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Bio-efficacy of biorational insecticides against major sucking insect-pests of okra (*Abelmoschus esculentus* L. Moench).

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Abstract
The experiment was conducted during March month of the year 2025 at research-cum-Instructional farm of Raj Mohini Devi College Agriculture and Research Station, Ajirma, Ambikapur, District, Surguja (C.G.).The bio-efficacy of birational insecticides against Leafhopper, aphid and whitefly of okra revealed that the six treatments including *Azadirachtin* (0.03% EC), Pongamia oil (1.0%), *Metarhizium anisopliae* (5ml/L), *Lecanicillium lecanii* (5ml/L), *Beauveria bassiana* (5ml/L) and a chemical standard Imidacloprid 17.8% SL, along with an untreated control, were evaluated results indicated that Imidacloprid showed the highest efficacy against sucking insect-pests. Among the biorational insecticides, *Azadirachtin* recorded the lowest population of aphid, leafhopper and whitefly as well as highest fruit yield (49.22 q/ha), followed closely by Pongamia oil, with both being statistically at par. Among microbial biopesticides, *Lecanicillium lecanii* emerged as the most effective in suppressing pest.

Keywords: Aphid, *Azadirachtin*, Biorational insecticides, *Beauveria bassiana*, Okra, Leafhopper, Whitefly, *Pongamia* oil, *Lecanicillium lecanii*, *Metarhizium anisopliae* and Imidacloprid.

Introduction
Okra (*Abelmoschus esculentus* L. Moench), commonly known as bhindi or lady's finger due to the shape of its pods, is an important vegetable crop cultivated widely in tropical and subtropical regions of the world. In India, okra is extensively grown during the Kharif and summer seasons In India, okra is cultivated throughout the country with major share in the states of Andhra Pradesh, West Bengal, Bihar, Gujarat, Odisha, Jharkhand, Maharashtra, Madhya Pradesh, Chhattisgarh, Assam, Uttar Pradesh and Haryana occupying an area of 532.66 thousand hectares with annual production of 6513 thousand metric tonnes. In Maharashtra, it is grown in an area of 8.91 thousand hectares with an annual production to the tune of139.28 thousand tonnes (Anonymous, 2021) [6]. The major insect pests are shoot and fruit borer, *Earias insulata* (Boisd.), *Earias vittella* (Boisd.); leaf hopper, *Amrasca biguttula biguttula* (Ishida); leaf roller, *Sylepta derogata* Fab; whitefly, *Bemisia tabaci* (Genn.); Aphid, *Aphis gossypii* Glov. and mite, *Tetranychus cinnabarinus* (Boisd.) Sucking pests such as whitefly, leaf hopper and aphid are major threat to the production of okra. leaf hopper (*Amarasca biguttula bigutula*) is one of the most serious pests of okra. It sucks the sap from underside of leaves and causes upward curling along the margin ultimately reducing the yield

In order to prevent infestation of the insect pests and to produce a quality crop, it is essential to manage the pest population at appropriate time with suitable control measures. The use of insecticides have undoubtedly resulted in the maximum production of food grain for the world food supply, but the proliferation of insecticides and their unilateral utilization have created many problems such as development of resistance in insect pests to insecticides, resurgence of insect pests, outbreak of secondary insect pests, insecticidal residues etc. Development of insecticide resistance in insect pests is now one of the major problems in pest management. It causes unexpected crop losses to the growers. Biopesticides have tremendous potential to replace or reduce synthetic pesticide usage and cost incurred in them. In general, biopesticides for plant disease and pest management includes organisms and product derived from them, biocontrol formulations, essential oils, botanical extracts and nano biopesticides. Biopesticides require regulatory guidelines and approval system as in case of synthetic pesticides with necessary modifications. The development of IPM modules may be considered to solve the problem of insect resistance. In the present scenario of climate change, the insect pest situation is also being changed with the variation in abiotic factors. The study was undertaken to find out the correlation of insect pest populations and their natural enemies with the weather parameters to know the favorable conditions for insect development. The insect natural enemies have received much less attention as natural control agents.

