Managing Coffee Leaf Rust Spread and Pesticide Resistance

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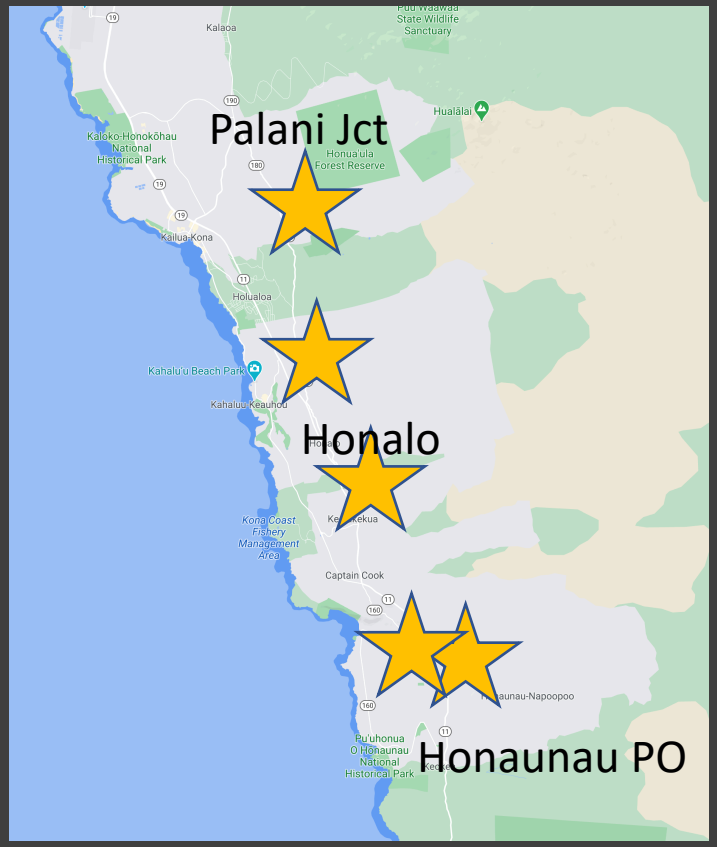
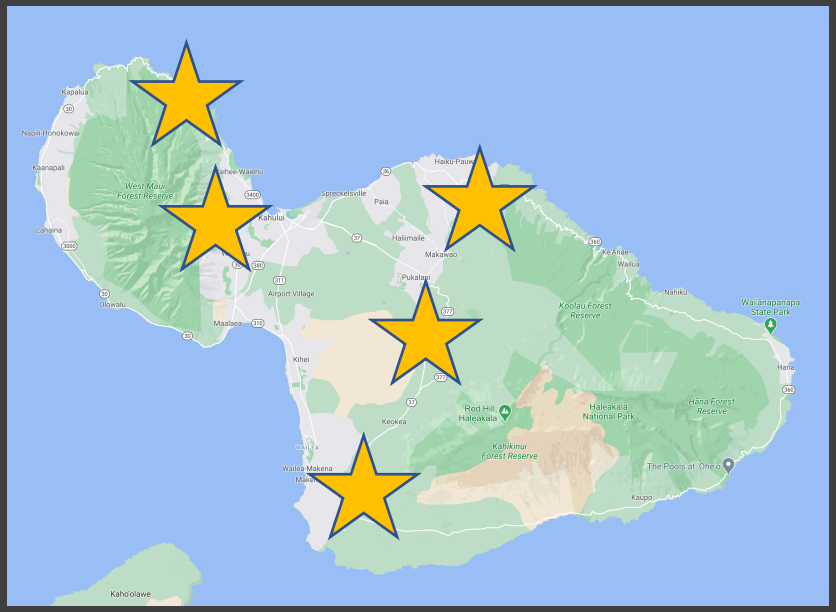
UH CTAHR

November 19, 2020





Reduce the spread of CLR

- Big Island – N. & S. Holualoa, Kainaliu, Honaunau
- Maui – Kahakuloa, Iao Valley, Haiku, Kula, Ulupalakua
- Take precautions

Sanitation protocols

hawaiicoffeeed.com

Welcome Coffee Growers!

