Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2020; 8(1): 319-324

Received: 13-11-2019
Accepted: 15-12-2019

S Gayathri
Department of Agricultural Entomology, AC & RI, Killikulam, Tuticorin, Tamil Nadu, India

B Geetha
Tapioca and Castor Research Station, Yethapur, Salem, Tamil Nadu, India

MI Manivannan
Horticultural Research Station, Kodaikanal, Tamil Nadu, India

Corresponding Author:
S Gayathri
Department of Agricultural Entomology, AC & RI, Killikulam, Tuticorin, Tamil Nadu, India

Efficacy of natural enemies (Predators and parasitoids) along with insect traps against major insect pests of brinjal

S Gayathri, B Geetha and MI Manivannan

Abstract
The field experiment was conducted in the farmer field at Agaram village, Thoothukudi District during *Rabi* season 2018-19 to study the influence of natural enemies on suppression of insect pest and improving the yield of brinjal. In the field study on release of natural enemies with erection of different kinds of traps, the treatment T4 (two releases of *Chrysoperla carnea* + 5 releases of *Trichogramma chilonis* + Pheromone trap + yellow + blue sticky trap) and T3 (two releases of *C. carnea* + 5 releases of *T. chilonis* + yellow + blue sticky trap) were found more effective against the population reduction of aphids, leafhoppers and whiteflies. Shoot damage (10.45 to 11.36) and fruit damage (15.36 to 16.14) were low in T4 (two releases of *C. carnea* +5 releases of *T. chilonis* + Pheromone trap + yellow + blue sticky trap) and T2 (*C. carnea* +*T. chilonis* +Pheromone trap) when compared to other treatments. The number of coccinellid adults (7.8 number/ plant), syrphids (1.5 number/ plant) and spiders (3.0 number/ plant) were also recorded more in T1 (two releases of *C. carnea* +*T. chilonis*) and T2 (*C. carnea* +*T. chilonis* +Pheromone trap) than other treatments.

Keywords: Natural enemies (predators and parasitoids), insect trap, major insect pest in brinjal

Introduction
Brinjal *Solanum melongena* (L.), also known as "egg plant" is one of the most economically important vegetable crops in South Asia. It referred as "King of Vegetables" belongs to the family Solanaceae. It is native of India and grown throughout the tropical, sub-tropical and temperate areas of the world except higher altitudes. In India it is grown extensively in about 729 thousand hectares with an annual production of 12.62MT. India is the second largest producer of brinjal next to China and it contributes to 94 percent of the country's total vegetable production. In India, the major brinjal growing states are Andhra Pradesh, West Bengal, Karnataka, Maharashtra, Orissa, Tamil Nadu, Bihar, Rajasthan and Uttar Pradesh (Nhb, 2014) [11]. Among the Solanaceous vegetables, brinjal is the most popular and also known high return cash crop by the farmers based on the commercial value and rich in minerals like iron, phosphorous, calcium and vitamins like A, B and C and due to its nutritive value (Choudhary, 1967) [4].

Biotic and abiotic factors affect the plant growth and productivity of brinjal. Among the various causes of low productivity in brinjal, one of the most important factors is the damage inflicted by the insect pests from nursery stage till harvesting. There are around 60 to 150 distinctive insect pests species infest the brinjal crop (Regupathy and Ayyasamy, 2016) [14]. Brinjal shoot and fruit borer is the most serious and destructive pests on brinjal, causes 70-90 per cent damage (Reddy and Kumar, 2004) [13] and (Chakraborti and Sarkar, 2011) [2]. The second major pest category was sucking pests viz., whitefly, aphids and leaf hopper which are economically important insect pests and cause damage up to 10-25 per cent depending on the intensity of infestation (Munde *et al.*, 2011) [10]. Chemical pesticides including synthetic pyrethroids are used by the farmers in controlling of various insect pests in brinjal. Pesticide poisoning is a major global health problem in the recent days. Due to these constraints, the research is being done on developing alternative economic and eco friendly methods of insect control. In crop field 50 - 90% of the insect pests are controlled by natural enemies (DeBach and Rosen, 1991) [6]. The beneficial action of natural enemies is important for reducing the population of insect pests. Biological control of pests by natural enemies viz., predators (Coccinellids, *Chrysoperla* and spider), parasitoid (*Trichogramma* sp.), with sex pheromone

