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ASSESSMENT THE EFFICACY AND ECONOMIC OF INSECTICIDES AND BIO-PESTICIDES AGAINST MAJOR INSECT PEST COMBINATION OF BRINJAL (*SOLANUM MELONGENA* LINN.) cv. JB-64

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Abstract

The result reported that, efficacy of different insecticidal treatments against pest complex Emamectin benzoate @ 10 g.a.i/ha was found to be most effective as it recorded lowest infestation, of all the recorded pests followed by Pyriproxifen + fenpropethrin 500 ml/ha. Highest fruit yield was registered in Emamectin Benzoate @10 g.a.i/ha (120.66 q ha^{-1}), followed by Pyriproxifen+fenpropethrin 500 ml/ha (115.47 q ha^{-1}) as compared to control (60.07 q ha^{-1}), highest net profit per hectare was registered in Emmamectin Benzoate @ 10 g.*a.*i/ha (Rs. 54572) with highest cost benefit ratio was registered in Pyriproxifen 10% EC + Fenpropethrin 15% EC @ 500 ml/ha(1:15.69). On the basis of the efficacy of different biopesticides treatments *Passilomyces fumosoresus* @ 1l/ha was found to be the most effective as it recorded lowest infestation of all recorded pests followed by *Beauveria bassiana* @ 1l/ha. Highest fruit yield was registered in *Passilomyces fumosoresus* @ 1l/ha (85.06 q ha^{-1}), followed by *Beauveria bassiana* @ 1l/ha (80.05 ha^{-1}), highest net profit was registered in *Passilomyces fumosoresus* @ 1l/ha (Rs. 21672/ha) with highest cost benefit ratio in *Passilomyces fumosoresus* @ 1l/ha (1:6.53).

Key words : Brinjal, JB-64, insecticide, biopesticides, efficiency, economic.

Introduction

Brinjal (*Solanum melongena*), also known as eggplant or aubergine belonging to the family Solanaceae, is one of the common and popular vegetables grown throughout the world including India. In India, brinjal occupies 39.34 per cent (0.68 million ha.) of the world's area of 1.72 million ha. In Madhya Pradesh, brinjal occupies 0.23 million ha. area with a production and productivity of 2.81 million tonnes and 12.0 t/ha (NHB, 2012). Among the various causes of low productivity of the brinjal, one of the most important factors is the damage inflicted by the insect-pests. It is subjected to attack by number of insect pests right from nursery stage till harvesting (Regupathy *et al*., 1997). The yield loss due to the pest is to the extent of 70-92 per cent (Reddy and Srinivas, 2004; Jagginavar *et al*., 2009; Chakraborti and Sarkar, 2011). The infested fruits become unfit for consumption due to loss of quality and hence, lost their market value. Although, insecticidal control is one of the common means against the fruit borer, many of the insecticides applied are not effective in the satisfactory control of this pest. Brinjal being a vegetable crop, use of chemical insecticides will leave considerable toxic residues on the fruits. Beside this, sole dependence on insecticides for the control of this pest has led to insecticidal resistance by the pest (Natekar *et al*., 1987 and Harish *et al*., 2011).

Hence, there is an urgent need to look for alternate and safer methods. In order to evolve and design pest control & management practices based on sound ecological footing and economically feasible, information on the pest complex is a pre requisite. Hence, efficacy and economic of insecticides & bio-pesticides against major insect pest complex of Brinjalare very essential to

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adopt suitable control measures in a particular region.

Materials and Methods

The present investigation entitled, "Assessment the efficacy and economic of insecticides & bio pesticides against major insect pest complex of brinjal (*Solanum melongena* Linn.) *cv.* JB-64" was carried out in Randomized Block Design with 4 replications. Knapsack sprayer was used (water required for spraying 300 liter / ha & Spraying No. 3 (11th and 23th February, 2nd April, 2013).

Treatment details

(A) Efficacy of insecticides against major insect pest complex of brinjal:

Code	Treatments	Dose (gorml) a.i./ha
T_1	Difenthiuoron 50%WP :	600
T_2	Emamectin Benzoate 5% SG :	200
T_3	Pyriproxifen 10% EC :	500
T_4	Pyriproxifen 5%+ Fenpropathrin 15% EC :	500
T_5	Rynaxypyr 20 EC :	150
T_6	Control :	-

(B) Efficacy of Bio pesticides against major insect pest complex of brinjal:

