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SUNFLOWER RUST

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Sunflower rust, caused by the fungus *Puccinia helianthi*, can cause significant yield and quality losses on susceptible sunflower hybrids under conditions favorable for rust development. *P. helianthi* has been reported from every state where either cultivated or wild sunflowers are found.

SYMPTOMS

The first signs of rust usually appear when sunflowers are at or past bloom. Conditions are more favorable for infection when sunflower plants have reached maximum size and the plants have formed a dense canopy. Cinnamon-brown pustules (uredia) occur first on lower leaves, then on the upper leaves, and eventually on the petioles, stems, and back of the flower head. Uredial pustules occur on both the upper and lower surface of the leaves, are roughly circular, and measure up to 1/16 inch in diameter. Several pustules may merge into a much larger, irregularly-shaped aggregate pustule. Pustules may or may not be surrounded by a chlorotic (yellow) border.

Uredial pustules contain one-celled urediospores, often referred to as summer spores, which are the repeating stage (Figure 1). Urediospores are easily dislodged from the pustules and can be blown by wind for great distances. Leaves with many pustules may wilt due to water loss through the ruptured leaf surface.

With the onset of cool weather, the uredial pustules change into telial pustules, which are characteristically dark brown or black. These telial pustules contain two-celled teliospores, which are the overwintering stage of the rust fungus. In addition to the color difference between urediospores and teliospores, the black teliospores do not dislodge easily from the leaf.

In early spring, the teliospores germinate to produce basidiospores, which infect sunflower seedlings. The first signs of infection are yellow-orange (aecial) pustules on either the upper or lower surface of the cotyledons and leaves of sunflower seedlings. Viewed with a 10X hand lens, the aecia resemble groups of small orange cups. The aecia measure up to 1/16 inch in diameter but they generally occur in groups of three to eight, arranged in a circle that may range from 1/4 inch to 5/8 inch in diameter, and are usually surrounded by a broad chlorotic border.

SURVIVAL AND SPREAD

Sunflower rust completes its entire life cycle on sunflower and can only infect sunflower. *Puccinia helianthi* overwinters throughout the upper Midwest as black telial pustules on infected sunflower debris. Early season rust infection (aecia) may occur on wild, volunteer or hybrid sunflowers. The aeciospores are then wind-blown to other plants to initiate uredial infections.

Conditions favorable for infection are free water on the leaves, either from rainfall or dew, and warm temperatures. A minimum of only two hours of wet leaves is sufficient for rust infection; six to eight hours of leaf wetness will produce the maximum amount of infection. Urediospores will germinate and infect at night temperatures ranging from 55 to 85 degrees Fahrenheit. Depending upon temperature, seven to 14 days elapse after infection until the first uredial pustules appear.

Figure 1.

A single pustule can produce 1,000 or more urediospores, and each pustule can produce several “crops” of spores. Urediospores can be blown for many miles to infect other fields. If weather conditions are favorable, new infections can occur every 10 to 14 days. When temperatures drop below 50 F for an extended period, the uredial pustule is stimulated to change into a telial pustule. Once a uredial pustule changes to the black telial pustule it cannot revert back to the uredial stage, and thus rust infection for that season has ended.

FACTORS AFFECTING RUST SEVERITY AND YIELD LOSSES

To effectively plan rust control strategies, it is necessary to understand the factors that influence rust severity and subsequent yield losses. Some of these factors, such as choice of hybrid and planting date, are entirely controllable by the grower, while others, such as the weather and time of infection, are beyond direct control. All, however, have a cumulative effect on rust severity.

Weather has a profound effect both on the initial infection process and on the speed with which a rust epidemic progresses. As night temperatures increase, rust spores can infect more quickly. With extended periods of leaf wetness, more spores germinate and are able to infect. At 77 F over 90 percent of the spores germinate if the leaf stays wet for three hours. At 68 F, the leaf must stay wet for eight hours for 90 percent spore germination.

