The Bioscan 9(1): 393-397, 2014 (Supplement on Plant Pathology)
AN INTERNATIONAL QUARTERLY JOURNAL OF LIFE SCIENCES
www.thebioscan.in

EVALUATION OF DIFFERENT PEST MANAGEMENT MODULES FOR THE INSECT PEST COMPLEX OF BRINJAL DURING RABI SEASON IN ZONE - III OF BIHAR

S. TAMOGHNA, C. NITHYA AND K. RANDHIR*
Department of Agricultural Entomology,
*Department of Vegetable and Floriculture, Bihar Agricultural University, Sabour - 813 210, Bhagalpur, Bihar, INDIA
e-mail: tamoghnasaha1984@gmail.com

KEYWORDS
Leucinodes orbonalis
Management modules
Coccinellid
Spider
Syrphid

Received on :
17.01.2014

Accepted on :
13.02.2014

***Corresponding author**

ABSTRACT

Field experiment was conducted from 2011 to 2013 to evaluate the effectiveness of different pest management modules against major pest *viz.* shoot and fruit borer (*Leucinodes orbonalis*), leaf hopper (*Amrasca biguttula biguttula*), white fly (*Bemisia tabaci*) and aphid (*Aphis gossypii*) of brinjal during rabi season in Zone-III of Bihar. The modules consisted of organic module (M1): soil application of FYM+weekly clipping of infested shoot+ pheromone traps+ *Trichogramma chilonis*+NSKE+ Bt, IPM module (M2): seedling root dip in imidacloprid +maize border crop+ clipping of infested shoots+ pheromone traps+ cypermethrin, bio-rational module(M3): imidacloprid+thiomethoxam+spinosad+ indoxacarb + emamectin benzoate and untreated check (M4). The impacts of treatments on natural enemies as well as pollinators were also assessed. The results revealed that minimum shoot and fruit (5.10 and 15.18 per cent, respectively) infestation was found in bio-rational module which was followed by IPM module (7.28 and 18.94 cent, respectively). Effectiveness of this module was also reflected on reduction in sucking pest *viz* white fly (5.68 per 3 leaves), hopper (6.28 per 3 leaves) and aphid (4.34 per 3 leaves) infestation and fruit yield (327.68 q/ha) which was significantly higher in comparison to other modules. However, IPM module (coccinellids: 5.20-7.80 /plant, spiders: 4.80-5.80 /plant and syrphids: 2.70-4.20 /plant) and organic module (coccinellids: 4.20-6.60 /plant, spiders: 2.80-4.00 /plant and syrphids: 2.00-2.60 /plant) were safer to natural enemies as well as pollinators. As per as cost benefit ratio is concerned, highest cost benefit ratio was obtained in IPM module (1: 31) followed by bio-rational module (1: 22).

INTRODUCTION

Brinjal (*Solanum melongena* Linnaeus) also known as eggplant is referred as "King of vegetables", originated from India and now grown as a vegetable throughout the tropical, sub-tropical and warm temperate areas of the world. It is grown in almost all states of India with an area of 55.7 thousand hectares under cultivation and production of 1215.6 thousand metric tons (Anonymous, 2011). Among the major constraints in economic cultivation of brinjal, pest infestation causes heavy losses. Brinjal is attacked by plethora of insect and mite pests starting from seedling stage to senescence. The crop is attacked by number of insect pests but the major ones include jassid (*A. biguttula biguttula)*, aphid (*A. gossypii*), white fly (*B. tabaci*) and shoot and fruit borer (*L. orbonalis* Guenee). *L. orbonalis* Guenee, is the major problem in the cultivation of brinjal. Yield losses reaching as high as 85-90% has been reported (Patnaik, 1997; Misra, 2008; Jagginavar *et al*., 2009). In India, this pest has a countrywide distribution and has been categorized as the most destructive and most serious pest causing huge losses in brinjal. Farmers largely follow the chemical method as it produces quick results. High-frequency application of chemicals is the common scenario. However, these chemicals, in many cases, invited the problems of pesticide resistance, resurgence, secondary pest outbreak, environmental contamination, residual toxicity and toxicity to beneficial organisms and disturbance in homeostasis of natural populations (Suadrshan and Pijush, 2010; Bhusan *et al*., 2011).

