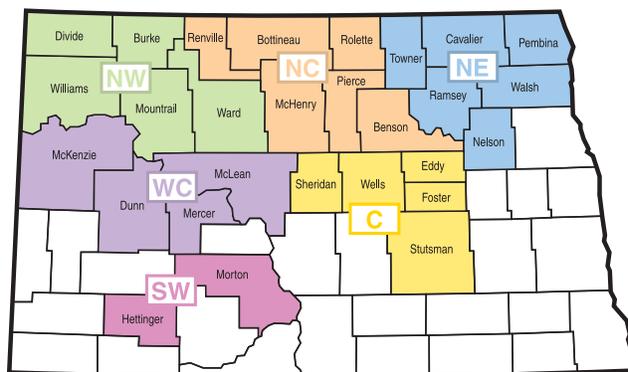


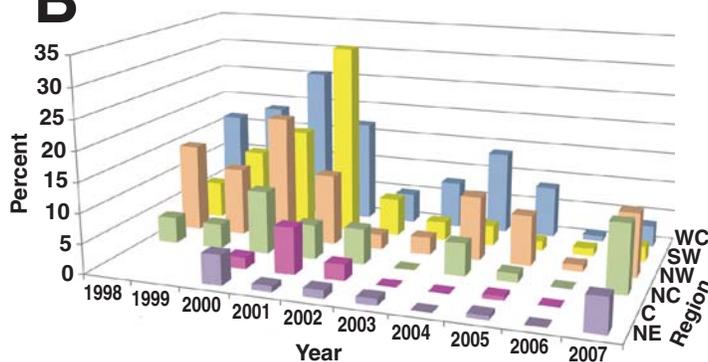
# Sclerotinia of Canola

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**A**



**B**



**Figure 1. North Dakota regions (A) surveyed between 1998 and 2007 and (B) percent of plants infected with SSR. Data were generated from a season-end canola survey after swathing.**

## Sclerotinia stem rot

(SSR) is one of the most serious and common diseases of canola in North Dakota. Average statewide yield losses in North Dakota and Minnesota have reached 13 percent, with losses in some fields as high as 50 percent. SSR occurs almost every year and in most regions of the state (Figure 1).

In recent years, new management tools, including a forecasting model to aid in fungicide decision making, have become available. Additionally, multiple fungicides now are labeled, giving canola producers options that were not accessible a couple of years ago.

**NDSU**

**NDSU Extension Service  
 N.D. Agricultural Experiment Station**

North Dakota State University  
 Fargo, North Dakota 58108

June 2009

This publication is based in part on publications A-1208, "Canola Flowering and Fungicide Application Timing," by Terry Gregoire, Duane Berglund and Art Lamey, and PP-1201, "Sclerotinia Stem Rot of Canola: Biology and Management," by Arthur Lamey and Carl Bradley.

## Cause

The fungal pathogen *Sclerotinia sclerotiorum* causes sclerotinia (also called white mold) in more than 400 different plant species, including canola, dry beans, soybeans, sunflowers, flax and the pulse crops (peas, lentils, chickpeas).



## Symptoms and Signs

Symptoms on canola plants don't appear until after flowering. The first visible symptom is a mushy, light brown target pattern on and around cast petals (colored parts of the flower). Infection then spreads from the infected leaf petioles (slender stalk connecting the leaf to the plant) into branches and eventually to stems (Figure 2). Infected areas become bleached, taking on the appearance of dry bone and frequently become brittle and shredded (Figure 3). If infection occurs in the main stem, plants may die early and become prone to lodging (Figure 4). Standing dead plants may be visible in fields with severe SSR infection (Figure 5). After infection is well-established, hard, black structures (sclerotia), which resemble rat droppings, may be produced in infected tissues (Figure 3). The sclerotia are the survival structure of the pathogen and, although they are not produced in every infection, they are a definitive sign of SSR.

