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Plant Pathology Fact Sheet

Strawberry Fruit Rots

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Strawberry fruit rot diseases often make it difficult to obtain high yields of quality berries. Kentucky's typically moist springtime growing conditions favor these diseases, which often begin with infections of flowers at bloom. Diseases causing the decay of developing and ripe strawberries include gray mold, leather rot, and anthracnose.

Gray Mold

Gray mold is the most common and economically important strawberry fruit rot disease in Kentucky. Also called Botrytis rot or ash mold, it is an ever-present threat to strawberries both in the field and after harvest.

Symptoms and Signs

This disease can develop on petals, flower stalks, and fruit caps, as well as fruit. Infections of mature fruit usually appear as soft, light brown areas on the fruit surface. These areas spread rapidly throughout the berry until it is completely destroyed. Rotted berries retain their general shape and become tough and dry. Little or no leak is associated with this disease. As the berries dry out, they become covered by a distinctive gray, dusty-appearing fungal growth, from which gray mold gets its name (Figure 1).

Figure 1. *Botrytis* sporulating on infected fruit

Cause and Disease Development

Gray mold is caused by the fungus *Botrytis cinerea*. This organism commonly occurs on a wide range of host plants, including ornamentals and vegetables, as well as other fruit crops. It is also well-adapted for survival, overwintering as mycelia or sclerotia in dead leaves and decaying plant tissue. Spores are disseminated to susceptible strawberry tissue by air currents, splashing rain, or insects. Infection can occur within hours in the presence of moisture from rain, dew, or overhead irrigation.

FIGURE 2. FRUIT IN CONTACT WITH A DISEASED BERRY

B. cinerea has the ability to colonize either living or dead tissue. It often becomes established in dead or dying tissue before moving into healthy tissue. The fungus often first colonizes deteriorating floral parts; from there infections may quickly destroy the developing berry. Less frequently, the fungus can remain latent until fruit are well ripened or even harvested. Mature fruit, especially those that are injured or bruised, are highly susceptible to gray mold infection. Fruit resting on the soil or touching other diseased berries are commonly affected (FIGURE 2).

Fruit infection is often most severe in shaded and protected areas under a canopy of leaves. Air movement tends to be poor and humidity high in these locations. *B. cinerea* is active over a wide range of temperatures and humidity; however, optimum conditions for infection and disease development occur between 60°F and 70°F, and at a relative humidity above 90%. Under these conditions, gray mold can explode in an unprotected berry patch and produce a severe epidemic in as little as 48 hours. As the disease becomes more and more established in a particular field, it becomes proportionally harder to control.

LEATHER ROT

Leather rot is another important fruit rot disease of strawberries in Kentucky. This disease primarily affects fruit; however, blossoms may also become infected.

Symptoms and Signs

Fruit Infections can occur at any stage of development, from immature green fruit to red ripened berries. The disease is easiest to spot on green berries where affected areas have a brown margin or are completely dark brown. Eventually the entire berry becomes brown. Fully mature fruit may show no outward symptoms other than a slight discoloration and softening. Internal browning, however, may be evident when the fruit is cut. The disease gets its name from the tough, leathery appearance of infected berries in the later stages of decay (FIGURE 3). A white moldy growth may be observed on the fruit surface. Infected fruits eventually dry up and mummify.

FIGURE 3. LEATHER ROT SYMPTOMS

The pathogen gives infected fruit an off-flavor and odor. Even mildly infected berries have a bitter taste. Because mature berries may appear symptomless at harvest, infected strawberries may be picked along with healthy ones. Unfortunately, the bitter flavor of diseased berries is imparted into processed products.

FIGURE 4. ANTHRACNOSE SYMPTOMS

Cause and Disease Development

Leather rot is caused by the fungus-like organism *Phytophthora cactorum*. This organism overwinters as thick-walled oospores in the soil. Under cool, moist conditions oospores germinate to produce sporangia; which in turn release infective spores capable of swimming in a film of free moisture. These motile spores can infect fruit in direct contact with the soil, or they may be carried by windblown or splashing water to fruit surfaces. Sporangia forming on infected fruit can cause secondary infections when spread to healthy fruit. Overwintering oospores form in the mummified fruit that drops to the ground.

ANTHRACNOSE FRUIT ROT

Anthracnose is not generally considered a significant problem in Kentucky strawberry fields. However, while this disease is infrequent, anthracnose fruit and crown rot infections can severely reduce plant stands and yields when it does occur. Only the fruit rot phase will be discussed here.

Symptoms and Signs

Round, firm, whitish-tan, sunken lesions develop on ripening fruits (FIGURE 4). Masses of slimy, cream- to salmon-colored fungal spores may form in the center of the spot. Lesions turn dark brown and can enlarge until the entire fruit is rotted. Infected fruits eventually become dried, shriveled mummies.

Cause and Disease Development

The fungus *Colletotrichum acutatum* is most commonly associated with anthracnose fruit rot. This organism can persist as dormant spores or other fungal structures in infected plants, mummified fruit, and plant debris. During warm, rainy, humid weather disease development and spread can occur very rapidly. Short distance spread in the field is accomplished when spores are carried via rain splash or by movement of equipment. Long distance spread can occur with the movement of strawberry transplants from the nursery to the grower.

FRUIT ROT DISEASE MANAGEMENT

Strawberry producers need to manage strawberry diseases by providing a consistent and acceptable level of disease control with minimal fungicide use. Good cultural practices can reduce disease pressure. When disease pressure is decreased, then the need for fungicide decreases and the effectiveness of the fungicides that are used increases. Fruit rot management practices begin as early as pre-planting and continue until post-harvest.