Materials and Methods

The experiment was conducted during summer 2025 at research-cum-Instructional farm of Raj Mohini Devi College Agriculture and Research Station, Ajirma, Ambikapur, District, Surguja (C.G.). The observations of leafhopper, aphids, and whiteflies were recorded on a per-plot basis. For each observation, five plants were randomly selected from each plot, and three leaves (one each from the bottom, middle, and top) of each plant were examined visually to assess pest infestation levels. Data on pest populations were recorded at specified intervals — one day prior to each insecticidal spray (as a pre-count), and subsequently at 3, 7, and 14 days after each spray (as post-counts).

Table 1: Details of treatment

Sr. No.	Common name and Formulations	Doses (g or ml/l)
1.	*Metarhizium anisopliae*(10^{10}CFU/ml)	5.0
2.	*Lecanicillium lecanii* (10^{10}CFU/ml)	5.0
3.	*Beauveria bassiana* (10^{8}CFU/ml)	5.0
4.	*Azadirachtin* (0.03% EC)	5.0
5.	Pongamia oil 1.0%	10.0
6.	Imidacloprid 17.8% SL	0.30
7.	Untreated control	-

Results and Discussion

Efficacy of biorational insecticides against leafhopper

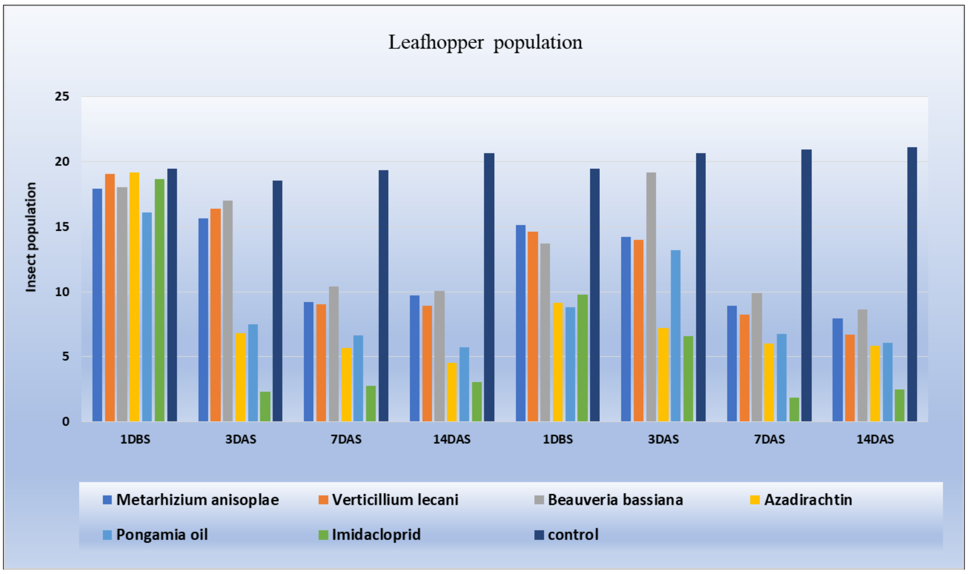
The leafhopper population before the first spray (Table 2) ranged from 16.08 to 19.45 leafhoppers per plant, with no significant differences among treatments. At 3 DAS, imidacloprid recorded the lowest population (2.33 leafhoppers/plant), followed by azadirachtin (6.83 leafhoppers/plant) and pongamia oil (7.50 leafhoppers/plant), which were statistically at par. Metarhizium anisopliae (15.63 leafhoppers/plant), *Lecanicillium lecanii* (16.05 leafhoppers/plant), and *Beauveria bassiana* (16.37 leafhoppers/plant) followed, while the control recorded 18.57 leafhoppers/plant. At 7 DAS, imidacloprid remained superior (2.77 leafhoppers/plant), followed by