Coffee Leaf Rust (CLR) in Hawaii: Fungal Attacker Revealed

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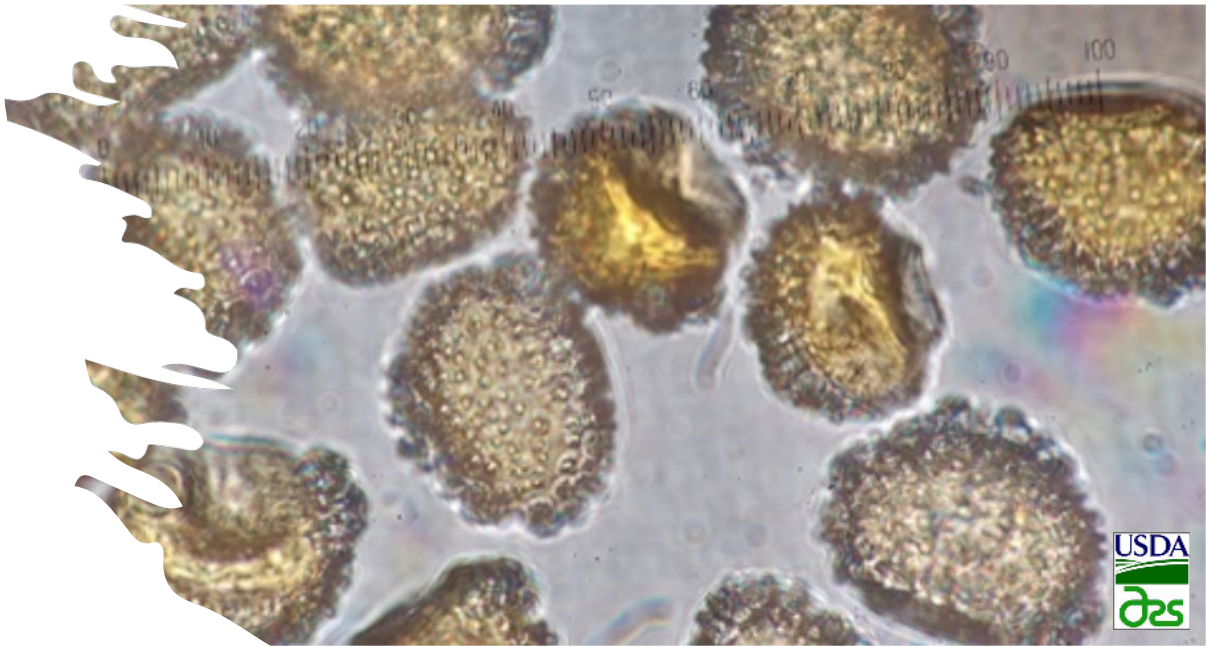


Coffee Leaf Rust (CLR)

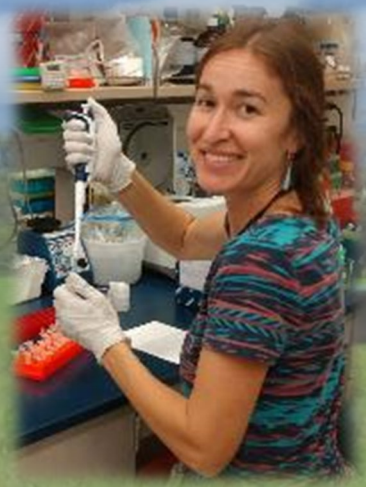
- Pathogenicity
  - Disease Cycle
  - Biology/Development/ Genetics
- Management
  - Fungicides
  - Varieties
  - Natural Enemies

CLR Teamwork!

