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Predatory behaviour of red ant (*Oecophylla smaragdina* F) on various insect pests of different crops

Mamta Bhagat, Jayalaxmi Ganguli and Rashmi Gauraha

Abstract
Studies on the feeding and predatory behaviour of weaver ant, *Oecophylla smaragdina* Fabricius (Hymenoptera, Formicidae) were conducted in the IINET (In Vivo Insect Natural Enemies Testing) field beside the Biocontrol laboratory, department of Entomology, IGKV, and Raipur, Chhattisgarh. The ants were found to be active foragers, scavengers, and predators prevalent in the vicinity of several horticultural plantations and crops. The workers ants preyed on many insect species and fed on nectar exudates from plants as well as sticky secretions produced by Homopteran and Lepidopteran insects. Results of the present study revealed that *O. smaragdina* attached a number of species of aphids, mealy bug, lepidopteran larvae and few beetles. It consumed 100% sucking pests tested such as Green sting bug, *Chinavia hilaris* and hibiscus mealy bug, *Maconellicoccus hirsutus* and moderately preferred to consume different species of aphids, *i.e* among oleander aphid, *Aphis nerii* (71.2%), Aonla aphid, *Setaphis bougainvilleae* (71%), Cowpea aphid, *Aphis Craccivora* (62.5%), Mustard aphid, *Lipaphis erysimi* (72.5%), Cabbage aphid, *Brevicoryne brassicae* (70.4%) and 67% of chrysanthamum aphid, *Macrosiphoniella sanborni*, whereas, gundhi bug (0%) was not preferred for their feeding, perhaps due to the unpleasant odour, emitted by them. Other than sucking pests, *O. smaragdina* highly preferred larvae of lemon butterfly, *Papilio demoleus* (100%), chickpea pod borer, *Helicoverpa armigera* (100%), rice horn caterpillar, *Melanitis leda ismene* (100%) and while comparatively lesser feeding preference was seen in case of tobacco cut worm larvae, *Spodoptera litura* (72%), red pumpkin beetle, *Raphidopalpa foveicollis* (70%), fall army worm larvae, *Spodoptera frugiperda* (68%), and in leaf defoliator larvae, *Euproctis spp.* (54%) consumption was noticed. Tussock moth larvae, *Lymantriidae* (0.00%), Bihar hairy caterpillar larvae, *Spilosoma oblique* (0.00%) were not at all since preferred may be due to the presence of hairs /setae on their body.

Keywords: Biological control, feeding potential, *Oecophylla smaragdina*, predatory behaviour

Introduction
The Asian weaver ant, *Oecophylla smaragdina* Fabricius (Hymenoptera: Formicidae) also known as green ant, is an arboreal species of ant found ubiquitously in Australia Indonesia, Phillipines and Asian countries including China, Taiwan, and India. In the early centuries of the first millennium A.D. [3], people of south china used weaver ants to protect their citrus orchards since by inserting a nest and promoting colony expansion using bamboo poles connecting the branches of adjacent trees. The ant is known to inhabit many kinds of tree / shrubs species. In Chhattisgarh also, it is available in plenty on mango orchards and is highly palatable among the tribals of Bastar plateau. In general, *O. smaragdina* was observed nesting on fruit trees such as Citrus (*Citrus limon)*, Mango (*Mangifera indica*), karonda (*Carissa carandas*) and on the ornamental shrub, hibiscus (*Hibiscus rosa-sinensis*), at the Horticultural farm of IGKV, Raipur,(C.G.). Weaver ants have been known to prey on many insect species as well as nectary exudates from plants and sugary secretions produced by homopterans and caterpillars. They are ferocious foragers, attacking almost any organisms on their way. It is because of this predatory attribute that the species has been used for biological control in many parts of the world.
The name *Oecophylla* derives from the Greek: oikos (house) and phyllo (leaf) [7]. The castes of weaver ant, *O. smaragdina* are easily differentiated into small and large workers, males and females. Major workers (adults) were found to be 8.00mm in length compared to 5.00mm in case of minor workers. Pupae of major workers and minor workers measured 4.00mm and 3.00mm in length respectively [1].

