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Management of Brinjal Shoot and Fruit Borer, *Leucinodes orbonalis* through Eco-Friendly Approaches

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ABSTRACT

A field experiment on evaluation of eco-friendly management approaches for against key Lepidopteran insect pest of brinjal i.e., shoot and fruit borer, Leucinodes orbonalis was conducted during late Kharif season 2015-16 in the Insectary premises, Department of Entomology, S.V.Agril.College, Tirupati, Acharya N.G.ranga Agricultural University. A total of 11 treatments were imposed including farmers practice. Except farmers practice, all the treatments were composed by combining different environment friendly components. The components includes 3 organic manures i.e FYM , Vermicompost, neem cake; important cultural practices i.e. clipping of infested shoots, collection of infested fruits, their destruction at regular intervals; use of egg parasitoid, Trichogramma chelonis and application of safer insecticides i.e Azadirachtin, spinosad. From 10 to 60 days after transplanting, mean shoot damage was recorded and from 60 to 120 days, mean fruit damage was recorded at 10 days interval. The shoot damage by L. orbonalis was comparatively lowest (24.67) in T_{11} i.e. farmers practice. Among the ten ecofriendly treatments, T_3 (Basal application of FYM @ 8 t/ha + clipping of infested shoots at 4 days interval + collection and destruction of bored fruits at every harvest + application of spinosad 45% SC at 30 and 50 DAT @0.01%) and T_7 (Basal application of vermicompost @ 6 t/ha + clipping of infested shoots at 4 days interval + collection and destruction of bored fruits at every harvest + application of spinosad 45% SC at 30 and 50 DAT @ 0.01%) recorded lower shoot damages viz., 28.33 and 27.33 per cent. Lowest mean number of damaged fruits (15.12) were recorded in T_{11} i.e. farmers practices. In T_7 and T_3, 17 to 20 per cent fruit damage was recorded. Highest yield of fruits was obtained in T_{11} (8115 kg ha^{-1}) followed by the T_7 (6630 kg ha^{-1}) and T_3 (5655 kg ha^{-1}).

Key words: *Brinjal, Shoot and fruit borer, Leucinodes arbonalis, Shoot damage, Fruit damage on number basis, Safer methods*

INTRODUCTION

Brinjal (*Solanum melongena* L.), also known as eggplant or aubergine belonging to the family "Solanaceae", is one of the common and popular vegetables grown throughout the world. Brinjal is the second important vegetable crop next to tomato grown in an area of 0.68 million hectares with annual production of 12.9 million tonnes accounting about 8.3 per cent of total vegetable production of the India.

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The area under brinjal crop in Andhra Pradesh occupies 58 thousand hectares with annual production of 1160 thousand tonnes. The damage due to insect pests is one of the major reasons for the lower productivity in brinjal. This crop is vulnerable to attack of as many as 26 insect pests, starting from nursery to harvesting of the crop. Among all the insect pests, shoot and fruit borer, *Leucinodes orbonalis* Guenee is most destructive one. It causes upto 70 percent damage to shoots and fruits of brinjal. To combat *Leucinodes*, farmers currently are using wide variety of toxic chemicals, applying them more frequently. Due to short pickings of brinjal, toxic residues of powerful synthetics poses human and animal health hazards. The indiscriminate use of pesticides also leads to environmental pollution and disruption of natural enemies. Practicing alternative strategies for management of problematic pests like *L. orbonalis* is an important criterion. In this line, the present study was taken up to evaluate some eco-friendly approaches with combinations of all safer practices against *Leucinodes arbonalis*.

MATERIAL AND METHODS

The experiment was laid out in randomized block design with eleven treatments replicating thrice with a net plot size of 4×5 m along with bunds all around and irrigation channel in between the replications.

