



COOPERATIVE EXTENSION

UNIVERSITY OF HAWAII AT MĀNOA
COLLEGE OF TROPICAL AGRICULTURE AND HUMAN RESOURCES

Managing Pesticide Resistance

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<https://www.hawaiicoffeeed.com/clr.html>

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New publication

- Some symptoms of CLR
- Why spray to suppress CLR

www.HawaiiCoffeeEd.com/clr

Spraying to Suppress Coffee Leaf Rust (*Hemileia vastatrix*)

(Published Nov. 4, 2020)

Coffee Leaf Rust (CLR), *Hemileia vastatrix*, has been identified in Hawaii. This disease of coffee will cause defoliation, reduced berry size, branch, and tree death. Infections typically start on the lower portion of the tree before reaching the higher leaves. The first symptoms are small, pale yellow spots on the upper surface of leaves (Fig. 1A). On the undersides of leaves, infectious spores appear resembling a patch of yellow- to dark orange-colored powder (Fig. 1B, Fig. 2). These young lesions steadily increase in size with the center of the lesion turning necrotic and brown [1]. Stem and berry infection are rare, but CLR can also affect young seedlings.

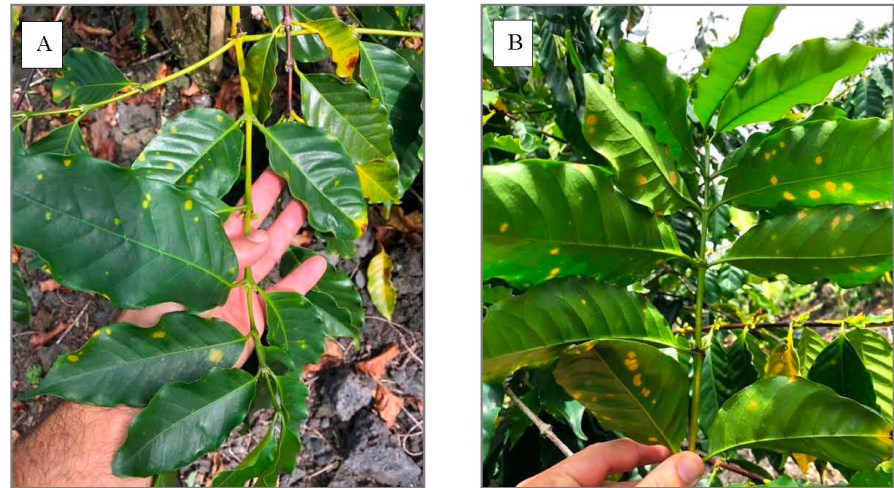


Figure 1: Coffee leaf rust on the upper leaf surface (A) and lower leaf surface (B) of coffee.

Why spray to suppress coffee leaf rust?

Over a three to five-month period, one CLR lesion can produce upwards of 400,000 spores that become airborne and easily spread throughout a farm and between farms. If left untreated, berry production and foliage losses caused by CLR on non-resistant coffee varieties can be significant, ranging between 30% and 80% [4,5]. Yield is completely lost when the tree is killed.

Plant susceptibility to CLR attack increases with berry yield and host density [4]. Field sanitation, proper pruning, fertility, CLR monitoring, and early detection are key for reducing this pathogen

Brackets e.g. [2], correspond to literature citations found in the Literature Cited section. This publication is expected to evolve as more is learned about coffee leaf rust in Hawaii.

- Contact fungicide;
<5% infection rate
- ONLY use approved pesticides
- Follow the label
- Rotate to prevent pesticide resistance
- Use proper PPE
- Low pressure sprayer for initial spray
- Calibrate your sprayer to determine rate per gallon

threat to tree health and production. When applied properly, and at <5% infection rate of total farm foliage, contact fungicides can be helpful in protecting coffee trees from initial and increased disease severity [10]. While contact fungicides are available for Hawaii coffee producers, currently, there are no approved systemic fungicides for use in Hawaii. Physical removal, containment, and destruction of leaves and branches displaying lesions can help to reduce CLR inoculum and infection [2].



Figure 2: Close-up of powder-like coffee leaf rust spores on the underside of a coffee leaf.

This document provides suggestions for producers on the use of fungicides for the suppression of CLR on farms and the use of fungicides to reduce establishment severity of the pathogen. Special attention is needed for pesticide resistance management to fungicides with product rotation and proper use. Additional CLR information can be found at www.HawaiiCoffeeEd.com/clr.