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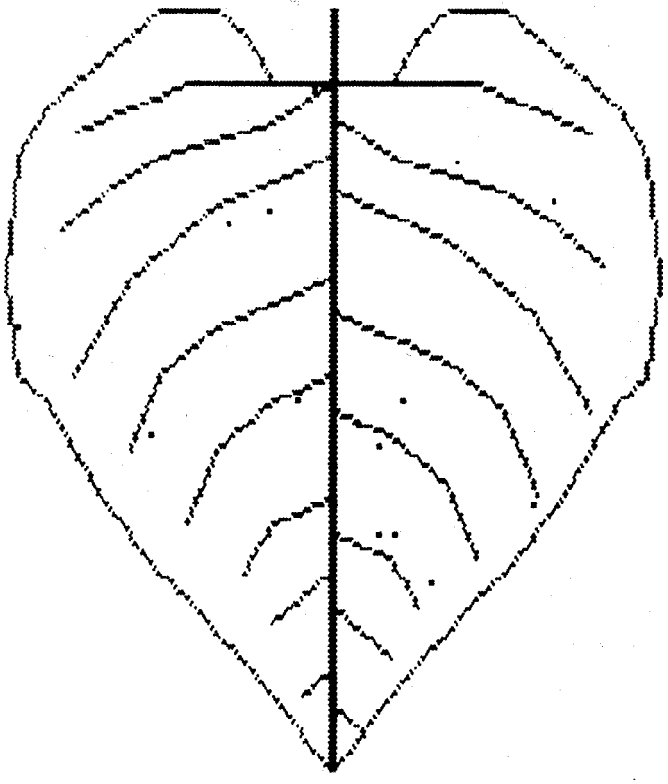
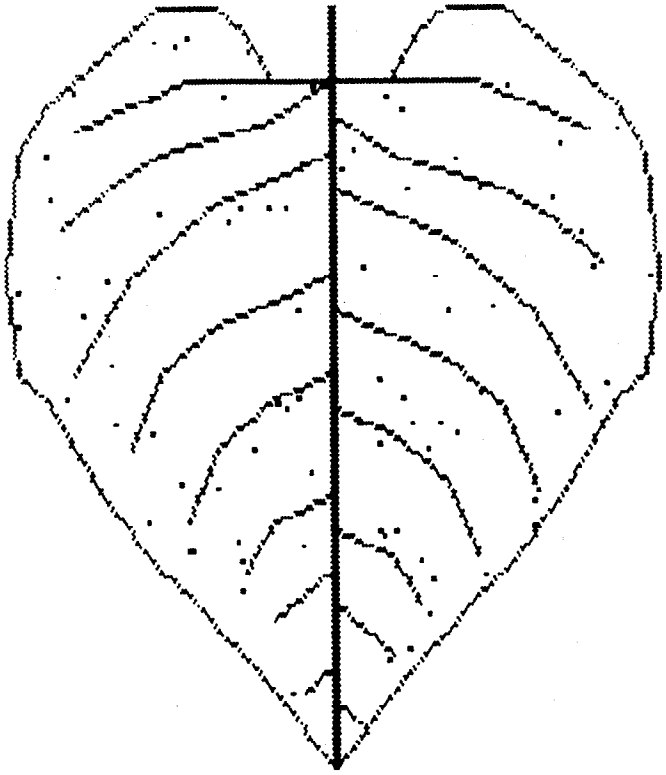
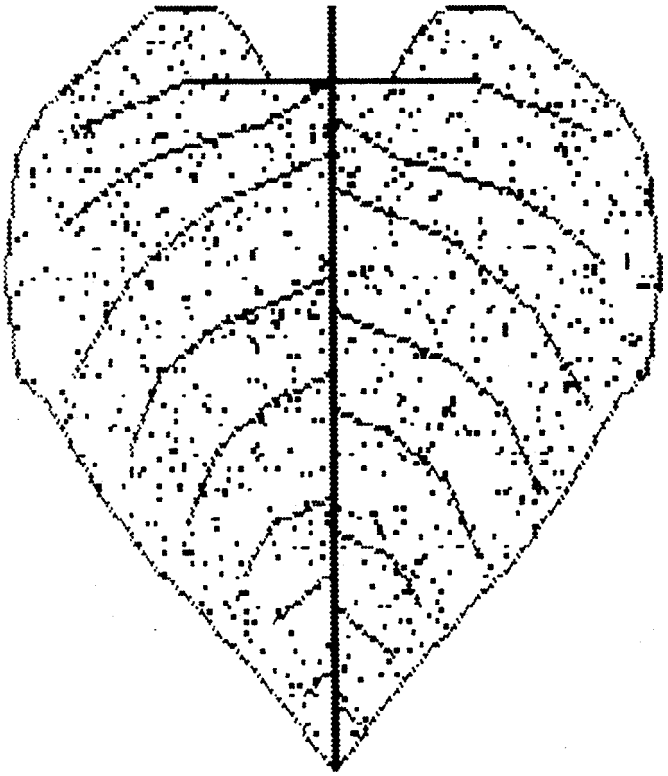