Treatment	Details
T_1	Basal application of FYM @ 8 t/ha + clipping of infested shoots at 4 days interval + collection and destruction of bored fruits at every harvest.
T_2	Basal application of FYM @ 8 t/ha + clipping of infested shoots at 4 days interval + collection and destruction of bored fruits at every harvest+ arranging *Trichogramma* cards @ 60000 per ha at 30 and 50 DAT .
T_3	Basal application of FYM @ 8 t/ha + clipping of infested shoots at 4 days interval + collection and destruction of bored fruits at every harvest + application of spinosad 45% SC at 30 and 50 DAT @ 0.01%.
T_4	Basal application of FYM @ 8 t/ha + clipping of infested shoots at 4 days interval + collection and destruction of bored fruits at every harvest + application of azadirachtin 0.5% EC (10000ppm) @ 0.1%.
T_5	Basal application of vermicompost @ 6t/ha + clipping of infested shoots at 4 days interval + collection and destruction of bored fruits at every harvest.
T_6	Basal application of vermicompost @ 6t/ha + clipping of infested shoots at 4 days interval + collection and destruction of bored fruits at every harvest + arranging *Trichogramma* cards @ 60000 per ha at 30 DAT and 50 DAT
T_7	Basal application of vermicompost @ 6 t/ha + clipping of infested shoots at 4 days interval + collection and destruction of bored fruits at every harvest + application of spinosad 45% SC at 30 and 50 DAT @ 0.01%.
T_8	Basal application of vermicompost @ 6 t/ha + clipping of infested shoots at 4 days interval + collection and destruction of bored fruits at every harvest + application of azadirachtin 0.5% EC (10000ppm) @ 0.1%.
T_9	Application of neem cake @ 1t/ha at 2 times before sowing and 30 DAT+ clipping of infested shoots at 4 days interval + collection and destruction of bored fruits at every harvest.
T_{10}	Application of neem cake @ 1t/ha at 2times before sowing and 30 after transplanting + clipping of infested shoots at 4days interval + collection and destruction of bored fruits at every harvest + application of spinosad 45% SC at 30 and 50 DAT@ 0.01%.
T_{11}	Farmer general practices (application of fertiliser as the farmers practice, alternate spraying of three insecticides commonly used by the farmers viz., thiodicarb75WP @0.075%, rynaxypyr18.5SC @ 0.006% and imidacloprid 17.8 SL@ 0.005%)).

The variety C.V.K was selected for the experiment. It bears round shape fruits which are green in colour. It is relatively susceptible for brinjal shoot and fruit borer. The seedlings after nursery care were transplanted in the main field after 30 days of sowing. Irrigation was given immediately after transplanting of the seedlings. After that, irrigation was given at 7 days interval and also on requirement. Hand weeding was done frequently to

maintain the plots weed free throughout the crop period.

Imposing the treatments

- As basal application, in four treatments i.e. T_1, T_2, T_3, T_4, FYM was applied @ 8t/ha and in another four treatments i.e. T_5, T_6, T_7, T_8, vermicompost was applied @ 6t/ha and in another two treatments i.e. T_9, T_{10}, neemcake was applied @ 1t/ha. In the treatment T_{11}, entire dose of phosphorus and potash and half of dose of the nitrogen were applied before transplanting and the remaining half of the nitrogen was applied a month after transplanting by band placement method.
- FYM, vermicompost and neem cake were applied as two spilt doses i.e. half quantity as basal dressing and another half at 30 DAT.
- In the treatments from T_1 to T_{10}, the drooped shoots (dead hearts) were regularly observed and clipped with blade at 1cm below to the bored hole. This operation was carried at 4 days interval. All the collected dead hearts were destructed.
- In the above treatments i.e. T_1 to T_{10}, from 60 to 120 DAT, the fruits with entry and exit holes of *L. orbonalis* were also all collected and destroyed at 4 days interval.
- In T_2 and T_6, in addition to the cultural practices imposed, the trichogramma cards (as egg parasitoid on *L. orbonalis*) were arranged (purchased from NBAIR, Bangalore) two times i.e. at 50 DAT and 70 DAT @ 60000/ha.
- In T_3, T_7 and T_{10}, in addition to the cultural practices Spinosad 45% SC was sprayed @0.01% two times i.e. at 30 and 50 DAT.
- In T_4 and T_8, in addition to cultural practices, azadirachtin 10000 ppm was applied as foliar spray @ 0.1% at 30 DAT and 50 DAT.
- T_{11} includes farmer practices *i.e.* application of synthetic insecticides for three times the following are the details on insecticides, concentration and time of spray.

1. Thiodicarb 75WP 30DAT	0.075%
2. Rynaxypyr 18.5 SC 50 DAT	0.006%
3. Imidacloprid 17.8 SL 70 DAT	0.005%

Recording data on infestation of *L. orbonalis*

In all the treatments, in each replication, five plants were randomly selected for recording the data on *L. orbonalis*. In this selected plants at 10, 20, 30, 40, 50 days after transplanting the total number of shoots and infested shoots (dead hearts) were noted down. At 60, 70, 80, 90, 100, 110 and 120 DAT. The total number of fruits and bored fruits were recorded from the tagged plants in all the plots. The data on number of dead hearts and number of larva per plant was recorded in different treatments up to 50 DAT at 10 days interval and converted into angular values. Fruit infestation was also found out based on the number basis from 60 days after transplanting to 120 days after transplanting.

