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Performance of Selected Novel Insecticides againt Okra Jassid, *Amrasca biguttula* (Hemiptera: Jassidae) and Their Impact on Crop Productivity

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ABSTRACT

Background: Okra (*Abelmoschus esculentus*) is a nutrient-rich vegetable widely grown in Bangladesh, supporting rural and low-income diets. Its production, however, is severely affected by the okra jassid, *Amrasca biguttula* Ishida (Homoptera: Jassidae).

Methods: A field trial was conducted in RCBD to evaluate the efficacy of four novel insecticides on BARI Dherosh-2. Treatments included T_1= Buprofezin 40% SC @ 0.4 ml L^{-1}, T_2= Spinosad 2.5% SC @ 0.4 ml L^{-1}, T_3= Lufenuron 5% EC @ 0.5 ml L^{-1}, T_4= Spinetoram 11.7% SC @ 0.3 ml L^{-1} and an untreated control.

Result: Spinetoram consistently recorded the lowest jassid populations (2.68, 3.06 and 3.07/3 leaves/plant) after the 1st, 2nd and 3rd sprays, at 10-day intervals while the control had the highest (7.90, 9.68 and 11.40/3 leaves/plant). Corresponding reductions over control were 66.07%, 68.39% and 73.07%. Spinetoram (T_4) also produced the highest cumulative yield (3.96 kg/plot) with a 97.93% increase over control and the greatest benefit-cost ratio (2.76). Therefore, Spinetoram 11.7% SC @ 0.3 ml L^{-1} is an effective and promising option for managing okra jassid and enhancing okra production.

Key words: BCR, Management, Newer insecticides, Okra jassid, Yield.

INTRODUCTION

Okra (*Abelmoschus esculentus* L., Malvaceae) is an important summer vegetable cultivated in tropical and subtropical regions worldwide Kumar and Kumar, 2017). It is one of the most popular vegetables in Bangladesh and is widely grown across the country. The crop is mainly cultivated during the *kharif* season when temperature, humidity and rainfall are favorable for growth (Reddy *et al.*, 2017). Okra plays a vital role in supplying vegetables to markets, particularly when other vegetables are scarce (Rahman *et al.*, 2017). The pods are rich in proteins, carbohydrates, vitamins (A, B and C) and essential minerals such as potassium, calcium, magnesium and iron (Gemede *et al.*, 2015; Bagwale *et al.*, 2016). Fruit is also rich source of antioxidant (Chandrasekaran *et al.*, 2024). In Bangladesh, about 99,079 metric tons are produced from 12,654 hectares with an average yield of 7.83 t ha^{-1}, which is lower than the 15-20 t ha^{-1} reported in more productive countries (BBS, 2024; Massrie, 2025). Insect pests significantly limit okra productivity in Bangladesh.

Among various insect pests, the okra jassid, *Amrasca biguttula* Ishida (Homoptera: Jassidae), is a major threat to okra production (Singh *et al.*, 2013). Both nymphs and adults feed on the underside of leaves by sucking plant sap, causing upward curling and crinkling, which are typical symptoms of infestation (Bhutto *et al.*, 2017). The pest also injects toxins into plant tissues, reducing photosynthetic activity and sometimes transmitting viral diseases. Severe infestation leads to “hopper burn,” characterized by leaf browning, crumbling, broken margins and stunted plant growth. Yield losses may reach 54-66% at the vegetative stage and up to 60-70% if left uncontrolled (Singh *et al.*, 2013). Farmers often rely on chemical insecticides for rapid control; however, excessive use can cause pest resistance, resurgence, ecological imbalance and environmental hazards (Ambethar, 2009; Konlan *et al.*, 2016; Lengai *et al.*, 2019; Mweke *et al.*, 2020). Bio-rational pesticides such as Spinetoram, Lufenuron, Spinosad and Buprofezin offer eco-friendly alternatives; however, their field efficacy against okra jassid in Bangladesh is scanty and requires further evaluation.

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MATERIALAS AND METHODS

The experiment was conducted from March to August 2024 at the research field of the Department of Entomology, Hajee Mohammad Danesh Science and Technology University,

Dinajpur (25°41′N, 88°39′E; 37.35 m above sea level). The site lies in AEZ-1 (Old Himalayan Piedmont Plain) with sandy loam soil and acidic pH (5.2). The study evaluated four bio-rational pesticides against okra jassid.