Code	Treatments	Formulation/ha
T_1	*Passilomyces fumosoresus*	: 1×10^{12} spores/ml
T_2	*Beauveria bassiana*	: 1×10^{12} spores/ml
T_3	*Metarhizium anisopliae*	: 1×10^{12} spores/ml
T_4	*Verticillium lecanii*	: 1×10^{12} spores/ml
T_5	Neem soap	: 10 g/L
T_6	Pongamia soap	: 10 g/L
T_7	Control (Untreated)	: -

Methods of Observation

Pre-treatment observations on brinjal pest complex were recorded 24 hours before spraying, while post-treatment observations were taken 3, 7 and 10 days after application of the treatment. Observation on brinjal sucking pest & shoot and fruit borer were recorded on 5 randomly selected plants plot^{-1}. Fruit infestation by shoot and fruit borer was assessed by counting the total number of damage and healthy shoot fruit^{-1} at each picking per plot.

$$\text{Percent shoot/fruit infestation} = \frac{\text{Total no. of damage shoots fruit}^{-1}}{\text{Total no. of healthy and damageshoot fruit}^{-1}} \times 100$$

The mean data on sucking pest complex were transformed to square root transformed values and statistically analysed as per the method given by Snedecor and Cochran (1967).

The percentage data on damaged fruits and fruit yield loss data were transformed to arcsin transformation and statistically analysed as per the method given by Snedecor and Cochran (1967).

Results and Discussion

(A) Efficacy of insecticides against major insect pest complex of brinjal

1. Jassid : The efficacy of five insecticides named Difenthiuron 50% WP 300 g.a.i./ha, Emamectin benzoate 5% SG 10 g.a.i./ha, Pyriproxifen 10% EC 50 g.a.i./ha, Pyriproxifen 10% EC + Fenpropethrin 15 %EC 500 ml/ ha, Rynaxypyr 20% EC 30 g.a.i./ha. were tested against insect pest complex on brinjal.

On the basis of overall mean (mean of three spraying) all the insecticidal treatments significantly reduced the infestation and registered higher fruit yields as compared to untreated control Emmamectin Benzoate @ 10 g.*a*.i/ ha was found to be the most effective as it recorded lowest infestation which was significantly better than Pyriproxifen 10% EC @ 50 g.a.i./ha and control. Similar finding have been reported by several workers (Anil and Sharma, 2008; Dutta *et al*., 2007).

2. White fly : The result of present study showed that Emamectin Benzoate 5% SG @10 g.*a*.i/ha was found to be the most effective which was significantly better than all the treatments except Pyriproxifen 10% EC + Fenpropethrin 15% EC 500 ml/ha., Rynaxypyr 20% EC @ 30 g *a.i.*/ha., similar findings have been reported by Anil and Sharma (2008), Dutta *et al.* (2007) and Adiroubane and Raghuraman (2008).

3. Aphid : The result of present study showed that Emamectin Benzoate 5% SG @10 g.*a*.i/ha was found to be the most effective and significantly better than all the insecticidal treatments but at par with Pyriproxifen 10% EC + Fenpropethrin 15% 500 ml/ha. Similar findings have been reported by Anil and Sharma (2008), Dutta *et al.* (2007) and Adiroubane and Raghuraman (2008).

4. Shoot and fruit borer : The result of present study showed that Emmamectin Benzoate @ 10 g.*a*.i/ha in which was significantly better than all the insecticidal treatment followed by Pyriproxifen 10% EC + Fenpropethrin 15% EC 500 ml/ha, Rynaxypyr 20% EC @ 30 g *a.i.*/ha. The maximum percent fruit damage was recorded in control. Similar finding have been reported by Wankhedeet *al*. (2009), Misra *et al*. (2011) as emamectin benzoate (Proclaim 5 SG; 200 g/ha) was the

Table 1 : Efficacy of different insecticides against brinjal Jassid during *Rabi* 2012-13.

