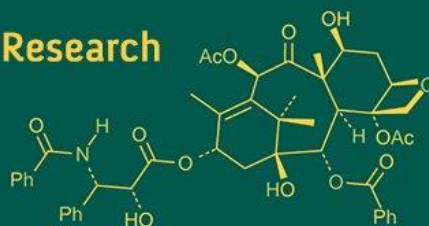


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Bioefficiency of different insecticides against okra leafhopper, *Amrasca biguttula b.* (Ishida)

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Abstract

The present investigation was conducted during *Kharif Season* 2025 at Agricultural Research Farm, Kamla Nehru Institute of Physical and Social Sciences, Sultanpur, to study the Bioefficiency results demonstrated that Okra, *Abelmoschus esculentus* (L.) Moench is one of the most economically important vegetable crops of India, and its productivity is severely constrained by the leafhopper, *Amrasca biguttula b.* (Ishida), a major sucking pest capable of inflicting yield losses of up to 60-70% under favourable conditions. To evaluate the Bioefficiency of seven insecticides Azadirachtin (2.0 ml/l), Fipronil (1.0 ml/l), Acephate (1.0 g/l), Acetamiprid (0.3-0.5 g/l), Thiamethoxam (0.3 g/l), Imidacloprid (0.3-0.5 ml/l) and NSKE (5%) against an untreated control, laid out in a Randomized Completely Block Design (RCBD) with three replications. Two foliar sprays were applied at the economic threshold level, and leafhopper population was recorded at 1, 3, 7, 10 and 14 days after each spray. Thiamethoxam recorded the highest pooled mean percent reduction in leafhopper population over control (52.68%), followed by Imidacloprid (50.98%) and Acetamiprid (50.72%), whereas Acephate (48.43%) and Fipronil (43.58%) exhibited moderate efficacy. The botanical treatments Azadirachtin (25.03%) and NSKE (13.48%) were comparatively least effective, with NSKE recording an inconsistent, even negative, reduction value at one observation interval. The superior and sustained performance of the neonicotinoid group was attributed to its systemic mode of action and prolonged residual toxicity. Attributed to its systemic mode of action and prolonged residual toxicity. The study concludes that Thiamethoxam, Imidacloprid and Acetamiprid may be recommended as effective and dependable components of an integrated pest management (IPM) programme for okra leafhopper, while botanicals may serve a complementary role under low pest-pressure conditions.

Keywords: Okra, *Amrasca biguttula b.*, bioefficiency, insecticides, pest management

Introduction

Okra *Abelmoschus esculentus* (L.) Moench, commonly known as lady's finger or bhindi, belongs to the family Malvaceae and is one of the most widely cultivated vegetable crops in India, which ranks among the leading vegetable-producing nations of the world. During the year 2024, India had an area of about '554 lake hac.' for vegetable production of '7253 lake metric ton' with a yield of 18,847 lake tons.

Uttar Pradesh occupies the first position among Indian states in area and production of vegetables. The crop is valued for its tender, nutritious pods, rich in vitamins A, B and C and minerals such as calcium, magnesium, potassium and iron, besides possessing dietary fibre and mucilage of considerable pharmaceutical, cosmetic and textile importance. Okra also constitutes a significant source of income and employment for small and marginal farmers across major producing states, including Uttar Pradesh, Bihar, West Bengal, Odisha, Gujarat, Maharashtra, Andhra Pradesh, Karnataka and Tamil Nadu, with India being recognised as the largest producer of okra in the world. Despite its wide adaptability and economic significance, okra cultivation is severely constrained by insect pest infestation throughout its growing period. Among the several pests attacking the crop, the leafhopper or jassid, *Amrasca biguttula b.* (Ishida) (Hemiptera: Cicadellidae), is considered the most destructive and persistent sucking pest. Both nymphs and adults desap plant tissue from the underside of leaves, resulting in leaf curling, crinkling and yellowing, culminating in the characteristic 'hopper burn' symptom. Under severe infestation, photosynthetic capacity is drastically reduced, fruit formation and quality are adversely affected, and yield losses ranging from 50