If the weather is favorable, small mushroom-like structures (called apothecia) will be produced on the sclerotia (Figure 6). Apothecia resemble miniature golf tees that are usually no bigger than 1/4 inch wide and can be difficult to find. However, if they are found around the time of flowering, they are a sign that the pathogen is producing spores and conditions may be favorable for infection.

**Figure 2. Canola stem and branch infected with sclerotinia.**

(Photo by Luis del Rio, NDSU)

**Figure 3. A shredded, bone-white stem containing sclerotia.**

(Photo originally published in PP-1201, "Sclerotinia Stem Rot of Canola: Biology and Management")



**Figure 4. Lodging resulting from sclerotinia infection.**

(Photo originally published in PP-1201, "Sclerotinia Stem Rot of Canola: Biology and Management")



**Figure 5. Field infected with sclerotinia stem rot.** (Photo originally published in PP-1201, "Sclerotinia Stem Rot of Canola: Biology and Management")

**Figure 6. Apothecia of sclerotinia, cups are approximately 1/8 to 1/4 inch in diameter.** (Photo by Sam Markell, NDSU)



## Disease Cycle

The pathogen produces sclerotia in infected stems, which fall to the ground during harvest. The pathogen can survive on or in the soil for many years as sclerotia.

One to two inches of rain in a one- to two-week period will moisten soil enough for sclerotia to germinate and produce apothecia. Apothecia can produce millions of spores (ascospores) that are dispersed by wind; however, most ascospores remain trapped in the canopy near the apothecia. The great majority of spores do not travel more than 150 feet, but some spores do travel well into adjacent fields when the right conditions persist.

Spores can infect floral parts directly, but most infections occur when spores land on dead or dying tissue. Canola petals that die after flowering provide an excellent food source for the SSR spores. Spores that land on these senescing petals can germinate and the pathogen will begin to grow. Once the pathogen is established, it invades healthy plant tissue and may progress into petioles, branches and the stem.

Environment plays a major role in SSR infection and severity. Weather conditions around flowering are a critical determinant for infection. As a general rule of thumb, one to two inches of rain are needed within a week or two of flowering. If rain does not occur prior to flowering, the soil will be too dry for sclerotia to germinate, no apothecia and spores will be produced and infection will not take place. If spores are produced, the canopy must be wet for much of two days for the spores to germinate and infection to take place. However, even when ample moisture is available, if temperatures are too hot during this time (above 86 degrees Fahrenheit), spores may die before they can begin to grow. If infection occurs, disease development will not occur above 86 degrees, but it will resume once cooler temperatures return. Similarly, if weather becomes dry, disease progression will slow and increase only when the canopy becomes wet.

## Management

**Crop Rotation** — Crop rotation is important to limit the buildup of sclerotia. Try to avoid more than one highly susceptible crop (sunflowers, canola, crambe, dry beans, soybeans) in a rotation. Semileafless peas support less buildup of sclerotinia than the vining types and may be acceptable in crop rotations. In irrigated trials at Carrington, N.D., no sclerotia were produced in flax; therefore, flax may be a relatively safe crop in rotation with canola. Additionally, cereals are not susceptible to SSR. A preferred rotation would have canola planted after two or more nonsusceptible crops. Despite appropriate crop rotation, some sclerotia can survive for long periods of time and can germinate and cause infection many years after they were produced. Additionally, infection can occur from spores blown in from other fields.

**Tillage** — Management of SSR with tillage is uncertain. Deep tillage may bury sclerotia deep enough that they do not produce apothecia. However, some data indicate that these sclerotia do not break down as fast as those near the surface and may result in infection if they are brought back near the surface later. Additionally, even if deep tillage is done, it is probably of limited value if used on one or a few fields and not areawide.

**Resistance** — All canola varieties are susceptible to some degree. However, some varieties may be less susceptible than others. A great deal of energy and resources are being used in an attempt to identify sources of resistance and breed resistant canola.

