Biocontrol of home invading rubber litter beetle, *Luprops tristis* with weaver ants (*Oecophylla smaragdina*)

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ABSTRACT

Seasonal mass invasion of a litter-dwelling detritivorous beetle, *Luprops tristis* (Fabricius) (Coleoptera: Tenebrionidae) into residential buildings prior to the onset of south west monsoon showers and subsequent aggregation in prolonged state of dormancy render them a very serious nuisance pest in rubber plantation tracts in the Western Ghats. Despite their widespread presence as a nuisance pest with astonishing abundance, no efficient strategies for controlling the population build up of *L. tristis* have been developed and its presence in residential buildings during the rainy season and in the bottom layers of rubber litter during post rainy season makes insecticide based control a tough task. Predatory efficiency of weaver ants (*Oecophylla smaragdina,* Fabricius) on *L. tristis* were tested in both lab and field conditions. Active predation of the weaver ants on the beetle *L. tristis* during both nocturnal and diurnal conditions and the non-deterrence by the gland secretions indicates that weaver ants is an efficient natural predator of *L. tristis,* and has the potential to be used as an effective biocontrol agent to regulate the population build up of *L. tristis.* However, the lack of host plants of weaver ants in the monoculture rubber plantations and the negative attitude of stakeholders in view of their aggressiveness may hinder the introduction of weaver ants as an effective predator of *L. tristis* in rubber plantations.

Key words: Mupli beetle, predation, weaver ants

INTRODUCTION

Seasonal mass invasion of a litter-dwelling detritivorous beetle, *Luprops tristis* Fabricius (Coleoptera: Tenebrionidae) commonly known as *Mupli vandu* or *Ola prani* or *Olachathan* very serious nuisance pest in rubber plantation tracts in the Western Ghats in southern India (Sabu *et al.,* 2008). Despite three decades of their widespread presence as a nuisance pest with astonishing abundance, no efficient strategies for controlling the population build up of *L. tristis* have been developed and its presence in residential buildings during the rainy season and in the bottom layers of rubber litter layers during post rainy season makes insecticide based control a tough task. Presence of many alternate host plants in addition to rubber indicates that it has the potential to spread into non-rubber belts (Sabu *et al.*, 2012). Among the natural predators *viz*., house lizards (*Hemidactylus frenatus,* Schlegel), huntsman spiders (*Heteropoda venatoria,* Latreille), domestic fowl (*Gallus gallus,* Linnaeus) and weaver ants (*Oecophylla smaragdina,* Fabricius) that feed up on *L. tristis,* all except weaver ants are deterred by the defensive glands secretions of the beetle (Sabu *et al.,* 2008; Aswathi and Sabu, 2011). *Oecophylla smaragdina* known as the 'living pesticide' is utilized in biological control of crop pests (Konishi and Itô, 1973; Hölldobler and Wilson, 1990). In modern times, a number of ecologists, studying biological pest management in the tropics, have tried to test its economical value with rigorous scientific methods, and most of them have suggested that the predatory power of *Oecophylla* is most outstanding among ants in their localities (Way and Khoo, 1992; Peng *et al*., 2004, 2008, 2011; Peng and Christian, 2005; Van Mele, 2008).We hypothesize that in an applied biological control context, weaver ants (*Oecophylla smaragdina*) are most likely to be an effective biocontrol against *L. tristis* in rubber plantations as it actively patrols canopies and ground floor (Holldobler and Wilson, 1990) and preys upon or deters a wide range of potential pests. In the present effort, predatory efficiency of weaver ants on *L. tristis* were tested in both lab and field conditions.

MATERIALS AND METHODS

The experiment was carried out during March–May 2011. The laboratory experiments were conducted at the Department of Zoology, Devagiri College campus, Calicut, Kerala and the field experiments in a rubber plantation adjoining the college campus. *L. tristis* are nocturnally active beetles present in upper litter layers during dusk to dawn and with a cryptic nature present below litter layers during day time (Sabu *et al*., 2008). In contrast weaver ants are active during both day and night (Tsuji *et al.*, 2004). Hence experiments were conducted during both day and night. Beetles were collected from the rubber plantation litter by litter sifting and ten beetles each were transferred to mesh-topped large clay vessel (13 x 35 cm) half-filled with soil and freshly fallen rubber plantation litter.

