Journal homepage:https://www.environcj.in/

Environment Conservation Journal

ISSN 0972-3099 (Print) 2278-5124 (Online)

Bioefficacy of different insecticides against pests and harvest time residues in Brinjal fruits

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ARTICLE INFO

Received : 04 October 2023
Revised : 31 December 2023
Accepted : 04 January 2024

Available online: 28 February 2024

Key Words:
Chlorantraniliprole
Fenpropathrin
Chemical control

ABSTRACT

An experiment was conducted to study the bioefficacy of six different insecticides (thiamethoxam 25 WG @ 0.01%, thiacloprid 21.7 SC @ 0.0032%, buprofezin 25EC @ 0.05%, spinosad 48 SC @ 0.017%, chlorantraniliprole 18.5 SC @ 0.007% and fenpropathrin 30 EC @ 0.01%) with a control (water spray) against sucking pests *viz*., shoot and fruit borers, jassids, whiteflies and aphids, and harvest time residues in brinjal (*Surti Ravaiya*) at the College Farm, North Asian University, and Navsari during summer-2020. Among the different insecticides evaluated, chlorantraniliprole and spinosad were the most effective, fenpropathrin and buprofezin were the least effective insecticides against shoot and fruit borers, respectively. Thiamethoxam and thiacloprid were the most effective agents. Fenpropathrin and buprofezin were the least effective against whiteflies, jassids and aphids. After two hours of spray, the initial deposition order of the experimental insecticides was buprofezin (10.382 mg/kg) > fenpropathrin (5.602 mg/kg) > chlorantraniliprole (5.097 mg/kg) > thiamethoxam (4.886 mg/kg) > spinosad (3.984 mg/kg) > thiacloprid (3.332 mg/kg), while after 4 days of spray, the residue status of the brinjal fruit was in the order of fenpropathrin (0.539 mg/kg) > chlorantraniliprole (0.154 mg/kg) > thiacloprid (0.127 mg/kg) > thiamethoxam (0.099 mg/kg) > buprofezin (0.076 mg/kg) > spinosad (BDL). Overall, the highest percentage degradation of insecticide residues in brinjal fruits was registered with spinosad (100%), followed by buprofezin (99.26%), thiamethoxam (97.97%), chlorantraniliprole (96.97%), thiacloprid (96.18%) and fenpropathrin (90.37%) after 4 days of II spray.

Introduction

Brinjal (*Solanum melongena* L.) is known as the "king of vegetables" and originated in India. Globally, Brinjal is cultivated in China, Turkey, Syria, Egypt, Indonesia, the Philippines, Thailand, France, Taiwan, Italy and the USA. It is the third most important vegetable crop grown throughout the year in all parts of India and contributes 17.8% of the total production of vegetables in the country. In India, brinjal, a major vegetable crop, was cultivated on approximately 7.27 lakh hectares, with an annual production of 123.23 lakh tones during 2016-17 (Anonymous, 2017). In India, the major brinjal growing states are Andhra Pradesh, Karnataka, West Bengal, Tamil Nadu, Maharashtra, Orissa, Uttar Pradesh, Bihar, Rajasthan and Gujarat. In Gujarat, it is cultivated on 0.65 lakh hectares, with an annual production of 11.44 lakh tonnes and a productivity of 17.37 tonnes per hectare (Anonymous, 2013). The plant species Brinjal suffers severely from attack by various insect pests, which reduces fruit yield and quality. In India, the crop is damaged by more than 26 insect pests, which were obtained from the nursery stage. Specifically, shoot and fruit borers (*Leucinodes orbonalis* G.), jassids (*Amrasca*

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Doi:https://doi.org/10.36953/ECJ.25612724

biguttula biguttula I.), whiteflies (*Bemisia tabaci* G.) and aphids (*Aphis gossypii* G.) are the major and important insect pests (Kumar *et al.,* 2017). Chemical insecticides are used as frontline defense sources against insect pests in India. However, their indiscriminate and continuous use has created a number of problems (Narenderan *et al*., 2020). Hence, new insecticides available on the market need to be evaluated for their efficacy against sucking pests of brinjal. Keeping this in mind, the present investigation was conducted at College Farm, Navsari Agricultural University, Navsari, during summer 2020 to evaluate the effectiveness of different insecticides against sucking pests of brinjal and to quantify harvest time residues in brinjal fruits.