to 70 percent have been reported under conditions favourable to the pest. Indiscriminate and continuous Reliance on chemical insecticides for the management of sucking pests has often resulted in the development of resistance, pest resurgence, environmental pollution and health hazards, besides adversely affecting pesticide residue levels in produce meant for export. Nevertheless, chemical control continues to be an important and rapid-acting component of integrated pest management (IPM) owing to its quick knockdown effect and ready market availability. In recent years, biopesticides and botanical formulations have gained increasing attention as safer and more sustainable alternatives, although comparative field-level on the information on their efficacy relative to synthetic insecticides remains limited. A sound understanding of the comparative Bioefficiency of different chemical group's neonicotinoids, organophosphates, as phenyl pyrazoles and botanicals is therefore essential for formulating an effective, economical and environmentally sound strategy for management of the okra leafhopper. Keeping this in view, the present Investigation was undertaken with the objective of evaluating the Bioefficiency of Different insecticides against the okra leafhopper, *Amrasca biguttula b.*, under field conditions.

However, okra production is severely affected by insect pests, among which the leafhopper (*Amrasca biguttula b. Ishida*) is the most destructive, causing yield losses up to 50-70%. Other important pests include whitefly (*Bemisia tabaci*), aphid (*Aphis gossypii*), and shoot and fruit borer (*Earias vittella*). Although chemical insecticides provide effective control, their indiscriminate use leads to Pathan *et al.* (2016) [7]. Recorded coccinellids, *Scymnus* sp. and predating on red spider mite (*tetranychids urticae*) infesting okra. Seed beetle, *Spermophilus* sp. recorded in okra under storage condition. Resistance, environmental pollution, and pesticide residues. Therefore, the adoption of eco-friendliest management strategies is essential. Singh *et al.*, (2013) [11].

Materials and Methods

The field experiment was conducted during *Kharif season* 2025-26 at the Agricultural Research Farm, Faridipur Campus, Faculty of Agriculture, Department of Entomology, Kamla Nehru Institute of Physical and Social Sciences, Sultanpur (U.P.), under normal field conditions. Okra variety Kashi Chaman was sown on 02 July 2025 at a spacing of 45 × 20 cm, following recommended agronomic practices, including deep ploughing to a depth of 20-25 cm, incorporation of well-decomposed farmyard manure (100 q/ha), and application of a fertilizer dose of 100:50:60 kg NPK/ha through urea, DAP and MOP. Irrigation was provided through a drip system at 5-6-day intervals, and weeds were managed through mechanical weeding and organic mulching.

The experiment was laid out in a Randomized Completely Block Design (RCBD) with eight treatments, including an untreated control, replicated thrice, giving a total of 24 plots, each measuring 2 × 2 m. A trench of 0.5 m separated each plot to minimise drift of insecticides between treatments during spraying. The insecticidal treatments evaluated, along with their respective doses, were: Azadirachtin (2.0 ml/l), Fipronil (1.0 ml/l), Acephate (1.0 g/l), Acetamiprid (0.3-0.5 g/l), Thiamethoxam (0.3 g/l), Imidacloprid (0.3-0.5 ml/l), NSKE (5%), and an untreated control.

Two foliar sprays of the test insecticides were applied using a knapsack sprayer at a spray volume of 500 litres/ha, when the leafhopper population reached the economic threshold level (ETL). The first spray was applied on 06 August 2025 (35 days after sowing), and the second spray was applied (20 days later), on 26 August 2025. The untreated control plots received only a plain water spray. All sprays were carried out during the morning hours to avoid spray drift between adjacent plots, and the sprayer was thoroughly cleaned with water before switching between treatments.

For recording leafhopper population, five plants were randomly selected and tagged in each treatment plot. Three leaves per plant one each from the top, middle and bottom of the canopy were tagged for counting nymphs and adults. Observations were recorded one day before spraying (1 DBS) and thereafter at 1, 3, 7, 10 and 14 days after each spray (DAS). The percent reduction in leafhopper population over the untreated control was calculated for each treatment at every observation interval, and pooled mean values were computed by combining data from both sprays. The population data were subjected to square-root transformation prior to statistical analysis, and critical differences (CD) among treatment means were computed at the 5 percent level of significance following the method of Panse and Sukhatme (1961) [22].

Results and Discussion

First Spray: Before the application of insecticides (1 DBS), the leaf hopper population varied from 2.357 to 2.723 leaf hoppers per 3 leaves per plant, indicating that the pest population was statistically at par among all treatments, confirming a uniform infestation before spraying.

