MITE BE SMART: NECTAR VOLUME AND ABUNDANCE OF *RHINOSEIUS COLWELLI* IN *CENTROPOGON TALAMANCENSIS*

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Abstract: The mite, *R. colwelli,* resides in *C. talamancensis* flowers and is dependent on hummingbirds for dispersal between flowers. Mite abundance in flowers is positively correlated with number of hummingbird visits, but variation within flowers with equal numbers of hummingbird visits could be attributed to differences in nectar volume. We hypothesized that mites preferentially choose to jump onto flowers with more nectar. We simulated hummingbird visits to flowers with manipulated nectar volume and then quantified mite abundance. We found that flowers with more nectar had more mites. This suggests that mites are able to choose which flowers to inhabit. This may be important because nectar is a food resource and possibly an indicator of a senescing flower.

Key Words: dispersal, hummingbirds

INTRODUCTION

The mite, *Rhinoseius colwelli,* resides in the flowers of *Centropogon talamancensis* (Campanulaceae), which are pollinated by *Eugenes fulgens* hummingbirds. Both mites and hummingbirds consume the *C. talamancensis* nectar. The mites are dependent on the hummingbirds for dispersal between flowers, as they climb onto the bird's beak during a hummingbird visit (Colwell 1973).

Mite abundance in *C. talamancensis* is positively correlated with number of hummingbird visits (Colwell et al. 1974). However, our preliminary data showed that there was still variation in mite abundance between flowers that receive equal pollinator visitation. We hypothesized that this variation might be due to differences in nectar volume, with more mites in flowers with more nectar. If so, this suggests that mites will choose to leave the hummingbird's bill in flowers that contain more nectar. We tested this prediction experimentally in a montane forest in Costa Rica.

METHODS

We created 17 artificial patches of *C. talamancensis* flowers at Estacion Biologica Cuerici, Cerro de la Muerte. Each patch consisted of six randomly selected flowers that we had removed from various *C. talamancensis* plants from around the station. We removed all nectar from each flower using capillary tubes, and then added 8 μL of 30% sugar water to three of the six flowers; thus creating no-nectar and nectar treatments in each patch. Mites were larger than the capillary tube opening; therefore, we assumed they were not disturbed during nectar removal or addition, thus maintaining their original distribution among flowers. The simulated nectar was 50% higher in sugar concentration and three times higher in volume than occurred in flowers in the field. This was done to

exaggerate the difference between no-nectar and nectar treatments.

We created an artificial hummingbird beak using a black toothpick. We inserted the artificial beak into each flower for 2 s to simulate a hummingbird visit. Each flower was visited 10 times in a random order. After these simulated visitations, we dissected each flower and counted mites. We analyzed data with a two-way ANOVA with patch as a random effect and nectar as a fixed effect using JMP 5.0.1. We confirmed that data met the assumptions of normality and homogeneity of variances.

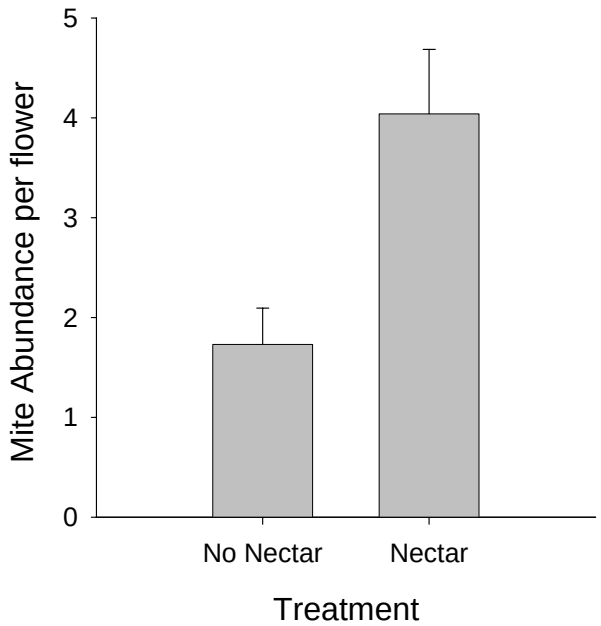

Figure 1. Average mite abundance per flower was higher in the nectar treatment than in the no-nectar treatment.

RESULTS

Total mite abundance in patches ranged from 2 to 39 individuals. Mite abundance was higher in flowers in the nectar treatment (mean = 4.04 $\pm$ 0.65 SE) than in the no-nectar treatment (mean = 1.73 $\pm$ 0.36 SE; $F = 10.50$, df = 1, 79, $P < 0.0025$, Fig 1). One patch was excluded from analysis because of extremely high mite abundance within the patch; however, nectar was still a significant factor when these data were included. Variance in mite abundance between patches was not significant ($F = 1.46$, df = 1, 15, $P > 0.20$).

DISCUSSION

The higher mite abundance in flowers with nectar supports our hypothesis that *R. colwelli* may choose to leave their hummingbird carrier at flowers with greater nectar. This is important to mites because nectar is a food resource. Additionally, increased mite abundance at high-nectar flowers may provide greater access to genetically different mates.

It appears that mites also choose to leave flowers with decreased or low nectar volume, which may be indicative of a senescing flower. Hummingbirds may visit senescing flowers less, thus decreasing the mites' opportunities for dispersal away from diminishing resources to nectar-rich resources. Therefore, the ability to leave a flower with decreased or low nectar may be important for mite survival.

Our experiment did not test the specific cue that mites use to determine nectar abundance. An additional experiment could examine whether sugar concentration, moisture levels, or both act as the cue. Our experiment also exaggerated factors involved in mite dispersal such as nectar

abundance and sugar concentration, and pollinator visits. It would be interesting to examine mite dispersal patterns under realistic conditions to see if this pattern persists.

LITERATURE CITED

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DISTRIBUTION AND ABUNDANCE OF LIANAS IN PRIMARY AND SECONDARY FORESTS AT CERRO DE LA MUERTE

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Abstract: To evaluate the effect of forest structure on liana distribution and abundance, we compared the abundance and cross-sectional area at breast height of lianas between primary forest and secondary montane forests. Primary forest had a higher density of lianas and trees than secondary forest. The mean cross-sectional area of each liana and the number of lianas per tree were not significantly different for the two forest types. The number of lianas per tree was positively related to tree cross-sectional area, possibly because larger trees provide more surface area upon which lianas can climb. Lianas likely colonize and attain greater canopy cover in primary forests than secondary forests, though the species of lianas in each forest type may differ.

Key Words: cross-sectional area, montane forest, structural parasite

INTRODUCTION

Lianas are an important component of tropical forest structure, contributing significantly to total leaf production, woody biomass, and species diversity (Bullock 1990). As photosynthetic structural parasites on trees, liana success is affected by forest structure. Previous work by Laurance (2001) showed that liana abundance was greater near forest edges and in disturbed areas and decreased with tree biomass (Laurance 2001).

Over time, forest structure develops and changes through successional processes. To test changes in liana community with changing forest structure, we examined the difference in liana abundance and size between primary and secondary montane forests in the Talamanca Range, Costa Rica. Similar to disturbed areas, secondary forests have higher light availability and a greater height-stratified network of small branches and stems than primary forests