trap are major ecosystem service delivered to agricultural worldwide for sustainable yield with safe environment. The preceding investigations exposed that most of the brinjal farmers use conventional pesticides for the management of insect pests and their indiscriminate use leads to resurgence of pest population and adverse effect on beneficial microorganisms such as pollinators and natural enemies (Srinivasan and Babu 2009) [16] which focused on aimless utilization of pesticides prompts different issues in agro-biological system.

Materials and Methods

The field experiment was conducted in the farmer field at Agaram village, Thoothakudi District during *Rabi* season 2018-19 in an area of 0.10 acre to study the influence of natural enemies on suppression of insect pest and improving the yield of brinjal. The brinjal variety KKM 1 was used for the field experiment and the thirty days old seedlings were transplanted in the spacing of 60 X 60 cm for brinjal. Experimental trial was laid out under Randomized Block Design with four replications. The predator, green lacewing *Chrysoperla carnea* Stephens @ 20,000 egg/ acre was released two times. The parasitoids, *Trichogramma chilonis* egg card was cut into small pieces and released by tagging under the surface of the leaves @ 2.5 cc/ acre. Sticky traps (yellow and blue colored) @ 20 traps/ acre and pheromone trap @ 5/ acre were laid out for attracting the insect pests in brinjal from seedling stage to harvests stage. The experiment consisted of five treatments *viz.*,T1 - Two releases of *Chrysoperla carnea* @ 20,000 egg/ acre +Five releases of *Trichogramma chilonis* @ 2.5 cc/ acre, T2 - Two releases of *Chrysoperla carnea* @ 20,000 egg/ acre + Five releases of *Trichogramma chilonis* @ 2.5 cc/ acre + Pheromone trap @ 5 number/ acre, T3 - Two releases of *Chrysoperla carnea* @ 20,000 eggs/ acre+ Five releases of *Trichogramma chilonis* @ 2.5 cc/ acre + Yellow sticky trap @ 20 no./ acre + Blue sticky trap @ 20 number/ acre, T4 - Two releases of *Chrysoperla carnea* @ 20,000 eggs/ acre + Five releases of *Trichogramma chilonis* @ 2.5 cc/ acre + Pheromone trap @ 5 no./acre + Yellow sticky trap @ 20 no./ acre + Blue sticky trap @ 20 no./ acre and T5 - Untreated check. The population of insect pests along with their natural enemies and damage level were recorded at weekly intervals. The per cent damage caused by insect pests of brinjal was statistically analyzed and subjected into square root or angular transformations (Gomez and Gomez, 1984) [8].

Result

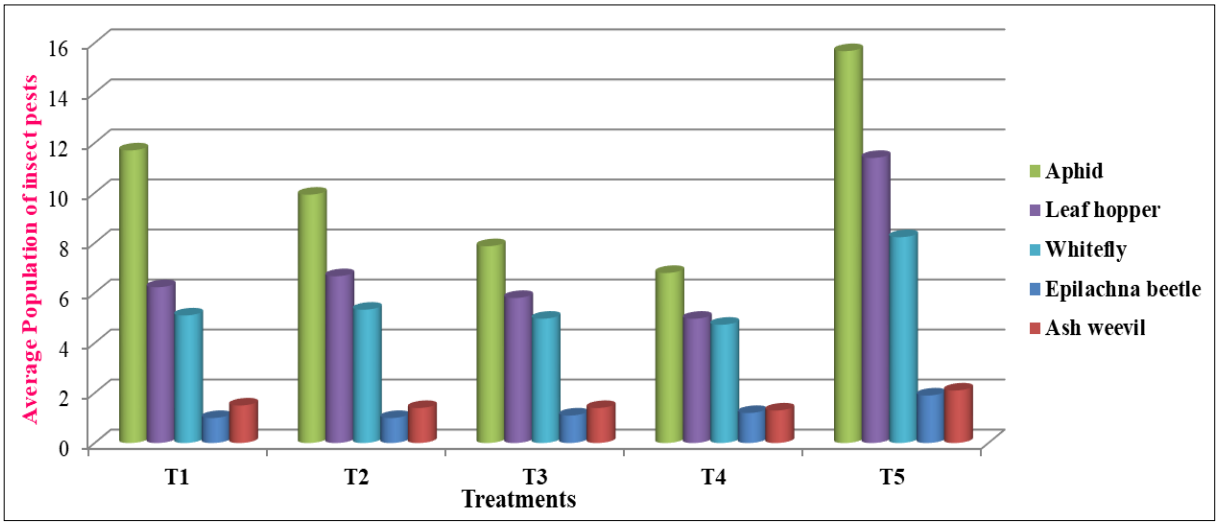
Efficacy on sucking pests and defoliators