Tr. no.	Treatments	Dose g.a.i/ha	Mean of jassid nymph and adult population / 6 leaves					
			Pre Treatment	Mean of three sprayings				Overall mean
				Days after spraying				
				1	3	7	10	
T_1	**Difenthiuron 50% WP**	300	3.69 (1.92)	1.68(1.30)	2.70 (1.64)	2.43 (1.55)	2.48 (1.57)	2.32 (1.52)
T_2	**Emamectin benzoate 5%SG**	10	3.27 (1.80)	1.07 (1.03) L	2.22(1.49) L	2.16 (1.47) L	2.21(1.49) L	1.92 (1.38) L
T_3	**Pyriproxifen 10% EC**	50	3.83 (1.95)	1.34 (1.15)	2.84 (1.68)	2.65 (1.63)	2.70 (1.64)	2.38 (1.54)
T_4	**Pyriproxifen 10% EC + Fenpropethrin 15%EC**	500 ml/ha	3.41 (1.85)	1.10 (1.05)	2.36 (1.53)	2.21 (1.49)	2.25 (1.50)	1.98 (1.40)
T_5	**Rynaxypyr 20% EC**	30	3.54 (1.88)	1.30 (1.14)	2.47 (1.57)	2.36 (1.53)	2.41 (1.55)	2.14(1.46)
T_6	**Control (Untreated)**	-	4.05 (2.01)H	4.10 (2.02)H	4.12 (2.03)H	4.22 (2.05)H	4.26 (2.06)H	4.18 (2.04)H
	S.Em.±	-	0.10	0.09	0.07	0.04	0.06	0.04
	CD at 5%	-	NS	0.29	0.22	0.13	0.17	0.14

Table 2 : Efficacy of different insecticides against brinjal Aphid during *Rabi* 2012-13.

Tr. no.	Treatments	Dose g.a.i/ha	Mean of aphid nymph and adult population / 6 leaves					
			Pre Treatment	Mean of three sprayings				Overall mean
				Days after spraying				
				1	3	7	10	
T_1	**Difenthiuron 50% WP**	300	15.62 (3.92)	5.03 (2.24)	6.04 (2.45)	5.98 (2.44)	6.06 (2.46)	5.78 (2.40)
T_2	**Emamectin benzoate5%SG**	10	15.29 (3.91)	4.48 (2.08) **L**	5.45 (2.33) L	5.32 (2.31) **L**	5.38 (2.32) **L**	5.16 (2.26) **L**
T_3	**Pyriproxifen 10% EC**	50	15.96 (3.99)	4.63 (2.15)	6.25 (2.50)	6.26 (2.50)	6.18 (2.49)	5.83 (2.41)
T_4	**Pyriproxifen 10% EC + Fenpropethrin 15 EC**	500 ml/ha	15.42 (3.93)	4.55 (2.13)	5.83 (2.41)	5.75 (2.40)	5.82 (2.41)	5.49 (2.34)
T_5	**Rynaxypyr 20% EC**	30	15.57 (3.95)	4.57 (2.14)	6.05 (2.46)	5.95 (2.44)	6.04 (2.46)	5.65 (2.38)
T_6	**Control (Untreated)**	-	16.16 (4.02)	7.13 (2.67) **H**	7.14 (2.67)**H**	7.06 (2.66)**H**	7.41 (2.72)**H**	7.19 (2.68)**H**
	S.Em.±	-	0.13	0.36	0.07	0.02	0.03	0.03
	CD at 5%	-	NS	1.08	0.21	0.06	0.08	0.09

Table 3 : Efficacy of different insecticides against brinjal whitefly during *Rabi* 2012-13.

Tr. no.	Treatments	Dose g.a.i/ha	Mean of whitefly nymph and adult population / 6 leaves				Overall mean
			Pre Treatment	Mean of three sprayings			
				Days after spraying			
				1	3	7	10	
T_1	**Difenthiuron 50% WP**	300	3.75 (1.94)	1.38 (1.17)	3.40 (1.84)	3.51 (1.87)	3.54 (1.88)	3.00 (1.73)
T_2	**Emamectin benzoate5%SG**	10	2.88 (1.68)	1.23 (0.99)**L**	2.71 (1.60)**L**	2.61 (1.61)**L**	2.54 (1.59)**L**	2.27 (1.49)**L**
T_3	**Pyriproxifen 10% EC**	50	3.85 (1.95)	1.43 (1.19)	3.76 (1.94)	3.68 (1.92)	3.71 (1.93)	3.15 (1.74)
T_4	**Pyriproxifen 10% EC + Fenpropethrin 15 EC**	500 ml/ha	3.23 (1.75)	1.29 (1.05)	2.97 (1.72)	2.92 (1.71)	2.86 (1.69)	2.51 (1.56)
T_5	**Rynaxypyr 20% EC**	30	3.48 (1.86)	1.33 (1.14)	3.16 (1.78)	3.06 (1.75)	3.03 (1.74)	2.65 (1.61)
T_6	**Control (Untreated)**	-	4.45 (2.11)**H**	3.80 (1.91)**H**	4.50 (2.12)**H**	4.42 (2.10)**H**	4.50 (2.12)**H**	4.31 (2.07)**H**
	S.Em.±	-	0.10	0.17	0.09	0.02	0.02	0.05
	CD at 5%	-	NS	0.51	0.27	0.06	0.06	0.16

Table 4 : Efficacy of different insecticides against brinjal shoot and fruit borer infestation during *Rabi* 2012-13.