HOME | COFFEE LEAF RUST | CBB MANAGEMENT | EVENTS AND ANNOUNCEMENTS | MORE... | LOG IN

- CLR Sanitation Protocol
- CLR HDOA Field Guide and Submission Form
- CLR Spray Publication - English
- Publicación CLR Spray - Español
- Translatable CLR Spray Publication
- CLR Publications

Select Language | Powered by Google Translate

f Rust (*Hemileia vastatrix*)

Offic be Found on Maui and Kona (Hawaii Island)

Proper Pesticide Use is of Extreme Importance to Prevent Pesticide Resistance by Coffee Leaf Rust and Other Coffee Diseases

The following publication provides important information for Hawaii coffee growers, about the proper methods of spraying to suppress coffee leaf rust (CLR) while preventing pesticide resistance by rust and other diseases on farms. The article includes:

- List of fungicides currently licensed by the Hawaii Department of Agriculture with directions for use on coffee grown in Hawaii.
- Some symptoms of CLR
- Why spray to suppress CLR

COOPERATIVE EXTENSION

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

(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

CLR Sanitation Protocol
(Adopted from Rapid Ohia Death Protocol)

As a precaution, please adopt the following decontamination protocols regardless of where you are surveying/gathering materials.

Decontaminate before and after you survey/collect samples.

Never go from a suspected affected site to another site without cleaning your shoes, tools, and vehicle (when possible).

Tools and shoes should be cleaned with 70% rubbing alcohol solution after removal of any surface debris. Correctly label a spray bottle with a Sharpie pen as "70% isopropyl alcohol - Flammable". Fill the spray bottle with isopropyl alcohol. Always take this bottle with you in any field vehicle for use after all field activities. Store in vehicle in such a manner that it does not spill.

A freshly prepared 10% solution of chlorine bleach and water can be used as long as tools are oiled afterwards, as chlorine bleach will corrode metal tools.

Clothing should be machine washed with detergent in hot water.

Vehicles used in infected areas should be thoroughly cleaned; power washing is recommended.

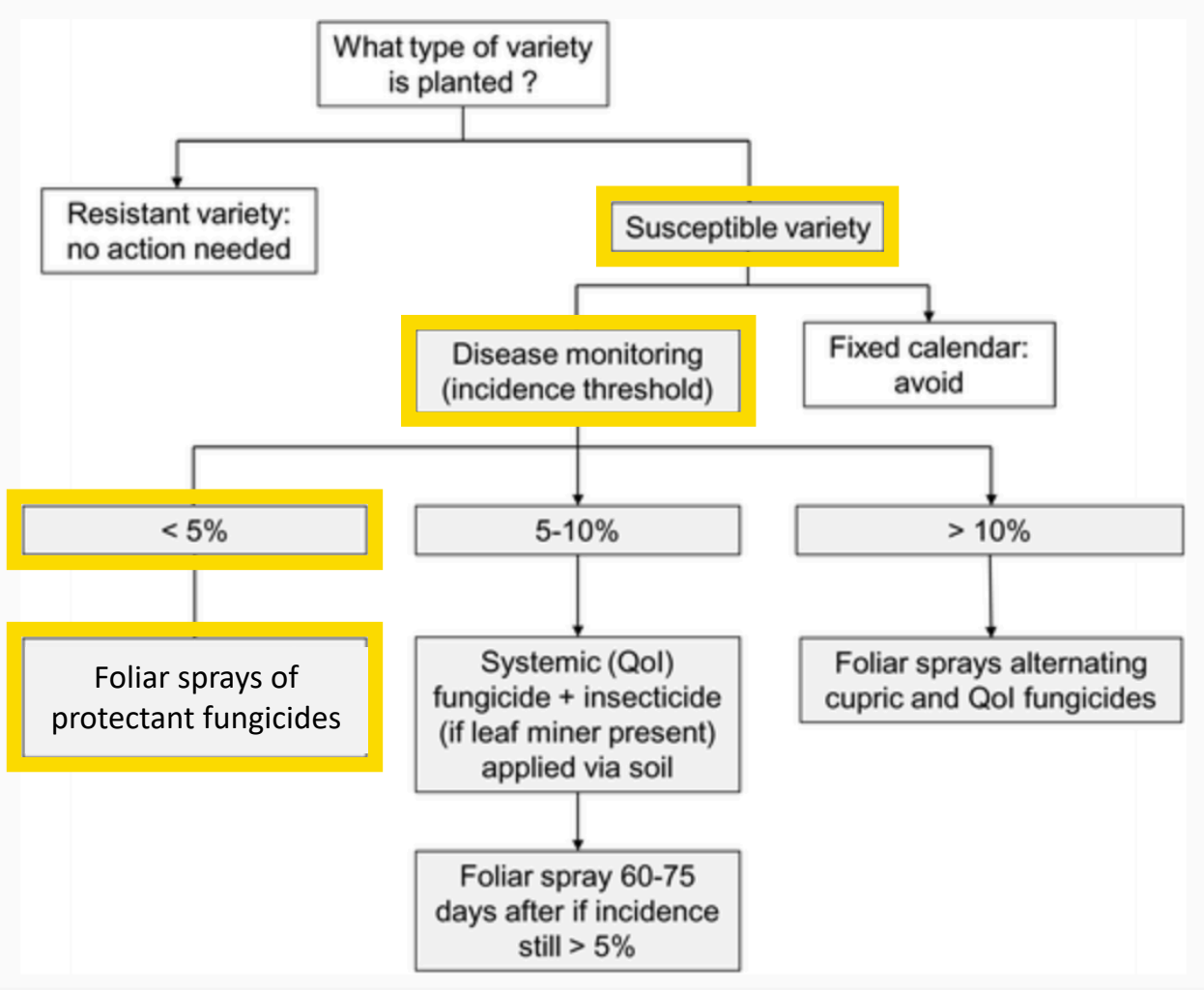
Please be careful of the alcohol and bleach, and follow all label precautions to prevent damage to your eyes, skin, respiratory system, clothing, and equipment.