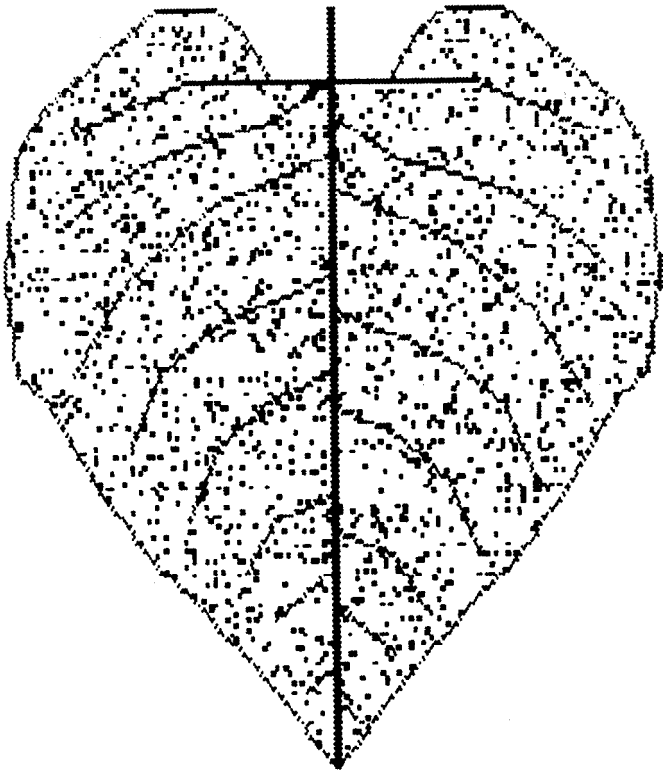
Leaf Area Affected .1%



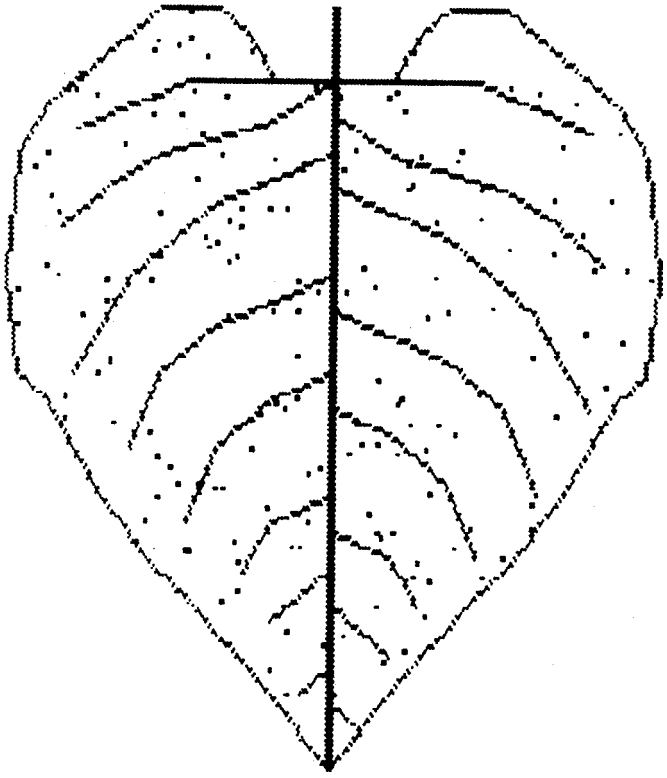
Leaf Area Affected .5%



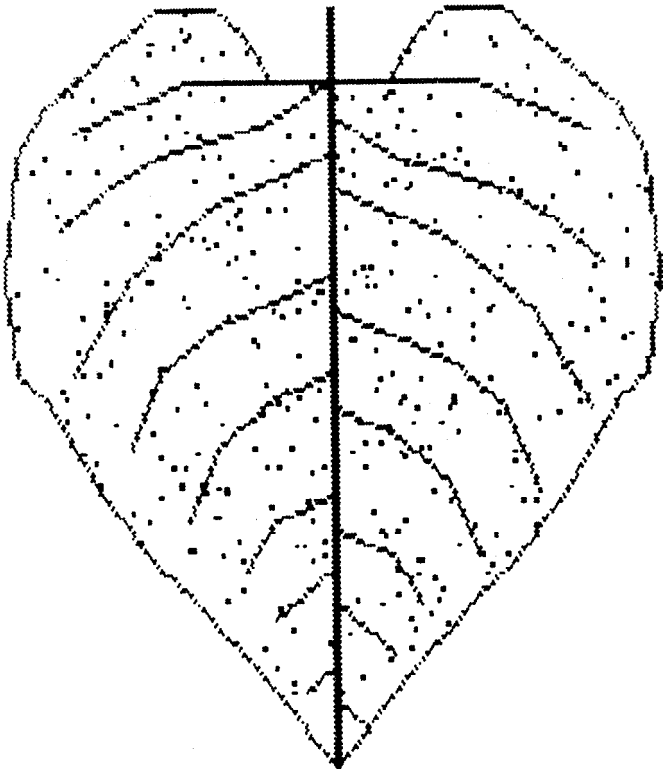
Leaf Area Affected 5%



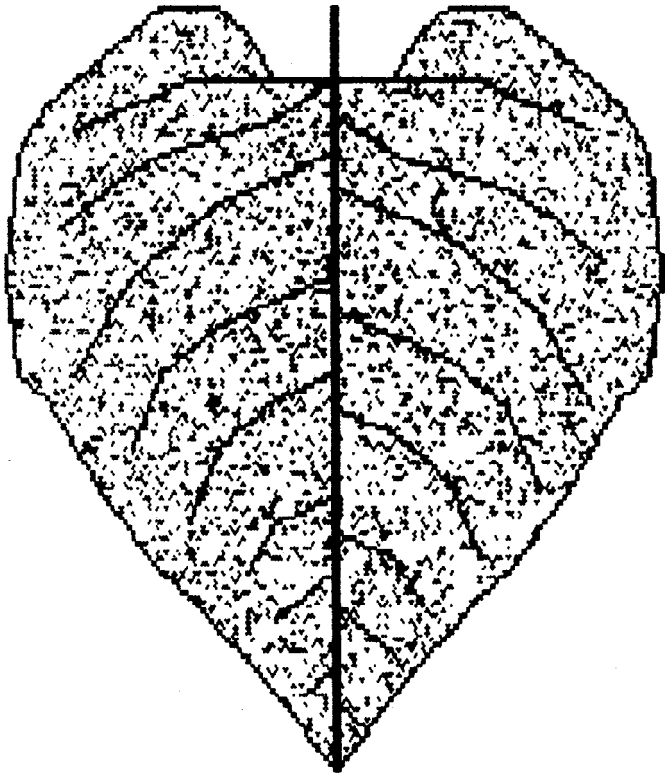
Leaf Area Affected 10%



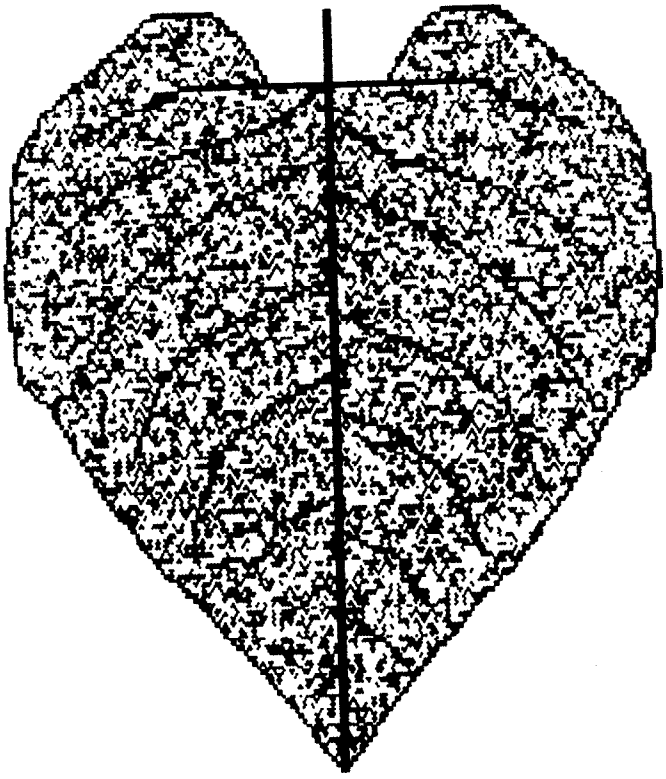
Leaf Area Affected 1%



