

INFORMATION ON SOOTY MOLD



During the past few years several residents of Broward County have complained that a dark, sooty material has been settling on vegetative and man-made surfaces near their homes. The residents have been concerned that the material is from anthropogenic (man-made) sources. At least ten such samples have been collected and analyzed by Environmental Protection Department (EPD) personnel. The samples have been analyzed using a stereoscope, a polarized light microscope (PLM), and gas chromatography with flame ionization detection (GC/FID). All of the samples thus far have been determined to be sooty mold. This information sheet was designed to aid DPEP inspectors and the residents of Broward County in identification of the material and in return ease fears that this black material is due to pollution.

The figures below illustrate the appearance of sooty mold on leaves and man-made structures. Please note that in Figure 4 the leaf surface is shown as a magnified image.



Figure 1. Sooty mold from aphids (Texas & M University 1).

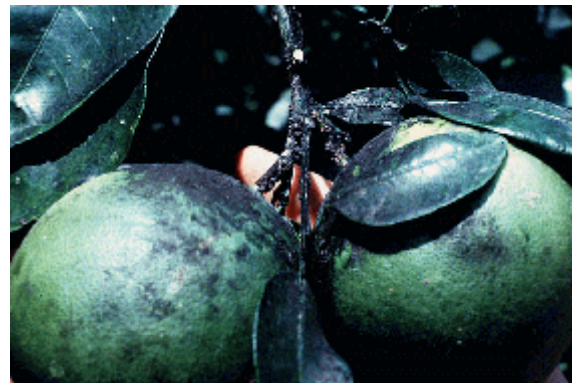


Figure 2. Sooty mold on citrus tree and fruit (Texas A & M University 2).



Figure 3. Sooty mold growth on home rain gutter located below a silver maple tree (Kessler).

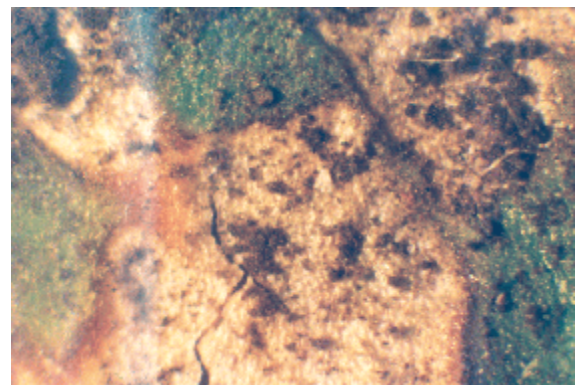


Figure 4. Magnified image of portion of citrus leaf with sooty mold and decay (Broward County EPD).

ANALYSES PERFORMED AT EDP

Under the stereomicroscope, leaves with sooty mold have been observed to have dry patches, insects, and other biological debris (see Figure 4). Under the PLM, sooty mold has the typical appearance of a mold, with masses of cottony growth, known as mycelium. The mycelium is made up of individual hyphae (fibers). Specialized hyphae branches, conidiophore, produce successive conidia. The conidia are asexual spores which are transparent to translucent, light yellow to dark brown, usually oval structures (McCrone and Delly). They are often linked in straight to twisted chains of several to possibly hundreds conidia. They can be mechanically separated by pressing and sliding the cover slip over the sample, as seen in Figure 7 .

It is important to note that under PLM, emissions from most anthropogenic sources would commonly be opaque, not transparent / translucent. Anthropogenic emissions would generally not be linked in the intricate patterns observed as are the sooty mold samples. Emissions from high temperature combustion sources can undergo coagulation, but this occurs very near the emission source and these large agglomerates deposit near the source due to their size. Additionally, the black substance observed on these samples have a cellular structure. Only biological materials have such structures. Below are several PLM images taken at EPD of sooty mold, as well as, an image from a U.S. Forestry Service (U.S.F.S.) website on recognizing sooty mold.

