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The role of open areas in the spread of Coffee Rust in San Luis de Monteverde, Costa Rica.

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Background Information

Hemileia vastatrix, commonly known as Coffee Rust or Roya, has been plaguing Central and South American coffee plantations for decades (Avelino et al, 2006). As an airborne fungus it attacks the leaves in such a way that photosynthetic rates are decreased, and the yield of the plant suffers (Anerson et al, 2000). Much has been learned about its effect on a decreased coffee yield. However, little is known how the disease spreads as the industry continues to grow from subsistence agriculture to large scale monocultures. With this switch of agricultural practice, the way that the plots are organized and planted must shift to create higher yields (Avelino et al, 2004). When coffee plots move from small operations to large ones, a higher percentage of plants are exposed to edges, necessary service roads, and both individual plants and entire plots are packed closer together, potentially increase the spread of coffee rust (Avelino et al, 2006).

Methods

Questionnaire
We developed a questionnaire that was distributed to coffee farmers on three separate plots. The questions pertained to clear cutting, intercropping, NPK (Nitrogen, Phosphorus, and Potassium) treatments, and plant variety.

Image 1: Roya on leaf

Field sampling
We visited four different coffee plots (Images 2-4) to record the amount of roya that was visible and the spatial distribution of plants in the plot.

At location four we conducted a pair analysis observing three variables: 1) beans on the plant 2) leaves with roya 3) leaves on the ground surrounding the plant and gave them a numerical value based on their abundance (0-3).