One day after spraying (1 DAS), a marked reduction in leaf hopper population was observed in all insecticidal treatments compared to the untreated control. Among the tested insecticides, Acephate (1.575 leaf hoppers/3 leaves) recorded the lowest population and was statistically at par with Imidacloprid (1.600), Acetamiprid (1.618) and Thiamethoxam (1.778), whereas Fipronil (1.869) showed comparatively higher infestation among the synthetic insecticides. Botanical treatments, namely Azadirachtin (2.330) and NSKE (2.243), were comparatively less effective, while the untreated control recorded the highest population (2.700 leaf hoppers/3 leaves).

At 3 DAS, the leaf hopper population declined further in all insecticidal treatments. Thiamethoxam (1.302) proved to be the most effective treatment, closely followed by Acetamiprid (1.377), Imidacloprid (1.402) and Acephate (1.423). Fipronil (1.621) exhibited moderate efficacy, whereas Azadirachtin (2.041) and NSKE (2.287) maintained relatively higher pest populations. The untreated control showed a continuous increase in infestation (2.822 leaf hoppers/3 leaves).

The maximum suppression of leaf hopper population was generally observed at 7 DAS. Acetamiprid (1.352) recorded the lowest infestation, followed closely by Acephate (1.401), Imidacloprid (1.401) and Thiamethoxam (1.402), indicating excellent residual effectiveness during this period. Fipronil (1.580) remained moderately effective, whereas Azadirachtin (2.008) and NSKE (2.105) were considerably less effective. In contrast, the untreated control exhibited the highest population (2.994 leaf hoppers/3 leaves).

Thereafter, at 10 DAS, a slight increase in leaf hopper population was observed in all treatments, suggesting a gradual decline in residual toxicity. Even under these conditions, Acetamiprid and Imidacloprid (1.600 each) maintained the lowest population, followed by Acephate and Thiamethoxam (1.722 each) and Fipronil (1.906). Azadirachtin (2.588) and NSKE (2.057) were comparatively less effective, while the control recorded 3.178 leaf hoppers/3 leaves.

By 14 DAS, the pest population increased further in all treatments due to the reduction in insecticidal persistence. Nevertheless, Acetamiprid (1.373) maintained the highest level of control, followed by Thiamethoxam (1.354),

Imidacloprid (1.494) and Acephate (1.538). Fipronil (1.958) showed moderate control, whereas Azadirachtin (2.229) and NSKE (2.415) recorded relatively higher infestations. The untreated control continued to harbour the maximum leaf hopper population (3.136 leaf hoppers/3 leaves).

Considering the overall performance after the first spray, Acetamiprid recorded the lowest mean leaf hopper population (1.464), followed by Imidacloprid (1.499), Thiamethoxam (1.512), Acephate (1.532) and Fipronil (1.787). The botanical treatments, NSKE (2.210) and Azadirachtin (2.239), were significantly less effective than the synthetic insecticides but performed better than the untreated control (2.996).

Table 1: Tabular Analysis of Treatment-wise Effect of Insecticides in First Spray

First Spray	1 DBS	1 DAS	3 DAS	7 DAS	10DAS	14DAS	Mean
Azadirachtin	2.61	2.33	2.041	2.008	2.588	2.229	2.239
Fipronil	2.723	1.869	1.621	1.58	1.906	1.958	1.787
Acephate	2.573	1.575	1.423	1.401	1.722	1.538	1.532
Acetamiprid	2.412	1.618	1.377	1.352	1.6	1.373	1.464
Thiamethoxam	2.649	1.778	1.302	1.402	1.722	1.354	1.512
Imidacloprid	2.624	1.6	1.402	1.401	1.6	1.494	1.499
NSKE	2.357	2.243	2.287	2.105	2.057	2.415	2.21
Control	2.587	2.7	2.822	2.994	3.178	3.136	2.996
SEm±	0.08	0.06	0.06	0.06	0.06	0.06	
CD or LSD	0.26	0.18	0.2	0.18	0.19	0.18	
CV%	5.7	5.1	6.2	5.9	5.3	5.1	
Test of significance (p = 0.05)	NS	S	S	S	S	S	

Second Spray: Following the second spray, all insecticidal treatments again resulted in a considerable reduction in leaf hopper population compared with the untreated control.