Mention of trademark, proprietary product, or vendor does not constitute a guarantee or warranty of the product by the U.S. Dept. of Agriculture and does not imply its approval to the exclusion of other products or vendors that also may be suitable.

Scouting & monitoring

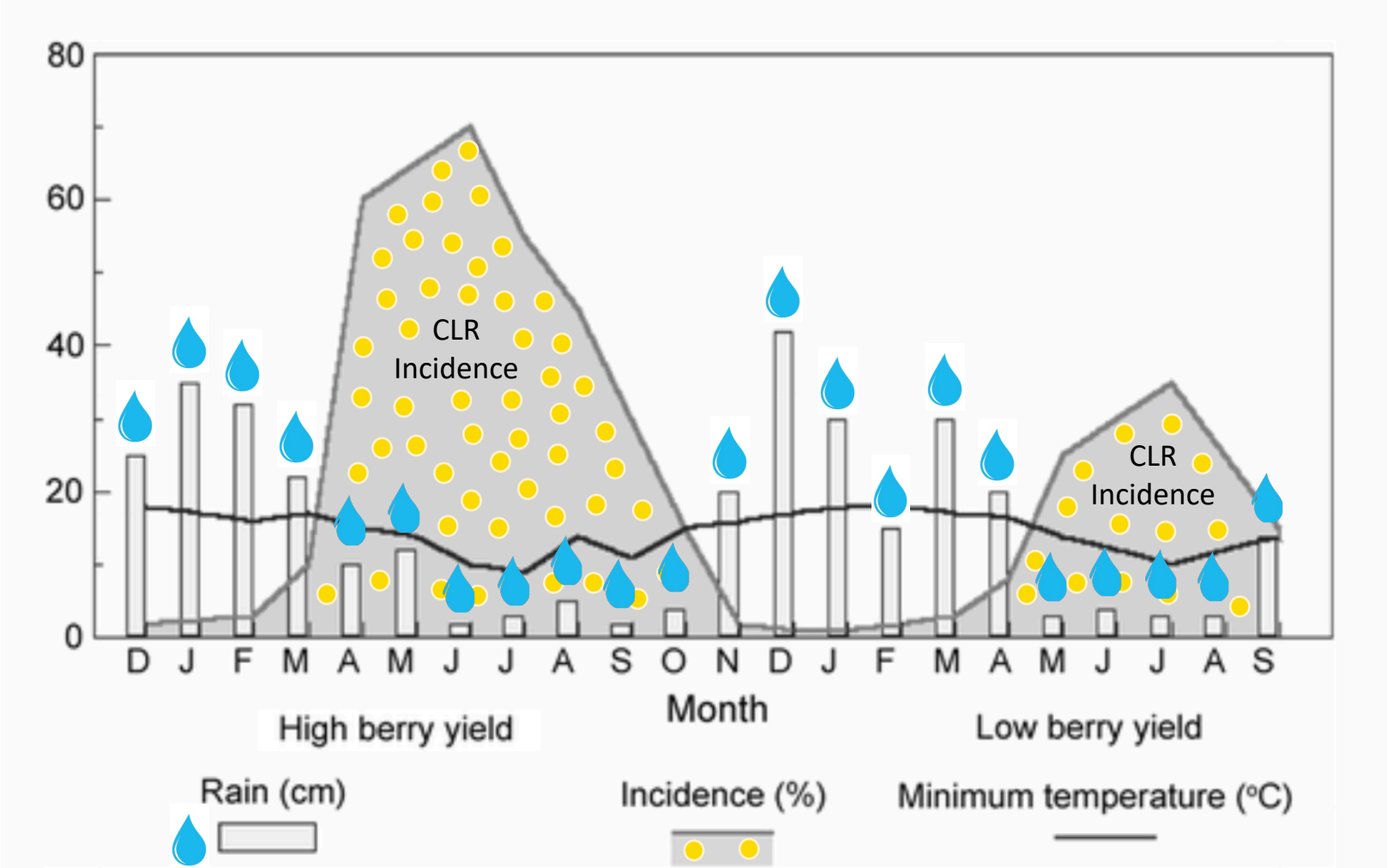
- Contact fungicides are most effective when infection is <5%
  - Early detection
- Current and future production affected
  - Spray to kill CLR spores and reduce the impact

