JBiopest, 5 (Supplementary): 188-191 (2012)

Potential of rubber litter dwelling ants as biocontrol agent of home invading nuisance pest, *Luprops tristis*

Sabu K. Thomas* and P. Aswathi

ABSTRACT

Identification of rubber plantation litter floor as the breeding and feeding habitat of the home invading nuisance pest, *Luprops tristis* (Fabricius) and presence of its egg, larval forms and pupae in litter layers leads to the possibility of using litter dwelling predatory ants as a potential biocontrol agent to control its population build up. Search for data on the predatory litter ant species associated with rubber plantations revealed that no data exists on the species composition and abundance of litter ant community associated with the rubber plantation forests of the Western Ghats. In the present study, collection of litter ants from the rubber plantations were done following the annual leaf shedding employing pit fall traps and with traps baited with live mobile and immobile *L. tristis* beetles to identify the ants that may prey upon the beetles. Results revealed low abundance and species richness of litter ants in rubber plantation litter habitat and none of the ant species present in the rubber plantation litter could be used as a biocontrol agent to control *L. tristis* as all are deterred either by the defensive gland secretion or by the larger size and the active movement of *L. tristis* beetle.

Key words: Biocontrol, litter dwelling beetle, predator, rubber litter ants

INTRODUCTION

Luprops tristis (Fabricius, 1801) (Coleoptera: Tenebrionidae: Lagriinae: Lupropini) is a litter dwelling detritivorous beetle abundant in rubber plantations in south India. Its seasonal invasion into residential buildings, indoor nocturnal movements, mass aggregation and subsequent prolonged dormancy make them a serious nuisance pest (Sabu and Vinod, 2009; Sabu *et al*., 2008). 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 of rubber litter layers during post rainy season makes insecticide based control a practically tough task. Hence there is a critical need to develop environmentally benign control tactics and identification of natural enemies and their introduction would be a right step in this direction. Search for the natural predators in aggregation sites revealed that though huntsman spider (*Heteropoda venatoria*) and house gecko (*Hemidactylus frenatus*) occasionally prey upon these beetles, they are deterred by the defensive gland secretions released by the beetles (Aswathi and Sabu, 2011). No other suitable natural predators exists in their aggregation sites and next option is to spot the potential natural enemies in its breeding and feeding habitat namely rubber plantation litter habitat. Search for the potential predators in rubber plantation litter stands revealed that a major fraction of litter arthropods in rubber plantation litter stands is ants (Vineesh, 2007; Jobi, 2006) which are well known generalist predators often used as biological control agents of insect pests (Dirk and Frank, 2011; Hölldobler and Wilson, 1990). There is a possibility that, some of the ant species are not deterred by the glandular secretions and could turn out to be potential biocontrol agent of *L. tristis.* However, as such no species specific data about rubber litter dwelling ant composition from the region exists.

Furthermore, during the efforts to identify the natural enemies of *L. tristis* in residential buildings and to identify the potential effect of defensive gland secretions in deterring the potential predators in residential buildings (Aswathi and Sabu, 2011), it was observed that even the small sized ants would feed on immobile *L. tristis* in contrast to the non-feeding reported from rubber plantation litter (Sabu *et al.,* 2008). Hence we hypothesize that all ant species are not deterred by the defensive gland secretions and there may be a few ants that are deterred by the large size and active movements of the beetle which would be the reason for non-predation by a set of smaller ants in rubber litter habitat. With this background, the present work provides data on the species composition and abundance pattern of the litter ant community in rubber plantations; attempts to identify the rubber litter dwelling ants that feed upon *L. tristis* and to ascertain the reasons for the non-predation of *L. tristis* by the litter dwelling ants.

MATERIALS AND METHODS

The study was conducted in the rubber plantations near by the Devagiri College campus, Calicut from May to July, 2011. The major ant species present in the rubber plantation was collected using pit fall traps and *L. tristis* baited traps were used to identify the potential predatory ants of *L. tristis*. A set of 10 pit fall traps were kept 20 meters apart from each other for sampling. Sampling was done for 12 hrs. Trapped litter ants were transferred to 70% ethyl alcohol, identified and abundance and incidence data were recorded.

