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## G92-1103 White Mold of Dry Beans

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## White Mold of Dry Beans

White mold symptoms, infection and control are covered here.

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One of the most important diseases affecting dry beans in western Nebraska and Colorado is white mold caused by the fungus *Sclerotinia sclerotiorum*. In a recent year, losses from this disease averaged as high as 20 percent, with a few individual field losses exceeding 65 percent.

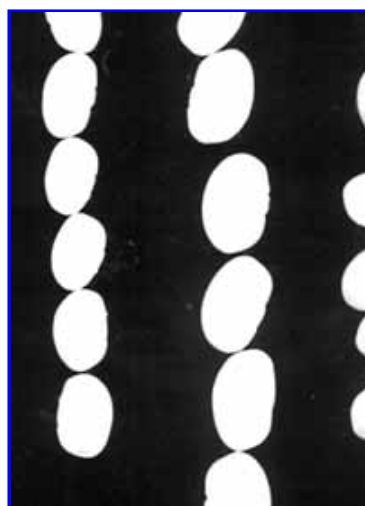


**Figure 1. Symptoms of white mold disease. Note soft rotting on pods and white moldy growth.**

White mold is first observed as wet, soft spots or lesions on infected leaves, branches, stems and pods. These lesions enlarge into a watery, rotten mass of tissue that is covered by a white moldy growth (*Figure 1*). Infection of stems and branches causes affected plant parts to wilt and later die, taking on a bleached and dried appearance (*Figure 2*). This bleaching symptom is characteristic of white mold infected pinto and great northern types and differs from normal tan color resulting from senescence (aging) or other diseases. Black and irregularly shaped sclerotia (resting structures of the fungus) form on and within infected plant parts, which tend to become shredded.

