ORIGINAL ARTICLE

ASSESSMENT OF *RHYNOCORIS MARGINATUS* (FAB.) (HEMIPTERA: REDUVIIDAE) AS AUGMENTED CONTROL IN GROUNDNUT PESTS

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ABSTRACT

All the life stages of the reduviid predator *Rhynocoris marginatus* (Fab.) were released (30, 50 and 70 Days After Seedling Sowing -DAS) into the groundnut field at 5000/hectare. *Spodoptera litura* (Fab.), *Helicoverpa armigera* (Hubner), *Atractomorpha crenulata*, *Chrotogonous trachypterus*, *Aphis craccivora*, *Mylabris pustulata* and *Mylabris indica* were observed during the study period. *R.marginatus* significantly reduced *S.litura*(85.89%) followed by *H.armigera*(67.65%), A.*craccivora*(46.34%)and *A.crenulata a*nd C.tra*chypterus* (42.86%). *R.marginatus* had no impact on the *Mylabris* spp. populations observed during the study period. *R.marginatus* not affect the other predatory fauna such as coccinellids (*Menochilus sexmaculatus* Fab., *Coccinella septumpunctata*) praying mantis, wasp, damselfly (*Agriochemis feminafemina* Braucer) and spiders (*Lycosa tista* Tikader and *Hippasa pisaurina* Pocock)found in the control and predator released field. Maximum production of groundnut was observed in the predator-released field (1480 Kg/hectare) than the sole crop (1104 Kg/hectare) and the results were statistically significant. Similarly, the net gain and the cost benefit ratio were also the highest in the *R.marginatus* released groundnut field.

KEY WORDS: *Rhynocoris marginatus*, reduviid hunter bug, augmentative control, groundnut pests

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DETALIED ABSTRACT

In recent years *Spodoptera litura* (Fab.), *Helicoverpa armigera* (Hubner), *Atractomorpha crenulata, Chrotogonous trachypterus, Aphis craccivora, Mylabris pustulata* and *Mylabris indica* have emerged as important pests of groundnut in India. We seek ecologically sound and economically viable Integrated Pest Management (IPM) programme for groundnut to control these pests. We report on augmentative release trials against these pests involving a reduviid predator *Rhynocoris marginatus* (Fab.). Life stages of *R. marginatus* were released (30, 50 and 70 Days After Seedling Sowing -DAS) into the groundnut field at 5000/hectare. *R.marginatus* significantly reduced *S.litura*(85.89%) followed by *H.armigera*(67.65%), A.*craccivora*(46.34%) and *A.crenulata a*nd *C.*tra*chypterus* (42.86%). *R.marginatus* had no impact on both the *M. pustulata* and *M. indica* populations observed in this study. Maximum groundnut production was observed in the predator-released field (1480 Kg/hectare) than the non-predator field (1104 Kg/hectare). Similarly, the net gain and the cost benefit ratio were also the highest in the *R.marginatus* released groundnut field. Furthermore, this predator could not affect the other natural enemies present in the field such as coccinellids (*Menochilus sexmaculatus* Fab., *Coccinella septumpunctata*) praying mantis, wasp, damselfly (*Agriochemis feminafemina* Braucer) and spiders (*Lycosa tista* Tikader and *Hippasa pisaurina* Pocock). From the results we concluded that this reduviid is a promising natural enemy for most of the groundnut pests and hence this IPM component can be incorporated in the groundnut IPM programme.

INTRODUCTION

Arachis hypogea Linn. is an important oilseed and cash crop accounting for more than one-third of the total oilseed production in India. Groundnut defoliators like *Spodoptera litura* (Fab.) [1], *Aproaerema modicella* Dev., and *Helicoverpa armigera* Hubner causes heavy damage to the groundnut by feeding on leaves, flowers and the flower buds [2]. Usage of chemical pesticide causes not only leaves the toxic residue in the food chain but also makes us to face the hike in the cost [3]. Hence there is an urgent need to utilize the biological control agents for the defoliators control. Published works from India showed that *Chrysoperla carnea* (Banks) [4] and *Rhynocoris marginatus* [5,6] are the natural enemies of *H.armigera* and *S.litura*. *R.marginatus* is a generalist predator found in agro-ecosystems such as groundnut, cotton and soybean [7] and also in semi-arid zone, scrub jungle and forest. Augmentation of native/exotic natural enemies can strengthen the integrated pest management (IPM) programme considerably. The successful augmentative reduviid predators in agricultural field like palm[8], groundnut [6, 9], cotton [10] and soybean and cotton [11,12] have been studied. Field-testing is an important step in evaluating the use of natural enemies as augmented biological control agents [13]. To create the awareness and to develop experimental skills among the small and marginal groundnut farmers, the non-chemical, eco-friendly experiments ie field release of *R.marginatus* was carried out in the farmer's field. The pest population and their infestation rate, and the yield of groundnut in the control and the experimental plots of the groundnut field will provide the clear picture of sustainable effective predator component in IPM. In this study we evaluated the impact of *R.marginatus* on the chosen groundnut population and their infestation, groundnut production were evaluated.