Two types of baited traps were used, one with leg-removed *L. tristis* (here after referred as immobile beetles) and the other with normal field collected mobile *L. tristis* beetles for identifying the ant species that may prey up on the beetle. Immobile beetles were used to test whether the active movements of the beetles are preventing the predation by ant predators. Five beetles each were placed in plastic vials covered with nylon nets of appropriate mesh size and the vials were kept 20 meters apart from each other in rubber plantation litter floor loosely covered with rubber litter. Each experiment was replicated 10 times. Sampling was done at 12 hrs intervals (6 am-6 pm; 6 pm-6 am period). Significance level of variation in the abundance was analyzed with ANOVA employing Minitab academic software.

RESULTS

Species composition and abundance pattern of litter ants: Six species of ants were collected using pit fall traps with *Myrmica smythiesi* (Florel), *Lophomyrmex quadrispinosus* (Jerdon) and *Diacamma rugosum* (Le Guillou) as the major species and *Anoplolepis gracilipes* (Smith), *Mernoplus bicolor* (Guérin-Méneville), *Camponotus sericeus* (Fabricius) as the minor species. *M. smythiesi* was the dominant species ($p<0.05$). *Anoplolepis gracilipes, L. quadrispinosus* and *M. smythiesi* were the major species as per frequency data, being collected from all the ten pits. *Diacamma rugosum* was collected from eight pits and *M. bicolor* from four pits. *Camponotus sericeus* showed the lowest incidence (Table 1).

Predatory experiments using *L. tristis* as prey: *Lophomyrmex quadrispinosus, M. smythiesi* and *D. rugosum* were found feeding on immobile *L. tristis* with the highest incidence of predation by *D.rugosum*. *Diacamma rugosum* was present during morning hours and the other two species (*M. smythiesi, L. quadrispinosus*) during day time (Table 2). *Anoplolepis gracilipes* alone was recorded from all experiment set ups with mobile *L. tristis* beetles as prey.

DISCUSSION

The study revealed low species richness and abundance of litter ants in rubber plantations compared to regional forests (Vineesh, 2007; Vineesh *et al.,* 2007). Lesser incidence of prey resources in the rubber plantations, and the distinct seasonal availability of litter in rubber plantations which are devoid of litter for a considerable period of time due to faster decomposition and the seasonal leaf shedding of the deciduous rubber trees (Vineesh, 2007; Sabu and Vinod, 2009), could be the reason for the low species richness of ants in monoculture rubber plantation 'forests'. Another reason could be the abundance of yellow crazy ant which is among the most aggressive invasive ants in the world (Holway *et al.,* 2002*,* Wetterer, 2005). Yellow crazy ant has been implicated in ecological meltdowns (Hill *et al.,* 2003; O'Dowd *et al.,* 2003) because of its profound effects on local fauna (Bos *et al.,* 2008; Nirdev *et al.*, 2011). It is a generalist with respect to nesting sites and food preferences and can develop super colonies in warm and moist soils and litter layers (Abbott, 2006) and is likely to profit from low tree densities at the cost of native tree-nesting and foraging ant species (Bos *et al.*, 2008).

Dominance of *Myrmica smythiesi* in rubber plantations indicate that this species is the most adapted to survive in rubber plantation litter. Data is lacking about its habitat preference or feeding preferences to reach at conclusions for

Table 1. The abundance (mean± SD) and incidence data of litter ants trapped with pit fall traps from rubber plantation.

Species	Abundance	Incidence
Anoplolepis gracilipes	3.60±1.65	10
Lophomyrmex quadrispinosus	9.80±3.71	10
Diacamma rugosum	7.00±5.58	8
Myrmica smythiesi	16.20±7.57	10
Mernoplus bicolor	2.60±3.44	4
Camponotus sericeus	0.20±0.42	2

Table 2. The incidence data of the ant species collected from the rubber plantations using baited traps (n=10) with mobile and immobile *L. tristis* as bait

