



Postharvest Rots of Banana

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The two primary postharvest rots of banana (*Musa* spp.) fruits in Hawai'i are crown rot and anthracnose. The diseases usually appear on ripening fruits either at points of sale (farmers' markets, grocery stores) or later, after purchase. Occurrence of these two diseases is closely linked to poor cultural and disease management practices in the banana field, to unclean packinghouses, and to improper postharvest handling. The diseases can be serious problems for growers who fail to manage them with a combination of integrated practices. Infected fruits are safe for humans to consume; however, the infections reduce fruit quality, shelf life, and marketability.

This publication describes the symptoms of crown rot and anthracnose diseases of banana in Hawai'i, their causal pathogens, and the conditions favoring the diseases. A set of integrated management practices that successful banana growers and marketers use to inhibit disease development and reduce rots is given.

The host

Banana and the closely related plantain, or cooking banana, occur in a great diversity of forms resulting from the mixing of *Musa acuminata* and *Musa balbisiana* in their genetic makeup. They are usually large, perennial, monocotyledonous herbs 6–30 ft (2–9 m) tall arising from large, belowground rhizomes (corms). This group is native to the Indo-Malesian, Asian, and Australian tropics, but these plants are now grown throughout the tropics and subtropics.

The pathogen

The fungus *Colletotrichum musae* can cause both crown rot and anthracnose; in addition, crown rot diseases may also be caused by fungal pathogens in the genera *Fusarium*, *Acremonium*, *Verticillium*, and *Curvularia*.

These pathogens exist in banana fields on dead banana leaf or inflorescence tissues. They disperse by wind and water, and by some insects, birds, and rats.

Disease development

In Hawaii, these pathogens are found wherever bananas are grown but are more prevalent in high-rainfall areas, and especially where growers do not follow good field and packinghouse sanitation practices. The general conditions favoring postharvest banana disease symptom development are as follows:

- Poor disease management and cultural practices in banana fields for fungal diseases of leaves and fruits (no de-trashing, poor weed control, mats not regularly pruned to thin out plant population density, and poor soil fertility management).
- High rainfall and high relative humidity.
- Poor sanitation in banana fruit packinghouses (facilities not kept clean and orderly).
- Poor fruit packinghouse practices (bananas not washed and dried, dirty de-handing knives, dull knives or ragged cuts during de-handing of banana hands from stalks).
- Not enclosing banana bunches on plants in fields with perforated polyethylene sleeves.
- Fruits are not refrigerated after harvest and before ripening (56°F after packing and during shipping is appropriate).
- Fruits are not harvested on time (fruit bunches should be harvested green when the fingers are about three-fourths the caliper size of their maximum diameter).

With crown rot, infections by the various causal fungi occur in the fresh wounds created by severing the banana hands from the bunch stalks. The crown is tissue where



Crown rot: A brown to black color develops where the hand was severed from the bunch. Frequently a layer of whitish mold forms on the cut surface of the crown. The mold can penetrate deeply into the crown and necks of fingers and cause a dry, black rot. Fingers may detach prematurely from severely infected crowns. Disease may increase rapidly during banana fruit ripening. Photos: S. Nelson

the hand is cut from the stalk. The pathogens occur on flowers and leaf trash in banana fields and end up in the water used to wash banana fruits and to remove latex from the cut surfaces of the banana fruit crowns.

With anthracnose, the pathogen survives readily on dead and dying plant tissues, including banana leaves. The spores are spread among plant tissues mainly by splashing raindrop impact.

Primary symptoms

In both types of infection, disease symptoms can extend into the banana fruit pulp.

With crown rot, a brown to black color develops on the “crown” where the hand was severed from the bunch. Frequently, a layer of whitish mold later develops on the cut crown surface. The mold can penetrate deeply into the crown and the necks of the fingers, causing a dry, black rot. Fingers may detach prematurely from severely infected crowns. Disease may increase rapidly during fruit ripening.