azadirachtin (5.66 leafhoppers/plant) and pongamia oil (6.63 leafhoppers/plant). At 14 DAS, imidacloprid recorded 3.03 leafhoppers/plant, followed by azadirachtin (4.53 leafhoppers/plant), pongamia oil (5.70 leafhoppers/plant), *L. lecanii* (8.90 leafhoppers/plant), *M. anisopliae* (9.70 leafhoppers/plant), and *B. bassiana* (10.07 leafhoppers/plant), whereas the control recorded 20.66 leafhoppers/plant. The overall mean after the first spray was lowest in imidacloprid (2.71 leafhoppers/plant) compared to the control (19.52 leafhoppers/plant), followed by azadirachtin (5.67 leafhoppers/plant), pongamia oil (6.61 leafhoppers/plant), *M. anisopliae* (11.49 leafhoppers/plant), *L. lecanii* (11.45 leafhoppers/plant), and *B. bassiana* (12.49 leafhoppers/plant). Before the second spray, leafhopper populations ranged from 8.81 to 19.45 leafhoppers/plant with non-significant differences. At 3 DAS, imidacloprid recorded the lowest population (6.59 leafhoppers/plant), followed by azadirachtin (7.23 leafhoppers/plant) and pongamia oil (13.18 leafhoppers/plant). At 7 DAS, imidacloprid remained superior (1.83 leafhoppers/plant), followed by azadirachtin (6.01 leafhoppers/plant) and pongamia oil (6.73 leafhoppers/plant). At 14 DAS, imidacloprid recorded the minimum population (2.50 leafhoppers/plant), followed by azadirachtin (5.83 leafhoppers/plant) and pongamia oil (6.07 leafhoppers/plant), while the control recorded 21.12 leafhoppers/plant. The overall mean after the second spray was lowest in imidacloprid (2.61 leafhoppers/plant), followed by azadirachtin (5.75 leafhoppers/plant), pongamia oil (6.34 leafhoppers/plant), *M. anisopliae* (9.71 leafhoppers/plant), *L. lecanii* (9.10 leafhoppers/plant), and *B. bassiana* (10.56 leafhoppers/plant), compared to 20.23 leafhoppers/plant in the untreated control.

