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Mitigation Strategies for Coffee Rust (*Hemileia vastatrix*) in Hawaii

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Introduction

Coffee rust (*Hemileia vastatrix*) is a devastating and widespread disease of coffee (*Coffea* spp.) which can lead to significant yield losses (McCook and Vandermeer, 2015; Monroig Inglés et al., 2002). This document provides strategies, particularly for commercial control, to mitigate coffee rust. It is worth noting that **not** all control measures such as systemic fungicides and even some resistant cultivars are currently available in Hawaii. It is possible, however, that these may be available in the future.

Management Strategy	Benefits	Notes
Resistance		
Resistant and Tolerant Coffee Varieties	- Saves time and money through improvement in the efficacy of other management strategies - Excellent yield and cup quality in some varieties	- The World Coffee Research variety catalog (https://varieties.worldcoffeeresearch.org/varieties) contains a list of many of the resistant/tolerant varieties, including information on yield and cup quality - There are at least 50 distinct races of this pathogen with race II being the most widespread (Rodrigues Jr et al., 1975; Talhinhas et al., 2017). The effectiveness of a resistant coffee variety depends on the pathogen race present. We do not know the race present in Hawaii, which would impact how the rust is managed through resistance. - Older varieties are typically not as effective against newer races of rust (McCook and Vandermeer, 2015) - No resistant variety is effective against all races of coffee rust, but some are effective against the most common races
Chemical		
Protective fungicides	- Inhibits pathogen's ability to infect new leaves and thus, slows development of the disease	- Conventionally, rust management has been performed using protective copper fungicides which are applied according to a fixed schedule (Belan et al., 2020; Capucho et al., 2013). Fungicide labels should always be followed as overuse of copper-based chemistries may cause toxicity to the plant - The University of Hawaii Cooperative Extension Service has provided a list of approved fungicides, including organic options, which includes potential interactions with other treatments, application rates, and projected costs (https://www.hawaiicoffeeed.com/clr.html)

Management Strategy	Benefits	Notes
Chemical (continued)		
Protective fungicides (continued)		- Most effective when disease incidence is <5% (de Melo Virginio Filho and Astorga Domian, 2015; de Souza et al., 2011; Zambolim, 2016) - Must be reapplied several times throughout the season, according to label - Number of reapplications depends on how often weather is conducive to the rust's development. Often four or five sprays is adequate, with less usually needed during low-yielding years (de Souza et al., 2011; Zambolim, 2016) - First spray is typically applied after first flower or prior to the start of the rainy season (de Melo Virginio Filho and Astorga Domian, 2015) - Stickers, spreaders, and adjuvants help ensure even coverage of lower leaf surfaces, where the rust infects, and provides lasting spray adhesion (Kawabata, 2020) - Low pressure applications will help achieve even coverage and minimize spreading the rust (Kawabata, 2020)
Cultural		
Disease monitoring	- Early detection of rust makes management easier	- Monitor throughout season - Increase monitoring when weather supports rust development: alternating high (72-82°F) and low (55-61°F) temperatures; mean temperatures of 72-75°F and 80% or greater relative humidity (Avelino et al., 2004; Capucho et al., 2013) - Examine primarily lower 1/3 of plants
Pruning shade trees (when grown in shade system)	- Reduces spore viability and germination due to sun exposure and increased air flow, lower humidity and shorter leaf wetness	- Limit shade coverage to 30-50% - Prune shade trees 1 or 2 times yearly, ensuring that canopies do not touch - Maintain as few trees as possible to achieve adequate shading as trees tend to compete with coffee for water and nutrients (de Melo Virginio Filho and Astorga Domian, 2015; Elevitch et al., 2009)

Management Strategy	Benefits	Notes
Cultural (continued)		
Pruning coffee plants	- Maintains plant productivity - Removes diseased leaves and limits leaves that can be infected - Reduces spore viability and germination due to sun exposure and increased air flow, lower humidity and shorter leaf wetness	- For pruning styles and guidelines, see the production guide by Bittenbender and Smith (2008) at: https://www.ctahr.hawaii.edu/oc/freepubs/pdf/coffee08.pdf
Adequate plant spacing	- Increases airflow in the canopy, reducing spore germination - Reduces nutrient and water competition between plants	- Follow spacing guidelines for lower-density plantings, when feasible, as recommended by Bittenbender and Smith (https://www.ctahr.hawaii.edu/oc/freepubs/pdf/coffee08.pdf) or local extension services
Proper nutrition and pH	- Improves plant productivity and defense against diseases	- Perform regular soil and leaf nutrient and pH tests, and amend soil or apply foliar fertilizers, as recommended by local extension (Bittenbender and Smith, 2008) - Nutrient stress can lead to an increase in rust, particularly in years of heavy fruit loads (Avelino et al., 2004; Zambolim, 2016)
Weeding	- Reduces nutrient and water competition with coffee plants	- Weed control options can be found at https://www.ctahr.hawaii.edu/oc/freepubs/pdf/coffee08.pdf

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