The Fungi That Cause Rot in Sweetpotatoes

Harold T. Cook

Diseases destroy 20 to 40 percent of the sweetpotato crop in the field, in storage, and in transit to market. The average annual production from 1939 to 1948 of nearly 62 million bushels had a farm value of about 119 million dollars. The losses thus might be set at 24 million to 48 million dollars each year.

More than 40 fungus diseases attack sweetpotatoes. Most of the damage is caused by seven of them. Diseases that affect the growing crop reduce the yield and the proportion of choice size potatoes and cause disfigurements and skin blemishes that reduce their salability. Those that affect the potatoes in storage, in transit, and at the market cause decay, shriveling, and unattractive appearance.

The greatest monetary losses arise from damage in storage, in transit, and at the market. Sweetpotatoes are extremely perishable after they are dug and many decay before they reach the consumer. The later the decay occurs, the greater the monetary losses because of the added costs of harvesting, storing, grading, cleaning, packing, shipping, and marketing.

**STEM ROT** is one of the worst field diseases. It is found in all our growing areas. It destroys more than 50 percent of the plants in some fields. It lowers total yield and the number of medium size, uniformly shaped sweetpotatoes preferred for marketing.

Stem rot is most conspicuous about 2 weeks after the sprouts are set in the field. By that time many of the diseased sprouts are dead or are yellow and dying. The inside of the stem and vines of infected plants are brown or black instead of the normal white color. The stem is often split near the ground level and decayed. Some of the diseased plants develop new roots above the decayed part of the stem and survive the entire growing season.

The potatoes produced by the infected plants are usually small and decayed at the stem end. Their vascular tissues are brown. Sometimes a tuft of new sprouts grows from the stem end at harvest. Diseased sprouts growing from diseased seed potatoes in the plant bed sometimes can be recognized by a faint purplish tint, which shows through the white part of the stem and is caused by the dark tissues.

Stem rot is caused by *Fusarium oxysporum* f. *batatas* or *F. hyperoxysporum*. The fungi can live indefinitely in the soil. They also overwinter in stored sweetpotatoes that are diseased. They are usually spread from one locality to another by the exchange or sale of diseased seed potatoes or plants. They also may be carried in soil that adheres to farm implements.

Varieties of the Jersey group, including Big Stem Jersey, Little Stem Jersey, Maryland Golden, and Nancy Hall, are very susceptible to stem rot. Porto Rico is intermediate in resistance. Southern Queen, Triumph, and Yellow Strassburg are quite resistant—but most of the more resistant varieties have poor table quality. A breeding program has been started to develop resistant kinds of good eating quality.

**BLACK ROT** is serious in the seedbed and field. It is especially destructive in storage and transit. It causes some reduction in yield, and some of the potatoes have visible black rot spots on them at harvest. Frequently, however, potatoes that appear free from black rot at harvest are so badly diseased at the end of storage or on arrival...
at market that they are nearly a total loss.

The most conspicuous symptom is the circular, dark-brown or black spots on the potatoes. The spots vary in size from mere specks to 1 or 2 inches in diameter. The blackening usually extends into the potato only as far as the vascular ring, but in some varieties it extends much farther. Sometimes small, black bristles, the fruiting bodies of the fungus, develop at the center of the spots.

Black rot may cause small, round black spots on the white underground stem of the sprouts or it may cause blackening and decay of most of the base of the stem, a condition that is sometimes referred to as black shank.

Black rot is caused by the fungus Ceratostomella fimбриata, which may remain alive in the soil for several years. It also lives from one season to the next on infected sweetpotatoes in storage. It is usually spread from one farm area to another by the exchange or purchase of plants and seed potatoes. Harvested potatoes become infected by spread of the fungus spores during grading, brushing, and washing. When lots containing a few infected potatoes are washed, the wash water becomes contaminated by the fungus spores and nearly all of the potatoes become infected. Such potatoes may appear sound when they are packed for shipping after washing, but they may be heavily infected when they arrive at the market.