Material and Methods

The Brinjal (var. *Surti Ravaiya*) crop was transplanted during the third week of February (17-02-2020) and raised by adopting recommended agronomical practices at College Farm, N. M. College of Agriculture, NAU, Navsari. Six different insecticides (thiamethoxam 25 WG @ 0.01%, thiacloprid 21.7 SC @ 0.0032%, buprofezin 25EC @ 0.05%, spinosad 48 SC @ 0.017%, chlorantraniliprole 18.5 SC @ 0.007%, and fenpropathrin 30 EC @ 0.01%) were evaluated in combination with the control. The experiment was laid out in a randomized block design with four replications. Insecticides were applied via foliar spray with the help of a knapsack sprayer (15 liters). The first spray of insecticides was given when the maximum population of insect pests was found (25-4-2020), and the second spray was given 15 days after the first spray. The observations were recorded prior to one day before spray as well as 1, 3, 5, 7, 10 and 14 days after each spray. The incidence of shoot and fruit borers was recorded as the percentage of fruit damaged by *L. orbonalis*. The populations of whiteflies (adults), jassids (nymphs and adults) and aphids (nymphs and adults) were counted from three leaves, representing the top, middle and bottom portions of five randomly selected plants from each plot and each replication. The data thus obtained were converted into the number of whiteflies/jassids/aphids per leaf from each replicate of each treatment and were statistically analyzed after suitable transformation was employed. To quantify residues from brinjal fruits, marketable brinjal fruits (approximately 1 kg) were brought to the laboratory at 0 days, *i.e.*, before spray II (control); after 1 day (2 hrs. after II spray) and 4 days after II spray (at first picking after II spray) from each plot and each replication. Insecticide residues were extracted using a modified QuEChERS extraction method and quantified (Sante, 2017) via previously standardized LC–MS/MS and GC–MS/MS through a validation procedure according to the SANTE guidelines. The residues of thiamethoxam, thiacloprid, spinosad, chlorantra niliprole and fenpropathrin were quantified through previously standardized LC–MS/MS, while the residue of buprofezin was quantified via GC–MS/MS.

Results and Discussion

Shoot and fruit borer

The application of insecticides significantly reduced the damage caused by *L. orbonalis* at all sampling times (Table 1). The pooled data for all the pickings indicated that chlorantraniliprole (0.007%) significantly decreased fruit damage (5.61%), which was similar to that of spinosad (0.017%) (7.44%). However, 0.017% spinosad was found to be at par with 0.01% fenpropathrin (8.93%), and again, it was found at par with 0.05% buprofezin (9.48%). Thiamethoxam 25 WG @ 0.01% and thiacloprid 21.7 SC @ 0.0032% were less effective. The maximum fruit damage infestation (21.12%) was recorded in the untreated control. These findings closely align with the findings of Niranjana *et al.* (2017), Choudhary *et al.* (2018), and Narayan *et al.* (2019), who demonstrated the superiority of chlorantraniliprole over alternative pesticides for mitigating fruit borer infestations (*L. orbonalis*).

Sucking pests (Whitefly)

The application of insecticides also significantly reduced the mean number of whiteflies per leaf at all sampling times except before I spray (Table 2). The pooled data for sprays (except before spray I and II) revealed that thiamethoxam (0.007%) was significantly more effective (1.48 whiteflies/leaf) than the other treatments. The next most effective treatment was 0.0032% thiacloprid (2.01 whiteflies/leaf), which was on par with 0.05% buprofezin (2.43 whiteflies/leaf). The treatments *viz*. In addition, 0.01% fenpropathrin (2.61 whiteflies/leaf), 0.0017% spinosad (2.85 whiteflies/leaf

Table 1: Effect of different insecticidal treatments on the percentage of fruit damage in Brinjal

