PP1557
Plant Disease Management
NDSU Extension Service

Sunflower Rust

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Sunflower rust is a disease capable of causing yield loss in all sunflower production regions in the U.S. and Manitoba. Severe infection will decrease head size, seed size, oil content and yield. Sunflower rust epidemics are influenced by environmental conditions and the time of disease onset (when rust first occurs); therefore, incidence and severity vary from year to year. According to data collected from National Sunflower Association-sponsored surveys, the incidence and severity of sunflower rust in the U.S. has increased steadily throughout the 2000s. In North Dakota, sunflower rust commonly is reported, and dramatic yield reductions have been recorded in localized "hot spots."

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Cause

Sunflower rust is caused by the fungal pathogen *Puccinia helianthi.* Different races of the pathogen exist and can change through time. Periodic race surveys done by the U.S. Department of Agriculture-Agricultural Research Service in Fargo have recovered up to 39 different races in one growing season. Each race may have the ability to cause disease on different resistance genes, sometimes overcoming a resistant hybrid. Generally, confection hybrids are more susceptible to rust than oilseed hybrids, and higher yield losses in confections are reported more commonly.

Figure 1. The pycnial stage of rust is the first observable sign of the pathogen. It can be found on the upper sides of leaves or cotyledons.
(Photo by Robert Harveson, University of Nebraska Panhandle Research and Extension Center)

Signs and Symptoms

The sunflower rust pathogen goes through five spore stages during its life cycle, four of which are visible with the unaided eye. The earliest visible stage is the pycnial stage, which has been observed as early as the first week of June in North Dakota. This stage is not seen often, but it occurs as a small (1/4 inch or less) yellow-orange spot on the top side of cotyledons or lower leaves (Figure 1). As the disease progresses, aecia will appear on the underside of the leaf, immediately opposite the pycnia. Aecia appear in clusters of orange cups similar in size to the pycnia (Figure 2).

If aecia are found, the most common stage of rust (uredinia) often is observed within two weeks. Uredinia pustules are small (1/16 inch) and can occur on upper or undersides of leaves (Figure 3a and 3b). Pustules are filled with cinnamon-brown spores (urediniospores) that may by surrounded by a chlorotic halo and can be rubbed off easily, leaving a dusty brown streak of spores (Figure 4). At season's end, the uredinia are converted to telia (Figure 5), a black structure that does not rub off.

Figure 2. The small aecial cups, or the second visible sign of rust, are on the underside of the leaves, opposite the pycnia. (Photo by Sam Markell)

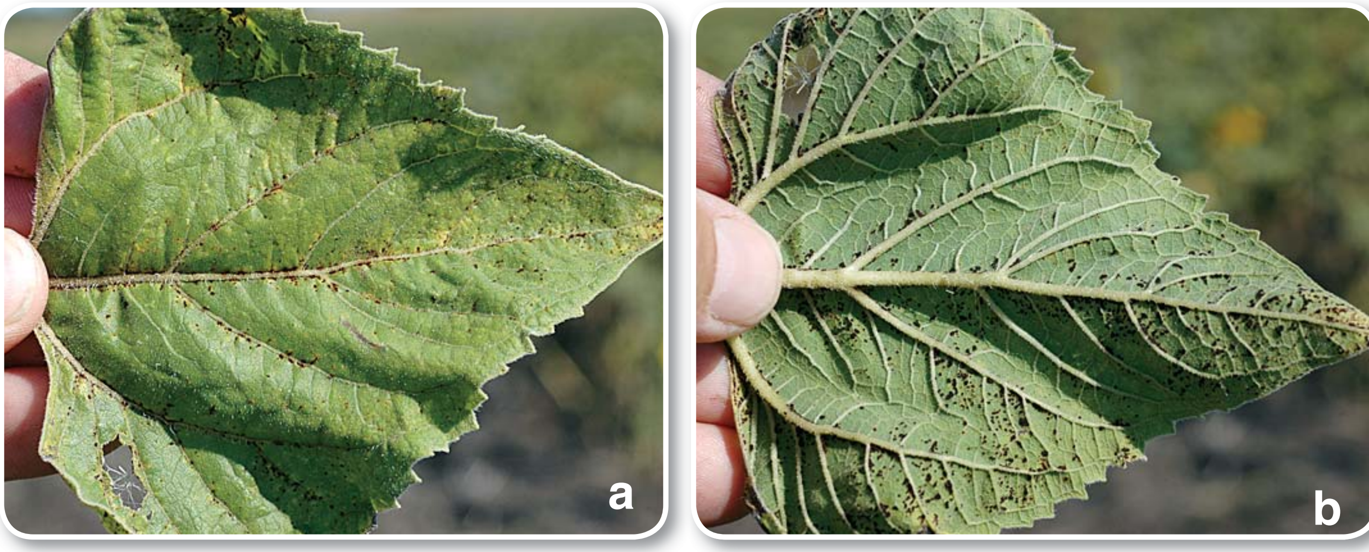


Figure 3a and 3b. Uredinia infections can vary in severity and can be found on both the upper-side (3a) and underside of leaves (3b). Pustule coverage is usually greater on the underside of the leaves.
(Photos by Sam Markell)