MATERIALS AND METHODS

Collection and rearing of *R.marginatus*

The reduviid predator *R.marginatus* nymphs and adults were collected from the Sivanthipatti scrub jungle bordering agro-ecosystem (77°16'10E 8°50'N) near Tirunelveli district, Tamil Nadu, India and successfully reared in the laboratory conditions (28 ± 2°C temperature, 68 ± 5% Relative Humidity and a 13L:11D photoperiods) on unnatural prey, *Corcyra cephalonica* Stainton in 1000ml plastic containers [14] in Crop Protection Research Centre (CPRC), St.Xavier's College, Palayamkottai.

Description of the field

The field release experiment was carried out in the farmer's field at Chakkammalpuram in Tuticorin District, Tamil Nadu, India in one acre. The field was subdivided in to six plots each of 675 m^2. Three plots were considered as control and remaining three were considered as experimental plots. The predator-free plot was consider as a control. Groundnut (TMV7 variety) was cultivated in the plot and the space between and within the plants was 10cm and 30cm respectively. Plots were separated by 1m of bare soil. The plots aligned linearly on an approximately north-south axis. The fertilizers were applied @ 20 Kg nitrogen, 60 Kg phosphorus and 30 Kr potash per hectare as basal dressing. Thinning and weeding followed by hoeing were done 35 DAS to maintain the proper plant distance and to keep the field free from weeds and make the soil loose. Earthing up was done before peg initiation of groundnut. The farmers were advised not to use insecticide during the experimentation.

Augmentative release of R.marginatus

Laboratory laid and emerged eggs and nymphs (I-V) of *R.marginatus*, respectively were released into the experimental plots from 7th May to 22nd June 2002 on 30, 50 and 70 days after seedling sowing (DAS). On release day the predators were transported to the farmer's field from the laboratory and released 330 predators (66 each of I, II, III, IV and V nymphal instars) and two batches of eggs (66 eggs) per plot between 6.00 to 7.00 A.M of the day. They were released under the foliage with the help of small wet paintbrushes.

Observation

The pest populations such as *S.litura, H. armigera, A. craccivora,* blister beetles (*Mylabris pustulata* and

Mylabris indica) and grasshoppers (*Atractomorpha crenulata* Fab. and *Chrotogonous trachypterus*), and their infestation were recorded both in the control and experimental plots. For the pest and their infestations incidence, 30 plants were selected randomly from each plot and their means value from both control and experimental categories were represented in the table and results. Six observations were made during the experiment (26, 34, 46, 54, 66, and 74 Days After Seedling Sowing - DAS). After the harvest the groundnut yield was recorded both in the control and experimental plots. The pod yield was expressed as Kg/hectare. Cost benefit ratio was calculated using the following formula [4] both in the control and predator released fields:

$$\text{Cost benefit ratio} = \frac{\text{Total gain}}{\text{Total cost of cultivation}}$$

Statistical analysis

The impact of *R.marginatus* release on the pest population was evaluated by correlation analysis (SYSTAT 9.0) between control and predator released groundnut field.

RESULTS AND DISCUSSION

Pest population

The most abundant pest insects in the groundnut field were *S.litura*, *H.armigera*, grasshoppers (*C.trachypterus* and *A.crenulata*), *A.craccivora*, and *Mylabris pustulata*. The predator has a significant influence on the pest incidence and their infestation. In the experimental field the pest incidence varied from 0.78 to 0.11 per plant for *S.litura*, 0.27 to 0.10 per plant for *C.trachypterus*, 0.29 to 0.26 per plant for *A.crenulata* and 51.77 to 27.78 per plant for *A.craccivora* (Table. 1).