Treatments	Percent damaged fruits/plot at each picking												Pooled Mean
	1	2	3	4	5	6	7	8	9	10	11	12	
Thiamethoxam 25 WG (0.01%)	25.70 (18.81)	23.20 (15.57)	23.02 (15.58)	22.50 (14.80)	21.75 (13.75)	20.82 (12.64)	20.26 (12.10)	19.52 (11.19)	19.34 (10.99)	18.10 (9.73)	17.94 (9.51)	17.97 (9.53)	20.85 (12.83)
Thiacloprid 21.7 SC (0.0032%)	23.45 (15.87)	23.15 (15.56)	22.76 (15.04)	21.94 (14.00)	20.65 (12.52)	20.51 (12.36)	19.62 (11.38)	18.76 (10.55)	18.44 (10.03)	18.04 (9.67)	17.50 (9.15)	17.95 (9.20)	20.21 (12.11)
Buprofezin 25 EC (0.05%)	22.03 (14.07)	21.52 (13.47)	18.56 (10.14)	18.73 (10.37)	18.68 (10.28)	18.36 (10.11)	16.80 (8.38)	16.18 (7.78)	15.80 (7.51)	15.50 (7.91)	15.60 (7.24)	15.68 (7.34)	17.77 (9.48)
Spinosad 48 SC (0.017%)	19.55 (11.21)	18.25 (9.86)	17.03 (8.60)	14.66 (6.51)	16.81 (8.44)	16.26 (7.84)	15.20 (6.90)	14.22 (6.04)	13.67 (5.67)	13.09 (5.16)	13.54 (5.53)	13.78 (5.80)	15.66 (7.44)
Chlorantraniliprole18.5 SC (0.007%)	17.24 (8.79)	16.58 (8.23)	14.93 (6.71)	14.82 (6.55)	13.81 (5.71)	13.48 (5.48)	12.35 (4.60)	11.95 (4.37)	11.55 (4.10)	11.39 (3.92)	11.93 (4.36)	12.16 (4.48)	13.69 (5.61)
Fenpropathrin 30 EC (0.01%)	20.46 (12.25)	19.83 (11.52)	20.78 (12.65)	17.92 (9.54)	17.06 (8.71)	16.58 (8.21)	17.83 (9.45)	16.95 (8.53)	14.51 (6.34)	14.17 (6.01)	15.19 (6.89)	15.36 (7.05)	17.22 (8.93)
Control (Water spray)	26.11 (19.39)	26.43 (19.82)	26.68 (20.20)	27.00 (20.69)	27.25 (21.01)	27.63 (21.54)	27.73 (21.65)	27.69 (21.62)	27.65 (21.55)	27.82 (21.79)	27.96 (21.99)	28.08 (22.16)	27.34 (21.12)
SEm ±	0.56	0.65	0.87	0.91	0.85	0.95	0.91	0.87	0.79	0.78	0.77	0.58	0.93
CD (0.05)	1.67	1.92	2.60	2.71	2.52	2.83	2.73	2.58	2.33	2.34	2.27	1.73	2.59
CV (%)	5.08	6.06	8.52	9.29	8.74	9.96	9.80	9.69	9.09	9.32	8.95	6.74	9.03

