ENTOMON 42(1) : 31-36 (2017)
Article No. ent. 42105

Ecological studies on red ant *Oecophylla smaragdina* (Fab.)

Amida Saparya and K. M. Sreekumar*

College of Agriculture, Kerala Agricultural University,Padnekkad, 671 314, Kerala, India.
Email: amidasaparya@gmail.com; sreekumar.km@kau.in

ABSTRACT: Seasonal variation in population, activity, interaction with other species of ants and effect of food provision with regard to red ant *Oecophylla smaragdina* was studied. The population and activity was maximum during summer months. Ant activity was positively correlated with ambient temperature. Red and the black ants *Tetraponera nigra*, *Paratrechina longicornis* were found to coexist whereas yellow crazy ant *Anoplolepis gracilipes* dominated and killed red ant members. Provisioning food such as chicken shank was found to increase the number of colonies rapidly.

KEY WORDS: *Oecophylla smaragdina,* abundance, inter specific interaction, food

INTRODUCTION

Ants are one of the most abundant and omnipresent arthropod groups on earth and are dominant in tropics and subtropics as scavengers and predators on many arthropods. Two humid-tropic species, *Oecophylla smaragdina* (Fab.) (Hymenoptera: Formicidae) in Asia and Australia and *O. longinoda* (Latreille) in Africa, exhibit similar biological traits. They are active throughout the year and their distribution and abundance depends on evergreen trees and shrubs. The genus *Oecophylla*, which is considered as a 'living pesticide' is one of the most impressive members of forest landscapes because of their dominance in local habitats, large body size, aggressiveness in addition to the peculiar nesting behaviour (Holldobler and Wilson, 1990). Offenberg (2015) reported that recent works on *Oecophylla* spp. showcase ants as highly efficient pest controllers and they can reduce pest numbers and their damage and increase yields in multiple crops. A number of ecologists, studying biological pest management in the tropics have suggested that the predatory power of *Oecophylla* is most outstanding among ants in their localities (Way and Khoo, 1992; Peng *et al*.,1999; Mele and Cuc, 2000). The efficiency of *Oecophylla* is comparable to chemical pesticides or higher, while at lower costs and they provide a rare example of documented efficient conservation biological control (Offenberg, 2015).

Peng *et al.* (2009) reported that the density of ants needed for effective protection was considered difficult to achieve under field conditions. So in order to augment red ants, its cultivation have to be undertaken. Here comes the importance in generating information on the effects of temperature, humidity, food provision, interactions with other ant species etc. on the ant activity and population build up which is undertaken in this study.

MATERIAL AND METHODS

Seasonal variation in population

The variations in the population of *O. smaragdina* in different seasons were studied by counting the

* Author for correspondence

live nests present on ten host plants throughout the year from March 2014 to March 2015 at 15 days intervals. The host plants included three mango trees and seven cinnamon trees present in the block No. 14 of college orchard of College of Agriculture, Padannakkad.

Measurement of ant activity

Ant activity was measured on two mango trees and three cinnamon trees, where the number of nests are almost the same. To measure the ant activity, the number of ants crossing 15 cm distance at the chest height of the host plant in 120 seconds time period was counted. Ant activity was measured during rainy, winter and summer months for a period of 30 days in each season. The measurement was done daily at 7 am, 11 am, 3 pm and 6 pm.

Interaction with other species of ants

Interaction between *O. smaragdina* and other ant species was studied by observing colonization by red ants on plants dominated by other ant species. *O. smaragdina* nests were placed on plants dominated by other ants within a height of 1 metre from the soil surface and the interaction between ants were observed. Red ant nests were collected from different trees like sapota, nut meg etc. Small branches on which the nests were built were cut carefully and collected directly in to plastic covers and tied properly. These nests were taken to the host trees and carefully tied on the host plant branches. The experiment was done on 10 selected cashew trees and 6 cowpea trellises. The study was conducted in cashew trees which were dominated by the two black ant species namely *Tetraponera nigra* Jerdon and *Paratrechina longicornis* (Latreille) and in cowpea trellises which were dominated by *Anoplolepis gracilipes.* The behaviour (aggressive / submissive) of the red ants towards other ants and colony establishment by red ants on the host plants were noted by taking observations for two months.