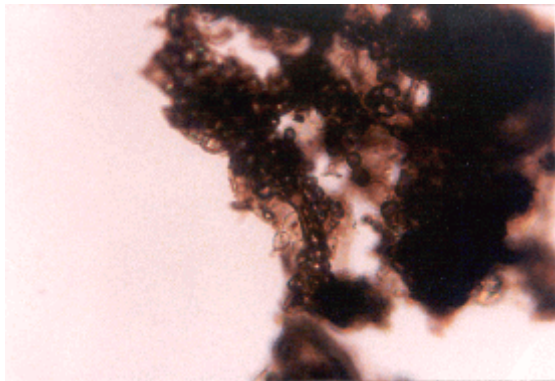


Figure 5. Chains of conidia and hyphae from a gardenia leaf. (Broward County EPD)

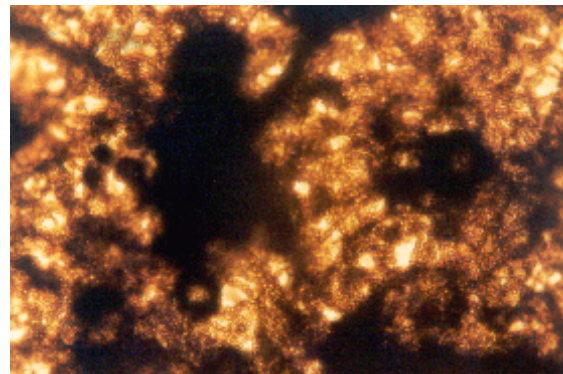


Figure 6. An intricate clump of hyphae and spore cells from a citrus leaf. (Broward County EPD)

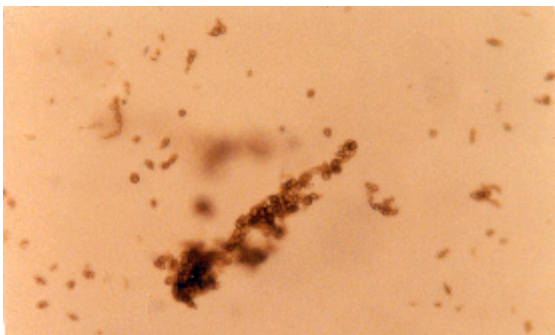


Figure 7. Mechanically separated spores and hyphae from a gardenia leaf. (Broward County EPD)

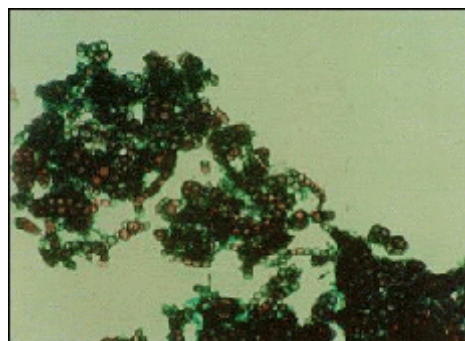
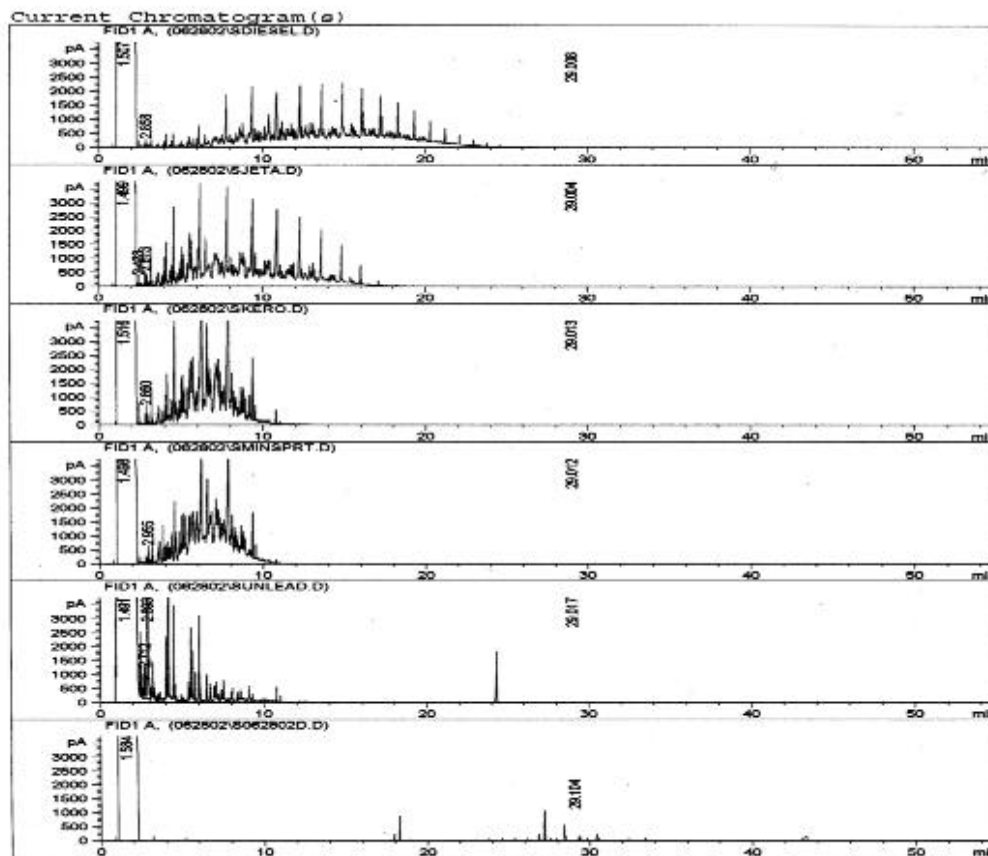