The fungus grows best at temperatures of 73° to 81° F., but also makes good growth at 55°, the lowest temperature at which sweetpotatoes should be stored. Little or no growth occurs at temperatures above 95°. When infected sweetpotatoes are held at 110° for a day, the fungus is killed. Most infection takes place through wounds.

No commercial variety of sweetpotatoes is entirely immune to black rot, but several unnamed seedling varieties have been discovered to be highly resistant.

Soft rot is the most serious disease in storage and transit. It may start soon after the potatoes are stored and destroy nearly all of the potatoes before the end of the storage period or it may not affect the potatoes until they have been removed from storage and cleaned, packed, and shipped to market.

It is easily recognized by the soft, mushy decay and the accompanying fuzzy gray and black mold. The affected tissues are moist, brown, and stringy. The decaying potatoes have a rather pleasant aromatic odor, which is quite noticeable in storage houses when potatoes are affected with the disease. The affected potatoes lose moisture rapidly and finally become dry and brittle.

Soft rot is usually caused by the common bread mold fungus, Rhizopus nigricans, but several other species of Rhizopus also may cause it. Rhizopus spores are almost universally present, because the bread mold fungus grows on a wide variety of vegetable material.

Species of Rhizopus responsible for soft rot grow well at the usual storage temperatures and even better at higher temperatures. Infection rarely takes place except at wounds, such as those where the potato is broken from the stem and at cuts and bruises caused in digging, cleaning, and packing. Less infection occurs in bruised potatoes that are held at a high relative humidity and about 85° F. temperature for a few days immediately after wounding, because the injuries heal so rapidly at this temperature and high humidity that the fungus cannot get established.

All varieties are susceptible to soft rot, but some decay more rapidly than others. Southern Queen and Nancy Hall are quite resistant. Porto Rico, Big Stem Jersey, and Triumph are intermediate. Yellow Jersey is very susceptible.

Scurf, or soil stain, has little effect on yield, but it causes a brown stain on the potato skin and increased shriveling in storage. It does not
spread to other potatoes in storage or cause decay.

The brown stain is only skin deep. It is usually worse at the stem end of the potato. It occurs as scattered blotches on lightly infected potatoes, but large areas may be brown or nearly black on badly infected ones.

Scurf is caused by *Monilochaetes infuscans*, a fungus that overwinters on potatoes in storage. It persists in the soil for several years. If potatoes are bedded, the fungus grows from the mother potato up to the base of the sprouts. After the sprouts are planted it spreads down to the new potatoes. Most of the infection apparently comes from the seed potatoes and is carried to the field on the sprouts.

Scurf is worse on heavy soils and those containing a large quantity of organic matter than on sandy soils.

Pox, or soil rot, is a widely distributed field disease, but generally it is less important than stem rot or black rot. It reduces the yield and the proportion of salable potatoes.

Its most conspicuous symptom is the pits it causes on the potatoes. The pits are one-fourth inch to more than an inch in diameter and have a jagged margin. In the early stages the infected spots are dark-colored and water-soaked. Later the skin of the potato covering the pit breaks and the contents fall out, leaving an empty cavity. The disease also kills the young feeding roots and causes dark lesions on the part of the stem below the soil line. Affected plants are usually stunted and have yellow leaves. Many of them die early.

*Streptomyces ipomoea*, the causal fungus, lives indefinitely in the soil and is spread in soil adhering to farm machinery or plants, by wind-blown soil, and by floodwaters. It likes soils that are less acid than pH 5.2. The addition of sulfur to the soil to make it more acid has reduced damage from pox in some places.

**INTERNAL CORK**, a new virus disease, was discovered in South Carolina in 1944. Since then it has been found in sweetpotatoes in many other areas, but it is most serious in South Carolina, Georgia, and North Carolina.

Sweetpotatoes affected with internal cork appear normal externally, but have dark brown to blackish corky spots scattered irregularly through the flesh. The corky tissues remain firm during cooking and have a slightly bitter taste. They vary in size up to about one-tenth inch in diameter and one-fifth inch in length. Closely grouped corky spots may affect large areas in the flesh. Leaves of plants affected with internal cork are sometimes marked with purplish ring spots.

