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White Mold (Sclerotinia Stem Rot) of Soybean

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White mold, also known as Sclerotinia stem rot, is a fungal disease of soybean that causes severe yield losses in South Dakota. In 2014, yield loss across the U.S. was estimated at 37.2 million bushels. Portions of fields of irrigated soybeans in South Dakota have shown yield losses of up to 50%. Although white mold can be sporadic in a field, yield losses increase when incidence is higher. For every 10% increase in white mold incidence, there is an estimated reduction in yield of 2-5 bushels per acre. White mold develops often as a few scattered infected plants, but in some years, this disease can reach high levels depending on weather and agronomic practices (Fig. 1).

Symptoms and signs of white mold

White mold symptoms begin after soybean flowering, partly because the white mold pathogen infects through the flower after pollination. Visible canopy symptoms of white mold include grayish green followed by necrosis leading to interveinal yellow blotches on leaves. These symptoms can be mistaken for other diseases such as brown stem rot, stem canker or sudden death syndrome. A closer look at infected plants in the middle canopy reveals typical signs of the white mold pathogen, white mycelia and formation of sclerotia on lower stem nodes (Fig. 2).

As symptoms advance, the fungus girdles the entire stem increasing above and below the infection point, leading to wilting of the plant (Fig. 3). Infected stems are bleached and such plants will have reduced pod fill above the bleached stem area. Other parts of the plants such as side branches, petioles and pods can also be infected especially if they are in contact with infected stems. Plants with advanced symptoms of white mold have sclerotia, which are hard, black fungal survival structures that look like mice droppings (Fig. 4). These can also be found inside the stem. Because white mold occurs in patches late in the season, symptoms are sometimes missed or mistaken for normal soybean maturity until harvest, when infected portions of the field have poor yield.

Fig. 1. Soybean field with moderate incidence of white mold. Inset: A close-up of white mold symptoms on soybean stem.

Fig. 2. Initial white mold symptoms. Notice the white mycelia and forming sclerotia.

Fig. 3. Soybean plant killed by white mold. If fewer plants are infected, they can easily be missed during scouting.

Fig. 4. Overwintering survival structures called sclerotia of the white mold fungus mixed with soybean grain harvested from an infected field.

Causal organism and disease cycle

White mold is caused by a fungal pathogen called *Sclerotinia sclerotiorum*. The fungus survives as sclerotia in the soil and can resist dry heat and freezing conditions. When the soil is shaded (from canopy closure, cloudy or foggy weather), moist, and temperatures are 40-60 degrees F inside the canopy, the sclerotia within 2 inches of top soil germinate into small cup-shaped mushrooms called apothecia. These tinny mushrooms produce millions of spores called ascospores, and when these land on senescing flowers under favorable weather conditions, infection is initiated (Fig. 2). Spores can be blown by wind over 160 feet away. Senescing flowers provide a nutrient base for infection initiation. Continued colonization of the stems leads to sclerotia production both outside and inside the stem, the new sclerotia will be the source of inoculum for future seasons. Hence white mold is a monocyclic disease, since it completes one disease cycle in a season.

Conducive weather for white mold development

White mold develops when soybean flowering coincides with prolonged air temperatures less than 85 degrees F and frequent rains providing more than 42 hours of continuous wet stem surface or more than 12 hours of surface wetness on a daily basis (Fig. 6). These conditions are likely to take place for early planted, late maturing soybeans. Early maturing soybean cultivars can escape white mold as they flower early and have shorter stature.

Other risk factors associated with white mold development

Risk for white mold development is increased by cultural practices that favor early canopy closure and lush growth, such as narrow row spacing, high soil fertility (especially from animal manure), and high plant population.