Growers & Producers

Lionel Sugiyama

Eva Brill



Karma Kissinger

Pepe Miranda

And Many Others




Pathogenicity Testing

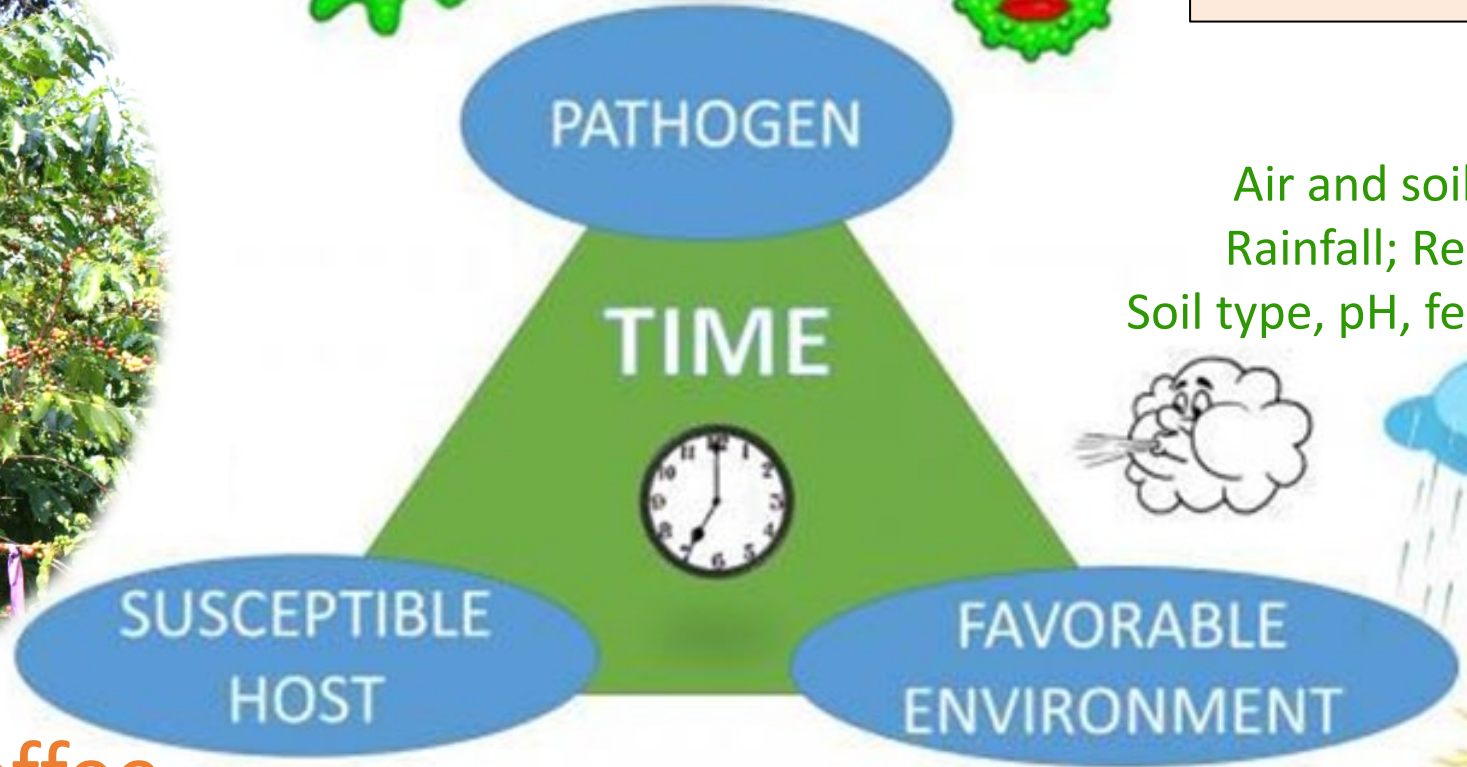
How is Disease Caused in Plants?

Symptoms versus Signs

Coffee

CLR

All parts of the disease triangle must occur at the right time and the right place for disease to occur



Air and soil temperatures;
Rainfall; Relative humidity;
Soil type, pH, fertility, moisture, etc.

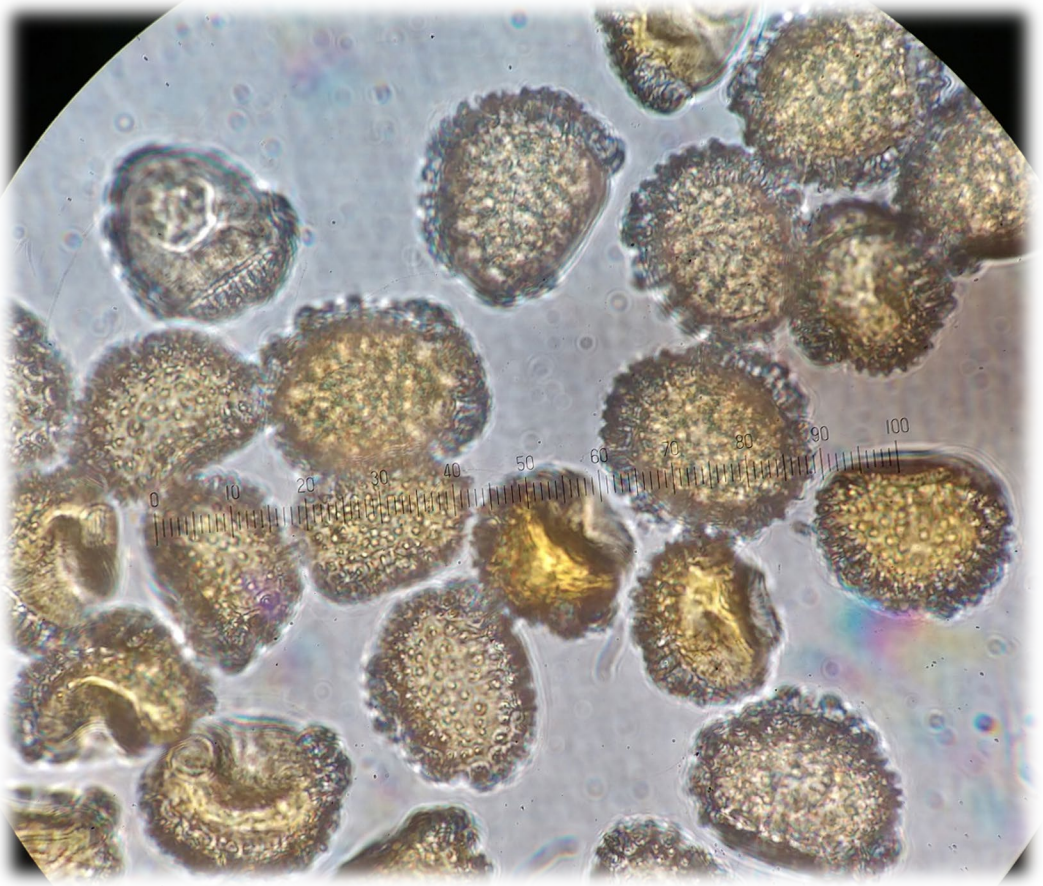
https://content.ces.ncsu.edu/extension-gardener-handbook/5-diseases-and-disorders

Pathogenicity Testing

- Collect fresh spores
- Adjust concentration to 1 x 10^5 spores/ml
- Brush on/spray on inoculum (Water control); Typica
- Growth chamber
- 2 days in the dark/ high humidity
- 12 light/12 dark
- Observe symptoms/ signs

