 10.15. Downy mildew symptoms observed on the stunted sunflower plant (Photo: Robert Harveson, UNL).

Rhizopus Head Rot (species of *Rhizopus*)

Rhizopus head rot is a sporadic, but potentially destructive disease when it does occur. Under optimal environmental conditions, such as a hailstorm followed by warm humid temperatures. Yield losses of 100 percent have been reported from this disease. Symptoms first appear on the backs of heads as a result of some type of wound, followed by a watery, soft rot that later dries and turns dark brown (Fig. 10.16). As disease progresses, heads may dry prematurely, and tissues may shrivel and become shredded (Fig. 10.17). These symptoms could then be easily confused with other diseases like Sclerotinia head rot. Rhizopus head rot is distinguished from the other diseases by the presence of grayish, mycelial strands growing within infected heads (Fig. 10.18). The disease can be caused by several species in the genus *Rhizopus*, but primarily *R. oryzae* (syn. *R. arrhizus*). The fungal spores

are ubiquitously found occurring naturally in soils and as a common airborne contaminant. Very few definitive management recommendations can be made for this disease, and no known disease-resistant hybrids are available. The primary management techniques would be limited to avoiding any form of mechanical damage to heads by controlling insect and bird feeding after flowering.

Figure 10.16. Beginning symptoms of Rhizopus head rot observed on the sunflower head (Photo: Robert Harveson, UNL).

Figure 10.17. Advanced symptoms of Rhizopus head rot observed on the sunflower head (Photo: Robert Harveson, UNL).

Figure 10.18. Gray-colored fungal strands observed on the sunflower head affected by Rhizopus head rot (Photo: Robert Harveson, UNL).

Verticillium Wilt *(Verticillium dahliae)*

Verticillium wilt occurs sporadically in South Dakota. The causal fungus survives in soil as microsclerotia, which upon germination infect sunflower roots. On the lower leaves, interveinal yellowing (chlorosis) spots develop, which may merge and grow larger. Over time the yellow spots become brown and necrotic and are surrounded by yellow halos given the leaves a mottled appearance (Fig. 10.19). Symptoms also progress up to new leaves as the pathogen moves upward in the stem's vascular system. Infected stems will show a reddish-brown discoloration of vascular elements (Fig. 10.20). Black streaky patches may be observed on the lower stems in severe infections. These black areas consist of thousands of the microsclerotia and can easily be rubbed off with a fingernail (Fig. 10.21). Yield loss occurs when plants are affected by Verticillium wilt during their reproductive growth stages. Verticillium wilt can be managed by rotating sunflower with non-hosts (e.g., wheat and corn) and avoiding fields with a disease history.

Figure 10.19. Yellow and brown spots observed on the leaves affected by Verticillium wilt (Photo: Robert Harveson, UNL).

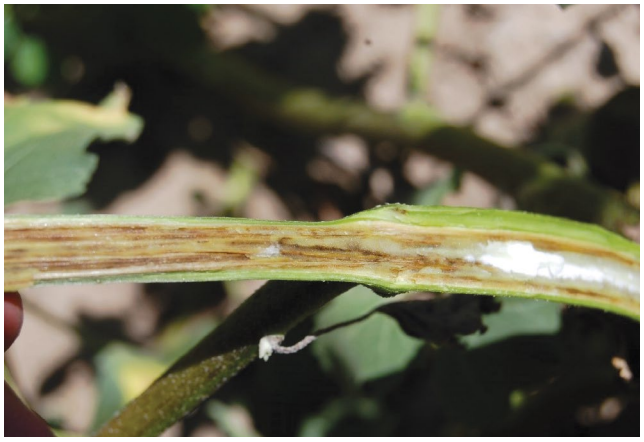

Figure 10.20. Internal discoloration of the stem affected by Verticillium wilt (Photo: Robert Harveson, UNL).

Figure 10.21. Brown-colored microsclerotia observed on the sunflower stem affected by Verticillium wilt (Photo: Robert Harveson, UNL).

Additional Information

Sunflowers can be impacted by other diseases in South Dakota. Additional information can be found at Sunflower Disease Diagnostic Series (https://www.ag.ndsu.edu/publications/crops/sunflower-disease-diagnostic-series/pp1727.pdf).

Fungicide recommendations are provided in the South Dakota Pest Management Guide for Alfalfa & Oilseeds (https://extension.sdstate.edu/south-dakota-pest-management-guides). These pest management guides are updated every year and has the list of fungicides labeled for use on sunflower in South Dakota.

Selected Reference

Kandel, H., Buetow, R., and Endres, G. (eds.) 2020. Sunflower production. A-1995. North Dakota State Extension Service, North Dakota State University, Fargo, ND, USA.

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P-00205-10