Table 1. Impact of *R.marginatus* on the groundnut pest level during different observation period

Days of observation	SLC	SLP	HAC	HAP	GHC	GHP	ACC	ACP	MYC	MYP
26	0.78	0.78	0.64	0.68	0.57	0.56	51.44	51.77	0.16	0.16
34	0.78	0.44	0.68	0.46	0.61	0.49	50.66	48.33	0.25	0.27
46	0.66	0.56	0.70	0.54	0.56	0.50	49.44	49.72	0.26	0.27
54	0.56	0.22	0.62	0.32	0.50	0.47	44.11	37.78	0.26	0.23
66	0.44	0.33	0.58	0.44	0.49	0.43	41.67	40.00	0.28	0.28
74	0.44	0.11	0.56	0.22	0.43	0.32	32.56	27.78	0.31	0.30
Mean	0.61	0.41	0.62	0.44	0.53	0.46	44.98	42.56	0.25	0.25

C – control and P – predator released; SL – *S.litura*, HA – *H.armigera*, GH – Grasshopper
AC- *A.craccivora*, MY – *Mylabris*

R.marginatus significantly suppressed this pest population from the initial count to the final count (S.litura, C.trachypterus and A.craccivora) except A.crenulata and Mylabris spp. During the first release of R.marginatus, there was a marked decline in the S.litura population from 0.78 per plant to 0.44 per plant. Then its population was increased to 0.56 per plant. After the second release of R.marginatus, the population was again dropped. Before the third release of the predator, there was a rise of S.litura population (0.33 per plant), which was comparatively lower than the pest population observed before the second release. The population was suddenly decreased to 0.11 per plant after 74 DAS. But in the control field, the population of S.litura ranged between 0.44 to 0.78 per plant. DHIR et al. [1] reported that one S.litura per plant at seedling and flowering stage could cause significant yield loss in groundnut. In our experiment, less than one S.litura larva per plant was observed in the predator released and control field. Hence the yield in the predator released was not much deviated from the control field. KALYANASUNDARAM et al. [4] reported that Chrysoperla carnea (Banks) effectively controlled S.litura population than H.armigera

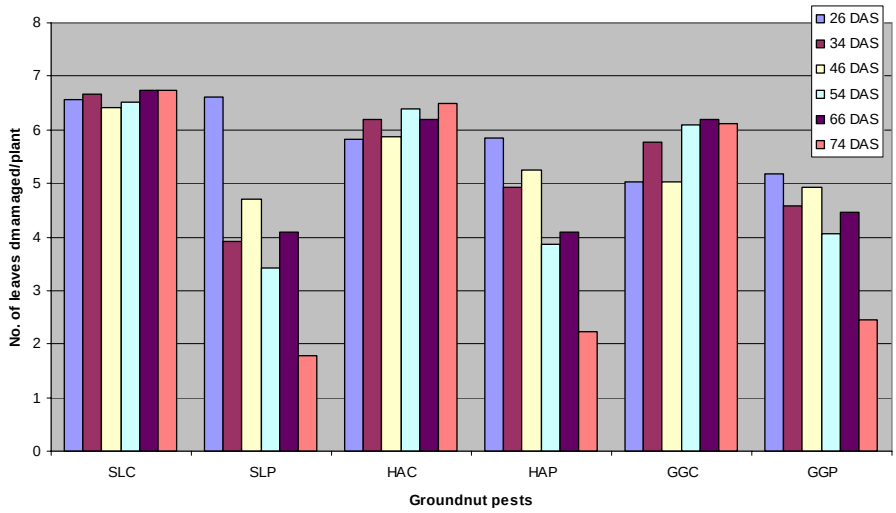
population. GRUNDY and MAELZER [11] reported that Pristhesancus plagipennis (Walker) has reduced the population of soybean and cotton pests.

