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White Mold of Beans

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The white mold fungus has been found in numerous Michigan bean fields. Losses occur under conditions of high humidity and abundant rainfall in fields with heavy vine growth. Less damage is seen in the varieties with an upright bush habit than in the older vine-type bean varieties. The more open growth habit of bush-type varieties reduces the time that soils are excessively wet and leaves and flowers are covered with free water. However, even bush-type varieties are subject to damage when plant growth is dense.

The Pathogen

White mold is caused by the fungus *Sclerotinia sclerotiorum*. This fungus is widely distributed throughout the U.S. and attacks many vegetable and field crops, and some ornamentals. Soybeans are susceptible to the white mold fungus but much less so than dry beans and green beans.

Life Cycle

Small, black, hard bodies called sclerotia (1/8- to 1/2-inch long) are produced on and in the stems and pods of infected plants (Fig. 1, page 3). At harvest, the sclerotia are scattered over the soil surface. Those buried by plowing may lie dormant for as long as 5 years. The sclerotia rarely serve as sources of inoculum in the same year they are produced but are a source of inoculum in subsequent seasons. The sclerotia germinate to form stems which can be up to 3 cm (1 inch) long. After the stems reach the soil surface, they are stimulated by light to form another structure, the apothecium, at their tips (Fig. 2). Only sclerotia that have gone through an extended chilling period and are in very wet soil will produce apothecia.

The apothecium produces ascospores which are discharged into the air. They may travel as far as one-half of a mile before landing on plant parts such as leaves and flowers. Ascospores are the source of nearly all the infections seen in beans. They generally infect only dying or dead plant material, especially aging flowers. Occasionally, wounds caused by hail or cultivation are sites of infection. Infection of healthy pods, leaves and stems generally results from an infected flower that has fallen onto or come into contact with other plant tissues (Fig. 3). Shortly after infection, white masses of mold appear on the infected tissues (Fig. 4) and black sclerotia begin to form in these areas and within the stems thus completing the life cycle (Fig. 5). Secondary spread down rows occurs when infected plant tissues come into contact with healthy tissues.

Figure 2. Apothecia of *Sclerotinia sclerotiorum* from germinated sclerotia.

Figure 3. White-mold-infected leaves and pods; leaf infection resulted from an infected blossom that fell on the leaf.

Figure 4. White mold on a bush bean. Note the dead leaves and stems.

Figure 5. White mold. Note sclerotia on pods; control on left.

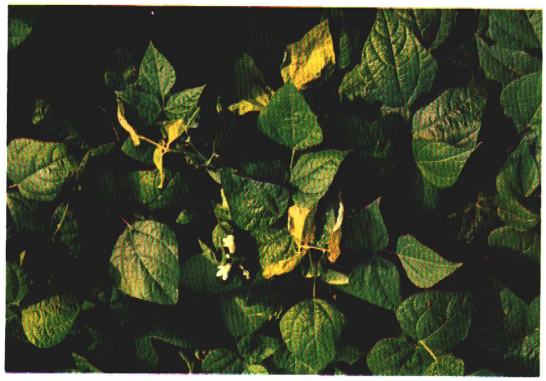

Figure 6. Early symptoms of white mold.

Symptoms

The fungus will often girdle the main stem or its branches causing the plant or plant parts to wilt and die. The leaves turn bright yellow and then brown (Fig. 6). Infected pods initially become soft and mushy, but later dry out and are light colored and shrivelled. Branches and stems killed by the fungus generally have a white, bleached appearance.

Environmental Factors

Sclerotia will germinate to form apothecia at soil temperatures ranging from 50 to 80 °F, but 55 to 60 °F appears to be optimal. Abundant rainfall is conducive to apothecial production because 10 days of continuously very wet soil (field capacity to saturation) is necessary for the germination of sclerotia.