Effect of food provision

The study on the effect of food provision on the population *O. smaragdina* was done in 6 selected cashew trees. The experiment was conducted in November - December months. The number of live nests constructed on 3 trees which were provided with artificial food such as fish offal or chicken shank (lower part of leg without meat and with spur, claw and skin) was counted and compared with that of 3 trees which were not provided with food over a period of two months. Two pieces of chicken shank was provided on the trees at a height of 1 metre where more tender leaves are present.

RESULTS

In the study on seasonal variation in *O. smaragdina* population, it was observed that there is a general tendency of increase in the number of nests during summer months and decrease during monsoon period as shown in the figure 1. In the months of June - July when the heavy rain started, the number of nests of red ant started decreasing. At the beginning the average numbers of live nests were 9.3 per host plant which increased to 9.65 in April which then decreased to 6.7 in May 2014. Thereafter, a decreasing tendency was observed till September 2014. Then onwards increasing trend was seen till January 2015 followed by a decreasing trend.

Ant activity was measured during rainy, winter and summer months for a period of 30 days in each season daily at 7 am, 11 am, 3 pm and 6 pm and the observations show that the higher temperature in summer directly influenced the ant activity and a positive correlation was found between the ant activity and temperature. During the whole summer period, the average temperature was 31.56 and the ant activity was 58.56 where a weak positive correlation coefficient of 0.193 was seen. In rainy season, the temperature was less and so the ant activity also was less. It was observed that during raining, red ant prefer to stay inside the nest. The ant activity was reduced with the reduction in temperature which indicates a positive correlation. During rainy season the average temperature was only 2^0C less than that of summer, but the ant activity was only 28.79. This severe reduction

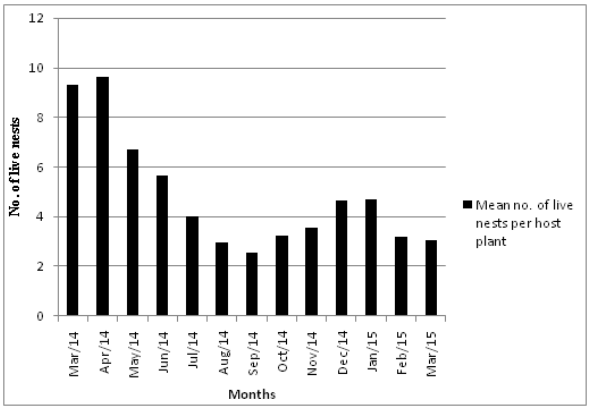

Fig. 1 Mean number of live nests constructed on host plants in every month from March 2014 to March 2015

during rainy season is due to the rains. It was observed that the average ant activity during the winter season was 12.79 with a temperature average of 28.16^{0}C. It can be concluded that in all the three seasons the relation between ant activity and temperature was positively correlated. The graphical representation of the data is shown in figure 2.

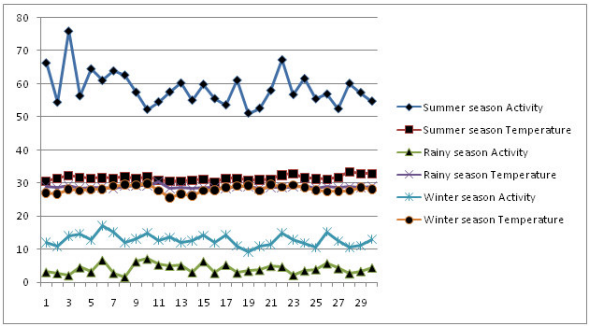

Fig. 2 Mean ant activity and temperature during the period of 30 days observed in three seasons

The observations on the ant activity and relative humidity for 30 days in each season show that the RH was higher in rainy season and a negative correlation was found between the ant activity and RH. During the whole summer period, the average RH was 69.29 % and the ant activity was 58.56 where negative correlation coefficient of -0.246 was observed. In rainy season, the RH was high and the ant activity was less. Here ant activity was reduced with the increase in RH which indicates a negative correlation. It was observed that the average ant activity during the winter season was 12.79 with RH average of 70.95. Here a positive correlation was obtained and the relation between ant activity and RH was negatively correlated in the other two seasons. The graphical representation of the data is shown in figure 3.