Figure 8. An image of sooty mold from a U.S.F.S. website. (Kessler)

To reassure the public that the black material observed on the leaves was not due to anthropogenic sources, a large number of leaves covered with sooty mold were collected and the black material was scraped off. An extraction was performed on the material in order to concentrate the organic compounds present in the sample. The sample was then analyzed by GC/FID. In chromatography, standards are run against unknowns under the same conditions to allow for the identification and quantification of the materials present in the unknown.



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Figure 9. Results from GC/FID analysis of petroleum-based fuel standards and sooty mold sample.

The results of the analysis are shown in Figure 9. The upper 5 spectra are (in descending order) standards for diesel fuel, jet fuel, kerosene, mineral spirits, and unleaded gasoline. Note the complexity of the spectra for each of the fuels, indicating that there are significant amounts of different hydrocarbons present in these fuels. The bottom spectrum corresponds to the sooty mold sample. This spectrum only contains a few peaks. The complex “fingerprints” observed for the fuel standards are not seen. Therefore, the organic components in each of these petroleum-based fuels are not present on leaves with sooty mold. There are several peaks observed on the spectra of the sooty mold sample, but they likely correspond to vegetable organic matter not

petroleum based fuels.

To help further classify the substance, a sample was taken to Mr. Jalil Vedaee an Extension Agent II/Horticulture at the University of Florida's Broward County Cooperative Extension Service Institute of Food and Agricultural Sciences. His independent analysis verified that the material on the leaves was sooty mold.

WHAT EXACTLY IS SOOTY MOLD?

From Kessler source. Sooty molds are dark fungi that grow on honeydew excreted by sucking insects (i.e., whiteflies, aphids, mealy bugs, and scale insects) or on exudates from leaves of certain plants. These insects have piercing-sucking mouthparts that enable them to puncture the leaf and suck the plant juices. Top sides of leaves on infested plants become pale or spotted from the insects feeding on the undersides. Sooty mold is not a parasitic organism and does not penetrate the plant tissue, rather it grows superficially on the honeydew excretions. Sooty mold causes a certain degree of injury, when its growth is very thick, by preventing sunlight from reaching the leaf and by making fruit black and unattractive. Fruit covered with sooty mold is smaller and does not color well. Many sooty mold fungi have mucilaginous cell walls that help them adhere to the surfaces on which they grow and serves to prolong periods of wetness by absorbing moisture for their growth. There are two types of sooty mold. 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 human-made structures. On outdoor structures and furniture, sooty mold growths are unsightly and may be difficult to remove. Many people are allergic to sooty molds, particularly the *Cladosporium* and *Aureobasidium* components common in sooty molds of the Eastern U.S.

In South Florida, sooty mold appears to be more prevalent on citrus trees, gardenias, and palm trees.

THE SIGNS OF SOOTY MOLD

From Williams source. Look for insects on the plants in question. Unless you're looking close, it can be difficult to see these insects on a plant. You can't depend on seeing portions of leaves eaten away because insects such as aphids and whiteflies don't have the ability to chew. Their size also make them difficult to see. The largest species are not more than a quarter inch in length. There are more visible signs that indicate these pests are present. If you see any of these signs, inspect the underside of leaves for aphids or whiteflies.

1. Look for new leaves that are malformed or distorted. Aphids and whiteflies prefer to feed on new, tender leaves; it is easier for them to insert their mouths into the new growth.
2. Look for the sticky honeydew.
3. Shake the plant. Whiteflies will quickly fly away from and back onto a plant.
4. Look for ants running along the trunk and stems of the plant. Ants feed on honeydew.