In the field study on release of natural enemies with erection of different kinds of traps, the sucking pest population was comparatively lower in T4 (*Chrysoperla carnea* + *T. chilonis* + Pheromone trap + yellow + blue sticky trap) in which the population reduction of aphid was 6.80 number/ plant, leafhopper (4.97 number/ plant) and whitefly (4.73 number/ plant). This was followed by the treatment T3 (two releases of *C. carnea* + 5 releases of *T. chilonis* + Yellow + Blue sticky trap) with the population reduction of aphid (7.87 number/ plant), leafhopper (5.80 number/ plant) and whitefly (4.97 number/ plant). The population of sucking pests was high in the treatment T1 (Two releases of *C. carnea* + *T. chilonis*) and T2 (*C. carnea* + *T. chilonis* + Pheromone trap) without sticky traps (Table 1). The sucking pests population was lower in treatment T4 (*Chrysoperla carnea* + *T. chilonis* + Pheromone trap + yellow + blue sticky trap) which recorded the highest population of 4.80 aphid/ trap, 18.98 leafhopper/ trap and 48.18 whitefly/ trap, followed by T3 (two releases of *C. carnea* + *5* releases of *T. chilonis* + Yellow + Blue sticky trap) treated plot with the population of 5.82 aphid/ trap, (20.77 leafhopper/ trap) and (45.23 whitefly/ trap) (Table 4). The population of epilachna beetle and ash weevil were low in T1 (Two releases of *C. carnea* + *T.* chilonis) and T2 (*C. carnea* + *T. chilonis* + Pheromone trap) which was ranging from 1.0 to 1.5 numbers/ plant (Table 1 and Fig 1).

Table 1: Efficacy of natural enemies with traps against insect pests in brinjal

Treatment	*Aphis gossypii* (number/ 3 leaves/ plant)	*Amrasca devastans* (number/ 3 leaves/ plant)	*Bemisia tabaci* (number/ 3 leaves/ plant)	*Henoepilachna vigintioctopunctata* (number/plant)	*Myllocerus subfasciatus* (number/ plant)
T1 - *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @ 2.5 cc five releases	11.70 (3.27)^{d}	6.23 (2.50)^{c}	5.10 (2.26)^{b}	1.0 (1.00)^{a}	1.5 (1.22)^{a}
T2- *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @ 2.5 cc five releases +Pheromone trap @ 5 no./acre	9.93 (3.31)^{c}	6.67 (2.58)^{d}	5.33 (2.31)^{c}	1.0 (1.00)^{ab}	1.4 (1.18)^{c}
T3 - *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @ 2.5 cc five releases + Yellow sticky trap @ 20 No./acre + Blue sticky trap @ 20 no./acre	7.87 (3.30)^{b}	5.80 (2.41)^{b} (27.10)(27.10)(27.	4.97 (2.23)^{a}	1.1 (1.04)^{b}	1.4 (1.18)^{c}
T4 - *Chrysoperla carnea* @20000 two release +*Trichogramma chilonis* @ *2*.5 cc five releases + Pheromone trap @ 5 no./acre + Yellow sticky trap @ 20 no./acre+ Blue sticky trap @ 20 no./acre	6.80 (3.13)^{a}	4.97 (2.23)^{a}	4.73 (2.18)^{a}	1.2 (1.09)^{c}	1.3 (1.14)^{b}
T5 - Untreated check	15.67 (3.42)^{c}	11.40 (3.37)^{e}	8.23 (2.86)^{d}	1.9 (1.37)^{d}	2.1 (1.45)^{d}
S Ed	0.24	0.10	0.09	0.37	0.62
CD at 0.05%	0.53	0.23	0.19	0.80	1.35