Intensive survey in Bihar revealed that maximum farmers are solely relying on old conventional group of insectides to control the insect pest of brinjal. It is therefore necessary to develop and follow a rational approach with greater reliance on pest management modules to promote sustainability and to reduce the number of application of hazardous chemicals. The present investigation was, therefore, planned to evaluate different management modules including microbial, cultural and new generation insecticide molecules for the management of insect pest complex in brinjal. Simultaneously this management module will help the farmers of Bihar to take adequate pest management in brinjal. Non-target effects were also assessed.

MATERIALS AND METHODS

The present investigation were laid out during the rabi seasons of 2010-11, 2011-12 and 2012-13 at AICRP Vegetable Research Centre, Sabour, Bhagalpur, Bihar (latitude 87°2´ 54"E, longitude 25°14´ 24"N, altitude 30 m a.s.l.).

The trials were conducted in randomized block design having

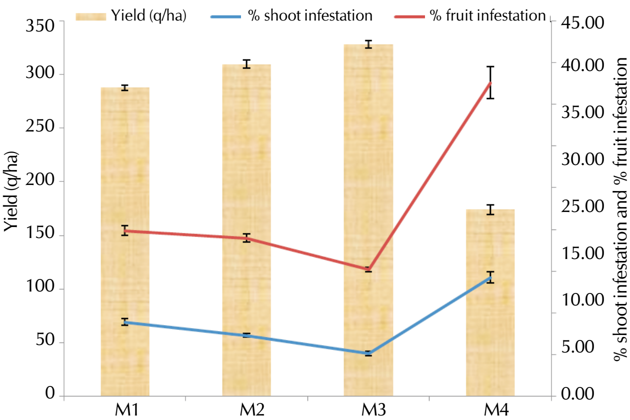

Figure 1: Effect of modules on reduction of shoot and fruit infestation and increase yield

plot size of 25 m^2 and spacing 75 × 75 cm at experimental research farm of the vegetable department. Four management modules were taken including an untreated check with five replications. Details of modules were given in Table 1. The seedlings were transplanted on 15th September 2010, 18th September 2011 and 17th September 2012. Brinjal variety, Mukta Keshi was raised as per recommended package of practices except insect-pest management practices.

The observations were recorded from 25 randomly selected and tagged plants in each plot (M1, M2, M3 and M4). Similarly to record the damaged fruits, the fruits were plucked from tagged 25 plants and then the number of total fruits, number of healthy fruits and number of damaged fruits were counted in each plot (Bhusan *et al*., 2011). For sucking pest three leaves per plant were observed. All the observations were done at 10-day-intervals starting from 21 DAT (days after transplanting) (Suadrshan and Pijush, 2010). Data regarding shoot damage were recorded from 35 up to 105 DAT and fruit damage was started from 65-70 DAT and till end of the final picking (Bhusan *et al*., 2011). Per cent increase in yield over the check was calculated using the following formula:

$$\text{Increase (\%)} = \frac{\text{Treatment yield - Control yield}}{\text{Treatment yield}} \times 100$$

Collected data were then subjected to pooled analysis of variance (ANOVA) after appropriate transformations according to Gomez and Gomez (1984). Meteorological parameters (Table 6) were obtained from meteorological unit of Bihar Agricultural University, Sabour.