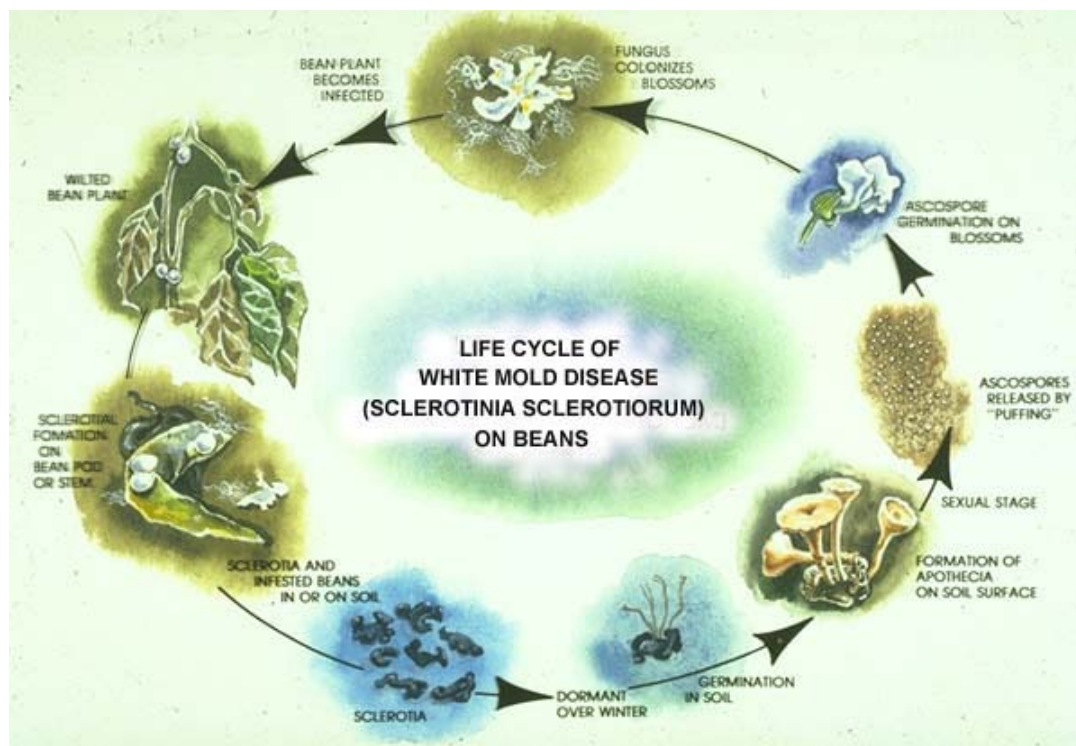


**Figure 2. Entire plant infected with *Sclerotinia sclerotiorum*. Note white, bleached stems and wilted leaves.**



**Figure 3. Seed on the left were harvested from white mold diseased bean plants while those on the right came from healthy great northern bean plants.**

Spread and development of white mold is greatly influenced by the prevailing weather conditions and certain agronomic practices. This disease tends to appear in localized areas of the field and only rarely is an entire field diseased. The disease, however, may cause serious yield losses during wet, cool periods near the end of the growing season. Yield loss occurs from rotted pods and reduced seed size on plants with girdled stems and branches (*Figure 3*). Agronomic practices such as irrigation management, plant density, and varietal growth characteristics are all closely linked with the life cycle of the pathogen (see below). Recent research has shown how management of these factors, in addition to the use of chemical control, can be most effectively combined to reduce disease severity and minimize yield losses to bean crops.



**Life Cycle of White Mold Disease)**

### ***Sclerotinia Sclerotiorum* on Beans**

- Sclerotia and infested beans in or on soil.
- Sclerotia.
- Dormant over winter.
- Germination in soil.
- Formation of apothecia on soil surface.
- Sexual stage.
- Ascospores released by "puffing."
- Ascospore germination on blossoms.
- Fungus colonizes blossoms.
- Bean plant becomes infected.
- Wilted bean plant.
- Sclerotial formation on bean pod or stem.

### **Survival of the Fungus**

The most important survival mechanism of *S. sclerotiorum* is the formation of sclerotia. A sclerotium is a compact mass of hardened mycelium (cobweb-like fungal threads) that contains reserve food materials. These structures are produced in abundance on infected plant tissue, allowing the fungus to survive during periods of unfavorable environmental conditions. Sclerotia are usually dark colored, circular to irregular in shape, and range in size from less than 1/8 inch in diameter up to the size of a large bean seed. The center of a sclerotium is usually cream or white in color. Studies have shown that up to 75 percent of sclerotia buried to a depth of 12 inches in a bean field remain alive and infective three years or longer.

*Sclerotinia sclerotiorum* can survive from one season to the next as mycelium in infected bean straw and seeds that have been scattered over the field during harvest. Post-harvest tillage reduces the potential for infection since diseased tissue is turned under and generally decomposes in the soil before the next bean growing season. However, sclerotial survival can still be a problem in subsequent seasons.

The fungus can be transported within infected seeds or in sclerotia-contaminated seedlots to be planted during the next growing season. Therefore, it is important to plant only certified seed that has had sclerotia and poor quality seeds removed during threshing and cleaning operations.

### **Infection of Beans**

Since sclerotia provide the main source of initial inoculum, they must germinate before infection of bean plants can occur. A sclerotium may germinate by either of two methods. It may germinate directly by producing white mycelial strands, which seldom exceed 1/4 inch in length. These strands usually do not penetrate living plant tissue until after colonizing dead or aging parts such as flowers or leaves. This form of germination does not occur frequently in bean fields in western Nebraska or in Colorado.

More commonly, a sclerotium germinates by producing one or more dark germ tubes or stipes which grow upward from a soil depth of less than 2 inches toward the soil surface. Upon reaching the surface, the tip of this stipe is stimulated by light to develop into a small (1/8 to 1/4 inch in diameter), flesh-colored and mushroom-like structure called an apothecium (see inset, *Figure 4*). These are first observed about 60 days after planting, which coincides with partial to complete row cover. An individual sclerotium can produce numerous apothecia simultaneously or sequentially throughout the growing season. Each apothecium produces millions of spores (fungus seeds) beneath the plant canopy. These are periodically released and spread to nearby plants.