Mean of 20 observations
Figures in parentheses are square root transformed values,
In a column, mean are not significantly different by DMRT (p = 0.05)



T1- *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @ 2.5 cc five releases
T2- *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @2.5 cc five releases +Pheromone trap @ 5 no./acre
T3 - *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @2.5 cc five releases + Yellow sticky trap @ 20 No./acre + Blue sticky trap @ 20 no./acre
T4 - *Chrysoperla carnea* @ 20000 two releases +*Trichogramma chilonis* @ 2.5 cc five releases + Pheromone trap @ 5 no./acre + Yellow sticky trap @ 20 no./acre+ Blue sticky trap @ 20 no./acre
T5– Untreated Check

Fig 1: Efficacy of natural enemies with different traps against sucking pest and other insect pest

Efficacy on shoot and fruit borer

Shoot damage (10.45% to 11.36%) and fruit damage (15.36% to 16.14%) were low in T4 (two releases of *C. carnea* +5 releases of *T. chilonis* + Pheromone trap + yellow + blue sticky trap) and T2 (*C. carnea* +*T. chilonis* +Pheromone trap) when compared to other treatments (Table 2). Shoot and fruit borer infestation was low in T4 (*Chrysoperla carnea* + *T. chilonis* + Pheromone trap + yellow + blue sticky trap) which attracted 15.53 male moths/ trap. The next best treatment was T2 (*C. carnea* + *T. chilonis* + Pheromone trap) which attracted (10.28 male moths/ trap). The highest marketable yield of 15.24 t/ha was recorded in T4 (*Chrysoperla carnea* + *T. chilonis* + Pheromone trap + yellow sticky trap + blue sticky trap) followed by T2 (*C. carnea* + *T. chilonis* + Pheromone trap) 13.67 t/ha when compared to the untreated check (8.63 t/ha) (Table 2 and Fig 2).

The population of natural enemies (coccinellids, syrphid and spider) was maximum in T1 (Two releases of *C. carnea* + *T.* chilonis) and T2 (*C. carnea* + *T. chilonis* + Pheromone trap) treated plots which showed the population of coccinellid (7.8 number/ plant), syrphid (1.5 number/ plant) and spider (3.0 number/ plant) (Table 3 & Fig. 3).

Discussion

Field studies were undertaken to identify the efficacy of natural enemies against insect pest of brinjal. Several workers have tried various natural enemies from different sources for successful ecofriendly management of brinjal pests. From the present investigation the highest population reduction of sucking pest was observed in T4 treated plots and it was followed by T2 and T3 due to the release of *Chrysoperla* @ 20000/ acre with the erection of yellow and blue sticky trap. The incidence of hadda beetle was lowest in T1 and T2 treated plots whereas the ash weevil population was minimum in T1 treated plot. In this study, the lowest shoot and fruit infestation was observed in T4 followed by T2 due to the five releases of *Trichogramma chilonis* + Pheromone trap @ 5 no./ acre. The population of natural enemies was highest in T1 treated plot when compared to other treatments. Maximum number of sucking pest and shoot and fruit borer were attracted towards the T4 treated plots due to the combination of *Chrysoperla, Trichogramma*, yellow and blue sticky trap, Pheromone trap. The present findings are in accordance with Raja *et al*. (1998) [12], reported that the field efficacy of *T. chilonis* was effective against the egg of *L. orbonalis.* Balakrishnan *et al.* (2005) [1]; Chakraborty, D., and D.M. Korat. 2010 [3] were reported that the field efficacy of *Chrysoperla carnea* was also effective against the reducing sucking insect pest population in cotton. According to Cork *et al.* (2001) [5]; Ghananand *et al.* (2009) [7] suggested that the erection of sex pheromone trap is used to reduce the incidence of shoot and fruit borer. Similar results were reported by Elanchezhyan and Baskaran, 2008; Ghananand *et al.*, 2009) [7] that the field efficacy of *T. chilonis* was effective against the egg of *L. orbonalis.* Balakrishnan *et al.* (2005) [1] reported the field efficacy of *Chrysoperla carnea* in the reducing sucking insect pest population in cotton. According to (DeBach and Rosen, 1991; Prasannakumar *et al.*, 2011) [6] who suggested that the erection of sex pheromone trap is used to reduced the incidence of shoot and fruit borer in brinjal.

