RESEARCH PAPER

Evaluation of Newer Insecticides and Entomopathogenic Fungus Against Aphid, Aphis gossypii on Okra

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ABSTRACT

Okra (Abelmoschus esculentus (L.) Moench) is one of the most widely cultivated vegetable crops in India, grown during both summer and kharif seasons. However, its productivity is severely constrained by infestations of sucking insect pests, particularly the aphid (Aphis gossypii), which causes significant yield losses by extracting sap from leaf tissues. Sustainable management of these pests requires the evaluation of novel insecticidal molecules with unique modes of action. A field experiment was conducted to assess the efficacy of new-generation insecticides against the okra sucking pest complex. The treatments included Diafenthiuron 50 WP @ 300 g a.i./ha, Broflanilide 20 SC @ 25 g a.i./ha, Spinetoram 11.7 SC @ 46.8 g a.i./ha, and Flonicamid 50 WG @ 75 g a.i./ha, along with botanical and microbial insecticides as comparative treatments. Observations on leafhopper population were recorded at 1, 5, 10, and 15 days after spraying (DAS). Among all treatments, the lowest mean population of leafhoppers was recorded in Flonicamid (2.31 leafhoppers per leaf) followed by Diafenthiuron (2.66), Spinetoram (3.22), and Broflanilide (3.64) one day after spraying. A similar trend persisted across subsequent observations at 5, 10, and 15 DAS. Botanical and microbial insecticides also showed significant reduction in pest population compared to the untreated control. The study demonstrated that novel insecticides, particularly Flonicamid and Diafenthiuron, were highly effective in suppressing leafhopper populations in okra. For sustainable and effective pest management, these molecules can be used alternately based on pest incidence and crop stage, reducing the risk of resistance development and minimizing ecological impact.

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Introduction

Okra, commonly known as lady's finger, belongs to the Malvaceae family and is a famous traditional vegetable in India. It is the most popular vegetable in the Malvaceae family and is locally referred to as Bhindi. It's South African. It is known by several names around the world. Okra is particularly renowned for its soft, sweet fruits in many sections of the country. It is mostly used as a fresh vegetable, although it is also canned, dehydrated, and frozen. Dry okra seeds contain 18-20% oil, 20-23% crude protein, and are high in iodine [1]. It has a good export potential, accounting about 60 percent of fresh veggies.

India is the world's second largest producer of vegetables, after China, with 68.73 million mt produced from 5.5 lakh hectares of land between 2021 and 2022. As a result, it produces and consumes a great amount of vegetables, which are an important dietary component. In India, okra was farmed on 5.48 lakh hectares, yielding 71.57 MT with a productivity of 13.04 MT per hectare. In Maharashtra, okra is produced on 13.31 thousand hectares, with an annual production of 1.35 lakh tones and a productivity of 10.03 MT/ha [2].

As many as 72 insect species have been observed on crops [3], including plant sap-sucking insects specialized for exploiting the sap for nourishment in order to attain complete biological value, particularly during the early stages of okra plant growth. According to studies, the primary sucking pests lower okra output by 17.46 percent [4]. Cotton aphid (*Aphis gossypii*) has been recognised as one of the major challenging insect pests that reduce okra pod harvest. To counteract the pest threat, a wide range of chemical insecticides are sprayed on this vegetable crop [5], resulting in harmful residues, the destruction of natural enemies, environmental disruption, and the development of resistance. Biological control of insect pests with diverse entomopathogenic microorganisms is becoming increasingly popular due to their target specificity, self-propagation, and clear environmental safety. Entomopathogenic fungi (EPF) such as *Beauveria bassiana*, *Metarhizium anisopliae*, and *Lecanicillium* (=*Verticillium*) lecanii have been efficient pest control agents for decades. Keeping all of the foregoing in mind, the current study was designed to evaluate the performance of eco-friendly, low-risk, low-dose molecules containing innovative chemistry synthetic insecticides against sucking pests. One significant benefit of these new products is that they offer a one-time solution for various target pests, cutting crop protection expenditures.