Table 1 provides a list of fungicides approved by the Hawaii Department of Agriculture for use on coffee in Hawaii and lists CLR on the label. Although there are other fungicides approved for use in Hawaii, unless coffee is listed on the label, you should not use these products on your coffee crop. Failure to adhere to pesticide regulations could result in legal action and fines by regulatory authorities.

Suggestions for preventative and suppression spray applications

THE LABEL IS THE LAW. READ AND FOLLOW PRODUCT LABELS FOR ALL PESTICIDES.

PRODUCT ROTATION IS HIGHLY RECOMMENDED TO REDUCE THE RISK OF PESTICIDE RESISTANCE BY COFFEE LEAF RUST AND OTHER DISEASES.

Personal protective equipment (PPE):

- ◊ Follow the label for proper use of PPEs.
 - Disposable PPEs may be a consideration for use.

Type of sprayer:

- ◊ According to experts at CIRAD, a French agricultural research center, motorized sprayers should not be used for initial CLR treatments to contain spores [3].
 - Spores may become airborne and spread if using a high pressure sprayer.
 - Reduce sprayer pressure or change the nozzle to create larger droplets as needed.
- ◊ Water quantity per acre will depend on individual spray calibration for your trees and farm.
 - Calibrate your sprayer by following examples and directions in publications for sprayer calibration [7,8,9].

- Good coverage
- Important to spray underside of leaves
- Field sanitation with pruning, weed control
- Rotate to prevent pesticide resistance
- Avoid phytotoxicity and wash-off
- Other additions
 - Compatibility
 - Spreader/sticker

Where and what to spray:

- ◊ Spray the entire coffee tree with emphasis on the undersides and topsides of the leaves.
 - A CLR spore produces germ tubes (germinates) that enter the plant via the stomata, which are found on the undersides of leaves [5].
- ◊ Spray all producing, non-producing, and seedling coffee plants.
 - Good spray coverage is important.
 - A slowed walking pace and deliberate spray application may be necessary to achieve complete coverage of the tree foliage and leaf surfaces.
- ◊ Consult the label about intentional ground spraying.

Trade Name	Active Ingredients	FRAC Group	PA Reg. No.	Labels	Notes	Compatibility with BotaniGard® ¹	<i>H. vastatrix</i> Rate (per acre)	Est. Cost ³ per Application/Acre	
								Low Rate	High Rate
Serenade ASO	QST 713 strain of <i>Bacillus subtilis</i>	44	64-1152	Label	OMRI	Yes, but NOT at 8 qts per 100 gal (see chart)	2.0-4.0 qts	\$23.50	\$47.00
Champ WG Agricultural Fungicide	Copper Hydroxide	M1	5146-1	Label		Unsure	2.0-4.0 lbs	\$17.00	\$34.00
Champ Formula 2 Flowable Agricultural Fungicide / Bactericide	Copper Hydroxide	M1	5146-64	Label		Yes ²	1.33-2.66 pints	\$7.48	\$9.84
Kocide 3000	Copper Hydroxide	M1	1411-2-70051	Label		Yes (see chart)	0.75-1.75 lbs	\$9.00	\$21.00
Kocide 3000-O	Copper Hydroxide	M1	1411-11-70051	Label	Organic	Yes ²	0.75-1.75 lbs	\$9.00	\$21.00
Nu-Cop 30HB	Copper Hydroxide	M1	2750-281	Label		Yes ²	0.75-1.75 lbs	\$9.00	\$21.00
Nu-Cop HB	Copper Hydroxide	M1	2750-132	Label		Unsure	1.0-2.0 lbs	\$12.00	\$24.00
Badge X2	Copper Oxychloride Copper Hydroxide	M1	0289-12-10163	Label	OMRI	Unsure	1.0-3.0 lbs	\$12.00	\$36.00
Badge SC	Copper Oxychloride Copper Hydroxide	M1	0289-3-10163	Label		Unsure	1.0-3.0 pints	\$5.88	\$17.63
DoubleNickel LC Biofungicide	<i>Bacillus amyloliquefaciens</i> strain D747	BM 02	0051-107	Label	OMRI	Yes ²	0.5-6.0 qts	\$7.50	\$90.00
DoubleNickel 55 Biofungicide	<i>Bacillus amyloliquefaciens</i> strain D747	BM 02	0051-108	Label	OMRI	Yes ²	0.25-3.0 lbs	\$9.63	\$115.50

- Some pesticide products are not compatible with certain additives such as those noted below.
- If the mixture of products causes phytotoxicity on the coffee trees, stop applications immediately.
- ◊ Sticker/spreader
 - Stickers help the product to adhere to the surface and remain on the plant following application. Spreaders and adjuvants help with dispersal and coverage by reducing water surface tension and allowing the droplets to spread and cover more surface area on leaves, branches, berries, etc.
 - A spreader could improve spray coverage.