Tr.	Treatment	Dose *g.a.i*/ha	Fruit infestation by shoot and fruit borer (%)*
T_1	**Difenthiuron 50% WP**	300	2.40 (8.82)
T_2	**Emamectin benzoate 5%SG**	10	0.92 (5.41) L
T_3	**Pyriproxifen 10% EC**	50	2.68 (9.33)
T_4	**Pyriproxifen 10% EC + Fenpropethrin 15% EC**	500 ml/ha	1.43 (6.80)
T_5	**Rynaxypyr 20% EC**	30	1.70 (7.44)
T_6	**Control (Untreated)**	-	10.94 (19.27) H
	S.Em.±	-	0.21
	CD at 5%	-	0.62

most effective in reducing the shoot damage by the brinjal shoot and fruit borer.

Economics of treatments

Fruit yield : In present study, Emamectin benzoate 5% SG @ 10 g.a.i./ha recorded significantly higher healthy fruit yield (120.66 q/ha) than other treatments, followed by Pyriproxifen 10% EC + Fenpropethrin 15% EC @ 500 ml/ha (115.47 q/ha), Rynaxypyr 20% EC @ 30 g.a.i./ha (111.68 q/ha), Difenthiuron 50% WP @ 300 g.a.i./ha (108.41 q / ha and Pyriproxifen 10% EC 50 g.a.i./ ha (91.66 q/ha). Similar finding have been reported by Adiroubane and Raghuraman (2008) and Dutta *et al.* (2007).

Net profit : Among the different treatments, highest net profit per hectare was registered in Emmamectin Benzoate @ 10 g.*a*.i/ha (Rs. 54572/-), followed by Pyriproxifen 10% EC + Fenpropethrin 15% EC @ 500 ml/ha (52082/-), Rynaxypyr 20% EC @ 30 g.a.i./ ha(42442/-), Difenthiuron 50% WP @ 300 g *a.i.*/ha (42442/-) and Pyriproxifen 10% EC 50g.a.i./ha (29547/-).

Cost benefit ratio : Among the different treatments, highest cost benefit ratio was registered in Pyriproxifen 10% EC + Fenpropethrin 15% EC @ 500 ml/ha (1:15.69) followed by Pyriproxifen 10% EC 50 g.a.i./ha (1:14.46), Emmamectin Benzoate @ 10 g.*a*.i/ha (1:9.06), Difenthiuron 50% WP @ 300 g.a.i./ha(1:7.19) and Rynaxypyr 20% EC @ 30 g.a.i./ha (1:6.79).

B. Efficacy of biopesticides against major insect pest complex of brinjal

1. Jassid : The efficacy of six microbials named *Passilomycesfumosoresus* @ 1 l/ha, *Beauveria*

Table 5 : Economics of different insecticides on pest complex of brinjal during *Rabi* 2012-13.

Tr.	Treatment details	Dose g *a.i.*/h	Fruit yield (q/ha)	Increase in yield over control (q/ha)	Cost of insecticide	Cost of treatments*	Cost of increased yield over control @ 500 /- per quintal	Net profit (Rs/ha)	Cost benefit ratio
T_1	**Difenthiuron 50% WP**	300	108.41	48.34	2600/-Rs/kg	5898	48340	42442	1:7.19 **L**
T_2	**Emamectin benzoate5%SG**	10	120.66**H**	60.59**H**	8000/- Rs/kg	6018	60590 **H**	54572	1:9.06 **H**
T_3	**Pyriproxifen 10% EC**	50	91.66	31.59**L**	550/- Rs/1	2043	31590 **L**	29547	1:14.46
T_4	**Pyriproxifen 10% EC + Fenpropethrin 15% EC**	500 ml/ha	115.47	55.40	1400/- Rs/1	3318	55400	52082	1:15.69
T_5	**Rynaxypyr 20% EC**	30	111.68	51.61	12000/- Rs/1	6618	51610	44992	1:6.79
T_6	**Control (Untreated)**	-	60.07**L**	-	-	-	-	-	-
	Em ±	0.13							
	CD at 5%	0.38							

bassiana @ 1 l/ha, *Metarrhizium anisopliae* @ 1 l/ha, *Verticillium lecanii* @ 1 l/ha, Neem soap @ 2.5 Kg/ha, Pongamia soap @ 2.5 Kg/ha.