**Biological Control** — The fungus *Coniothyrium minitans* can attack and kill sclerotia in the soil. The fungus is sold under different product names. Use of this fungus to battle sclerotinia is relatively new, and limited data exists. This fungus may be of greatest use under high disease pressure rotations or cropping practices (such as irrigation). Other biocontrol products will be entering the market in the near future; consult the most current “North Dakota Field Crop Fungicide Guide,” PP-622, for more information.

**Fungicides** — Numerous fungicides have become available in recent years, and new products likely will be available in the future. To find products available, consult the most current “North Dakota Field Crop Fungicide Guide,” PP-622. Fungicide trials are done frequently at NDSU’s Research Extension Centers in Carrington, Langdon and Minot (North Central REC). For the most current information, please visit their Web sites at [www.ag.ndsu.edu/research/recenthp.htm](http://www.ag.ndsu.edu/research/recenthp.htm).

**Making the decision to spray** (or not to spray) and spraying at the most appropriate growth stage are the two keys to managing SSR. In general, spraying is most beneficial when:

- One to two inches (or more) of rain occurred in the two weeks prior to flowering.
- More rain or high humidity is expected.
- Sclerotinia has been a problem in recent years.

A sclerotinia risk map and photographs of bloom stages should help growers make a spray decisions.

**Sclerotinia Risk Map** — Environmental information generated from the North Dakota Agricultural Weather Network (NDAWN) weather stations are used to determine if conditions are favorable for the germination of sclerotia, development of apothecia and spore release. This information is used to generate a map with color-coded indication of risk throughout North Dakota and the canola-growing areas in Minnesota.

The map is an effective tool to help growers assess their risk of SSR infection. However, several things should be kept in mind:

- The risk map only applies to you when your canola is in flower. Because the pathogen uses petals as a food source, no infection occurs prior to flowering.
- The map is meant as a regional guide to risk. The Risk Map is only as good as the information source, and even though NDAWN has approximately 67 weather stations, the

environmental conditions in your field may be different. If you know you have had more/less rain than the NDAWN stations nearest you, your risk may be higher/lower.

- The Sclerotinia Risk Map calculates the likelihood of sclerotia germinating and, thus, spores being available to cause infection. Your fields may have greater or less risk depending on other management techniques (crop rotation, less susceptible variety), field history and weather forecasts (for example, rain, humidity, temperature).

The map is available at [www.northerncanola.com](http://www.northerncanola.com) and [www.ag.ndsu.edu/sclerotinia/](http://www.ag.ndsu.edu/sclerotinia/).

### **Assessment of Flower Stages (Figure 7)** —

Although different fungicides may have slightly different recommendations for spray timing, they are most effective when made at or before 50 percent flowering. For this reason, assessing flower stages correctly is critical.

Flowering begins with the opening of the lowest bud on the main stem and continues upward with three to five or more flowers opening per day. Flowering at the base of the first secondary branch begins two to three days after the first flower opens on the main stem. Under reasonable growing conditions, flowering of the main stem will continue for 14 to 21 days. In general, the crop takes two to four days to move from first flower to 10 percent flower, one to two days from 10 percent to 20 percent flower, one to two days from 20 percent to 30 percent flower, etc.

*Early* flower stages can be accessed on the main stem. Sample multiple canola plants and count open flowers on the main stem only. At 10 percent flower, 10 flowers are open; at 20 percent flower, 14 to 16 flowers are open; at 30 percent flower, 20 or more flowers are open. Flower stages also can be estimated by field color. Color intensity steadily increases until its maximum intensity at 50 percent flower. By 60 percent flower, color intensity begins to wane.

Figure 7. Bloom stage identification. (Photos courtesy of BASF)



10% Bloom



20% Bloom



30% Bloom





**40% Bloom**



**50% Bloom**



**60% Bloom**





**Canola field.** (Photo by Sam Markell, NDSU)

## **For more information on this and other topics, see: [www.ag.ndsu.edu](http://www.ag.ndsu.edu)**

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