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FIELD EFFICACY STUDY OF DIFFERENT BIORATIONALS AND INSECTICIDES AGAINST BRINJAL SHOOT AND FRUIT BORER (*Leucinodes orbonalis* Guenee) UNDER TERAI REGION OF WEST BENGAL

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

At the Uttar Banga Krishi Viswavidyalaya's teaching farm, field tests were conducted on brinjal during the rabi seasons of 2018–2019 and 2019–2020 to assess the field efficacy of seven biorationals and insecticides against *Leucinodes orbonalis* Guenee, which infests brinjal (*Solanum melongena* L.). 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 in terms of 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 found to be the least effective compound against brinjal shoot and fruit borer.

Keywords: Bioefficacy; biorational; brinjal; insecticides; yield.

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1. INTRODUCTION

One of the staple vegetables in South and South-East Asia is the brinjal, *Solanum melongena* L. It is a member of the Solanaceae plant family, which also includes major crops like potatoes, tomatoes, tobacco, and chillies [1] The insect and many mite pests are there that seriously limit brinjal, *Solanum melongena* L. output. Between 70 and 92 percent damage has been recorded due to insect pest infestation [2] in brinjal. The crop is attacked by roughly 140 different insect pests. The fruit borer (*Leucinodes orbonalis*), the aphid (*Aphis gossypii*), the leaf hopper (*Amarasca biguttula biguttula*), the brinjal stem borer (*Euzophera particella*), and the hadda beetle (*Epilachna* spp.) are the most problematic pests of brinjal [3] *Leucinodes orbonalis*, the main pest that infests brinjal, is significant on a global scale since it causes major harm in every region where brinjal is being produced [4]. Synthetic pesticides are frequently used by farmers to treat pest issues because they have immediate results. These substances have contributed to the issues of pesticide resistance, revival, optional nuisance outbreak, ecological destruction, lasting toxicity, and toxicity to beneficial bioenemies of pests. Additionally, the financial components have higher than permissible quantities of chemical pesticide residue, which has been attributed to *Leucinodes orbonalis* (Guenne) developing resistance to the conventional hazardous insect sprays due to inconsistent insecticide usage [5,6]. It is vital to explore for alternate and safer procedures as a result. Biorationals can be used to mitigate the issues caused by the improper use of chemical sprays. The current study used this as its context as it compared the field efficacy of various biorational pesticides to chemical insecticides against the brinjal shoot and fruit borer (*Leucinodes orbonalis* Guenee.).

2. MATERIALS AND METHODS

The field study was conducted in the Uttar Banga Krishi Viswavidyalaya's Instructional Farm in Post-Pundibari, District-Cooch Behar, West Bengal, during the rabi seasons of 2018–2019 and 2019–2020. Seven treatments and three replications made up the trial's randomised block design. The 60 x 50 cm spacing was used to plant the 21-day-old seedlings of the 'lopcha' variety of brinjal. The plot was confined to a 5 x 3 m dimension. Except for plant protection measures, all suggested packages and methods were used to raise the crop. Five randomly chosen plants from each plot were used to record the pest observations. Starting 60 days following seeding, two insecticidal sprays were applied at 15-day intervals. Along with the untreated control, the treatments consisted of 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. Three, seven, and ten days following the spraying, observations were made. The number of injured shoots and the total number of healthy shoots observed from five randomly chosen plants per plot were calculated and expressed as a percentage to determine the extent of the shoot damage. Fruits from brinjal plants were picked at an interval of every two weeks. Based on the total number of injured fruits from each plot, the percentage of fruit damage was computed in both number as well as weight basis.

2.1 Statistical Analysis

The data obtained were subjected to appropriate transformation and analysed in OPSTAT statistical software.