RESULTS AND DISCUSSION

Shoot damage in different treatments

Overall mean shoot damage by *L. orbonalis* was comparatively lowest (24.67) in the treatment T_{11} *i.e.* farmer practices . T_3 and T_7 were found to be statistically insignificant from each other by recording 28.33 and 27.33 per cent overall mean shoot damage respectively. T_{10} was the next best treatment which recorded 39.33 per cent mean shoot damage during 10- 50 DAT. T_8 and T_4 resulted in insignificant shoot damage *i.e.* 43.00 and 44.67 per cent respectively. T_9, T_6 and T_2 recorded 45 to 55 per cent damage. Highest shoot damage was recorded in T_1. In T_{11}, T_7 and T_3, lowest shoot infestation noticed. **Fruit damage on number basis:**

- Lowest mean number of damaged fruits (15.12) were recorded in T_{11} *i.e.* farmers practices. In T_7, T_8, T_9 and T_3, 17 to 20 per cent fruit damage was recorded. In T_4, T_6, T_9 22-26 per cent damage was recorded. In T_1, T_2 and T_5, the highest of

31- 33 per cent mean fruit damage was noted down.

- In $T_{11,}$ as the three efficacious newer insecticides i.e. Thiodicarb, Rynaxypyr and Imidacloprid at recommended concentrations alternatively at intervals, the test insect was maintained at low levels. Thiodicarb a contact stomach poison works well against lepidopterans is a common known phenomenon.
- Though farmers practices (complete rely on synthetic fertilizers and pesticides) proved better, by considering the environmental pollution and pesticide residues in fruits, the next best treatments may be given importance for the recommendation. T_3, T_7 and T_{10} were the next best treatments with less infestation by *L. orbonalis* compared to the remaining seven treatments. In the above three treatments, vermicompost or FYM or neem cake were applied in two splits as organic nutrient sources. In addition, infested shoots and fruits were regularly collected and destroyed, and also applied spinosad @ 0.01% or azadirachtin 10000 ppm.
- Higher per cent shoot and fruit damage was recorded in the treatments *i.e.* which included only cultural practices; cultural practices + release of trichogramma parasitoid.
- When FYM, vermicompost and neem cake treatments are compared (along with only cultural practices), neem cake application was found superior in reducing the shoot and fruit infestation followed by vermicompost.
- Highest yield of fruits was obtained in T_{11} (8115 kg ha^{-1}) followed by the T_7 (6630 kg ha^{-1}) and T_3 (5655 kg ha^{-1}). Next better yields were obtained in T_9 (5180 kg ha^{-1}) followed by T_2 (4725 kg ha^{-1}), T_8 (4395 kg ha^{-1}) and T_6 (4280 kg ha^{-1}). In remaining treatments, 2615 to 3930 kg $ha^{-1}$was obtained.

The earlier reports related to the management of brinjal shoot and fruit borer through safer techniques with minimum utilization of synthetic insecticides is furnished below.

Chatterjee and Ray, observed that novaluron @ 37.5 g a.i /ha^{-1} resulted in lowest per cent shoot and fruit infestation by *L. orbonalis* Guenee on brinjal and resulted in maximum increase in yield of 45.00 and 57.67 per cent over untreated control. Singh *et al.*, reported that Cypermethrin @ 30g *a. i*/ha was superior (6.77and 21.64 % shoot and fruit damage respectively) over other treatments followed by nylon net barrier supplemented with clipping of affected shoots (11.91and 37.49% damage) and *Trichogramma chilonis* combined with multineem (13.41 % shoot damage and 45.9 % fruit damage). Sandip *et al.*[15], recorded lowest mean shoot as well as fruit infestation by *Leucinodes orbonalis* in the plots treated with spinosad 2.5SC and emamectin benzoate 5 SG. Krishnamurthy, reported that the egg parasitoid, *Trichogramma chilonis* as effective parasite of brinjal shoot and fruit borer, *L. orbonalis.*

Kaur *et al*., suggested the use of insecticides with mechanical clipping of infested shoots along with incorporation of neem as soil and foliar application for managing the brinjal shoot and fruit borer, *L. orbonalis*. Muregesan and Murugesh[11], reported that the plant products, neemoil, nimbecidine, neemcake extract and *Calotropis gigantea* were able to reduce the shoot damage by *L. orbonalis* more than 50 per cent in *kharif* brinjal. Aparna and Dethe[2]. reported spinosad as very effective chemical against brinjal shoot and fruit borer. Anoorag[1]. stated that Spinosad 45 SC @ 0.01 % was found most effective and showed 9.84 per cent shoot infestation, and fruit infestation of 6.87 per cent on number basis. Chakraborty[3]. reported that biorational integrated approach resulted in 2 per cent yield loss in brinjal as compared to 50 per cent and 45 per cent yield loss in chemical management and untreated control respectively.