Conclusion

It was concluded that the efficacy of natural enemies *viz.*, Predators and parasitoids with different traps showed most efficient results to control the sucking insect pests, shoot and fruit borer in brinjal, as they are also safe to environment, other organisms and human also. So it is suggested that these types of natural enemies with traps should be used in IPM programs to control the insect pest in brinjal.

Table 2: Efficacy of natural enemies against shoot and fruit borer, *Leusinodes orbonalis* G.

Treatment	Shoot Damage (%)	Fruit Damage (%)	Marketable healthy fruit Yield (t/ha)
T1 - *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @2.5 cc five releases	12.17 (20.42)^{c}	17.82 (24.97)^{c}	11.53^{c}
T2- *Chrysoperla carnea* @ 20,000 two releases + Trichogramma chilonis @2.5 cc five releases +Pheromone trap @ 5 no./acre	11.36 (19.70)^{b}	16.14 (23.69)^{b}	13.67 ^{b}
T3 - *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @2.5 cc five releases + Yellow sticky trap @ 20 No./acre + Blue sticky trap @ 20 no./acre	13.52 (21.57)^{d}	18.13 (25.20)^{cd}	10.98^{d}
T4 - *Chrysoperla carnea* @20000 two release +*Trichogramma chilonis* @ 2.5 cc five releases + Pheromone trap @ 5 no./acre + Yellow sticky trap @ 20 no./acre+ Blue sticky trap @ 20 no./acre	10.45 (18.86)^{a}	15.36 (23.07)^{a}	15.24^{a}
T5 - Untreated check	25.74 (30.49)^{e}	36.50 (37.17)^{d}	8.63^{e}
S Ed	0.13	0.19	-
CD at 5%	0.28	0.41	-

Mean of 20 observations
Figures in parentheses are arcsine transformed values
In a column, mean are not significantly different by DMRT (P=0.05)

Table 3: Population of other unreleased natural enemies observed in brinjal ecosystem

Treatments	Coccinellids (number/ plant)	Syrphids (number/ plant)	Spider (number/ plant)
T1 - *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @2.5 cc five releases	7.8 (2.79)^{a}	1.5 (1.22)^{a}	3.0 (1.73)^{a}
T2- *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @2.5 cc five releases +Pheromone trap @ 5 no./acre	6.7 (2.58)^{b}	1.1 (1.04)^{c}	1.7 (1.30)^{b}
T3 - *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @2.5 cc five releases + Yellow sticky trap @ 20 No./acre + Blue sticky trap @ 20 no./acre	4.4 (2.09)^{d}	1.0 (1.05)^{d}	1.5 (1.22)^{c}
T4 - *Chrysoperla carnea* @20000 two release +*Trichogramma chilonis* @ 2.5 cc five releases + Pheromone trap @ 5 no./acre + Yellow sticky trap @ 20 no./acre+ Blue sticky trap @ 20 no./acre	5.2 (2.28)^{c}	1.2 (1.09)^{b}	2.0 (1.41)^{d}
T5 - Untreated check	1.5 (1.22)^{e}	1.0 (1.00)^{e}	1.4 (1.18)^{e}
S Ed	0.40	0.50	0.58
CD at 5%	0.87	1.11	1.28

Mean of 20 observations
Figures in parentheses are square root transformed values,
In a column, mean are not significantly different by DMRT (p = 0.05)

