



Sooty Mold

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One of the questions most frequently asked at plant disease clinics in Hawai'i regards the annoying black growth that covers the surface of plant leaves. This growth, called "sooty mold," results from interactions among sap-feeding insects and non-parasitic fungi. These mold fungi do not infect the plant tissues—their damage is cosmetic—yet the science of plant pathology treats them as plant diseases because of their negative effects on photosynthesis: they block sunlight from reaching leaf chloroplasts, where the plant "harvests the sun" and produces energy for growth.

Sooty mold is also a significant postharvest problem for some vegetable and fruit commodities (for example, tomato and banana). The disease creates aesthetically disagreeable fruit spots that reduce the produce's quality, grade, and marketability.

In high-value landscapes, sooty mold presents a significant eyesore. Clusters of tall, insect-infested palms, for example, can shower plants in the landscape below with a sheen of sugary honeydew that feeds sooty mold fungi.

This publication discusses the occurrence of sooty mold in Hawai'i and what can be done to control the problem.

The plant hosts

Any plant that hosts phloem-feeding insects or upon which honeydew from these insects accumulates is susceptible to sooty mold. The problem occurs widely throughout the world's temperate and tropical regions. The fungi are indiscriminate in their selection of a host, requiring only that honeydew be present on it. The nega-

tive effects of sooty mold on plants include

- reduced leaf photosynthesis and gas exchange
- cosmetic damage reducing marketability of plants or produce and detracting from the aesthetic attributes of landscapes
- unhealthy mold spore counts in processed juices and purees made from infested materials.

Host example: noni

Noni (*Morinda citrifolia*) commonly hosts aphids, whiteflies, and scale insects, which often leads to the accumulation of black sooty mold on its foliage. The disease can be a problem when growers pick fruits for juicing, because infested fruits require more thorough washing, and the mold spores contribute to total mold counts in the processed juice, which must be kept to a minimum.

Host example: banana

Banana (*Musa* spp.) hosts both sooty mold and sooty blotch (which is defined below). Both are superficial diseases of the skin of banana fingers, causing diffuse, smoky grey to black areas. Sooty mold fungi require honeydew; sooty blotch fungi do not. According to the banana disease expert R.H. Stover, the most common cause of sooty mold on bananas in the Americas and the Philippines is *Cladosporium cladosporioides*. Sooty mold on banana fruits can be controlled in the field before harvest using insecticides, bunch covers, and field sanitation practices. Postharvest treatment is chlorination of the banana wash water, about 1 part household bleach to 100 parts water.

The disease

Sooty mold is a black, non-parasitic, superficial growth of fungi on plant surfaces. If you can completely rub the black material off the leaves or plant surfaces with your fingers, it is probably sooty mold; if you cannot rub or wash it off to reveal green, healthy plant tissue, it is probably not sooty mold. Most sooty molds warrant no management because they pose no major threat to plant health. Management is warranted when the molds affect the aesthetic value of fruits and landscapes.

The sooty mold fungi feed on honeydew produced by phloem-feeding insects. Some of the common genera of fungi involved are *Cladosporium*, *Aureobasidium*, *Antennariella*, *Limacinula*, *Scorias*, and *Capnodium*. Sap- or phloem-feeding insects associated with the disease include whiteflies, aphids, mealybugs, and scales.

Sooty mold can form under a wide range of environmental conditions in Hawai'i. Cool, moist, humid conditions favor some sooty molds. On outdoor structures and furniture, sooty mold growths are unsightly and may be difficult to remove.

Sooty mold growth is of two types. The first is a deciduous growth on leaves, which lasts for the life of the leaf. The second is persistent growth on stems and twigs of woody plants and on man-made structures or objects. In this type, growth is renewed from existing mycelium of the fungi produced the previous season.

Sooty blotch diseases are similar to sooty molds but are not associated with phloem-feeding insects. In other words, their formation and growth does not depend upon honeydew. They can occur, for example, on banana fruits and on petioles of palms in Hawai'i.

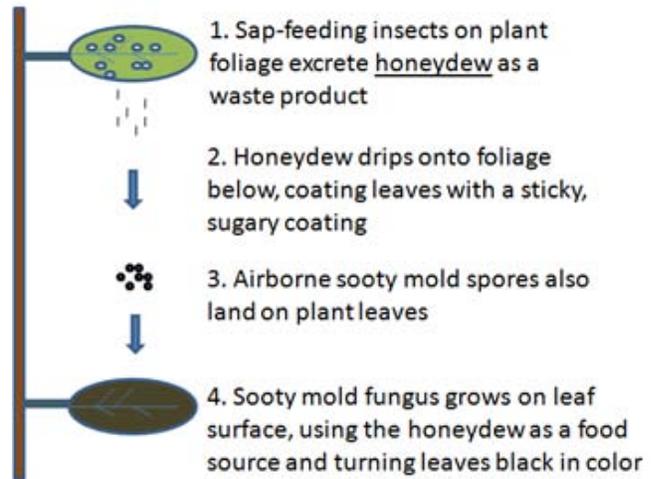
Many people are allergic to sooty molds, particularly to fungal species in the genera *Cladosporium* and *Aureobasidium*.

