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Red ant *Oecophylla smaragdina* (F.) (Hymenoptera: Formicidae) in the management of cowpea pests

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ABSTRACT: *Oecophylla smaragdina* treatment in the management of cowpea pests showed yields comparable with POP. More number of pods was harvested from T_2 (POP) followed by T_1 (red ant). Fresh weights of the pods were significantly low in control but T_1 and T_2 were on par. In the study on impact of selected pesticides on red ant showed low ant activity and number of live nests in the sprayed plants at one week after the treatment, compared to the pre-treatment count. Tobacco decoction @ 2.5 per cent did not seriously affect red ant activity.

KEY WORDS: Red ant, *Oecophylla smaragdina*, cowpea pests, indigenous knowledge

INTRODUCTION

Classical biological control has achieved some tremendous successes over the past century, yet scientists recognize that the opportunities are limited and greater attention is needed to increase the impact of native natural enemies (Greathead, 1991). The first written record of biological control dating from 304 AD is the use of red ant, *Oecophylla smaragdina* (F) (Hymenoptera: Formicidae) in Citrus (Huang and Yang, 1987). Though such time tested methods went into oblivion with the introduction of pesticides, they have been staging a comeback over the past two decades across the world (Mele, 2008). Red ants were extensively used for pest control in Africa and Asia on various crops like coconut, cocoa, coffee, citrus etc. (Mele and Cuc, 2000; Peng *et al.*, 1997; 1999; 2001). A paradigm shift in pest management have led to increased focus on *Oecophylla* in pest management of other crops like cashew, mango and timber crops also in addition to other tree crops (Mele, 2008; Sreekumar *et al.,* 2011).

Red ant, *O. smaragdina* is a self-perpetuating and effective biological control agent. The red ant is found in many different countries from Africa to Asia. Developing alternatives to pesticides is critical to maintaining agricultural production in view of the phasing out of low cost broad spectrum insecticides with newer but costly ones. This is all the more true for Kerala, since we are insisting in organic cultivation nowadays.Vegetable cowpea is an important crop of the state and harbours many pests such as aphids, pod borers, pod bugs etc. Vegetable cowpea is harvested on every alternate day without which the pods will become fibrous and non-marketable. For most of the pesticides, a minimum of five days is to be observed as waiting period which is not possible in the case of cowpea. At the same time, imparting faster methods of control is imperative in the case of cowpea to reduce crop damage and to protect aesthetic value of the produce. Sreekumar *et al*. (2006) reported that augmented control by red ant is being used by farmers in north Kerala in managing pests in kitchen gardens especially in cowpea but the effectiveness

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was not scientifically validated. Therefore studies were undertaken to know the effectiveness of *O. smaragdina* in managing the pests of cowpea and the effect of selected pesticides on *O. smaragdina* which will generate information on the use of pesticides to manage certain pest and diseases of cowpea without affecting red ant population.

MATERIALS AND METHODS

1. Effectiveness of *O. smaragdina* in managing the pests of cowpea:

An experiment was laid out in randomized block design with three treatments and seven replications. The cowpea variety Lola was raised and trailed on trellises separately. One replication contains one trellis and one trellis contains three plants. Red ants were harboured on the plant at young stage itself. Small branches of wild trees on which the nests built were cut carefully and collected directly in to plastic covers and tied properly. These nests were taken to the host plant and carefully tied on the host plant branches and trellises. Another method followed was to grow red ants on trees near the cow pea field by providing chicken offal and connecting the tree branches to cow pea trellis using nylon ropes. The plants were observed from the seedling stage to the end of the crop period. The observations noted were the number of damaged plant parts due to attack by major pests, number of adults and larval / nymphal stages of major pests and the yield. The yield parameters taken were the pod length, pod number and fresh weight of the pods. Aphid (*Aphis craccivora*) and leaf folder (*Nacoleia vulgaris*) were recorded as pests on cowpea plants during the crop period.

