DIFFERENTIAL NECTAR PRODUCTION OFFERED TO TWO SPECIES OF ANTS (*PSEUDOMYRMEX FERRUGINEA* AND *P. BELTI*) BY THEIR OBLIGATE MUTUALIST HOST *ACACIA COLLENSII*

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Abstract. Of two ant species, *P. ferruginea* and *P. belti*, that occur as obligate mutualists with *Acacia collensii*, the former has been reported to defend their host more aggressively. We addressed the question of whether acacias occupied by the more aggressive *P. ferruginea* will produce more nectar than acacias occupied by *P. belti*. Nectar production was quantified by counting the number of exuding nectaries on branches from which ants had been excluded for a 2 hour period in the dry forest of Palo Verde. Results showed that nectar production (# of nectaries exuding and absolute volume) by *P. ferruginea*-occupied acacias was significantly greater than nectar production by *P. belti*-occupied acacias. Findings support the idea that trees hosting the more aggressive *P. ferruginea* are healthier and more productive due to their mutualists' defensive success and therefore are capable of exuding more nectar than trees occupied by *P. belti*. (SAW)

INTRODUCTION (EWG)

Acacia trees (*Acacia collensii*) have evolved to exist in a mutualistic relationship with ants. Two species of ants, *Pseudomyrmex ferruginea* and *P. belti*, are obligate to this acacia. Previous observations of the ants have shown that *P. ferruginea* is more aggressive and potentially a better defender of the acacia plant (FSP project 1991, Janzen 1983). If so, acacia plants inhabited by *P. ferruginea* might provide more reward to maintain this more aggressive species. To test this possibility, we hypothesized that these acacias would exude a greater amount of nectar than those inhabited by *P. belti*.

METHODS (JVK)

Theoretically, rewards for ants should best be expressed in units of energy/time/unit of tree. For this study, we quantified reward as a volume of nectar produced. Volume was measured by keeping ants away from a selected branch for a fixed period and counting the number of nectaries that exuded over time, and by collecting nectar in capillary tubes and measuring the height of nectar taken up.

The experiment was performed at a site off the road 700m east of the OTS Field Station at Palo Verde National Park, Costa Rica. We selected trees with a 2-4cm diameter at breast height to standardize tree size. We assumed that trees within this range did not differ significantly in reward response to the ants. A total of 16 trees were treated, eight containing *P. ferruginea* and eight with *P. belti*. The two branches from each tree chosen for treatment were closest to breast height, extending in opposite directions if possible, and contained at least 15 nectaries. Ants were excluded by spreading tanglefoot on the chosen branches and removing any ants present. Trees were treated in an alternating pattern between *P. ferruginea* and *P. belti* acacia trees to reduce the effect of time of day on nectar production.

We returned to the trees two hours later to determine nectar production levels. We counted the number of exuding nectaries out of the first 15 individual nectaries from the tip of each treated branch. Ants still present on the branches were also counted to consider the effect of their feeding rate on nectar production. The cumulative volume of nectar from each ant species' acacia trees was also collected in capillary tubes and measured for comparison with the nectary data.

RESULTS (ABS)

The estimate of nectar volume produced by trees harboring *P. belti* ($4.81\pm4.39mm^3$) differed significantly ($U=173$, $p=.05$) from those occupied by *P. ferruginea* ($8.38\pm5.32mm^3$).

Despite the presence of tanglefoot, ants of each species invaded some of the excluded branches. If *P. belti* invaded branches in greater numbers than *P. ferruginea*, an apparent reduction of reward produced could have resulted. However, this was unlikely for two reasons. First, the number of *P. ferruginea* invaders ($n=61$) was not significantly different from the number of *P. belti* invaders ($n=73$; $U=98$, $p>0.1$). Second, a regression of the number of nectaries filled on the number of ants that invaded a branch suggests that one ant consumed nectar from approximately 0.5 nectaries in the 2 hour time interval (Figure 1). Given this relationship, we were able to transform the data to predict the number of nectaries that would have been filled without the ant invaders:

Predicted number of nectaries filled= (# of ant invaders) (slope) + (filled nectaries)

With these transformations, the difference in the nectar produced by *P. belti* trees ($7.09\pm4.68mm^3$) from that produced by *P. ferruginea* individuals ($10.28\pm3.66mm^3$) was more significant ($U=183$, $p<0.25$) than the non-transformed data ($p=.05$, see above).

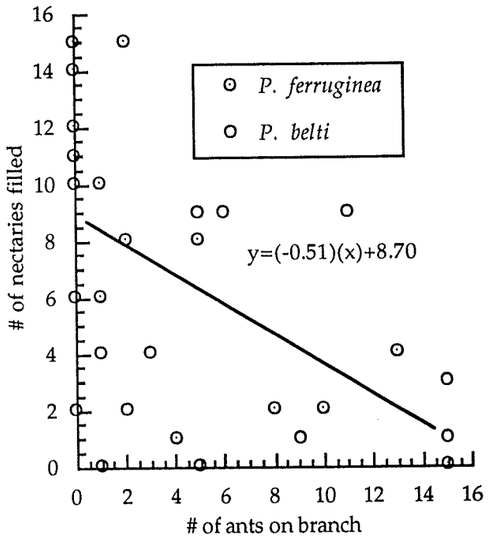

Figure 1. The number of nectaries filled as a function of the number of ants on the branch.

For the total nectar volume collected, $29.9mm^3$ was obtained from trees associated with *P. ferruginea* while $8.1mm^3$ was obtained from those with *P. belti*.

DISCUSSION (JLB)

The results gathered show that acacias occupied by *P. ferruginea* produced a greater amount of nectar, measured as percentage of nectaries exuding, than trees occupied by *P. belti*.

The absolute volumes supported these results and therefore we think the sampling technique is an accurate estimate of nectar volume. No analysis was performed on nutrient concentrations of the nectar, this is a possible area for future study.

P. ferruginea has been described as the more aggressive of the two ant species studied (FSP 91) which suggests two possible evolutionary scenarios. The more aggressive species might better defend the host tree, therefore increasing the tree's fitness and enabling it to produce greater volumes of nectar. Alternatively, the more aggressive ants could be more successful in initiating colonization and maintaining the more productive trees.

Differentiating between these two theories and their possible implications may be clarified by further investigation of a tree's fitness over time. Simultaneous volumetric measurements of nectar production from both species of occupied acacias would aid in this assessment.