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Studies on *Oecophylla smaragdina* as a bio-control agent against pentatomid bug infesting on *Pongamia* tree

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Abstract

Weaver ants, (*Oecophylla smaragdina*) have been found to predate on pentatomid bug (*Cyclopelta siccifolia*) infesting Pongamia *pinnata* tree in mid-western Ghat region of Shimoga district, Karnataka. The present study was undertaken to evaluate the potential of weaver ants, that are abundant on *P. pinnata* trees, to control the pentatomid bugs. Consistent and systematic field surveillance was carried out for a period of two months, March and July 2010. This showed that the number of pentatomid bugs colony found on branches of tree was significantly lower in tree with abundant weaver ants (11.21-16.84%) than in trees with fewer weaver ants (26.51-38.24%), or in trees without ants (61.42-75.47%) similarly, the branches damaged by pentatomid bug (9.42-11.43%) their in trees with abundant weaver ants which was significantly lower than in trees with fewer weaver ants (16.13-23.24%) and without ants (38.42-51.47%) in March and July. The pentatomid bug colony and their damage was significantly low on trees with abundant weaver ants than with fewer ants, or without the ants. Field observations regarding infestation of pentatomid bugs revealed that weaver ants are effective naturally occurring biological agents help in controlling damage caused by pentatomid bugs on *Pongamia* trees.

Key words

Biological control, *Oecophylla smaragdina,* Pentatomid bug, *Pongamia pinnata, Cyclopelta siccifolia,* Weaver ants.

Introduction

The penatatomid bugs *Cyclopelta siccifolia* (Westwood) commonly known as stink bug, are one of the major pest on *Pongamia pinnata*, *Erythrina indica* (Shashikumar *et al*.,1996; Hosetti *et al*., 1998) and *Robinia pseudoacacia* (Verma *et al*.,2005). *Pongamia* is a drought and saline resistant tree belonging to family leguminaceae. The tree contains kaepmferol and waxes as medically important components. A thick yellow-orange to brown oil is extracted from seeds. The oil is used as a fuel for cooking and lighting house hold lamps in rural area. The oil is also used as a lubricant, pesticide, water-paint binder and soap making and tanning industries. It is effective in enhancing the pigmentation of skin affected by leucoderma or scabies. Roots contain four furo flavines, namely, Karanjin, Pongapin, Pinnatin and Gamatin (Tanka *et al*., 1992). The kernel extract also have some antiviral property (Hosetti *et al*., 1997). This important tree is attacked by *Cyclopelta siccifolia*. They suck the sap from the tender branches of the *Pongamia* thereby reducing the quality of byproduct of the host tree and the seed production. Chemical insecticides tested against the pest (Naveed *et al*., 2001), have resulted in increased economic cost, reduction of natural predators, parasitoid of the insect pests, increased pest resistance to insecticides and environmental pollution.

Weaver ants, (*Oecophylla smaragdina* (Fabricius) Hymenoptera: Formicidae), are known to control over 40 species of insect pests on many tropical tree (Way and Khoo, 1992; Peng *et al.*, 1995, 2000a). This ant lives in leaf nests in the canopy of many tropical trees, and feeds on sugar-rich materials and a range of insects by patrolling various parts of trees. Barzman *et al*. (1996), Van Mele and Cuc (2000) and Van Mele *et al*. (2002) reported that weaver ants were used in citrus orchards in Vietnam. The weaver ant colonies have been successfully used to control red banded thrips in cashew orchards in the Northern territory and Papua New Guinea (Peng *et al.*, 1999). In light of the above, the present study was conducted to investigate the potential of weaver ants in reducing the population of pentatomid bug (*C. siccifolia*) living on *Pongamia* trees.

Materials and Methods

Assessment of pentatomid bug colony : Two field surveys (March and July, 2010) were conducted in B.R.Project area near Kuvempu University campus. In July, the pentatomid bug populations increased, due to newly hatched nymphs form the egg case. The numbers were enumerated by direct count methods. Weaver ant abundance on each tree was assessed at the same time. The number of ant trails on the main branches of a tree was counted by tapping the tree trunk with a stick, and the total number of main branches on the tree was also recorded. The percentage of the main branches with ant trails was calculated for each tree following the method of Peng and Christian (2004). Weaver ant population on a tree was treated as 'Abundant', if $\geq$ 50% of the main branches had ant trails, or as 'Fewer' if <50% of the main branches had ant trails. The pentatomid bug colony among three categories (trees with abundant weaver ants, and Fewer weaver ants, and without ants) were analyzed by a Kruskal-Wallis one-way ANOVA by ranks (nonparametric) (Siegel, 1956) using SYSTAT statistical software (Wilkinson, 1990).