The treatments were, T_1: Crop harbouring red ant, T_2: Pest management as per Package of Practices Recommendations Crops (POP) of Kerala Agricultural University, that is need based application of chemical pesticide Malathion/ DDVP and T_3: Untreated control. The cultivation practices followed were as per the Package of Practices Recommendations Crops (POP) of Kerala Agricultural University viz. spacing of 2 X 2 metre trailed on pandal at the rate of three plants per pit, farm yard manure was applied at the rate of 20 tonnes per ha and lime at the rate of 250 g per ha which was applied at the time of first ploughing. NPK fertilizers were applied in the ratio of 20:30:10 kg per ha. Half the quantity of nitrogen, whole of phosphorus and potash was applied at the time of final ploughing. The remaining nitrogen was applied 15-20 days after sowing and irrigation was given properly in all the stages of growth.

2. Impact of selected pesticides on red ant:

The experiment was laid out in randomized block design with five treatments and four replications. One replication contains one trellis and one trellis contains three plants. The cowpea variety Lola was raised and trailed over trellises and red ant colonies were established on it. The following treatments - T1: DDVP 76 EC 0.076 %, T2: Bordeaux mixture 1 %, T3: Tobacco decoction 2.5 %, T4: Azadirachtin 0.03 EC 0.0003 %, T5: Control were applied on the crop. These pesticides were sprayed on the plants. The experiment was done in the flowering stage of the crop. The yield parameters were analysed using ANOVA.

Impact of the pesticides on the red ant was assessed by observing the ant activity and number of live nests made on the trellises. To measure the ant activity, the number of ant movements over 15 cm length of the chest height of the host plant in 120 seconds time period at 7 am and 11am was counted as described by Amida Saparya and Sreekumar (2017). Establishment of the ant was noted by observing the number of live nests and ant activity. The data were analysed using Duncan's multiple range test (DMRT).

RESULTS AND DISCUSSION

1. Effectiveness of *O. smaragdina* in managing the pests of cowpea:

a) Number of damaged plant parts due to attack by major pests

Maximum number of pods were attacked in T_3 (Control) followed by T_1 (Red ants) and minimum in T_2 (POP). But the values were not significantly different. Number of damaged leaves was significantly high in control. T_1 and T_2 were on par.

Less number of leaves were affected in T_2 in which POP recommendations were followed. In both the parameters, plants under T_3 (control) were affected more followed by T_1 and T_2 respectively. There is no significant difference found between the treatments in the case of damaged plant parts by leaf folder. Leaf folder infestation was found in the initial stage of cowpea (first month) against which no control measure was adopted (Table 1).

The major pests which infested the cowpea during the crop period were aphids and leaf folder. The attack of aphid was higher and that of leaf folder was negligible. Spraying of malathion was done in T_2 (POP) for the management of aphids. But no spraying was done for leaf folder even in POP recommended treatment. Peng and Christian (2006) reported that the treatment with red ant plus soft chemicals produced lower levels of rejected fruits than the treatment with chemical insecticides.

b) Pest population on plants

More number of aphids were found on T_3 (Control) and it was significantly higher than other two treatments. T_1 and T_2 were on par. Aphid population was found less in T_2 in which recommendations were followed based on Package of Practices compared to the other two treatments. The data on number of leaf folder larvae recorded on the cowpea plants was analysed and there was no significant difference between these three treatments (Table 1).

The number of aphids was higher compared to leaf folder. The population of leaf folder was too less to initiate any management measure. The population of aphid was more in control than in the other two treatments. The plants harboured with red ant also were infested by a higher population of aphids because of their association with red ant. Red ant used to feed on the honey dew produced by aphids and in turn they protect aphids from natural enemies which is the basis of their mutual relationship. But Mele and Cuc (2007) reported that this relationship never associated with the outbreak of aphids.

c) Yield parameters of cowpea

There was no significant difference between the treatments in the case of pod number and pod length. More number of pods were harvested from T_2 (POP) followed by T_1 (red ant) and T_3 (control). An average pod length of 42.61cm was recorded in T_2 and 41.12 cm in T_1 where as in T_3 it was only 37.61 cm. Fresh weights of the pods were significantly low in control but T_1 and T_2 were on par (Table 2). The mean pod number was not significant between treatments but the highest value was observed in T_2 (POP). The pod number is basically a varietal character. A higher pod number in T_2 though it is statistically insignificant is due to the better protection of the crop. The same is the trend with mean pod length also. The mean fresh weight of the pods was significantly high in T_2 (POP) which is on par with T_1 (red ant) which shows that red ant protect cowpea pods from attack by pests.