3. RESULTS AND DISCUSSION

Prior to the initial spraying in the 2018–2019 growing season, the percent shoot damage ranged from 25.00 to 33.39% (Table 1). Chlorantraniliprole 18.5 SC recorded the lowest shoot infestation at 3 days following the initial spraying treatment, followed by Novaluron 5.25% + Emamectin Benzoate 0.9% SC, Flubendiamide 39.35 SC, and Bacillus thuringiensis var. *kurstaki*. These three therapies, however, were comparable to one another. The percent shoot damage at 7 DAS varied from 17.08 to 30.06%. Treatment with the least number of shoots were infested by Chlorantraniliprole (18.5 SC), Novaluron (5.25% + Emamectin Benzoate (0.9 SC), and Flubendiamide (39.35 SC). However, only Novaluron 5.25% + Emamectin Benzoate 0.9% SC and Chlorantraniliprole 18.5 SC were observed to be statistically superior to untreated control plots. The percentage of infested shoots ranged from 10.92 to 29.21 at 10 DAS. Treatment Flubendiamide 39.35 SC (11.06%), Novaluron 5.25% + Emamectin Benzoate 0.9% SC, and Chlorantraniliprole 18.5 SC (13.22%) showed the lowest shoot infestation rates (10.92%). All six treatments were found to be superior to the untreated control recorded (29.21%) at 10 days after the initial spraying. Prior to the second spraying in 2018–19, the range of the percent shoot damage was 12.53–30.55 (Table 1). The lowest shoot infestation was recorded at 3 days following the second spraying treatment with Chlorantraniliprole 18.5 SC (10.11%), closely followed by Novaluron 5.25% + Emamectin Benzoate 0.9% SC (10.95%). Again, Chlorantraniliprole 18.5 SC treatment had the lowest shoot infestation at 7 DAS (3.84%), followed by Novaluron 5.25% + Emamectin Benzoate 0.9% SC (5.27%), Flubendiamide 39.35 SC (7.46%), Spinosad

45 SC (8.57%), and *Bacillus thuringiensis* var. *kurstaki* (10.17%). However, only Novaluron 5.25% + Emamectin Benzoate 0.9% SC and Chlorantraniliprole 18.5 SC were found to be statistically superior to the untreated control. 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, with the exception of azadirachtin 50,000 ppm, were found to offer greater control over untreated plots (29.61%) at 10 days after the second spraying.

The % shoot damage before the first spraying in the 2019–2020 season ranged from 27.57 to 33.39 (Table 2). The percent shoot damage ranged from 20.33 to 36.05 percent at 3 days following the initial spraying. Treatment Following Flubendiamide 39.35 SC (21.17%), Novaluron 5.25% + Emamectin Benzoate 0.9% SC (24.29%), and *Bacillus thuringiensis* var. *Kurstaki* (25.59%), Chlorantraniliprole 18.5 SC recorded the lowest shoot infestation (20.33%). However, statistically speaking, the therapies were comparable. At 7 DAS, Flubendiamide 39.35 SC (16.67%) and Chlorantraniliprole 18.5 SC (15.51%) recorded the lowest shoot infestation rates. 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, which was closely followed by Flubendiamide 39.35 SC (12.92%). All six of the study's treatments were shown to offer superior control over untreated plots (39.54%) at 10 days after the initial spraying. Prior to the second spraying in 2019–20, the range of the percent shoot damage was 13.20–40.42 (Table 2). 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%). Only Flubendiamide 39.35 SC and Chlorantraniliprole 18.5 SC were shown to be statistically superior to the untreated control. Chlorantraniliprole 18.5 SC (6.05%) had the lowest shoot infestation at 10 days after spraying, followed by Flubendiamide 39.35 SC (7.44%). At 10 days after the second spraying, all six treatments in the study were shown to have greater control over untreated plots (43.11%). The findings are consistent with Misra [7], who claimed 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%. Emamectin benzoate, Novaluron, and Spinosad-treated plants displayed 0.56, 0.96, and 1.25 percent shoot damage, respectively, according to Anil and Sharma's [8] observations. Shirale et al. [9] tested the effectiveness of new generation insecticides against BFSB and found that the plots sprayed with Chlorantraniliprole 18.50% SC and Flubendamide 39.35% SC, respectively, had the least amount of fruit damage. According to Swini Reddy and Kumar [10], Flubendiamide, Emamectin benzoate, and Chlorantraniliprole had the lowest rates of shoot infestation. They also noted that Azadirachtin had the lowest effectiveness in suppressing BSFB, whereas Spinosad offered a moderate level of control. At first harvest in 2018–19, the percentage of fruits with infestation ranged from 12.41% to 35.84% (Table 3). All of the therapies outperformed the untreated control group, although there was no discernible difference between them. At second pickings, *Bacillus thuringiensis* var. *kurstaki* (21.60%) and Chlorantraniliprole 18.5SC (11.01%) produced the best results. Chlorantraniliprole 18.5SC, *Bacillus thuringiensis* var. *kurstaki*, and Novaluron 5.25% + Emamectin Benzoate 0.9% SC were the treatments that substantially differed from the untreated control group. The outcomes from Chlorantraniliprole 18.5 SC, however, were outstanding and far superior than those of all other treatments, including the untreated control. The third picking showed a similar pattern, with Chlorantraniliprole 18.5 SC recording the lowest mean percent fruit damage (11.21%), which was significantly better than all other treatments, including the untreated check. According to Yousafi et al. [11], the use of Spinosad, Flubendiamide, and Emamectin benzoate can be recommended for the treatment of BFSB. According to Vinayaka et al. [12], the most effective treatments were Emamectin benzoate 5% SG and Chlorantraniliprole 18.5% SC. 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. According to Saran et al. [13], Spinosad 45 SC at 200 ml/ha, Emamectin benzoate 5 SG at 200 gm/ha, and Chlorantraniliprole 20 SC at 150 ml/ha were found to be the most effective in lowering the incidence of shoot and fruit borer.