Leaf Area Affected 2%



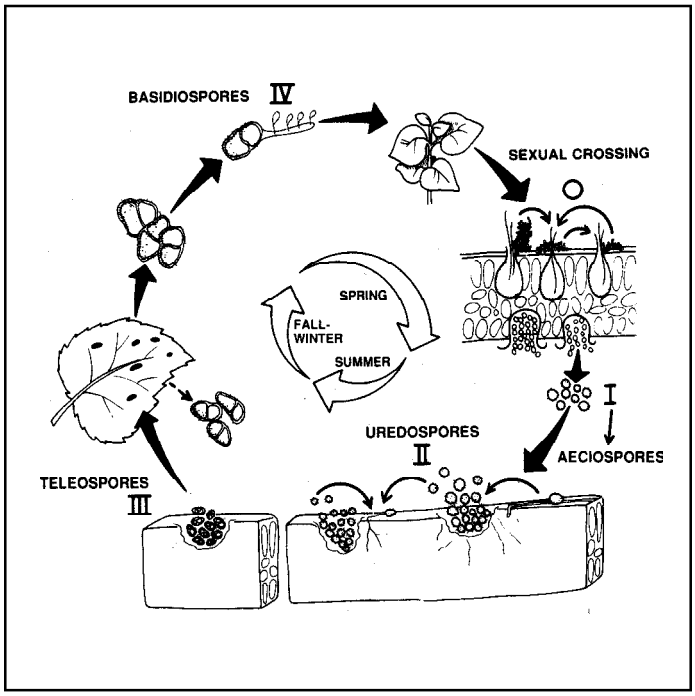
Leaf Area Affected 20%



Leaf Area Affected 40%

Once a rust spore has penetrated the leaf, only temperature has a bearing on its growth; rain or dew have no effect. Under cool conditions (65 F day/ 55 F night) rust takes about 14 days from the time of infection until the first uredial pustules appear and produce spores for a second wave of infection. At warmer temperatures (85 F day/ 75 F night) rust takes only eight days to produce pustules. At these warmer temperatures, the fungus produces more and larger pustules so that up to 80 percent more spores may be produced.

