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(Sam Markell, NDSU)

Canola Diseases: Sclerotinia Stem Rot

Fereshteh Shahoveisi, Canola Research Assistant, Department of Plant Pathology
Sam Markell, Extension Plant Pathologist, Department of Plant Pathology
Luis E. del Río Mendoza, Canola Pathologist, Department of Plant Pathology
Hans Kandel, Extension Agronomist, Department of Plant Sciences

Sclerotinia stem rot (SSR), also called white mold, affects canola and many other broadleaf crops and weeds. The disease can cause significant yield losses and has been reported from all canola-growing regions of North Dakota. However, it is commonly more prevalent and severe in northcentral and northeastern North Dakota.

Incidence of the disease varies year to year and is highly influenced by environmental conditions during the flowering period. Integrated pest management strategies that include crop rotation, use of resistant hybrids and fungicide application may reduce disease and limit potential yield losses.

Cause

Sclerotinia stem rot is caused by the fungal pathogen *Sclerotinia sclerotiorum*. The pathogen does not have different races or biotypes, and the same pathogen can infect most broadleaf crops grown in North Dakota. However, canola is among the more sensitive of the crops grown in the region.

Sign and Symptoms

Sclerotinia sclerotiorum can infect all above-ground parts of the plant, including flower petals, leaves, petioles, stems and pods. Initial infection takes place during flowering.

Typically, pathogen spores first colonize flower petals and begin to produce mycelium (fuzzy mold). The mycelium then quickly begins to invade healthy green tissues; the first visible symptom is soft, mushy, brown-white lesions formed on leaves and petioles that might be covered with decaying flower petals (Figure 1).

Once established, the lesions grow in and on the plant, eventually turning white-grayish or bleached-white, resembling dried bone. Lesions that reach the main stem are most damaging (Figure 2A, 2B).

As the damage progresses, the stem becomes brittle and the epidermis (outer layer) may shred (Figure 3). Under severe disease conditions, stem girdling resulting in wilting and lodging will occur. Light grayish to white fungal growth (mold) may appear on the lesions during periods of high humidity, which is why the disease commonly is called “white mold” (Figure 3).

At the end of the season, small black structures (sclerotia) about the size of rat or mouse droppings are formed in or on the stem where lesions exist (Figure 4). Sclerotia serve as survival structures and can persist for more than four years in the soil.

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Disease Cycle

The disease cycle begins when sclerotia germinate, typically in the early summer (second half of June). While many sclerotia may be incorporated into the soil during tillage, only sclerotia in the top 2 inches will germinate.

Continuous soil moisture for a minimum period of 10 days, accompanied by soil temperatures of 60 to 77 F, is required for germination. These conditions normally occur in mid to late spring when the canopy closes, often at the end of the rosette growth stage.

Sclerotia germinate to produce apothecia, small mushroomlike structures normally 0.2 to 0.4 inch in size; they resemble miniature golf tees or upside-down mushrooms. Apothecia (Figure 5A) easily can be mistaken for reproductive organs of a saprophytic fungus called "bird's nest;" these fungi decompose the plant tissues in the soil and do not cause any plant diseases (Figure 5B).

Once sclerotia germinate, apothecia will be produced within three to four weeks; however, if intermittent soil moisture conditions prevail, apothecia formation may take longer or be arrested completely. Fully formed apothecia release ascospores, the primary inoculum for the disease.

Ascospores can be carried by wind for long distances; however, most ascospores are deposited within 100 to 120 feet of the apothecia. While apothecia are difficult to find in a field (most easily observed where white mold was common in the previous year), their presence indicates that pathogen spores exist and the crop may be at risk.

The infection process begins when ascospores land on flower petals, where they germinate and grow. Notably, ascospores that land directly on other healthy plant tissues cannot infect plants.

From flower petals, the fungus grows into leaves, petioles, branches and stems. Once the pathogen penetrates the plant, it will colonize and feed on the plant tissues. Sclerotia will be formed inside or on the stem once the nutritional value of infected plant tissues has been exhausted or if environmental conditions become unfavorable for the fungus.

Temperature and moisture conditions during bloom are extremely important determinants for the establishment and development of Sclerotinia stem rot. Cool to moderate temperatures from 65 to 72 F are optimal for infection, and temperatures higher than 86 F will arrest the development of the disease temporarily.

Frequent and prolonged periods of free moisture (frequent rainfalls, heavy dews and fog) are equally critical for infection. If ascospores land on casted petals, they have a 50% chance of successfully developing a foliar lesion when a total of 48 hours of accumulated leaf wetness duration occurs in a period of six days (with average daily temperatures of 70 F).

If accumulated wetness increases to 66 hours, the probability of disease development increases to 70%. If dry weather before and during the flowering stage occurs, the likelihood of establishment and development of the disease is reduced.

Plant-to-plant transmission of the pathogen is relatively low but may occur when infected and healthy tissues are in direct contact. However, the amount of plant-to-plant transmission typically does not translate into economic yield reductions.

