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Evaluation of bio-pesticides and chemicals against brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee

SHIVANI PATTA[1], S.B. SINGH[1], RAJESH AARWE[1] and NIKKI BHARADWAJ[1]

[1]Department of Entomology, [2]Department of Plant Pathology, KNK College of Horticulture, Mandsaur, RVSKVV, Gwalior- 474002, (M.P.), India

***E-mail:** shivani.patta.5@gmail.com

ABSTRACT: The field experiment was conducted at K.N.K, College of Horticulture, Mandsaur (M.P.) to study the efficacy of certain bio-pesticides and chemicals against brinjal shoot and fruit bore, *Leucinodes orbonalis* Guenee in Mandsaur District of Madhya Pradesh during *rabi* season of 2022-23 and 2023-24. Emamectin benzoate 3% + thiamethoxam 12% @ 150 g ha^{-1} was the most effective in recording the minimum fruit infestation of (3.87%) and found at par with thiamethoxam 12.6% + lambda cyhalothrin 9.5% @ 125 ml ha^{-1}(5.81%) followed by Spinosad 45% SC @185 ml ha^{-1}(9.57%), Neem extract 3% @ 2500 ml ha^{-1}(10.06%), *Brahmastra* (Natural) @ 25 L ha^{-1} (10.95%), *Neemastra* (Natural) @ 25 L ha^{-1} (11.28%), *Agniastra* (Natural) @ 12.5 L ha^{-1} (12.38 %), *Beauveria bassiana* 1.15% WP @ 2500 g ha^{-1}(12.50%) and *Metarhizium anisopliae* 1.15% WP @ 2500 ml ha^{-1}(13.25%). The maximum fruit yield (257.00 q/ha), highest net profit (Rs. 372732.4 ha^{-1}) and highest cost benefit ratio (1:5.80) was recorded with the application of emamectin benzoate 3% + thiamethoxam 12%. Other treatments gave yield ranging from 202.80-85.57 q/ha with comparatively economics.

Keywords: Brinjal, Shoot and fruit borer, *Leucinodes orbonalis*, bio-pesticides, insecticides, yield, efficacy

INTRODUCTION

The eggplant or brinjal (*Solanum melongena* Linnaeus), is an important vegetable crop of India. Fruits of the brinjal plant are a good source of vitamins and minerals (Tripura *et al.,* 2017). Calcium, phosphorus, iron, and vitamins, are all present in very substantial amounts in its fruits. Because the pulp and seeds of brinjal contain more polyunsaturated fatty acids, it has the ability to lower cholesterol (Anonymous, 2024-25). It has become an important economic source for farmers and field laborers. It is also used as a raw material in pickle making, an excellent remedy for curing diabetes, good appetizer, good aphrodisiac, cardio tonic, laxative, and reliever of inflammation (Shridhara, 2019). Brinjal is grown extensively in India, in 6.81 lakh hectares, 128.10 lakh tones production and 18,800 kg/hectare (18.81 tones/ha) productivity. (Anonymous, 2023-24) [b]. In Madhya Pradesh total area under brinjal cultivation is 0.71 lakh hectares with production of 15.15 lakh tones and productivity of 21.33 tones (Anonymous, 2024).

Brinjal shoot and fruit borer, *Leucinodes orbonalis* Guenee. is considered to be the most dangerous and destructive pest, resulting in significant losses in brinjal production, causes crop losses ranging from 85 to 90 percent in different regions of the nation (Jangid and Kumar 2024). The recent trend to manage insects-pests is to apply novel insecticides with the combination of other group of insecticides but, due to knock down effect, synthetic insecticides are preferred. Further, an option is to use native plant products and organic components to avoid the residue problem. Additionally, it was discovered that diluted *Agniastra* 3% and *Bhramhastra* 3% exhibited promising organic treatments (Rathod *et al.,* 2016).The national interest is to produce residue free vegetables and other products. This functioned as the background for the present investigation, which looked at how well different organic and bio-rational pesticides, worked against fruit and shoots borer in the field as compared to combination chemical insecticides.