Assessment of damaged branches and leaves: The percentage of damaged branches per *Pongamia* tree was calculated as follows: Total number of damaged branches based on yellowing or wilting of leaves X 100/total number of branches in the main branch of the tree. Both abundance of weaver ants and damaged branch were assessed at the same time. The damage caused by the pentatomid bug was compared for groups of trees (those with abundant weaver ants, fewer weaver ants and no ants) using the Kruskal–Wallis one-way ANOVA by ranks (Siegel, 1956).

The percentage status of damaged leaves of the tree was calculated as follows: Total number of yellow coloration of leaves in the damaged branch X 100/Total number of (yellow+green) leaves in the damaged branch. If the calculated value fell in between 1 to 25% it was treated as mild, 26 to 50% severe, 51 to 75% lethal, if the branch showed wilting of leaves considered as 76 to100%, it is considered as dead. The mean percentage of damaged leaves in a tree was then calculated.

Results and Discussion

During March 2010, the average number of bugs colony found on branches of tree was significantly lower (p < 0.001, df = 3) in tree with abundant weaver ants (11.21%) than in trees with fewer weaver ants (26.51%), or in trees without ants (61.42%) (Table 1). Similar results were observed in July, trees with abundant weaver ants had significantly (p < 0.001, df = 3), lower infestation compared to trees with fewer weaver ants or in trees without ants. The pentatomid bug population was high in July (Table 1) compared to March due to emergence of the nymphs from the eggs.

In the study area, the general observation was that trees with abundant weaver ants were much less damaged by the pentatomid bugs than trees with fewer weaver ants or without weaver ants. The data from March 2010 trial indicated that 9.42% of branches in trees with abundant weaver ants were damaged by pentatomid bug, which was significantly lower (p < 0.001, df = 2) in trees with fewer weaver ants (16.13%) and without ants (38.42%) (Table 2). The mean percentage of damaged branches was more in July. This may be due to emergence of large number nymphs that suck sap from the tender branches (Table 2).

There was a considerable variation in the percentage of leaves damage which was categoriesed into mild, sever, lethal and dead groups. During March 2010, the percent damaged leaves was significantly lower (p < 0.001, df = 3) in tree with abundant weaver ants (15.4%) mild, (6.3%) severe than in trees with fewer weaver ants (19.6%) mild, (9.5%) sever, (2.3%) lethal and (0.4%) dead or in trees without ants (24.3%) mild, (16.1%) sever, (7.4%) lethal, (3.1%) dead. Further during July 2010 the damage to the

Table- 1: Population of *C.siccifolia* colony on *Pongamia* tree

		March 2010	July 2010
Tree with	N	No of bug colony tree^{-1}	No of bug colony tree^{-1}
Abundant *O. smaragdina*	15	11.21±3.5	16.84±6.2
Fewer *O. smaragdina*	8	26.51±8.5	38.24±5.8
No ants *O. smaragdina*	7	61.42±21.8	75.47±29.3
Kruskal –Wallis test		H=18.3, df =3, p < 0.001	H=25.3, df=3, p< 0.001

N= Number of trees examined; Values are mean of replicates ± SD

Table- 2: Damaged branches of *Pongamia* tree caused by *C. siccifolia*

		March 2010	July 2010
Tree with	N	No of bug colony tree^{-1}	No of bug colony tree^{-1}
Abundant *O. smaragdina*	15	9.42±1.4	11.43±4.2
Fewer *O. smaragdina*	8	16.13±3.1	23.24±7.8
No ants *O. smaragdina*	7	38.42±9.8	51.47±21.3
Kruskal –Wallis test		H= 19, df = 2, p < 0.001	H= 28.3, df = 2, p < 0.001