Our ONLY choice currently



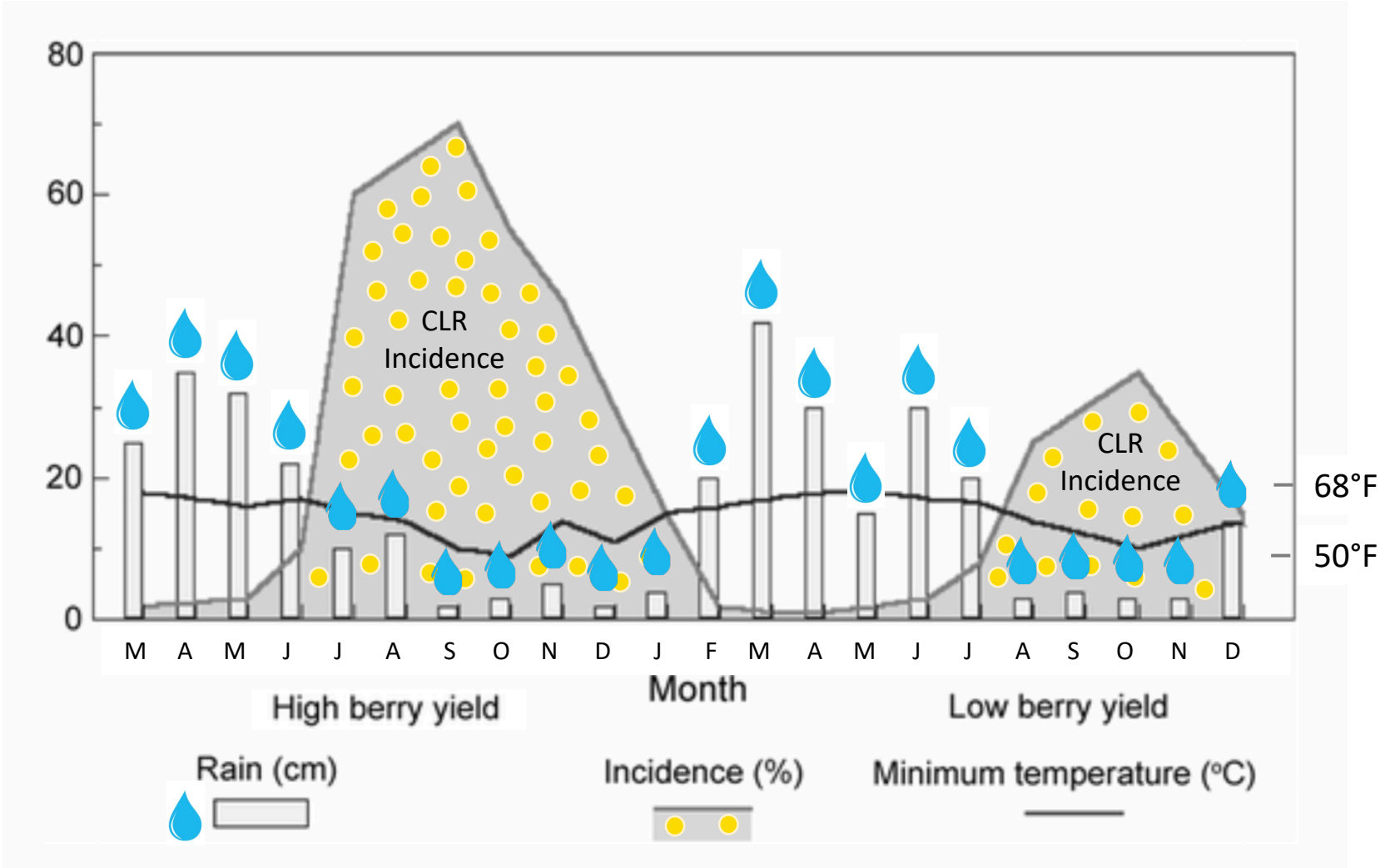
(Zambolim 2016)

Brazil



(Zambolim 2016)

Hawaii (Example)



(Zambolim 2016)