MATERIALS AND METHODS

The experiment was carried out during *rabi*, 2022-23 & 2023-24 on brinjal at Experimental farm of K.N.K, College of Horticulture, Mandsaur (M.P.). Seedlings of variety KSP-1229 rajat, were transplanted with at 60 x 45cm spacing in plot size of 3 x 3m. Randomized block design (RBD) was followed with treatments T_1-*Neemastra* (Natural) @ 25 L ha^{-1}, T_2-*Brahmastra* (Natural) @ 25 L ha^{-1}, T_3-*Agniastra* (Natural) @ 12.5

L ha^{-1}, T_4-*Metarhizium anisopliae* 1.15% WP @ 2500 ml ha^{-1}, T_5-Spinosad 45% SC @ 185 ml ha^{-1}, T_6-Neem extract 3% @ 2500 ml ha^{-1}, T_7-*Beauveria bassiana* 1.15% WP @ 2500 g ha^{-1}, T_8- Emamectin benzoate 3% + thiamethoxam 12% @ 150 g ha^{-1}, T_9-Thiamethoxam 12.6% + lambda cyhalothrin 9.5% @ 125 ml ha^{-1}. Observations were recorded on the fruit infestation terms of number of damaged fruits computed to pre-treatment observation and 3,7,10 days after each spray based on total no. of fruits and damaged fruit. Marketable fruit yield was also recorded. Data were subjected to ANOVA after transformation.

$$\text{Per cent fruit infestation} = \frac{\text{Total no. of infested fruit}}{\text{Total no. of fruits}} \times 100$$

***Neemastra* preparation**

Crushed 5 kg neem leaves in water, added 5 l cow urine and 2 kg cow dung, fermented for 24 hours with intermittent stirring, filter squeeze the extract around five liter and applied @ 25.0 liter per hectare.

***Brahmastra* preparation**

Crushed 3 kg neem leaves in 10 l of cow urine. Crushed 2 kg custard apple leaf, 2 kg papaya leaf, 2 kg pomegranate leaves, 2 kg guava leaves in water. Mixed and boiled up to 5 times at some interval till it become half. Kept it for 24 h, then filtered and squeezed the extract. This can be stored in bottles for 6 months and applied @ 25.0 liter per hectare.

***Agniastra* preparation**

Crushed 1 Kg Ipomoea leaves, 500 g chili, 500 g garlic and 5 kg neem leaves in 10 lit of cow urine. Mixed it well clockwise and closed it with a lid. Boiled the liquid for half of the quantity and then allowed it to cool and applied @ 12.5 l per hectare.