Their colonies are monogynous, with a single queen living for up to eight years [2]. Minor workers usually remain within the brood chambers where they tend larvae, while the major workers defend the colony [2, 12], assist with the care of the queen, and forage for food [14, 13].

Weaver ants are best known for their remarkable nest construction. They use the silk secreted by young larvae for stitching together leaves for making nests. They may have several nests dominating a few trees at once [9]. Nests are made on trees and they live in to effectively colonize themselves. The relationship between the weaver ants and their nesting plants is facultative, as the ants use the leaves of almost any kind of plants including trees, herbs and grass [14]. Use of weaver ants as predators is a potential to be exploited. The Asian weaver ant, *O. smaragdina*, is known as the 'living pesticide' utilized in biological control of the world earliest record in China [10, 14]. Weaver ants, *O. smaragdina* make up one of the most abundant and omnipresent arthropod groups on earth and play a major role in regulating the environment, yet relatively few entomologists have studied them in the context of pest management. In Australia, weaver ants have been reported to control all major cashew pests [15] and increased profits by at least 35%. Keeping the above facts in view, the present studies were conducted to evaluate the predatory potential of red ant, *O. smaragdina* against common harmful sucking and defoliator insect pests of agricultural and horticultural fruit and vegetable crops for an easy, eco-friendly management.

Materials and Methods

Methodology: Under this objective colonies / nests of the red ant (*O. smaragdina*) collected from mango orchard of the Horticultural farm of IGKV, Raipur and were maintained on small plants of mango, citrus (lemon), hibiscus, yellow flame tree, orchid tree and Kadam tree in the IINET (In Vivo Insect Natural Enemies Testing) field beside the Biocontrol laboratory of department of Entomology, IGKV, Raipur, (Chhattisgarh).The preference of the weaver ants, *O. smaragdina* on various insect pests on different crops and the number of larvae fed / unfed along with their mode of feeding were tested.

Feeding potential of weaver ant, *O. smaragdina* on various insect pest were carried out in completely randomized design replicated five times under laboratory controlled conditions at an average temperature of 24 ± 3 °C.

For testing the predatory efficiency of *O. smaragdina*, different sucking pests and other defoliator larval pests were collected from the adjoining fields and brought into the Biocontrol laboratory of department of Entomology, IGKV, Raipur, (Chhattisgarh). The experiment was conducted using a plastic container (8.00cm) with a small hole in the centre. Ten pairs of *O. smaragdina* and fixed number of different sucking pests such as different species of aphids i.e cowpea aphid, *Aphis craccivora*, mustard aphid, *Lipaphis erysimi*, cabbage aphid, *Brevicoryne brassicae*, chrysanthemum aphid, *Macrosiphoniella sanborni*, oleander aphid, *Aphis nerii*, mealy bugs along with green sting bug, *Chinavia hilaris* and gundhi bug, *Leptocorisa acuta* were released in plastic container. Among lepidopteran defoliators, larvae of lemon butterfly, *Papilio demoleus*, fall army armyworm, *Spodoptera frugiperda*, tobacco cutworm, *S. litura*, chickpea pod borer, *Helicoverpa armigera*, rice horn caterpillar, *Melanitis ismene*, lymantriidae larvae, bihar hairy caterpillar, *Spilosoma obliqua* and one coleopteran red pumpkin beetle, *Rhaphidopalpa foveicollis* was also tested.

Observation and Analysis

The observations were taken by the counting number of insect fed by weaver ant, *O. smaragdina* and total number of insect given at daily interval. The data were subjected to square root transformation and statistically analysed with CRD using OPSTAT

$$\text{Predatory efficiency of red ant (\%)} = \frac{\text{Number of insect fed by red ant}}{\text{Total number of insects}} \times 100$$

