Pest Management in Horticultural Ecosystems
Vol. 28, No.2 pp 32-38 (2022)

DOI Number: 10.5958/0974-4541.2022.00035.2

Field efficacy of different biorationals and insecticides against brinjal shoot and fruit borer (*Leucinodes orbonalis* Guenee) under *terai* region of West Bengal

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ABSTRACT: Field efficacy of seven insecticides, including biorationals, was evaluated against *Leucinodes orbonalis* (Guenee) at the teaching farm, Uttar Banga Krishi Viswavidyalaya, during the two consecutive *rabi* seasons of 2018–19 and 2019–20. The results showed that chlorantraniliprole 18.5 SC, flubendiamide 39.35 SC, and novaluron 5.25% + emamectin benzoate 0.9% SC were the most successful treatments resulted in the lowest shoot infestation (2.24-6.05%) and fruit infestation (number basis: 11.01-13.29% and weight basis: 11.94-15.75%). *Bacillus thuringiensis* var. *kurstaki* and chlorantraniliprole 18.5 SC both produced the highest commercial fruit yields, ranging from 13.54 to 14.54 t/ha and 14.11 to 14.51 t/ha, respectively. Azadirachtin 50,000 ppm was the least effective among the tested insecticides against brinjal shoot and fruit borer.

Keywords: Brinjal, shoot and fruit borer*, Leucinodes,* IPM, biorational, bioefficacy

INTRODUCTION

Brinjal (*Solanum melongena* L.) is one of the most important vegetables cultivated worldwide and one of essential staple vegetables in Asian countries, particularly India. The insect infestation resulted in 70 to 92 percent yield loss in brinjal. There are about 140 different insect pests that attack brinjal, among which the shoot and fruit borer, *Leucinodes orbonalis* (Guenne) (Lepidoptera: Crambidae) (Ghosh and Senapati, 2009). Farmers typically rely on synthetic insecticides to treat pest problems because they produce quick results (Misra, 2008). These compounds have brought issues of pesticide resistance, persistent toxicity, optional nuisance outbreak, ecological devastation, and toxicity to beneficial insects. Additionally, it has been reported that *L. orbonalis* has developed resistance to the most commonly used insecticides due to irregular insecticide usage (Hegde *et al*., 2009). Therefore, it is necessary to look for safer and alternative methods (Gowda *et al*., 2017). The problems brought on by the misuse of chemical sprays can be reduced by incorporating biorationals. This served as the backdrop for the current study, which examined the field effectiveness of various biorational pesticides compared to chemical insecticides against brinjal shoot and fruit borer.

MATERIALS AND METHODS

The field study was conducted in the instructional farm in Uttar Banga Krishi Viswavidyalaya, Cooch Behar, West Bengal, during the *rabi* seasons of 2018–19 and 2019–20. The evaluation consists of seven insecticides and biorationals (azadirachtin 50,000 ppm, flubendiamide 39.35 SC, novaluron 5.25% + emamectin benzoate 0.9% SC, spinosad 45 SC, *Bacillus thuringiensis* var. *kurstaki*, and chlorantraniliprole 18.5 SC) and replications thrice in a randomized block design. 21-day-old seedlings of the 'lopcha' transplanted plots of 5 x 3 m dimension with a spacing of 60 x 50 cm. All the crop management practices were ensured for raising a healthy crop, except for plant protection measures. In each plot, five plants were randomly tagged and used to record the pest observations. Two sprays were carried out from 60 days following seeding at an interval of 15 days. The injured shoots were observed on the tagged plants one day before the application and three, seven, and ten days after spraying. The mean number of injured shoots per plot was calculated and expressed in percentage to determine the extent of the shoot damage. The fruits from brinjal plants were picked at an interval every two weeks, and the total number of injured fruits from each plot was counted and expressed in percentage. The fruit yield per plot was recorded and converted into per hectare. The data were subjected to appropriate transformation and analysed in OPSTAT statistical software.

