Cooperative Extension Service
College of Tropical Agriculture and Human Resources
University of Hawai'i at Mānoa

Plant Disease
June 2008
PD-41

Cercospora Leaf Spot and Berry Blotch of Coffee

Scot C. Nelson
Department of Plant and Environmental Protection Sciences

Cercospora leaf spot (a.k.a. brown eyespot) and berry blotch are two phases of a common disease caused by the plant-pathogenic fungus *Cercospora coffeicola*. The disease can be economically important in Hawai'i at some locations or in some seasons due to the costs associated with managing it and to its damaging effects on plant growth, coffee cherry yield, and bean quality. In Spanish the diseases are called mancha ocular del cafeto and mancha de hierro.

Host plant

Coffea arabica L. (Arabica coffee) is among about 40 *Coffea* species in the family Rubiaceae that can be affected by this disease. *C. arabica* is a shrub or small tree grown for its beverage-yielding seeds. Its shiny, oval, pointed leaves are 3–6 inches long. Its flowers are white, fragrant, and massed in thick clusters at leaf axils along the wide-spreading branches. The genus originates from the Old World tropics, especially Africa. *C. arabica* is a native of tropical Africa and is now cultivated throughout the tropics; it grows wild on a number of islands in the Pacific.

Pathogen

The fungus *Cercospora coffeicola* Berk. & Cooke is distributed throughout the tropics and subtropics, including Hawai'i. There is morphological variation among *Cercospora* isolates from coffee in Hawai'i. The fungus' fruiting is amphigenous, occurring mostly on the upper leaf surface. Its stromata are slight to 50 µm in diameter, globular, and dark brown. Its conidiophores are in fascicles, 3–30 stalks, pale to medium brown, sometimes branched, septate, mildly to abruptly geniculate, 20–275 x 4–6 µm. The conidial scars are distinct and thickened. The conidia are hyaline, acicular to obclavate, nearly straight, with an acute apex and truncate or subtruncate base with a conspicuous, thickened hilum, indistinct multiseptate, 40–150 x 2–4 (–7) µm.

Pathogen dispersal is by spores (conidia) that are windborne (mostly during the daytime) and may also be spread by splashing rain and human contact such as movement of workers and by machinery within coffee fields and nurseries. The highest risk for infection occurs when the temperature range is 20–28°C (68–82.4°F) and there are from 36 to 72 hours of continuous environmental wetness. Factors that predispose the plant to infection include

- poor plant nutrition (low leaf nitrogen and potassium)
- general plant stress (drought, sun exposure, poor fertilizer management, or excessive weed competition)
- insufficient shade
- glyphosate (herbicide) injury
- poor soil or growth medium
- root diseases (e.g., coffee nematode decline, caused by rootknot nematodes; Rhizoctonia root rot).

Published by the College of Tropical Agriculture and Human Resources (CTAHR) and issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Andrew G. Hashimoto, Director/Dean, Cooperative Extension Service/CTAHR, University of Hawai'i at Mānoa, Honolulu, Hawai'i 96822. An equal opportunity/affirmative action institution providing programs and services to the people of Hawai'i without regard to race, sex, age, religion, color, national origin, ancestry, disability, marital status, arrest and court record, sexual orientation, or status as a covered veteran. CTAHR publications can be found on the Web site <http://www.ctahr.hawaii.edu/freepubs>.

Disease symptoms and signs

Leaves

The classic leaf symptom is circular spots with tan, gray, or white centers; lesions may be irregular in shape and cause leaf blight. Lesions begin as small, chlorotic spots that expand to become deep brown on the upper leaf surface. The centers of the spots turn grayish-white and are encircled by a distinct ring (0.2–0.6 inches in diameter) of brown tissue. The margins of the lesions are dark brown to reddish brown or purplish to black in color. Lesions are sometimes surrounded or ringed by a bright yellowish "halo," which is more visibly apparent on the upper leaf surface. Dark-colored and silvery-colored sporulation of the pathogen may be visible to the naked eye within the grayish-white centers of lesions. Affected leaves may defoliate prematurely.

Typical "brown eyespots," a diagnostic symptom.

Green berries

Lesions on berries are initially brown in color, sunken, longitudinal or irregular or oval in shape, with ashy centers, rarely 0.2 inches and sometimes encircled by a purplish halo (the halo is tissue which ripens prematurely due to the infection). Infections can occur at any stage of berry development.

Premature ripening of diseased cherries, a symptom and a damaging effect of Cercospora berry blotch disease. Prematurely ripened fruits usually are not picked on time and therefore constitute crop loss.

