

Field and Storage Diseases of Sweet Potatoes

Sweet potatoes are one of the most important vegetable crops produced in Alabama with approximately 6,000 acres grown annually. Sweet potatoes are susceptible to a variety of field and storage diseases. The most common diseases affecting sweet potato production in Alabama and the management practices required for their control are described in this circular.

Black Rot

Black rot is caused by the fungus *Ceratocystis fimbriata*. The disease can cause significant losses in storage, in the transplant bed, and in the field. The pathogen not only reduces yield and quality but also gives sweet potatoes a bitter taste.

Small, circular, slightly sunken, dark brown spots are the initial symptoms of black rot (Figure 1). Spots enlarge and appear greenish black to black when wet and grayish black when dry. Within the spots are small, black fungal structures (perithecia) with long necks which appear to the naked eye as dark bristles. The rot usually remains firm and shallow. If secondary fungi or bacteria invade the tissue however, the flesh beneath the spot turns black, and this blackened area may extend to the center of the root (Figure 2). Tissue near the discolored area may have a bitter taste. Eventually, the entire root may rot. Roots may appear healthy at harvest but rot in storage, during transit, or in the market.

The fungus survives in the soil in crop debris. Infected storage roots escape detection at harvest



Figure 1. Roots with black rot lesions (left and right) and uninfected roots (center).

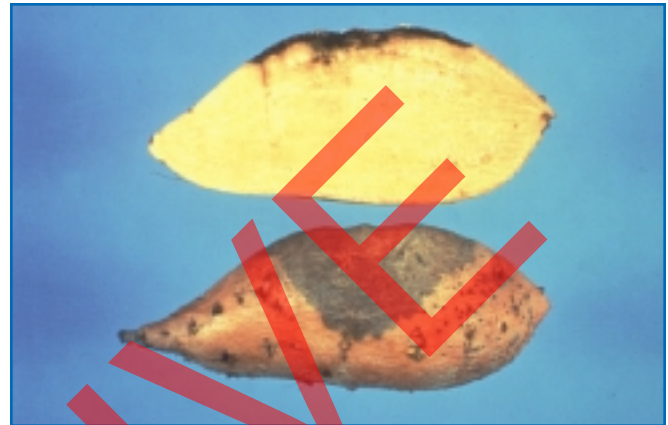


Figure 2. Internal and external views of roots infected with black rot.

or bedding. The fungus either colonizes the young shoots or infects the stem. Transplants and, subsequently, the main stem and daughter roots are thereby infected. When slips are pulled for transplanting, the stem carries the pathogen along with the plant.

The black rot fungus can produce tremendous numbers of spores during storage. These can contaminate washing machines, crates, and structures as well as the hands of workers. Contaminated items or dip tanks can serve as sources of fungal inoculum for new infections. Using contaminated equipment or washing and packing roots infected with black rot before curing may spread the disease. Black rot may develop on sweet potatoes during transit or in the marketplace. Entire lots may become infected as the fungus spreads quickly to roots surrounding a rotting sweet potato. As a result, entire crates of roots may be quickly destroyed in storage. Insects, such as the sweet potato weevil, may also transmit the disease in storage. Development and spread of the disease is rapid at temperatures greater than storage temperatures (55° to 60°F).

Control

- Control black rot with crop rotation, since most crops are unaffected by the disease.
- Disinfect seedbeds if a clean site is unavailable.

- Propagate plants from healthy stem cuttings.
- Cure roots immediately after harvest. (Cure roots at 85° to 95°F and 85 to 90 percent relative humidity for 5 to 10 days.)
- Apply a postharvest fungicide.
- Do not wash and package roots showing symptoms of black rot.
- Decontaminate equipment that comes into contact with an infected crop.
- Spray empty washing machines and crates with a fungicide.
- Fumigate storage structures.