Only a little internal cork is found when the sweetpotatoes are dug but corky spots increase in number and size during storage. The rate of increase is more rapid at 70° F. than at the recommended storage temperatures of 55° and 60°.

**JAVA BLACK ROT** ranks next to soft rot and black rot in importance as a storage disease. It occurs in all parts of the United States where sweetpotatoes grow and in many other countries. It was named Java black rot because it was first discovered on sweetpotatoes sent from Java. It is caused by a fungus, *Diplodia tubericola*.

It causes a dry rot of the roots. The decayed tissues, brown at first, turn black and hard. The fungus forms black protuberances on the surface of the potato. The decay usually starts at the ends, but sometimes at breaks on other parts of the potato. It progresses slowly and there is little evidence of the disease until about a week after infection. The potato rots in 4 to 8 weeks.

**SURFACE ROT**, a common storage disease, causes shallow, circular, depressed spots on the surface and a gradual drying out. It progresses so slowly that a great deal of damage may be done before the extent of the disease is recognized. The spots usually
are not more than three-fourths inch in diameter and seldom penetrate below the vascular ring. They usually are grayish brown, but sometimes they may be so dark-colored that they resemble black rot.

The disease is caused by the fungus *Fusarium oxysporum*. Infection apparently takes place through the small rootlets that are damaged when the potatoes are harvested. The disease does not become conspicuous until the potatoes have been in storage for 2 months.

Surface rot is worse on potatoes harvested when the ground is wet and when the potatoes are in the storage house several days before the curing process is started.

All varieties are affected, but Big Stem Jersey and Little Stem Jersey are more susceptible than some of the darker skinned varieties.

**The most effective and practical control of the field diseases is to plant only healthy seed potatoes and plants in healthy seedbeds and fields.**

Except for the fungi that cause stem rot and pox, none of the fungi that cause major diseases of sweetpotatoes remains alive in the soil for more than 2 or 3 years. A crop rotation of about 4 years generally rids a field of the fungi that cause black rot and scurf.

Plant beds should be thoroughly cleaned and filled with new soil or sand or new plant beds prepared.

Plants free of black rot or scurf can be had even from affected sweetpotatoes by planting vine cuttings or sprout cuttings instead of pulled sprouts. The cuttings will be free of those diseases because black rot and scurf do not affect the above-ground parts. It is more practical to use sprout cuttings than vine cuttings because they can be obtained and planted as early as pulled sprouts; vine cuttings cannot be made until much later. The sprout cuttings should be made by cutting the sprouts about 1.5 inches above the soil line of the plant bed without disturbing the below-ground parts. Once black rot and scurf have been eliminated from the sweetpotato seed stock, it is all right to use pulled sprouts in succeeding years.

Because the fungi that cause stem rot and pox live indefinitely in the soil, neither the use of clean planting stock nor crop rotation will eliminate those diseases from a farm. The most practical control is by the use of resistant varieties when suitable ones have been developed. The addition of sulfur to the soil to lower the reaction to slightly less than pH 5.2 reduces the amount of pox.

Much of the losses caused by black rot and scurf in storage and transit may be avoided by storing and shipping only potatoes that are free of those diseases. Black rot and scurf may be eliminated from the potato stocks by use of clean plants and crop rotation.

Losses in storage and transit caused by soft rot, Java black rot, and surface rot can be greatly reduced by proper curing so that wounds caused in harvesting, handling, washing, and packing will heal rapidly and wall out the decay fungi. Temperature and humidity are important in curing sweetpotatoes. The temperature should be about 85°F. and the humidity should be high. Only enough ventilation should be used to keep the potatoes from becoming wet. Frequently outside temperatures are high enough to favor healing when the sweetpotatoes are harvested and additional heat in the storage house is not necessary. Sweetpotatoes may be cured to reduce decay after they are taken from storage and washed and packed for shipment as well as when they are placed in storage in the fall. Storing sweetpotatoes at temperatures even slightly below 55°F. causes chilling injuries that make the sweetpotatoes more likely to decay.

**Harold T. Cook is a pathologist in the Bureau of Plant Industry, Soils, and Agricultural Engineering.**