***Figures in parenthesis are original values while outside are arc sine transformed values**
DAS - Days after spary

Table 2: Effect of different insecticidal treatments on whiteflies in Brinjal

Treatments	Average number of whiteflies/leaf														Pooled Mean
	I Spray							II Spray							
	Before spray	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	14 DAS	Before spray	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	14 DAS	
Thiamethoxam 25 WG (0.01%)	2.40 (5.82)	1.84 (3.38)	1.55 (2.42)	1.45 (2.10)	1.36 (1.87)	1.40 (1.97)	1.49 (2.22)	1.53 (2.35)	1.21 (1.47)	0.92 (0.85)	0.75 (0.57)	0.65 (0.43)	0.50 (0.25)	0.52 (0.29)	1.14 (1.48)
Thiacloprid 21.7 SC (0.0032%)	2.43 (5.93)	2.10 (4.40)	1.99 (3.98)	1.66 (2.75)	1.52 (2.33)	1.31 (1.72)	1.59 (2.53)	1.69 (2.87)	1.42 (2.02)	1.19 (1.42)	1.08 (1.17)	0.85 (0.74)	0.72 (0.52)	0.73 (0.55)	1.35 (2.01)
Buprofezin 25 EC (0.05%)	2.40 (5.82)	2.22 (4.93)	2.07 (4.28)	1.80 (3.27)	1.58 (2.48)	1.51 (2.28)	1.74 (3.03)	1.76 (3.12)	1.58 (2.50)	1.42 (2.02)	1.21 (1.47)	1.09 (1.20)	0.90 (0.82)	0.93 (0.87)	1.50 (2.43)
Spinosad 48 SC (0.017%)	2.36 (5.58)	2.31 (5.33)	2.19 (4.80)	1.95 (3.80)	1.60 (2.57)	1.69 (2.67)	1.79 (3.22)	1.82 (3.32)	1.78 (3.17)	1.54 (2.38)	1.41 (2.00)	1.29 (1.67)	1.09 (1.20)	1.11 (1.24)	1.64 (2.85)
Chlorantraniliprole18.5 SC (0.007%)	2.36 (5.57)	2.32 (5.35)	2.27 (5.15)	2.01 (4.07)	1.80 (3.27)	1.66 (2.77)	1.85 (3.43)	1.92 (3.72)	1.80 (3.23)	1.65 (2.72)	1.49 (2.22)	1.33 (1.78)	1.22 (1.50)	1.24 (1.53)	1.72 (3.08)
Fenpropathrin 30 EC (0.01%)	2.39 (5.72)	2.30 (5.28)	2.13 (4.57)	1.88 (3.53)	1.73 (3.00)	1.56 (2.45)	1.77 (3.15)	1.80 (3.23)	1.67 (2.80)	1.31 (1.73)	1.30 (1.70)	1.05 (1.12)	0.99 (0.98)	1.01 (1.03)	1.56 (2.61)
Control (Water spray)	2.40 (5.78)	2.43 (5.92)	2.45 (6.00)	2.47 (6.12)	2.50 (6.25)	2.52 (6.33)	2.54 (6.47)	2.55 (6.52)	2.56 (6.57)	2.58 (6.65)	2.59 (6.73)	2.61 (6.82)	2.63 (6.90)	2.64 (6.97)	2.54 (6.48)
SEm ±	0.08	0.06	0.06	0.05	0.06	0.04	0.05	0.07	0.04	0.06	0.05	0.06	0.04	0.05	0.06
CD (0.05)	NS	0.17	0.19	0.16	0.18	0.13	0.14	0.20	0.13	0.17	0.14	0.18	0.11	0.15	0.18
CV (%)	6.98	5.05	6.01	5.70	7.01	5.32	5.01	7.19	5.10	7.44	6.48	9.37	6.45	7.76	6.60

***The values in parentheses are the original values, while those outside the parentheses are the square root-transformed values. DAS- Days after spray**

and 0.007% chlorantraniliprole (3.08 whiteflies/leaf) were the least effective. The highest population of whiteflies (6.48 whiteflies/leaf) was observed in the control group. These findings are supported by workers who reported that thiamethoxam 25 WG had a greater efficacy than did buprofezin 25 EC in managing whitefly infestations in brinjal. According to studies conducted by Patil *et al*. (2016), Kumar *et al*. (2015), Kaur *et al*. (2015), and those involving thiamethoxam, thiacloprid, and buprofezin, the populations of sucking pests in brinjal and okra are reduced more effectively.

Jassid

Similarly, the application of insecticides significantly reduced the mean number of jassids per leaf in all the periodical observations except before I spray (Table 3). The pooled data for sprays (except before spray of I or II) revealed that thiamethoxam (0.01%) was significantly superior (1.71 jassids/leaf) to the other treatments; however, it was on par with thiacloprid (0.0032%) (2.01 jassids/leaf). The treatments, *viz.,* 0.05% buprofezin (2.73 jassids/leaf), were on par with 0.01% fenpropathrin (2.86 jassids/leaf). Spinosad (0.017%) (3.17 jassids/leaf) and chlorantraniliprole (0.007%) (3.39 jassids/leaf) were the least effective treatments. The highest population of jassids (7.06 whiteflies/leaf) was observed in the control group. The findings of Kaur *et al*. (2015) and Sangle *et al*. (2017) strongly support these findings.