Fusarium Surface Rot And Fusarium Root Rot

Fusarium surface rot and Fusarium root rot are caused by species of the fungus *Fusarium*. Fusarium surface rot is common on roots stored for any length of time after harvest. Fusarium root rot is a serious disease of sweet potatoes in the Southeast.

Surface rot occasionally occurs prior to harvest on roots that have been mechanically injured, split by growth cracks, or damaged by nematodes, insects, or other soil pests. Lesions on fleshy roots are circular, light to dark brown, firm, and dry. Decay remains shallow, usually not extending beyond the root's vascular ring. Externally, lesions appear solid brown and are often centered on a broken rootlet. When infected roots are stored for an extended period, the tissue around lesions dries and becomes shrunken, and the root eventually becomes hard and mummified.

Fusarium root rot may be difficult to distinguish from Fusarium surface rot by external symptoms. In some cases, surface rot may be an early stage of the more aggressive root rot. Root rot lesions are circular and commonly exhibit light and dark brown concentric rings. Internal rotting extends beyond the vascular area into the center of the root and may eventually affect the entire root (Figure 3). This pattern distinguishes root rot from surface rot. The tissue near the advancing margins of these lesions varies from orange to light brown and is more spongy and moist than either healthy tissue or older lesion tissue. Older lesion tissue is dark brown, dry, and spongy, and oval-shaped cavities occur near the root surface. These cavities often have white fungal growth on their inner surface. As the lesions grow, the infected tissue shrinks, dries up, and eventually mummifies. Frequently, rot begins at the ends of the storage root, a phase known as Fusarium end rot. Another phase, Fusarium stem canker, occurs on sprouts of infected mother roots in plant beds. In this phase,

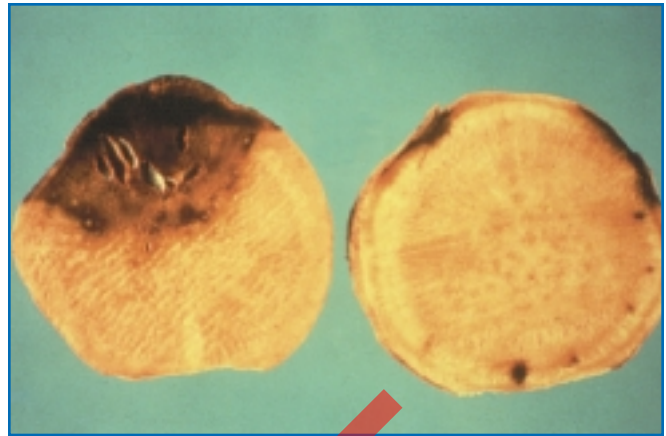


Figure 3. Cross section of root with symptoms of Fusarium root rot (left) and Fusarium surface rot (right).

a dark brown to black decay begins at the base of the sprout and progresses up the stem.

Species of *Fusarium* that cause surface rot and root rot can persist in soil for many years. Infection in the field may occur through rootlets or growth cracks. More commonly, however, roots contaminated with the fungus are invaded through wounds that occur during harvest. Surface rot or root rot that develops during storage spreads to other stored roots only when new wounds are made.

Surface rot is prevalent when sweet potatoes are mechanically harvested, when soil is wet and cold at harvest or excessively dry prior to harvest (causing increased skinning of sweet potatoes), when sweet potatoes are exposed to high or low temperatures for extended periods after digging and prior to curing, or when conditions are favorable for desiccation of wounded tissue.

Control

- To reduce Fusarium root rot, control surface rot.
- Use sanitary practices and properly handle harvested roots. These are the most effective control procedures for both pathogens.
 - Minimize injury during harvesting and handling, especially if the crop is lifted from wet soil.
 - Cure roots immediately after harvest.
 - Reduce surface rot in the field by controlling root-knot nematodes and insects that can rupture the skin of sweet potatoes.
 - Reduce spread of Fusarium root rot to sprouts in transplant beds by planting disease-free roots treated with fungicides.
 - To avoid transporting the stem canker phase of Fusarium to the field, cut transplants above the soil line.