RESULTS AND DISCUSSION

During 2018–19, the percent shoot damage ranged from 25.00 to 33.39% one day before insecticide

Table 1. Effect of different biorationals and insecticides on shoot damage due to *L. orbonalis* in brinjal (2018-19)

Tr. No.	Treatment	Dose	Shoot infestation (%) days after first spray				Shoot infestation (%) days after second spray			
			1 DBS	3 DAS	7 DAS	10 DAS	1 DBS	3 DAS	7 DAS	10 DAS
T1	*Bacillus thuringiensis* var. *kurstaki*	2g/l	25.49 (30.25) *	23.73 (29.02)	20.30 (26.70)	17.45 (24.62)	16.11 (23.65)	14.37 (22.24)	10.17 (18.56)	6.19 (14.35)
T2	Chlorantraniliprole 18.5SC	0.3 ml/l	28.41 (32.17)	21.11 (27.29)	17.08 (24.38)	13.22 (21.24)	12.53 (20.7)	10.11 (18.49)	3.84 (11.16)	2.24 (6.94)
T3	Spinosad 45 SC	1 ml/l	29.98 (33.12)	27.17 (31.34)	25.09 (30.04)	19.69 (26.33)	15.14 (22.86)	13.55 (21.56)	8.57 (16.96)	4.71 (12.22)
T4	Flubendiamide 39.35 SC	0.2 ml/l	28.08 (31.95)	22.04 (27.92)	18.52 (25.47)	11.06 (19.35)	16.56 (23.93)	11.88 (20.12)	7.46 (15.69)	5.79 (13.85)
T5	Novaluron 5.25% + Emamectin Benzoate 0.9% SC	1.5 ml/l	25.88 (30.54)	21.49 (27.56)	17.21 (24.48)	10.92 (19.27)	13.34 (21.38)	10.95 (19.11)	5.27 (13.23)	3.10 (8.30)
T6	Azadirachtin 50,000 ppm	3 ml/ litre	33.39 (35.26)	29.62 (32.95)	30.06 (33.21)	22.14 (28.04)	29.28 (32.72)	26.57 (30.98)	26.24 (30.74)	21.20 (27.36)
T7	Control (Water Spray)	-	25.00 (29.96)	31.54 (34.13)	23.05 (28.60)	29.21 (32.63)	30.55 (33.53)	28.35 (32.13)	29.95 (33.06)	29.61 (32.94)
	S.E. ±	-	1.34	1.55	1.09	1.09	1.09	1.35	1.44	2.29
	C.D. at 5%	-	NS	4.83	3.38	3.40	3.39	4.22	4.48	7.12

*Figures in parentheses are angular transformed values

Table 2. Bioefficacy of different biorationals and insecticides against shoot damage due to *L. orbonalis* in brinjal (First and second spraying-2019-20)

Tr. No.	Treatment	Dose	Shoot infestation (%) days after first spray				Shoot infestation (%) days after second spray			
			1 DBS	3 DAS	7 DAS	10 DAS	1 DBS	3 DAS	7 DAS	10 DAS
T1	*Bacillus thuringiensis* var. *kurstaki*	2g/l	28.22 (32.06)*	25.59 (30.30)	21.15 (27.32)	22.01 (27.91)	22.86 (28.54)*	17.37 (24.62)	13.28 (21.35)	11.63 (19.93)
T2	Chlorantraniliprole 18.5SC	0.3 ml/l	27.57 (31.6)	20.33 (26.78)	15.51 (23.17)	12.43 (20.61)	13.20 (21.27)	10.08 (18.48)	8.34 (16.65)	6.05 (14.18)
T3	Spinosad 45 SC	1 ml/l	31.02 (33.8)	28.21 (31.99)	23.32 (28.85)	17.92 (25.02)	18.90 (25.7)	15.24 (22.90)	12.43 (20.61)	10.85 (19.20)
T4	Flubendiamide 39.35 SC	0.2 ml/l	29.84 (33.1)	21.17 (27.29)	16.67 (24.08)	12.92 (20.78)	13.60 (21.6)	12.58 (20.75)	9.09 (17.50)	7.44 (15.82)
T5	Novaluron 5.25% + Emamectin Benzoate 0.9% SC	1.5 ml/l	27.96 (31.9)	24.29 (29.47)	17.70 (24.87)	16.38 (23.83)	17.20 (24.4)	14.32 (22.17)	11.32 (19.61)	9.20 (17.29)
T6	Azadirachtin 50,000 ppm	3 ml/l	33.39 (35.3)	30.90 (33.74)	29.18 (32.68)	28.33 (32.10)	29.21 (32.7)	23.90 (29.25)	24.57 (29.67)	24.66 (29.75)
T7	Control (Water Spray)	-	28.23 (32.00)	36.05 (36.87)	38.31 (38.21)	39.54 (38.93)	40.42 (39.4)	41.67 (40.18)	41.73 (40.22)	43.11 (41.01)
	S.E. ±	-	1.66	1.44	0.85	1.39	1.00	0.87	1.13	1.30
	C.D. at 5%	-	NS	4.49	2.64	4.32	3.20	2.70	3.51	4.06

