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Organic Control of White Mold on Soybeans

Agronomy Technical Note

Abstract
White mold has become a serious pest in commercial soybean production—especially where intensive production techniques are used. This publication discusses the various non-chemical options for addressing the problem, including varietal selection, canopy management, delayed planting, crop rotation, tillage reduction, and biofungicides.

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How White Mold Became a Problem

White mold, also known as sclerotinia stem rot, is caused by the fungus *Sclerotinia sclerotiorum*. It appears as fluffy white mycelial growth, most prominently on the stems. The organism begins its lifecycle when sclerotia—fungal structures capable of surviving winter—germinate on the soil surface, forming mushroom-like growths. These "mushrooms" eject microscopic spores. When spores land on soybean flower petals, they promptly germinate and colonization begins—progressing from the pods to the stems, destroying those plant structures prematurely. The disease may also spread further from inter-plant infection. Finally, a new generation of sclerotia are formed on the infected plant tissue; these pass through the combine and are returned to the soil surface. Some sclerotia are harvested with the beans and may be spread further through the hauling, cleaning, and storage processes (1).

White mold is heavily influenced by weather and microclimatic conditions. Progress of the

disease is favored by below-average air temperatures, high relative humidity, and soil moisture. When these conditions occur during the two weeks prior to peak flower on the lower stems, the disease incidence can be especially severe (1). However, the fact that white mold has gotten more severe in recent years has more to do with how soybeans are being grown.

Growers have been increasing soybean acreage and managing for higher yield levels. Many of the practices associated with these trends—shorter rotations, narrower rows, earlier planting—create a less healthy environment that favors white mold development (2).

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A number of techniques and strategies for managing white mold have been identified. Because white mold is proving so damaging to soybean yields, growers are encouraged to address the problem on several fronts, rather than settling on a single control measure.

Varietal Selection

Choosing soybean varieties that demonstrate a degree of tolerance or resistance to white mold is considered the first and principal step toward managing the disease. At the same time, the use of specific cultural practices can reduce the risk of infection and offer more flexibility in varietal selection. Varieties are commonly divided into four categories of disease reaction (3):

- ***Moderately Resistant.*** This is currently the highest form of genetic resistance available in soybeans. Moderately resistant varieties may exhibit 10–25% mortality in the field, but will still produce an acceptable economic yield. When used in rotation, these varieties will reduce overwintering sclerotia in the soil.

- ***Tolerant.*** Since plant mortality can reach as high as 26–50%, tolerant varieties should be used only where, because of field history and other management strategies, the risk of infection is moderate to low. Yields under these conditions are expected to be economically acceptable. Tolerant varieties, if infected, may increase overwintering sclerotia that can infect subsequent crops.

- ***Susceptible.*** Unless the risk of infection is very low, susceptible varieties are likely to produce unacceptable yields.

- ***Highly Susceptible.*** Highly susceptible varieties should be avoided when even the slightest risk of white mold exists.

Local Cooperative Extension and seed suppliers will have good information on the specific white-mold-tolerant varieties that are suitable for your region and for specific cultural conditions.

Canopy Management

Current wisdom encourages the use of narrow row spacing for soybeans to increase yields and enhance weed suppression through a dense, quickly closing canopy. Unfortunately, an early, dense crop canopy creates an environment friendly to white mold fungus. Dense planting strategies—accomplished either through the use of narrow rows or simply by increasing the seeding rate—require the use of moderately resistant varieties, unless there is no history of the disease on the field site (1).

Fertility & Planting Date

Early planting of soybeans provides for a longer growing season and increases the chance for higher yields. Unfortunately, it also increases the overlap time between soybean flowering and the release of white mold spores. For this reason, delayed planting can reduce disease incidence. Fertilization practices, especially the use of nitrogen-rich manures and fertilizers, can worsen white mold incidence by stimulating early, lush canopy growth (1).

Crop Rotation

White mold sclerotia are moderately long-lived in the soil. It is virtually impossible to eliminate them as long as host crops are planted at intervals of five years or less. White mold has a fairly wide host range that includes all beans, peas, sunflower, canola, cole crops, and carrots. Alfalfa is also a host crop (but apparently a poor one). Some non-host crops suitable for rotation include corn, small grains, and all grass crops.

While long rotations to non-host crops may not be feasible, research has demonstrated that shorter two- or three-year rotations to non-host crops are still highly effective in reducing sclerotia in the soil and should be seriously considered as part of any overall disease management strategy (1). University of Wisconsin plant pathologist Craig Grau specifically recommends a rotation of

corn→soybeans→small grains (in that specific order)—using either oats, wheat, or barley as the small grain crop (2).