Rhizopus Soft Rot

Rhizopus soft rot is caused by the fungus *Rhizopus stolonifer*. It is often referred to as the bread mold fungus. The disease mainly occurs after sweet potatoes have been harvested.

Infection and decay commonly occur at one or both ends of the root, although infection occasionally begins elsewhere. Rotting may be inhibited under dry conditions, but under humid conditions the affected sweet potatoes become soft and watery, and the entire root rots within a few days (Figure 4). If the humidity is high, the sweet potatoes become heavily “whiskered” with a grayish black fungal growth. This feature distinguishes Rhizopus soft rot from other storage rots. The color of the root is not significantly altered, but an odor is produced that attracts fruit flies to the area.

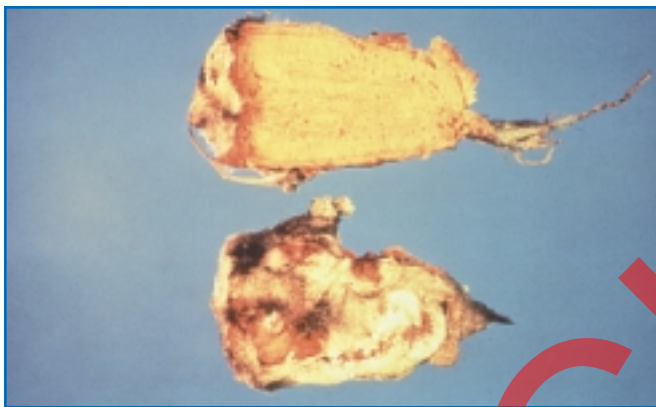


Figure 4. Internal and external views of roots infected with Rhizopus soft rot.

Spores of *Rhizopus* are common in the soil and in the atmosphere. In addition, the fungus can survive in crop debris and, to some extent, on contaminated equipment. The fungus usually infects through wounds made during harvesting and handling when airborne fungal spores or contaminated soil contacts the wounded surface. Once established, the fungus is capable of attacking healthy, uninjured tissue. Infection is especially likely if the relative humidity is between 75 and 85 percent during storage or transport. Also, the longer roots are stored, the more susceptible they become. Chilling and heat damage also predispose sweet potatoes to infection. Soft rot is very destructive when sweet potatoes are washed, packed, or shipped to market during cold weather.

Control

- Carefully handle sweet potatoes during harvest to prevent unnecessary wounding. This is the most important control method for soft rot.
- Properly cure roots immediately after harvest.

- Store roots at 55° to 60°F.
- Avoid handling stored roots because handling can create new wounds. Recuring is one possible solution to this problem.
- Apply a recommended fungicide after harvest.
- Do not allow sweet potatoes to be exposed to sunlight for extended periods (to prevent heat damage) or to be chilled in the field.

Java Black Rot

Java black rot, caused by the fungus *Diplodia gossypina*, is considered one of the most destructive diseases of sweet potatoes in the southern United States. The disease is most frequently observed on sweet potatoes in storage.

The disease usually progresses from one or both ends of the root. Affected tissue is first yellowish to reddish brown, turning black as the decay progresses (Figure 5). The decayed area is firm and moist. Infected roots often completely decay within 2 weeks and subsequently dry out, becoming mummified and extremely hard. During early stages of development, Java black rot can be confused with black rot, charcoal rot, and the Fusarium rots. In later stages, the skin is pimply with small, black spore-producing structures (stromata). These black fungal masses break through the surface of the root and take the shape of domes or cushions. Decay in storage is frequently restricted to the tip ($\frac{1}{2}$ to 1 inch) of the root. The tissue at the center of the lesion is usually solid black.