Coffee Leaf Rust: Prove Pathogenicity

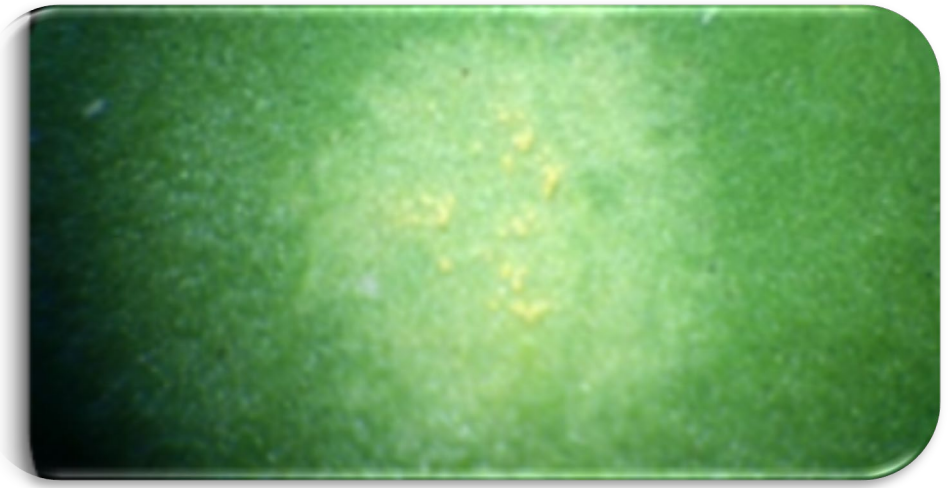
- Re-isolate spores and confirm by morphology and molecular ID
  - Obligate parasitic fungus
    - – can’t be cultured
  - Infection through stomata
    - Dark
    - High humidity
    - 22°C / ~72°F



Magnification of the urediniospores of coffee leaf rust (x400)