Crop culture

The land was ploughed with a power tiller and exposed to sunlight for one week to reduce soil-borne pests and pathogens. Subsequent ploughing, cross-ploughing and laddering were performed to obtain a fine tilth. The field was cleaned of weeds and residues and properly leveled to ensure uniform drainage and moisture distribution. The experiment was arranged in a randomized complete block design (RCBD) with three replications, comprising 15 plots per block. Each plot measured 2.0 m × 1.4 m, with adequate spacing maintained between plots. Well-decomposed cow dung was incorporated during final land preparation. Fertilizers were applied at recommended rates of 150 kg ha^{-1} urea, 120 kg ha^{-1} triple superphosphate (TSP), 100 kg ha^{-1} murate of potash (MoP) and 250 kg ha^{-1} mustard cake (FRG, 2018). Cow dung, mustard cake, TSP and MOP were applied as basal doses, while urea was top-dressed in two equal splits at 20 and 40 days after sowing. Seeds of the okra variety BARI Dherosh-2 were soaked in water for 24 hours before sowing and planted at a spacing of 35 cm × 35 cm. Regular intercultural operations, irrigation and manual weeding were performed to maintain healthy crop growth.

Treatments

Two insect growth regulators, buprofezin (0.4 ml L^{-1}) and lufenuron (0.5 ml L^{-1}) and two biopesticides, spinosad (0.4 ml L^{-1}) and spinetoram (0.3 ml L^{-1}), were evaluated against okra shoot and fruit borer along with an untreated control. Three sprays were applied using a knapsack sprayer, while control plots received only water. Foliar treatments were applied at 20 days after sowing and repeated at 10-day intervals. Jassid populations were recorded from upper, middle and lower leaves of randomly selected plants at 3, 7 and 10 days after spraying. Fruits were harvested at three-day intervals and the yield per plot was recorded. Pest reduction relative to the untreated control was also determined. The percentage increase or decrease over control was calculated to evaluate pest suppression efficiency compared with the untreated control using the following formulae:

$$\text{Reduction (\%) over control} = \frac{(C-T)}{C} \times 100$$

$$\text{Increase (\%) over control} = \frac{(T-C)}{T} \times 100$$

Where,
C = Represents pest population in the untreated control.
T = Pest population in the treated plots.

The weight of harvested fruits was recorded separately for each picking from every experimental plot. Fruits were weighed immediately after harvest using a digital balance to minimize moisture loss. The cumulative yield per plot was calculated by summing the weights from all picking events and yield per hectare was estimated using the following formula:

$$\text{Yield (kg/ha)} = \frac{\text{Yield kg plot}^{-1}}{\text{Plot area m}^2} \times 10000$$

Benefit cost ratio (BCR)

Marketable fruit yield was recorded from each experimental plot at three-day intervals throughout the harvesting period. The cumulative yield was used to estimate economic returns. Gross return was calculated by multiplying the total marketable yield by the prevailing local market price. Net income was determined by subtracting the total variable cost of cultivation from the gross return. The economic feasibility of the treatments was assessed using the benefit-cost ratio (BCR), as described by Begum *et al.* (2019):

$$\text{BCR} = \frac{\text{GR}}{\text{TVC}}$$

Where,
GR = Gross return.
TVC = Total variable cost.

Statistical analysis

Data were analyzed to determine the significance of treatment effects. ANOVA was performed using Statistix 10 and treatment means were compared using the LSD test at the 5% significance level.

RESULTS AND DISCUSION

Potency of four insecticides against okra jassids after first spray

The effects of four insecticides on the population of okra jassid after the first spray are presented in Table 1. All treatments significantly reduced jassid populations compared with the untreated control. The highest jassid population was recorded in the untreated control with 7.67, 7.77 and 8.27 individuals per plant at 3, 7 and 10 days after treatment (DAT), respectively (3 DAT: $p<0.01$, $F = 28.83$; 7 DAT: $p<0.01$, $F= 38.66$; 10 DAT: $p<0.01$, $F= 50.18$). In contrast, the lowest populations (3.13, 2.67 and 2.23 jassids per plant at 3, 7 and 10 DAT, respectively) were recorded in plots treated with spinetoram 11.7% SC @ 0.3 ml L^{-1}. This treatment resulted in the highest population reduced over the untreated control (66.07%), followed by spinosad 2.5% SC @ 0.4 ml L^{-1} (33.04%), whereas lufenuron 5% EC @ 0.5 ml L^{-1} showed the lowest reduction (8.86%). These findings indicate that spinetoram was the most effective treatment against jassid after the first spray. Similar results were reported by Khan *et al.* (2021), who observed significant reductions in jassid populations following spinetoram application. Mandi *et al.* (2020) and Navi *et al.* (2018) also reported superior efficacy of spinetoram-based treatments against leaf hopper infestations.