Overall, all treatments were significantly superior to the untreated control in reducing leafhopper populations. Imidacloprid was consistently the most effective treatment, while among the biopesticides, azadirachtin and pongamia oil were the most effective, followed by *Metarhizium anisopliae*, *Lecanicillium lecanii*, and *Beauveria bassiana*.

The effectiveness of imidacloprid against leafhopper and also effectiveness of *Metarhizium anisopliae* in case of biopesticides was reported earlier by Wawdhane *et al.* (2020) [36] which is in conformity with the present findings. Effectiveness of imidacloprid against leaf hoppers was earlier proved by Anand *et al.* (2013) [5] and Pawar *et al.* (2016) [28] which are in corroboration with present investigations. Similarly, Alam *et al.* (2018) [10] and Sarkar *et al.* (2016) [31] reported efficacy of pongamia oil against leaf hoppers which are in collaboration with present findings.

Table 2: Bio-efficacy of biorational insecticides against leafhoppers (*Amrasca biguttula biguttula*) in okra during summer-2025.

Treatments	Leafhopper population/plant 1st spray				Mean	Leafhopper population/plant 2nd spray				Mean	Overall mean of 1st and 2nd spray
	1DBS	3DAS	7DAS	14DAS		1DBS	3DAS	7DAS	14DAS		
T1 - *Metarhizium anisopliae*	17.93	15.63	9.03	9.70	11.45	15.15	14.20	8.89	7.97	10.35	9.71
(10^{10}CFU/ml)	(4.29)	(4.02)	(3.09)	(3.19)	(3.46)	(3.96)	(3.83)	(3.06)	(2.91)	(3.29)	(3.20)
T2 - *Lecanicillium lecanii*	19.07	16.37	9.20	8.90	11.49	14.6	14.01	8.23	6.70	9.64	9.10
(10^{10}CFU/ml)	(4.35)	(4.11)	(3.11)	(3.07)	(3.40)	(3.89)	(3.81)	(2.95)	(2.68)	(3.18)	(3.10)
T3 - *Beauveria bassiana*	18.03	17.01	10.40	10.07	12.49	13.7	19.18	9.90	8.63	12.57	10.56
(10^{8}CFU/ml)	(4.27)	(4.18)	(3.30)	(3.25)	(3.60)	(3.77)	(4.44)	(3.22)	(3.02)	(3.38)	(3.33)
T4 - *Azadirachtin*	19.18	6.83	5.66	4.53	5.67	9.16	7.23	6.01	5.83	6.35	5.75
(0.03% EC)	(4.44)	(2.71)	(2.48)	(2.24)	(2.48)	(3.11)	(2.78)	(2.55)	(2.52)	(2.58)	(2.50)
T5 - Pongamia oil 1.0%	16.08	7.50	6.63	5.70	6.61	8.81	13.18	6.73	6.07	8.66	6.34
	(4.07)	(2.83)	(2.67)	(2.49)	(2.67)	(3.05)	(3.70)	(2.69)	(2.56)	(3.03)	(2.62)
T6 - Imidacloprid 17.8% SL	18.67	2.33	2.77	3.03	2.71	9.79	6.59	1.83	2.5	3.64	2.61
	(4.35)	(1.78)	(1.53)	(1. 79)	(1. 73)	(3.21)	(2.66)	(1.53)	(1.73)	(2.03)	(1.76)
T7 - Untreated control	19.45	18.57	19.32	20.66	19.52	19.45	20.66	20.95	21.12	20.91	20.23
	(4.54)	(4.48)	(4.81)	(4.62)	(4.45)	(4.47)	(4.62)	(4.63)	(4.65)	(4.63)	(4.56)
Sem (±)	0.69	1.04	0.64	0.88		2.37	1.24	0.71	0.74		
CD (p = 0.05)	NS	3.22	1.98	2.73		NS	3.80	2.21	2.28		



Graph 1: Bio-efficacy of biorational insecticides against leafhoppers (*Amrasca biguttula biguttula*) in okra during summer-2025

Efficacy of biorational insecticides against aphids

Aphid populations before the first spray (Table 3) ranged from 8.22 to 11.22 aphids per 5 plants, with no significant differences among treatments. At 3 DAS, imidacloprid recorded the lowest aphid population (2.19 aphids/plant), followed by azadirachtin (6.89 aphids/plant) and pongamia oil (7.04 aphids/plant), which were statistically at par. Lecanicillium lecanii (15.29 aphids/plant), *Metarhizium anisopliae* (16.30 aphids/plant), and *Beauveria bassiana* (16.70 aphids/plant) followed, while the control recorded 18.57 aphids/plant. At 7 DAS, imidacloprid (3.03 aphids/plant) remained superior, followed by azadirachtin (8.10 aphids/plant) and pongamia oil (9.11 aphids/plant). At 14 DAS, imidacloprid recorded the minimum population (3.47 aphids/plant), followed by azadirachtin (6.20 aphids/plant) and pongamia oil (6.53 aphids/plant), whereas the control recorded 19.50 aphids/plant. The overall mean after the first spray was lowest in imidacloprid (2.90 aphids/plant) compared to the control (18.80 aphids/plant), followed by azadirachtin (7.06 aphids/plant), pongamia oil (7.56 aphids/plant), *L. lecanii* (11.22 aphids/plant), *M. anisopliae* (12.13 aphids/plant), and *B. bassiana* (12.35 aphids/plant).