*Figures in parentheses are angular transformed values

Table 3. Bioefficacy of different biorationals and insecticides against fruit damage (number basis) due to *L. orbonalis* in brinjal (2018-19 and 2019-20)

Tr. No.	Treatment	Dose	Mean per cent fruit infestation after each picking (Number Basis) during 2018-19			Mean per cent fruit infestation after each picking (Number Basis) during 2019-20		
			1st Picking	2nd picking	3rd picking	1st Picking	2nd picking	3rd picking
T1	*Bacillus thuringiensis* var. *kurstaki*	2g/l	19.60 (26.16) *	21.60 (27.24)	23.16 (28.54)	23.89 (29.09)*	25.42 (30.22)	28.69 (32.30)
T2	Chlorantraniliprole 18.5SC	0.3 ml/l	12.41 (20.24)	11.01 (19.24)	11.21 (19.34)	13.29 (20.77)	13.10 (21.14)	12.23 (20.04)
T3	Spinosad 45 SC	1 ml/l	18.45 (25.07)	29.48 (32.86)	33.26 (35.16)	18.28 (25.29)	27.08 (31.24)	26.70 (31.08)
T4	Flubendiamide 39.35 SC	0.2 ml/l	15.72 (23.23)	28.83 (32.35)	29.47 (32.85)	14.39 (18.40)	23.91 (29.23)	17.97 (25.04)
T5	Novaluron 5.25% + Emamectin Benzoate0.9% SC	1.5 ml/l	17.86 (20.76)	23.96 (29.28)	24.22 (29.46)	20.63 (22.51)	23.30 (28.66)	22.01 (27.92)
T6	Azadirachtin 50,000 ppm	3 ml/l	26.29 (30.47)	31.52 (34.02)	35.01 (36.25)	31.82 (34.11)	26.35 (30.83)	29.98 (33.19)
T7	Control (Water Spray)	-	35.84 (36.75)	39.12 (38.69)	44.59 (41.87)	42.93 (40.87)	37.36 (37.66)	41.33 (39.98)
	S.E. ±	-	3.94	2.24	1.79	6.01	1.86	1.79
	C.D. at 5%	-	NS	6.96	5.59	NS	5.79	5.57
	C.V. (%)	-	26.15	12.68	9.74	38.14	10.79	10.36

application (Table 1). Chlorantraniliprole 18.5 SC recorded the lowest shoot infestation at 3 days after spraying (DAS), followed by novaluron 5.25% + emamectin benzoate 0.9% SC, flubendiamide 39.35 SC, and *B. thuringiensis* var. *kurstaki*, however, the results are comparable with each other. The percent shoot damage at 7 DAS varied from 17.08 to 30.06 %, and application of novaluron 5.25% + emamectin benzoate 0.9% SC and chlorantraniliprole 18.5SC showed the lowest shoot damage compared to untreated control plots. During 10 DAS, flubendiamide 39.35 SC (11.06%), novaluron 5.25% + emamectin benzoate 0.9% SC (10.92%) showed the lowest shoot infestation rates.

Similarly, during the second spraying in 2018–19, the percent shoot damage ranged between 12.53– 30.55 (Table 1). The lowest shoot infestation was recorded at 3 DAS in chlorantraniliprole 18.5 SC (10.11%), closely followed by novaluron 5.25% + emamectin benzoate 0.9% SC (10.95%). The same trends were seen at 10 DAS, when plots treated with chlorantraniliprole 18.5 SC recorded the lowest shoot infestation (2.24%), followed by plots treated with novaluron 5.25% + emamectin benzoate 0.9% SC (3.10%), Spinosad 45 SC (4.71%), Flubendiamide 39.35 SC (5.79%), and *Bacillus thuringiensis* var. *kurstaki* (6.19%). All five of the study's treatments, except azadirachtin 50,000 ppm, offered more significant control over untreated plots (29.61 %) 10 days after the second spraying.

During 2019–20, the % shoot damage before the first spraying ranged from 27.57 to 33.39 (Table 2). The percent shoot damage ranged from 20.33 to 36.05 percent at 3 DAS. The application of flubendiamide 39.35 SC (21.17%), novaluron 5.25% + emamectin benzoate 0.9% SC (24.29%), *Bacillus thuringiensis* var. *kurstaki* (25.59%) and chlorantraniliprole 18.5 SC (20.33%) had comparable bioefficacy. At 7 DAS, flubendiamide 39.35 SC (16.67%) and chlorantraniliprole 18.5 SC (15.51%) recorded the lowest shoot infestation. The range of the shoot damage percentage at 10 DAS was 12.43 to 39.54. The lowest shoot infestation (12.43%) was recorded by chlorantraniliprole 18.5 SC, followed by flubendiamide 39.35 SC (12.92%).