The fungus survives free in the soil for several years or in crop debris. Infested soil sticks to the broken ends of sweet potatoes at harvest, and the fungus enters through these wounds or others created elsewhere on the root. Spores of the fungus can also survive on crates from one season to the next and infect newly wounded roots placed in infested crates. The fungus requires a wound for

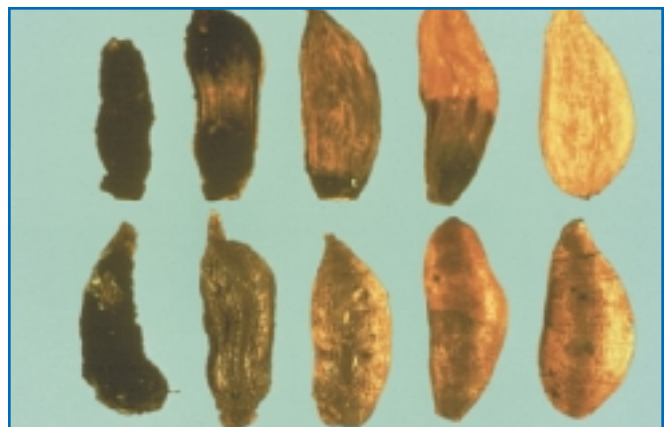


Figure 5. Internal and external views of roots with Java black rot at different stages of development.

entry into roots. The fungus does not spread on properly cured roots in storage; however, any subsequent handling can result in new wounds and secondary infections. If contaminated sweet potatoes are used as seed, the sprouts as well as the daughter roots may become infected.

Java black rot is a warm temperature disease, favoring temperatures between 68° to 86°F. The disease develops over a wide range of relative humidities. Roots become more susceptible to Java black rot with increased storage time or if chilled roots are returned to higher temperatures.

Control

- Wash and disinfect any previously used storage containers prior to harvest.
- Do not expose sweet potatoes to flooding or cold in the field.
- Minimize wounding during harvesting.
- Wash harvested roots and dip them in a fungicide. Then immediately cure the roots to ensure rapid wound healing.
- Although temperatures recommended for curing sweet potatoes are similar to optimal temperatures for Java black rot growth (68° to 86°F), cure sweet potatoes immediately after harvest to reduce incidence of the disease. High temperatures also promote rapid wound healing.
- Store sweet potatoes at 55° to 60°F and 90 percent relative humidity.

Bacterial Soft Rot

Bacterial soft rot, also known as bacterial stem and root rot, is caused by the pathogen *Erwinia chrysanthemi*. Rotting can occur in the field as well as during shipment and storage. The disease is known to occur only in the United States.

Roots are affected in the field, or more commonly in storage, by a soft rot that turns diseased tissue light brown and watery (Figure 6). Lesions on storage roots often have a dark brown margin.



Figure 6. Sweet potato with symptoms of bacterial soft rot.

Some storage roots appear healthy from the outside but are decayed internally. Infected roots show black streaks in the vascular tissue and eventually undergo a soft, moist decay. Mother roots often decay in plant beds.

In the field, brown to black, water-soaked lesions appear on stems and petioles. Eventually, the stem may become watery and collapse, causing the ends of vines to wilt. Usually, one or two vines may collapse, but occasionally the entire plant dies.

The bacterium invades the host through wounds. It survives in crop debris or in association with weeds. Sources of inoculum may include soil, infected mother plants, or contaminated wash water and harvesting equipment.

The disease is favored by warm, humid weather. Symptoms may not be visible at temperatures below 80°F but may appear rapidly at temperatures of 86°F or higher.

Control

- Carefully handle sweet potatoes during all stages of production. This is the most important control method for bacterial soft rot.
- Select mother roots from fields free of the disease.
- Cull roots infected during storage.
- Use vines cut above the soil surface for transplanting.
- Use a handling system that does not involve immersion of sweet potatoes in water.

Scurf

Also known as soil-stain, scurf is caused by the fungus *Monilochaetes infusans*. Damage from the disease is primarily superficial but still detracts from market value.

