Plant Disease Management
NDSU Extension Service

Downy Mildew of Sunflower

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Downy mildew is a common sunflower disease found in North Dakota and other northern Great Plains states and is capable of killing or stunting plants (Figure 1), reducing stands and causing yield loss. According to NDSU sunflower-disease surveys done between 2001 and 2008, 29 percent of North Dakota fields had downy mildew, and the disease was found in all sunflower growing areas of the state (Figure 2). When downy mildew is sporadic throughout the field, sunflowers are able to compensate for the infected plants and limit the amount of yield loss. However, downy mildew often occurs in heavily diseased patches, which limits the plants' abilities to compensate for the infected areas on a fieldwide scale.

Figure 1. Downy mildew infected sunflower (left) compared to healthy sunflower (right). (Photo by Sam Markell)

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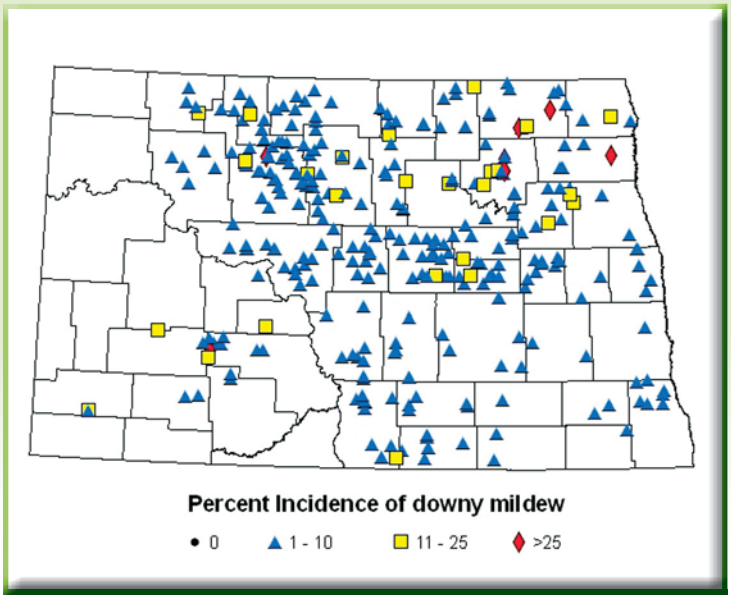

Figure 2. Sunflower fields infected with downy mildew in North Dakota, 2001-2008. Shapes indicate location and percent infected plants in each field (noninfected fields not shown). Map generated by NDSU I.P.M. survey data. (Map courtesy of Jan Knodel)

Figure 3. Downy mildew resulting in a blank spot in a field that subsequently was filled in by weeds. Note stunted sunflower in foreground. (Photo by Sam Markell)

Figure 4. Systemically infected plant with typical chlorotic symptoms bordering and covering leaf veins. (Photo by Sam Markell)

Figure 5. Masses of spores on underside of leaf; note white, cottony appearance (Photo by Sam Markell)

Cause

Downy mildew of sunflowers is caused by the soil-borne fungal pathogen *Plasmopara halstedii*. Since 2000, 12 physiological races of this fungus have been identified in North Dakota. Three races account for more than three-quarters of the population: race 710 (20 percent), race 730 (40 percent) and race 770 (23 percent). Prevalent races of downy mildew change through time; therefore, race surveys are conducted periodically by the USDA-ARS Sunflower Unit.

Signs and Symptoms

Downy mildew can be characterized broadly by two different types of symptoms: systemic and secondary. Systemic symptoms occur when seedlings are infected through the developing roots and the disease usually will kill plants, causing a reduction in stand sometimes resulting in sizeable blank spots in the field (Figure 3). If infected seedlings do survive, symptoms of systemic infection may be first witnessed on the cotyledons or the first true leaves and are characterized by a thickening and yellowing (chlorosis) of leaves. Chlorosis usually borders the veins of the leaves but can be present on the whole leaf (Figure 4). White cottony masses (fungal mycelium and spores) appear on the underside of infected leaves and are a good diagnostic sign of the disease (Figure 5). Systemically infected plants usually are severely dwarfed (Figure 6) and seed production will be reduced if the plant reaches maturity. Rare delayed systemic infections also can be seen in sunflower fields. These plants (six- to eight-leaf stage) will be moderately stunted and display typical downy mildew symptoms on the upper leaves but have no symptoms on the lower leaves.

Secondary infection results when windblown zoospores from infected leaves land on sunflower leaves. Symptoms include small, angular lesions that are chlorotic on the upper leaf surface and often are referred to as "local lesions" (Figure 7). Signs of secondary infections are white, cottony masses that appear on the underside of the angular lesions. Secondary infections rarely will cause systemic symptoms or yield loss.

Disease Cycle

Plasmopara halstedii survives for up to 10 years in soil as sexual, thick-walled oospores. Oospores are produced just beneath the epidermis of infected plants and are more common in roots than leaves. When soils are cool and water-saturated, oospores will germinate and form zoosporangia, which give rise to asexual, motile zoospores. Systemic infection results when zoospores infect the sunflower seedling before the root reaches 2 inches in length. Sunflower plants that survive this initial infection produce white zoosporangia on the underside of the chlorotic areas of leaves. When windborne zoosporangia land on sunflower leaves, secondary infections may occur. Secondary infection is most common when sunflower leaves remain wet for prolonged periods of time. Plants are susceptible to secondary infection for a much longer period than for systemic infection via root infection.

Figure 6. Systemically infected sunflower (right) compared with healthy sunflower (left); note severe dwarfing. (Photo by Sam Markell)

Figure 7. Secondary infection resulting in angular "local" lesions. (Photo by Sam Markell)

Management

Resistance – Planting downy mildew-resistant hybrids is very important to manage downy mildew. However, due to the development of new races, resistance may not be a sufficient management tool in all fields. Downy mildew races in our growing region are assessed by the resistance screening program conducted by the USDA-ARS Sunflower Research Unit in Fargo and some seed companies. This information is used to select which parental lines are best to develop new hybrids resistant to the current races.

Crop Rotation – Although crop rotation is important for other sunflower diseases such as sclerotinia, rust and phomopsis, rotation has a minimal effect on downy mildew management. Overwintering oospores will survive in the soil up to 10 years, rendering rotation practices impractical for downy mildew management.

Seed Treatment – Fungicide seed treatments can be an effective management tool for downy mildew. However, the downy mildew pathogen has developed resistance to two of the most commonly used fungicides, metalaxyl and mefanoxam. This fungicide resistance is classified as rate insensitive, meaning that once the downy mildew develops resistance, no amount of seed treatment will give disease control. However, other seed treatments such as Dynasty (azoxystrobin) are available and more will be labeled in the future. Refer to the most current issue of the "North Dakota Field Crop Fungicide Guide" (PP-622) for updated information on products and rates for application. The USDA Sunflower Unit annually collects samples of the downy mildew pathogen to monitor for resistance development to fungicides.

Foliar Fungicides – Foliar fungicide sprays are ineffective for the systemic infection of downy mildew, and none are recommended for such use. Foliar fungicide use for secondary infection is not economical since yield loss does not occur.

Control Weed Hosts – Wild and volunteer sunflowers are hosts of the downy mildew pathogen, and elimination can reduce the inoculum effectively. Additionally, elimination of wild and volunteer sunflowers can reduce inoculum of other economic sunflower diseases, including rust and sclerotinia.

For more information on this and other topics, see: www.ag.ndsu.edu

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