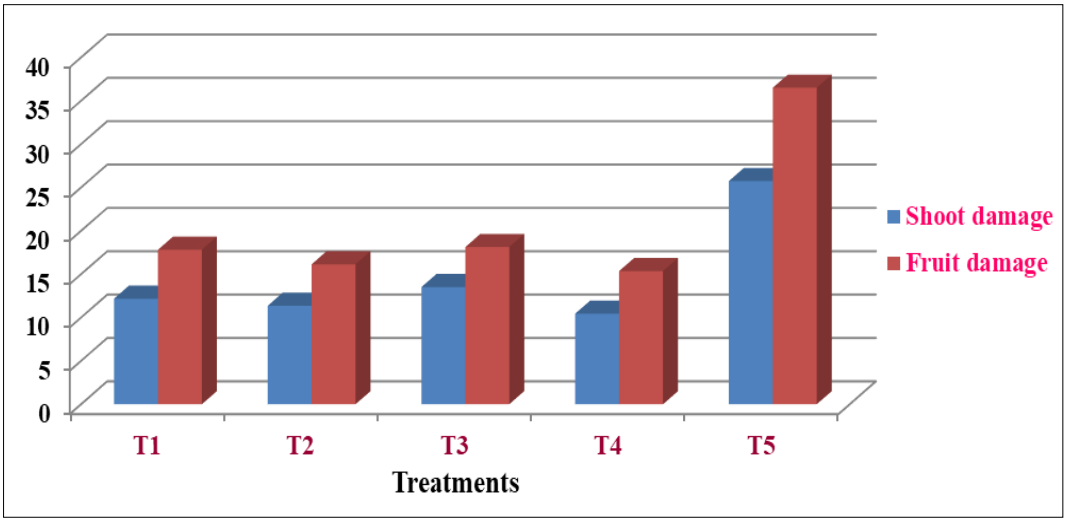
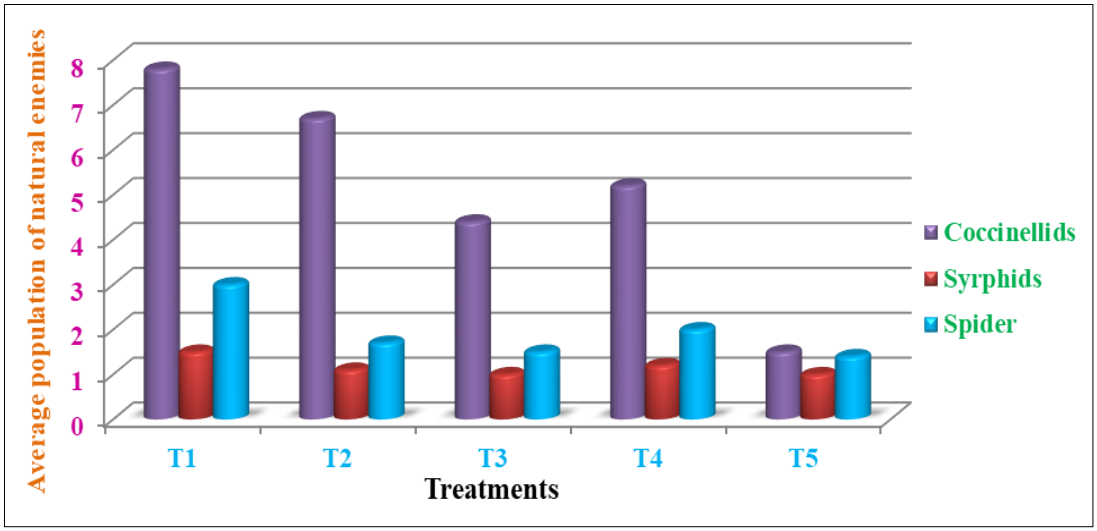


Fig 2: Efficacy of natural enemies with traps against *Leucinodes orbonalis* G.



