Soilborne Blight Diseases of Peanut

John P. Damicone
Extension Plant Pathologist

Hassan A. Melouk
Plant Pathologist, USDA/ARS

Southern blight and Sclerotinia blight are the two most important soilborne diseases of peanuts in Oklahoma. These diseases have the potential to cause severe economic losses, because they cause rapid wilting and death of peanut plants prior to maturity. The disease cycles and symptom progression of the two diseases are similar, but the chemicals and many of the cultural practices used to manage them are different. Sclerotinia blight can also be potentially more destructive, persistent, and difficult to control than southern blight. Therefore, it is critical that each disease be properly identified so that appropriate controls can be implemented.

Southern Blight

Southern blight is caused by the fungus *Sclerotium rolfsii* and is a widespread disease of peanut and other crops in Oklahoma. Southern blight causes the greatest yield losses in peanut of any disease in the United States. Disease development is favored by hot and moist conditions in the peanut canopy. Therefore, the disease occurs mainly in mid- to late-season in Oklahoma. The fungus primarily attacks the base of stems near the soil line, but any plant part in contact with soil may be damaged. Infected plants are generally killed prior to maturity. Peg and pod infections are common and result in pod loss at harvest. Populations of *S. rolfsii* increase in infested fields cropped to peanut unless control measures are taken. High populations of the pathogen combined with favorable conditions for southern blight can result in yield losses of 25 percent or more.

Symptoms

The first readily apparent symptom of southern blight is rapid yellowing and wilting of limbs or entire plants (Figure 1). Affected limbs and plants then turn brown and die as a result of decay of the lower stem. Advanced symptoms of southern blight are very similar to those of Sclerotinia blight. The base of diseased plants must be closely examined for signs of the fungus to distinguish between the two diseases. Early detection of the disease is also possible if lower stems are examined prior to development of advanced symptoms.

Southern blight infection is characterized by a white or cream-colored moldy growth (mycelium) covering lower stems and imparting a white-washed appearance to the base of affected plants (Figure 2). The mycelium of the southern blight fungus is coarse, rope-like, closely appressed to stems, and may radiate out over the soil surface (Figure 3). This is best observed when the soil surface is moist. Mycelium may also be seen growing from decaying plant matter on the soil surface. Lesions (dead areas) on infected stems and pegs are at first light brown, then become dark brown. Advanced symptoms develop when lesions coalesce to girdle the lower stem. Small, round, mustard seed-like structures soon develop on the mycelium (Figure 4). These structures are called sclerotia and serve as reproductive and survival structures of the fungus. The sclerotia first appear as white tufts that later become light brown and finally dark brown at maturity. Sclerotia are uniformly round, about 1/16 inch in diameter, and are produced in large quantities on dead peanut tissue.

Disease Cycle

Initial southern blight infections arise from sclerotia which overwinter in peanut fields. Sclerotia of the fungus are similar to seeds of a plant in that they remain dormant until conditions become favorable for germination. Conditions that favor germination and infection are high moisture, warm to hot temperatures, and the presence of dead plant litter on the soil surface. Moisture requirements can be met from irrigation or rainfall. Conditions that favor growth of the fungus normally begin to develop at pegging when limbs grow rapidly along the soil surface and the canopy becomes dense. Leaf litter arising from leafspot infections, natural leaf aging, and weed or old crop residues stimulate germination of sclerotia and serve as a food base for the fungus. The fungus then grows outward from the food sources and infects any part of the peanut in contact with the soil surface. Plant tissues are killed by an acid produced by the fungus. Disease development below the soil surface can be extensive in sandy, well-aerated soils resulting in severe peg and pod rot.

When plants are killed and the food supply of the fungus becomes limiting, numerous sclerotia develop that easily dislodge and fall to the soil surface. Sclerotia survive well at the soil surface but survive poorly when buried deep because the fungus has a high demand for oxygen. Sclerotia at or near the soil surface can survive three to four years, while survival is a year or less when sclerotia are buried deeply.