Image 2: CIEE House Plot

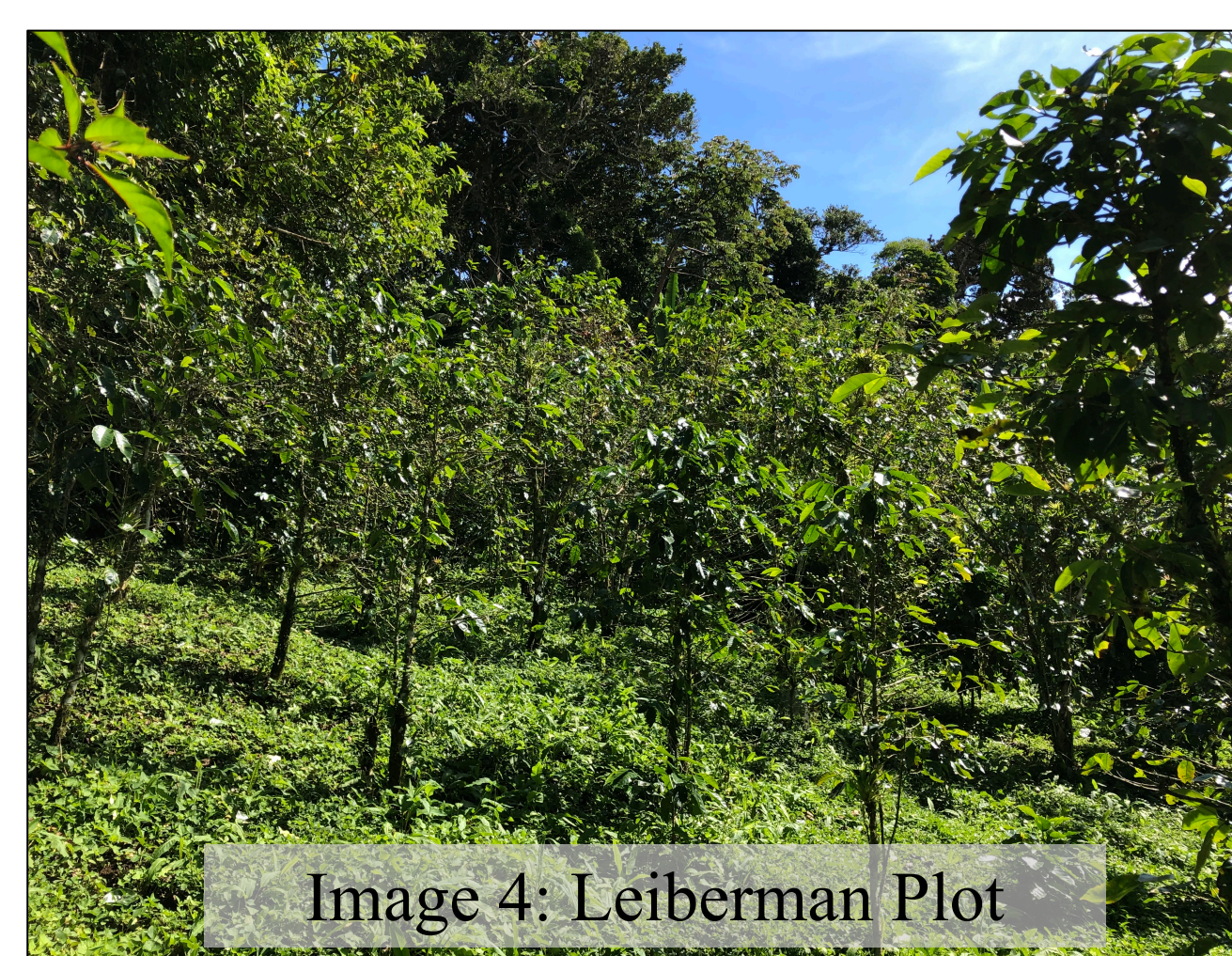Image 3: Mora Plot

Image 4: Leiton Plot

Image 4: Leiberman Plot

Questions

Does increased proximity to open areas increase the prevalence of coffee rust?

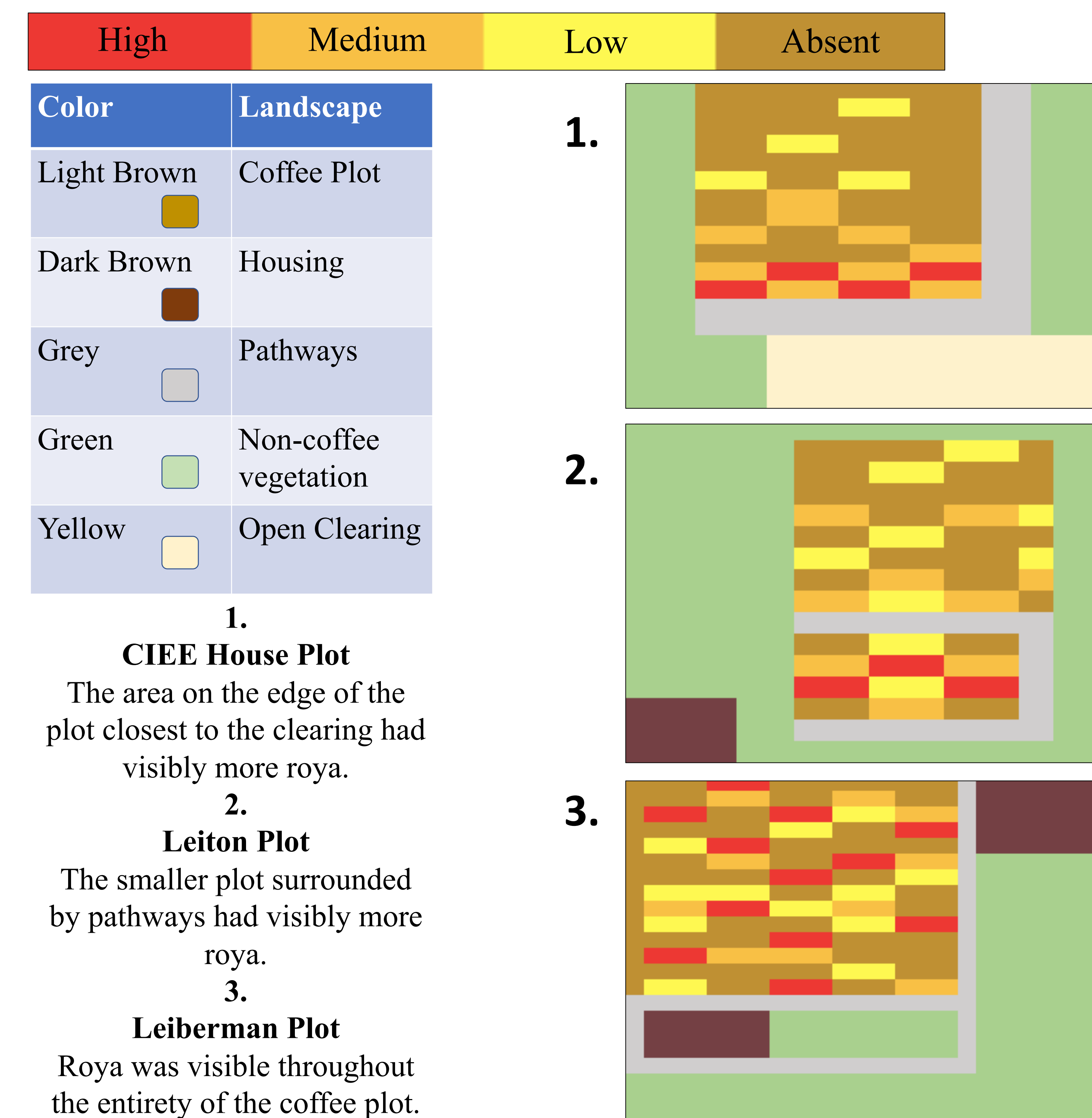### Does vegetation act as a barrier in the spread of coffee rust between plants?