In present study, *Passilomyces fumosoresus* @ 1l/ha were found to be the most effective, which was significantly better than *Verticillium lecanii* @ 1l/ha *Metarrhizium anisopliae* @ 1l/ha and Pongamia soap @ 2.5 Kg/ha but at par with *Beauveria bassiana* @ 1l/ha and Neem soap @ 2.5 Kg/ha. In the present study, among the microbials *Verticilium lecanii* @ 2.5 kg/ha was the least effective against brinjal jassid. The present studies collaborate with the finding of Birla (2011).

2. Aphid : In present study, *Passilomyces fumosoresus* @ 1l/ha spores/ml was found to be the most effective treatment, which was significantly better than all the treatment except *Beauveria bassiana* @ 1l/ha, followed by Neem soap @ 2.5 Kg/ha, which was significantly better than Pongamia soap @ 2.5 Kg/ha, but at par with*Verticilliumlecanii* @ 1l/ha and *Metarrhizium anisopliae* @ 1l/ha.

3. Whitefly : In present study, *Passilomyces fumosoresus* @ 1l/ha was found to be the most effective, which was significantly better than all the biopesticidal treatments, followed by *Beauveria bassiana* @ 1l/ha which was significantly better than *Metarrhizium anisopliae* @ 1l/haand Pongamia soap @ 2.5 Kg/ha but at par with Neem@ 2.5 Kg/ha and *Verticillium lecanii* @ 1l/ha. Neem soap and *Verticillium lecanii*were also significantly better than pongamia soap.

4. Shoot and fruit borer: On the basis of overall mean, the differences in the percent fruit damage among different treatments were significant. All the microbial treatments significantly reduced the fruit damage and registered higher fruit yields as compared to untreated control. Several workers have also reported similar findings, as application of microbials effectively reduced the fruit damage due to *L. orbonalis* with increased fruit yields than control (Mahesh and Men, 2007b; Singh and Yadav, 2007; Gautam *et al*., 2008; Adiroubane and Raguhuraman, 2008; Naik *et al*., 2008c; Ghosh and Senapati, 2009; Gopal *et al*., 2009a, 2009b and Pareet and Basavanagoud, 2009).

In present study, *Passilomyces fumosoresus* @ 1l/ha, which was significantly better than all the biopesticides tested excepted *Beauveria bassiana* @ 1l/ha. Neem soap @ 2.5 Kg/ha was also significantly better than Pongamia soap @ 2.5 Kg/ha, but at par with *Verticillium lecanii* @ 1l/ha and *Metarrhizium anisopliae* @ 1 l/ha. Present finding are supported by several workers *viz*. Mahesh and Men (2007b) and Gopal *et al*. (2009b). They

Table 6 : Efficacy of different biopesticides against brinjal Jassid during *Rabi* 2012-13.

Tr.	Treatments	Dose/ha	Mean of Jassid nymph and adult population / 6 leaves				
			Mean of three sprayings				
			Days after spraying				
			Pre-treatment	3	7	10	Overall mean
T_1	*Passilomyces fumosoresus*	1 l	2.90 (1.66)	3.27 (1.80)	3.18 (1.78)	2.59 (1.60)	3.08 (1.75)
T_2	*Beauveria bassiana*	1 l	3.39 (1.84)	3.31 (1.82)	3.21 (1.79)	3.26 (1.80)	3.26 (1.81)
T_3	*Metarrhizium anisopliae*	1 l	4.21 (2.03)	3.70 (1.92)	3.61 (1.90)	3.29 (1.81)	3.53 (1.88)
T_4	*Verticillium lecanii*	1 l	3.66 (1.91)	3.55 (1.88)	3.43 (1.85)	3.26 (1.81)	3.41 (1.85)
T_5	Neem soap	2.5 Kg	3.58 (1.89)	3.47 (1.86)	3.30 (1.82)	3.17 (1.78)	3.31 (1.82)
T_6	Pongamia soap	2.5 Kg	3.92 (1.96)	3.88 (1.97)	3.81 (1.95)	3.35 (1.83)	3.68 (1.92)
T_7	Control (Untreated)	-	4.01 (2.00)	4.04 (2.01)	4.36 (2.09)	4.20 (2.05)	4.20 (2.05)
	S.Em.±	-	0.13	0.02	0.03	0.06	0.02
	CD at 5%	-	NS	0.08	0.10	0.19	0.08

Table 7 : Efficacy of different Biopesticides against brinjal aphid during *Rabi* 2012-13.

