Soybean producers are adapting management practices to maximize yield, and white mold (Sclerotinia stem rot) is a disease found in high yield potential soybeans. This situation is unfortunate because white mold penalizes the progressive soybean grower.

Although several factors are believed responsible for the increased occurrence of white mold, none may be more important than management practices or environmental conditions that promote greater crop canopy density. The growth and pathogenic activity of the white mold fungus is governed by the environment in the crop canopy, and is particularly favored by dense soybean canopies created by plantings in narrow row widths, high seeding densities, early planting, high soil fertility and other

Risk Factors for White Mold Development

Common questions asked about white mold are:

- Why do I have a white mold problem?
- How did the white mold pathogen *(Sclerotinia sclerotiorum)* get into my field?
- How long has it been present?
- What can I do to control it?

Reducing the risk of white mold and maximizing soybean yield in the presence of white mold can be achieved on a field-by-field basis by choosing management practices that: 1) prevent or slow the introduction of the white mold pathogen into a field; 2) steadily work towards reducing the number of sclerotia of the white mold fungus in the soil; 3) finding a management system that provides a feasible compromise to lower white mold potential yet maintain maximum yield potential. Maintenance of soybean plant health requires that management practices be tailored to specific fields or regions.

Table 1 The risk of white mold development in a specific field will depend on both seasonal and long-term factors.

Seasonal risk factors	Long-term risk factors
Weather: cool temperatures (<85° F), normal or above normal precipitation, above normal soil moisture; and prolonged morning fog and leaf wetness during flowering and early pod development.	***Field/cropping history:*** inoculum of pathogen will gradually increase if: other host crops are grown in rotation with soybean; interval between soybean crops is shortened; and white mold susceptible varieties are grown.
Early canopy closure: due to early planting, high plant population, narrow rows, excessive plant nutrition and optimal climatic conditions. Dense canopy increases apothecia density.	***Weed management systems:*** degree of broadleaf weed control; herbicides used in rotation systems may be suppressive to white mold.
History of white mold: density of white mold pathogen; apothecia present on soil surface at flowering; distribution of pathogen/disease in field.	***Topography of field:*** low areas, tree lines and other natural barriers to impede air movement.
Soybean variety planted: physiological functions and plant structure govern reaction.	***Pathogen introduction:*** contaminated and infected seed; movement of infested soil with equipment; wind carried spores from areas outside the field.

Variety Selection

Variety selection is the foundation of a white mold management plan. The soybean variety will determine the effect of canopy modifying management practices, the effectiveness of crop rotation and the ability of agricultural chemicals to suppress white mold. Once a variety is selected, decisions can be made regarding row width, plant population, planting date and if chemicals should be considered in a management plan.

One or more traits appear to determine how a soybean variety reacts to the white mold pathogen. Possible traits governing variety reaction are: inherent physiological traits that determine the rate and severity of symptom development, plant architecture, lodging traits, maturity, and response to management practices that govern canopy development. Although all plant parts can be infected, lesions on the main stem frequently are lethal and result in low seed number and weight. However, at the present time there are no known soybean varieties that are totally resistant to white mold.

Research studies indicate that soybean yield is reduced 0.25 to 0.50 bushels per acre for each 1% increment of plant mortality.

Performance of individual varieties in a white mold environment can be found in "Wisconsin Soybean Variety Test Results". Publication A3654. University of Wisconsin.

Table 2 Reaction types of soybean varieties and comments on utility for reducing the risk of white mold.

Reaction Type	Description	Comments
Moderately Resistant	Plant mortality: 10-25% Acceptable yield.	Currently the highest form of resistance available. May aid in eventually reducing sclerotia density in soil. Can be used in conjunction with management practices designed to maximize yield.
Tolerant	Plant mortality: 26-50% Yield comparable to moderately resistant varieties.	Varieties of this reaction type may be used if other traits are needed but not found in moderately resistant varieties. Varieties of this reaction type can be considered for fields or management systems that are of moderate to low risk for white mold. Yield is acceptable, but varieties of this reaction type may increase inoculum and increase risk of white mold in consequent years.
Susceptible	Plant mortality: 26-50% Yield not acceptable. Many varieties within this group express inconsistent reactions.	High risk reaction type in high white mold potential environments; lower risk if used in conjunction with practices designed to reduce crop canopy density. Varieties within this group must be evaluated in many trials.
Highly Susceptible	Plant mortality: >50% Very low yield in the presence of white mold.	This type of variety should be avoided in fields even with a low risk of white mold.