With anthracnose, symptoms occur as peel blemishes, as black or brown, sunken spots of various sizes on fruits. The spots may bear masses of salmon-colored fungal acervuli with their associated conidia in the lesions. The spots may have triangular-shaped or angular edges. The pathogen may cause symptoms on green fruit and may also enter the cut crown after hands are severed from stalks. Premature ripening of affected fruits may occur after infection.

Integrated management practices

Banana fruits should be handled carefully at all times to avoid bruising or other injuries. To deter postharvest diseases, growers and marketers should adopt the following practices.

Field sanitation. Once per week, remove dead or dying leaves from banana plants and place them topside down on the ground or, preferably, remove them from the area. This is known as de-trashing.

Pruning. Prune banana mats to increase air circulation, reduce relative humidity, lessen competition among shoots for water and nutrients, and promote large, healthy plants and bunches. Mats should contain no more than three or four pseudostems.

Weed control. Manually or chemically, keep climbing weeds off of banana plants, and control tall grasses. This will reduce relative humidity and leaf wetness within and under the banana canopy.

Soil fertility and water. Promote vigorous plant growth with sufficient irrigation and use mulches and fertilizers to stimulate plant growth and maturation.

Field drainage. Promote good field drainage to prevent pools of water from collecting in fields after rainfall.

Black leaf streak control. Control black leaf streak or other foliar diseases in fields using good plant nutrition, de-trashing, pruning, weed control, and approved fungicides rotations. Some banana fruit-infecting fungi can colonize the banana leaves turned necrotic by black



Anthracnose: Symptoms occur as peel blemishes, as black or brown, sunken spots of various sizes on fruits that may bear masses of salmon-colored acervuli with their associated conidia. Spots may have triangular-shaped or angular edges. The pathogen may cause symptoms on green fruit and may also enter the crowns after fruits are severed from stalks. As with crown rot, fruits may ripen prematurely. Photos: S. Nelson (left) and W. Nishijima

leaf streak disease.

Bunch management. Remove leaves that rub against bunches to reduce fruit injury. Spray bunches with approved fungicides before bagging them with perforated polyethylene sleeves. The sleeves protect bunches from detrimental factors that cause injury and disease. De-flower the bunch stalk and finger tips before bagging.

Preharvest fungicides. Some growers apply copper fungicide spray to banana fruits after deflowering fingers and before bagging.

Harvesting. Harvest bunches when fruits are still green and measure $\frac{3}{4}$ of the mature width of fruit. Avoid bruising fruit during harvest and transport to the packinghouse by handling them carefully. Allow harvested bunches to cool overnight before processing by hanging them under cover from direct sunlight.

Packinghouse practices. Keep packinghouses clean. Use fresh water every time bananas are processed. Add soap or bleach to the tank water used to remove latex from severed hands. Use a clean, sharp knife to de-hand fruits from stalks. The cuts should be smooth and even, not ragged or jagged. Place severed hands in tanks of clean wash water to stop the flow of latex plant sap. Do not put hands or banana fingers with symptoms of disease in the wash water. After 5 minutes, remove bananas from wash water and place them on cushioned drying tables.

Packing. Pack dried banana hands in fresh, clean

boxes. Wrap sets of fruits within boxes in plastic designed for that purpose in order to maintain high humidity in boxes. Higher humidity in packing boxes is reported to deter the banana postharvest diseases.

Shipping. Cool the bananas to 56°F after packing and deliver them promptly to a ripening facility. Ripen without delay according to accepted protocols.

Marketing. Keep ripe bananas cool and market them as soon as possible.

Fungicides. Banana growers in Hawai'i do not generally use postharvest fungicide on harvested fruits, aside from dilute bleach solutions in packinghouse wash water. However, banana growers in other countries sometimes use dips or sprays of fungicides such as thiabendazole to deter crown rot and anthracnose disease development.

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