RESULTS AND DISCUSSION

During two years study and also in pooled analysis, the treatment of insecticidal combination played significant role in reducing the infestation on brinjal fruits. Although all the treatments exhibited significant effect over untreated check in all the intervals of observation during overall study 2023-24 (Table 2) and pooled (Table 3). In first year (Table-1), emamectin benzoate 3% + thiamethoxam 12% @ 150 g ha^{-1} was gave highest reduction over control (91.13%) followed by thiamethoxam 12.6% + lambda cyhalothrin 9.5% @ 125 ml ha^{-1}(85.45%), Spinosad 45% SC @185 ml ha^{-1}(75.35%), Neem extract 3% @ 2500 ml ha^{-1}(73.92%), *Brahmastra* (Natural) @ 25 L ha-^{1} (70.74%), *Neemastra* (Natural) @ 25 L ha-^{1} (68.10%), *Beauveria bassiana* 1.15% WP @ 2500 g ha^{-1}(65.67%) and *Agniastra* (Natural) @ 12.5 L ha-^{1} (64.88%), *Metarhizium anisopliae* 1.15% WP @ 2500 ml ha^{-1}(63.88%). During second year (Table-2), emamectin benzoate 3% + thiamethoxam 12% @ 150 g ha^{-1} (90.03%) again recorded highest reduction followed by Thiamethoxam 12.6% + lambda cyhalothrin 9.5% @ 125 ml ha^{-1}(86.20%), Spinosad 45% SC @185 ml ha^{-1}(77.91%), Neem extract 3% @ 2500 ml ha^{-1}(76.91%), *Neemastra* (Natural) @ 25 L ha-^{1} (76.52 per cent), *Brahmastra* (Natural) @ 25 L ha-^{1} (75.66%), *Agniastra* (Natural) @ 12.5 L ha-^{1} (74.36%), *Beauveria bassiana* 1.15% WP @ 2500 g ha^{-1}(73.06%) and *Metarhizium anisopliae* 1.15% WP @ 2500 ml ha^{-1} (71.22%). Further same trend of infestation reduction in fruit and shoot borer was noted in pooled analysis (Table 3) as it was maximum (90.57%) in emamectin benzoate 3% + thiamethoxam 12% @ 150 g ha^{-1} followed by thiamethoxam 12.6% + lambda cyhalothrin 9.5% @ 125 ml ha^{-1} (85.84%), Spinosad 45% SC @ 185 ml ha^{-1} (76.68%), Neem extract 3% @ 2500 ml ha^{-1} (75.49%), *Brahmastra* (Natural) @ 25 L ha^{-1}(73.32%), *Neemastra* (Natural) @ 25 L ha^{-1}(72.52%), *Agniastra* (Natural) @ 12.5 L ha^{-1} (69.84%), *Beauveria bassiana* 1.15% WP @ 2500 g ha^{-1} (69.54%) and M*etarhizium anisopliae* 1.15% WP @ 2500 ml ha^{-1} (67.72%). The present observations on the effectiveness of combination of insecticides are in partial conformity with those of Mollah (2025) in brinjal against *L. orbonalis* found lowest fruit infestation with Emamectin benzoate 1% + azadirachtin 1%. Rahman *et al.* (2019) reported that emamectin Benzoate +Abamectin @ 0.50 g/L recorded the lowest fruit infestation. Another study by Anand *et al.* (2014) reported that emamectin benzoate, in combination with azadirachtin-based Neem Baan, provided the lowest fruit infestation by both number and weight basis. Furthermore, the past results of the experiment by Kumari *et al.* (2023); Sood *et al.* (2023); Siddhartha *et al.* (2025) proved that the use of emamectin Benzoate protected brinjal fruit significantly from BSFB infestation. Spinosad 45 SC and emamectin benzoate 5 SG, 0.002% was found to be equally efficacious for lowering the infestation of BSFB reported by Warghat *et al.* (2020) and (Jangid and Kumar 2024).

Likewise, in a separate study conducted by Ullah *et al*. (2021), it was reported that Neem oil 5% had the lowest fruits infestation, the most flowers per plant and the maximum brinjal yield. Singh *et al.* (2025) noted

Table 1. Efficacy of organic and bio-rational insecticide against brinjal shoot and fruit borer during *rabi*, 2022-23