Similarly, during the second spraying of 2019–20, the range of the percent shoot damage was 13.20–40.42. (Table 2). The chlorantraniliprole 18.5 SC reported the

Table 4. Bioefficacy of different biorationals and insecticides against fruit damage (weight basis) due to *L. orbonalis* in brinjal (2018-19 and 2019-20)

Tr. No.	Treatments	Dose	Mean per cent fruit infestation after each picking (Weight Basis) during 2018-19			Mean per cent fruit infestation after each picking (Weight Basis) during 2019-20		
			1st Picking	2nd picking	3rd picking	1st Picking	2nd picking	3rd picking
T1	*Bacillus thuringiensis* var. kurstaki	2g/l	23.02 (28.61) *	20.10 (26.61)	21.11 (27.33)	18.22 (25.24)	16.47 (23.90)	17.20 (24.49)
T2	Chlorantraniliprole 18.5SC	0.3 ml/l	15.78 (23.39)	14.04 (21.99)	13.98 (21.93)	12.20 (20.42)	11.94 (20.20)	12.38 (20.58)
T3	Spinosad 45 SC	1 ml/l	19.70 (26.31)	17.31 (24.58)	18.49 (25.45)	15.96 (23.51)	15.70 (23.33)	15.95 (23.52)
T4	Flubendiamide 39.35 SC	0.2 ml/l	17.29 (24.56)	16.54 (23.98)	17.77 (24.92)	14.93 (22.69)	14.51 (22.36)	14.33 (22.24)
T5	Novaluron 5.25% + Emamectin Benzoate 0.9% SC	1.5 ml/l	18.27 (25.27)	17.42 (24.63)	17.40 (24.64)	16.19 (23.71)	15.22 (22.94)	15.06 (22.81)
T6	Azadirachtin 50,000 ppm	3 ml/l	25.29 (30.17)	24.06 (29.35)	24.25 (29.45)	18.54 (25.49)	17.40 (24.64)	19.04 (25.85)
T7	Control (Water Spray)	-	35.18 (36.33)	37.62 (37.82)	37.95 (38.00)	28.19 (32.06)	28.98 (32.50)	30.91 (33.75)
	S.E. ±	-	1.08	0.67	0.83	0.62	0.87	0.45
	C.D. at 5%	-	3.39	2.08	2.58	1.94	2.72	1.41
	C.V. (%)	-	6.77	4.28	5.24	4.36	6.23	3.18

lowest shoot infestation at 3 and 7 DAS treatments (10.08% and 8.34%), followed by flubendiamide 39.35 SC (12.58% and 9.09%). Chlorantraniliprole 18.5 C (6.05%) had the lowest shoot infestation at 10 days after spraying, followed by flubendiamide 39.35 SC (7.44%). The findings are consistent with the results of Misra (2011), who reported that chlorantraniliprole at 40 and 50 g a.i./ha was the most effective against the brinjal shoot and fruit borer, reducing shoot damage by 95–97 %. Anil and Sharma (2011) also documented that the application of emamectin benzoate, novaluron, and spinosad resulted in 0.56, 0.96, and 1.25 percent shoot damage, respectively. Shirale *et al*. (2012) tested the effectiveness of new-generation insecticides against BFSB. They found that the plots sprayed with chlorantraniliprole 18.50% SC and flubendiamide 39.35% SC had the least percentage of fruit damage.

According to Swini Reddy and Kumar (2022), flubendiamide, emamectin benzoate, and chlorantraniliprole had the lowest rates of shoot infestation. Further, they also noted that Azadirachtin had shown the lowest effectiveness in suppressing BSFB, whereas spinosad offered a moderate level of control.

During 2019–20, the % shoot damage before the first spraying ranged from 27.57 to 33.39 (Table 2). The percent shoot damage ranged from 20.33 to 36.05 percent at 3 DAS. The application of flubendiamide 39.35 SC (21.17%), novaluron 5.25% + emamectin benzoate 0.9% SC (24.29%), *Bacillus thuringiensis* var. *kurstaki* (25.59%) and chlorantraniliprole 18.5 SC (20.33%) had comparable bioefficacy. At 7 DAS, flubendiamide 39.35 SC (16.67%) and chlorantraniliprole 18.5 SC (15.51%) recorded the lowest shoot infestation. The range of the shoot damage percentage at 10 DAS was 12.43 to 39.54. The lowest shoot infestation (12.43%) was recorded by chlorantraniliprole 18.5 SC, followed by flubendiamide 39.35 SC (12.92%).