Cost of eggplant fruits: Rs 1000/q; labour charges: Rs 147/ day, neem cake: Rs 26/kg; pheromone trap with lure: Rs 140/ piece; Trichogramma: Rs 40/card; verticillium: Rs 250/kg; milk: Rs 30/l; nske: 28/kg seed; multineem: Rs 320/l; Cost of newer molecules: imidacloprid 17.8 SL: Rs 1144/l; indoxacarb 15.5 SC: Rs 3500/l; emamectin beazoate 25 WG: Rs 13000/kg; spinosad 45 SC: Rs 9000/l, thiomethoxam 25WG: Rs 2025/ kg; cypermethrin 10 EC: Rs 484/l.

RESULTS AND DISCUSSION

Data pertained in Table 2 on shoot infestation revealed that all the treatments were effective against the borer, though varied in their efficacies (5.10 to 14.20) and were significantly superior to the check. The present observation showed that minimum (5.10 and 64 %) shoot infestation was found with biorational module (M3: root dip in imidacloprid+ thiomethoxam+ spinosad+ indoxcarb+ emmamectin benzoate) (Fig. 1) followed by IPM module (7.28 and 49%) (M2: root dip in imidacloprid+ maize as a border crop+ weekly clipping of infested shoots and fruits+ Erection of pheromone traps+ alternate spray of neem insecticides and cypermethrin). However, maximum shoot infestations (8.88 and 37%) were recorded with organic module (M1: Soil application of FYM and neem cake+ weekly clipping of infested shoots and fruits+ pheromone traps+ thiomethoxam and verticillium+ NSKE+ Bt).

In the present investigation root dip in imidacloprid plus first foliar spray of thiomethoxam 25 WG @ 0.5 g/l at 40 DAT plus second foliar spray of spinosad 45 SC @ 0.5 ml/l at 60 DAT plus third foliar spray of indoxacarb 14.5 SC @ 0.5 ml/l at 75 DAT and fourth foliar spray of emamectin benzoate 25 WG @ 0.4 g/l at 90 DAT gave maximum protection in terms of shoot damage. The present study is substantially supported by the findings of Sandip *et al*. (2009), Anil and Sharma (2010), Tayde and Simon (2010) and Singh (2010) in brinjal against *L. orbonalis*. Hirekurubar and Ambekar (2008) and Sandip *et al*. (2007) reported that indoxacarb, emamectin benzoate and spinosad were most effective in reducing the shoot damage

Table 1: Pest management module details

Pest management module	details
M1	Soil application of FYM @ 10 t/ha + Neemcake @ 500 kg/ha as basal application Weekly clipping of infested shoot from the appearance of pests Erection of pheromone traps @ 100 traps/ha for mass trapping4-5 release of *Trichogramma chilonis* @ 1.5 lakh/ha from flowering stage at weekly interval First spray of *Verticillium lecanii* @ 4 g/l + milk @ 5 ml/l (spraying should be done in the evening hours) at 40 DAT for sucking pests. Second spray of NSKE 4% 30 days after transplanting (DAT)Third spray of Bt formulation @ 2 gm/l at 50 DATFourth spray of *B. bassiana* @ 4 gm/l at 60 DAT
M2	Seedling root dip in imidacloprid @ 1 ml/L for three hours before transplantingTwo rows of maize as a border crop Weekly clipping of infested shoots and fruits at the appearance of shoot and fruit borer Erection of pheromone traps @ 100 traps/ha for mass trapping of shoot and fruit borer Four alternate spray of neem insecticides and cypermethrin @ 0.5 ml/L at 10 days interval from flowering
M3	Seedling root dip in imidacloprid 200 SL@ 1 ml/L for three hours before transplantingFirst foliar spray of thiomethoxam 25 WG @ 0.5 g/L at 40 DATSecond foliar spray of spinosad 45 SC @ 0.5 ml/l at 60 DAT Third foliar spray of indoxacarb 14.5 SC @ 0.5 ml/L at 75 DAT Fourth foliar spray of emamectin benzoate 25 WG @ 0.4 g/l at 90 DAT
M4	Untreated check

Table 2: Effect of different pest management modules on the infestation and damage by *Leucinodes orbonalis* Guenee (Pooled data of three years)