N= Number of trees examined; Values are mean of replicates ± SD

Table 3 : Damaged leaves of *Pongamia* tree caused by *C. siccifolia*

		March 2010				July 2010			
Tree with	**N**	**Mild**	**Severe**	**Lethal**	**Dead**	**Mild**	**Severe**	**Lethal**	**Dead**
Abundant									
O. smaragdina	15	15.4±4.4	6.3±2.1	—	—	16.8±8.4	9.35±4.7	0.3±0.4	0.1±0.6
Few.*O.smaragdina*	8	19.6±6.4	9.5±7.4	2.3±0.4	0.4±0.2	20.6±11.4	11.2±6.4	3.6±2.1	1.3±4.2
No *O.smaragdina*	7	24.3 ±11.4	16.1± 9.3	7.4±3.4	3.1±4.1	26.5 ±12.6	18.7±7.2	12.3±3.8	6.2±5.8
Kruskal –Wallis test	H=21, df=3, p < 0.001			H=23.4, df=2, p < 0.001					

N= Number of trees examined; Values are mean of replicates ± SD

leaves, mild (20.6%), severe (11.2%), lethal (3.6%) and dead (1.3%) with fewer ants. In contrast to the trees with abundant and fewer weaver ants the damage was significantly more in trees without ants(Table 3).

A range of the Hemiptera bugs have been reported on various crops and trees. Among these *Scotinophara coarctata* is one of the sever pest of rice, the adult and nymphs suck the plant sap through stem and nodes, the feeding leads to desiccation of the plant, discoloration (reddish-brown or yellow) of the leaves, death of the upper leaves and failure of young leaves to unfold(Estoy *et al*., 2000). Similarly, *Cyclopelta siccifolia* sucks the sap from the tender twigs of the tree and cuts off the nutrient conduction to the foliar region leading to the wilting and yellowing of the leaves (Shashikumar *et al.*1996). The symptoms of attack on tender twigs initially results in the leaves turning light yellow, with increase in infestation leaves completely turns yellow and in severe conditions fall of leaves occurs. If the infestation persists for two to three consecutive years the branches dry and tree dies (Naveed *et al*., 2000). Hence to control the pest incidence various chemical trials have been carried out earlier (Naveed *et al*., 2001, 2009). But the heavy use of insecticides has resulted in increased economic cost, and there by reduced natural predators and parasitoids of the insect pests and increased insect pest resistance to insecticides and environmental pollution as well (Peng and Christian, 2004).

To minimize the use of insecticide to control the pest, a range of natural enemies of the pentatomid bug have been reported and tried on various crops and trees. These include parasitoid wasps, *Telenomus triptus*, *T.cyrus*, *T.chloropus, Psix lacunatus,* and *Trissolcus basalis* (Hymenoptera) and predators, *Agonium daimio*(ground beetle), *Lycosa pseudoannulata*, *Oxyops javanus*(Spider), *Solenopsis geminate*(red ant), on rice black bug *Scotinophara coarctata* (Estoy *et al*., 2000), a parasitoids wasps *Trissolcus* (= *Telenomus)biproruli T. biproruli* on *Bibrorulus bibax* (James, 1998). *Trissolcus basalis* is an important egg parasitoid of green vegetable bug *Nezara viridula* (Loch and Walter, 1999). Tachinid parasitoids like *Trichopoda pilipes*, and *Trichopoda pennipes* attacking adult bugs *Bogosia antinorii* Rondani, (Waterhouse, 1998; Waterhouse and Sands, 2001). In contrast to the above *Trissolcus basalis* has proved effective in reducing *N. viridula* populations (Coombs, 2003). *Psix virisous* is the only one egg parasitoid wasp reported on *C.siccifolia* (Naveed *et al*., 2001). But the weaver ant has not been studied as a natural enemy of the pentatomid bug *C.siccifolia* so far.

Weaver ants, *Oecophylla smaragdina*, are known to control over 40 species of insect pests on many tropical tree (Way and Khoo, 1992; Peng *et al*., 1995; 2000a). These ants are effective in limiting damage to *Pongamia pinnata* tree branches and leaves by the *Cycloplta siccifolia*. Data from the field surveys in (Tables1, 2 and 3) were consistent, and demonstrated that trees with abundant weaver ants were significantly less damaged than trees with fewer, or without, weaver ants in natural conditions. Similar results were noticed in case of red band thrips on mango studied by Peng and Christian (2004) and similarly weaver ant colonies have been successfully used to control the main insect pests in cashew orchards in the Northern Territory and Papua New Guinea (Peng *et al*., 1999). The present results indicate that weaver ants may be employed as new bio control agent tool to control *C.siccifolia*.

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