The southern blight fungus does not produce spores which move in the air, so the disease is confined to localized areas in a field where sclerotia reside. Centers of disease are numerous where high numbers of sclerotia reside near the

Figure 1. Wilted plant or "flagging" from either southern blight or Sclerotinia blight. The base of this plant must be closely examined to determine which disease is the cause.

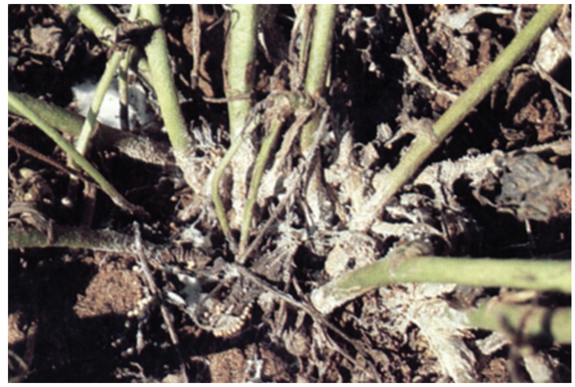

Figure 2. Mycelium of the southern blight fungus at the base of an infected plant. Note the sclerotia developing on the leaf litter at the bottom and center of the photograph.

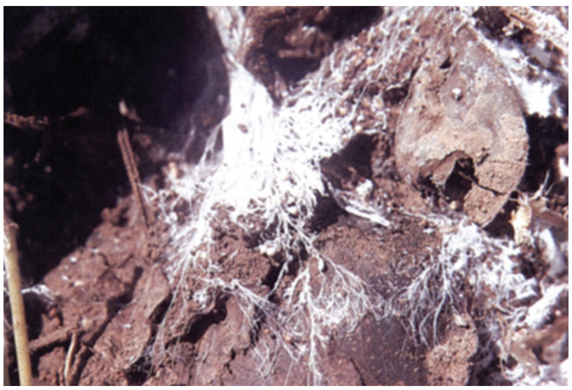

Figure 3. Coarse, rope-like mycelium of the southern blight fungus radiating out over the surface of moist soil.

Figure 4. Close-up of the small, uniformly round sclerotia of the southern blight fungus.

soil surface and conditions are favorable for southern blight. Disease centers are less numerous where few sclerotia are present at the soil surface or when conditions are unfavorable for southern blight. The occurrence and severity of southern blight epidemics are difficult to predict because of interactions between numbers of sclerotia near the soil surface, moisture and temperature levels, amount of plant residue, and canopy density.

Control

Cultural practices to manage southern blight can be very effective, because actions taken to reduce the populations of sclerotia at the soil surface can directly reduce disease incidence. Integration of cultural practices with chemical applications as warranted will generally result in the most satisfactory and economical control.

Moldboard plowing in the spring turns under crop residue and buries sclerotia where they cannot cause disease. Most aspects of cultivation during the growing season encourage southern blight development. Increased soil aeration from cultivation allows deeper penetration of the fungus where pegs and pods can be readily attacked. Cultivation is a useful means of weed control; however, cultivation, known as dirting, that moves soil onto the limbs or crown of the plant should be avoided. Buried sclerotia are brought to the soil surface by this practice and deposited near the crown area where infections are more likely to occur. Dirting also forms a trough that retains moisture and plant litter at the crown of the plant.

Several other practices can be adopted to reduce moisture retention in the canopy, thus discouraging southern blight development. Planting on a raised bed promotes drainage and drying of the canopy. Planting on a bed also reduces the accumulation of plant litter in the pegging zone by permitting washing of litter into the row furrows. Irrigations should be properly timed to allow application of adequate but not excessive amounts of water and to maximize the dry period between irrigations. Application of small amounts of water frequently (every 2 to 3 days) should be avoided as continuous canopy wetness will result.