The time of initial infection also is very critical on disease development. First, early infections obviously have more time to produce repeated infections. Rust starting on June 15 could produce 10 or 11 successive crops of spores, compared to only four or five spore crops if rust did not start until August 15. Second, rust infection has a more profound effect on pre-bloom plants than on older plants. In greenhouse experiments, plants infected prior to bloom suffered a 40 percent yield loss compared to only a 10 percent yield loss when infection was delayed until two weeks after bloom. Lastly, younger plants are more susceptible to rust than plants which have already flowered.



Rust disease cycle.

MANAGING RUST

Effective disease management may consist of one or more control measures, including cultural practices, hybrid choice, and/or fungicide sprays. Many cultural practices have a small, but cumulative, effect upon the severity of rust and other diseases.

Sunflowers should NOT be planted two years in a row in the same field. Rust spores in debris of the previous crop can infect seedlings almost immediately upon emergence. Rotations away from sunflower for more than one year, while helpful in controlling other soil-borne fungal diseases, are not necessary for rust control. If possible, avoid planting next to a field that had sunflower last year. If rust occurs on volunteer sunflower plants in the vicinity of a planted field, they should be destroyed as soon as possible to prevent the spores from blowing into the planted field.

Early planting and short season hybrids will generally have less rust. Any cultural practice which fosters a dense canopy, which in turn traps dew, increases chances of a severe rust infection. Thus, avoiding high plant stands and high nitrogen fertilization would reduce rust severity.

Hybrid choice is probably one of the most effective means of controlling rust. Rust resistance is available in both oilseed and confection hybrids and this information can be obtained from seed dealers and through state extension publications, such as "North Dakota Hybrid Sunflower Performance Testing," circular # A-652, which is revised annually. This information is usually based on field evaluations at one location under natural infection by one rust race. Rust resistance in sunflower, however, is race specific. A particular hybrid may be listed as totally resistant (to one or more races of rust), but that hybrid may be infected, either slightly or severely, by other races. If possible, use rust ratings from trials nearest your farm.

Currently there are at least five races of rust present in North America, with race 3 being the predominant race in the midwestern U.S. and adjacent Canada. The predominant race may change from year to year and also vary by location. Most commercial hybrids have good levels of resistance to race 3. No hybrids are resistant to race 4, nor are any resistant to all races. In choosing a hybrid for rust resistance, it should be remembered that disease resistance may not necessarily be associated with high yielding ability. In general, confection hybrids are more susceptible to the current rust races than are oilseed hybrids.

Fungicides may be considered as a last alternative in controlling rust. Currently no fungicides have a federal label for use against sunflower rust. A "specific exemption" (section 18) may be granted by the EPA in some years for use of a specific fungicide for that single year. Consult your local extension pathologist or county agent for information on which chemicals may be used legally on sunflower. The decision to spray a fungicide should be based on the severity of rust and the expected net income from the crop. Fungicide application should be considered when rust appears early in the growing season. Confection sunflower, with their higher value and greater rust susceptibility, would more likely pay back the cost of fungicide application.

Deciding at what point it is economically feasible to spray sunflowers for rust control is difficult at best. At present, we feel that when rust pustules cover 5 percent of the lower leaves at or before flowering, the potential for yield loss exists. If weather conditions are favorable for rust development, fungicide applications should be considered.

SEVERITY ASSESSMENT DIAGRAMS

The diagrams on the inside pages of this circular provide a standardized method to help growers, consultants, extension personnel and researchers quantify rust severity (the percent leaf area affected by rust). Estimates of rust severity vary considerably from person to person and most people cannot estimate percentages accurately over the entire range. With the aid of these diagrams it should be possible to train your eye to accurately estimate rust severities and to insure that estimates made by different people are similar.

The diagrams cover rust severities ranging from 0.1 to 40 percent. When 40 percent of the leaf surface is covered by pustules, the highest level usually observed in the field, practically 100 percent of the leaf tissue is infected by the fungus.

Assessments of rust severity should be done in several random spots across a field. Avoid field margins, but do look at both high and low spots. Make separate severity estimates on lower, middle, and upper leaves. Finally, note the growth stage of the sunflower (see NDSU color sheet, "Stages of Sunflower Development").

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