After the first picking in 2019–2020, the percentage of infested fruit on a number of fruit basis varied from 13.29 to 42.93 percent (Table 3). In comparison to the untreated check, all of the study's treatments effectively controlled the brinjal shoot and fruit borer, but there was no statistically significant difference between the treatments themselves. The lowest percentage of fruit infection was found in Chlorantraniliprole 18.5 SC-treated plots at second picking (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, when

Table 1. Bioefficacy of different biorationals and insecticides against shoot damage due to *L. orbonalis* in brinjal (First and second spraying-2018-2019)

Tr. No.	Treatments	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*	2 gm/liter	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/liter	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/liter	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/liter	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/liter	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-2019-2020)

Tr. No.	Treatments	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*	2 gm/liter	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/liter	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/liter	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/liter	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/liter	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/litre	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 (2018-2019 and 2019-2020)

Tr. No.	Treatments	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*	2 gm/liter	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/liter	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/liter	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/liter	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/liter	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/litre	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

Table 4. Bioefficacy of different biorationals and insecticides against fruit damage (weight basis) due to *L. orbonalis* in brinjal (2018-2019 and 2019-2020)

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	2 gm/liter	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/liter	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/liter	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/liter	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/liter	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/litre	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

Table 5. Yield of brinjal recorded in different biorational treatments in 2018-2019 and 2019-2020

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	-

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 2018–2019 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 seen, with Chlorantraniliprole 18.5 SC recording the lowest percent of fruit infestation based on fruit weight (13.98%), followed by Novaluron 5.25% + Emamectin Benzoate 0.9% SC (17.40%) and Flubendiamide 39.35 SC (17.77%). After first picking, the mean percent of fruit infection on a fruit weight basis ranged from 12.20 to 28.19% in the 2019–2020 academic year (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%). All of the investigated treatments outperformed untreated control plots in all three pickings. As a result, it was clear from the findings of the percent fruit damage on a weight basis showed that the chemical pesticide Chlorantraniliprole 18.5 SC had the greatest outcomes. According to Mainali et al. [14], plots treated with Spinosad and Chlorantraniliprole had the lowest mean fruit infection rates. According to Kameshwaran and Kumar [15], Emamectin benzoate 25 WG at 11 g a.i./ha and Chlorantraniliprole 20 SC at 40 g a.i./ha caused the least amount of damage. In both years, the yield of brinjal fruits differed significantly between different treatments at each of the three picking times. In the years 2018–2019 and 2019–2020, it varied between 11.48 and 14.11 t/ha and 10.50 and 14.67 t/ha, respectively. The Chlorantraniliprole 18.5 SC 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. [14], 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 fruit yield of 34.39 percent and 29.77 percent over the untreated check, respectively. Additionally, Sarnabati and Ray [16] 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.

4. CONCLUSION

The field effectiveness of different biorationals and insecticides against the brinjal shoot and fruit borer (*Leucinodes orbonalis* Guenee) was studied, and it is pretty evident that all the treatments under consideration outperformed the untreated control. Over the course of the two trial years, the medication Chlorantraniliprole 18.5 SC had the lowest rate of fruit and shoot infection. The plots treated with chlorantraniliprole 18.5 SC produced the most marketable fruit in terms of yield. In our current trial, every treatment successfully managed the pest that was a worry for the untreated check. Flubendiamide 39.35 SC, Novaluron 5.25% + Emamectin Benzoate 0.9% SC, and *Bacillus thuringiensis* var kurstaki were the next-best treatments. Spinosad 45 SC was utilised as a treatment for fruit infection and shoot damage, and it was discovered to be only marginally effective against BFSB. The least efficient concentration was azadirachtin, 50,000 ppm. In light of this, it can be said that Chlorantraniliprole 18.5 SC can be very effectively included into future crop protection programmes against the brinjal shoot and fruit borer with alternative spraying with Flubendiamide 39.35 SC, Novaluron 5.25% + Emamectin Benzoate 0.9% SC, and *Bacillus thuringiensis* var kurstaki.

ETHICAL APPROVAL

As per international standard or university standard ethical approval has been collected and preserved by the authors.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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