Results

Table 1: Questionnaire results from coffee farmers regarding their farming practices

	Clear Cut	Intercropping	NPK Treatments	Plant Variety
CIEE House Plot	None	None	None	CR-95
Mora Plot	None	Corn, plantains	None	CR-95
Leiton Plot	None	Banana, sugar cane	None	CR-95
Leiberman Plot	0.3 m radii around each plant	Oranges	Beginning and middle of rainy season	Mixed forest varieties and CR-95

Table 2: Pair analysis and contingency table results for Leiberman Plot

Variables	Beans Vs Roya	Roya Vs Leaves on ground	Leaves on ground Vs Beans	Center plants Vs Edge plants	Even pair Vs Odd pair
P- Value	0.1 < P < 0.5	0.5 < P < 0.75	P < 0.01	0.75 < P < 0.9	0.25 < P < 0.5
Association	None	None	Associated	None	None

Table 3: Heat map of coffee rust abundance on three plots based on observations

High	Medium	Low	Absent

Color	Landscape
Light Brown	Coffee Plot
Dark Brown	Housing
Grey	Pathways
Green	Non-coffee vegetation
Yellow	Open Clearing

1.

1.
CIEE House Plot
The area on the edge of the plot closest to the clearing had visibly more roya.
2.
Leiton Plot
The smaller plot surrounded by pathways had visibly more roya.
3.
Leiberman Plot
Roya was visible throughout the entirety of the coffee plot.

Discussion

Each of the coffee farmers had different management practices (Table 1). The highest proportion (abundance) of roya was found on the Leiberman plot which had the only use of NPK additions as well as clear cutting which could have contributed to the coffee plants having considerably more roya throughout the plot in comparison to the other three locations. A positive association was found between the amount of leaves on the ground and beans on the plant where the fewer number of leaves on the ground coincided with fewer beans on the plant (p <.01). All other variables were found to be unassociated (Table 2). While an association was not found between edge and center plants, the association between leaves on the ground and beans suggest a relationship between clearing around the plants and overall yield. Overall, we can assume that farming practices and plant distribution have some influence on the abundance of roya and the relationship should be explored further when considering moving to a larger scale operation.

References

- Arneson, P.A. (2000). Coffee rust. The Plant Health Instructor.
- Avelino, J., Cristancho, M., Georgiou, S., Imbach, P., Aguilar, L., Bornemann, G., ... & Morales, C. (2015). The coffee rust crises in Colombia and Central America (2008–2013): impacts, plausible causes and proposed solutions. Food Security, 7(2), 303-321.
- Avelino, J., Willocquet, L., & Savary, S. (2004). Effects of crop management patterns on coffee rust epidemics. Plant pathology, 53(5), 541-547.
- Avelino, J., Zelaya, H., Merlo, A., Pineda, A., Ordóñez, M., & Savary, S. (2006). The intensity of a coffee rust epidemic is dependent on production situations. Ecological modelling, 197(3-4), 431-447.

Acknowledgements