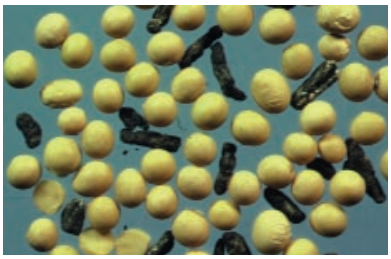


Figure 1. *Sclerotinia sclerotia in harvested soybean seed. Sclerotia are the survival structure of the white mold fungus.*

Canopy Management

Altering crop management practices intended to enhance yield potential such as planting date, row width and seeding rate can also influence canopy development. Other factors such as soil fertility, manure applications and tillage intensity also modify canopy development.

Figure 2. *Apothecia (mushroom structures) develop from sclerotia. Their development and density is increased under a dense crop canopy. Spores released from apothecia infect soybean plants.*

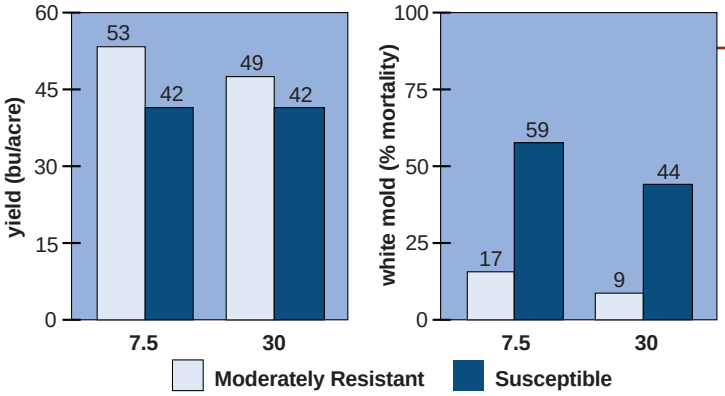
Planting Date

Early planting can result in higher yields because the crop has longer to grow and mature. In the presence of white mold, some of the early planting yield advantage can be lost especially with susceptible varieties. Therefore, in fields where the disease has been severe in the past, late planting can provide some control.

Table 3 Effect of planting date on white mold incidence and soybean yield.

Average of six soybean varieties grown at Hancock, WI; 1994-95.

Planting Date	Yield	White Mold
	bu/acre	% mortality
April 24	51	37
May 4	48	32
May 15	46	34
May 31	49	17
June 15	43	6



Row Width

High soybean yield potential is maintained when soybean are planted in narrow rows. Planting a variety that has moderate resistance to white mold in narrow rows resulted in higher yields than using a susceptible variety in wide rows, even when disease incidence was slightly higher.

Figure 3. *Performance of moderately resistant and susceptible varieties. Incidence of white mold (% plant mortality) in high white mold environments in 7 trials planted in narrow (7.5 in.) and wide (30 in.) rows. Wisconsin, 1992-97.*

Seeding Rate

Planting more than 200,000 seeds/acre often results in higher soybean yield unless white mold is severe. Using higher seeding rates with varieties that have moderate resistance to white mold resulted in higher yield even with 25% plant mortality. Using seeding rates less than 200,000 with susceptible varieties resulted in more yield and less disease than at the higher rates.

Table 4 Influence of soybean varieties on the response to seeding rates.

	Susceptible Variety		Moderately Resistant Variety	
Seeding Rate	Yield	White Mold	Yield	White Mold
seeds/acre	bu/acre	% mortality	bu/acre	% mortality
125,000	35	91	56	13
175,000	45	74	52	39
225,000	38	88	58	26
275,000	39	91	62	25

Crop Rotation

The density of sclerotia declines each year a nonhost crop is planted. Research suggests that two or more years of corn, small grains or other non-host crops lower the risk of white mold, but only if a moderately resistant variety is used in conjunction with rotation. Examples of highly susceptible crops are edible beans and dry beans, sunflower and canola. Pea, potato, alfalfa and red clover are less susceptible crops.

Crop rotation alone will not control white mold especially in high yield environments. Crop rotation is an important component of a comprehensive and integrated management plan that must include other components such as variety selection and canopy management.

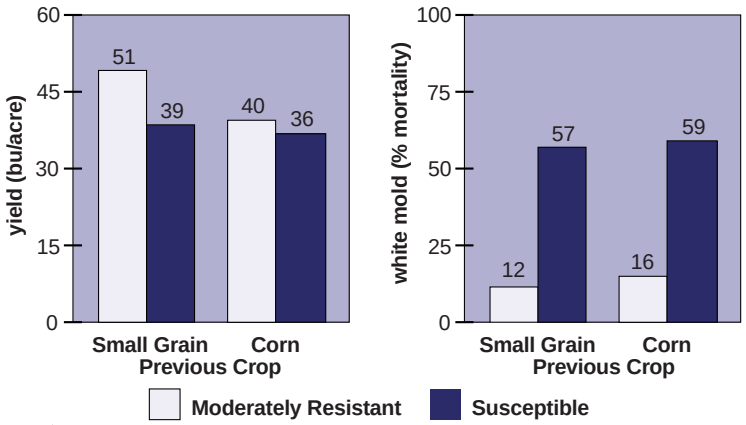


Figure 4. *Rotation effect of two years of a previous crop of corn or small grain on white mold incidence and soybean yield. Data are from two Wisconsin locations averaged across three tillages in 1997.*