Similarly, during the second spraying of 2019–20, the range of the percent shoot damage was 13.20–40.42. (Table 2). The chlorantraniliprole 18.5 SC reported the lowest shoot infestation at 3 and 7 DAS treatments (10.08% and 8.34%), followed by flubendiamide 39.35 SC (12.58% and 9.09%). Chlorantraniliprole 18.5 C

(6.05%) had the lowest shoot infestation at 10 days after spraying, followed by flubendiamide 39.35 SC (7.44%). The findings are consistent with the results of Misra (2011), who reported that chlorantraniliprole at 40 and 50 g a.i./ha was the most effective against the brinjal shoot and fruit borer, reducing shoot damage by 95–97 %. Anil and Sharma (2011) also documented that the application of emamectin benzoate, novaluron, and spinosad resulted in 0.56, 0.96, and 1.25 percent shoot damage, respectively. Shirale *et al*. (2012) tested the effectiveness of new-generation insecticides against BFSB. They found that the plots sprayed with chlorantraniliprole 18.50% SC and flubendiamide 39.35% SC had the least percentage of fruit damage. According to Swini Reddy and Kumar (2022), flubendiamide, emamectin benzoate, and chlorantraniliprole had the lowest rates of shoot infestation. Further, they also noted that Azadirachtin had shown the lowest effectiveness in suppressing BSFB, whereas spinosad offered a moderate level of control.

At first harvest/picking during 2018–19, the percentage of fruits with infestation ranged from 12.41 to 35.84. (Table 3). All treatments outperformed the untreated control group, although there was no discernible difference between them. *Bacillus thuringiensis* var. *kurstaki* (21.60%) and chlorantraniliprole 18.5SC (11.01%) produced the best results at second pickings. Chlorantraniliprole 18.5SC, *Bacillus thuringiensis* var. *kurstaki*, and novaluron 5.25% + emamectin benzoate 0.9% SC substantially differed from the untreated control group. However, the outcomes from chlorantraniliprole 18.5SC were outstanding and far superior to those of all other treatments, including the untreated control. The percent fruit damage during third picking showed a similar pattern, with chlorantraniliprole 18.5SC recording the lowest mean percent fruit damage (11.21%), which was significantly better than all other treatments. Yousafi *et al*. (2015) recommended spinosad, flubendiamide, and emamectin benzoate to treat BFSB. Similarly, Vinayaka *et al.* (2019) also reported that the emamectin benzoate 5% SG and chlorantraniliprole 18.5% SC were most effective against BSFB. The insecticides *Bacillus thuringiensis* 5% WP and Azadirachtin 5% EC were shown to be the least effective against BFSB, whereas Spinosad 45% SC was found to be fairly effective. Saran *et al.* (2018) reported spinosad 45 SC @ 200 ml/ha, emamectin benzoate 5 SG @ 200 gm/ha, and chlorantraniliprole 20 SC @ 150 ml/ha were found to be the most effective in lowering the incidence of the shoot and fruit borer.

After the first picking in 2019–20, the percentage of infested fruit (number of fruit basis) varied from 13.29 to 42.93 (Table 3). During second picking, the lowest percentage of fruit infection was found in chlorantraniliprole 18.5 SC treated plots (13.10%), followed by novaluron 5.25% + emamectin benzoate 0.9% SC (23.30%), flubendiamide 39.35 SC (23.91%), and *Bacillus thuringiensis* var. *kurstaki* (25.42%). Similar patterns emerged after the third picking, in which chlorantraniliprole 18.5 SC (12.23%), flubendiamide 39.35 SC (17.97%), and novaluron 5.25% + emamectin benzoate 0.9% SC (22.01 %) offered the best management in terms of lowest percent fruit infestation. After initial picking, the mean percent of fruit infection on a fruit weight basis ranged from 15.78 to 35.18 percent in the 2018–19 growing season (Table 4). On the fruit weight basis, chlorantraniliprole 18.5 SC treated plots showed the lowest percentage of fruit infestation (15.78 %), followed by flubendiamide 39.35 SC (17.29%), novaluron 5.25% + emamectin benzoate 0.9% SC (18.27%), and spinosad 45% SC (19.70%). After the second picking, spinosad 45% SC (17.31%), flubendiamide 39.35 SC (16.54%), and chlorantraniliprole 18.5 SC (14.04%) reported the lowest percentage of fruit infection based on fruit weight. After the third picking, a similar pattern was observed.