Crop rotation is an effective practice for management of southern blight, but rotation crops must be carefully selected because the southern blight fungus has a wide host range. Corn, grain sorghum, sudan grass, and cotton are excellent rotation crops for southern blight control. Two-year rotations are required where southern blight has become severe. In fields where incidence of southern blight is low, a one-year rotation will reduce chances of southern becoming severe. Fallowing between peanut crops is only effective if land is kept free of weeds.

Fungicide applications are often required in fields where southern blight is a main factor limiting production. Two approaches to chemical control can be considered. Fungicide may be applied at a specific growth stage (eg., pegging) or at the first appearance of disease, whichever occurs first. This preventive approach is useful in fields continuously cropped to peanut and where southern blight is a known problem. Secondly, fungicide application may be delayed until the disease becomes established. This approach may be necessary because a timely preventive application was not made or because the disease increased unexpectedly where it has not been a prior problem. Reduced costs may result from delaying the first application long enough to negate the need for a second treatment, or any treatment if the disease fails to develop. These benefits may be offset by a reduction in the level of control achieved. Fields should be scouted weekly throughout the season to monitor the status of southern blight.

Currently registered fungicides provide only 40 to 60 percent control of southern blight. New compounds may soon be registered for southern blight that have improved effectiveness. It is essential that fungicides be applied properly so that maximum benefit can be achieved. Consult the most recent Peanut Production Guide (OCES Circular E-608) for the latest information on recommended fungicides and methods of application for control of southern blight.

Leafspot control has a variable effect on southern blight. Controlling leafspot will markedly reduce leaf litter accumulation near the crown area so that southern blight development is not encouraged. However, recent research indicates that where populations of southern blight sclerotia are high, foliar disease control increases the level of southern blight. The healthy canopy is thought to entrap moisture and maintain a more favorable environment for disease development. Where levels of sclerotia are low, leafspot control decreases the southern blight development. Leaf litter apparently provides a food source for the fungus to enhance growth and infection at low population levels. Foliar disease control is an essential component of peanut production. The potential for reduced yield from leafspot exceeds any possible benefit from allowing leafspot to develop in order to possibly lessen southern blight where populations of the pathogen are high. Furthermore, leaf litter provides an excellent substrate on which populations of the southern blight fungus can increase to possibly cause more infections in following peanut crops.

Southern Blight Management Tips

1. Practice crop rotation with non-susceptible crops such as corn, sorghum, or cotton.
2. Moldboard plow to bury sclerotia and crop residue.
3. Plant on a raised bed to improve drainage and reduce levels of moisture in the canopy.
4. Avoid the practice of dirting peanuts where soil is moved against plant limbs and crowns during cultivation.
5. Apply fungicides to reduce losses when southern blight is a main factor limiting production.
6. Time irrigations to apply adequate but not excessive amounts of water and avoid frequently applying small amounts of water.
7. Maintain foliar disease control to reduce accumulation of leaf litter in the pegging zone.

Sclerotinia Blight

Sclerotinia blight, caused by the fungus *Sclerotinia minor*, is a destructive mid- to late-season disease of peanuts. The disease was first found in 1971 on peanuts in the U.S. in Virginia. It has since been found in North Carolina, Oklahoma, and Texas. The disease has recently become more serious in Oklahoma because of increased planting of runner varieties, which are very susceptible to Sclerotinia blight. The disease is similar to southern blight in that Sclerotinia survives in the soil by forming resistant seed-like structures (sclerotia) and attacks plants near the soil line. Sclerotinia blight, however, is potentially more damaging because of its ability to rapidly spread within the peanut canopy. In Oklahoma, yield losses in experimental plots infested with Sclerotinia have ranged from 7 percent to over 80 percent. The disease usually becomes severe late in the growing season, but may occur in Oklahoma as early as July, depending upon weather conditions. Because the disease often occurs late, losses are primarily from peanut loss at harvest as a result of stem and peg rot.