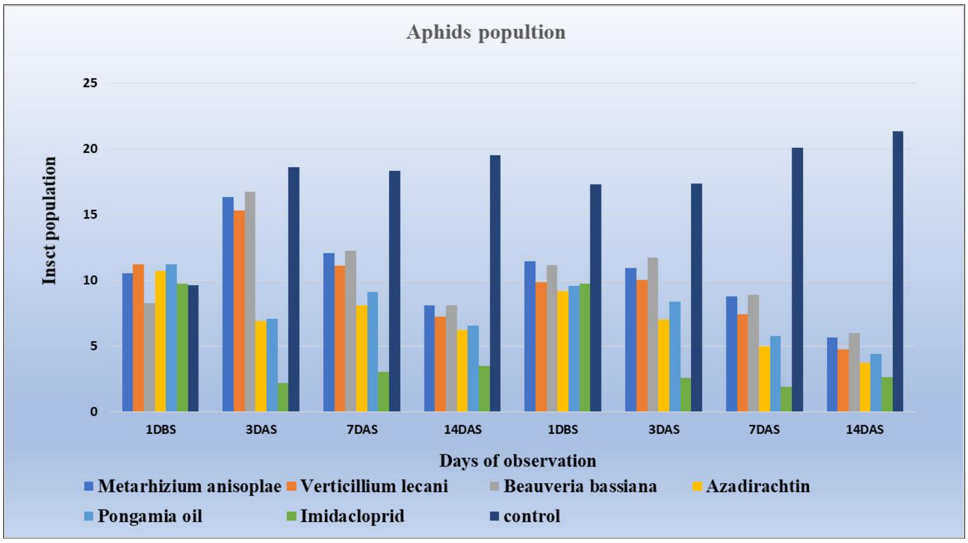
Before the second spray, aphid populations ranged from 7.93 to 17.31 aphids/plant with non-significant differences. At 3 DAS, imidacloprid recorded the lowest population (2.57 aphids/plant), followed by azadirachtin (7.01 aphids/plant) and pongamia oil (8.37 aphids/plant). At 7 DAS, imidacloprid (1.86 aphids/plant) was superior, followed by azadirachtin (4.95 aphids/plant) and pongamia oil (5.70 aphids/plant). At 14 DAS, imidacloprid recorded 2.60 aphids/plant, followed by azadirachtin (3.70 aphids/plant) and pongamia oil (4.37 aphids/plant), while the control recorded 20.66 aphids/plant. The overall mean after the second spray was lowest in imidacloprid (2.34 aphids/plant), followed by azadirachtin (6.17 aphids/plant), pongamia oil (6.17 aphids/plant), *L. lecanii* (7.38 aphids/plant), *M. anisopliae* (8.44 aphids/plant), and *B. bassiana* (8.83 aphids/plant).

The pooled mean of both sprays showed aphid populations ranging from 2.62 to 19.20 aphids/plant, with imidacloprid recording the lowest population (2.62 aphids/plant), followed by azadirachtin (6.17 aphids/plant), pongamia oil (6.84 aphids/plant), *L. lecanii* (9.30 aphids/plant), *M. anisopliae* (10.29 aphids/plant), and *B. bassiana* (10.59 aphids/plant). According to studies by Wawdhane *et al.* (2020) [36] which is in conformity with the present findings. Similar results in respect of effectiveness of this insecticide against aphids was documented earlier by Gaikwad *et al.* (2020). Result in respect of effectiveness of biopesticides *L. lecanii* for aphids documented by Naik and Shekharappa (2009). Superiority of pongamia oil in controlling aphid population was earlier proved by Sarkar *et al.* (2016) [31] which is in line with present findings. The relative study as documented by earlier workers could support the present results.

Table 3: Bio-efficacy of biorational insecticides against aphids (*Aphis gossypii*) in okra during summer-2025