Aphid

Similarly, spraying of insecticides also significantly reduced the mean number of aphids per leaf at all sampling times except before I spray (Table 4). The pooled data for sprays (except before spray I and II) revealed that thiamethoxam (0.01%) was significantly superior (0.60 aphids/leaf) to the other treatments; however, it was on par with thiacloprid (0.0032%) (0.78 aphids/leaf). Buprofezin (0.05%) (0.94 aphid/leaf) was found to be the next most effective treatment, which was on par with fenpropathrin (0.01%) (1.05 aphids/leaf) and spinosad (0.017%) (1.20 aphids/leaf). Chlorantraniliprole (0.007 percent; 1.32 aphids/leaf) was the least effective treatment. The highest population of aphids (3.31 aphids/leaf) was observed in the control group. The findings of Mokal *et al.* (2018) and Kumar and Kumar (2017) provide strong support for these results.

Harvest time of insecticide residues

No insecticide residues were detected before spraying on the brinjal fruit (Table 5). After two hours of spraying, the deposition order of the experimental insecticides was as follows: buprofezin 25 EC (10.382 mg/kg) > fenpropathrin 30 EC (5.602 mg/kg) > chlorantraniliprole 18.5 SC (5.097 mg/kg) > thiamethoxam 25 WG (4.886 mg/kg) > spinosad 48 SC (3.984 mg/kg) > thiacloprid 21.7 SG (3.332 mg/kg). After 4 days of II spray, the residue status of the brinjal fruit decreased in the order of fenpropathrin 30 EC (0.539 mg/kg) > chlorantraniliprole 18.5 SC (0.154 mg/kg) > thiacloprid 21.7 SG (0.127 mg/kg) > thiamethoxam 25 WG (0.099 mg/kg) > buprofezin 25 EC (0.076 mg/kg) > spinosad 48 SC (BDL). After 4 days of II spray, the highest percentage reduction in deposited insecticide residues in brinjal fruits was registered with spinosad 48 SC (100%), followed by buprofezin 25 EC (99.26%), thiamethoxam 25 WG (97.97%), chlorantraniliprole 18.5 SC (96.97%), thiacloprid 21.7 SG (96.18%) and fenpropathrin 30 EC (90.37%). The outcomes closely align with the research conducted by Hafez and Singh (2016), Chauhan *et al*. (2013), Shahoo *et al.* (2013), and Ramadan *et al.* (2016).

Conclusion

Among the six insecticides tested for their efficacy against sucking pests that infest Brinjal, the best insecticide for preventing fruit damage was chlorantraniliprole 18.5 SC, followed by spinosad 48 SC and fenpropathrin 30 EC. In contrast, buprofezin 25 EC, thiamethoxam 25 WG, and thiacloprid 21.7 SG were found to be relatively less effective. In regard to controlling the infestation of sucking pests, thiamethoxam 25 WG was found to be the most effective pesticide, followed by thiacloprid 21.7 and buprofezin 25 EC. In contrast, spinosad 48 SC, chlorantraniliprole 18.5 SC, and fenpropathrin 30 EC were found to be somewhat less successful. After four days of II spraying, spinosad 48 SC (100%) decomposed the most deposited pesticide residues in Brinjal fruits, followed by buprofezin 25 EC (99.26%), thiamethoxam 25 WG (97.97%), chlorantraniliprole 18.5 SC (96.97%), thiacloprid 21.7 SG (96.18%) and fenpropathrin 30 EC (90.37%).

Conflict of interest

The authors declare that they have no conflicts of interest.