Modules	Mean of shoot infestation (%)	Per cent reduction in shoot infestation over control (%)	Mean of fruit infestation (%)	Per cent reduction in fruit infestation over control (%)	Mean No. of holes/ fruit	Mean No. of larvae/ fruit
M1	8.88 (17.32)	37.46	19.80 (26.41)	47.28	2.32 (8.58)	1.74 (7.52)
M2	7.28 (15.65)	48.73	18.94 (25.79)	49.57	1.84 (7.61)	1.38 (6.68)
M3	5.10 (13.04)	64.08	15.18 (22.92)	59.58	1.32 (6.52)	0.90 (5.40)
M4	14.20 (22.12)	-	37.56 (37.78)	-	4.96 (12.84)	4.34 (11.98)
S.Em (±)	0.40	-	0.68	-	0.67	0.50
CD (p=0.05)	1.22	-	2.11	-	2.07	1.53

*Figures in parentheses are arc sine transformed values

Table 3: Effect of different pest management modules on sucking insect pest complex of brinjal (Pooled data of three years)

Modules	Mean of whiteflies population/3 leaves	Mean of leafhoppers population/3 leaves	Mean of Aphid population /3 leaves
M1	8.86 (3.05)	9.66 (3.18)	6.82 (2.70)
M2	7.84 (2.89)	8.44 (2.99)	6.28 (2.60)
M3	5.68 (2.48)	6.28 (2.60)	4.34 (2.20)
M4	13.20 (3.70)	14.04 (3.81)	11.17 (3.41)
S. Em (±)	0.09	0.07	0.06
CD (p=0.05)	0.27	0.23	0.19

*Figures in parentheses are arc sine transformed values

Table 4: Yield and economics of different pest management modules in brinjal (Mean of three years)

Treatments (Concentration)	Yield q/ha	Increase in yield over control	Gain in yield over control (q/ha)	Value of additional yield	Total Cost (Treatment and Labour cost)	Net Gain	Benefit: Cost ratio
M1	287.44	39.58	113.76	113760	17767	95993	1:6.40
M2	309.36	43.86	135.68	135680	4401	131279	1:30.83
M3	327.68	47.00	154.00	154000	7069	146931	1:21.79
M4	173.68	-	-	-	-	-	-
S. Em (±)	3.81	-	-	-	-	-	-
CD (p=0.05)	11.74	-	-	-	-	-	-

against okra shoot and fruit borer (*Earias* spp.).

Considering fruit infestation in Table 2 indicated that mean per cent fruit infestation varied from 19.80 to 37.56. The mean fruit infestation was minimum (M3: 15.18 and 60%) with bio-rational module (Fig 1) followed by IPM module (M2: 18.94 and 50%). Relatively maximum fruit infestation was noticed with organic module (M1: 19.80 and 47%). The present results are in conformity with Sandip *et al*. (2009), Anil and Sharma (2010), Tayde and Simon (2010) and Singh (2010) against *L. orbonalis*. They reported that among different insecticides, the lowest mean fruit infestation was recorded in the plots treated with spinosad 2.5 SC followed by indoxacarb 14.5 SC and emamectin benzoate 5 SG against shoot and fruit borer in brinjal. The present observations on the effectiveness of emamectin benzoate, spinosad and indoxacarb are in conformity with those of Hirekurubar and Ambekar (2008) and Sandip *et al*. (2007) in okra against okra shoot and fruit borer (*Earias* spp.).

Regarding mean number of holes and larvae per fruit in Table 2 indicated that minimum (1.32 and 0.90) infestation was recorded with bio-rational module which was at par with IPM module (1.84 and 1.38). However, maximum (2.32 and 1.74) was observed with organic module. Hosamani *et al*. (2011) reported that the minimum larval population was noticed in rynaxypyr at 30 g/ha (0.60 larva per plant) and it was on par with 25 g/ha and spinosad at 45 g/ha, which recorded 0.79 and 0.92 larva per plant, respectively; these treatments were significantly superior over the rest of the treatments.