S. No.	Treatment	Dosage (G or ml/ ha or %)	Fruit damage by shoot and fruit borer							Overall Reduction (%)
			After first spray				After second spray			
			1 DBS	3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	
T_1	*Neemastra* (Natural)	25 L	23.81 (29.54)	17.83 (25.32)	19.62 (26.64)	20.47 (27.20)	11.63 (20.25)	11.29 (19.98)	12.45 (21.01)	**68.10**
T_2	*Brahmastra* (Natural)	25 L	22.95 (28.96)	16.29 (24.00)	18.42 (25.63)	19.05 (26.00)	11.10 (19.83)	10.73 (19.53)	11.42 (20.13)	**70.74**
T_3	*Agniastra* (Natural)	12.5 L	24.17 (29.78)	18.60 (25.88)	21.01 (27.53)	25.58 (30.68)	12.68 (21.20)	12.40 (20.98)	13.71 (22.08)	**64.88**
T_4	*Metarhizium anisopliae* 1.15% WP	2500 ml	23.95 (29.63)	19.35 (26.41)	24.06 (29.62)	26.63 (31.27)	13.24 (21.70)	12.84 (21.39)	14.10 (22.44)	**63.88**
T_5	Spinosad 45% SC	185 ml	24.10 (29.73)	13.85 (22.25)	16.07 (23.98)	16.24 (24.08)	9.32 (18.26)	9.24 (18.18)	9.62 (18.55)	**75.35**
T_6	Neem extract 3%	2500 ml	23.97 (29.65)	15.14 (23.18)	16.93 (24.65)	17.30 (24.88)	10.72 (19.49)	9.85 (18.67)	10.18 (18.97)	**73.92**
T_7	*Beauveria bassiana* 1.15% WP	2500 g	24.32 (29.87)	19.76 (26.73)	22.54 (28.65)	25.33 (30.47)	12.42 (20.99)	12.19 (20.79)	13.40 (21.82)	**65.67**
T_8	Emamectin benzoate 3% + Thiamethoxam 12%	150 g	23.68 (29.46)	6.50 (15.28)	7.04 (15.89)	7.89 (16.77)	3.25 (10.96)	2.85 (10.47)	3.46 (11.35)	**91.13**
T_9	Thiamethoxam 12.6% +Lambda cyhalothrin 9.5%	125 ml	23.38 (29.23)	8.57 (17.43)	9.07 (17.93)	9.66 (18.56)	5.28 (13.92)	4.70 (13.05)	5.68 (14.20)	**85.45**
T_{10}	Untreated	-	23.93 (29.61)	25.76 (30.82)	28.33 (32.47)	31.02 (34.13)	34.55 (36.29)	36.89 (37.69)	39.04 (38.94)	-
	S Em±	-	0.50	1.37	1.48	1.58	1.27	1.19	1.35	-
	CV %	-	NS	10.03	10.11	10.34	10.86	10.31	11.16	-
	CD at 5 %	-	NS	4.08	4.39	4.68	3.78	3.55	4.01	-

The values in parentheses are angular transformed values, DBS= Days before spray, DAS = Days after spray

that modified *Agniastra* (MAA) at 7.5 L/ha, significantly lowered the fruit damage (10.15%) due to shoot and fruit borer followed by modified Brahmastra (MBA) at 10 L/ ha. However, we discovered that the following treatments were quite helpful in managing BSFB. Furthermore, Akter *et al.* (2017) recorded lowest fruit infestation in the plots treated with spinosad 45 SC followed by emamectin benzoate 5 SG. Mahajan *et al.* (2020) stated that neem oil 2% @ 5ml/lit showed efficient treatments against BSFB. These findings are also in partial support to present study.

Yield

In both years, the yield of brinjal fruits (Table-4) differed significantly between different treatments. In 2022-23 and 2023-24, the yield varied between 90.02 and 268.88 q/ha and 81.13 and 245.13 q/ha, respectively. The Emamectin benzoate 3% + Thiamethoxam 12% treated plots produced the highest overall pooled yield (257.00 q/ha) which exhibited significance with Thiamethoxam 12.6% +Lambda cyhalothrin 9.5% (202.80 qt ha^{-1}), Spinosad 45% SC @185 ml ha^{-1}(192.71 qt ha^{-1}), Neem

Table 2. Efficacy of organic and bio-rational insecticide against brinjal shoot and fruit borer during *rabi*, 2023-24