Figure 4. Uredinia can be rubbed off easily and often will leave a "streaky" appearance when agitated.
(Photo by Andrew Friskop)

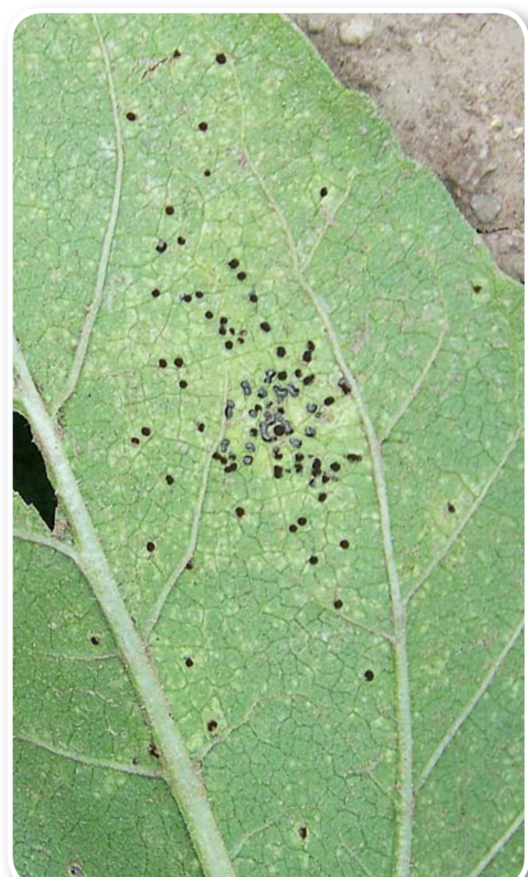


Figure 5. Telia are the black overwintering structure for the pathogen and remain on the plant's surface when agitated.
(Photo by Andrew Friskop)

Disease Cycle

Sunflower rust can occur at any time during the growing season, but disease onset is dependent on the environment and inoculum source. Additionally, sunflower rust occurs only on cultivated or wild sunflowers; it is not the same rust disease associated with wheat or dry beans. When disease occurs early, it is usually the result of inoculum that overwintered as telia on sunflower residue (previous crop residue or wild sunflowers). Late-season epidemics are generally a result of urediniospores blown in from distant fields.

Puccinia helianthi has five spore stages that occur on wild and cultivated sunflowers. The pathogen can undergo sexual recombination, which facilitates the development of new races of sunflower rust. Sexual recombination begins when basidiospores infect a sunflower and give rise to pycnia, where receptive hyphae (female) and spermagonia (male) cross-fertilize. The resultant mycelium gives rise to aecia in eight to 10 days. Aecia produce aeciospores (disseminated by wind) that infect the sunflower and give rise to uredinia, the economically important stage of the disease cycle.

Urediniospores are produced in uredinial pustules and can be disseminated long distances by wind. Urediniospores can infect most of the plant tissue, including stems, bracts, petioles and leaves (Figure 6a and 6b). In favorable conditions of free moisture (dew) and warm temperatures (55 to 85 F), the uredinial stage repeats its cycle every 10 to 14 days. Because infection is favored by free moisture, infection may be most severe in leaf depressions (Figure 7), on leaf veins or in other areas where moisture persists. When temperatures fall beyond the favorable range for infection and disease development, the repeating cycle (uredinia) slows and or stops. However, the disease progression may resume when environmental conditions are favorable.

Late-season cold temperatures or host maturity will initiate the change from uredinia into the

Figure 6a and 6b. Uredinia also can infect other areas of the sunflower plant, such as stems (6a), petioles and bracts (6b). (Photos by Sam Markell)

Figure 7. Infection is favored in areas of moisture retention, as indicated by a leaf depression. (Photo by Sam Markell)

overwintering telial stage. Once the telia occur, the disease cycle for that growing season ceases. In the spring, teliospores germinate and produce basidia, which are visible by microscope only. Basidiospores will infect leaves, leading to pycnia, and the cycle repeats.