- Other additions
 - Foliar fertilizers
 - Beauveria products
- Controlling anthracnose and cercospora
- Other considerations
 - REI
 - Solution pH
 - Min and max rates per appl.
 - Max appl. per year or season
- Read and follow the label



- If anticipating rain, a sticker and spreader could improve spray adhesion and coverage.
- ◇ Foliar fertilizers
 - Consult with the fungicide and foliar fertilizer labels.
- ◇ Approved *Beauveria bassiana* products
 - Review the product label and the BioWorks BotaniGard® compatibility chart.
 - <https://www.bioworksinc.com/wp-content/uploads/products/shared/botani-gard-tank-mix-compatibility.pdf>
 - According to the above link, tests were not carried out to evaluate impact on the partner product integrity or for plant phytotoxicity.

Spraying to control [anthracnose](#) (*Colletotrichum* sp.) and cercospora leaf spot and berry blotch (*Cercospora coffeicola*) [5] on coffee as well as CLR:

- ◇ Spraying to control *Colletotrichum* sp., another fungal disease on coffee in Hawaii, may require higher rates than necessary for CLR. Consult the product label.
- ◇ Conduct annual or biennial [leaf tissue and soil sample](#) tests to determine and prevent plant and soil toxicities when applying copper-based and other products.

Other important considerations:

- ◇ Re-entry interval (REI) following a spray application.
 - Follow the required REI, being especially mindful of pickers and when they will enter the field for harvest.
 - Also, follow any restrictions regarding application before crop harvest. This is typically referred to on the label as the Pre-Harvest Interval or PHI.
- ◇ pH of spray solution.
 - Labels may have warnings for phytotoxicity with low (or high) pH of the spray solution.
- ◇ Minimum and maximum rates per application.
 - Follow the label rate. Underuse of a product can cause pesticide resistance by the pest or disease and additional losses if spray applications are ineffective.
 - Overuse of a product can cause plant, soil, and environmental toxicities and hazards, is a violation of product use, and has increased costs to the producer.
- ◇ Maximum applications per year or season.
 - Follow the label instructions.
 - Again, overuse of a product can cause plant, soil, and environmental toxicities and hazards, is a violation of product use, and has increased costs to the producer.

ALWAYS READ AND FOLLOW THE PESTICIDE PRODUCT LABEL DIRECTIONS.

If you have questions, contact your [local Cooperative Extension](#) or statewide coffee agent, Andrea Kawabata, at andreak@hawaii.edu. Texts and photos can be sent to (415) 604-1511.

- Acknowledgements
- Literature resources



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Table 1. List of fungicides currently licensed by the Hawaii Department of Agriculture with directions for use on coffee grown in Hawaii. Licensed products and label changes happen frequently. Refer to http://npirspublic.ceris.purdue.edu/state/state_menu.aspx?state=HI or <https://opendata.hawaii.gov/> for currently licensed products and their approval labels (11/4/20).

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¹ See the BioWorks BotaniGard® Compatibility Chart [here](#). “Unsure” means that the exact product was not listed as tested by BioWorks. Per email from BioWorks dated 11/2/20, these products still need to be tested for compatibility with *Beauveria bassiana*. Results will be forthcoming.

² Per email from BioWorks dated 11/2/20, these products have been determined compatible with BotaniGard®.

³ Estimated costs are based on local retail prices and are for the fungicide only.

Mention of a trademark or proprietary name does not constitute an endorsement, guarantee, or warranty by Ms. Shriner, the University of Hawaii Cooperative Extension Service, United States Department of Agriculture, Hawaii State Department of Agriculture, or its employees and does not imply recommendations to the exclusion of other suitable products.

Contact and Info:

- HDOA
 - [CLR field guide and submission form](#)
 - Submit photos and coffee leaf sampling form to HDOA.PPC@HAWAII.GOV with the Subject: Suspect Coffee Leaf Rust
 - Pest Control Branch Phone: 808-973-9525
- CTAHR
 - ADSC submission for disease until Dec. 18, 2020
 - www.hawaiicoffeeed.com/clr
 - Sanitation protocol
 - CLR publications (work in progress)
 - andreak@hawaii.edu
 - Text (415) 605-1511