Treatments	Aphids population/plant 1st spray				Mean	Aphids population/plant 2nd spray				Mean	Overall mean of 1st and 2nd spray
	1DBS	3DAS	7DAS	14DAS		1DBS	3DAS	7DAS	14DAS		
T1 - *Metarhizium anisoplae*	17.51	16.30	12.03	8.07	12.13	11.43	10.9	8.77	5.66	8.44	10.29
(10^{10}CFU/ml)	(4.19)	(4.03)	(3.46)	(2.85)	(3.56)	(3.38)	(3.30)	(2.97)	(2.37)	(2.91)	(3.21)
T2 - *Lecanicillium lecanii*	15.29	15.22	11.11	7.25	11.22	10.86	10.03	7.40	4.72	7.38	9.30
(10^{10}CFU/ml)	(3.91)	(3.80)	(3.33)	(2.69)	(3.34)	(3.29)	(3.16)	(2.72)	(2.17)	(2.71)	(3.05)
T3 - *Beauveria bassiana*	16.70	16.22	12.24	8.10	12.35	11.74	11.17	8.77	5.97	8.83	10.59
(10^{8}CFU/ml)	(4.27)	(4.18)	(3.30)	(2.85)	(3.58)	(3.50)	(3.42)	(2.96)	(2.54)	(3.05)	(3.33)
T4 - *Azadirachtin*	10.7	6.89	8.10	6.2	7.06	9.16	7.01	4.95	3.7	5.22	6.17
(0.03% EC)	(4.44)	(2.83)	(2.48)	(2.24)	(2.76)	(2.93)	(2.85)	(2.33)	(2.05)	(2.39)	(2.58)
T5 - Pongamia oil 1.0%	11.22	7.04	9.11	6.53	7.56	9.58	8.37	5.77	4.37	6.17	6.84
	(3.35)	(2.71)	(2.67)	(2.49)	(2.83)	(3.10)	(2.98)	(2.50)	(2.21)	(2.58)	(2.71)
T6 - Imidacloprid 17.8% SL	9.72	2.19	3.03	3.47	2.90	4.72	2.57	1.86	2.6	2.34	2.69
	(4.35)	(2.78)	(1.53)	(1.73)	(1.84)	(2.50)	(1.75)	(1.54)	(1.76)	(1.69)	(1.77)
T7 - Untreated control	9.59	18.57	18.33	19.5	18.80	17.31	17.37	20.07	21.33	19.59	19.20
	(4.54)	(1.68)	(1.81)	(1.88)	(4.39)	(4.39)	(4.23)	(4.54)	(4.67)	(4.48)	(4.44)
Sem (±)	1.51	1.02	0.71	1.07		2.06	1.22	1.08	0.83		
CD (p = 0.05)	NS	3.15	2.20	3.30		NS	3.75	3.34	2.56		

Figures in parentheses are square root transformed (√x+0.5) values, DBS - Days before spray, DAS - Days after spray.



Graph 2: Bio-efficacy of biorational insecticides against aphids (*Aphis gossypii*) in okra during summer-2025

Efficacy of biorational insecticides against whitefly

The whitefly population before the first spray (Table 4) ranged from 5.92 to 7.37 whiteflies per plant, with no significant differences among treatments. At 3 DAS, imidacloprid recorded the lowest population (1.90 whiteflies/plant), followed by azadirachtin (4.53 whiteflies/plant), which was at par with pongamia oil (4.90 whiteflies/plant). Lecanicillium lecanii (6.23 whiteflies/plant), *Metarhizium anisopliae* (6.63 whiteflies/plant), and *Beauveria bassiana* (6.63 whiteflies/plant) followed, while the control recorded the highest population. At 7 DAS, imidacloprid remained superior (1.53 whiteflies/plant), followed by azadirachtin (2.36 whiteflies/plant) and pongamia oil (3.24 whiteflies/plant). At 14 DAS, imidacloprid again recorded the minimum population (1.37 whiteflies/plant), followed by azadirachtin (1.73 whiteflies/plant) and pongamia oil (2.90 whiteflies/plant), while the control recorded 8.13 whiteflies/plant. The overall mean after the first spray was lowest in imidacloprid (1.67 whiteflies/plant) compared to the control (7.35 whiteflies/plant), followed by azadirachtin (3.19 whiteflies/plant), pongamia oil (3.90 whiteflies/plant), *L. lecanii* (4.58 whiteflies/plant), *M. anisopliae* (4.87 whiteflies/plant), and *B. bassiana* (4.87 whiteflies/plant).