Data pertained in Table 3 indicated that the cumulative mean number of whiteflies, leafhoppers and aphid were significantly lowest (5.68, 6.28 and 4.34 per 3 leaves) in bio-rational module. It was followed by IPM module (7.84, 8.44 and 6.28 per 3 leaves) and organic module (8.86, 9.66 and 6.82). The present results are in conformity with Jyoti (2006) who reported mean number of leafhoppers and whiteflies were significantly lowest in avermectin, spinosad and diafenthiuron. Aparna and Dethe (2012) reported that spinosad and emamectin benzoate afforded moderate control of jassid, whitefly and aphid in brinjal. Rana *et al*. (2006) also reported imidacloprid at 2ml as well as thiomethoxam and carbosulfan each at 2 g/kg seed were quite effective in controlling jassid (*Amrasca devastans* [*A. biguttula biguttula*]) and whitefly (*B. tabaci*).

The safeness of treatments to predatory coccinellids and spiders and syrphids was a necessary factor to take into account (Table 5). Based on three years observation on the mean population of coccinellids, spiders and syrphids indicated that IPM module was safer to the predator as well as pollinator by recording 5.20 to 7.80 coccinellids/ plant, 4.80

to 5.80 spiders/ plant and 2.70 to 4.20 syrphids/ plant followed by organic module (4.20 to 6.60 coccinellids/ plant, 2.80 to 4.00 spiders/ plant and 2.00 to 2.60 syrphids/ plant). The present study are substantially supported by the findings of Sardana *et al*. (2006) who reported significantly higher populations of coccinellids, predatory spiders and Chrysoperla were observed in IPM field of brinjal plant. Similarly Shah *et al*. (2011) was also found that mass trapping through sex pheromone traps (40 traps/ha) + clipping of infested shoot at weekly interval starting from 20 days after transplanting (DAT) + spray application of neem seed kernel extract (NSKE) @ 4% were safer to predatory spider's population as compared to other modules in brinjal.

Economics of different insecticides

The data in terms of economics of different modules presented in Table 4 indicated that all the modules recorded increase in marketable yield over untreated check. Bio-rational module recorded highest marketable yield (328 q ha-1), increase in marketable yield (47%) and net profit (Rs. 146931). The next best treatment was IPM module (309 q ha-1, 44%, Rs: 131279). The cost benefit ratio calculated on the basis of cost of protection for different modules indicated in chronological order was IPM module (1:31) > biorational module (1:22) > organic module (1:6). In spite of lower effectiveness, yield and net profit, IPM module recorded higher ICBR because of lower price of these traps, insecticides etc. While, bio-rational module recorded comparatively lower ICBR in spite of their higher effectiveness, yield and net profit, because of very high price of these insecticides. The present study is in conformity with Jyoti (2006) who reported emamectin benzoate 0.001 and spinosad 0.0045 recorded highest marketable fruit yield in brinjal. Sandip *et al*. (2009) reported that the highest marketable fruit yield of 143.50 q ha-1 was recorded in spinosad treatment followed by indoxacarb and emamectin benzoate with 126.90 and 121.30 q ha^{-1} respectively. The highest net ICBR was in module-2 (1:2.21), which was almost same to module-1 (1:2.20). The highest (1:2.21) net ICBR was in module-2 including clipping of infested shoots + application of potash @ 100 kg/ha + field sanitation + spray application of spinosad @ 0.0135% alternated with azadirachtin @ 0.0006% at 20 days interval, which was almost same to module-1 (1:2.20) including mass trapping through sex pheromone traps (40 traps/ha) + clipping of infested shoot at weekly interval starting from 20 days after transplanting (DAT) + spray application of neem seed kernel extract (NSKE) @ 4% (Shah *et al*., 2011). Bhusan *et al*. (2011) reported that highest benefit cost ratio was obtained in clipping of infested shoot at fortnightly interval before insecticidal application alternate spray of Multineem (1500ppm azadirachtin) and combination product against *L. orbonalis* in brinjal.