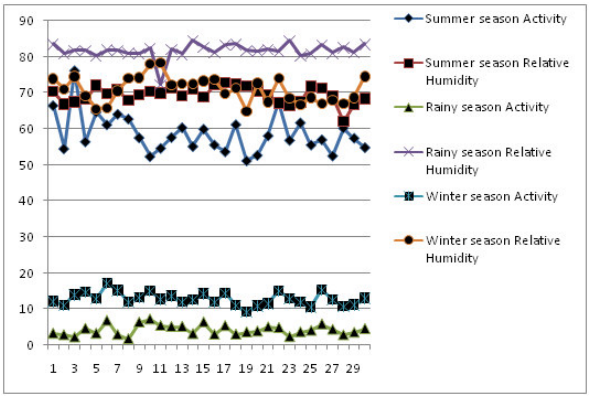

Fig. 3 Mean ant activity and relative humidity during the period of 30 days in three seasons

Mean ant activity and temperature at 7 am, 11 am, 3 pm and 6 pm in all the seasons are presented in Table 1. The ant activity was found less during morning hours when the temperature was less. Comparatively high activity was found in all other times. The average ant activity at 7 am was 12.84 where as it was 33.65 at 11 am, 32.06 at 3 pm and 30.70 at 6 pm, irrespective of the seasons.

Interaction between *O. smaragdina* and *Tetraponera nigra* and *Paratrechina longicornis* was studied by observing the number of nests built by red ant on 10 cashew trees dominated by the other two ant species for a period of one month and the data is presented in figure 4. The data showed that out of 10, on 5 trees red ants could not be established. But on 4 trees they could built one new nest each and on one tree 2 new nests were built. On first, third and sixth tree, there was no increase in nest construction during the period. But on fifth plant, the number of nests increased to 2, then to 3 and again to 2 during the period. The same trend was seen on ninth tree also. There was no direct fight

Fig. 4 Mean number of nests constructed by red ant on the trees dominated by black ants

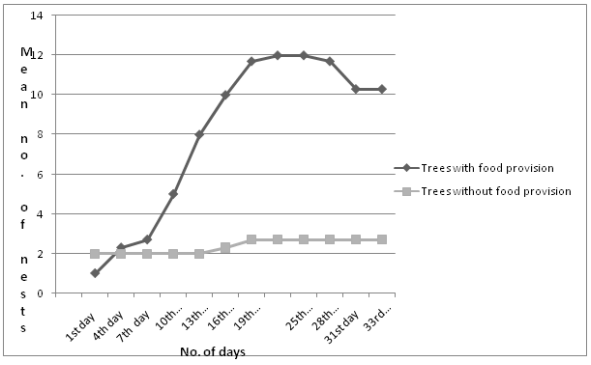

Fig. 5 Number of nests constructed by red ants on the trees provided with and without food

was noticed between black ants and red ant up on encounter. The interaction between them was found as submissive and they coexist.

Interaction between red ant and yellow crazy ant, *Anoplolepis gracilipes* was studied by observing the number of nests build by red ants on six cowpea trellises dominated by the yellow crazy ant. Here, the interaction between yellow crazy ants and red ant was found as aggressive and yellow crazy ant was dominant over red ant. When a red ant colony was introduced on a cowpea trellis colonized by yellow crazy ant, fierce fighting between the individuals of the two species was observed. Severe mortality was inflicted on the side of red ants when compared to yellow crazy ants. No red ant nest could be established on trellises harboured by yellow crazy ant and repeated introduction yielded the same result. Within 3 to 4 hours all the individuals of intruder were completely decimated.

The data on food provision done in six selected cashew trees are shown in figure 5. On an average, the number of nests on the cashew trees provisioned with food increased 10 times where as it was only 1.35 times when food was not provided over a period of 33 days which is significant.