Ant species	frequency of occurrence in traps	
	mobile beetles	immobile beetles
Anoplolepis gracilipes	10	0
Lophomyrmex quadrispinosus	0	4
Diacamma rugosum	0	10
Myrmica smythiesi	0	6
Mernoplus bicolor	0	0
Camponotus sericeus	0	0

the higher abundance in rubber plantation litter. *Myrmica* ants are predatory forms foraging mainly on the ground surface, in litter or on herbs. They nest in soil, frequently under stones and pieces of old wood, in rotting tree stumps, in logs and branches lying on the ground, under moss, in tufts of grass, and in litter **(**Elms *et al.,* 1998**).** It could be their capacity to nest in soil below stones and pieces of old wood lying on the ground in rubber plantations that lead to its higher abundance in rubber litter. Collembolans make up a significant fraction of the *Myrmica* food (Reznikova and Panteleeva, 2001). However, abundance of collembola is not so high in rubber plantations (Vineesh, 2007) and hence that may not be the major reason for its high abundance in rubber belts. *Lophomyrmex quadrispinosus* is a common ground dweller and surface scavenger in secondary forests, with a heterogenous diet that includes many kinds of dead and living invertebrates, isopods, arachnids, termites, cockroaches, flies, larvae of various insect groups as well as other ants. They are well adapted for hunting other invertebrates (Fabrizio, 1994). Its subterranean trails that makes it less exposed in the ground surface of rubber plantation litter stands with seasonal litter availability, peculiar mandibular dentition that is useful in cutting hard objects (Fabrizio, 1994) and the presence of dead post dormancy *L. tristis* beetles as abundant prey resource in rubber plantation litter (Sabu *et al.,* 2008) could be the factors that promote its abundance in rubber plantations. Food of the hunter gatherer species, *Diacamma rugosum* usually consists of dead insects and to a lesser extent any sweet secretions (Abe and Uezu, 1977). Availability of dead post dormancy *L. tristis* beetles and sweet secretions present on the fallen rubber flowers could be the reasons for its abundance in rubber litter stands. *D. rugosum* construct simple terrestrial nests, with no distinct mound, and are present beneath stones and decaying bark of logs and at the base of large trees (Harindra, 2010). Its terrestrial nests were used only for a short period as the colony kept moving to new sites and this ability to shift nests could be a reason for their prominence in rubber litter stands with seasonal litter availability.

Among the six species of ants recorded from rubber litter none fed on the mobile and live beetles kept in containers whereas three species fed on immobile beetles. Non-feeding on caged mobile beetles indicates that it could be the large size and the defensive gland secretions of *L. tristis* which makes it non-choice for others**.** However, feeding by three species on immobile beetles namely, *M. smythiesi, L. quadrispinosus* and *D. rugosum,* indicate that these three ant species are deterred by active movements and hence their inability to prey up on *L. tristis* beetles. Other three species, *M. bicolor, C. sericeus* and the crazy ant, *A. gracilipes,* which subdue and kill prey items using formic acid secretions (O'Dowd, 2004), are deterred by the defensive gland secretions of *L. tristis*. It leads to the conclusion that none of the litter ants in rubber litter stands are capable of preying upon *L. tristis* beetles and none could be used a biocontrol agent to regulate the population of *L. tristis*. However, considering the low species richness of litter ants in the present study site which was a homogenous rubber plantation without other native trees, there may be other species of litter ants in the more heterogeneous rubber plantations in other regions that might be preying up on *L. tristis.* Further studies in heterogeneous rubber plantations are required to rule out the possibility of finding a litter ant species that feed up on *L. tristis*.

ACKNOWLEDGEMENTS

Financial assistance provided by Kerala State Council for Science Technology and Environment (KSCSTE), Government of Kerala is gratefully acknowledged. The authors are grateful to K. A. Karmaly (St. Xavier's College, Alwaye) for identification of ants.

REFERENCES

Abbott, K. L. 2006. Spatial dynamics of supercolonies of the invasive yellow crazy ant, *Anoplolepis gracilipes*, on Christmas Island, Indian Ocean. *Diversity and Distribution*, **12**: 101–110.

Abe, T. and Uezu, K. 1977. Biology of *Diacamma rugosum* (Le Guillou) in the Ryukyu Islands with special reference to foraging behavior. In: *Proceedings of the 8th International Congress,* IUSSI, 142–143 **PP**.

Aswathi, P. and Sabu, T. K. 2011. Weaver ant (*Oecophylla smaragdina*), huntsman spider (*Heteropoda venatoria*) and house gecko (*Hemidactylus frenatus*) as potential biocontrol agents of the nuisance pest, *Luprops tristis*. *Halteres,* **3**: 56–61.

Bos, M. M., Steffan-Dewenter, I. and Tscharntke, T. 2008. The invasive Yellow Crazy Ant in Indonesian cacao agroforests and the decline of forest ant diversity. *Biological Invasions*, **10**: 1399–1409.