Table 3: Effect of different insecticidal treatments on jassids in brinjal

Treatments	Average number of jassids/leaf														Pooled Mean
	I Spray							II Spray							
	Before spray	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	14 DAS	Before spray	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	14 DAS	
Thiamethoxam 25 WG (0.01%)	2.46 (6.07)	2.14 (4.57)	1.92 (3.68)	1.59 (2.53)	1.58 (2.53)	1.11 (1.25)	1.27 (1.63)	1.35 (1.84)	1.18 (1.40)	0.95 (0.92)	0.77 (0.61)	0.77 (0.60)	0.61 (0.38)	0.63 (0.41)	1.21 (1.71)
Thiacloprid 21.7 SC (0.0032%)	2.52 (6.38)	2.21 (4.90)	2.08 (4.32)	1.81 (3.30)	1.39 (1.99)	1.39 (1.95)	1.45 (2.13)	1.55 (2.42)	1.39 (1.95)	1.19 (1.42)	0.94 (0.89)	0.61 (0.38)	0.63 (0.41)	0.66 (0.44)	1.31 (2.01)
Buprofezin 25 EC (0.05%)	2.44 (5.98)	2.33 (5.43)	2.19 (4.80)	2.01 (4.03)	1.88 (3.55)	1.62 (2.63)	1.76 (3.12)	1.84 (3.38)	1.66 (2.77)	1.40 (1.97)	1.15 (1.33)	1.11 (1.23)	0.96 (0.93)	0.98 (0.97)	1.59 (2.73)
Spinosad 48 SC (0.017%)	2.40 (5.78)	2.40 (5.78)	2.29 (5.23)	2.23 (4.98)	2.02 (4.10)	1.80 (3.25)	1.97 (3.92)	1.99 (3.98)	1.74 (3.05)	1.53 (2.37)	1.30 (1.70)	1.16 (1.35)	1.06 (1.15)	1.08 (1.18)	1.72 (3.17)
Chlorantraniliprole18.5 SC (0.007%)	2.40 (5.77)	2.45 (6.02)	2.37 (5.63)	2.26 (5.12)	2.13 (4.55)	1.87 (3.52)	2.01 (4.07)	2.05 (4.20)	1.81 (3.28)	1.58 (2.52)	1.35 (1.85)	1.23 (1.52)	1.12 (1.27)	1.14 (1.30)	1.78 (3.39)
Fenpropathrin 30 EC (0.01%)	2.43 (5.90)	2.37 (5.62)	2.25 (5.07)	2.13 (4.53)	1.75 (3.08)	1.73 (3.02)	1.91 (3.65)	1.91 (3.67)	1.70 (2.92)	1.49 (2.22)	1.25 (1.58)	0.99 (1.00)	0.88 (0.78)	0.89 (0.80)	1.61 (2.86)
Control (Water spray)	2.52 (6.37)	2.54 (6.43)	2.55 (6.52)	2.58 (6.67)	2.59 (6.73)	2.62 (6.87)	2.65 (7.00)	2.67 (7.15)	2.69 (7.22)	2.70 (7.28)	2.71 (7.35)	2.73 (7.47)	2.75 (7.55)	2.77 (7.67)	2.66 (7.06)
SEm ±	0.07	0.07	0.08	0.06	0.08	0.07	0.06	0.07	0.06	0.06	0.06	0.06	0.05	0.05	0.07
CD (0.05)	NS	0.21	0.23	0.17	0.25	0.21	0.18	0.21	0.19	0.17	0.17	0.16	0.16	0.15	0.20
CV (%)	5.87	6.04	6.79	5.17	8.77	8.20	6.45	7.00	7.20	7.43	8.28	9.04	9.43	8.48	7.30

*** The values in parentheses are the original values, while those outside are the square root-transformed values**
DAS – Days after spray