S. No.	Treatment	Dosage per ha	Fruit damage by shoot and fruit borer							Overall Reduction (%)
			After first spray				After second spray			
			1 DBS	3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	
T_1	*Neemastra* (Natural)	25 L	36.81 (35.95)	12.72 (21.27)	15.09 (23.12)	16.12 (24.01)	10.58 (19.36)	9.91 (18.69)	10.11 (18.89)	**76.52**
T_2	*Brahmastra* (Natural)	25 L	35.95 (37.14)	13.24 (21.69)	15.56 (23.57)	16.50 (24.20)	10.80 (19.55)	10.21 (18.98)	10.48 (19.25)	**75.66**
T_3	*Agniastra* (Natural)	12.5 L	37.17 (37.86)	15.44 (23.43)	16.32 (24.13)	16.91 (24.63)	11.21 (19.88)	10.67 (19.40)	11.04 (19.76)	**74.36**
T_4	*Metarhizium anisopliae* 1.15% WP	2500 ml	36.95 (37.73)	17.10 (24.74)	17.73 (25.24)	19.67 (26.62)	12.36 (20.95)	11.83 (20.47)	12.39 (20.93)	**71.22**
T_5	Spinosad 45% SC	185 ml	37.10 (37.82)	11.45 (20.20)	12.53 (21.11)	12.94 (21.43)	9.04 (17.98)	8.71 (17.64)	9.51 (18.43)	**77.91**
T_6	Neem extract 3%	2500 ml	36.97 (37.74)	12.05 (20.73)	13.12 (21.60)	14.01 (22.33)	10.39 (19.14)	9.72 (18.55)	9.94 (18.76)	**76.91**
T_7	*Beauveria bassiana* 1.15% WP	2500 g	37.32 (37.95)	16.09 (23.98)	16.87 (24.57)	17.85 (25.33)	11.62 (20.25)	11.13 (19.78)	11.60 (20.21)	**73.06**
T_8	Emamectin benzoate 3% + Thiamethoxam 12%	150 g	36.68 (37.57)	5.67 (14.15)	6.11 (14.63)	7.29 (15.97)	4.36 (12.55)	3.97 (12.14)	4.29 (12.50)	**90.03**
T_9	Thiamethoxam 12.6% +Lambda cyhalothrin 9.5%	125 ml	35.38 (36.78)	6.87 (15.62)	7.52 (16.08)	8.40 (17.08)	5.37 (13.95)	5.06 (13.47)	5.94 (14.44)	**86.20**
T_{10}	Untreated	-	36.93 (37.72)	37.09 (37.80)	39.06 (38.96)	41.39 (40.32)	41.83 (40.59)	42.35 (40.89)	43.06 (41.30)	**0.00**
	S Em±	-	0.58	1.36	1.45	1.46	1.31	1.25	1.31	
	CV %	-	NS	10.52	10.78	10.46	11.14	10.84	11.12	
	CD at 5 %	-	NS	4.04	4.31	4.34	3.90	3.72	3.90	

The values in parentheses are angular transformed values, DBS= Days before spray, DAS = Days after spray

extract 3% @ 2500 ml ha^{-1}(184.82qt ha^{-1}), *Brahmastra* (Natural) @ 25 L ha^{-1}(166.87qt ha^{-1}), *Neemastra* (Natural) @ 25 L ha^{-1}(162.31qt ha^{-1}), *Agniastra* (Natural) @ 12.5 L ha^{-1}(152.52qt ha^{-1}) followed by *Beauveria bassiana* 1.15% WP @ 2500 g ha^{-1}(138.98qt ha^{-1}) and *Metarhizium anisopliae* 1.15% WP @ 2500 ml ha^{-1}(120.62qt ha^{-1}). The pooled lowest fruit yield 85.57 quintal per hectare registered in untreated check. The findings of previous researchers are in partial support as Kumari *et al.* (2023) reported the highest brinjal fruit yield obtained with treatment Emamectin benzoate 5 SG. A slight similar result was noted with Sood *et al.* (2023) reported maximum fruit yield in emamectin benzoate (51.67 q/ ha) which was at par with Brahmastra (45.50 q/ ha) and *Agniastra* (41.67 q/ ha). Application of Cyclone 2.5 EC (Lambda-cyhalothrin) has significantly increased marketable yield and decreased infested fruit yield compared to untreated control as reported by Rahman *et al.* (2019).