Ascospores will not infect dying or dead flowers unless free water from dew or rain is present. Leaves and stems are rarely infected directly. Ascospores will survive for varying lengths of time depending upon the relative humidity (RH) and temperature in the bean canopy. Lower RH can increase survival time of ascospores up to 2 weeks, and higher RH decreases the survival time to a few days. Therefore, ascospores may land on plant tissue and lie dormant until conditions are favorable for germination and infection. The time that free water is required decreases as the temperature increases. A 48-hour period of continued wetness may be required for infection at 50 °F, but only 16 hours at 75 °F.

Control

The white mold fungus spends a major portion of its life cycle in the soil as sclerotia. Attempts to control white mold disease through treatment of the soil with fungicides or deep plowing have generally been unsuccessful. There are probably two reasons for this: 1) all the sclerotia are not killed or buried deep enough, and viable sclerotia can each produce thousands of ascospores and, 2) ascospores may be blown in from adjacent fields.

Therefore, the most effective means of control is through the use of chemicals to protect the plant from infection, and by using cultural practices and varieties that decrease the time that soil and foliage remain wet. Conditions should be provided that will allow wet plants to dry out rapidly. Maintaining proper spacing between rows and avoiding crowding of plants within the row increases air circulation and promotes drying of soil and foliage.

Once high populations of sclerotia build-up in the soil, rotation has little effect on reducing the white mold pathogen because of the longevity of the sclerotia, and because numerous other crops and weeds are hosts of *S. sclerotiorum*. Rotation is, however, a sound agronomic practice to reduce the incidence of other foliar and root diseases, especially *Fusarium* root rot.

All bean varieties are susceptible to white mold. Varieties with a shorter flowering period and an upright-bush habit may be less likely to be severely affected under heavy disease pressure. Also, such varieties re-

spond better to chemical control because of shorter times needed for protection and because of a less extensive canopy.

Because white mold is not a problem every year, but only when there is abundant rainfall and an extensive canopy cover, chemical control may not be advisable as a normal management practice. Chemical control can be effective when:

1. **The chemical is applied before infection has occurred.**
2. **The chemical adheres to the plant for a considerable period of time.**
3. **The chemical penetrates the canopy and reaches the flowers, which are the most important sites of initial infection.**

These conditions require that the timing of sprays be adjusted so that a maximum number of flowers are protected by a chemical that moves into the canopy before the canopy closes.

Growers should look for 10 days of continuously wet soils between emergence and flowering. Plan on spraying at peak bloom. Peak bloom in determinate, bush bean varieties occurs between 10 and 14 days after the appearance of the first flower in a field, or about 6 to 8 days after a single flower has been observed on 50% of the plants in a field.

Timing of the chemical application is critical. Spraying after peak bloom will be considerably less effective