Materials and Methods

The research work comprising field experiments were conducted during Summer season of 2022 at the Experimental Farm of Loknete Mohanrao Kadam College of Agriculture, Sonsal-Hingangaon, Kadegaon. It has subtropical climate having an average rainfall of 455 mm. Okra cv. Pusa Sawani was raised by using standard cultivation practices given by MPKV, Rahuri except plant protection measures. The experiment was replicated for three times under Randomized Block Design with nine treatments. The okra seeds were dibbled in the plot size of 3.0 x 2.7 m area with 30cm × 20cm spacing. The treatment viz. T_1 Azadirachtin 0.03 EC@1.5 lit, T_2 *Verticillium lecanii* 1 x 10^8cfu/ml 1.15 WP @ 2.5 kg/ ha, T_3 *Metarhizium anisopliae* 1 x 10^8cfu/ml 1.15 WP@ 2.5 kg/ha, T_4 *Beauveria bassiana* 1 x 10^8cfu/ml 1.15 WP@2.5 kg/ha, T_5 Diafenthuron 50 WP@ 300gm a.i/ha, T_6 Broflanilide 20 SC @ 25 gm a.i/ha, T_7 Spinetorum 1.7 SC @ 46.8 gm a.i/ha, T_8 Flonicamid 50 WG @ 75 gm a.i/ha and T_9 Untreated control were applied from 30 days age of the crop. The spraying operation was performed with hand operated knapsack sprayer equipped with hollow cone nozzle. All the three replications were treated at a time. All the three rounds of spray applications of insecticides were undertaken at an interval of 15 days. The data of leafhopper pests were recorded from randomly selected five plants in each plot. From each plant three leaves i.e. top, middle and bottom were considered for recording observations a day before and 1, 5, 10 and 15 days after the treatment application.

Statistical Analysis

The experimental data were subjected to statistical analysis as per the method of statistical analysis of Randomized Block Design as proposed by [6].

Result and Discussion

Field bio efficacy observed against aphids during summer 2022

After first spray

Aphid population counts per leaf ranged from 5.17 to 5.74 prior to treatment. Table 1 presents information about how various insecticides affect the number of aphids after their initial spray. The most effective treatment was flonicamid (1.22 aphids per leaf) at 1 DAS, which was at par with diafenthiuron (1.30 aphids per leaf), both being superior to theuntreated control. The next best treatment was spinetoram (1.61 aphids per leaf), followed by broflanilide (2.35 aphids per leaf). Among the botanical and biopesticides, the most effective treatment was azadirachtin (4.35 aphids per leaf), followed by *V. lecanii* (4.17 aphids per leaf), *M. anisopliae* (4.57 aphids per leaf) and *B. bassiana* (4.60 aphids per leaf), which were at par with each other.

At 5 DAS also the most promising treatments were found to be flonicamid (1.42 aphids per leaf) and diafenthiuron (1.90 aphids per leaf), which were statistically on par with each other. Spinetoram (2.33 aphids per leaf) and broflanilide (3.07 aphids per leaf), which were at par with each other, were observed to be the next promising treatments, followed by azadirachtin (3.00 aphids per leaf).

Table 1: Efficacy of different botanical, biopesticides and insecticides for the management of aphid, *A. gossypii* on Okra after first spray during summer 2022

Tr. No.	Treatments	Dose (l or kg or g a.i./ ha)	Mean no. of aphids/leaf					
			1 DBS	1 DAS	5 DAS	10 DAS	15 DAS	Mean
T_1	Azadirachtin	1.5 l	5.43 (2.43)*	3.63 (2.03)	3.00 (1.87)	2.10 (1.61)	3.21 (1.92)	2.99 (1.86)
T_2	*Verticillium lecanii*	2.5 kg	5.34 (2.42)	4.17 (2.16)	3.63 (2.03)	2.97 (1.86)	3.40 (1.97)	3.54 (2.01)
T_3	*Metarhizium anisopliae*	2.5 kg	5.63 (2.48)	4.57 (2.25)	3.87 (2.09)	3.43 (1.98)	4.03 (2.12)	3.98 (2.11)
T_4	*Beauveria bassiana*	2.5 kg	5.46 (2.44)	4.60 (2.26)	4.20 (2.17)	4.53 (2.24)	6.23 (2.59)	4.89 (2.32)
T_5	Diafenthiuron	300 g	5.60 (2.47)	1.30 (1.34)	1.90 (1.55)	2.57 (1.75)	2.32 (1.68)	2.02 (1.58)
T_6	Broflanilide	25 g	5.74 (2.50)	2.35 (1.69)	3.07 (1.89)	3.37 (1.97)	3.13 (1.90)	2.98 (1.86)
T_7	Spinetoram	46.8 g	5.54 (2.46)	1.61 (1.45)	2.33 (1.68)	3.07 (1.89)	3.07 (1.89)	2.52 (1.73)
T_8	Flonicamid	75 g	5.52 (2.45)	1.22 (1.31)	1.42 (1.38)	1.72 (1.49)	1.97 (1.57)	1.58 (1.44)
T_9	Untreated control	-	5.17 (2.38)	5.32 (2.41)	5.83 (2.52)	6.87 (2.71)	7.37 (2.80)	6.35 (2.61)
	S.E.m ±	**-**	**0.04**	**0.06**	**0.05**	**0.03**	**0.05**	**0.02**
	C.D. at 5%	**-**	**NS**	**0.17**	**0.15**	**0.10**	**0.14**	**0.06**
	P-value	**-**	**0.720**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

*figures in the parenthesis are $\sqrt{x + 0.5}$ transformed values; DBS- Day Before Spraying; DAS- Days After Spraying; NS = Non-significant

Among the biopesticides, the bioefficacy in descending order was *V. lecanii* (3.63 aphids per leaf), followed by *M. anisopliae* (3.87 aphids per leaf) and *B. bassiana* (4.20 aphids per leaf).