Economics of different insecticides

Emamectin benzoate 3% + thiamethoxam 12% ha^{-1} yielded the highest net return (Rs. 372732.4 ha^{-1}) and benefit-cos ratio (5.80) (Table 4) followed by

Table 3. Efficacy of organic and bio-rational insecticide against brinjal shoot and fruit borer during *rabi*, 2022-23 and 2023-24 (Pooled)

S. No.	Treatment	Dosage (G or ml/ ha or %)	Fruit damage by shoot and fruit borer							Overall Reduction (%)
			After first spray				After second spray			
			1 DBS	3 DAS	7 DAS	10 DAS	3 DAS	7 DAS	10 DAS	
T_1	*Neemastra* (Natural)	25 L	30.31 (33.60)	15.28 (23.29)	17.35 (24.88)	18.29 (25.61)	11.10 (19.80)	10.60 (19.34)	11.28 (19.95)	**72.52**
T_2	*Brahmastra* (Natural)	25 L	29.45 (33.05)	14.77 (22.85)	16.99 (24.60)	17.78 (25.10)	10.95 (19.69)	10.47 (19.25)	10.95 (19.69)	**73.32**
T_3	*Agniastra* (Natural)	12.5 L	30.67 (33.82)	17.02 (24.66)	18.67 (25.83)	21.24 (27.66)	11.94 (20.54)	11.54 (20.19)	12.38 (20.92)	**69.84**
T_4	*Metarhizium anisopliae* 1.15% WP	2500 ml	30.45 (33.68)	18.23 (25.57)	20.90 (27.43)	23.15 (28.95)	12.80 (21.33)	12.34 (20.93)	13.25 (21.68)	**67.72**
T_5	Spinosad 45% SC	185 ml	30.60 (33.78)	12.65 (21.23)	14.30 (22.54)	14.59 (22.75)	9.18 (18.12)	8.97 (17.91)	9.57 (18.49)	**76.68**
T_6	Neem extract 3%	2500 ml	30.47 (33.69)	13.60 (21.95)	15.03 (23.12)	15.66 (23.61)	10.55 (19.31)	9.79 (18.61)	10.06 (18.87)	**75.49**
T_7	*Beauveria bassiana* 1.15% WP	2500 g	30.82 (33.91)	17.93 (25.35)	19.70 (26.61)	21.59 (27.90)	12.02 (20.62)	11.66 (20.28)	12.50 (21.01)	**69.54**
T_8	Emamectin benzoate 3% + Thiamethoxam 12%	150 g	30.18 (33.51)	6.08 (14.72)	6.58 (15.26)	7.59 (16.37)	3.81 (11.75)	3.41 (11.31)	3.87 (11.92)	**90.57**
T_9	Thiamethoxam 12.6% +Lambda cyhalothrin 9.5%	125 ml	29.38 (33.01)	7.72 (16.52)	8.30 (17.00)	9.03 (17.37)	5.33 (13.93)	4.88 (13.26)	5.81 (14.32)	**85.84**
T_{10}	Untreated	-	30.43 (33.66)	31.43 (34.31)	33.69 (35.71)	36.20 (37.23)	38.19 (38.44)	39.62 (39.29)	41.05 (40.12)	**0.00**
	S Em±	-	0.54	1.37	1.46	1.52	1.29	1.22	1.33	
	CV %	-	NS	10.27	10.44	10.40	11.00	10.57	11.14	
	CD at 5 %	-	NS	4.06	4.35	4.51	3.84	3.63	3.95	