CLR monitoring – Icafé method

- Randomly select 10 trees per acre

- Locate a branch from the middle of the tree
  - Count the total number of leaves on the branch, including those with rust symptoms
  - Count the number of leaves showing rust symptoms on that same branch

$$\text{Rust incidence} = \frac{\text{No. of leaves with rust symptoms x 100}}{\text{Total no. of leaves on the branch}}$$

$$4.7\% = \frac{7 \times 100}{150}$$

(Filho and Domian 2019)

CLR monitoring

- Randomly select 10 trees per plot
- Randomly collect 10 leaves per tree from the lower third of the plant
  - Middle of the branches (third or fourth pair of leaves)
  - Collect a total of 100 leaves per plot
- Count the number of leaves with CLR and determine percentage of symptomatic leaves
  - 4 of 100 leaves displaying CLR symptoms = 4% incidence
- Sample at the beginning of rainy season & harvest

(Zambolim 2016)





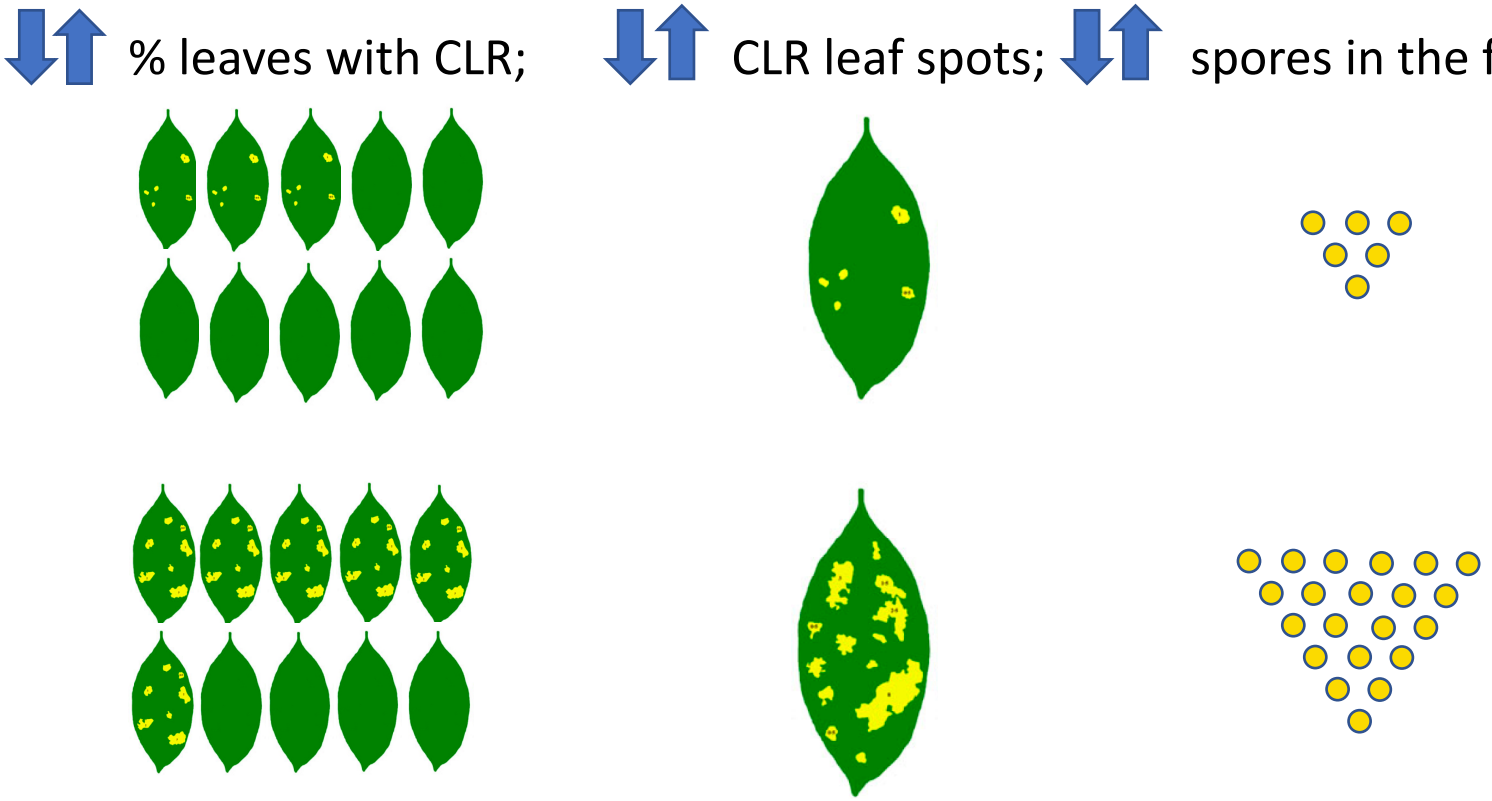




https://www.hawaiicoffeeed.com/clr.html

Photo Credits: HDOA & farmers

- % incidence is related to leaf area with rust and also related to the number of sporulating pustules per leaf