Dirk, S. and Frank van Veen, F. J. 2011. Ecosystem engineering and predation: the multi-trophic impact of two ant species. *Journal of Animal Ecology*, **80**(3): 569–576.

Elms, G. W., Thomas, J. A., Wardlaw, J. C., Hochberg, M. E., Clarke, R. T. and Simcox, D. J. 1998. The ecology of Myrmica ants in relation to the conservation of Maculinae butterflies. *Journal of Insect Conservation*, **2**: 67–78.

Fabrizio Rigato. 1994. Revision of the myrmicine ant genus *Lophomyrmex*, with a review on its taxonomic position (Hymenoptera: Formicidae). *Systemic Entomology*, **19**: 47–60.

Harindra E. Amarasinghe. 2010. Species composition and nesting habits of ants in a hill-country home garden in Sri Lanka. *Asian Myrmecology,* **3**: 9–20.

Hill, M., Holm, K., Vel, T., Shah, N. J. and Matyot, P. 2003. Impact of the introduced crazy ant *Anoplolepis gracilipes* on Bird Island, Seychelles. *Biodiversity and Conservation*, **12**: 1969–1984.

Hölldobler, B. and Wilson, E. O. 1990. The Ants. Belknap Press, Harvard University Press, Cambridge, MA.

Holway, D. A., Lach, L., Suarez, A. V., Tsutsui, N. D. and Case, T. J. 2002. The causes and consequences of ant invasion. *The Annual Review of Ecology, Evolution and Systematics,* **33**: 181–233.

Jobi, M. C. 2006. Studies on the biology of *Luprops curticollis (*Coleoptera:Tenebrionidae) and rubber litter insect dynamics in relation to rubber litter fall patterns. *Ph. D. Thesis.* University of Calicut, Kerala. 248 **P**.

Nirdev, P. M., Jobi, M. C. and Sabu K. Thomas. 2011. Analysis of the predator reluctance and prey rejection of weavers ants with Luprops as single prey resource. *Journal of biopesticides,* **4**(2): 106 – 108.

O'Dowd, D. J. 2004. ISSG - Global Invasive Species Database: *Anoplolepis gracilipes*. http://issg.appfa.auckland.ac.nz/database/species distribution_display.asp/si=110 & ri = 18874&pc.

O'Dowd, D. J., Green, P. T. and Lake, P. S. 2003. Invasional 'meltdown' on an oceanic island. *Ecology Letters*, **6**: 812–817.

Reznikova, Zh. I. and Panteleeva, S. N. 2001. Interaction of the Ant *Myrmica rubra* L. as a Predator with Springtails (Collembola) as a mass Prey. *Doklady Biological Sciences,* **380**: 475–477. Translated from Doklady Akademii Nauk, **380**(4): 567–569.

Sabu, T. K. and Vinod, K. V. 2009. Population dynamics of the rubber plantation litter beetle *Luprops tristis*, in relation to annual cycle of foliage phenology of its host, the para rubber tree, *Hevea brasiliensis*. *Journal of Insect Science*, **9**(56): 1–10.

Sabu, T. K., Vinod, K. V. and Jobi, M. C. 2008. Life history, aggregation and dormancy of the rubber plantation litter beetle, *Luprops tristis*, from the rubber plantations of moist south Western Ghats. *Journal of Insect Science,* **8**: 1.

Vineesh, P. J., Sabu, K. T. and Karmaly, K. A. 2007. Community structure and functional group classification of litter ants in the montane evergreen and deciduous forest of Wayanad region of Western Gats, southern India. *Oriental Insects,* **41**: 427–442.

Vineesh, P. J. 2007. Ecology and diversity of entomofauna in the litter stands of monoculture and natural forests in Kannur district. *Ph.D. Thesis.* University of Calicut, Kerala, India.

Wetterer, J. K. 2005. Worldwide distribution and potential spread of the long-legged ant, *Anoplolepis gracilipes* (Hymenoptera: Formicidae). *Sociobiology*, **45**: 77–97.

Sabu K. Thomas* and P. Aswathi
Post Graduate & Research Department of Zoology, St. Joseph's College, Devagiri, Calicut-673008, Kerala State, India.
*Phone: +91 0495 235145, E-mail: sabukthomas@gmail.com

Received: August 16, 2011 Revised: October 10, 2011 Accepted: January 27, 2012