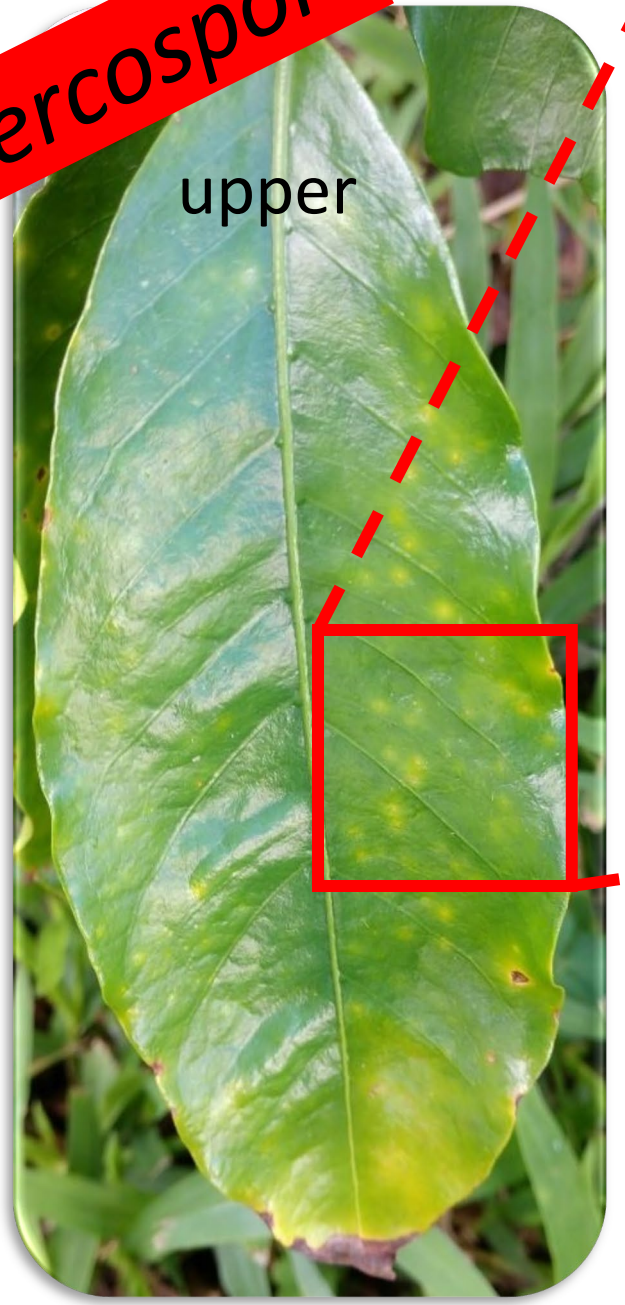
CLR Biology & Development

Coffee Leaf Rust: Symptoms & Signs



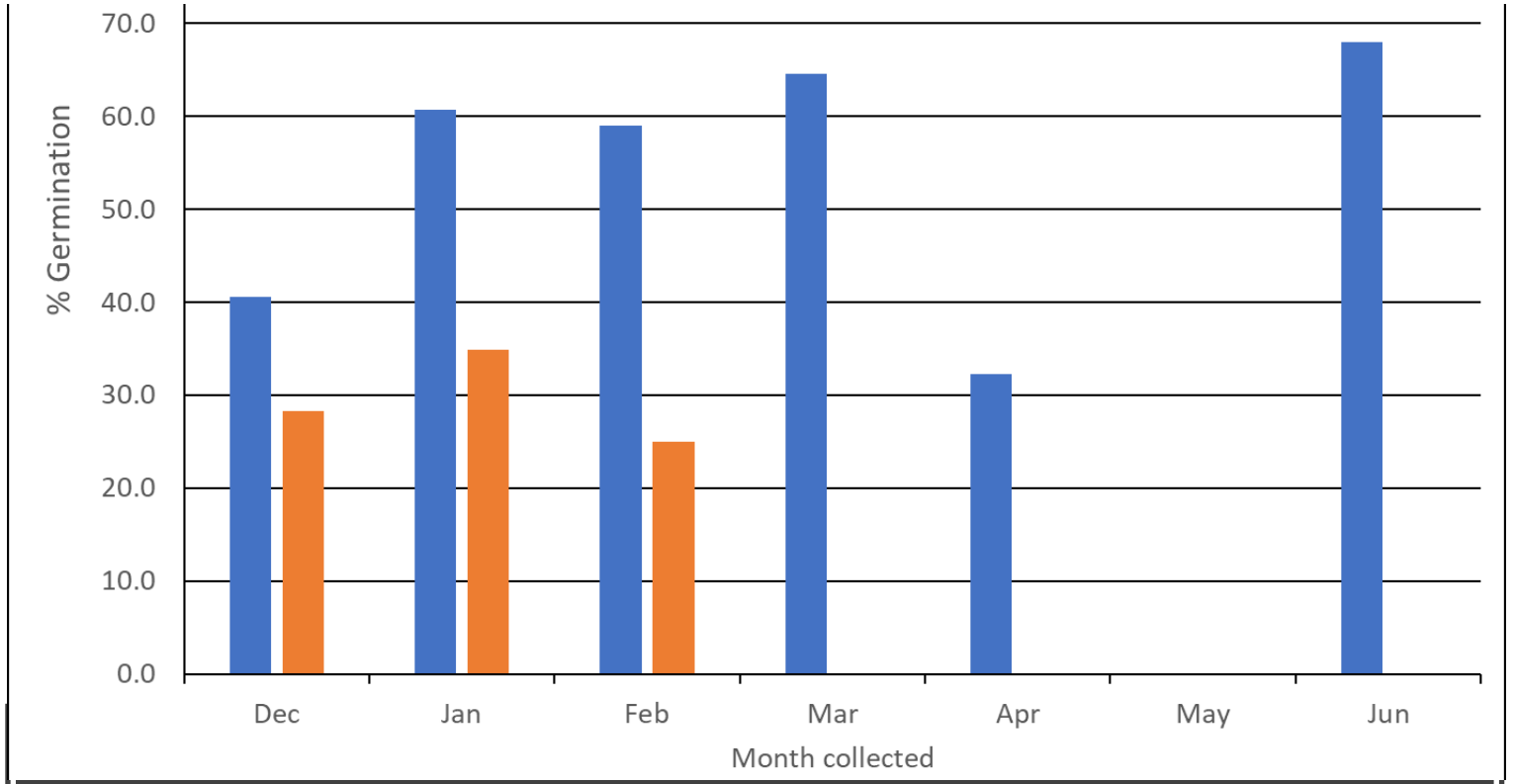
- Under optimum conditions with susceptible variety
- First observable symptoms: small, pale yellow spots on the upper surfaces of the leaves (~21 days)
- Spots gradually increase in size; spores appear on the lower leaf surface
- Lesion centers become necrotic (~35 days)
- Infected leaves fall off (~70 days)

Cercospora



Visual Aids for Early Detection: check ***shape*** (circular or irregular), ***location*** (upper and/or lower surface; leaf veins), and presence /absence of ***necrosis***

CLR



Stage of Infection/Environment Affects Spore Viability

Coffee Leaf Rust: Symptoms & Signs

- Lesions can develop anywhere on the leaf
- First spots can appear on any leaf in the canopy
  - Initial stages of the epidemic; windblown spores
- Multiple infections visible on the same leaf
- Typica cotyledons can become infected

