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White Mold

(*Sclerotinia* Stem Rot)

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White mold of soybean, also called *Sclerotinia* stem rot, is present throughout most of the northern states. It is considered a minor disease in Indiana, but can cause significant damage in infested fields. The areas at greatest risk are northern Indiana (north of Interstate 70) and states further north. Cool, wet conditions during early reproductive stages favor disease development when the pathogen is present. The disease is often most severe in varieties that have a denser, faster-closing canopy.

Figure 1. *A single soybean plant with severe white mold symptoms.*

Symptoms

White mold first becomes apparent when single plants within a generally healthy canopy wilt and die rapidly in July and August. Leaves remain on the stem but turn brown, and the entire plant dies (Figure 1).

Close inspection of the lower stem reveals a bleached area, often originating from a leaf axil and extending 2 to 6 inches in each direction along the stem (Figure 2). When a lesion girdles the stem, the tissue above it dies — not all the stem tissue will die, but all leaf tissue generally dies. Under moist conditions the bleached area may be covered with the fungus' fluffy white mycelium. Eventually, black, oblong structures, from 1/8-inch to 3/4-inch long, may be visible in the center of the bleached area.

Figure 2. *This photo shows a close-up of a white mold lesion, not the characteristic sclerotia embedded in the mycelium mass.*

These black structures, called sclerotia, also develop inside the stem, and can be easily seen when the stem is split in the bleached area (Figure 3). Sclerotia are the fungus' survival structures. Sclerotia are initially soft, but harden with age. The sclerotia's interior is white or pink. When cutting, the inside of the fungal bodies is clear.

Infected plants may produce no seed. Yield loss from this disease in a field depends on the number of infected plants and the stage when the plants are killed.

Causal Agent

White mold is caused by *Sclerotinia sclerotiorum*, a fungus that has a wide host range, including alfalfa, beans, canola, clover, peppermint, potato, sunflower, and tomato. It can also infect several weed hosts, such as amaranths, castor bean, dandelion, lambsquarters, ragweed, and velvetleaf.

Disease Cycle

Sclerotia can persist in the soil for several years. Although they decline over time, it apparently takes only a few to generate the density of ascospores needed for an epidemic.

Figure 3. *This photo shows white mold sclerotia close up. These structures develop on and in the plant tissue and can survive in soil for several years.*

When conditions are favorable and the sclerotia are within 1 inch of the soil surface, light brown fruiting bodies of the fungus, called apothecia, emerge from the soil. The apothecia are 1/8-inch to 3/4-inch diameter, and consist of a cuplike structure on a short stalk. Spores are produced on the surface of the cuplike structure, and are forcefully ejected when they mature.

Apothecia can be confused with the sporulating structures of bird's nest fungi. Bird's nest fungi are frequently observed on old corncobs found on the soil surface in minimum tillage systems. This fungus, although intriguing for its beauty, does not cause any disease on soybean.

Wind currents transport the spores produced by white mold apothecia to soybean plants, where they can cause infections under wet, humid conditions. Spores can infect any part of the plant, but senescing flowers seem to be a common point of infection. When it infects a flower, the fungus grows down through the flower stalk (pedicel) and invades the stem. Floral infection explains why stem lesions are commonly centered at a node. They also appear to infect at points where dead flower parts adhere to the plant and provide a nutrient source for infection. Once in the plant, the fungus consumes plant nutrients and eventually girdles the stem, killing the tissue above the lesion.

Sclerotia are similar in size and density to soybean seed and can easily end up in the grain bin when seed from an infected soybean crop is harvested. Some sclerotia are ejected from the combine in stem tissue, which can distribute sclerotia over more of the field. The combine can also transport sclerotia to uninfested fields following the harvest of an infested site.

Because sclerotia survive in the soil, soil movement could also transport inoculum from one field to another. Once sclerotia find conducive conditions in the field and are about 1 to 2 inches from the soil surface, they will produce apothecia and initiate new infections.