Potency of four insecticides against okra jassid after second spray

After the second spray (Table 2), insecticide treatments again showed significant effects on jassid populations (3 DAT: p<0.01, F= 36.85; 7 DAT: p<0.01, F= 62.25; 10 DAT: p<0.01, F= 130.19). The lowest jassid population was recorded in the spinetoram treatment with 3.73, 3.10 and 2.37 individuals per plant at 3, 7 and 10 DAT, respectively. In contrast, the untreated control recorded the highest populations (9.17, 9.70 and 10.17 jassids per plant). Spinetoram @ 0.3 ml L^{-1} provided the greatest reduction in jassid population (68.39%) followed by spinosad (49.59%). These results are consistent with Khan *et al.* (2021) and Nadeem *et al.* (2022), who also reported significant suppression of jassid populations after the second spray of spinetoram.

Potency of four insecticides against okra jassids after third spray and yield

The effectiveness of the tested insecticides after the third spray is presented in Table 3. All treatments significantly reduced jassid populations compared with the untreated control (3 DAT: p<0.01, F = 68.98; 7 DAT: p<0.01, F = 108.47; 10 DAT: p<0.01, F = 105.70). The untreated control recorded the highest jassid population, with 10.87, 11.30 and 12.03 jassids per plant at 3, 7 and 10 days after treatment (DAT), respectively. In contrast, plots treated with spinetoram 11.7% SC @ 0.3 ml L^{-1} showed the lowest jassid population (3.73, 2.97 and 2.53 jassids per plant at 3, 7 and 10 DAT, respectively), resulting in the highest population reduction (73.07%) over the control. Spinosad 2.5% SC @ 0.4 ml L^{-1} also demonstrated considerable effectiveness, reducing the jassid population by 60.00%, whereas lufenuron exhibited

Table 1: Field efficacy of four insecticides against okra jassid after first spray.

Treatments/dose		Number of jassids/3 leaves/plant				Decrease (%)
(ml L^{-1}) water		3 DAS	7 DAS	10 DAS	Pooled mean	on control
T_1	0.4	6.87a	6.47b	6.13b	6.49b	17.85
T_2	0.4	5.73b	5.10c	5.03c	5.29c	33.04
T_3	0.5	7.33a	7.03ab	7.23a	7.20ab	8.86
T_4	0.3	3.13c	2.67d	2.23d	2.68d	66.07
T_5	-	7.67a	7.77a	8.27a	7.90a	-
CV (%)	-	8.47	9.64	9.82	8.26	-

Means in a column with different letters differ significantly at the 0.05% probability level. DAS= Days after spray, T_1= Buprofezin, T_2= Spinosad, T_3= Lufenuron, T_4= Spinetoram and T_5= Untreated control.

Table 2: Field performance of four insecticides against okra jassid after second spray.

Treatments/dose		Number of jassids/3 leaves/plant				Decrease (%)
(ml L^{-1}) water		3 DAS	7 DAS	10 DAS	Pooled mean	over control
T_1	0.4	6.20c	5.67c	5.87c	5.91c	38.95
T_2	0.4	5.60c	4.36d	4.67d	4.88d	49.59
T_3	0.5	7.40b	6.83b	7.00b	7.07b	26.96
T_4	0.3	3.73d	3.10e	2.37e	3.06e	68.39
T_5	-	9.17a	9.70a	10.17a	9.68a	-
CV (%)	-	9.01	9.35	7.29	7.95	-

Means in a column with different letters differ significantly at the 0.05% probability level. DAS = Days after spray, T_1 = Buprofezin, T_2 = Spinosad, T_3 = Lufenuron, T_4 = Spinetoram and T_5 = Untreated control.

Table 3: Field performance of four insecticides against okra jassid after third spray and yield of okra.