During 2019–20, after first picking, the mean percent of fruit infection on a fruit weight basis ranged from 12.20 to 28.19% (Table 4). On a fruit weight basis, chlorantraniliprole 18.5 SC treated plots had the lowest percentage of infested fruit (12.20%), followed by flubendiamide 39.35 SC (14.93%) and spinosad 45% SC (15.96%). The present study's findings show that based on the percent fruit damage (weight basis), chlorantraniliprole 18.5 SC had the most significant outcomes. Mainali *et al.* (2015) also recorded that plots treated with spinosad and chlorantraniliprole had the lowest mean fruit infection rates. Kameshwaran and Kumar (2015) reported that the plots treated with emamectin benzoate 25 WG @ 11 g a.i./ha and chlorantraniliprole 20 SC @ 40 g a.i./ha had the least amount of damage due to BSFB.

In both years, the yield of brinjal fruits differed significantly between different treatments at each of the three picking times. In 2018–19 and 2019–20, the yield varied between 11.48 and 14.11 t/ha and 10.50 and 14.67 t/ha, respectively. The chlorantraniliprole 18.5SC treated plots produced the highest overall yield in 2018–19 (14.11 t/ha), followed by *Bacillus thuringiensis* var. *kurstaki* (13.54 t/ha). The plots treated with flubendiamide 39.35 SC had the highest yield (14.67 t/ha) during 2019–20, followed by those treated with *Bacillus thuringiensis* var. *kurstaki* (14.54 t/ha). Similar findings were reported by Mainali *et al.* (2015), who claimed that the chlorantraniliprole treated plots had the highest marketable yield (32.03 mt/ha), followed by spinosad (30.93 mt/ha), with increases in marketable

Table 5. Yield of brinjal recorded in different biorational treatments in 2018-19 and 2019-20

Tr. No.	Treatments	Yield (t/ha) during 2018-19			Total Yield (t/ha)	Yield (t/ha) during 2019-20			Total Yield (t/ha)
		1st Picking	2nd picking	3rd picking		1st Picking	2nd picking	3rd picking	
T1	*Bacillus thuringiensis* var. kurstaki	4.22	4.32	5.00	13.54	4.30	5.00	5.24	14.54
T2	Chlorantraniliprole 18.5SC	4.28	4.49	5.34	14.11	4.17	5.02	5.32	14.51
T3	Spinosad 45 SC	3.57	4.30	5.08	12.95	4.40	4.58	5.21	14.19
T4	Flubendiamide 39.35 SC	4.00	4.16	4.15	12.31	4.53	5.06	5.08	14.67
T5	Novaluron 5.25% + Emamectin Benzoate 0.9% SC	3.83	4.03	4.79	12.65	4.02	4.58	5.07	13.67
T6	Azadirachtin 50,000 ppm	3.79	3.95	4.13	11.87	4.26	4.93	4.85	14.04
T7	Control (Water Spray)	3.62	3.84	4.02	11.48	3.19	3.64	3.67	10.50
	S.E. ±	0.14	0.08	0.12	-	0.12	0.16	0.08	-
	C.D. at 5%	0.44	0.24	0.37	-	0.37	0.49	0.26	-

fruit yield of 34.39 percent and 29.77 percent over the untreated check, respectively. Sarnabati and Ray (2017) noted that plots treated with chlorantraniliprole produced a maximum yield of 13.83 t/ha. Therefore, it was evident that in terms of brinjal yield, plots treated with chemical insecticides such as chlorantraniliprole 18.5 SC and flubendiamide 39.35 SC performed better than plots treated with biorationals.

CONCLUSION

The results of the present study show that chlorantraniliprole 18.5 SC treated plot had the lowest percentage of fruit and shoot infection during the year. Further, chlorantraniliprole 18.5 SC treated plots also had the highest marketable fruit output in terms of yield. Flubendiamide 39.35 SC, novaluron 5.25% + emamectin benzoate 0.9% SC, and *Bacillus thuringiensis* var *kurstaki* are the next best chemicals in terms of reducing pest damage and yield return. Azadirachtin 50,000 ppm was the least effective.

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MS Received: 31 August 2022
MS Accepted : 15 November 2022