Management

Resistance — Choosing a rust-resistant hybrid is an important management tool. However, new races of the pathogen can develop and overcome genetic resistance. Consequently, scouting fields for rust is important even if a resistant hybrid is planted. For information on rust-resistant hybrids, several resources may be available, including 1) North Dakota State University publication A-652, "North Dakota and South Dakota Hybrid Sunflower Performance Testing," which publishes rust evaluations in hybrid performance trials when a natural epidemic occurs; 2) The National Sunflower Association website, www.sunflowernsa.com, which periodically publishes rust resistance ratings conducted by the USDA-ARS in Fargo; and 3) seed companies, which often evaluate their hybrids for rust resistance

Crop Rotation — Rust spores can travel long distances, so crop rotation will not prevent rust epidemics. However, crop rotation will help break up the rust life cycle, which will reduce the likelihood of frequent race changes and delay the onset of an epidemic. Rotation also is important for the management of other sunflower diseases such as Sclerotinia, Downy Mildew and Phomopsis.

Controlling Wild Sunflowers — Wild sunflowers are a critical reservoir for the pathogen (Figure 8). All 61 species of *Helianthus* found in North America are hosts to the rust pathogen. All spore stages readily occur on wild sunflowers, which increases the sunflower rust problem in two ways. First, when the early spore stages appear on volunteer and wild sunflowers, the onset of uredinia is earlier. This allows more infection cycles to take place, which creates a greater yield loss potential. Secondly, sexual recombination occurs when the pathogen completes its life cycle. This may result in new races that overcome available resistance. Therefore, removal of wild sunflower populations around fields is strongly recommended.

Figure 8. Wild sunflowers (in this case, Jerusalem artichoke, or Helianthus tuberosus) can be "rust reservoirs" and provide spores to infect neighboring fields of cultivated sunflower.
(Photo by Sam Markell)