The cowpea harvested from red ant harboured plants had more lustre and more preferred by the consumers in the initial stage which lasted up to two months. Thereafter there was aphid infestation which reduced the aesthetic value of the produce entailing low consumer preference. The aphid

Table 1. Mean number of damaged cowpea plant parts and its population under different treatments

Treatments	Mean no. of damaged		No. of aphids
	Pod	Leaf	
T_1: Red ant	16.4	34.6	297.14
T_2: POP	15.4	16	120.42
T_3: Control	20	96.4	559.85
CD (0.05%)	14.802^{NS}	45.67^{**}	262.38^{**}

Table 2. Mean yield parameters of cowpea under different treatments

Treatments	Pod number	Pod length(cm)	Fresh weight (kg)
T_1: Red ant	157.8	41.12	2.23
T_2: POP	228.2	42.61	3.14
T_3: Control	157.8	37.61	1.49
CD (0.05%)	79.889^{NS}	5.740^{NS}	0.996^{**}

population lasted till the end of the harvesting season both in T_1 (red ant) and T_3 (control). In T_2 (POP) aphids were managed by spraying malathion two times.

2. Impact of selected pesticides on red ant:

a) Impact of selected pesticides on the number of live nests of red ant

The impact of pesticides was assessed by observing the number of live nests present and ant activity on cowpea. The numbers of live nests present were significantly lowest in DDVP treated plants consistently during the observation period of 7 days. The impact on nest building was found more in T_1 (DDVP 0.076 %) from the next day after spraying till the seventh day which was followed by T_4 (Azadirachtin 0.0003 %). The live nests present on all the plants before spraying was on par. One week after the treatment, number of live nests present on the sprayed plants were low compared to the pre-treatment count. The impact was low in T_3 (Tobacco decoction 2.5 %) (Table 3).

b) Impact of selected pesticides on the activity of red ant

The red ant activities in different trellis were on par on the day before the spray. The impact on the activity of red ants was found more in T_1 (DDVP 0.076 %) followed by T_4 (Azadirachtin 0.03 %), T_2 (Bordeaux mixture 1 %), T3 (Tobacco decoction 2.5 %) and T_5 (Control) respectively immediately after spraying. T_5 was found significantly high compared to all other treatments on the first readings taken after spraying. The impact was found lesser in T_5 followed by T_3 and T_2 one week after spraying. The treatment T_1 has much impact on the activity of red ants from the first day followed by T_4.

The impact of DDVP was more on the ant activity and nest building of red ants. The mean numbers of nests were 2.75 before spraying and from the next day of spraying itself it become 0.5 till the seventh day. The mean ant activity was 56.75 before spraying and it is reduced to 7.50 on the seventh day. The results are in agreement with the findings of Mele and Cuc (2007) who reported that only less toxic and highly selective pesticides should be used in the fields where red ants are present and organophosphates and pyrethroids should be avoided. Mele and Cuc (2000) reported that nearly all chemicals are harmful to *Oecophylla*. When compared to DDVP, Azadirachtin which is a derivative of neem has less influence on red ant activity and nest building. Azadirachtin is recommended in organic farming

Table 3. Impact of selected pesticides on the nest building of red ant

Treatments	Mean number of live nests of red ant on cowpea trellises								Mean
	Before spray	Day one	Day two	Day three	Day four	Day five	Day six	Day seven	
T_1: DDVP 0.076 %	2.75	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
T_2: Bordeaux mixture 1%	2.75	1.50	1.00	1.00	1.00	0.50	0.50	0.50	0.85
T_3: Tobacco decoction 2.5%	2.50	2.00	1.75	1.75	1.75	1.75	1.75	1.75	1.78
T_4: Azadirachtin 0.03 %	2.75	1.00	1.00	0.50	0.50	0.50	0.50	0.25	0.60
T_5: Control	2.75	1.75	1.25	1.25	1.25	1.25	1.25	1.25	1.32
SE(+/-)	0.228	0.344	0.247	0.230	0.230	0.211	0.211	0.196	
CD(0.05)	0.49 ^{NS}	0.75*	0.54*	0.502*	0.502*	0.461*	0.461*	0.427*	