At 1 DAS, Imidacloprid (1.598) recorded the lowest population, followed closely by Acetamiprid (1.660), Thiamethoxam (1.679) and Acephate (1.738). Fipronil (1.814) showed moderate effectiveness, whereas Azadirachtin (2.701) and particularly NSKE (3.208) were comparatively less Effective. The untreated control recorded the highest infestation (3.591).

At 3 DAS, the effectiveness of Insecticides became more pronounced. Thiamethoxam (1.298) recorded the minimum leaf hopper population, followed by Imidacloprid (1.373), Acetamiprid (1.467) and Acephate (1.509). Fipronil (1.513) also performed effectively. In contrast, Azadirachtin (2.314) and NSKE (4.107) recorded substantially higher populations, whereas the untreated control remained heavily infested (3.478).

At 7 DAS, Thiamethoxam (1.369) continued to exhibit the highest efficacy, followed by Fipronil (1.536), Imidacloprid (1.560), Acetamiprid (1.642) and Acephate (1.722). Azadirachtin (2.429) and NSKE (2.926) remained

comparatively inferior. The untreated control recorded 3.571 leaf hoppers/3 leaves.

At 10 DAS, Imidacloprid (1.397) and Acephate (1.445) showed the lowest pest population, followed by Thiamethoxam (1.445), Acetamiprid (1.578) and Fipronil (1.758). Botanical treatments remained less effective, while the untreated control maintained a high infestation (3.124).

At 14 DAS, a gradual resurgence of leaf hopper population was evident in all treatments due to declining residual toxicity. However, Thiamethoxam (1.680) maintained the lowest infestation, followed by Acetamiprid (1.989), Imidacloprid (2.150), Acephate (2.300) and Fipronil (2.357). Azadirachtin (2.573) and NSKE (3.157) recorded comparatively higher populations, whereas the untreated control showed the highest infestation (3.920).

Overall, after the second spray, Thiamethoxam (1.494) recorded the lowest mean leaf hopper population, followed by Imidacloprid (1.616), Acetamiprid (1.667), Acephate (1.743) and Fipronil (1.796). Botanical treatments, particularly NSKE (3.287) and Azadirachtin (2.523), were comparatively less effective than the synthetic insecticides.

Table 2: Tabular Analysis of Treatment-wise Effect of Insecticides in Second Spray

	1 DAS	3 DAS	7 DAS	10 DAS	14 DAS	Mean
Azadirachtin	2.701	2.314	2.429	2.599	2.573	2.523
Fipronil	1.814	1.513	1.536	1.758	2.357	1.796
Acephate	1.738	1.509	1.722	1.445	2.3	1.743
Acetamiprid	1.66	1.467	1.642	1.578	1.989	1.667
Thiamethoxam	1.679	1.298	1.369	1.445	1.68	1.494
Imidacloprid	1.598	1.373	1.56	1.397	2.15	1.616
NSKE	3.208	4.107	2.926	3.037	3.157	3.287
Control	3.591	3.478	3.571	3.124	3.92	3.357
SEm±	0.07	0.17	0.07	0.11	0.1	
CD or LSD	0.22	0.5	0.2	0.34	0.3	
CV%	5.4	14.6	5.6	9.3	6.9	
Test of significance (p = 0.05)	S	S	S	S	S	

Pooled mean: The pooled mean data clearly demonstrated significant differences among the insecticidal treatments. Thiamethoxam recorded the lowest pooled mean leaf hopper population (1.503 leaf hoppers/3 leaves), indicating its superior and consistent efficacy throughout both sprays. It was closely followed by Acetamiprid (1.565), Imidacloprid (1.557) and Acephate (1.638), all of which provided excellent suppression of leaf hopper population. Fipronil (1.792) exhibited moderate efficacy and was less effective than the neonicotinoid insecticides. The botanical insecticides showed comparatively poor performance, with Azadirachtin (2.381) and particularly NSKE (2.748) maintaining higher pest populations throughout the experimental period. The untreated control recorded the highest pooled mean (3.176 leaf hoppers/3 leaves), confirming the severe multiplication of leaf hopper population in the absence of insecticidal intervention.