- Wild: leaves drop prematurely, leaving twigs with no leaves; regrowth observed

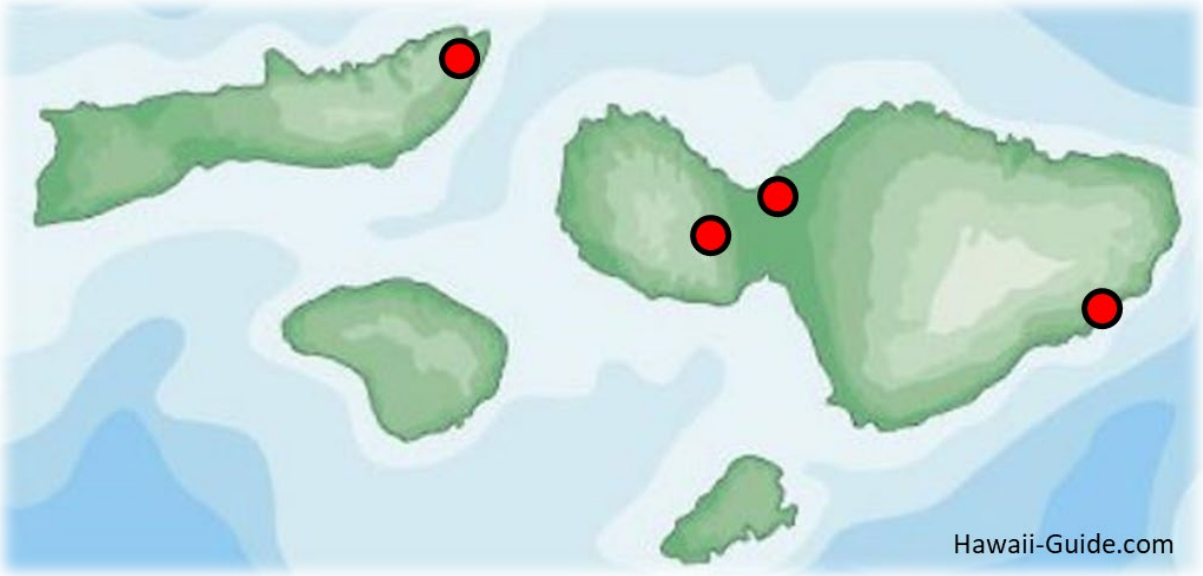
CLR impact on wild coffee in Kona

Characterization of CLR in Hawaii

- ARS PBARC Lab: Basic molecular ID
  - All Hawaii isolates are identical
- Genotyping (Dr. Aime, Purdue U.)
  - Molecular analysis/Geographical location
    - Central America and the Caribbean: Jamaica, Panama, Guatemala, El Salvador, and Honduras
- Single introduction
- Race identification (Dr. Vítor Várzea & Dr. Maria do Céu Silva, University of Lisbon, Portugal)
  - Screening a set of coffee plant differentials that contain various resistance genes

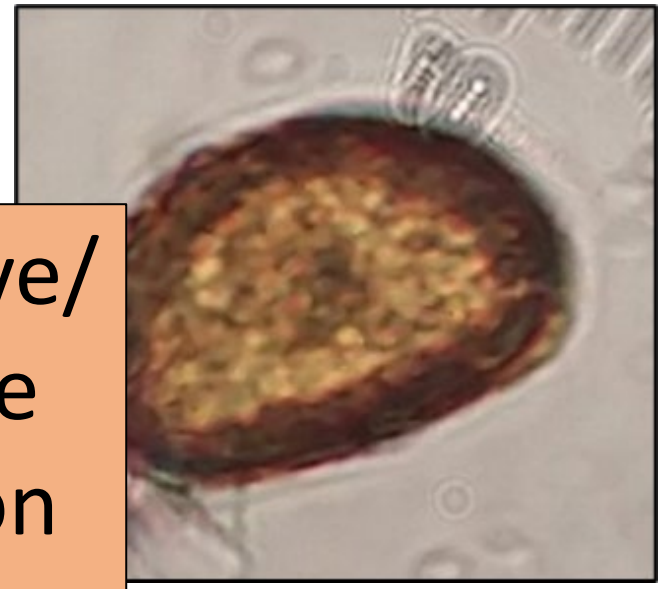
CLR Early Detection (DLNR/MISC)

Active spore traps: battery powered; on timers; can be used directly for molecular ID

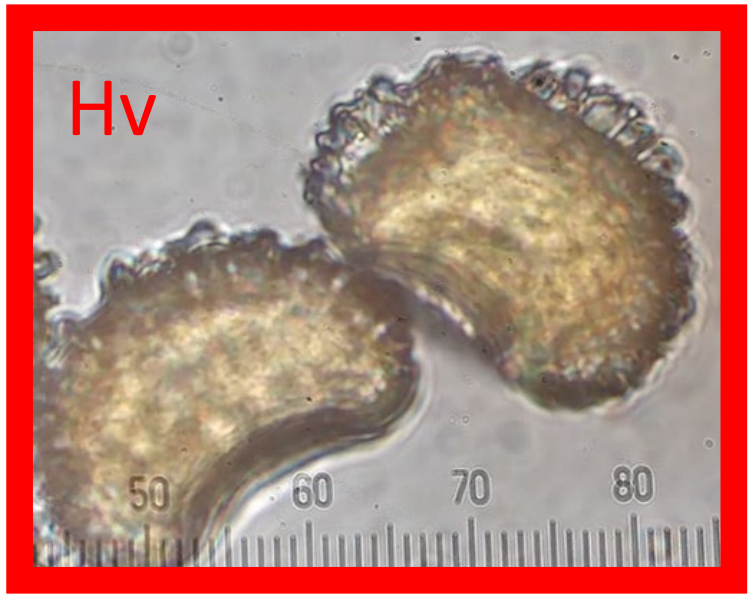


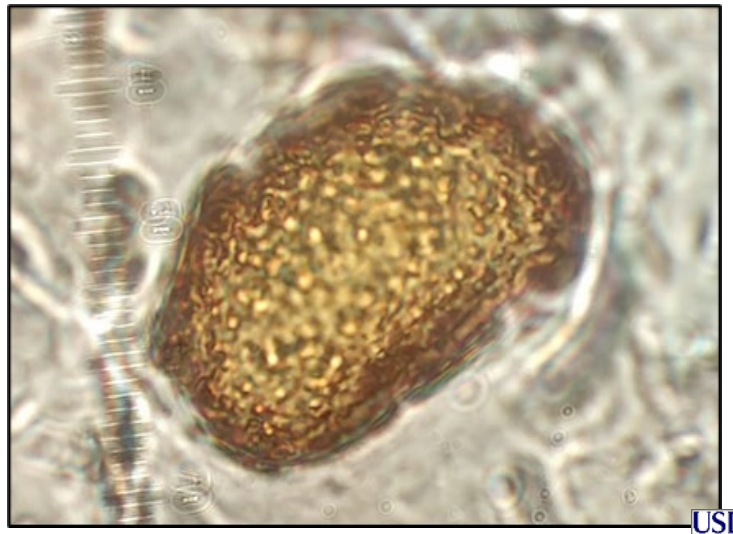
Maui: DLNR Baseyard; Koali; Hanaula: Oct 2019 to Dec 2020 (Feb/Aug 2020)
Molokai: Puu O Hoku: June 2020 to Mar 2021