DISCUSSION

In the study of seasonal variation in population, the recolonisation of red ant after the rainy season was less. It was because, when the red ant population was diminished on many host plants during the fag end of the rainy season, *Anoplolepis* got established and dominated. Heavy mulching at the base of the coconut trees provided during winter months provided a very good environment for *Anoplolepis* to harbour and multiply leading to the dominance of *Anoplolepis* in that area. *Anoplolepis* make their nests in soil and debris. In addition to this, weeding and subsequent tilling activity in the orchard led to clearing of ground vegetation of the area. This human intervention also made the recolonization of red ant difficult. In such areas, co existence of *Anoplolepis* and *Oecophylla* did not occur and *Anoplolepis* dominated. Mele and Cuc (2007) reported that if red ant's environment is disturbed by weeding, spraying, pruning etc, they will move to a quieter environment. This is in line with the results by Seguni *et al.,* (2011), who reported that, the effect of ground vegetation management on *Oecophylla longinoda* and its competitor, the ground-nesting ant, *Pheidole megacephala*, in a citrus orchard in Tanzania. When ground vegetation was present, *P. megacephala* tolerated *O. longinoda* and to some extent cohabited with this ant on citrus trees. After clean cultivation, *P. megacephala* displaced *O. longinoda* from tree crowns and became the sole occupant of the majority of trees.

Ant activity is severely reduced by rains. During rains they stay inside their nests. A simulation of rain like a spray of water also makes them less active and forces them to stay inside the nest, which is helpful in collecting the nests for spread to crops for pest management purpose. Peng and Christian (2005) reported that ant aggressiveness is greatly

Table 1. Mean ant activity and temperature at 7 am, 11 am, 3 pm and 6 pm during 30 days period

Sl.no	7 am		11 am		3 pm		6 pm	
	Activity	Temperature	Activity	Temperature	Activity	Temperature	Activity	Temperature
1	12.10	25.10	40.20	31.10	27.50	30.20	37.40	29.20
2	11.40	25.70	25.00	31.00	25.70	30.50	37.50	28.80
3	12.90	25.50	46.70	31.60	34.30	33.00	36.70	29.80
4	11.70	24.70	26.80	30.60	32.10	31.90	37.90	30.00
5	11.50	24.90	40.30	31.50	33.70	31.60	29.50	29.50
6	12.90	25.50	41.50	29.80	36.70	32.10	29.90	30.60
7	12.60	25.90	37.10	31.00	33.40	31.00	34.40	30.50
8	12.40	26.80	33.30	31.70	36.70	31.80	29.10	30.40
9	12.50	25.90	39.30	30.80	32.80	32.30	28.10	30.90
10	14.10	27.10	29.50	31.10	33.50	32.50	32.30	30.60
11	12.80	26.50	33.60	30.90	29.70	31.70	30.60	29.70
12	14.00	26.10	29.70	29.60	34.00	29.90	33.00	27.20
13	12.50	26.60	32.90	29.90	36.10	29.30	30.60	29.20
14	13.40	25.50	28.10	31.10	30.10	29.80	30.80	27.50
15	12.00	25.50	40.10	31.50	33.80	30.80	30.50	28.90
16	13.80	26.40	26.40	31.40	34.90	30.50	27.90	27.50
17	14.20	25.90	31.50	31.70	30.30	31.40	30.20	29.00
18	12.80	26.30	31.10	31.10	33.80	32.20	31.20	29.48
19	12.90	25.60	26.00	31.50	26.20	32.20	29.80	29.50
20	12.00	25.00	29.30	31.30	31.20	29.50	25.30	30.30
21	14.80	27.00	31.40	31.40	35.80	31.30	26.90	29.80
22	12.90	25.80	39.90	31.20	41.50	32.20	31.00	30.90
23	13.40	27.50	33.10	31.10	30.20	31.40	28.70	31.20
24	12.60	26.70	31.90	31.30	34.40	30.80	32.30	30.80
25	13.30	25.70	33.90	31.20	27.00	30.50	27.00	29.50
26	12.90	25.40	37.10	30.40	32.90	30.90	28.60	30.00
27	11.80	25.30	31.90	30.80	26.90	31.10	27.90	30.00
28	11.30	26.50	34.90	31.30	30.70	31.60	29.70	30.50
29	13.70	26.70	34.40	31.20	26.50	31.70	29.10	30.50
30	14.20	26.90	32.90	31.70	29.90	31.00	27.10	30.40
Mean	12.84	26.00	33.65	31.06	32.06	31.22	30.70	29.73