The values in parentheses are angular transformed values, DBS= Days before spray, DAS = Days after spray

thiamethoxam 12.6% + lambda cyhalothrin 9.5% (Rs. 280624.8 ha^{-1} and B: C 4.37). Among herbal products, *Brahmastra* (Natural) @ 25 L ha^{-1} gave net returns of Rs. 213719 ha^{-1} and B:C ratio of 3.05 and *Neemastra* (Natural) @ 25 L ha^{-1} followed with B:C ratio of 3.00). In our study Spinosad and neem pesticides were found to be efficacious after combination insecticides with the maximum BC ratio. Sahu *et al.* (2023) assessed that Emamectin benzoate 5 SG @ 200 g/ha (1:17.04) had the highest brinjal fruit yield (265.61 q/ha), the highest net profit (Rs. 63,075.78), and the highest cost-benefit ratio. Additionally, the BC ratio of brinjal fruit treated with Emamectin Benzoate was higher than that of *Brahmastra*, *Neemastra* and *Agniastra*, as shown by Tayde and Sharma (2017). Our results also concur with those of Gandla and Kumar (2022) and Yousafi *et al.* (2016) who found that Emamectin benzoate was the most cost-effective treatment for BSFB in the field, with a higher BC ratio than Spinosad and neem oil. Further, Khanal *et al.* (2021) concluded that both marketable yield and Benefit-Cost ratio of under treatment of Emamectin benzoate against brinjal fruit borer were highest followed

Table 4. Effect of insecticides on brinjal fruit yield during *rabi* 2022-23 & 2023-24 (Pooled)

S. No.	Treatment	Yield, 2022-23 (q ha^{-1})	Yield, 2023-24 (q ha^{-1})	Pooled Yield (q ha^{-1})	B:C Ratio
T_1	*Neemastra* (Natural)	164.04	160.58	162.31	3.00
T_2	*Brahmastra* (Natural)	177.62	156.11	166.87	3.05
T_3	*Agniastra* (Natural)	153.71	151.33	152.52	2.75
T_4	*Metarhizium anisopliae* 1.15% WP	114.80	126.44	120.62	2.11
T_5	Spinosad 45% SC	197.13	188.29	192.71	3.85
T_6	Neem extract 3%	191.09	178.56	184.82	3.61
T_7	*Beauveria bassiana* 1.15% WP	138.27	139.69	138.98	2.56
T_8	Emamectin benzoate 3% + Thiamethoxam 12%	268.88	245.13	257.00	5.80
T_9	Thiamethoxam 12.6% +Lambda cyhalothrin 9.5%	211.82	193.78	202.80	4.37
T_{10}	Untreated	90.02	81.13	85.57	1.32
	S Em±	18.68	16.90	18.96	
	CD at 5 %	55.49	50.22	52.86	

by Jholmal and Neem Kavach. Whereas, Jangid and Kumar 2024 proved that Spinosad 45 SC (180 q/ha, 1:9.3) was more effective among all other treatments, followed by emamectin Benzoate5 SG (155.60, 1:9.2).

Conclusion

It is clear that all the treatments were able to significantly lower the infestation of BSFB in the field. It was concluded that combination insecticides emamectin benzoate 3% + thiamethoxam 12% 150 g ha^{-1} and thiamethoxam 12.6% + lambda cyhalothrin 9.5% @ 125 ml ha^{-1} were the best among the tested bio-rational pesticides, while Spinosad and organic pesticides were equally efficacious for the management of BSFB. Fruit yield and BC ratio of emamectin benzoate 3% + thiamethoxam 12%was highest followed by thiamethoxam 12.6% + lambda cyhalothrin 9.5% @ 125 ml ha^{-1}, spinosad 45% SC @ 185 ml ha^{-1}, Neem extract 3% @ 2500 ml ha^{-1}, *Brahmastra* (Natural) @ 25 L ha-^{1}, *Neemastra* (Natural) @ 25 L ha-^{1}, *Agniastra* (Natural) @ 12.5 L ha-^{1}, *Beauveria bassiana* 1.15% WP @ 2500 g ha^{-1} and *Metarhizium anisopliae* 1.15% WP.

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