Red cherries

Large, sunken, blackened areas develop, which may be covered with a silvery sheen of fungal spores. Infections that penetrate to the seed may cause the pulp to adhere to the parchment during processing, causing damage to the product. Diseased cherries may be subject to attack and further degradation by opportunistic bacteria or fungi such as *Colletotrichum gloeosporioides* (a ubiquitous fungus that causes anthracnose of many crops). The conspicuous presence of *C. gloeosporiodes* as an opportunist and secondary invader of cherries damaged first by *C. coffeicola* can confuse the disease diagnosis. As a result, in Hawai'i some coffee farmers erroneously refer to the disease caused *C. coffeicola* as "anthracnose."

Cercospora berry blotch on mature coffee berries.

Crop damage

Damage to leaves causes defoliation, reduced photosynthetic leaf area, and loss of plant vigor. Damage to cherries and seeds (beans), when the disease is severe, leads to general crop loss (yield reduction, berry shriveling, premature berry drop, premature ripening, and reduced coffee grade). Coffee beans may be stained or

Off-grade, discolored coffee as a result of berry blotch disease

The typical "purple halo" symptom results from premature ripening of diseased tissues. Berry infections typically begin at the blossom end of fruits (where there is a small, circular receptacle which holds water after dew or rainfall), and progresses basipetally along the longitudinal axis of the fruit, toward the peduncle.

off-grade and parts of the cherry pulp may adhere to the parchment, resulting in difficulty in coffee milling, discolored parchment and beans, and a sour taste of the processed beans.

Integrated pest management practices (IPM) for Cercospora leaf spot and berry blotch

- Maintain adequate plant nutrition (coffee plants suffering from elemental deficiencies such as nitrogen and potassium are more susceptible to this disease). In fact, the disease may be effectively prevented or controlled in most locations with a proper fertility regime.
- Perform periodic coffee plant tissue analysis and soil testing to determine the appropriate fertilizer regime; this can be based upon UH-CTAHR Agricultural Diagnostic Service Center (ADSC) recommendations.
- Practice sanitation and crop debris management: after pruning coffee plants, remove crop debris from the field, do not pile it up against the plants in the field or leave it between rows (leaf and berry debris can harbor the pathogen and initiate further cycles of Cercospora leaf and berry disease).
- Choose the planting location to avoid very high elevations and rainy locations where disease may tend to occur; orient rows so they are perpendicular to prevailing winds, so plant canopies and leaves become dry more quickly after rainfall.
- Select a reasonable planting density (number of plants per acre).
- Don't intercrop coffee with other *Coffea* species.

The pruned plant exhibiting nutrient deficiency symptoms (foreground) has Cercospora leaf spots, whereas the normal plant (background) is free of Cercospora leaf spots, illustrating that adequate coffee plant nutrition is a key to preventing this disease (note: the yellowing of the plant in the foreground could be caused by a number of factors).


New re-growth after pruning (left) is susceptible to infection. At high, cloudy, wet altitudes (>2000 ft) in Hawai'i, leaf spots may become leaf blights, causing more damage (right).

- Strive to minimize plant stresses such as drought, under-nutrition, planting on impermeable rock outcroppings, root-knot nematodes, and root rot; these predispose coffee plants to infection.
- Provide or ensure adequate soil drainage (this minimizes root rot).
- Grow coffee under shade (35–65%), or in an agroforestry setting.
- Avoid over-irrigation (this will minimize plant stresses such as root rot and will reduce relative humidity within the plant canopy).
- Avoid working with coffee plants and moving through fields and nurseries when diseased plants are wet (this minimizes potential dispersal of fungal conidia within and among moist plants).
- Prune coffee trees to increase air circulation in the canopy.
- Harvest cherries on time, before disease progresses too far.
- Avoid injuring coffee plants with herbicides, especially glyphosate (plants injured by this herbicide may be more susceptible to infection due to nutritional deficiencies).
- Control weeds (this minimizes plant stress and relative humidity in the plant canopy).
- Apply fungicide sprays to foliage where environmental conditions are particularly conducive to infection and disease development (please refer to Fungicide Recommendations below).
- Avoid planting coffee transplants too deep in soils.
- Protect new coffee foliage re-growth with fungicide sprays after pruning (immature leaves are more susceptible to infection than mature leaves).

Fungicide options

In Hawai'i, copper fungicides such as Kocide products (see table) are normally used against this pathogen. It is important to protect the fruits from the leaf phase of the disease. For Kocide 101 products, use from 1.5–6 pounds of product per acre in 50–100 gallons of water. Add a

Table 1. Some fungicides registered for coffee in Hawai‘i (2008) for control of Cercospora leaf spot and berry blotch
(source: Hawaii Pesticide Information Retrieval System; always consult the product's label before using the product).