Table 4. Impact of selected pesticides on the activity of red ant

Treatments	Mean activity of red ant on cowpea trellisesbefore and days after spray									Mean
	Before	same day	One	Two	Three	Four	Five	Six	Seven	
T_1: DDVP 0.076% *	56.75	14.25	12.50	8.50	10.75	8.75	8.50	10.25	7.50	10.13
T_2: Bordeaux mixture 1%	44.50	23.00	17.50	18.75	20.75	15.00	15.75	15.50	16.00	17.78
T_3: Tobacco decoction 2.5%	50.25	25.00	27.75	33.75	33.00	32.00	23.25	31.50	32.25	29.81
T_4:Azadirachtin 0.03%	62.00	20.50	17.25	13.75	9.25	11.25	10.75	9.00	7.50	12.41
T_5: Control	54.75	57.25	40.50	42.25	43.25	42.25	46.25	37.00	43.25	44
SE(+/-)	2.407	2.480	3.685	3.779	3.912	4.369	4.449	4.246	3.702	
CD(0.05)	5.244	5.403	8.031	8.234	8.524	9.521	9.695	9.251	8.067	

*Immediate mortality was noticed after the spray of DDVP

practices. Spraying of Azadirachtin reduced the number of live nests from 2.75 to 0.25 on the seventh day. The ant activity was reduced from 62 on the day before spray to 7.5 on the seventh day. Bordeaux mixture is an essential plant protection chemical which is used for managing many diseases of cowpea such as anthracnose, web blight, *Cercospora* and *Alternaria* leaf spot etc. From the data, it can be discerned that spraying of BM (1%) reduced the number of live nests from 2.75 to 0.5 on the seventh day. The ant activity was reduced from 44.5 on the day before spray to 16 on the seventh day. Tobacco decoction is usually prepared and applied by farmers for pest management in cowpea. The impact of Tobacco decoction on the nest building and ant activity was less. The ant activity was 50.25 before spraying which reduced to 32.25 on the seventh day (Table 4).

The study showed that the yields in plants as per POP recommendation and in plants in which red ants introduced for pest management are comparable. There are limitations in the use of pesticides in cowpea since waiting period is less. Harbouring red ant is an organic way of pest management which is desirable. Management of cowpea pests by tobacco decoction 2.5 % did not seriously affect ant activity.

REFERENCE

Greathead D. J. (1991) Biological control in the tropics: present opportunities and future prospects. Insect Science and Application12: 3-8.

Huang H.T. and Yang P. (1987) The ancient cultured citrus ant. Bioscience 37: 665- 671.

Mele P. V. (2008) A historical review of research on the weaver ant *Oecophylla* in biological control. Agriculture and Forest Entomology 10: 13-22.

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.

Peng R.K. and Christian K. (2006) Effective control of Jarvis's fruit fly, *Bactrocera jarvisi* (Diptera: Tephritidae), by the weaver ant, *Oecophylla smaragdina* (Hymenoptera: Formicidae), in mango orchards in the Northern Territory of Australia. International Journal of Pest Management 52(4): 275-282.

Peng R.K., Christian K. and Gibb K. (1997) Control threshold analysis for the tea mosquito bug, *Helopeltis pernicialis* (Hemiptera: Miridae) and preliminary results concerning the efficiency of control by the green ant, *Oecophylla smaragdina* (Hymenoptera: Formicidae) in Northern Australia.

International Journal of Pest Management 43(3): 233-237.

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.

Peng R.K., Christian K. and Gibb K. (2001) Potential of using colonies of the green ant, *Oecophylla smaragdina* (F.) to control cashew insect pests. Technical Bulletin, Department of Primary Industries and Fish. 288: 81-93.

AmidaSaparya and Sreekumar K.M. (2017) Ecological studies on red ant *Oecophylla smaragdina* (Fab.) Entomon 42(1): 31-36

Sreekumar K.M., Thampan C and Govindan M. (2006) Indigenous knowledge of farming in North Malabar.Centre for Environment Education, Nehru foundation for Development, ThaltejTekra, Ahmedabad. 170 p.

Sreekumar K.M., Vasavan, N., Madhu S., Sijila J., Sreedharan M.P., Sreelekha S. and Tom Cheriyan (2011) Managing tea mosquito bug (*Helopeltis antonii* Sign.) in cashew by augmenting red ants (*Oecophylla smaragdina* (F.). Journal of Plantation Crops 39 (1): 110-113.

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