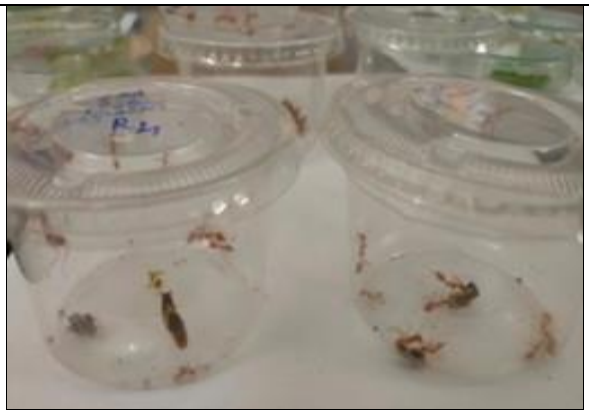
Nests of *O. smaragdina* collected from mango trees

Releasing nest on hibiscus plant

Newly constructed nest of *O. smaragdina* in Hibiscus plant by joining leaves

In Vivo Insect Natural Enemy Testing (IINET) beside Biocontrol laboratory, IGKV Raipur

Plate 1: Collection of *Oecophylla smaragdina* from mango orchard and maintaining on IINET (In Vivo Insect Natural Enemies Testing) field beside the Biocontrol laboratory, IGKV, Raipur

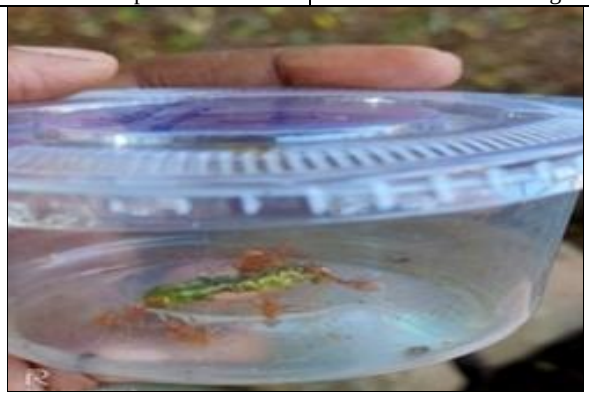


Red ant feeding on larvae of lemon butterfly, *Papilio demoleus*

Red ant feeding on larvae of *spodoptera litura*

Red ant feeding on Rice horn caterpillar

Red ant feeding on *Spodoptera frugiperda*



Red ant feeding on *Helicoverpa armigera*

Plate 2: Testing predatory efficiency of *O. smaragdina* on different lepidopteran insect pests.

Results and Discussion

Red weaver ant, *O. smaragdina* within the nests kept inside the insect rearing cages and fixed number of sucking pests, as mentioned in Table 1 were provided under laboratory condition. The predatory efficiency of weaver ant, *O. smaragdina* were determined by counting total number of insects fed. The data presented in the Table 1 indicating the rate of consumption, showed significant differences between each other. As per experiment *O. smaragdina* attached a number of species of aphids, mealy bugs, bug, lepidopteran larvae and few beetles, among these, it preferred to consume 100% in case of sucking pests such as Green sting bug, *Chinavia hilaris* and hibiscus mealy bug, *Maconellicoccus hirsutus* and moderately preferred to consume different species of aphids *i.e.* among Oleander aphid, *Aphis nerii* (71.2%), aonla aphid, *Setaphis bougainvilleae* (71%), cowpea aphid, *Aphis Craccivora* (62.5%), mustard aphid, *Lipaphis erysimi* (72.5%), cabbage aphid, *Brevicoryne brassicae* (70.4%) and 67% of chrysanthamum aphid, *Macrosiphoniella sanborni*, whereas, in case of gundhi bug (0.00%), *i.e.* no feeding was observed indicating non preference, which perhaps may be due to the unpleasant they odour, emitted by them.

Other than sucking pests, as depicted in Table 2, few lepidopteran larvae were also tested. The preference among different lepidopteran larvae also varied significantly. *O. smaragdina* highly preferred larvae of lemon butterfly, *Papilio demoleus* (100%), chickpea pod borer, *Helicoverpa armigera* (100%),rice horn caterpillar, *Melanitis leda ismene* (100%) and while in case of tobacco cut worm larvae, *Spodoptera litura* (72%), Pumpkin beetle, *Raphidopalpa foveicollis* (70%), fall army worm larvae, *Spodoptera frugiperda* (68%), defoliator larvae, *Euproctis spp.* (54%) consumption was recorded. Larvae of Tussock moth, *Lymantriinae* (0.00%), larvae of Bihar hairy caterpillar, *Spilosoma obliqua* (0.00%) were not at all since preferred which may be due to the presence of hairs /setae on their body.