T1- *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @ 2.5 cc five releases
T2- *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @2.5 cc five releases +Pheromone trap @ 5 no./acre
T3 - *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @2.5 cc five releases + Yellow sticky trap @ 20 No./acre + Blue sticky trap @ 20 no./acre
T4 - *Chrysoperla carnea* @ 20000 two releases +*Trichogramma chilonis* @ 2.5 cc five releases + Pheromone trap @ 5 no./acre + Yellow sticky trap @ 20 no./acre+ Blue sticky trap @ 20 no./acre
T5 – Untreated Check

Fig 3: Population of unreleased natural enemies

Table 4: Efficacy of traps against sucking insect pests and shoot and fruit borer in brinjal

Treatment	Mean number of insects attracted/ trap/ crop period				
	Aphis gossypii	***Amrasca devastans***	***Bemisia tabaci***	**Shoot & fruit borer**	**Other insects (ants, weevils, flies)**
T1 - *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @2.5 cc five releases	-	-	-	-	-
T2- *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @2.5 cc five releases +Pheromone trap @ 5 no./acre	-	-	-	10.28	-
T3 - *Chrysoperla carnea* @ 20,000 two releases + *Trichogramma chilonis* @2.5 cc five releases + Yellow sticky trap @ 20 No./acre + Blue sticky trap @ 20 no./acre	5.82	20.77	45.23	-	13.96
T4 - *Chrysoperla carnea* @20000 two release +*Trichogramma chilonis* @ 2.5 cc five releases + Pheromone trap @ 5 no./acre + Yellow sticky trap @ 20 no./acre+ Blue sticky trap @ 20 no./acre	4.80	18.98	48.18	15.54	18.24
T5 - Untreated check	-	-	-	-	-

References

1. Balakrishnan N, Baskaran RK, Mahadevan NR. Evaluation of management modules of bollworms on cotton under rainfed conditions. Annals of Plant Protection Sciences. 2005; 13(2):373-378.
2. Chakraborti S, Sarkar P. Management of *Leucinodes orbonalis* Guenee on eggplants during the rainy season in India. Journal of Plant Protection Research. 2011; 51(4):325-328.
3. Chakraborty D, Korat DM. Feeding efficiency of green lacewing, *Chrysoperla carnea* (Stephens) on different species of aphids. Karnataka Journal of Agricultural Science. 2010; 23(5):793-794.
4. Choudhary B. Brinjal vegetables. National book Trust, India, New Delhi, 1967, 50-58.
5. Cork A, Alam SN, Das A, Das CS, Ghosh GC, Farman DI *et al*. Female sex pheromone of brinjal fruit and shoot borer, *Leucinodes orbonalis* blend optimization. Journal of Chemical Ecology. 2001; 27(9):1867-1877.
6. DeBach P, Rosen D. Biological control by natural enemies: CUP Archive, 1991.
7. Ghananand T, Prasad CS, Lok N. Moths trapping of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. Annals of Plant Protection Sciences. 2009; 17(2):319-321.
8. Gomez KA, Gomez AA. Statistical Procedures for agricultural Research (2nd edn.), Wiley Interscience Pub. John Wiley and Sons, New York, 1984, pp. 680.
9. Javed MW, Malik MK, Jafir M. Management dynamics of potential bio-pesticides against polyphagous sucking pests on eggplant (*Solanum melongena* L.), 2018.
10. Munde AD, Latpate CB, Shinde ST, Badgujar AG. Integrated management of aphids and jassids infesting brinjal. Journal of entomological Research. 2011; 35(1):43-49.
11. Nhb G. Indian Horticulture Database. National Horticulture Board, Gurgaon, Ministry of Agriculture, Government of India, 2014, pp. 286.
12. Raja J, Rajendran B, Pappiah CM. Management of egg plant shoot and fruit borer *Leucinodes orbonalis* G, 1998.
13. Reddy NA, Kumar CA. Studies on the seasonal incidence of insect pests of tomato in Karnataka. Pest Management in Horticultural Ecosystems, 2004, 10(2).
14. Regupathy A, Ayyasamy R. A guide on crop pests:

Namrutha Publications, 2016.
15. Srinivasan G, Babu PCS. Sex pheromones for brinjal shoot and fruit borer, *Leucinodes orbonalis*. Indian Journal of Entomology. 2000; 62(2):225-226.
16. Srinivasan R. Insect and mite pests on eggplant, 2009, 9. AVRDC-World Vegetable Center.