reduced by spraying water on trees prior to harvest. Their observations suggest that green ants either go back to their nests or stay on the underside of twigs and leaves when it is raining.

Food provision greatly increases the multiplication potential of the red ant evidenced by the increase in the number of nests within a short time. Chicken shank which was usually discarded by chicken shops was used in the experiment. Meat, dead rats and fish offal are also effective as a protenaceous food source as reported by Mele and Cuc (2007). This is in line with the results by Sreekumar *et al.,* (2010) who reported that the provision of food in the initial

days helps in the early establishment of the new colony and connecting the plants harboured by red ants using nylon ropes is found to be easy, if the colonies were found to be nearby. It was observed that, once provided these materials act as a source of food for about a month. The food material is not decayed because of the antibacterial activity of the ant secretions. Das *et al*., (2013) reported that the gastric secretions of *Oecophylla* have strong antibacterial activity against a range of gram negative and gram positive bacteria.

ACKNOWLEDGEMENTS

The senior author acknowledges the Kerala Agricultural University for financial support in the form of KAU Junior Research Fellowship. This work forms a part of the project funded by KSCSTE, Thiruvananthapurm, Kerala

REFERENCES

Das P., Dileepkumar R., Krishnan A., Nair A.S. and OommenO.V. (2013) Antibacterial action of gastric secretions from *Oecophylla smaragdina*, an Asian Red Weaver Ant. Journal of Entomology Research 37(4): 12-15.

Holldobler B. and Wilson E.O. (1990) The Ants. Springer, Berlin, 732 p.

Mele P. V. and Cuc N. T. T. (2000) Evolution and status of *Oecophylla smaragdina* (F.) as a pest control agent in citrus in the Mekong Delta, Vietnam. International Journal of Pest Management 46: 295-301.

Mele P.V. and Cuc N.T.T. (2007) Ants as friends. CAB International, 68p.

Offenberg J. (2015). Ants as tools in sustainable agriculture. Journal of Applied Ecology 52: 1197-1205.

Peng R. K. and Christian K. (2005) Integrated pest management in mango orchards in Northern Territory Australia, using the weaver ant, *Oecophylla smaragdina* (Hymenoptera: Formicidae) as a key element. International Journal of Pest Management 51(2): 149-155.

Peng R.K., Christian K. and Gibb K. (1999) The effect of colony isolation of the predacious ant, *Oecophylla smaragdina* (F.) (Hymenoptera; Formicidae), on protection of cashew plantations from insect pests. International Journal of Pest Management 45(3): 189-194.

Seguni Z.S.K., Way M.J. and Mele P.V. (2011) The Effect of Ground Vegetation Management on Competition between the Ants *Oecophylla longinoda* and *Pheidole megacephala* and Implications for Conservation Biological Control. Crop Protection 30 (6):713-717.

Sreekumar K.M., Vasavan N., Madhu S., Sijila J., Sreedharan M.P. and Sreelekha S. (2010) Utilization of red ants (*Oecophylla smaragdina* F.) to manage tea mosquito bug *(Helopeltis antonii* Sign.) in cashew. *Proceedings of 22nd Kerala Science Congress*, 23-31 January 2010, Kerela Forest Research Institute, Peechi. Kerala State Council for Science, Technology and Environment, Government of Kerala, pp. 16-17.

Way M.J. and Khoo K.C. (1992) Role of ants in pest management. Annual Review of Entomology 37: 479- 503.

(Received 15 September 2016; revised ms accepted 05 October 2016; published 31 March 2017)