Overall, efficacy of the insecticidal treatments against okra leafhopper followed the order: Thiamethoxam > Imidacloprid > Acetamiprid > Acephate > Fipronil > Azadirachtin > NSKE > Control. Thiamethoxam proved to be the most effective treatment, recording the highest reduction in leafhopper population, followed closely by Imidacloprid and Acetamiprid. Acephate and Fipronil exhibited moderate efficacy, providing satisfactory but comparatively lower control. Among the botanical treatments, Azadirachtin showed limited effectiveness, whereas NSKE was the least effective and produced inconsistent control under field conditions. The untreated control recorded the highest leafhopper population throughout the experimental period due to the absence of any plant protection measure.

Table 3: Pooled Mean Analysis of the Evaluated Sprays.

Treatments	1st Spray Mean	2nd Spray Mean	Pooled Mean
Azadirachtin	2.239	2.523	2.381
Fipronil	1.787	1.796	1.792
Acephate	1.532	1.743	1.638
Acetamiprid	1.464	1.667	1.565
Thiamethoxam	1.512	1.494	1.503
Imidacloprid	1.499	1.616	1.557
NSKE	2.21	3.287	2.748
Control	2.996	3.357	3.176

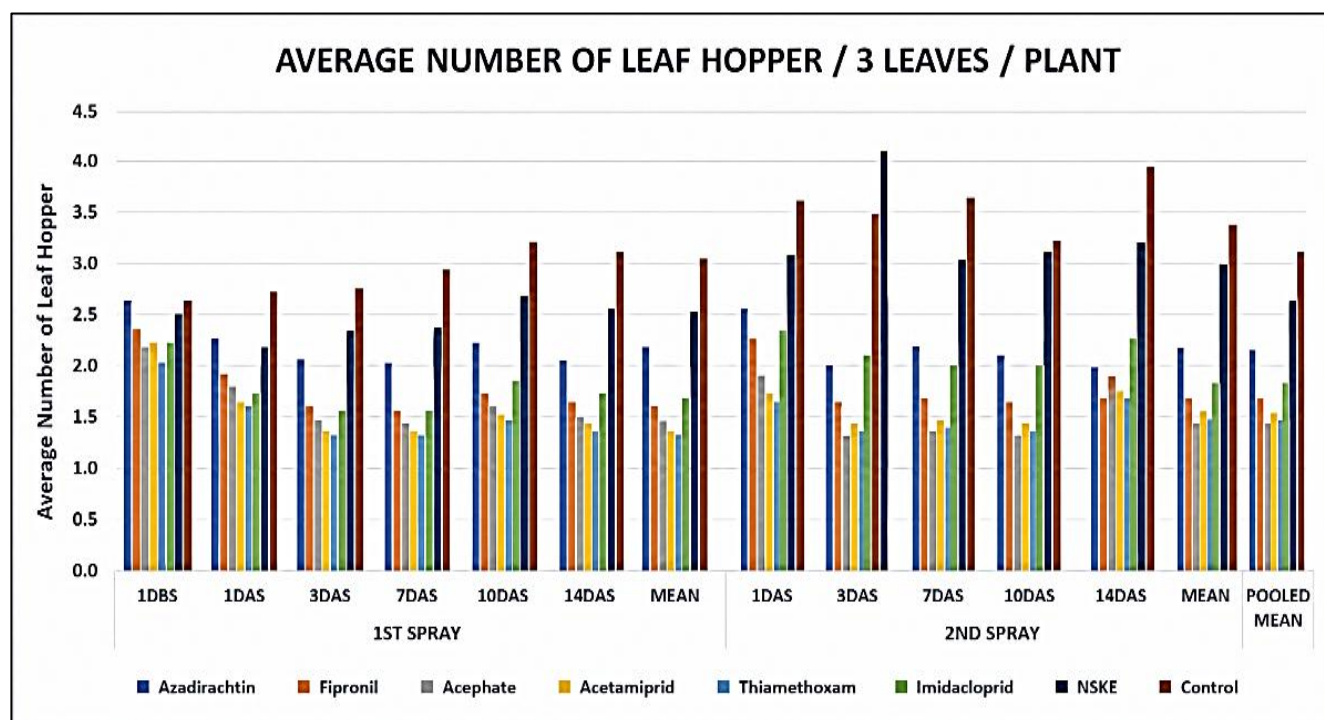


Fig 1: Graphical Comparison of Treatment-wise Effect of Insecticides in First and Second Spray