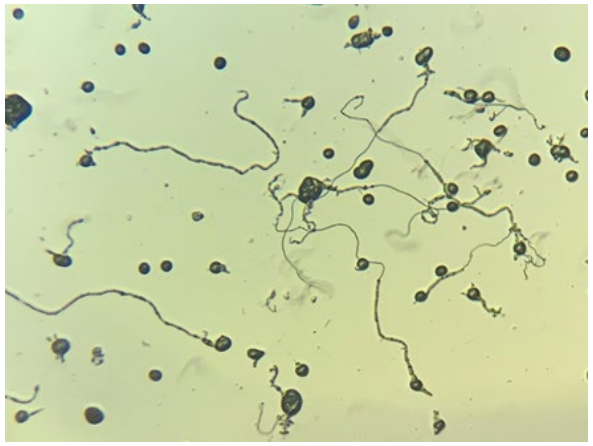
CLR was not detected in any spore trap using PCR
Increased sensitivity using nested PCR approach = 2 CLR +

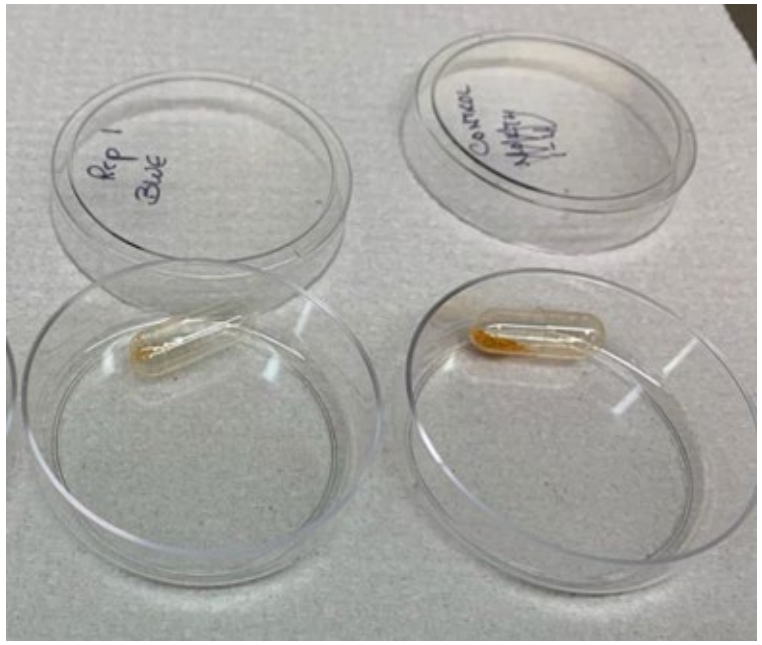


* Sensitive/ accurate detection for + ID









Laboratory and Field Fungicide Testing

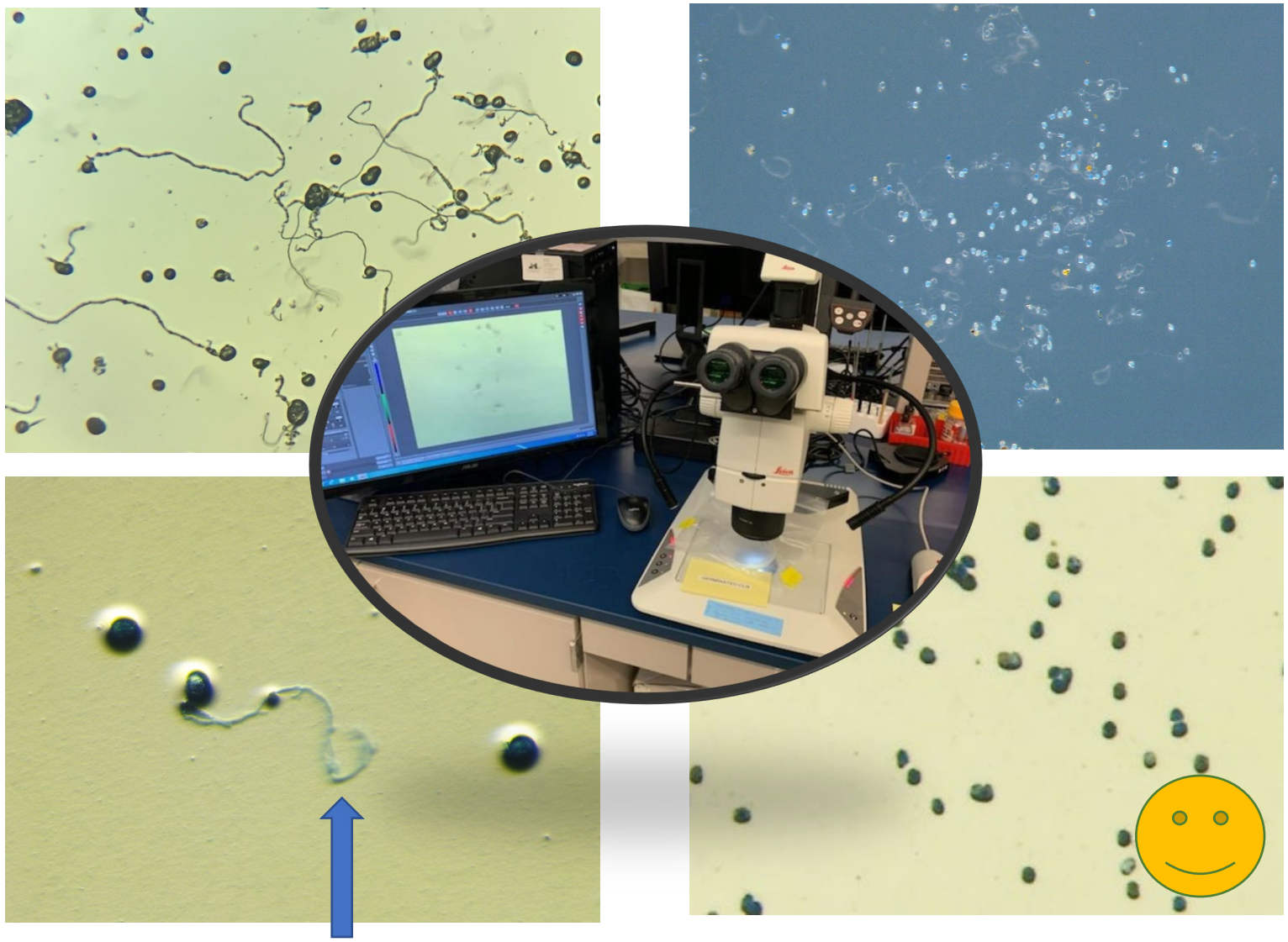
Mention of trademark, proprietary product, or vendor does not constitute a guarantee or warranty of the product by the U.S. Dept. of Agriculture and does not imply its approval to the exclusion of other products or vendors that also may be suitable