Product name	Active ingredient	Formulation*
Champ Formula 2 Flowable Agricultural Fungicide/Bactericide	Copper hydroxide (37.5%)	FC
Champion Wettable Powder Agricultural Fungicide	Copper hydroxide (77%)	WP
Champion WG Agricultural Fungicide	Copper hydroxide (77%)	WP
DuPont Kocide 101 Fungicide/Bactericide	Copper hydroxide (77%)	WP
DuPont Kocide 2000 Fungicide/Bactericide	Copper hydroxide (53.8%)	WDG
DuPont Kocide 4.5 LF Fungicide/Bactericide	Copper hydroxide (53.8%)	WDG
DuPont Kocide DF Fungicide/Bactericide	Copper hydroxide (61.4%)	WDG
Griffin Kocide 2000 Fungicide/Bactericide, Griffin Kocide 2000 T/N/O Fungicide/Bactericide	Copper hydroxide (53.8%)	WDG
Griffin Kocide DF Dry Flowable Fungicide/Bactericide	Copper hydroxide (61.4%)	WDG
Griffin Kocide 101 Fungicide Wettable Powder	Copper hydroxide (77%)	WP
Griffin Kocide LF Fungicide/Bactericide	Copper hydroxide (23%)	EC
Griffin Kocide 4.5 LF Fungicide/Bactericide	Copper hydroxide (37.5%)	FC
Nu-Cop 50WP	Copper hydroxide (77%)	WP
Nu-Cop 50 HB	Copper hydroxide (77%)	EC
Nu-Cop 50 DF	Copper hydroxide (77%)	WDG
Monterey Liqui-Cop Copper Fungicidal Garden Spray	Tetraaminecopper (31.4%)	EC

*EC = emulsifiable concentrate; WP = wettable powder; WDG = water dispersible granules; FC = flowable concentrate

spray adjuvant or "spreader/sticker" product such as the organosilicate Tactic™ (1% v/v) to enhance coverage and product adhesion to foliage. Sprays should coincide with dry weather and calm winds. Three spray applications per season should suffice (occurring approximately once per month), beginning at flowering. Thorough coverage of the plant canopy is very important. Large farms in Hawai‘i utilize tractor-mounted mist blowers. Always refer to the fungicide label(s) for instructions and personal protective equipment and proper site of application (for example, copper fungicides should be applied to leaves, and not to roots). Be aware that use of copper fungicides may eliminate fungi that perform biological control of the green scale (*Coccus viridis*) insect pest of coffee.

General disease notes

Symptoms of Cercospora berry blotch disease may be confused with a condition of coffee referred to as "overbearing dieback."

The yellow halo around lesions is caused by a toxin produced by *Cercospora* species, known as cercosporin.

Premature ripening of infected berries and cherries occurs due to ethylene gas emission during the disease process. Ethylene is a plant-ripening, or senescence, hormone that is also produced by some plant-pathogenic fungi during infection and disease development.

Some farmers in Hawai‘i confuse Cercospora berry blotch with "anthracnose," when in fact the opportunistic and ubiquitous anthracnose fungus (*C. gloeosporioides*) tends not to be the primary agent, but rather a secondary invader of tissues already damaged by *C. coffeicola*.

References

American Phytopathological Society list of coffee diseases (J.M. Waller, primary collator, last update 10/29/98). http://www.apsnet.org/online/common/names/coffee.asp.

Bittenbender, H.C., and V.E. Smith. 2000. Growing coffee in Hawaii. CTAHR, Univ. of Hawai‘i. http://www.ctahr.hawaii.edu/ctahr2001/PIO/ForSalePubsDetail.asp?id=1.

Mulder, J.L., and P. Holliday. 1974. *Cercospora coffeicola*. IMI descriptions of fungi and bacteria, (no. 42) sheet 415. CAB International, Kew, Surrey, UK.

CABI. Crop protection compendium. http://www.cabicompendium.org/NamesLists/CPC/Full/CERCCO.htm.

Daub, M.E., and M. Ehrenshaft. 2000. The photoactivated Cercospora toxin: Contributions to plant disease and fundamental biology. Annual Review of Phytopathology 38:461–490.

FAO. Arabica coffee manual. http://www.fao.org/docrep/008/ae939e/ae939e0b.htm.

Liberato, J.R., and R.G. Shivas. 2007. Brown eye spot of coffee (*Cercospora coffeicola*) pest and diseases image library. http://www.padil.gov.au/viewPestDiagnosticImages.aspx?id=391.

Nelson, S.C. 2005. Coffee pest and disease image gallery. http://www.ctahr.hawaii.edu/nelsons/coffee/coffee.html.

Smith, V.E., and S.C. Nelson. 2004. Hawaii Coffee Quarterly, issue no. 1. http://archive.constantcontact.com/fs082/1101940814295/archive/1101945218479.html.

Staver, C., F. Guharay, D. Monterroso, and R.G. Muschler. 2001. Designing pest-suppressive multistrata perennial crop systems: Shade-grown coffee in Central America. Agroforestry Systems 53:151–170.

UH-CTAHR. The Farmer's Bookshelf. http://www.ctahr.hawaii.edu/fb.

Acknowledgment

Review of this publication by Fred Brooks and Virginia Easton Smith is much appreciated.