Reduced Tillage

While deep plowing may bury the sclerotia after a "bad" season, repeated plowing and other conventional tillage operations eventually distribute long-lived sclerotia throughout the plow zone, while still leaving plenty on the soil surface to germinate each season. Research from Wisconsin has demonstrated that white mold incidence can actually be reduced under no-till cultivation. While the sclerotia in no-till fields all remain on the soil surface where they could germinate next year, they are also fully exposed to weathering and decay. This situation reduces the population considerably (1).

Unfortunately, no-till strategies for organic production are still largely in the early stages of development. (Ask for the ATTRA publication *Pursuing Conservation Tillage Systems for Organic Crop Production* for more details.) Since some cultivation is still likely under organic management, growers are encouraged to explore minimum-tillage options as these tend to keep the disease confined to patches rather than spreading it throughout the field (2).

Weed Control

Good weed control can also reduce white mold incidence. Several common weed species—including lambsquarter, common ragweed, red-root pigweed, and velvet leaf—are alternate hosts for white mold. As a result, their presence in soybeans, in rotation crops, and on field borders can help to maintain a ready population of sclerotia for future crop infection. Sudden outbreaks of white mold in soybean fields that were previously mono-cropped to continuous corn have been explained by the presence of weed hosts (1).

Alternative Fungicides

Since several fungal organisms prey on white mold in crop fields (4), there are good prospects for the development of biofungicides as a tool for white mold management. The most consistently effective of the predatory organisms evaluated has been *Coniothyrium minitans*. At least one commercial field-crop formulation of *C. minitans* is now on the market under the trade name Contans® (5). Contans is manufactured by the German company Prophyta. Prophyta's distribution agent in the U.S. is Encore Technologies (6), which can be contacted for more details on availability and clearance of Contans for specific crop use.

There do not appear to be any current recommendations for the use of sulfur- or copper-based fungicides for white mold management in soybeans. One traditional text on disease management (7) did suggest that there might be some efficacy from their use. Unless a product is clearly labeled for a specific use, however, growers are advised to contact Cooperative Extension and the product manufacturer before experimenting on a commercial crop.

Summary

White mold can be a serious disease problem in commercial soybeans; its management has become a major consideration. The drive for higher yields has been a chief factor in making white mold such a serious problem. Cultural practices like delayed planting, wider rows, lower seeding rates, and avoiding excess N fertilization can reverse this trend but may sacrifice per-acre yields. Longer crop rotations may reduce annual soybean acreage, but can introduce greater diversity and stability to the farm system.

At present, varietal selection is the foundation for most white mold management plans—especially those that continue to employ high-yield production practices that favor the disease. The choice of a cultivar should be based on the risk of infection—a

factor influenced by weather conditions, cultural practices, and field history.

References:

1) Grau, Craig. 1998. White mold of soybean. University of Wisconsin—Cooperative Extension. <http://plantpath.wisc.edu/~soyhome.pp/>.

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3) Grau, Craig, Edward S. Oplinger, and James E. Kurle. 1998. White mold in soybean: Soybean variety selection. University of Wisconsin Cooperative Extension, Madison, WI. <http://plantpath.wisc.edu/~soyhome.pp/>.

4) Agrios, George. 1988. Plant Pathology, 3rd edition. Academic Press, New York, NY. p. 430–431.

5) Fravel, Deborah. 1999. Commercial biocontrol products for use against soilborne crop diseases. United States Department of Agriculture, Beltsville, MD. January 1. <http://www.barc.usda.gov/psi/bpdl/bioprod.htm#Contans>.

6) Encore Technologies, LLC
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7) Westcott, Cynthia. 1971. Plant Disease Handbook, 3rd edition. Van Nostrand Reinhold Co., New York, NY. p. 351–353.

Additional Resources:

Diver, Steve. 1998. Compost Teas for Plant Disease Control. ATTRA Pest Management Technical Note.

While not discussed as an alternative control option in the text—the author is unaware of any compost tea trials for white mold control—such materials might be efficacious and could be worth investigating. Particularly relevant to this is a discussion of "protective biofilms" featured on the Soil Foodweb Inc. website at <http://www.soilfoodweb.com/leaf.html>.

Brunoehler, Ron. 1999. Put white mold on hold: Researchers identify resistant varieties. Soybean Digest. April. p. 34.

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