Pre-planting and planting

Planting site

• Select a planting site with good soil drainage. Leather rot requires free water (saturated soil) in order to develop.

• Choose planting sites in full sun with good air circulation. Avoid shady locations.

• Plant new beds periodically in different sites well away from old strawberry beds. Over the years strawberry beds accumulate more and more dead leaves and other organic debris that is often infected with pathogenic fungi. Thus, fungal inoculum levels are higher and disease pressure is increased each subsequent spring, making fungicide choices and timing more critical.

Plant selection

• Select and purchase only disease-free transplants from a reputable nursery. Before transplanting, inspect plants carefully for any symptoms of disease.

• Reduce disease pressure by using cultivars that are resistant or less susceptible to these diseases. For example, while there are no strawberry cultivars with strong resistance to gray mold, some cultivars (e.g. Earliglow) are somewhat less susceptible than average.

Plant density and row spacing

• Orient rows toward the prevailing winds in order to facilitate leaf drying.

• Reduce the over-all density of the strawberry beds. The thicker and heavier the foliar growth, the longer the tissue stays wet in the canopy. This is particularly true of blossoms and fruit. Wet plants provide an environment favorable to infection.

Production practices

Fertility and irrigation

• Avoid the use of excess nitrogen fertilizer. Excess nitrogen promotes dense foliage that stays wetter longer. It also results in softer berries that may be more susceptible to fruit rots.

• Fertilize strawberry beds at renovation time and during flower bud initiation. Avoid springtime applications which encourage lush disease-susceptible growth.

• Schedule irrigation so that foliage and fruit will dry as quickly as possible. If any of these diseases become established in the planting, overhead irrigation should be avoided.

Sanitation, weed control, and mulch

• Weeds in the planting reduce air circulation, causing fruit and foliage to stay wet for longer periods. Gray mold, in particular, is a more serious problem in strawberry beds with poor weed control compared with beds where weeds are well managed.

• Straw mulch keeps berries from contacting the soil where the fruit rot fungi overwinter. In addition, mulch aids in preventing infested soil from splashing up onto the berries. Research in Ohio has shown that a good layer of straw mulch is very beneficial in controlling leather rot.

• Pick up and destroy old leaves in the bed to reduce fungal inoculum build-up of the gray mold fungus. Removal of rotted fruit from the planting could be highly beneficial. Unfortunately, while these practices can work well for backyard plantings, they are often impractical for commercial growers.

• Avoid moving people (pickers) and machinery from a field or area that is infected to a clean or uninfected field. Fungal spores and bacteria can be transported on workers' shoes, hands, and clothing.

Pre-bloom to bloom

Fungicides

• When the cultural practices listed above are followed carefully, fungicide sprays are usually not needed, especially in backyard gardens.

• If fungicides are needed for disease control, they should be applied preventively and in a timely manner. Fungicide suggestions for commercial strawberry fruit rot management can be found in the *Midwest Commercial Small Fruit and Grape Spray Guide (ID-94)*. Home gardeners should consult *Disease and Insect Control Programs for Homegrown Fruit in Kentucky, Including Organic Alternatives (ID-21)*.

• Late maturing varieties usually require more fungicide protection than early strawberries. This is because warm, disease-favorable weather is more likely to occur and high levels of fungal inoculum are left over from the earlier varieties.

Gray mold

• Two or three fungicide applications at bloom time (early bloom, mid-bloom, late bloom) are more effective in stopping gray mold than fungicide applications made after fruit begins to form and ripen. Research clearly shows that growers who apply just two bloom sprays obtain gray mold control as good as a full-season fungicide program.

• Where gray mold has been a significant problem before, applications should begin at the white bud stage of flower development. Also, where frost has damaged a planting and a marketable crop remains, great care should be taken to maintain a strict fungicide spray program.

Leather rot

• The timing of fungicide applications for leather rot control depends on the specific chemical used. Generally, foliar sprays may begin between 10 percent bloom and fruit set, and continue at 7 to 14 day intervals while conditions are favorable for disease development.

Anthracnose

• Fungicides for anthracnose control are most effective when used in a protectant program.

• If anthracnose was a problem during the previous growing season, consider a more intensified spray program. Sprays should begin at bloom and continue to harvest.

• Once established in a planting, anthracnose is difficult to control with fungicides.

Harvest

Strawberry fruits are very perishable and easily bruised. The following harvest practices should be considered in order to reduce fruit rot problems.

• Pick berries as soon as they are ripe; avoid overripe berries.

• Pick fruit frequently and early in the day.

• Handle berries with care during harvest to avoid bruising.

• Home gardeners should pick and remove rotted fruits from the field. This may not be practical in commercial plantings, but it could be highly beneficial.

• Get the berries out of the sun as soon as possible.

• Refrigerate harvested berries immediately (inform your customers).

• Market the berries as rapidly as possible.

Post-harvest

• Remove infected plant parts, old leaves, and other plant debris from the bed to reduce the amount of fruit rot pathogen inoculum. Leaf removal at renovation is helpful.

Additional Resources

• Disease and Insect Control Programs for Homegrown Fruit in Kentucky, ID-21 (University of Kentucky)
http://www.ca.uky.edu/agc/pubs/id/id21/id21.pdf

• Midwest Small Fruit and Grape Spray Guide, ID-94 (University of Kentucky et al.) *2 MB file*
http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/ID-94.pdf

• Midwest Small Fruit Pest Management Handbook, B-861 (University of Kentucky et al.) *73 MB file*
http://www.ca.uky.edu/agcollege/plantpathology/ext_files/PPFShtml/MwSmFruitPMHandbook.pdf

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