Nesting colonies of the weaver ants along with the tree branches were cut from the rubber plantation and the cut end of the tree branch was dipped in water kept in a plastic container (6 cm diameter and 25 cm height) half filled with sand in the laboratory. Bottle holding the nesting colony of weaver ants was kept in the middle of the earthen vessel containing *L. tristis* beetles and rubber litter. The whole set up was kept in the middle of a plastic tray half filled with water. The diurnal (6 am–6 pm) and nocturnal (6 pm–6 am) feeding experiments were conducted and the number of fed and unfed beetles were recorded at 12 hrs intervals. Each experiment was replicated ten times employing fresh nesting colonies of weaver ants to avoid the possibility of predator reluctance due to repeated feeding on the same prey items as recorded for domestic fowl (personal observations, First author). The same experiment was conducted in field conditions by placing the earthen vessels with beetles in the midst of weaver ants infested litter accumulated in the base of a low height mango tree.

Significance level of variation in the number of fed beetles between field and laboratory experiment set ups and between nocturnal and diurnal experiment set ups were analysed with one-way ANOVA. All statistical analyses were done with Minitab 16 Academic Software for windows.

RESULTS

The weaver ants effectively preyed upon *L. tristis* during both day and night feeding experiments conducted in field and laboratory set ups. 99.5% and 97 % feeding was recorded in both field and laboratory the experiment set ups respectively. There was no significant variation in the number of beetles fed in laboratory and filed experiments and in the nocturnal and diurnal experiments in both field and laboratory ($p>0.05$, Table 1).

DISCUSSION

Active predation of the weaver ants on the beetle *L. tristis* during both nocturnal and diurnal conditions and the non-deterrence by the gland secretions (Aswathi and Sabu, 2011) indicates that weaver ants are an efficient natural predator of *L. tristis*, and has the potential to be used as an effective biocontrol agent to regulate the population build up of *L. tristis*.

Table 1. Number of *L. tristis* (Mean ± SD) consumed by weaver ants in laboratory and field experiments.

Experiment type	Mean ±SD		
	Nocturnal	Diurnal	Nocturnal+ Diurnal
Field	10.00±0.00	9.90±0.32	9.95±0.22
Laboratory	9.80±4.20	9.60±0.70	9.70±0.56

Our observations revealed that the gland secretion of *L. tristis* makes the initial attackers to move away from the beetle. But the relentless confrontation by other ants from different fronts makes *L. tristis* defenseless and the weaver ants take away the caught beetle. It is possible that the glands become empty of secretions after the initial confrontation with initial attackers and makes the beetle defenseless against the subsequent attackers. Encouraged by the present results which lead to the identification of first effective predator of the *L. tristis* in the region, the next step is introduction of the concept to the stakeholder namely the rubber planters in the *L. tristis* identified plantation belts. We anticipate the following practical difficulties in the attempt for controlling *L. tristis* with weaver ants in rubber plantations.

Negative attitude of people towards weaver ants and unawareness of their beneficial effects: It is certain that the proposal to introduce weaver ants against the beetle is less likely to be welcomed by the stakeholders in view of their aggressiveness and the practical difficulties it would pause to the rubber labourers during daily rubber tapping. Weaver ant aggression has been an obstacle for its use in many parts of the world, mainly in plantations, and therefore *Oecophylla* has often been considered a pest (Way and Khoo, 1992). Van Mele and Cuc (2003) describe how to reduce ant bites when collecting nests or harvesting fruit by dusting the hands with wood ash which is an effective local practice (Brigitta, 2003) that was developed independently in Asia and Africa and is well known to the farmers in the region.

Lack of the host plants and the low abundance of weaver ants in rubber plantations belts: Though very common in the region, weaver ants are less common in rubber plantations (personal observations). It is attributed to the synchronous leaf shedding and leaf sprouting of deciduous rubber tees in the monoculture rubber plantations lasting two weeks (Sabu and Vinod, 2009) which would not facilitate nest construction in the canopy; lack of food resources in the rubber estates linked to the removal of native trees that harbours the weaver ants and the resulting absence of host plants of the weaver ants and lesser incidence of prey resources in the canopy due to the near absence of herbivorous insects feeding on rubber leaves and litter arthropod prey resource in rubber plantation litter stands which are devoid of litter for a considerable period of time due to faster decomposition of rubber leaf litter (Vineesh, 2007). Hence weaver ants based attempts to control of *L. tristis* would warrant introduction of the preferred host plants of weaver ants in the monoculture rubber plantations. Though weaver ants are good ground foragers (Jander and Jander, 1998) they are predominantly arboreal in nature and selection of low height host plants is expected to bring the ants more frequently to the ground level.

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