Table 1: Testing the predatory efficiency of the red ant, *O. smaragdina* on different sucking pests.

Treatment	Name of insects	Mean number of insect fed	Percentage of insect fed
1	Cowpea aphid (*A.craccivora*)	0.624(1.274)	62.5
2	Mustard aphid (*L. erysini*)	0.725(1.313)	72.5
3	Chrysanthamum aphid *(Macrosiphoniella sanborni*)	0.675(1.292)	67.00
4	Oleander aphid (*Aphis nerii*)	0.712(1.309)	71.2
5	Cabbage aphid (*Brevicoryne brassicae*)	0.704(1.305)	70.4
6	Aonla aphid (*Setaphis bougainvilleae*)	0.71(1.307)	71.00
7	Mealy bug (*Maconellicoccus hirsutus*)	1(1.414)	100.00
8	Green sting bug (*Chinavia hilaris)*	1(1.414)	100.00
9	Gundhi bug (*Leptocorisa acuta*)	0(1.000)	0.00
C.D.			0.041
SE(m)±			0.014

Table 2: Testing the predatory efficiency of red ant, *O. smaragdina* on few other insect pests.

Treatment	Name of insects	Mean number of insect fed	Percentage of insect fed
1	Leaf defoliator (*Euproctis spp.*)	0.54(1.240)	54.00
2	Lemon butterfly (*Papilio demoleus*)	1(1.414)	100.00
3	Tobacco cut worm *(spodoptera litura*)	0.72(1.302)	72.00
4	Fall army worm *(Spodoptera frugiperda)*	0.68(1.280)	68.00
5	Chickpea pod borer *(Helicoverpa armigera)*	1(1.414)	100.00
6	Rice horn caterpillar (*Melanitis leda ismene*)	1(1.414)	100.00
7	Tussock moth *(Lymantriinae)*	0(1.000)	0.00
8	Pumpkin beetle (*Raphidopalpa foveicollis*)	0.70(1.300)	70.00
9	Bihar hairy caterpillar (*Spilosoma obliqua)*	0(1.000)	0.00
C.D.			0.136
SE(m)±			0.047

The present findings confirms the weaver ant, *O. smaragdina* as an efficient predator of different insect pests of various crops, which corroborates with the findings of [5] who also reported that weaver ants, *O. smaragdina* (Fabricius), are effective in controlling Jarvis's fruit fly, *Bactrocera jarvisi* (Tryon), a major insect pest in mango and many insect pests in citrus, cashew and mango orchards. However, the present studies on the predatory aspects of *O. smaragdina* on different insect pest revealed that it can also predate on more insect pests with a maximum mean consumption of green sting bugs, mealy bugs, lemon butterfly, chickpea pod borer, rice horn caterpillar was observed as compared to other insect pests such as tobacco caterpillar, fall army worm and red pumpkin beetle. No preference or consumption was recorded in hairy caterpillars.

Similarly, [5] also reported that fruits of mango trees were much less damaged on trees with weaver ants (51%) than on trees without the ants (2.5–15.7%) which indicates predatory ability of red ants and supports the present findings.

The present studies are in agreement with [4] who also reported the weaver ant (*Oecophylla smaragdina* Fabricius, 1775) as an aggressive predator that can be used in controlling the pests of teak stand particularly against termites and defoliators. Their study showed that in the laboratory, mortality of termite was 100% after 12h of weaver ant presence. In the teak stand, the presence of weaver ant decreased the termite attacks and also the defoliation.

Conclusion

Thus from the present studies it can be concluded that, the weaver ants (*O. smaragdina*) are highly aggressive predators capable of predating few of the very severely damaging polyphagous sucking pests like aphids and mealy bugs along with managing few problematic and economically important

defoliator pests like *H. armigera*, *P. Demoleus* and *M. Ismene*. The predatory and foraging behaviour of weaver ant as observed in the present studies are beneficial depending on the host species. Hence, with an understanding of the population dynamics of the species, red ants can be utilized for an eco-friendly and economically viable insect pest management in future.

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