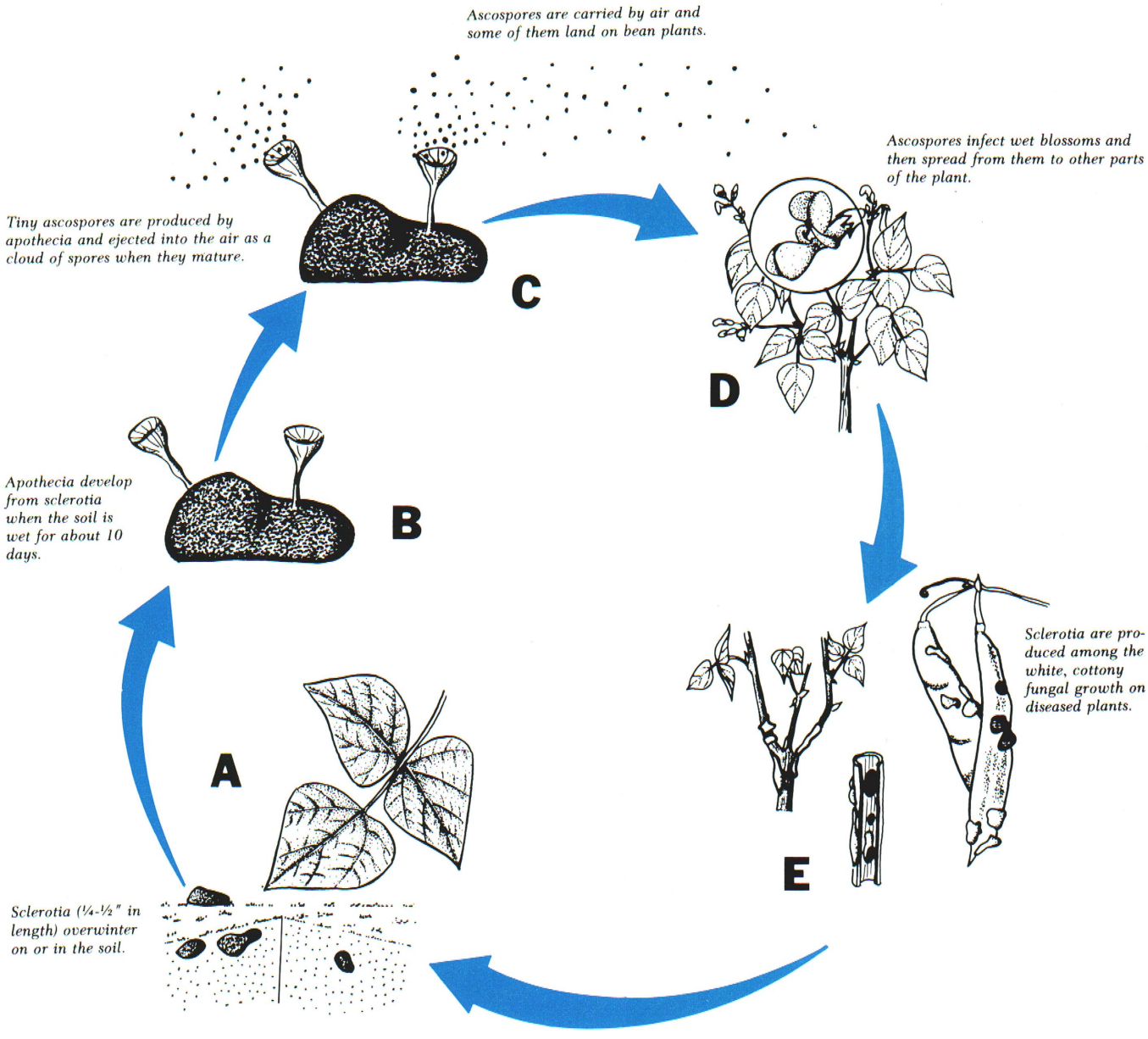

Figure 1. Disease Cycle of White Mold on Beans

because a large percentage of flowers may already be infected, and later sprays may not reach the flowers because of canopy cover. Spraying earlier than peak bloom will result in too few flowers being protected.

The question of whether one or two sprays should be made has not been adequately researched in Michigan. Generally, one spray should provide sufficient protection, but in very wet years two sprays may be necessary. Apply a second spray 7 to 10 days after the first spray. While the time that flowers are wet is important in determining infection, using this criterion for determining when to spray does not allow enough lead time to apply a chemical for effective control. Both bush and vine type beans should be sprayed on the same flowering schedule.

Application of a chemical can be made by airplane or ground spray equipment. Ground equipment may be more effective if field conditions permit and if the plants aren't severely damaged. Ground rigs should be equipped with a single over-the-row nozzle and drop nozzles between the rows about 5 inches above the ground. Use 25 to 50 gallons of water per acre for ground application at 60 to 100 psi. Use 5 gallons of water per acre for air application. Benomyl (50% wettable powder) has been superior to other registered fungicides in reducing the white mold disease. Apply at the rate of 1.5 pounds/acre for a single spray and 1 pound/acre if two sprays are to be made.

Remember, chemical control of white mold is a preventive measure and should be started when a disease problem is predicted and not after the disease has started and is easily observed in the field. Be on the lookout for disease alerts from the Cooperative Extension Service. Your County Extension Agricultural Agent can supply the latest information on EPA approved chemicals for control of white mold.

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