Tillage

Studies indicate higher yields and less white mold with reduced till systems. Less white mold in no-till systems is attributed more to restricted canopy development than to less inoculum. Tillage has an effect on position of sclerotia within the soil profile. With reduced tillage sclerotia are positioned in the upper 1-3 inches of the soil profile and will die faster than sclerotia buried at greater depths. Thus, no-till or shallow tillage systems are recommended in the years that a nonhost crop is planted. Moldboard plowing is discouraged for soil conservation considerations and because deep burial tends to slow mortality of sclerotia. Sclerotia are likely spread within the field with tillage activity. Consequently, the pathogen may remain confined longer to "hot spots" within the field in no-till fields. The wind disseminated spores produced by apothecia are a means for the pathogen to distribute itself in no-till fields.

Table 5 Tillage influence on soybean yield, white mold incidence, sclerotia and apothecia density.

Tillage	Yield	White Mold	Sclerotia Density	Apothecia
	bu/acre	%	no./ liter soil	total/sq. ft.
No-till	47	20	0.6	1.0
Chisel	46	34	1.0	2.7
Moldboard	42	34	1.2	2.8

Average of three Wisconsin locations and three varieties in 1997.

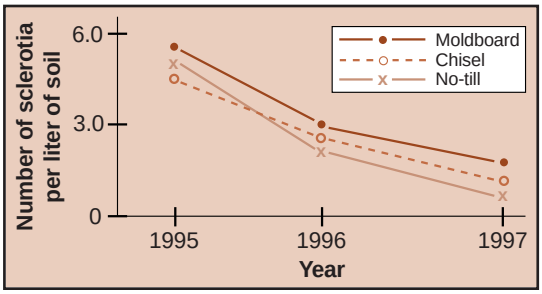


Figure 5. *Sclerotia density observed over three years in spring soil samples, taken from*

Fungicides

Benlate and Topsin-M are registered for use on soybean and are effective against white mold. To be effective, the product must penetrate through the canopy and cover flowers on the lower nodes when the disease is present. Seed producers should consider fungicides to control white mold in all types of varieties, but most importantly in susceptible varieties within a company's product line. Although greater seed yield is important, other advantages in using fungicides in seed fields are improved seed quality and reducing movement of the white mold pathogen into clean fields with seed.

Weed Management

It is important to control broadleaf weeds that are also hosts of the white mold pathogen, especially in crops grown in rotation with soybeans. In addition, the application of 2-6 ounces/acre of Cobra at the R1 growth stage has suppressed white mold in moderately susceptible varieties. Herbicides that shorten plant height are frequently associated with lower incidence of white mold. The role of herbicides on white mold suppression is not fully understood and is being explored.

White Mold Management Plans

Excessive soil fertility, weather conditions that are highly favorable for vegetative growth and variety traits that influence canopy density may modify benefits of suggested tactics presented in this table.

White Mold in Previous Soybean Crop	Variety Selection	Canopy Modification	Crop Rotation Interval	Tillage Options	Agricultural Chemicals
<5% diseased plants aggregated in field	Avoid highly susceptible varieties	Narrow rows; 200,000 plants/ acre	Minimum of 1 year out of soybean	Consider shallow tillage if possible	Adjustments to herbicide program not needed
<5% diseased plants uniformly distributed in field	Consider moderately resistant or tolerant varieties	Narrow rows; <200,000 plants/ acre	Minimum of 1 year out of soybean	Consider shallow tillage if possible	Adjustments to herbicide program not needed
5-25% diseased plants	Moderately resistant varieties	Narrow rows; 200,000 plants/ acre	Minimum of 1 year out of soybean	Shallow tillage to no-till	Adjustments to herbicide program not needed
5-25% diseased plants	Tolerant varieties	Narrow rows; <200,000 plants/ acre	1 to 2 years out of soybean	Shallow tillage to no-till	Consider white mold suppressive herbicides for tolerant varieties
25-50% diseased plants	Moderately resistant varieties	Narrow rows; <200,000 plants/acre	1 to 2 years out of soybean	Shallow tillage to no-till	Adjustments to herbicide program not needed
>50% diseased plants	Moderately resistant varieties	Wide rows; 150,000 plants/acre	2-3 years out of soybean	Shallow tillage to no-till	Adjustments to herbicide program not needed

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