More Than a Cup: Analysis of a Fungal Disease in Shade Grown *Coffee arabica*

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Background

Coffee is among the most valuable legally traded commodities from the developing world[1]. *Coffee arabica* is a traditionally a shade grown crop; however, the global area within which coffee is being grown is decreasing, while the amount of coffee produced is increasing, due to sun farming practices.

Mycena citricolor (Figure 1), commonly known as *ojo de gallo* is a fungus known for being a major pest of coffee[3]. This pest affects coffee yields and quality. *M. citricolor* does well in high humidity and under a closed canopy[2].

Figure 1. *Mycena citricolor* on juvenile coffee leaf.

Objectives/Hypotheses

In this study we explore the spatial patterns of *M. citricolor* as well as its relationship with 2 main variables: overstory canopy cover and soil moisture. **We hypothesized that there will be a direct negative relationship between canopy cover and presence of fungus and a positive relationship between soil moisture and fungus presence.**

Methods

- Our study site (Figure 7) was located in a pre-montane wet forest in San Luis, Costa Rica. Our study plot was partially shaded and contained about two hundred plants of the CR95 variety, which were planted in the spring of 2018.
- We selected 20 plants using stratified random sampling. We measured soil moisture through soil cores and soil probing five centimeters from the base of each selected coffee plant.
- Canopy cover was measured using a densiometer facing all four cardinal directions.
- Fungus was evaluated by counting the number of leaves infected on each plant at the beginning and end of the sampling period.

$$\frac{number\ of\ leaves\ with\ M.\ citricolor}{total\ number\ of\ leaves} x100$$

- We qualitatively estimated the fungal incidence across the infected campus plot and graphically displayed the data using a heat map.

Results

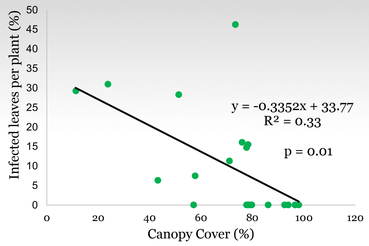

Figure 2. Negative correlation between the amount of canopy cover (%), taken with the densiometer, and the amount of fungus present on the plant (%) on the first day of the study (10/06/2018).

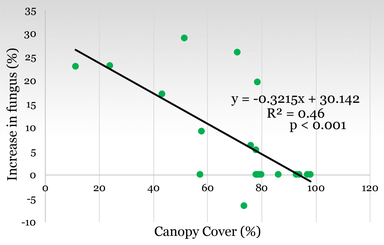

Figure 3. Relationship between the amount of canopy cover (%) and the increase in fungus (%) between the first and last sampling dates.

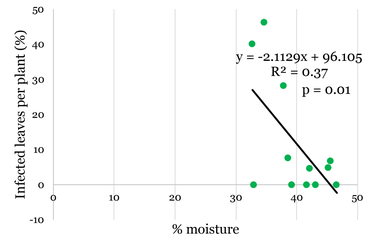

Figure 4. Relationship between percent soil moisture from soil cores and percent fungus in juvenile coffee plants.

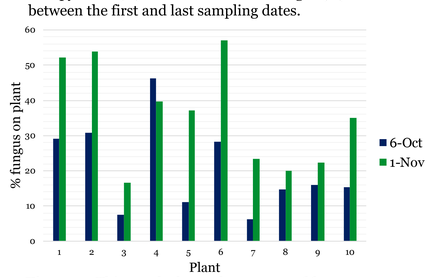

Figure 5. This graph shows the amount of fungus spread per plant (%) in the 10 plants with ojo de gallo. Blue and green bars represent first and last day of sampling, respectively.

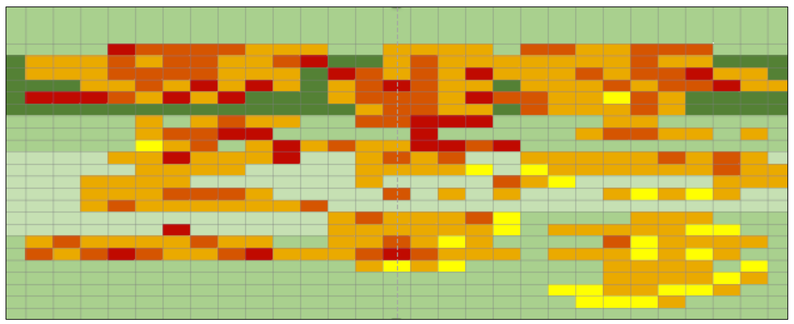

Figure 6. Heat map of fungal incidence in campus coffee plot. The different shades of green in the background are used to depict different slope (the darker the green the highest the elevation). The yellow, light orange, dark orange, and red colors are used to depict the 4 levels of fungus presence on each plant, from none to high, respectively.

Figure 7. Sample plot on UGA Costa Rica campus.

Acknowledgements

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Results continued

- With increasing overstory cover, there is a decrease in the amount of fungus present (Figure 2) and of fungus growth (Figure 3) on the plant (p=0.01).
- Plants with fungus at the start of the study had an increase in fungus at the end of the study (Figure 5). Plants without fungus remained without fungus.
- There was a negative relationship between percent soil moisture and percent fungus (r^2= 0.37; p= 0.035) (Figure 4).
- Plants without fungus were collected in one area, while plants with varying degrees of fungal incidence were spread throughout the campus plot (Figure 6). Plants with high fungal incidence tend to be clumped together.

Conclusions

- Quantifying the range of moisture and cover within which *M. citricolor* is most present allows for farmers to potentially shift growing practices to avoid loss of yield.
- Previous research found *M. citricolor* to be linked to humidity[2]. The difference between soil moisture effects and humidity effects may be due to stress put on the plant through soil moisture.
- Trees providing the canopy cover may serve as wind protection, making it more difficult for the fungus to spread between plants within a plantation[4].
- Fungus may spread more easily under low light conditions.
- Future research would benefit from larger sample sizes, more sampling periods, and sampling across different seasons.

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