- Spray contact fungicides when infection is <5% (4/100)

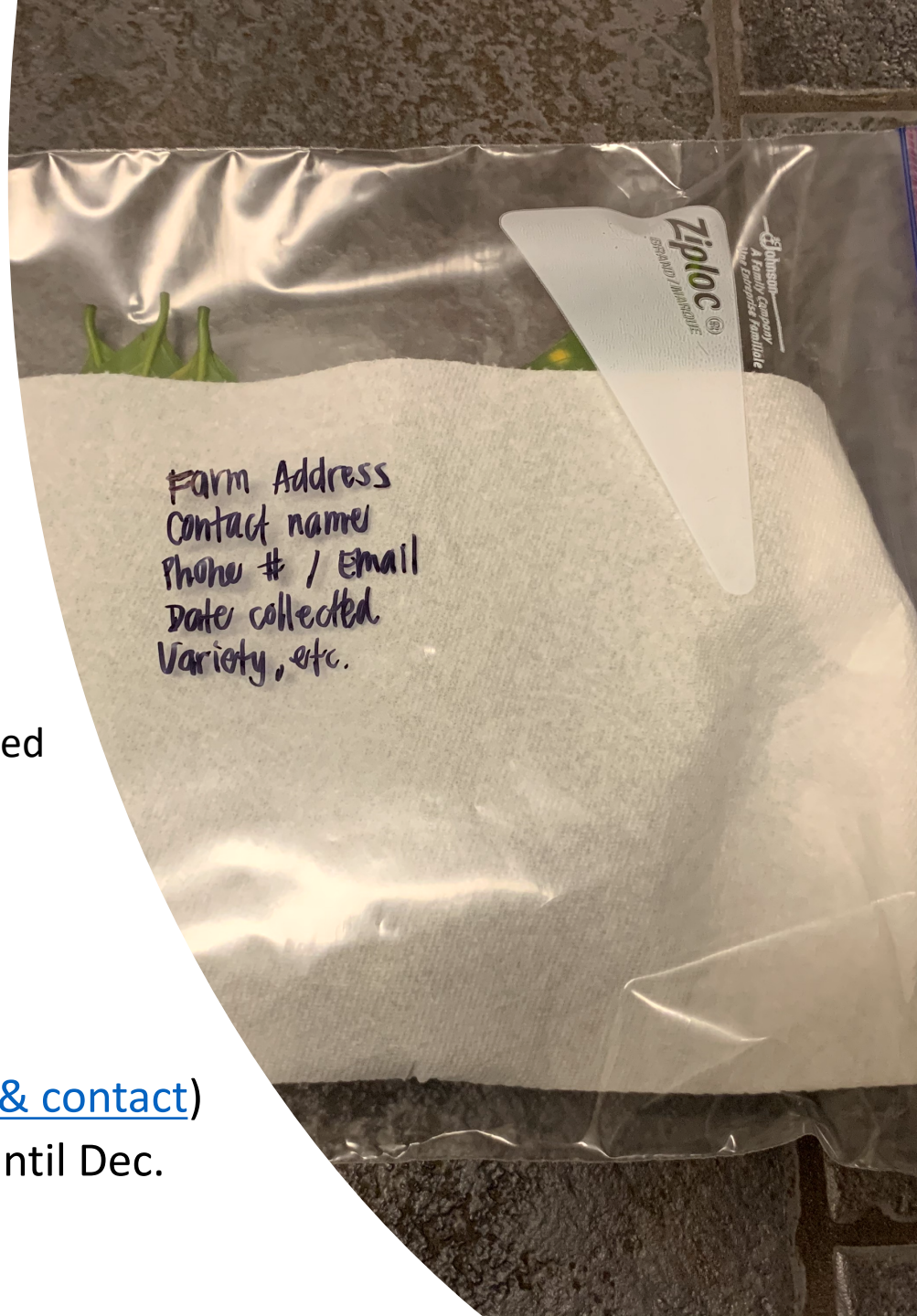
(Zambolim 2016; Capucho et al. 2011)

Rust on your farm?