Table 4: Effect of different insecticidal treatments on aphids in brinjal

Treatments	Average number of aphids/leaf														Pooled Mean
	I Spray							II Spray							
	Before spray	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	14 DAS	Before spray	1 DAS	3 DAS	5 DAS	7 DAS	10 DAS	14 DAS	
Thiamethoxam 25 WG (0.01%)	1.65 (2.72)	1.33 (1.77)	1.12 (1.27)	0.94 (0.88)	0.87 (0.77)	0.62 (0.38)	0.76 (0.58)	1.03 (1.07)	0.72 (0.52)	0.58 (0.33)	0.46 (0.22)	0.48 (0.24)	0.28 (0.08)	0.33 (0.12)	0.71 (0.60)
Thiacloprid 21.7 SC (0.0032%)	1.64 (2.70)	1.45 (2.10)	1.24 (1.55)	1.11 (1.23)	0.75 (0.57)	0.82 (0.67)	0.96 (0.92)	0.90 (0.82)	0.89 (0.80)	0.72 (0.52)	0.60 (0.37)	0.37 (0.15)	0.48 (0.23)	0.49 (0.24)	0.82 (0.78)
Buprofezin 25 EC (0.05%)	1.62 (2.63)	1.53 (2.35)	1.35 (1.83)	1.21 (1.47)	0.99 (0.98)	0.98 (0.97)	0.97 (0.94)	1.01 (1.03)	0.90 (0.82)	0.79 (0.63)	0.74 (0.55)	0.56 (0.32)	0.44 (0.20)	0.50 (0.25)	0.91 (0.94)
Spinosad 48 SC (0.017%)	1.63 (2.67)	1.57 (2.47)	1.43 (2.05)	1.31 (1.72)	1.22 (1.50)	1.09 (1.20)	1.19 (1.42)	1.26 (1.58)	1.13 (1.28)	0.91 (0.83)	0.77 (0.60)	0.73 (0.53)	0.64 (0.42)	0.66 (0.44)	1.05 (1.20)
Chlorantraniliprole18.5 SC (0.007%)	1.66 (2.75)	1.60 (2.58)	1.47 (2.18)	1.39 (1.93)	1.27 (1.62)	1.15 (1.32)	1.24 (1.55)	1.29 (1.67)	1.15 (1.32)	0.97 (0.95)	0.82 (0.68)	0.78 (0.62)	0.71 (0.50)	0.73 (0.54)	1.11 (1.32)
Fenpropathrin 30 EC (0.01%)	1.64 (2.70)	1.54 (2.40)	1.40 (1.97)	1.26 (1.60)	1.14 (1.32)	0.83 (0.70)	1.09 (1.20)	1.14 (1.32)	0.99 (0.98)	0.86 (0.75)	0.67 (0.45)	0.68 (0.47)	0.59 (0.35)	0.61 (0.38)	0.97 (1.05)
Control (Water spray)	1.63 (2.67)	1.65 (2.75)	1.69 (2.87)	1.71 (2.92)	1.75 (3.07)	1.77 (3.15)	1.80 (3.23)	1.82 (3.32)	1.85 (3.44)	1.87 (3.52)	1.89 (3.58)	1.90 (3.62)	1.94 (3.77)	1.96 (3.85)	1.82 (3.31)
SEm ±	0.05	0.06	0.05	0.04	0.04	0.04	0.04	0.05	0.04	0.04	0.03	0.04	0.03	0.03	0.05
CD (0.05)	NS	0.16	0.15	0.13	0.13	0.11	0.12	0.14	0.11	0.10	0.09	0.11	0.09	0.10	0.14
CV (%)	6.8	7.22	7.06	6.68	7.51	7.19	6.59	7.76	6.69	7.36	7.05	9.76	7.95	8.99	8.03

***The values in parentheses are the original values, while those outside are the square root-transformed values.**
DAS- Days after spray

Table 5: Status of sprayed insecticide residues in brinjal fruits at harvest

Insecticides	Residues (mg/kg)			Percent reduction after harvest over 0 day (control)
	Control	1 day (After 2 hrs. of spray)	After harvest (4 days of after second spray)	
Thiamethoxam 25 WG 0.01% (4.0 g/10 L water)	ND	4.886	0.099	97.97
Thiacloprid 21.7 SC 0.032% (15.0 ml/10 L water)	ND	3.332	0.127	96.18
Buprofezin 25 EC 0.05% (20.0 ml/10 L water)	ND	10.382	0.076	99.26
Spinosad 48 SC 0.017% (4.0 ml/10 L water)	ND	3.984	BDL	100.00
Chlorantraniliprole 18.5 SC 0.007% (4.0 ml/10 L water)	ND	5.097	0.154	96.97
Fenpropathrin 30 EC 0.01% (3.0 ml/10 L water)	ND	5.602	0.539	90.37
Control (Water spray)	ND	ND	ND	-

***BDL – Below detectable level**
ND – Not detected

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