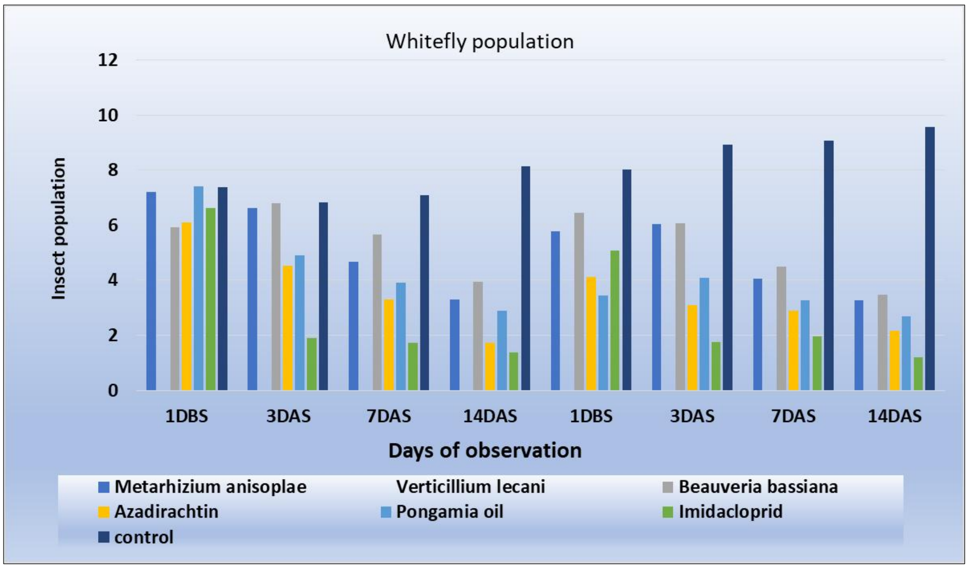
Before the second spray, whitefly populations ranged from 3.46 to 8.03 whiteflies per plant with no significant differences. At 3 DAS, imidacloprid recorded the lowest population (1.75 whiteflies/plant), followed by azadirachtin

(3.10 whiteflies/plant) and pongamia oil (4.10 whiteflies/plant). At 7 DAS, imidacloprid (1.97 whiteflies/plant) remained superior, followed by azadirachtin (2.90 whiteflies/plant) and pongamia oil (3.27 whiteflies/plant). At 14 DAS, imidacloprid recorded the minimum population (1.20 whiteflies/plant), followed by azadirachtin (2.17 whiteflies/plant) and pongamia oil (2.70 whiteflies/plant), while the control recorded 9.57 whiteflies/plant. The overall mean after the second spray was lowest in imidacloprid (1.46 whiteflies/plant) compared to the control (9.19 whiteflies/plant), followed by azadirachtin (2.72 whiteflies/plant), pongamia oil (3.84 whiteflies/plant), *L. lecanii* (3.52 whiteflies/plant), *M. anisopliae* (4.46 whiteflies/plant), and *B. bassiana* (4.68 whiteflies/plant). The pooled mean of both sprays showed that whitefly populations ranged from 1.66 to 8.27 whiteflies per plant, with imidacloprid recording the lowest population (1.66 whiteflies/plant), followed by azadirachtin (3.54 whiteflies/plant), pongamia oil (3.65 whiteflies/plant), *L. lecanii* (4.10 whiteflies/plant), *M. anisopliae* (4.70 whiteflies/plant), and *B. bassiana* (5.04 whiteflies/plant), while the untreated control recorded the highest population (8.27 whiteflies/plant).

Effectiveness of imidacloprid against whitefly was recorded by Hemadri *et al.* (2018), Pawar *et al.* (2016) [28] and Dhar and Bhattacharya (2015). The effectiveness of *L. lecanii* in reducing damage caused by whitefly was earlier reported by Halder *et al.* (2021) [17] which confirms present findings. Sarkar *et al.* (2016) [31] and Sridharan *et al.* (2015) [35] reported pongamia oil was found promising for management of whitefly which is in tune with the present investigations.