- 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
  - andreak@hawaii.edu
  - Text (415) 604-1511

Sample submission

- Collect leaves with CLR symptoms
- Enclose in a clean, unused ziplock
  - Place leaves between clean, unused papertowels in ziplock
- Keep cool and refrigerated
- CTAHR Extension Office (locations & contact)
  - Hilo ADSC samples accepted until Dec. 18, 2020



Confirmed CLR ID

- Spray as soon as possible with an approved fungicide
- Maintain field sanitation
  - Weed control
  - Removal of heavily infected branches and leaves
  - Ag burn permit or compost and cover
    - Dry spores can survive for about 6 weeks
  - Consider stump pruning in large areas for CBB and CLR control
    - Remove lower laterals for spraying and splash
- Improve or maintain tree health

Spray publication

- Some symptoms of CLR
- Spray to suppress CLR and reduce the impact

www.HawaiiCoffeeEd.com/CLRSprayEnglish

www.HawaiiCoffeeEd.com/CLRSprayEspanol.html

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

(Published Nov. 4, 2020; updated Nov. 14, 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.

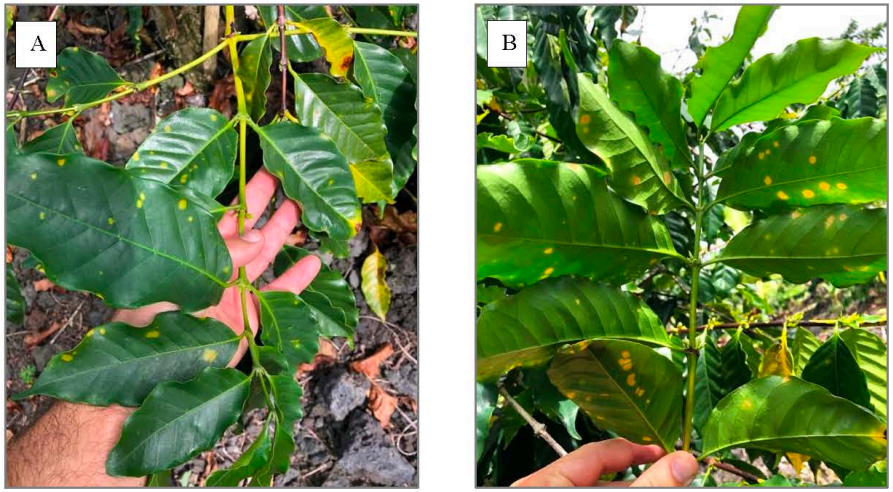

Figure 1: Coffee leaf rust on the upper leaf surface (A) and lower leaf surface (B) of coffee.

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].

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.

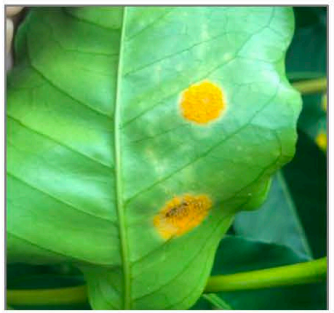

Figure 2: Close-up of powder-like coffee leaf rust spores on the underside of a coffee leaf.

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
  - Spreader/sticker

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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.
  - Field sanitation and early detection of CLR is important.
  - CLR mycelium require a living host tissue or cell to remain alive; however, its urediniospores can survive about six weeks and through dry periods [1].
- ◊ Reduce the development of pesticide resistance to the products listed in Table 1.
  - It will be more difficult to control diseases with resistance to approved fungicides.
  - Alternate and rotate the use of fungicides in different FRAC groups as listed in Table 1.
    - This typically applies to the use of all pesticides unless noted on the label.
  - For example, if you use a blue product like Serenade ASO (FRAC Group 44) for your first application, then use a yellow product such as Kocide 3000 (FRAC Group M1) for your next application. Then, switch back to Serenade or rotate to a pink product (FRAC Group BM 02). Avoid using the same colored product in back-to-back applications.
  - If your farm is certified organic, an example for rotation is to use a pink product like DoubleNickel LC, then use a yellow product like Badge X2 next. Then, switch back to DoubleNickel LC or rotate to a blue product. Again, avoid using the same colored product in back-to-back applications.

When to spray:

- ◊ Avoid spraying during rain, drought, and in high heat, if possible.
- ◊ Follow the product label for frequency of application.

Other additions to the fungicide:

- ◊ Consult with the product label before mixing and combining other products with the fungicide.
  - 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.

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- ◊ Consult the label about intentional ground spraying.