White mold management

White mold development is strongly influenced by weather conditions. Since it is not possible to predict the weather conditions during soybean flowering at planting time, it is highly recommended to use a proactive integrated approach for white mold management. Knowing the factors favorable for white mold development can help avoid practices that increase its risk, especially for fields with a history of white mold. The following are approaches to white mold management:

- Select cultivars with tolerance to white mold; some seed companies provide ratings for soybean cultivars against white mold.
- Crop rotation helps break the pathogen life cycle. Care should be taken when selecting crops to rotate with soybeans. Most broad-leaf crops such as alfalfa, sunflower, dry beans, are also hosts of white mold. Small grains and corn are good non-host crops for white mold. For field with a history of white mold epidemics, 2-3 years rotation away from soybeans is recommended. Each year the number of viable sclerotia decreases especially if the field is under no-till.
- Deep tillage to bury sclerotia helps prevent the sclerotia from developing into mushrooms.

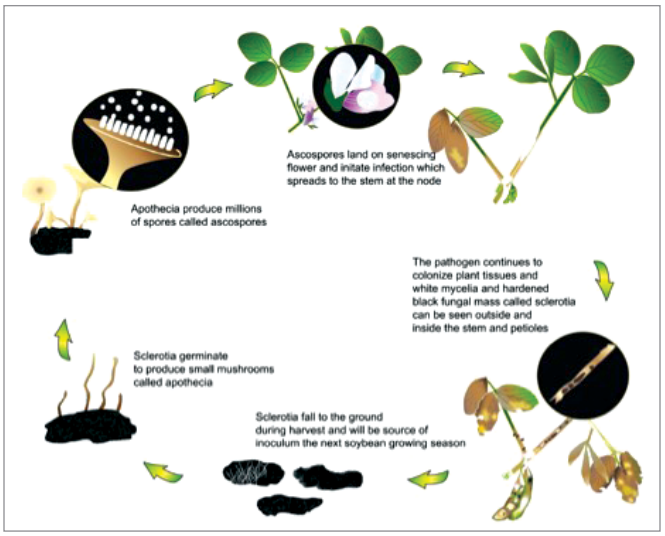

Fig. 5. White mold disease cycle (Illustration by of Renee Tesdall, Iowa State University Extension)

Fig. 6. Cloudy and foggy weather conditions are conducive for white mold development.

However, after deep tillage care should be taken in subsequent seasons to prevent bringing buried sclerotia back to near the soil surface, as buried sclerotia can survive more than 3 years.

- Wide row spacing of more than 20 inches helps delay canopy closure and hence prevent sclerotia from developing into mushrooms. However white mold can develop in wider row spacing if favorable weather is experienced after canopy closure.
- Soil fertility programs that use animal manure in fields with a history of white mold should be avoided. Animal manure tend to encourage quick lush growth which favors white mold development.
- A well-timed fungicide can prevent white mold development. The best timing for fungicide control is R1 (beginning flowering). Use flat-fan spray nozzles to improve mid-canopy coverage. Fungicides with good white mold control include picoxystrobin (Aproach), flutriafol (Topguard), prothioconazole (Proline), fluopyram + prothioconazole (Propulse), tetraconazole (Domark), thiophanatemethyl (Topsin-M, other generics), and boscalid (Endura).
- Some herbicides with lactofen as the active ingredient such as Cobra are labeled with language to suggest suppression of white mold. These do not directly inhibit white mold fungus but rather either help open up the plant canopy or delay flowering as well as inducing plants to resist white mold pathogen. The use of these herbicides should be weighed against side effects on the plants such as crop injury from late application.
- Some biological control agents do provide some level of white mold control. A common commercial biological control agent is Contans. This product is incorporated into the soil in fall or spring. It contains another fungus that feeds on and destroys the white mold sclerotia. There is better control of white mold increase with repeated use of the product.
- Practice good weed control program. Several broad leaf weeds such as lambsquarters, chickweed, field pennycress, velvet leaf and others are all white mold hosts.

Additional resources

Peltier, A. J., et al 2012. Biology, yield loss and control of sclerotinia stem rot of soybean. Journal of Integrated Pest Management 3 (2).

Mueller, D., et al 2014. White mold fact sheet. Crop Protection Network. online https://goo.gl/vt8clr

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