Symptoms

Symptoms of Sclerotinia blight may appear anytime from mid- to late- season when weather conditions are cool to moderately warm and wet. The first symptom of Sclerotinia blight is the wilting and yellowing of lateral or main branches (Figure 1). Affected branches near the soil line must be closely examined for definitive identification of Sclerotinia. A fluffy or cottony, white moldy growth (mycelium) develops around diseased areas of lower stems (Figure 5). The mycelium of Sclerotinia is most easily observed in mornings when dew is present or after a rain, and may disappear later in the day when sunlight dries the lower canopy. This is in contrast with the coarse, rope-like mycelium of southern blight which remains visible under somewhat drier conditions. Dead areas (lesions) develop on affected stems that appear sunken, elongated, and light tan to almost pale white (Figure 6). Soon entire limbs wilt and turn yellow. Affected branches die and turn dark brown in color and eventually whole plants may be killed.

The small seed-like survival structures (sclerotia) of Sclerotinia are black and irregularly shaped and range in size from 1/24 to 1/16 inch (Figure 7). These sclerotia may aggregate into larger masses that appear similar to mouse droppings. These are clearly different from the tan to brown and round sclerotia of the southern blight fungus. Sclerotia may not be evident during the early stages of disease development. Sclerotia are formed in and on infected stems, leaflets, pegs, pods, and roots. A characteristic symptom of Sclerotinia blight is stem shredding (Figure 8). Diseased stem tissue will shred easily when rolled between the thumb and fingers. Shredding is the result of the rotting of all stem tissues except the vascular strands. Shredding of pegs results in loss of pods in the soil at harvest.

Disease Cycle

Sclerotinia overwinters and survives between peanut crops in the soil as sclerotia. Viable sclerotia, capable of infecting peanuts, have been found in the plow layer of infested soils for up to four years after a peanut crop. Sclerotia rapidly germinate and infect plants under conditions of cool

Figure 5. White, fluffy mycelium of Sclerotinia growing on infected stems in a wet canopy.

Figure 6. Vines killed by Sclerotinia blight are pale white or straw-colored.

Figure 7. Small, irregularly shaped, black sclerotia of Sclerotinia.

Figure 8. Stems infected with Sclerotinia shred easily when rolled between thumb and forefinger.

to moderate average daily temperatures (65 to 70°F), high soil moisture, and high relative humidity (95 to 100%). Stems, leaves, and pegs lying adjacent to germinating sclerotia become infected. The disease can spread rapidly under favorable conditions as infection can occur in 24 hours and symptoms appear in 72 hours. The fungus directly infects healthy plant parts, but mechanically damaged vines are more prone to infection. Sclerotia are formed in large numbers after the fungus consumes all available nutrients from infected plant parts. Sclerotia become dislodged from plants and fall to the soil or remain in infected plant parts left after harvest.

Spread of Sclerotinia blight from plants infected by sclerotia is limited because the fungus does not produce airborne spores during the growing season. Sclerotia may germinate and form a small, cup-shaped mushroom which produces airborne spores. In Oklahoma, these spores are produced in the early spring, several weeks before peanuts are planted. For this reason airborne spores are not considered an important part of the disease cycle or a means of disease spread. Spread of the disease to healthy parts of the same plant or to an adjacent healthy plant occurs only when mycelium of the fungus comes in contact with healthy parts. Conditions favoring active growth of the fungus also favor spread to healthy plants. Centers of diseased plants occur in fields because of the limited distance which secondary spread occurs. Centers of blighted plants become more numerous as concentrations of sclerotia in soil increase. Concentrations of sclerotia have been found to exceed 30 per pint of soil. A concentration as low as five sclerotia per pint of soil is sufficient to cause severe blight when environmental conditions are favorable.