Trade Name	Active Ingredients	FRAC Group	EPA Reg. No.	Labels	Notes	Compatibility with BotaniGard®[1]	*H. vastatrix* Rate (per acre)	Est. Cost[3] per Application/Acre	
								Low Rate	High Rate
Serenade ASO	QST 713 strain of *Bacillus subtilis*	44	264-1152	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	55146-1	Label		Unsure	2.0-4.0 lbs	$17.00	$34.00
Champ Formula 2 Flowable Agricultural Fungicide / Bactericide	Copper Hydroxide	M1	55146-64	Label		Yes[2]	1.33-2.66 pints	$7.48	$9.84
Kocide 3000	Copper Hydroxide	M1	91411-2-70051	Label		Yes (see chart)	0.75-1.75 lbs	$9.00	$21.00
Kocide 3000-O	Copper Hydroxide	M1	91411-11-70051	Label	Organic	Yes[2]	0.75-1.75 lbs	$9.00	$21.00
Nu-Cop 30HB	Copper Hydroxide	M1	42750-281	Label		Yes[2]	0.75-1.75 lbs	$9.00	$21.00
Nu-Cop HB	Copper Hydroxide	M1	42750-132	Label		Unsure	1.0-2.0 lbs	$12.00	$24.00
Badge X2	Copper Oxychloride + Copper Hydroxide	M1	80289-12-10163	Label	OMRI	Unsure	1.0-3.0 lbs	$12.00	$36.00
Badge SC	Copper Oxychloride + Copper Hydroxide	M1	80289-3-10163	Label		Unsure	1.0-3.0 pints	$5.88	$17.63
DoubleNickel LC Biofungicide	*Bacillus amyloliquefaciens strain D747*	BM 02	70051-107	Label	OMRI	Yes[2]	0.5-6.0 qts	$7.50	$90.00
DoubleNickel 55 Biofungicide	*Bacillus amyloliquefaciens strain D747*	BM 02	70051-108	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.

- Good coverage
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Badge SC	Copper Oxychloride Copper Hydroxide	M1	0289-3-10163	Label		Unsure	1.0-3.0 pints	$5.88	$17.63
DoubleNickel LC Biofungicide	*Bacillus amyloliquefaciens strain D747*	BM 02	0051-107	Label	OMRI	Yes[2]	0.5-6.0 qts	$7.50	$90.00
DoubleNickel 55 Biofungicide	*Bacillus amyloliquefaciens strain D747*	BM 02	0051-108	Label	OMRI	Yes[2]	0.25-3.0 lbs	$9.63	$115.50

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Other additions to the fungicide:

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- Other additions
  - Foliar fertilizers
  - Beauveria
  - Compatibility
- 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

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    - 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/botanigard-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).

Trade Name	Active Ingredients	FRAC Group	EPA Reg. No.	Labels	Notes	Compatibility with BotaniGard®[1]	*H. vastatrix* Rate (per acre)	Est. Cost[3] per Application/Acre	
								Low Rate	High Rate
Serenade ASO	QST 713 strain of *Bacillus subtilis*	44	264-1152	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	55146-1	Label		Pending	2.0-4.0 lbs	$17.00	$34.00
Champ Formula 2 Flowable Agricultural Fungicide / Bactericide	Copper Hydroxide	M1	55146-64	Label		Yes[2]	1.33-2.66 pints	$7.48	$9.84
Kocide 3000	Copper Hydroxide	M1	91411-2-70051	Label		Yes (see chart)	0.75-1.75 lbs	$9.00	$21.00
Kocide 3000-O	Copper Hydroxide	M1	91411-11-70051	Label	Organic	Yes[2]	0.75-1.75 lbs	$9.00	$21.00
Nu-Cop 30HB	Copper Hydroxide	M1	42750-281	Label		Yes[2]	0.75-1.75 lbs	$9.00	$21.00
Nu-Cop HB	Copper Hydroxide	M1	42750-132	Label		Pending	1.0-2.0 lbs	$12.00	$24.00
Badge X2	Copper Oxychloride + Copper Hydroxide	M1	80289-12-10163	Label	OMRI	Pending	1.0-3.0 lbs	$12.00	$36.00
Badge SC	Copper Oxychloride + Copper Hydroxide	M1	80289-3-10163	Label		Pending	1.0-3.0 pints	$5.88	$17.63
DoubleNickel LC Biofungicide	*Bacillus amyloliquefaciens strain D747*	BM 02	70051-107	Label	OMRI	Yes[2]	0.5-6.0 qts	$7.50	$90.00
DoubleNickel 55 Biofungicide	*Bacillus amyloliquefaciens strain D747*	BM 02	70051-108	Label	OMRI	Yes[2]	0.25-3.0 lbs	$9.63	$115.50

[1] See the BioWorks BotaniGard® Compatibility Chart here. "Pending" 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.

Summary

- Survey your entire farm for CLR at least monthly
- Report suspicious leaf symptoms immediately
- Begin CLR control immediately
- Spray approved fungicides only
- Rotate fungicides to reduce pesticide resistance
- Maintain farm health and sanitation

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