Management

White mold management is difficult when environmental conditions are favorable for the disease. The sclerotia can remain in the soil for several years, and lose their viability slowly. The most effective defense against white mold is to keep the fungus out of a field, but this can be difficult.

Avoid harvesting disease-infested fields before harvesting healthy fields unless the combine can be cleaned thoroughly. If a field with white mold is harvested, clean the combine before moving to fields with no history of the disease. If white mold is restricted to a portion of the field, that restricted area should be harvested last and independently from the rest of the field. If the disease is already present in a field, keep sclerotia out of the upper layer of the soil, and prevent the sclerotia from distributing over a wider area.

Planting

In infested fields, some have proposed spacing soybean rows wider apart than optimal for yield. Wider rows allow air to circulate to the soil surface while the crop is starting to flower. This promotes a drier soil surface and lower humidity around the base of the plants, which would interfere with sclerotia development, spore formation, and infection.

However, if it is cool, overcast, and rainy, wide rows may not have any effect on white mold. Moreover, extremely wide rows (more than 30 inches) may actually increase spore dispersal by allowing more air movement near the soil surface. In the absence of the disease, plants grown in 30-inch rows will often not yield as much as those grown in narrow rows.

But if the disease is severe in a field, moving to wide rows may provide some control. Still, while the incidence of white mold in wider rows may be reduced, the yield in wide row systems is seldom higher than narrow row systems. University of Wisconsin researchers advocate not going to 30-inch row spacing to avoid lower white mold potential. Instead, they recommend 15-inch row spacings.

In white mold years, row width has little influence on white mold incidence. Lowering the plant population is a better approach. Avoid planting 200,000 plants per acre regardless of row width. In fields with a history of white mold, 125,000 to 150,000 plants per acre are recommended.

Tillage

Conventional wisdom suggests that burying sclerotia deeply by plowing will reduce white mold. If sclerotia are more than 2 inches below the soil surface, they do not produce apothecia. If a field where white mold was a problem is plowed, the soil should not be further disturbed in subsequent years. But if buried sclerotia are brought to the surface a year to two later, some will still be viable and can produce spores.

However, in recent research in Wisconsin, no-tillage treatments that presumably leave sclerotia on the soil surface, were reported to have lower apothecia numbers. Tillage that buries sclerotia would probably also reduce the number of spores produced but may result in greater canopy density compared to no-till, which may offset the benefit of burying sclerotia by increasing disease conduciveness of the canopy environment.

Rotation

Rotating with nonhost crops can potentially reduce white mold incidence. But rotation must be carefully considered since the sclerotia are long-lived and do not necessarily decline sufficiently in one growing season to reduce disease pressure. Also, because of its wide host range, the fungus could reproduce on weeds, which would nullify the effectiveness of the nonhost crop.

Introducing a small grain somewhere in rotation with soybean will eventually result in a lower incidence of white mold. Corn is not a good rotation crop, but small grains are. A corn–soybean–winter wheat rotation has a meaningful impact on white mold. A corn–soybean rotation poses a higher risk situation.

Resistant Soybean Varieties

Partial resistance to white mold has been identified, and seed dealers provide ratings on the resistance levles of their varieties. Breeding efforts continue because partial resistance is prone to being overcome and other disease resistance characteristics may have priority when breeders develop new soybean varieties.

Chemical and Biological Control

Several fungicides can provide some level of disease suppression, but proper timing and good canopy penetration are essential. Fungicide application may be more effective when disease pressure is no more than moderate.

In addition to fungicides, there are reports that several beneficial organisms, when applied to soil, can degrade sclerotia faster than resident soil microbes can. Several of these microorganisms are currently being developed for commercial use. And are in the process of being introduced to the market.

White mold is a severe disease of soybean in isolated areas of the Midwest. When a field has a history of white mold, a combination of strategies that includes resistant varieties, row spacing, tillage, and possibly fungicide applications, should be employed.

All photos by Andreas Westphal.

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