**Figure 4. Fungal growth on senescent blossoms and leaves.**

**Inset shows apothecia on soil surface.**

Infection resulting from spore dissemination from field to field is not of great importance. Irrigation runoff water is known to transport suspended spores, mycelia, and sclerotia within and between fields. Bumblebees also have been shown to carry spores or other fungal propagules within or between bean fields.

The fungus spores must come in contact with and colonize dead or senescent plant tissue such as flowers on the soil surface beneath the plant canopy (*Figure 4*). These colonized flowers also may be lodged in branch axils or stuck to developing pods.



**Figure 5. Sclerotial formation on infected pods. White moldy growth darkens with age and becomes sclerotia.**

After colonization of this dead tissue, the fungus then can directly invade healthy tissue and produce the typical watery soft rot symptoms and subsequently new sclerotia (*Figure 5*). The disease then moves rapidly within and between adjacent plants in the field. White mold infection is often localized initially within the more moist and cool irrigation furrows, and in low-lying areas of a field.

### **White Mold Control**

No single control or disease management measure effectively prevents the infection process. However, studies are finding various measures can reduce the damage caused by white mold and thereby minimize yield losses.

Since white mold sclerotia can survive for many years in the soil, crop rotation generally does not prevent infection. The practice does help reduce the number of sclerotia within that field, however, and hence the potential for disease loss.

Conversely, continuous cropping of beans increases the potential for damage and yield losses, not only from white mold but also from root rots and bacterial blights. Therefore, it is recommended that bean fields be rotated in a three-year cropping cycle.

Disease potential also can be reduced by using cultural practices that minimize excessive vine growth. Thick, dense growth causes cooler than surrounding temperatures and high moisture beneath the plant canopy--conditions favorable for disease. Viny plant types should be planted only on coarse textured soils and well-sloped land. To avoid excess canopy development, apply fertilizer rates only within the recommended levels.

Plant populations and row widths can influence white mold development, especially in fields with a known history of the disease. It is advisable to use recommended planting rates and row widths to avoid dense canopies.

Efficient use of irrigation water also is important since progressive development of the disease is dependent upon a moist soil surface beneath the plant canopy. White mold infection can be greatly reduced by keeping the soil surface as dry as possible during pod filling and maturing. Apply irrigation water only when required by the crop for satisfactory growth.

If practical, holding ponds or other crop reuse systems (hay or corn land, for example) may be used to trap bean field irrigation runoff. This prevents contaminating irrigation systems or other bean fields with infested debris or pathogen structures of *S. sclerotiorum* or other pathogenic organisms.

Another control measure to consider is the use of fungicidal sprays. While university test results have been somewhat erratic from year to year, benomyl (Benlate), thiophanate-methyl (Topsin-M) and iprodione (Rovral) have provided a satisfactory degree of white mold disease management. It is recommended that the chemical be applied when 80 to 100 percent of the plants have one or more flowers and small pods (less than 1/4 inch in length).

Timing of fungicidal application is critical to protect as many early blossoms as possible from infection. The fungicide must be applied in sufficient water to provide thorough coverage of blossoms, stems and leaves, especially those closest to the soil surface. Chemical management is more effective for upright plant growth habits.

Strip cropping, with beans and corn for example, often is done for reduction of wind erosion. Other short rotation practices also are being used for conservation. However, these practices favor an increase in fungal pathogen inoculum and can lead to increased severity of white mold in these fields. Routine use of fungicide sprays may be needed under these conditions.

Varietal improvement by breeding for disease resistance and a more open plant canopy continues to be studied by personnel at the Universities of Nebraska and Colorado State. A primary problem is breaking the positive relationship between high yield and high white mold potential. Incorporation of these new varieties within an overall disease management strategy that includes adequate crop rotation, cultural practice modifications, efficient irrigation practices, and the application of proper chemicals will effectively reduce dry bean losses from white mold.

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***C-32, Field Crops***

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