Disease cycle

Dissemination. Air currents or rainwash or rainsplash bear and spread the causal fungi.

Inoculation. Spores land on a leaf surface (or other plant surface) upon which a sheen of honeydew has been deposited by phloem-feeding insects.

Symptom and disease development. Using the sugary honeydew as a food source, the sooty mold fungi begin to grow on the plant sugars deposited by parasitic insects upon foliage, turning the surface various shades of black. No infection occurs, these fungi are non-parasitic and non-pathogenic to plants.



The sooty mold cycle. In this series of events, ants often tend and protect the phloem-feeding insects, feed upon the excreted honeydew, and protect the parasitic insects from their natural enemies. Diagram: S. Nelson

Fungal reproduction. The fungus produces more fungal spores on the foliage.

Fungal survival. The fungi survive saprophytically as mycelium or spores on plant debris or on inanimate objects such as vehicles.

Integrated pest management of sooty mold

The best way to control most sooty mold fungi is to prevent their establishment by eliminating their sugary food supply. Thus, control phloem-feeding insects on the foliage. Controlling the phloem-feeding insects may require control of the ants that tend and protect them.

Once sooty mold occurs, an insect control program should be started. Choice of insecticide depends on the site of application and the target pest(s). Read the insecticide label carefully to ensure that the intended plant (the "site") and targeted insect(s) are specified on it, and follow all label directions.

If high-value plants are affected, sooty mold can be carefully washed from plants using soapy water or dilute household bleach solution (1 part bleach to 99 parts water).

Because sooty molds are fungi, general-purpose fungicides applied to control other diseases may have some effect in killing them and minimizing their spread, although fungicide applications will not remove the black

color from the leaves. Read the fungicide label carefully to see if the intended use is allowed, particularly when the application is in or near a food crop. Tips for sooty mold management include the following:

- Dip or wash produce after harvest using dilute solutions of sodium hypochlorite (household bleach).
- Control phloem-feeding insects with insecticides (note, however, that use of insecticides often kills pests' natural enemies, as well as the pests).
- Control phloem-feeding insects with natural enemies.
- Control ants with physical barriers or insecticide baits.
- Control sooty mold fungi with fungicides.
- Moderate use of fertilizers, because over-fertilization can attract certain phloem-feeding insects.

Reference

Stover, R.H. 1975. Sooty moulds of bananas. Transactions of the British Mycological Society 65: 328–330.

Acknowledgment

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Sooty mold on palm leaves. The whitish insects in the photographs below (center and right) are coconut mealybugs (*Nipaecoccus nipae*) feeding on the foliage.

All photos by S. Nelson





Scale insects feeding on a noni (*Morinda citrifolia*) plant led to the development of sooty mold on leaves and fruits.



Sooty mold appears on harvested fruits of the banana cultivar 'Santa Catarina Prata' ('Dwarf Brazilian' apple banana). The mold presents a marketing problem for the grower, who must attempt to remove or prevent the blemishes before marketing the affected fruits.



Long-legged ants tend a colony of citrus aphids on a noni branch.



Sooty mold on a banana leaf associated with coconut mealybug (*Nipaecoccus nipae*) feeding on foliage in the canopy above this leaf. The cleared "tracks" on the leaf surface indicate where a slug or snail was moving on the leaf surface and presumably consumed the spores of the sooty mold fungi.



Sooty mold on noni associated with feeding by green scale insects (*Coccus viridis*), visible in these photos feeding next to the leaf veins.



Coconut mealybugs on a banana leaf



A colony of green scale insects (*Coccus viridis*) on a coffee (*Coffea arabica*) vertical



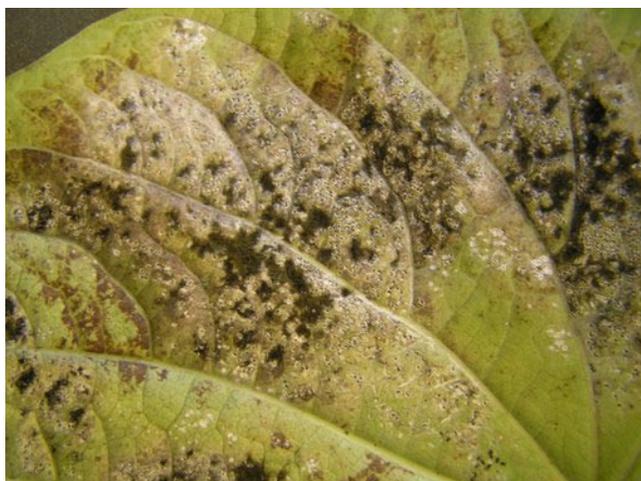
Sooty mold on a coffee leaf



Sooty mold on coffee foliage (left) and cherries (above) associated with feeding by green scales (*Coccus viridis*)



A native Hawaiian gardenia plant (left and above) heavily infested with sooty mold and phloem-feeding scale insects. When dry, the mold can sometimes peel away from the leaf surface.



Black sooty mold associated with white fringe guava whitefly pupae on a kava ('awa, *Piper methysticum*) leaf