According to Ghimire and Khatiwada[5], highest marketable fruit yield of brinjal as well as lowest fruit infestation for number and weight basis was obtained from

use of barrier + clipping practices followed by the use of barrier alone. Rahman et *al.*[13], suggested removal and prompt destruction of the brinjal shoot and fruit borer infested shoots and fruits at regular intervals as an effective strategy to manage *L. orbonalis*. Duca *et al.*[4], stated that weekly removal of *Leucinodes* damaged fruits and shoots resulted in the highest weight of healthy fruits and lowest incidence of damage fruits in Brinjal. The experiment of Jhala *et al.*[8], revealed that netting plus continuous clipping of infested shoots reduced the shoot and fruit borer damage by *L. orbonalis* and recorded higher marketable yield of brinjal.

In a field experiment conducted to study four components of integrated pest management, *viz.*, application of neem oil cake at 100 kg/acre at transplanting stage, Pheromone traps installation at 25/acre at starting stage of buds and flowers in 45 days old crop on weekly basis, and mechanically removal of infested shoots following neem oil spray at 10-12 days intervals. These IPM components significantly reduced *L. orbonalis* infestation on brinjal cultivars. This approach has demonstrated better yield of marketable fruits, with increase in cost[14]. Kavitharaghavan *et al.*[9], carried out experiment with the use of bio fertilizers in addition to farm yard manure, neem cake, poultry manure and macho cake. They showed that the shoot and fruit borer damage was consistently less in the plots treated with PM + Bio fertilizers + N.C. along with the field release of bio control agents. Koushik *et al.*[10], reported that under the field conditions, the combination of *Fusaruim semitectum* $3.6x10^{15}$+ *N. rileyi* $2x10^{8}$+ spinosad (15 g a.i/ha) and removal and destruction of infected shoots and fruits reduced the infestation of *L. orbonalis* effectively.

The trials of Nayak *et al.*[12], showed that IPM module (M_4 : neem cake @ 2 Q/ha (50 % at transplanting and 50 % at 3 weeks after transplanting), alternate spraying of neem oil (300 ppm) @ 5 ml/l of water and *B.t* @ 2 g/l of water at 10 days interval, installation of pheromone traps from 30 DAT @ 70 $ha^{-1}$and regular collection and destruction of infested plant parts was found to be highly effective in minimizing the BSFB infestation with the minimum shoot (7.8%), flower bud (6.4%) and fruit damage (8.8%) in comparison to the farmers' practice of indiscriminate application of different insecticides and ITK (indigenous technical knowledge). Niranjan *et al*., reported that soil application of neem cake @ 2.5 q ha^{-1}, removal and destruction of infected shoots and fruits and alternate spraying of triazophos 40 EC @ 1250 ml $ha^{-1}$and neem oil @ 2.5 lit ha^{-1} at 10 days interval was found to be the most effective and economical among three modules assessed for management of shoot and fruit borer of brinjal.

Table 1: The mean per cent shoot and fruit damage (number basis) by *Leucinodes orbonalis during* late *Kharif* 2015-16

Treatments	Shoot damage	Fruit damage on number basis	Yield (kg/ha^{-1})
T_1	62.67 (48.27)	32.92 (35.02)	2615
T_2	55.33 (32.17)	30.96 (33.82)	4725
T_3	28.33 (32.17)	17.07 (24.41)	5655
T_4	44.67 (41.96)	22.04 (28.01)	3825
T_5	58.00 (49.62)	30.79 (33.72)	3265
T_6	49.33 (44.64)	25.68 (30.46)	4280
T_7	27.33 (31.53)	18.91 (25.78)	6630

T_8	43.00 (40.99)	20.37 (26.83)	4395
T_9	45.67 (42.53)	24.12 (29.42)	5180
T_{10}	39.33 (38.86)	19.34 (26.09)	3930
T_{11}	24.67 (29.79)	15.12 (22.89)	8115
Mean	43.48	23.39	9.36
C.D	1.68	1.55	1.18
SE(m)±	2.73	2.38	1.64

The data on dead hearts and fruit damage on number basis is mean of three replications
Figures in parentheses are angular transformed values

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