In Vitro Fungicide Assays

Method

Reg. for use: 7
Julie/UH IR-4: 7
Additional: 10+

*Direct contact/ timing

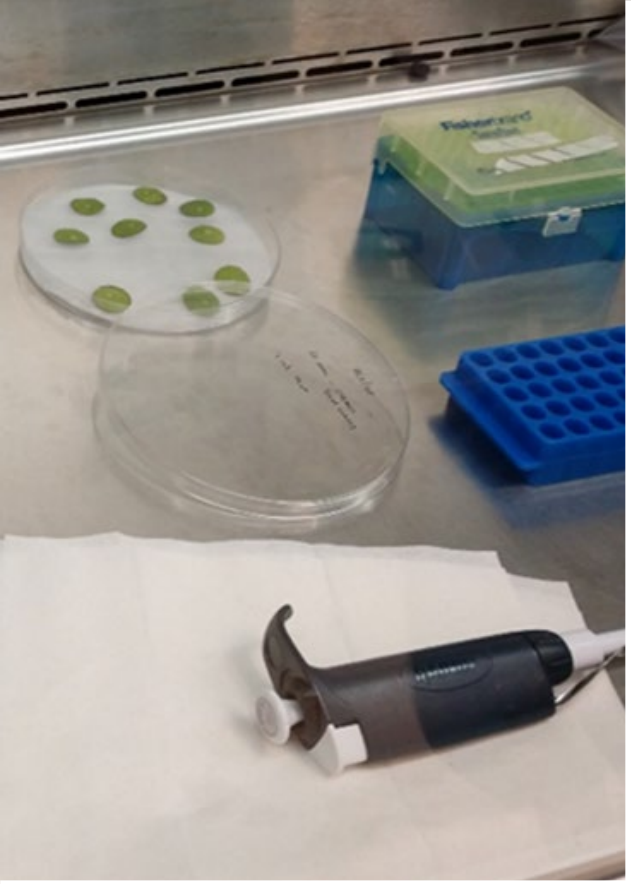


Sanitation Protocols Developed

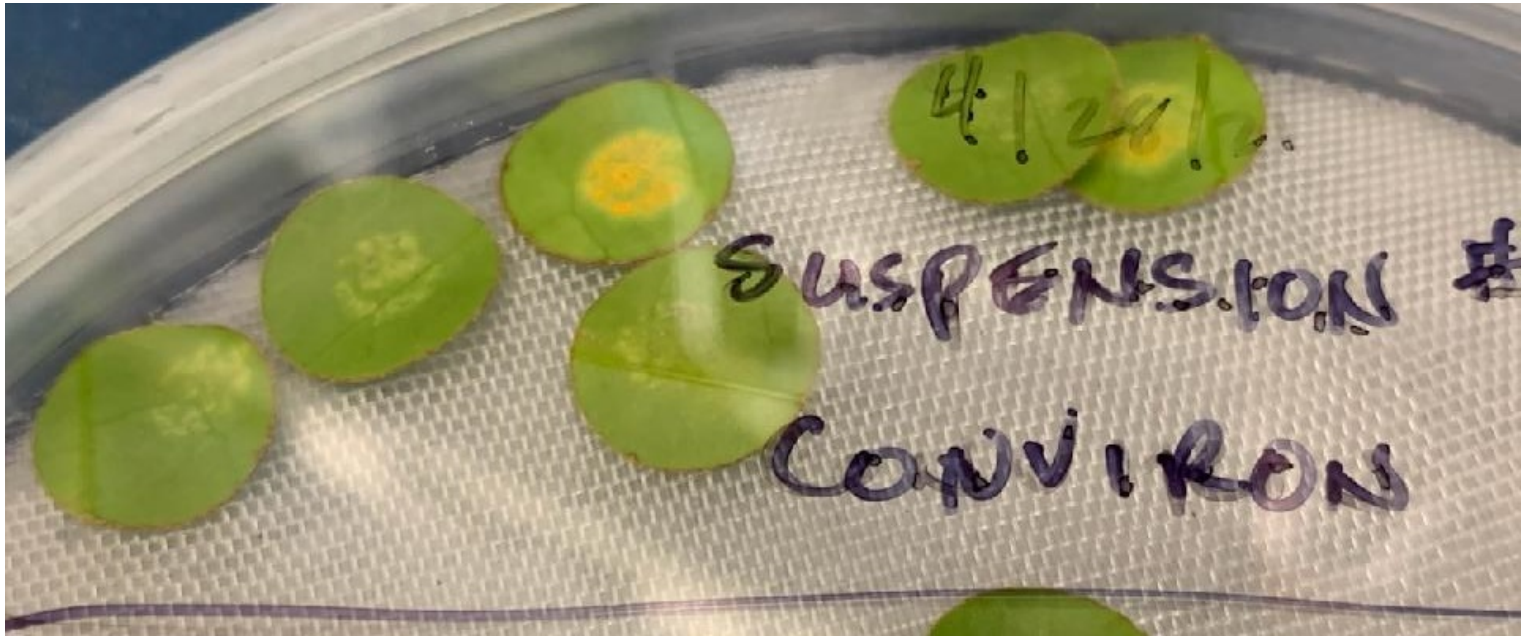
- 70%, 80%, 95% Ethanol
- 70%, 91% IPA
- 10% Freshly Prepared Bleach Solution