Sclerotia are also the primary means of long distance spread of Sclerotinia blight. Sclerotia are easily moved from field to field with soil or infested peanut straw. Movement of farm implements from infested to clean fields is an important means of disease spread. Research in Oklahoma has also shown that sclerotia fed to cattle in infested peanut straw can pass through the digestive tract of cattle and remain viable. Sclerotia may be then deposited with dung in clean fields. Sclerotia are also small and light enough to be moved with wind-driven soil. Water moving over soil infested with *Sclerotinia* may also move sclerotia within fields or to nearby fields. Contaminated water could arise from irrigation or rainfall runoff from infested fields. Tillage practices help move sclerotia throughout the plow zone, but probably have a minimal effect on increasing the size of contaminated areas. Plowing buries sclerotia at the surface and in turn brings buried sclerotia to the surface. Expansion of infested areas from plowing alone occurs, but at a slow rate.

Sclerotinia is seedborne and has been found as a contaminant of seed from research plots at levels as high as 12 percent. Transmission of the disease from contaminated seed lots to resulting plants ranged from zero to 36 percent, depending on the variety, when seeds were grown in the greenhouse under conditions favorable for the disease. However, over 400 commercial seed lots from different areas of Oklahoma have been tested to date for the presence of Sclerotinia and only four were positive. The percent contamination in those four seed lots averaged only 0.5 percent. This research indicates that although introduction of Sclerotinia into clean fields by seed is possible, it may not be an important means.

Sclerotinia has a wide host range which includes both cultivated and weed hosts. Susceptible crops include alfalfa, rape, canola, sunflower, bean, sweet potato, tobacco, cole crops, and soybean. However, some of these crops such as soybean may not become severely diseased when grown in infested fields in Oklahoma. Alternate hosts may aid in the establishment of Sclerotinia in clean fields or the build-up of Sclerotinia in fields already infested.

Control

Because Sclerotinia blight can be very damaging and difficult to control, steps should be taken to limit the spread of the fungus and its entry into clean fields. Tractors, plows, combines, and other farm implements leaving infested fields should be carefully cleaned and washed prior to entering clean fields. Soil and peanut straw should be completely removed from these implements. Cattle fed with peanut straw from fields infested with Sclerotinia should not be pastured on clean fields. Peanut hay taken from infested fields should not be fed to cattle grazing on clean fields. To eliminate the potential for importing the disease into fields on peanut seed, seed should be treated with a fungicide known to reduce Sclerotinia.

A combination of cultural and chemical management practices will provide the most satisfactory control of Sclerotinia blight. Practices that reduce moisture retention in the canopy and promote aeration should be adopted. These include planting on a raised bed, and avoidance of narrow row spacings and overly heavy seeding rates. Irrigation timing is also important. Enough water should be applied at each irrigation to permit thorough and prolonged drying of the soil surface before the next application.

Excessive vine damage should be avoided because Sclerotinia easily infects wounded plant parts. Vine injury can be minimized by cultivating early or not at all and by using tractors with narrow tires.

The upright growth habit of Spanish varieties forms a more open canopy than runner varieties which have a dense and prostrate canopy. This open canopy is less favorable to blight development. Research has shown that in a field severely infested with Sclerotinia, the three-year average yield reduction for a Spanish variety was 16 percent compared to 62 percent for a runner variety. A Spanish variety with resistance to Sclerotinia blight, Tamspan 90, was recently released. The resistance in Tamspan 90 is related to canopy structure. Fewer diseased plants and sclerotia per plant develop on this variety compared to other Spanish or runner varieties. Spanish varieties, preferably one with resistance, should be planted to reduce losses from Sclerotinia in severely infested fields.

Another important aspect of variety selection is maturity length. Spanish and other short-season varieties have the advantage of earlier harvest dates. Because Sclerotinia blight in Oklahoma is normally most severe in September and October, long-season runner varieties are particularly vulnerable. A short-season variety that matures 20 to 30 days earlier than a long-season variety will reduce losses by lessening the exposure of plants to blight-favorable weather.