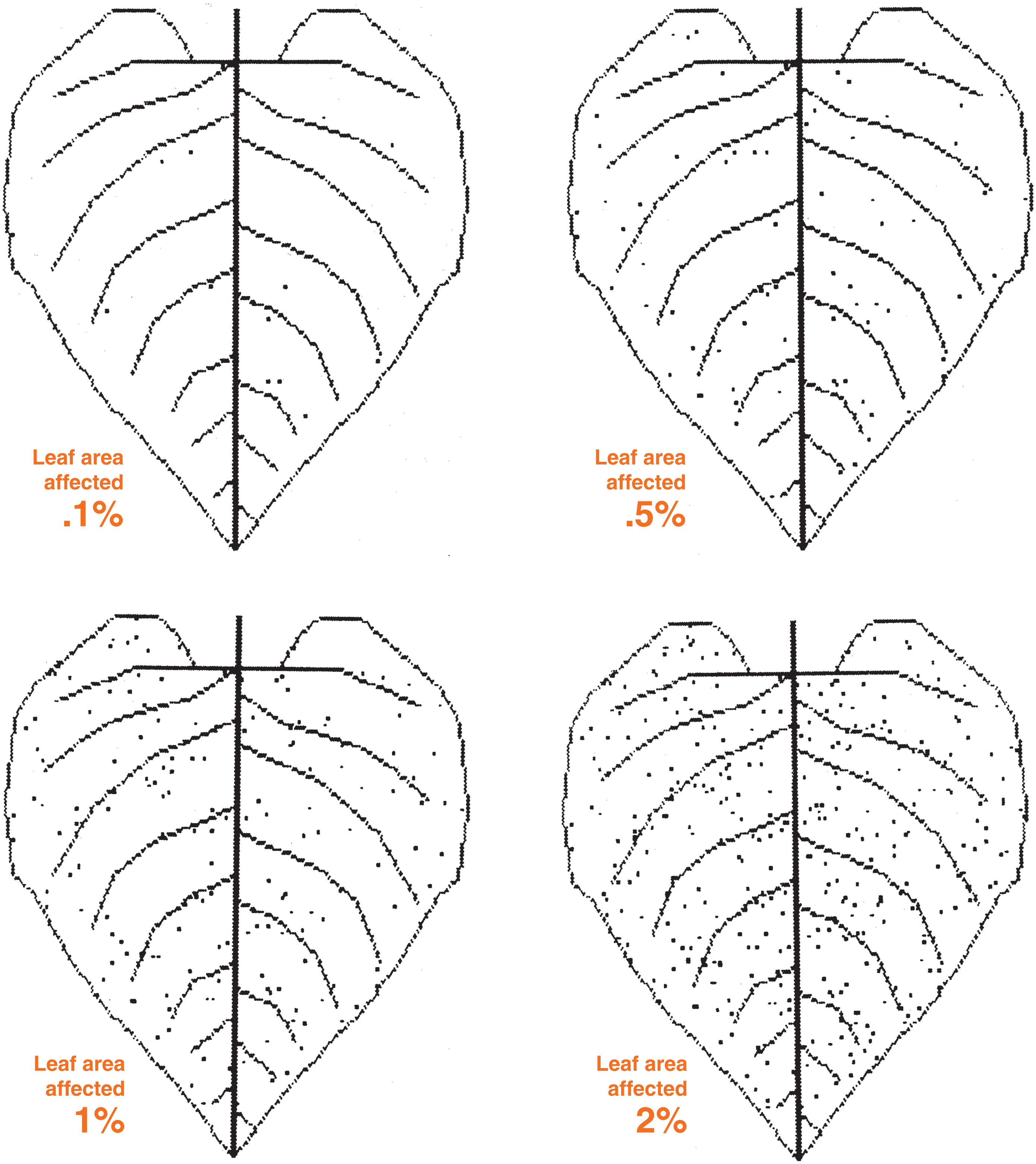
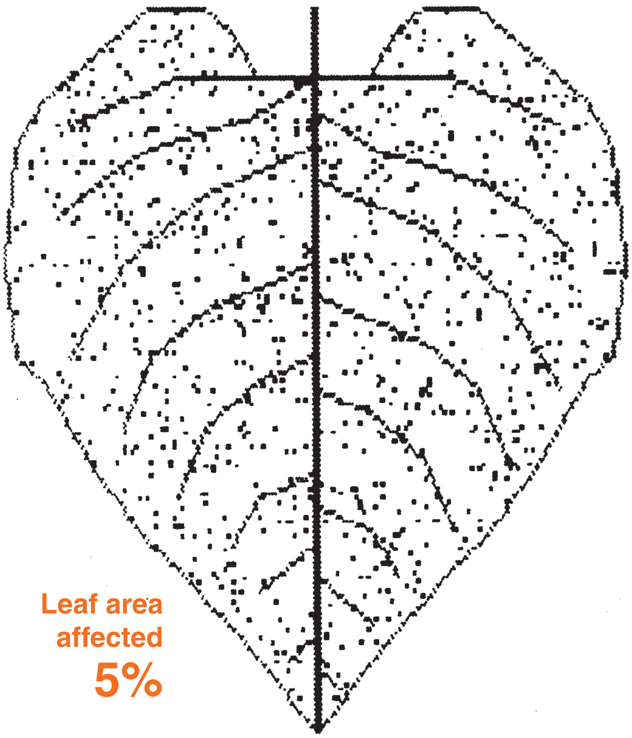
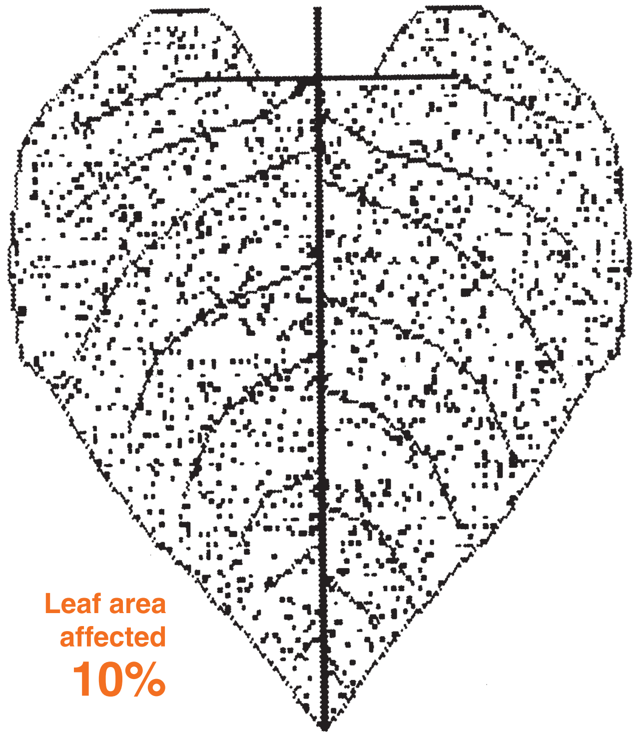