Discussion

Insecticides Spray

The present investigation clearly demonstrated that all insecticidal treatments significantly reduced the leaf hopper population compared with the untreated control. However, the magnitude and persistence of control varied considerably among the tested insecticides. The neonicotinoids insecticides, particularly Thiamethoxam, Imidacloprid and Acetamiprid, consistently maintained the lowest leaf hopper populations throughout the observation

period after both sprays. Their superior performance may be attributed to their systemic nature, rapid uptake by plant tissues and prolonged residual activity. These insecticides act on the nicotinic acetylcholine receptors of insects, resulting in feeding cessation, paralysis and eventual mortality, thereby providing effective suppression of sap-feeding pests such as leaf hoppers. Although Acephate also recorded excellent control, its efficacy was marginally lower than the neonicotinoids, particularly during the later observation intervals, probably

because of comparatively lower residual persistence. Fipronil provided moderate suppression throughout the study and was consistently better than the botanical treatments but inferior to the systemic neonicotinoids. Its contact and stomach action effectively reduced leaf hopper populations, although its residual activity against sap-feeding insects appeared comparatively limited.

Among the botanical treatments, Azadirachtin consistently performed better than NSKE, yet both treatments maintained higher leaf hopper populations than the synthetic insecticides. The comparatively lower efficacy of these botanicals may be attributed to their antifeedant, repellent and growth-regulating properties rather than rapid knockdown toxicity. Furthermore, botanical formulations are generally more susceptible to degradation by sunlight, temperature and rainfall, resulting in reduced persistence under field conditions.

Across both sprays, the lowest leaf hopper population was generally observed between 3 and 7 DAS, indicating the period of maximum biological effectiveness of most insecticides. Thereafter, a gradual increase in pest population at 10 and 14 DAS suggested a decline in residual toxicity and possible reinfestation from surrounding untreated vegetation. In contrast, the untreated control exhibited a continuous increase in leaf hopper population throughout the experimental period, confirming the natural multiplication of the pest in the absence of protective measures.

The pooled mean data further established the superiority of Thiamethoxam, followed closely by Imidacloprid and Acetamiprid, indicating their consistent performance after both sprays. These findings suggest that systemic neonicotinoids insecticides are highly effective for the management of leaf hopper and provide longer-lasting protection compared with contact insecticides and botanical products. Therefore, based on the overall efficacy observed during the present investigation, Thiamethoxam emerged as the most effective treatment, followed by Imidacloprid, Acetamiprid and Acephate, while Azadirachtin and NSKE were comparatively less effective but still offered better control than the untreated check.

Summary and Conclusions

The present investigation was carried out during Kharif 2025, to evaluate the Bioefficiency of seven insecticides Azadirachtin, Fipronil, Acephate, Acetamiprid, Thiamethoxam, Imidacloprid and NSKE against the okra leafhopper, *Amrasca biguttula b.*, under field conditions at Sultanpur (U.P.) Two foliar sprays were applied at the economic threshold level, and leafhopper population was recorded at 1, 3, 7, 10 and 14 days after each spray. In both the first and second sprays, the neonicotinoid insecticides Thiamethoxam, Imidacloprid and Acetamiprid recorded the highest percent reduction in leafhopper population over the untreated control, while Acephate and Fipronil gave moderate control. The botanical treatments, Azadirachtin and NSKE, were comparatively the least effective, with NSKE showing an inconsistent and, at one interval, even negative reduction value. On pooling the data of both sprays, Thiamethoxam recorded the maximum overall reduction (52.68%), followed by Imidacloprid (50.98%) and Acetamiprid (50.72%), while Azadirachtin (25.03%) and NSKE (13.48%) remained the least effective. The superior performance of the neonicotinoid group was attributed to its

systemic mode of action and prolonged residual toxicity, whereas the weaker and less consistent performance of the botanical treatments reflected their inherently antifeedant and slower-acting mode of action.