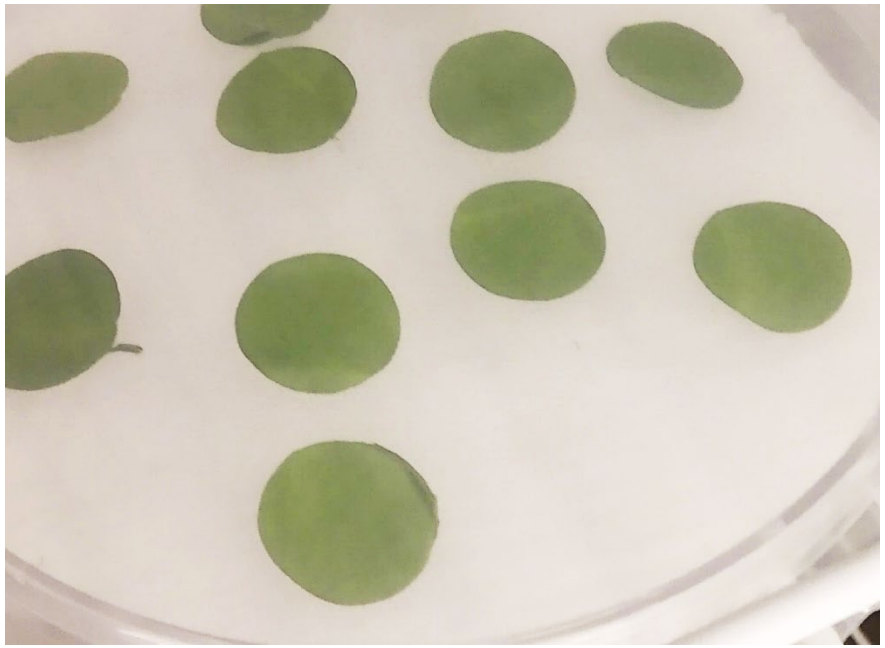
Field Fungicide Trial

- Badge X2
- Kocide 3000-O
- Cueva
- DoubleNickel
- Serenade
- Oxidate 2.0



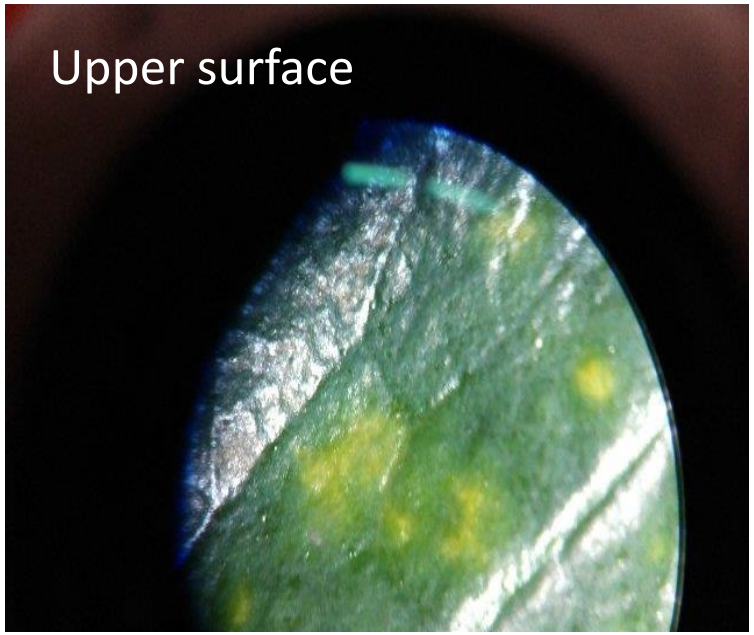
Variety Testing (HARC)





Typica v. Obata

Typica v. Tupi v. Obata



Potted Tupi & Obata

Natural Enemies of CLR

Mycoparasites

Combating CLR in HI

- Reduce % incidence and severity
- Improve/maintain plant and soil health
- Scout regularly for disease symptoms
    - Early and accurate detection
- Weed control and pruning
- Practice good hygiene and sanitation
- Manage as a continuous epidemic
- Short- & Long-term strategies
- No silver bullet/Use integrated approach

Thank you!

Questions?

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