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Analysis of the predator reluctance and prey rejection of weaver ants with *Lupro*ps as single prey resource

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ABSTRACT

Massive seasonal invasion of the litter dwelling beetle, *Luprops tristis* (Fabricius, 1801) (Coleoptera: Tenebrionidae: Lupropini), into the residential buildings and their prolonged stay in a state of dormancy during the rainy season has been a serious nuisance in the rubber plantation belts of Kerala for the last three decades. The deterring defensive secretion of the beetles is the prime reason for the non-predation by any of the vertebrate or non vertebrate predators present in the breeding habitat or in the aggregation shelters. Recent efforts revealed that the weaver ants (*Oecophylla smaragdina* Fabricius, 1775) could be a potential bio-control agent of *Luprops* beetles. However, the possibility of its failure as a bio-control agent remains as repeated feeding on a prey item with repelling defensive gland secretion leading to development of predator reluctance and prey rejection. The present work ascertained the effect of repeated feeding of weaver ants on *Luprops* and the results indicate that repeated feeding did not lead to predator reluctance and point out the potential of weaver ants as an effective bio-control agent against *Luprops*. Low abundance of weaver ants in rubber plantations in contrast to their higher incidence in the scarce native trees in rubber plantation belts indicates that rubber tree is not a preferred host plant for weaver ants. Further, the possibility of regular feeding on *Luprops* that are readily available in rubber plantations, leads to questions about prey suitability and the effects on the rates of development, reproduction or survival of weaver ants which calls for post-evaluation studies in field conditions after the preliminary field trials.

Key words: Mupli beetles, weaver ants, bio-control agent, Predator reluctance

INTRODUCTION

The litter dwelling detritivorous beetle *Luprops tristis* (Mulpi beetle), inhabiting the rubber plantation litter is a serious nuisance pest in Kerala, as huge aggregations comprising millions of individuals invade residential buildings and these nocturnally active creatures have been making lives of people miserable in the rubber plantation belts of the south western Ghats for the last three decades. The life history, aggregation and dormancy, population dynamics and defensive glands of the *Luprops* beetles are well studied (Sabu *et al*., 2008; Vinod and Sabu, 2009; Sabu and Vinod, 2009; Abhitha *et al*., 2010). No efficient strategies for controlling the population build up of *L. tristis* is available and its selection of rubber litter layers as breeding habitat and residential buildings as shelter during the rainy season makes insecticide based control a tough task. There is a critical need to develop environmentally benign control tactics by identifying the natural enemies and biopesticides that would enable regulation of its population build though not complete eradication. Search for the potential biocontrol agents in its natural habitat revealed that none of the potential natural enemies feed upon live *Luprops* possibly due to the defensive glands secretion released. However recent efforts revealed the possibility of employing weaver ants as a potential biocontrol agent as they are not repelled by the secretions and they readily feed upon *Luprops* in the studies conducted in lab and in field conditions (Aswathi and Sabu, 2011). These findings are significant considering the deterring effect of defensive gland secretions of *Luprops* on vertebrate and invertebrate predators. However, the deterring effect of gland secretions of *Luprops* even on larger predators like birds and lizards and the rejection of *Luprops* as a food item by domestic hens after a few attempts leads to the question whether the gland secretions and its probable obnoxious taste will prevent the weaver ants from selecting it as a regular food item after the initial attempts. Hence, there is a possibility that though identified as a potential biocontrol agent, it may turn out to be a failure in the long run. In the present study, feeding pattern of weaver ants on *Luprops* was evaluated in no choice experimental set up to assess whether repeated feeding leads to prey rejection and its failure as an effective biocontrol agent.

MATERIALS AND METHODS

Collection of weaver ants and *Luprops* beetles

The experiment was carried out during June 2011 at Department of Zoology, St. Joseph's College, Devagiri, Calicut, Kerala. *Luprops* beetles were obtained from rubber plantation by litter sifting during the month of April and were reared in the lab. Nesting colony of the weaver ants along with the tree branch was cut and the cut end was dipped in water kept in a plastic container (6 cm diameter and 25cm height) half filled with sand.

Experimental set up

The container holding the nesting colony of weaver ants was kept in the middle of the earthen vessel half filled with rubber litter. The whole set up was kept in the middle of a plastic tray half filled with water. A fixed number of beetles (n=10) was released into the clay vessel and were provided with wilted tender rubber leaves for feeding. Numbers of fed and unfed beetles were recorded at 24 hrs intervals and fed beetles were replaced with fresh ones from the stock collection for five days. Five replicates were maintained. Significance level of variation in the number of fed beetles on second, third, fourth and fifth day in relation with first day was analysed with one-way ANOVA. All statistical analyses were done with Minitab 16 Academic Software for windows.