Treatments/dose		Jassids/3 leaves/plant			Pooled	Decrease (%)	Cumulative	Increase (%)
(ml L^{-1}) water		3 DAS	7 DAS	10 DAS	mean	over control	yield (kg)	over control
T_1	0.4	5.27c	4.60c	5.03c	4.97c	56.40	1.69c	39.28
T_2	0.4	4.87c	4.37c	4.43c	4.57c	60.00	2.84b	68.99
T_3	0.5	7.03b	6.57b	6.80b	6.80b	40.35	1.77c	41.34
T_4	0.3	3.73d	2.97d	2.53d	3.07d	73.07	3.96a	97.93
T_5	-	10.87a	11.30a	12.03a	11.40a	-	0.67d	-
CV (%)	-	9.15	9.07	9.88	9.05	-	2.34	-

Means in a column with different letters differ significantly at the 0.05% probability level. DAS= Days after spray, T_1= Buprofezin, T_2= Spinosad, T_3= Lufenuron, T_4= Spinetoram and T_5= Untreated control.

Table 4: Field performance of four insecticides on the economic analysis and benefit cost ratio (BCR) of okra in jassid.

Treatments	Yield (Kg/ha)	Gross return (Tk/ha)	Cost of production (Tk/ha)			Net return (Tk/ha)	BCR
			Common cost	Treatment cost	Total		
T_1	6035.71	301785.5	250000	3760	253760	48025.5	1.19
T_2	10142.86	507143	250000	5400	255400	251743	1.98
T_3	6321.43	316071.5	250000	4900	254900	61171.5	1.24
T_4	14142.86	707143	250000	5940	255940	451203	2.76
T_5	2392.86	119643	250000	-	250000	-130357	0.48

T_1= Buprofezin, T_2= Spinosad, T_3= Lufenuron, T_4= Spinetoram and T_5= Untreated control, BCR= Benefit cost ratio.

comparatively lower efficacy (40.35%). Similar results were reported by Hanchinal *et al.* (2024) and Kamal *et al.* (2023), who also documented significant suppression of jassid populations following the application of spinetoram.

Significant differences among treatments were also observed in terms of marketable fruit yield. Among the evaluated treatments, spinetoram 11.7% SC @ 0.3 ml L^{-1} consistently produced the highest yield across all harvests. The cumulative yield was highest in the spinetoram-treated plots (3.96 kg $plot^{-1}$), whereas the untreated control recorded the lowest yield (0.67 kg $plot^{-1}$). Yield improvement over the control was also greatest with spinetoram (97.93%), followed by spinosad (68.99%) and buprofezin (39.28%). The increased yield in treated plots is likely associated with effective suppression of jassid populations, which reduced feeding damage, improved photosynthetic activity and promoted healthier plant growth. These findings are consistent with earlier studies. Visnupriya and Muthukrishnan (2017) reported that spinetoram-treated plots produced the highest okra yield (50.5 q h^{-1}). Similarly, Kulkarni and Kumar (2022) observed maximum yield (137.9 q ha^{-1}) following spinetoram application.

Evaluation of insecticides on benefit cost ratio (BCR)

The economic analysis of different treatments is presented in Table 4. Among the treatments, spinetoram 11.7% SC @ 0.3 ml L^{-1} recorded the highest benefit-cost ratio (BCR) of 2.76, indicating the greatest economic return. Spinosad 2.5% SC @ 0.4 ml L^{-1} ranked second with a BCR of 1.98, while the untreated control recorded the lowest BCR (0.48). These results demonstrate the economic advantage of insecticide application for jassid management in okra cultivation. Similar findings were reported by Mandi *et al.* (2020), who observed a BCR of 2.31 for spinetoram-based treatments. Hanchinal *et al.* (2024) also reported favorable economic returns with spinetoram application. The superior performance of spinetoram may be attributed to its unique mode of action targeting the insect nervous system, resulting in rapid pest suppression and improved crop productivity.

CONCLUSION

The superior performance of spinetoram may be attributed to its unique mode of action on the insect nervous system, targeting nicotinic acetylcholine and γ-aminobutyric acid (GABA) receptors, which leads to rapid excitation followed by paralysis and death of the insect. This mechanism enhances its effectiveness against sucking pests such as jassids. The results of the present study indicate that spinetoram 11.7% SC @ 0.3 ml L^{-1} effectively reduced jassid populations and significantly increased marketable fruit yield. Therefore, spinetoram can be considered a promising biorational option for sustainable management of okra jassid and improved crop productivity under field conditions.

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Disclaimer

The views expressed in this study are solely those of the authors and do not necessarily reflect the views of the affiliated institution or funding agency.

Informed consent

The Institutional Ethical Committee approved all experimental methods and authorized protocols.

Conflict of interest

The authors declare that they have no competing interests regarding the publication of this article. No funding or sponsorship influenced the study design, data collection, analysis, decision to publish, or preparation of the manuscript.

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