Thus the present study suggested that root dip in imidacloprid plus first foliar spray of thiomethoxam 25 WG @ 0.5 g/l at 40 DAT plus second foliar spray of spinosad 45 SC @ 0.5 ml/l at 60 DAT plus third foliar spray of indoxacarb 14.5 SC @ 0.5 ml/l at 75 DAT and fourth foliar spray of emamectin benzoate 25 WG @ 0.4 g/l at 90 DAT were superior in reducing the shoot as well as fruit infestation by *Leucinodes orbonalis* and recorded highest yield.

Table 5: Effect of different pest management modules on the natural enemy-complex in the brinjal ecosystem

Modules	Mean number of coccinellids/plant				Mean number of spiders/plant				Mean number of syrphids/plant			
	30 DAT	50 DAT	70 DAT	90 DAT	30 DAT	50 DAT	70 DAT	90 DAT	30 DAT	50 DAT	70 DAT	90 DAT
M1	4.20 (2.16)	5.00 (2.34)	6.20 (2.58)	6.60 (2.66)	3.20 (1.91)	2.80 (1.79)	3.60 (2.02)	4.00 (2.11)	2.20 (1.63)	2.00 (1.57)	2.40 (1.70)	2.60 (1.75)
M2	5.20 (2.38)	6.20 (2.58)	7.30 (2.79)	7.80 (2.88)	4.80 (2.27)	5.40 (2.41)	5.80 (2.51)	5.60 (2.46)	2.70 (1.78)	3.10 (1.89)	3.60 (2.02)	4.20 (2.17)
M3	1.10 (1.25)	1.30 (1.32)	1.36 (1.35)	1.52 (1.39)	0.80 (1.09)	0.60 (0.99)	1.30 (1.30)	1.50 (1.41)	0.80 (1.09)	1.00 (1.16)	1.30 (1.30)	1.50 (1.41)
M4	5.10 (2.36)	5.80 (2.51)	6.60 (2.66)	6.80 (2.70)	3.60 (2.02)	4.00 (2.12)	4.50 (2.23)	5.10 (2.36)	2.60 (1.75)	2.90 (1.84)	3.40 (1.96)	3.60 (2.02)
S. Em (±)	0.09	0.10	0.08	0.11	0.15	0.14	0.09	0.08	0.09	0.14	0.09	0.07
CD (p=0.05)	0.27	0.32	0.24	0.34	0.46	0.44	0.27	0.26	0.29	0.43	0.29	0.21

*Figure in the in parentheses is "x transformed value

Table 6: Meteorological data of the experimental area

Month	Temperature (°C)						Rainfall (mm)		
	2010-11		2011-12		2012-13		2010-11	2011-12	2012-13
	Max	Min	Max	Min	Max	Min			
August	33.6	26.0	30.8	25.4	31.8	25.4	160.4	459.9	140.8
September	32.2	24.5	30.8	25.1	31.0	24.5	120.3	153.9	102.1
October	31.8	22.3	31.	22.6	30.8	19.6	21.4	41.2	41.0
November	28.5	17.1	27.5	15.4	27.0	12.4	09.4	-	14.8
December	24.4	09.3	21.4	10.1	21.0	06.9	00.6	-	-
January	19.6	06.6	20.5	09.2	20.3	05.2	03.0	17.7	-
February	25.8	09.9	25.8	09.9	25.2	09.7	02.8	-	14.6

(B.A.U., Sabour

ACKNOWLEDGEMENT

The author is thankful to All India Coordinated Research Projects (AICRP), Varanasi for providing financial grant to carry out the research work.

REFERENCES

Anil and Sharma, P. C. 2010. Bioefficacy of insecticides against *Leucinodes orbonalis* on brinjal. *J Environ Biol.* **31(4):** 399-402.

Anonymous 2011. Indian Horticulture Database-2011, National Horticulture Board (NHB).