Symptoms of scurf begin during the growing season as small, dark brown to black spots that develop on roots and later merge to form irregular lesions (Figure 7). Lesions enlarge until the entire

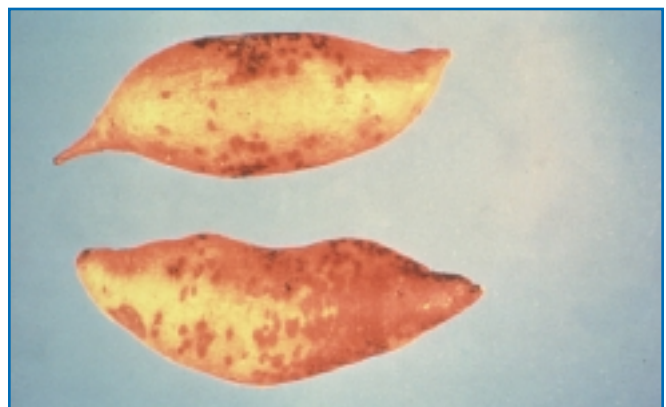


Figure 7. Sweet potatoes with symptoms of scurf.

surface of the root is discolored. Copper-skinned sweet potatoes usually have brown lesions, and red-skinned sweet potatoes have black lesions. Symptoms are restricted to the skin of storage roots and do not directly affect the underlying tissue. Affected tissue can be easily scraped off. Cracks may develop on severely affected sweet potatoes and result in shrinkage because of water loss. Scurf-infected sweet potatoes are more susceptible to invasion by other fungi.

Scurf lesions continue to enlarge when sweet potatoes are put into storage, and new lesions appear if high relative humidity is maintained. The optimum temperature for disease development is 75°F, but scurf can develop to a lesser extent over a wide range of temperatures. Disease development is greatest when soil moisture is optimal for plant growth.

Most scurf infections result from the use of infected propagating material. The fungus can also survive in crop debris in the soil for 1 to 2 years. Disease severity is greater and persistence of the pathogen longer in fine-textured, highly organic soils. The disease has a narrow host range that consists only of species in the genus *Ipomoea*.

Control

- Use only scurf-free, fungicide-treated sweet potatoes as seed roots. Bed these in soil free of the disease.
- Cut transplants at least 1 inch above the soil line, and dip them in a fungicide.
- Grow sweet potatoes after a 3- to 4-year rotation with other crops.

Charcoal Rot

Charcoal rot, caused by the fungus *Macrophomina phaseoli*, can cause losses of sweet potatoes in storage, but serious losses seldom occur. The disease is sometimes confused with black rot and Java black rot.

Symptoms in storage begin as a reddish brown to brown, firm, moist rot, initially restricted to the area just beneath the sweet potato skin. As the

decay progresses, the pathogen moves toward the center of the sweet potato, causing further rot (Figure 8). Two distinct zones become apparent within the infected tissue. The leading edge continues as a reddish brown decay, and a zone of black develops behind the zone of active decay. Although the lesions are sometimes restricted, charcoal rot usually consumes the entire root, which eventually dries, becoming hard and mummified.



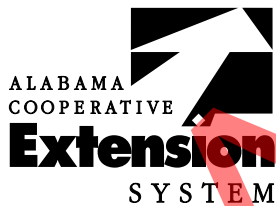
Figure 8. Internal views of root with charcoal rot.

The fungus is soilborne and survives in plant debris or in the soil. There has been no evidence that the fungus can be carried in roots used for bedding. The fungus has a wide host range which includes many crops grown in rotation with sweet potatoes, such as soybean, cotton, sorghum, and corn. It requires a wound to enter the root.

High temperatures (84° to 88°F) appear to favor disease development. Charcoal rot is more common in storage houses that are too warm or in crates located too close to heaters. Also, infection is greater if harvested roots are scalded by sunlight before being placed in storage.

Control

- Properly cure sweet potatoes immediately after harvest to reduce the incidence of charcoal rot.



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Source for illustrations: APS Compendium slide set for sweet potatoes.

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