Table 4: Bio-efficacy of biorational insecticides against whitefly (Bemisia tabaci) in okra during summer-2025

Treatments	1st Spray				Mean	2nd Spray				Mean	Overall Mean
	1 DBS	3 DAS	7 DAS	14 DAS		1 DBS	3 DAS	7 DAS	14 DAS		(1st & 2nd Spray)
T1 – *Metarhizium anisopliae* (10^{10} CFU/ml)	7.22	6.63	4.67	3.30	4.87	5.78	6.03	4.07	3.27	4.46	4.70
T2 – *Lecanicillium lecanii* (10^{10} CFU/ml)	6.33	6.23	4.47	3.03	4.58	6.11	5.04	3.50	2.99	3.84	4.10
T3 – *Beauveria bassiana* (10^{8} CFU/ml)	5.92	6.80	5.67	3.93	5.47	6.44	6.07	4.50	3.47	4.68	5.04
T4 – Azadirachtin (0.03% EC)	6.11	4.53	3.30	1.73	3.19	4.11	3.10	2.90	2.17	2.72	3.54
T5 – Pongamia oil (1.0%)	7.40	4.90	3.90	2.90	3.90	3.46	4.10	3.27	2.70	3.36	3.65
T6 – Imidacloprid (17.8% SL)	6.62	1.90	1.74	1.37	1.67	5.08	1.75	1.97	1.20	1.64	1.66
T7 – Untreated Control	7.37	6.83	7.10	8.13	7.35	8.03	8.92	9.07	9.57	9.19	8.27



Graph 3: Bio-efficacy of biorational insecticides against whitefly (*Bemisia tabaci*) in okra during summer-2025

Conclusion

The present finding indicated that the cumulative average of leafhopper populations after both sprays, imidacloprid was found to be the most effective treatment, recording the lowest population of 2.61 leafhoppers per three leaves per plant. Among the biorational insecticides, *Azadirachtin* (5.75 leafhoppers/plant) and pongamia oil (6.34 leafhoppers/plant) were the next most effective treatments and were statistically on par with each other. The next best treatments were *Lecanicillium lecanii* (9.10 leafhoppers/plant), *Metarhizium anisopliae* (9.71 leafhoppers/plant), and *Beauveria bassiana* (10.56 leafhoppers/plant), showing comparatively higher surviving populations.

The cumulative average of aphid populations after both sprays imidacloprid was the most effective treatment, recording 2.90 and 2.34 aphids per three leaves per plant after the first and second sprays, respectively, with the lowest overall mean of 2.62 aphids per three leaves per plant. Among the biorational insecticides, azadirachtin recorded 7.06 aphids per plant after the first spray and 6.17 aphids per plant overall, and was statistically at par with pongamia oil, which recorded 7.56 aphids per plant after the first spray and 6.84 aphids per plant overall. The next effective treatments were *Lecanicillium lecanii* (11.22 aphids), *Metarhizium anisopliae* (12.13 aphids), and *Beauveria bassiana* (12.35 aphids) per three leaves per plant. The untreated control recorded 19.59 aphids per three leaves per plant after the second spray. The pooled mean of both sprays showed that whitefly populations ranged from 1.66 to 8.27 whiteflies per plant, with imidacloprid recording the lowest population (1.66 whiteflies/plant), followed by azadirachtin (3.54 whiteflies/plant), pongamia oil (3.65 whiteflies/plant), *L. lecanii* (4.10 whiteflies/plant), *M. anisopliae* (4.70 whiteflies/plant), and *B. bassiana* (5.04 whiteflies/plant), while the untreated control recorded the highest population (8.27 whiteflies/plant). Azadirachtin was effective in managing sucking pests on okra, resulting in lower pest populations and higher marketable yields. Among microbial biopesticides, *Lecanicillium lecanii* was the most effective. All microbial biopesticides were safer to predatory coccinellids, whereas imidacloprid recorded the lowest coccinellid population.

Fig 1: *Amrasca biguttula biguttula*

Fig 2: *Bemisia tabaci*

Fig 3: *Aphis gossypii*

Fig 4: *Coccinella septempunctata*

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