REMOVAL OF SOOTY MOLD

FROM PLANTS OR TREES

From Williams source. The way to control sooty mold is to stop it before it gets started and the way to do that is to control the insect populations. Aphids and whiteflies can be controlled on smaller plants in a number of ways. If the infestation is small, you can simply spray them off the plants with a heavy stream of water from a garden hose. With larger populations, you may need to use an insecticide. Insecticidal soap, malathion, diazinon and orthene can be used, but spray to get good coverage underneath the foliage and always follow label directions. These insects can also be held in check in nature by adverse weather conditions including

low temperatures and heavy rains.

FROM HUMAN-MADE OBJECTS

From Kessler source. Sooty molds can be indirectly controlled by reducing populations of sucking insects that excrete honeydew. Outdoor furniture can be hosed down with water during periods of honeydew excretion, particularly during drought. Here is the recipe for a good cleaning solution for removing sooty molds from plastic or painted surfaces. Be sure to wear rubber gloves when cleaning with this solution (Kessler).

Powdered household detergent	1/3 cup
Household liquid bleach	1 quart
Trisodium phosphate	2/3 cup
Water	3 quarts

FOLLOW-UP

While sooty mold is unsightly, it is naturally occurring. It is not pollution. It can be difficult to identify sooty mold, especially on human-made objects. If the material is only present on some areas of your property (especially on certain plants, such as gardenias and citrus trees), it is likely to be sooty mold. Anthropogenic pollution emissions would be distributed over the entire area, not concentrated only on some surfaces.

If there is any question or concern that the material is not sooty mold, but rather derived from pollution sources, please call the Environmental Protection Department at (954) 519-1499. An inspector will go check out the situation and bring a sample to the lab for analysis if need be.

Sooty mold cases can also be referred to Sandy Granson (or another scientist) at the University of Florida's Broward County Cooperative Extension Service Institute of Food and Agricultural Sciences at (954) 370-3725.

REFERENCES

Williams, L. (2002) **Sooty Mold : Control sooty mold on plants by stopping it before it starts**, Department of Horticulture, Okaloosa County Cooperative Extension Service, University of Florida (<http://okaloosa.ifas.ufl.edu/sootymold.html>)

McCrone, W. C. and J. G. Delly (1973) **The Particle Atlas: An encyclopedia of techniques for small particle identification, Edition Two**, Ann Arbor Science Publishers, Inc., Ann Arbor, MI.

Kessler, Jr Kenneth J. (1992) **How to Recognize Sooty Mold**, U.S. Department of Agriculture, Forest Service, U.S.A. (http://www.na.fs.fed.us/spfo/pubs/howtos/ht_sooty/ht_sooty.htm)

Texas A&M University, Agricultural Extension Services (2002) **Integrated Pest Management (IPM) Page**. (<http://hortipm.tamu.edu/>)

Texas A&M University, Horticultural Sciences Department (2002) **Texas Citrus and Subtropical Fruits - Pest Management**, (<http://aggie-horticulture.tamu.edu/citrus/sootymold.htm>)

OTHER INFORMATIONAL WEBSITES RELATED TO SOOTY MOLD

Broward County Extension Education Division, Family & Consumer Science's **What's Bugging Me? - A Guide for Environmental Landscape Pest Control by Homeowners**. (<http://www.co.broward.fl.us/agriculture/english/consfam/in043.htm>).

University of Florida Department of Entomology and Nematology, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences's **Ornamental Insects Sheet**. (http://edis.ifas.ufl.edu/BODY_IN024)

U.S. Department of Agriculture's **Whitefly Knowledgebase**. (<http://whiteflies.ifas.ufl.edu>)

Virginia Cooperative Extension Service's **Sooty Mold of Conifers and Hardwoods**. (<http://www.ext.vt.edu/pubs/plantdiseases/450-618/450-618.html>)

Cornell University's **Sooty Mold Fact Sheet**. (<http://plantclinic.cornell.edu/FactSheets/sooty/sootymold.htm>)

Ohio State University Extension's **Sooty Molds on Trees and Shrubs Fact Sheet**. (<http://ohioline.osu.edu/hyg-fact/3000/3046.html>)

Later's **Gardening Problems Page**. (<http://www.laters.com/default.htm>)

Florida's Department of Agriculture and Consumer Services's **Giant Whitefly, Aleurodicus dugesii Cockerell, in Florida Page**. (<http://doacs.state.fl.us/~pi/enpp/ento/giant.htm>)

University of Florida, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences's **Some Common Diseases of Tahiti Lime in Florida Page**. (http://edis.ifas.ufl.edu/BODY_VH049)