RESULTS

The weaver ants preyed effectively on *Luprops* beetles with an average of 84% on first day and 80%, 78%, 74% and 76% respectively on the next four days. The number of beetles preyed by the ants on the first day do not vary significantly from that of each of the following day ($p>0.05$) (Table 1).

DISCUSSION

Results establish that the weaver ants are not deterred by the gland secretions and continued feeding on the same prey item does not deter them and they readily feed on *Luprops*. Hence *Oecophylla* could be used as a potential bio-control against *Luprops*. In addition to their direct feeding, their presence in rubber plantations would lead to deposition of trail pheromones on the substrate where they forage throughout the home range of the colonies (Hçlldobler and Wilson, 1978; Hçlldobler, 1983). It has also been shown that these pheromones which are very persistent (Beugnon and Dejean, 1992) and covering the entire ant territories may present reliable cues of ant presence and predation risk and therefore warn potential prey (Offenberg *et al.*, 2004a, 2004b). Hence we postulate that introduction of weaver ants and its establishment will lead to direct feeding as well as the possibility of *Luprops* not selecting plantations with incidence of weaver ants as its breeding habitat.

Positive aspect of the present study is that it enabled identification of a native natural predator against *Luprops* that is not deterred by its defensive mechanism. Next step is post-evaluation studies in field conditions. A practical suggestion to promote progress in the selection of bio-control candidates is to publish, prior to release, a prioritized list of candidates together with predictions for the establishment and effectiveness of each one, based on whatever preliminary studies have been done (Kluge, 2000). Comparison of predictions and post-release results would contribute to the improvement of the methods used. We anticipate two main risks in biocontrol of *Luprops* with weaver ants while attempting to launch them in the field.

Low abundance of weaver ants in rubber plantations in contrast to their aggregation on specific native trees in the rubber plantation belts indicate that the rubber trees are not preferred host plant of weaver ants for the following reasons. The synchronous annual leaf shedding of rubber trees followed by 2-3 weeks of 'no-leaf' conditions in the monoculture rubber plantation forests (Sabu and Vinod, 2009) and the very rare occurrence of alternate host plants for nest construction in rubber plantations do not facilitate the establishment of ant colonies for more than a season. Introduction of native host plants that can grow in the shade of rubber like *Terminalia paniculata* Roth. (Maruthu), *Careya*

Table 1. Predatory behavior of weaver ants on *Luprops* beetles

Set up	No. of beetles fed				
	Day1	Day 2	Day 3	Day 4	day 5
A	8	8	8	7	7
B	10	10	9	9	10
C	8	6	7	6	7
D	9	9	8	7	7
E	7	7	7	8	7
Mean ± SD	**8.4 ± 1.14**	**8 ± 1.58**	**7.8 ± 0.84**	**7.4 ± 1.14**	**7.6 ± 1.34**

arborea Roxb. (Pezhu), *Eupatorium odoratum* L. (Appa), *Theobroma cacao* L. (Cocoa) and *Mangifera indica* L. (mango tree) could solve the problem of non-availability of host plants during the leaf shedding period in rubber belts. Another reason for the low abundance of weaver ants could be the near absence of herbivorous and phytophagous insect pests and hence the low prey resource availability in rubber plantations. It is likely that the annual spraying of Bordeaux mixture, COC (Phytolan) and sulphur dust done on a regular basis in rubber plantations prevent the establishment of fungivorous and herbivores insects that might have attracted omnivores/predators to rubber canopy. It is likely that the low abundance of food resources in the canopy may lead to more frequent foraging of weaver ants in rubber litter floor.

The possibility of higher feeding on *Luprops* with defensive gland secretions and its distastefulness, leads to questions about prey suitability. If certain types of prey are not suitable (i.e., they have low nutritional quality for the predator), the predator may ultimately reject the prey, or it may continue feeding, but with detrimental effects. The negative effects include reduced rates of development, reproduction or survival. In some cases, predators continue feeding when the prey contains toxins that result in the predator's death (Obrycki and Orr, 1990, Hodek, 1993; Albuquerque *et al*., 1997). Analysis of these aspects requires long time; hence we suggest to conduct post-evaluation studies in field conditions after the introduction of weaver ants selected *Luprops* infected plantations and to control the emerging patterns.

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