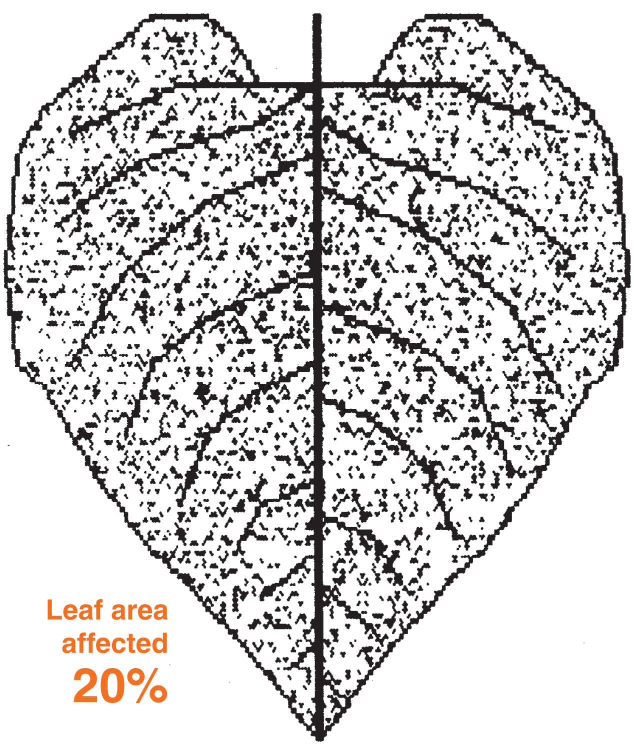
Figure 9. The disease assessment scales should be used in determining the optimum time for a fungicide application. This is done by estimating the average severity of the upper four fully expanded leaves.



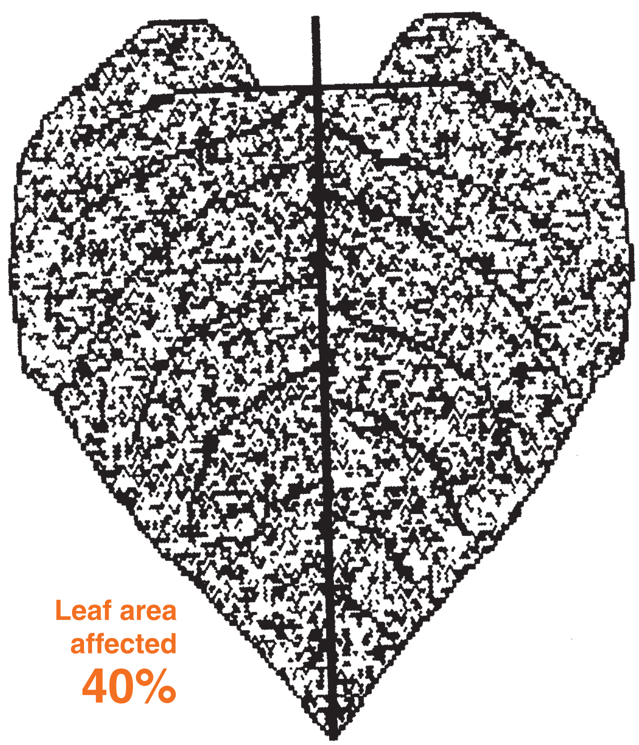
Leaf area affected 5%



Leaf area affected 10%



Leaf area affected 20%



Leaf area affected 40%

Foliar Fungicides — Fungicides are a critical tool for managing rust. Applying fungicides in a timely manner will limit new infections and slow the progression of an epidemic. At the time of this printing, all labeled products, including FRAC 3 products (Tebuconazole) and FRAC 11 products (Pyraclostrobin and Azoxystrobin), will reduce rust. Refer to the most current issue of the “North Dakota Field Crop Fungicide Guide” (PP-622) for updated information on labeled products and rates of application.

Fungicide Timing and Disease Assessment Diagrams — The disease assessment diagrams provided in this publication are a guide to help assess rust severity (Figure 9). These can be most useful when considering thresholds for fungicide applications. To use, compare diagrams to the amount of sunflower rust in different parts of the canopy.

A fungicide application is most likely economical when average disease severity reaches 1 percent on the upper four, fully expanded leaves prior to or during bloom (R5). Fungicide applications at R6 or later have not been proven to impact yield positively. If sunflower rust is found early in the season while plants are in vegetative stages, multiple fungicide applications may be warranted. Please consult an expert if an early occurrence of rust is found.

(Photo by Andrew Friskop)

This publication is based in part on publication PP-998, “Sunflower Rust,” by Thomas Gulya, Robert Venette, James Venette and H. Arthur Lamey. June 1990.

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