Aparna, K. and Dethe, M. D. 2012. Bioefficacy study of biorational insecticide on brinjal. *J. Biopest.* **5(1):** 75-80.

Bhushan, S., Chaurasia, H. K. and Ravi, S. 2011. Efficacy and economics of pest management modules against brinjal shoot and fruit borer (*leucinodes orbonalis*). *The Bioscan*. **6(4):** 639-642.

Gomez, K. A. and Gomez, A. A. 1984. Statistical Procedure for Agricultural Research. *J. Wiley and Sons,* New York.

Hirekurubar, R. B. and Ambekar, J. S. 2008. Bio-efficacy of newer insecticides against shoot and fruit borer of okra and their impact on natural enemies. *Crop Res. (Hisar).* **36(1/3):** 302-307.

Hosamani, A. C., Chowdary, L. R., Bheemanna, M. and Hanchinal, S. G. 2011. Field bioefficacy of Rynaxypyr 20 SC against fruit borer complex in okra. *Ann. Plant Prot. Sci.* **19(2):** 463-464.

Jagginavar, S. B., Sunitha, N. D. and Biradar, A. P. 2009. Bioefficacy of flubendiamide 480 SC against brinjal fruit and shoot borer, Leucinodes orbonalis Guen. *Karnataka J. Agric. Sci.* **22(3):** 712-713.

Jyoti, D. P. 2006. Biorational approaches for the management of brinjal shoot and fruit borer. *M.Sc Thesis*, University of Agricultural Sciences, Dharwad, Karnataka, India.

Misra, H. P. 2008. New promising insecticides for the management of brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. *Pest Manag. Hort. Ecosystem.* **14(2):** 140-147.

Patnaik, H. P. and Singh, K. M. 1997. Efficacy of Bacillus thuringiensis Berliner and conventional insecticides against brinjal shoot and fruit borer under different spraying schedules. *Orissa J. Hort.* **25:** 18-21.

Rana, S. C., Singh, P. B., Pandita, V. K. and Sinha, S. N. 2006. Evaluation of insecticides as seed treatment for control of early sucking pests in seed crop of okra. *Ann. Plant Prot. Sci.* **14(2):** 364-367.

Sandip, P., Chatterjee, M. L., Shanowly, M. and Samanta, A. 2009. Field evaluation of some new insecticides against brinjal shoot and fruit borer, *Leucinodes orbonalis* (Guen.). *Pestic. Res. J.* **21(1):** 58-60.

Sandip, P., Shanowly, M., Arunava, S. and Chatterjee, M. L. 2007. Bioefficacy of some new insecticides against the okra shoot and fruit borer, *Earias vittella* (F.). *Pest Manag. Econ. Zool.* **15(1):** 53-56.

Sardana, H. R., Bambawale, O. M., Singh, D. K. and Kadu, L. N. 2006. Conservation of natural enemies through IPM in brinjal (Solanum melongena L.) fields. *Entomon*. **31(2):** 83-88.

Shah, K. D., Bharpoda, T. M. and Jhala, R. C. 2011. Evaluation of eco-friendly pest management modules against brinjal shoot and fruit borer, Leucinodes orbonalis. *Green Farming*. **2(5):** 556-560.

Singh, S. S. 2010. Comparative efficacy of certain bio-rational insecticides and *Bacillus thuringiensis* based bio-insecticides against *Leucinodes orbonalis* Guen. In brinjal. *Indian J. Hortic.* **67(3):** 353-356.

Sudarshan, C. and Pijush, K. S. 2011. Management of *leucinodes orbonalis* guenee on eggplants during the rainy season in India. *J. Plant. Pro. Res*. **51(4):** 325-328.

Tayde, A. R. and Simon, S. 2010. Efficacy of Spinosad and Neem Products against Shoot and Fruit Borer (*Leucinodes orbonalis* Guen.) of Brinjal (*Solanum melongena* L.). *Trends in Biosciences*. **3(2):** 208-209.