Tr.	Treatments	Dose/ha	Mean of aphid nymph and adult population / 6 leaves				
			Mean of three spraying				
			Days after spraying				
			Pre-treatment	3	7	10	Overall mean
T_1	*Passilomyces fumosoresus*	1 l	16.02 (3.97)	13.92(3.73)	11.39 (3.38)	9.49 (3.08)	11.60 (3.40)
T_2	*Beauveria bassiana*	1 l	16.23 (4.03)	14.08(3.75)	11.99 (3.46)	10.05(3.17)	12.04 (3.46)
T_3	*Metarrhizium anisopliae*	1 l	16.97 (4.12)	14.61(3.82)	12.45 (3.53)	10.42(3.23)	12.49 (3.53)
T_4	*Verticillium lecanii*	1 l	16.70 (4.09)	14.35(3.79)	12.21(3.49)	10.41(3.23)	12.32 (3.50
T_5	Neem soap	2.5 Kg	16.46 (4.06)	14.16(3.76)	11.94 (3.46)	10.29 (3.21)	12.13 (3.48)
T_6	Pongamia soap	2.5 Kg	17.03 (4.13)	14.48 (3.81)	12.75 (3.57)	10.81(3.29)	12.68 (3.55)
T_7	Control (Untreated)	-	17.53 (4.18)	15.34 (3.92)	13.11 (3.62)	12.02 (3.47)	13.49 (3.67)
	S.Em.±	-	0.15	0.01	0.02	0.02	0.02
	CD at 5%	-	NS	0.04	0.05	0.07	0.06

Table 8 : Efficacy of different biopesticides against brinjal whitefly during *Rabi* 2012-13.

Tr. no.	Treatments	Dose/ha	Mean of whitefly nymph and adult population / 6 leaves				
			Days after spraying				
			Pre-treatment	3	7	10	Overall mean
T_1	*Passilomyces fumosoresus*	1 l	3.14 (1.77)	3.03 (1.73)	2.78 (1.67)	2.95 (1.71)	2.92 (1.71)
T_2	*Beauveria bassiana*	1 l	3.54 (1.88)	3.46 (1.86)	3.35 (1.83)	3.40 (1.84)	3.40 (1.84)
T_3	*Metarrhizium anisopliae*	1 l	3.75 (1.94)	3.68 (1.92)	3.57 (1.89)	3.43 (1.85)	3.56 (1.89)
T_4	*Verticillium lecanii*	1 l	3.69 (1.92)	3.59 (1.89)	3.50 (1.87)	3.38 (1.84)	3.49 (1.87)
T_5	Neem soap	2.5 Kg	3.67 (1.91)	3.55 (1.88)	3.44 (1.85)	3.34 (1.83)	3.44 (1.86)
T_6	Pongamia soap	2.5 Kg	3.89 (1.96)	3.78 (1.94)	3.64 (1.91)	3.80 (1.95)	3.74 (1.93)
T_7	Control (Untreated)	-	4.07 (1.97)	4.48 (2.12)	4.38 (2.09)	4.31 (2.08)	4.39 (2.10)
	S.Em.±	-	0.11	0.05	0.02	0.04	0.01
	CD at 5%	-	NS	0.16	0.07	0.14	0.03

Table 9 : Efficacy of different biopesticides against brinjal shoot and fruit borer infestation during *Rabi* 2012-13

Tr. no.	Treatment	Dose / ha	Fruit infestation by shoot and fruit borer (%)*
T_1	***Passilomyces fumosoresus***	1 l	1.51 (6.95)
T_2	***Beauveria bassiana***	1 l	1.90 (7.78)
T_3	***Metarrhizium anisopliae***	1 l	3.92 (11.34)
T_4	***Verticillium lecanii***	1 l	3.49 (10.68)
T_5	**Neem soap**	2.5 Kg	3.04 (9.92)
T_6	**Pongamia soap**	2.5 Kg	6.85 (14.93)
T_7	**Control (Untreated)**	-	10.89 (19.20)
	S.Em.±	-	0.74
	CD at 5%	-	2.22

Table 10: Economics of different biopesticides on pest complex of brinjal on during *Rabi* 2012-13.