Figure 1. Fuzzy growth of *Sclerotinia* beginning from flower petal. (Luis del Rio Mendoza, NDSU)

Figure 2. Developing lesion (A) and spread (B) of Sclerotinia stem rot. (Sam Markell, NDSU)

Figure 3. Canola stems with tan lesion beginning to shred and covered with fuzzy white mycelium (mold). (Sam Markell, NDSU)

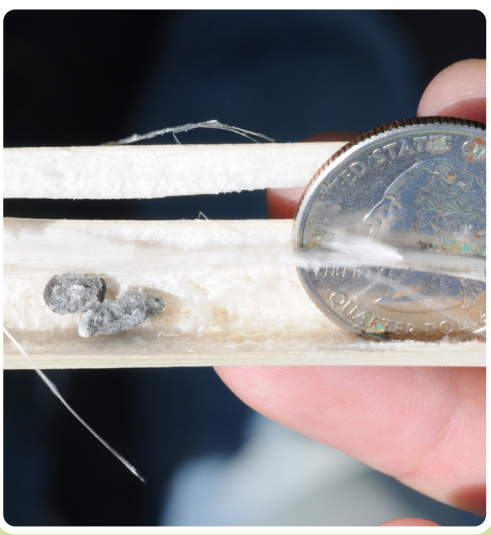

Figure 4. Sclerotia inside canola stem. (Sam Markell, NDSU)

Management

Scouting

Searching for apothecia in the field close to the flowering period can provide information about the risk of disease development. When scouting fields for apothecia, you must distinguish that from similar structures produced by other fungi.

Apothecia are light brown to tan and less than 0.4 inch in size, with short stalks, and their top is not rounded (Figure 5A). Lookalike fungi are common, particularly the bird's nest fungi, which is similar in size, shape and color, but often contains an egglike fungal growth (Figure 5B).

Once the disease occurs, scouting is of minimal value because management tools (such as foliar fungicides) cannot rescue the crop.

Resistant hybrids

Canola hybrids with high levels of resistance to Sclerotinia stem rot are not available yet; however, researchers at North Dakota State University are transferring resistance from promising sources into breeding lines.

Selecting hybrids that are resistant to lodging and produce a less dense canopy may reduce the severity of the disease. Dense canopies (and lodged plants) trap the humidity, creating longer periods of free moisture and a very favorable microclimate for infection and disease development.

Crop rotation

The longevity of sclerotia in the soil and the wide host range of the pathogen limit the efficiency of crop rotations. However, we recommend planting canola or other susceptible crops (sunflowers, dry beans, soybeans and pulse crops) no more than every two to three years. Small grains and corn are ideal rotational crops. Flax, while a broadleaf crop, is less sensitive to white mold and can be a viable rotation crop for Sclerotinia stem rot management as well.

Weed management

Many broadleaf weeds, such as mustard, pigweed, ragweed and shepherd's purse, are susceptible to SSR. Thus, effective broadleaf weed management is very important. Similarly, effective management of volunteer canola will increase the effectiveness of crop rotation.

Seeding

Plant canola seeds that are free of sclerotia. You also must consider seeding rates and the use of wide row spacing that provide ventilation conditions and reduce the duration of high humidity conditions within the canopy. However, we do not recommend that you adjust seeding rates to a level that may compromise yield potential.

Disease forecasting

Disease prediction models and forecasting systems are powerful tools to help predict or assess the risk of the infection. The Sclerotinia stem rot risk map is available at www.ag.ndsu.edu/sclerotinia/riskmap.html. This color-coded map predicts the risk of the disease development based on temperature and precipitation data collected by North Dakota Agricultural Weather Network weather stations throughout North Dakota and is updated every 48 hours during the canola flowering season.

In addition, the Sclerotinia risk calculator can be used to tailor the risk to the conditions of a particular field. The calculator allows growers to enter in specific field information (such as history of white mold in the field, length and nature of crop rotations, etc.) to predict a more precise risk of infection.

Figure 5. Apothecia of *Sclerotinia sclerotiorum* (A) compared with bird's nest fungi (B). (Sam Markell, NDSU)

Biological control

Several biological compounds are available, and more will likely become available in future years. More information More information can be found in the "North Dakota Field Crop Fungicide Guide," PP622, available at www.ag.ndsu.edu/extplantpath/publications-newsletters/2019-field-crop-plant-disease-management-guide.

Foliar fungicide application

When conditions are favorable for disease, foliar fungicide application can reduce the severity of SSR and prevent significant yield losses. We recommend growers consider utilizing the Sclerotinia risk map and risk calculator (www.ag.ndsu.edu/sclerotinia/riskmap.html) to help predict risk, but also encourage growers to consider specific microclimate conditions in their fields.

The timing of fungicide applications is very important. Foliar fungicides are recommended when 20% to 50% of the flowers are open. Canola typically reaches 10% flowering two to four days after the first flower appears on the main stem. From this point, we can expect another 10% increase in blooming every one or two days.

To calculate the percent of the flowering, collect flowers from the main stem of multiple plants and count the number of the open flowers; flowering is at 10% if 10 flowers are open, 20% when 14 to 16 flowers are open and 30% when 20 or more flowers are open. Further, the color of the field helps estimate the percentage of flowering; when 50% of the flowers are open, the color of the field has the highest intensity and the color starts to wane when flowering reaches 60%. Typically, fungicide applications made after the crop has reached 100% flowering do not produce positive economic returns.

Multiple fungicides are available in North Dakota. For more information about fungicide use to manage this disease, see the "North Dakota Field Crop Disease Management Guide," PP622, available at www.ag.ndsu.edu/extplantpath/publications-newsletters/2019-field-crop-plant-disease-management-guide.

▲ **Sclerotinia stem rot damage of canola.**

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