Planting and harvest dates can also be adjusted to reduce losses from Sclerotinia blight. Research has shown that in fields where levels of infection are high and fungicide are not applied, yields of the runner variety Okrun decline steadily with time after 135 days after planting. The normal maturity for Okrun in Oklahoma is about 160 days. This differs from the Spanish variety Spanco where yields increase with time from 115 to 135 days after planting and decline thereafter. The normal maturity for Spanco is about 135 days. Therefore, digging runner peanuts early will reduce losses from Sclerotinia blight. Spanish varieties may be dug at normal maturity, but no later, to avoid late season losses.

A fungicide program is usually required where Sclerotinia is a problem. Proper timing and use of an appropriate method of application are essential for maximum disease control. Fungicides should be applied in a preventive manner to achieve thorough coverage of basal stems. Fungicides only protect healthy plant parts from infection. Fungicides do not cure established infections or kill sclerotia. Therefore, the first fungicide application should be made when symptoms are first noticed or preferably before when conditions first become favorable for disease after pegging. Fields should be carefully scouted throughout the season to monitor the activity of Sclerotinia blight. Even when properly applied, currently available fungicides have only been moderately effective in reducing losses from Sclerotinia blight. Research over several years has demonstrated that fungicide usage results in about a 45 percent reduction in the potential yield loss from the disease. Consult the most recent Peanut Production Guide (OCES Circular E-608) for the latest information on recommended fungicides and methods of application for control of Sclerotinia blight.

Most foliar fungicides used to achieve a high level of leafspot control increase the severity of Sclerotinia blight. This effect is thought to be caused by leaf retention which provides a dense canopy that retains moisture. However, use of chlorothalonil (Bravo) on a 14-day schedule has been linked to increased Sclerotinia blight in fields infested with the fungus. This effect can be minimized by applying Bravo at intervals no closer that 21 days. For growers on a 14-day leafspot program, this means alternating Bravo applications with another leafspot fungicide.

Because sclerotia of Sclerotinia are persistent in soil, it is unlikely that crop rotation will result in satisfactory disease control. Conversely, continuous cropping of susceptible runner varieties will result in a rapid build-up of Sclerotinia blight making profitable peanut culture difficult. A carefully selected rotation should significantly reduce the rate of blight increase in infested fields. Corn, sorghum, cotton, and small grains are excellent rotation crops for reducing build-up of Sclerotinia.

Sclerotinia Blight Management Tips

1. Avoid spreading Sclerotinia from infested to clean fields on equipment, peanut hay, or animals.
2. Plant Spanish varieties or a resistant variety in fields with a history of severe Sclerotinia blight.
3. Plant early to escape late-season infections.
4. Plant on raised beds and avoid narrow row spacings or high seeding rates.
5. Time irrigations to apply adequate but not excessive amounts of water and avoid frequently applying small amounts of water.
6. Avoid excessive mechanical injury to vines.
7. Apply a fungicide recommended for control of Sclerotinia blight.
8. Do not make applications of Bravo in a leafspot schedule closer than 21 days apart.
9. Dig runner varieties early to avoid late-season losses, do not delay digging of Spanish varieties past normal maturity.

References

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Relative Levels of Expected Impacts and Costs of Management Practices for Control of Southern and Sclerotinia Blights

	Southern blight		Sclerotinia blight	
Practice	**Expected impact**	**Cost**	**Expected impact**	**Cost**
crop rotation	high	low	low	low
raised bed planting	moderate	low	moderate	low
residue management	high	moderate	low	moderate
variety selection	low	low	high	low
fungicide use	high	high	high	high
planting dates	low	low	moderate-high	low
harvest date	low	low	moderate-high	low
cultivation[1]	moderate	low-high	low	low-high
leafspot control	moderate	high	low	high
irrigation timing	high	low	high	low

[1] Reduced or modified cultivation; costs will be high if herbicides are used in place of cultivation, high if additional equipment with narrow tires is required, or low if timing or equipment is adjusted (see text).

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