Tr. no.	Treatment details	Dose/ ha	Fruit yield (q/ha)	Increase in yield over control (q/ha)	Cost of insec-ticide	Cost of treatm-ents*	Cost of increased yield over control @ 500 /- per quintal	Net profit (Rs/ha)	Cost benefit ratio
T_1	*Passilomyces fumosoresus*	1 l	85.06 H	24.99	700 /- Rs/Kg	3318	24990 H	21672 H	1:6.53 H
T_2	*Beauveria bassiana*	1 l	80.05	19.98	700 /- Rs/Kg	3318	19980	16662	1:5.02
T_3	*Metarrhizium anisopliae*	1 l	69.08	9.01	700 /- Rs/Kg	3318	9010	5692	1:1.71
T_4	*Verticillium lecanii*	1 l	70.06	9.99	700 /- Rs/Kg	3318	9990	6672	1:2.01
T_5	Neem soap	2.5Kg	72.07	12.00	240 /- Rs/lit	3010	12000	8982	1:2.97
T_6	Pongamia soap	2.5 Kg	68.06	7.99	320 /-Rs/lit.	3618	7990 L	4372 L	1:1.20 L
T_7	Control (Untreated)	-	60.07**L**	-	-	-	-	-	-
	S.Em.±		0.02						
	CD at 5%		0.05						

* Mean of 6 picking, Labour rate per day = (Two labours required for spraying 1 ha brinjal crop in 1 day) ,Yield rate: Rs = 1000 /- per quintal @ Rs= 203/-, L= Lowest, H = Highest.

also reported that *Bacillus thuringiensis* var. *kurstaki* @ 0.05% to 0.25 or 2.0 to 2.5 ml/L or 1 L/ha were found effective in reducing the fruit infestation due to *L. orbonalis.* In the present study, the next effective group of treatments were *Verticilium lecanii* @ 3.75 kg/ha, *Metarhizium anisopliae* @ 2.5 kg/ha, followed by *Verticilium lecanii* @ 3.25 kg/ha, but did not differ significantly from each other. The next but least effective treatment was, *Beauveria bassiana* @ 1 kg/ha, *Beauveria bassiana* @ 1.5 kg/ha and was found to be significantly superior to control.

Economics of treatments

Increase in yield over control : Among the different treatments, highest increase in fruit yield over control was registered in *Passilomyces fumosoresus* @ 1l/ha (24.99 q/ha) followed by *Beauveria bassiana* @ 1l/ha (19.18 q/ha).

Net profit : Among the different treatments, highest cost benefit ratio was registered in *Passilomyces fumosoresus* @ 1l/ha (Rs. 21672/ha), this was followed by *Beauveria bassiana* @ 1l/ha (Rs. 16662) and Pongamia soap @ 2.5 Kg/ha recorded the lowest net profit (Rs. 4372/ha) among different biopesticides tested.

Cost benefit ratio : Among the different treatments, highest net profit per hectare was registered in *Passilomyces fumosoresus* @ 1l/ha (1:6.53), *Beauveria bassiana* @ 1l/ha (1:15.02), Neem soap @ 2.5 Kg/ha (1:2.97), *Verticillium lecanii* @ 1l/ha (1:2.01) and *Metarhizium anisopliae* @ 1l/ha (1:1.71), Pongamia soap @ 2.5 Kg/ha (1:1.20).

Conclusion

The study of present investigation concluded that on the basis of the efficacy of different insecticidal treatments against pest complex, Emamectin benzoate @ 10 g.a.i/ ha was found to be most effective as it recorded lowest infestation, of all the recorded pests followed by Pyriproxifen + fenpropethrin 500 ml/ha Highest fruit yield was registered in Emamectin Benzoate @10 g.a.i/ha (120.66 q / ha), followed by Pyriproxifen + fenpropethrin 500 ml/ha (115.47 q / ha) as compared to control (60.07 q/ha). On the basis of the efficacy of different biopesticides treatments *Passilomyces fumosoresus* @ 1l/ha was found to be the most effective as it recorded lowest infestation of all recorded pests followed by *Beauveria bassiana* @ 1l/ha. Highest fruit yield was registered in *Passilomyces fumosoresus* @ 1l/ha (85.06 q/ha) followed by *Beauveria bassiana* @ 1l/ha (80.05/ ha).

References

Anil and Sharma (2008). Bio efficacy of insecticides and microbials against pest complex of brinjal. *J. of Envi. Biology* , **3(1)** : 399-402.

Adiroubane, D. and K. Raghuraman (2008). Plant products and microbial formulation in the management of brinjal shoot and fruit borer, *Leucino desorbonalis* (Guenee). *J. Biopest.,* **1(2)** : 124-129.

Birla, M. (2011). Studies on insect pest complex of brinjal, *Solanum melongena* (Linn.) and their management. *M.Sc. (Ag.) Thesis* submitted to JNKVV Jabalpur (MP) pp. 1-72.