The H.armigera population was ranged between 0.56 and 0.64 in the control groundnut plot but it showed a decline from 0.68 to 0.22 per plant in a predator-released field. The percentage of reduction was 67.75, which was lower than S.litura. The grasshopper population was reduced from 0.56 to 0.32 per plant. The percentage of reduction was 42.86 per cent. Similar trend was also observed in A.craccivora. For instance in predator released field, its population was decreased from 51.77 to 32.56 per plant and it was statistically significant (r = 0.94). The percentage of reduction during the initial stage was 46.34. The Mylabris spp. population was more or less similar in both control and predator released fields (r = 0.97) and hence R.marginatus had no influence on Mylabris spp. Our results clearly showed that the augmentative release of R.marginatus in the groundnut field successfully reduced the pest population and their damage except Mylabris spp. AMBROSE and CLAVER [15] already reported that R.marginatus reduced S.litura, Dysdercus cingulatus and M.pustulata in cotton. CLAVER and AMBROSE [12] revealed that adult R.kumarii significantly suppressed the H.armigera larval population during the initial infestation, but the subsequent suppression of H.armigera was not significant. SAHAYARAJ [5] observed that nymphal instars of R.marginatus preferred only fourth and fifth larval instars of A.modicella. Furthermore, the pest suppression potential of reduviids varied among species as well as from pest to pest [16 – 17]. In the present investigation also more than 40% of suppression in S.litura, H.armigera, A.crenulatus, C.trachypterus and A.craccivora by R.marginatus was noticed in groundnut field.

Infestations

The leaf infestation caused by the pests in the groundnut field was greatly reduced by the predator R.marginatus. The leaf damage per plant by S.litura was reduced from 6.61 to 1.78 after the predator release. The percentage of reduction of leaf damage was 73.07. The reduction in leaf damage by H.armigera (5.84 to 2.24) grasshopper (5.17 to 2.24) was also declined after the predator released. The percentage of reduction in leaf damage after the release of R.marginatus showed the following trend: S.litura (73.07) > H.armigera (61.64) > grasshopper (52.41) (Fig.1). The infestation caused by the A.craccivora and Mylabris spp. was not visually noticed. The reduction in the infestation of lepidopteran larvae by reduviids like Zelus exsanguis Stal. and Arilus cristatus Linn. in cotton and soybean field cage plot was noticed in U.S.A.[18 - 21]. In India, SAHAYARAJ and AMBROSE [10] also reported similar suppression by peiratine reduviids, Ectomocoris tibialis Distant against red cotton bug D.cingulatus.

Figure 1. Impact of *Rhynocoris marginatus* on the defoliation level of groundnut pests



Other Predator Populations

Other predatory fauna such as coccinellids (Menochilus sexmaculatus Fab. and Coccinella rependa), praying mantids (Mantis spp.), wasp, damselfly and spiders were observed both in the control and predator released groundnut field. Among the natural enemies observed in this study, coccinellids was the highest in the control (0.67/plant) and predator released groundnut field (0.56/plant) than other predators. The other predators showed the declining trend from the control to the predator released field as follows: Spiders>Preying mantids >Damselfly>Wasp. TIPPING et al [22] reported that release of Podisus maculiventris increased other predators about 10 days after the first release. Hence it is necessary to analyze the interaction between predators, when some generalist predator may attack on other specialist predator, which may cause negative effects on pest control. Proper assessment of the role of reduviids predators in regulation of insect pests in diverse crop system and the management of environment and habitat to increase predator population need attention as described by CLAVER and AMBROSE [12].

Yield and cost benefit ratio

The highest groundnut pod yield (1480 Kg ha –1) was obtained from the R.marginatus released groundnut field and it was reduced to 1104 Kg ha-1 in the control field. The cost benefit ratio was higher in the predator-released field (1:2.0) than the control groundnut field (1:1.8). The cost of cultivation was lesser in control field (Rs.14375) than the predator released field (Rs.15375). The net gain in the control field was lesser (Rs.11610 ha-1) than the predator released field (Rs.15380 ha-1). The increasing pest population and their infestation in the control groundnut field affected the yield [23,24]. Furthermore, the groundnut yield was affected by the defoliation in the plants [25,26]. The reduction in yield loss in the R.marginatus released field was observed where the leaf defoliation was greatly reduced than the control field.

CONCLUSION

The augmentative release of R.marginatus in the groundnut field successfully reduced the pest population viz. S.litura, H.armigera, A.craccivora, A.crenulata and C.trachypterus. So this reduviid predator can be used as bio -control agent in the groundnut ecosystem under Integrated Pest Management (IPM) programme

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