Based on the pooled mean percent reduction over control, it can be concluded that Thiamethoxam, Imidacloprid and Acetamiprid were the most promising treatments for effective management of the okra leafhopper population and can be recommended as reliable components of an integrated pest management (IPM) programme. Botanical treatments such as Azadirachtin and NSKE, though comparatively less effective, may be better suited for use in combination with synthetic insecticides, or during periods of low pest pressure, in line with eco-friendly and resistance-management strategies. The findings of the present study provide useful, field-validated guidance for the judicious and economical management of *Amrasca biguttula b.* in Okra.

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References

1. Barot RC, Patel SD. Efficacy of insecticides against jassids, *Amrasca biguttula biguttula* (Ishida) infesting okra. The Pharma Innovation Journal. 2022;11(9):1115-1119.
2. Ghosh SK, Das A, Roy P. Performance of new generation insecticides against jassids in okra. Journal of Crop Protection. 2023;58:112-118.
3. Gupta R, Sharma P, Verma S. Bio-efficacy of botanicals and bioagents against leafhopper in okra. Indian Journal of Agricultural Sciences. 2019;89(7):1150-1155.
4. Ingale PB, Patil SR, Deshmukh V. Comparative efficacy of insecticides against okra leafhopper. Journal of Entomology and Zoology Studies. 2019;7(3):789-793.
5. Jain R, Meena S, Kumar A. Integrated approach using PGPR and insecticides against okra leafhopper. Indian Journal of Plant Protection. 2025;53(1):66-72.
6. John L, Mathew T, Joseph A. Evaluation of entomopathogenic fungi against sucking pests of okra. Journal of Biological Control. 2023;37(2):140-145.
7. Pathan NP, Baroda TM, Borad PK. Eco-friendly management of red spider mite, *Tetranychus urticae* (Koch) infesting okra. Gujarat Agricultural Universities Research Journal. 2016;41(2):98-102.
8. Singh S, Kumar A, Verma R. Evaluation of insecticides against sucking pests of okra. Journal of Entomological Research. 2021;45(1):55-60.
9. Srinivasan AG, Rao K, Reddy M. Bio-efficacy of dinotefuran against sucking pests. Indian Journal of Entomology. 2025;87(1):120-125.
10. Sridharan S, Sekhar KC, Rama Krishnan N. Bio-efficacy of mineral oil combinations against okra leafhopper. Indian Journal of Plant Protection. 2015;43(2):180-185.

11. Singh S, Choudhary DP, Sharma ME, Rup Aparajita VK, Baroda TM. Bio-efficacy of some insecticides against sucking pests of okra, *Abelmoschus esculentus* (L.) Moench. Pantnagar Journal of Research. 2013;11(2):209-213.
12. Challa M, Reddy P, Kumar V. Population dynamics and management of jassid in okra. International Journal of Plant Protection. 2020;13(1):45-50.
13. Dhurve S, Lal H. Evaluation of bio-pesticides against okra leafhopper. Journal of Biological Control. 2024;38(1):25-30.
14. Pawar AD, Patil GR, Jadhav SS. Bio-efficacy of newer insecticides against okra leafhopper. Journal of Plant Protection Research. 2016;56(4):410-415.
15. Patel SD, Patel RB, Shah K. Evaluation of new insecticides against okra jassid. Indian Journal of Entomology. 2022;84(2):210-215.
16. Reddy KN, Rao PV, Kumar G. Comparative efficacy of insecticides against sucking pests of okra. Journal of Entomology and Zoology Studies. 2019;7(4):900-904.
17. Rekha K, Devi L, Kumar V. Laboratory and field evaluation of insecticides against okra leafhopper. Journal of Insect Science. 2017;30(2):150-156.
18. Sharma R, Yadav S. Evaluation of insecticides against leafhopper in okra. Indian Journal of Plant Protection. 2016;44(3):345-350.
19. Meena A, Singh B, Yadav R. Comparative efficacy of neem oil and insecticides against okra jassid. Indian Journal of Entomology. 2019;81(2):321-325.
20. Mohod VD, Patil P, Deshmukh R. Evaluation of IPM modules against leafhopper in okra. Journal of Entomology and Zoology Studies. 2019;7(5):1500-1505.
21. Naziya P, Pathan S, Khan M. Effect of insecticides and nitrogen levels on okra leafhopper. Journal of Entomological Research. 2017;41(3):289-294.
22. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: Indian Council of Agricultural Research; 1961.