Chakraborti, Sudarshan and Pijush Kanti Sarkar (2011). Management of *Leucino desorbonalis* Gunee on egg plants during the rainy season in India. *J. Pl. Protec. Res*., **51(4)** : 325-328.

Dutta, N. K., M. S. Alam, M. Nasiruddin, A. K. Das and T. S. Munmun (2007). Efficacy of some new chemical insecticides against Brinjal Shoot & Fruit Borer (*Leucinodes orbonales* Guen.). *J. of Subtropical Agri. Res. and Devel*., **5(3)** : 301-304.

Ghosh, S. K. and S. K. Senapati (2009). Seasonal fluctuation in the population of *Leucinodes orbonalis* (Guen.) in the sub-Himalayan region of West Bengal, India and its control on eggplant (*Solanum melongena* L.). *Precision Agriculture*, **10(5)** : 443-449.

Gopal, Madhuban, Chitra Srivastava and Jayakrishnan Saimandir (2009). IPM package for brinjal shoot and fruit borer (*Leucino desorbonalis* Guen.). Proceedings of the National Symposium on "IPM strategies to combat emerging pests in the current scenario of climate change". January 29-30, 2009, College of Horticulture and Forestry, Central Agricultural University, Pasighat, Arunachal Pradesh.

Harish, D. K., A. K., Agasimani, S. J. Imamsaheb and Satish S. Patil (2011). Growth and yield parameters in brinjal as influenced by organic nutrient management and plant protection conditions. *Res. J. Agri. Sci*., **2(2)** : 221-225.

Jagginavar, S. B., N. D. Sunitha and A. P. Biradon (2009). Bioefficacy of flubendiamide 480 SC against brinjal shoot and fruit borer, *Leucin doesorbonalis* (Guen.). *Kar. J. Agri. Sci*., **22(3)** : 712-713.

Mahesh, P. and U. B. Men (2007). Effect of Bt formulations on yield of brinjal by managing, *Leucino desorbonalis*. *Ann. Pl. Protec. Sci*., **16(2)** : 490-491.

Misra, H. P. (2011). Bio-efficacy of chlorantraniliprole against shoot and fruit borer of brinjal, *Leucino desorbonalis* Guenee. *J. of Insect Science* (Ludhiana), **24(1)** : 60-64.

Naik, V. C. B., P. A. Rao, P. V. Krishnayya and V. S. Rao (2008). Seasonal incidence and management of spotted leaf beetle, *Heno sepilachna viginotiocto punctata* (F.) in brinjal. *J. Appl. Zool. Res*., **19(1)** : 1-4.

Natekar, M. G., Samarjit Rai and N. P. Agnihotri (1987). Bioefficacy of synthetic pyrethroids and their residues in brinjal fruit. *Pestology*, **11(6)** : 18-22.

Pareet, J. D. and K. Basavanagoud (2009). Evaluation of bio-pesticides against brinjal shoot and fruit borer and sucking pests. *Ann. Pl. Prot. Sci*., **17(2)** : 463-464.

Reddy, Eswara and S. G. Srinivas (2004). Management of shoot and fruit borer, *Leucin doesorbonalis* (Guen.) in brinjal using botanicals/oils. *Pestology*, **28(5)** : 50-52.

Regupathy, A., S. Palanisamy, N. Chandramohan and K. Gunathilagaraj (1997). A guide on crop pests. Sooriya Desk Top Publishers, Coimbatore, 264 P.

Singh, K. I., S. Athokpam, M. P. Singh and P. S. Devi (2007). Comparative efficacy of certain bio-rational insecticides and endosulfan against *Leucino desorbonalis* Guenee in brinjal crop. *Indian J. Ent*., **69(3)** : 250-255.

Snedecor, G. W. and W. G. Cochran (1967). *Statistical Methods*, Oxford and IBH Publishing Company, New Delhi, pp: 1-292.

Suroshe, S. S., K. D. Reddy and K. N. Reddy (2004). Bio-efficacy of certain insecticides against major insect pests of brinjal. *Journal of Research ANGRAU*, **32(4)** : 18-24.

Veeravel, R. and P. Baskaran (1995). Succession of insectpests of brinjal (*Solanum melongena*) under unsprayed conditions. *Bulletin of Entomology, New Delhi*, **36(1/2)** : 49-56.

Wankhede, S. M., V. D. Kale and S. M. Gangurde (2009). Evaluation of bio-efficacy and persistence toxicity of some novel insecticides against larvae of the brinjal shoot and fruit borer, *Leucino desorbonalis* Guenee. *Pest Management and Economic Zoology*, **17(1)** : 77-83.