Among all the treatments, flonicamid (1.72 aphids per leaf) demonstrated the highest level of effectiveness at 10 DAS, except, azadirachtin (2.10 aphids per leaf) and diafenthiuron (2.57 aphids per leaf), with which it was at par. In the descending order of efficacy, the next promising treatments were *V. lecanii* (2.97 aphids per leaf), spinetoram (3.07 aphids per leaf) and broflanilide (3.37 aphids per leaf), which were at par with each other, followed by *M. anisopliae* (3.43 aphids per leaf). The least effective treatment was *B. bassiana* with (4.53 aphids per leaf), except for the untreated control.

Observation on 15 DAS revealed that the treatment flonicamid was superior by recording 1.97 aphids per leaf, on par with diafenthiuron (2.32 aphids per leaf), spinetoram (3.07 aphids per leaf) and broflanilide (3.13 aphids per leaf). Among the biopesticides, the most effective treatment was azadirachtin (3.21 aphids per leaf). The least effective treatment was *B. bassiana* (6.23 aphids per leaf), except for the untreated control.

Mean aphid population during the first spray revealed that, among different treatments, flonicamid (1.58 aphids per leaf) was found to be more effective, followed by diafenthiuron (2.02 aphids per leaf) and spinetoram (2.52 aphids per leaf), which were at par with each other. The next effective treatment was broflanilide (2.98 aphids per leaf), which was at par with azadirachtin (2.99 aphids per leaf). Among the biopesticides, the most effective treatment was *V. lecanii* (3.54 aphids per leaf), which was at par with *M. anisopliae* (3.98 aphids per leaf). The least effective treatment was *B. bassiana* with 4.89 aphids per leaf, except the untreated control (6.35 aphids per leaf).

After the second spray

The observations of the aphid survival population fifteen days following the first spray were used as a pre-count for the second spray. Table 2 contains the observations on the aphid survival population at 1, 5, 10, and 15 days following the second spray.

It could be seen from the data that one day after the second spray, flonicamid (1.26 aphids per leaf) was found to be a more effective treatment than the rest of the treatments except diafenthiuron (1.77 aphids per leaf). In order of efficacy, the next promising treatment was spinetoram (2.03 aphids per leaf), followed by broflanilide (2.27 aphids per leaf). Among the botanical and biopesticides lowest population of aphids was recorded in azadirachtin (2.97 aphids per leaf), which was at par with *V. lecanii* (3.27 aphids per leaf) and *M. anisopliae* (3.70 aphids per leaf).

At 5 DAS, the most promising treatments were flonicamid (1.60 aphids per leaf), diafenthiuron (2.06 aphids per leaf) and spinetoram (2.13 aphids per leaf), and they were statistically on par with each other. Broflanilide (2.57 aphids per leaf) and azadirachtin (2.67 aphids per leaf) were at par with each other and observed to be the next promising treatments, followed by *V. lecanii* (3.00 aphids per leaf), *M. anisopliae* (3.33 aphids per leaf) and *B. bassiana* (5.17 aphids per leaf).

Ten days following the application of the treatments, the treatments viz., flonicamid (1.97 aphids per leaf), diafenthiuron (2.23 aphids per leaf), spinetoram (2.33 aphids per leaf) and broflanilide (2.67 aphids per leaf) recorded the least aphids population, followed by azadirachtin (2.37 aphids per leaf) and *V. lecanii* (2.83 aphids per leaf), which were at par with each other. *B. bassiana*was the least effective treatment when compared to other insecticides.

On 15 DAS, there was a gradual increase in aphid population in all the treatments. Least population was recorded in flonicamid (2.13 aphids per leaf), which was found to be at par with diafenthiuron (2.47 aphids per leaf), followed by spinetoram (2.63 aphids per leaf), broflanilide (2.77 aphids per leaf), azadirachtin (3.13 aphids per leaf), *V. lecanii* (3.80 aphids per leaf) and *M. anisopliae* (4.13 aphids per leaf). The treatment *B. bassiana* (4.93 aphids per leaf), found to be the least effective in suppressing the population of aphids.

Mean aphids population during the second spray indicated that, among botanical, biopesticides and insecticides, flonicamid recorded the lowest population of aphids (1.74 aphids per leaf), which was at par with diafenthiuron (2.13 aphids per leaf). In other treatments, reduction in aphids' population was in the order of spinetoram > broflanilide > azadirachtin > *V. lecanii* > *M. anisopliae* > *B. bassiana*.

After third spray

Fifteen days after the spray, the observation of the survival population of aphids after the second spray was treated as pre-count data for the third spray. The post-spray observation data obtained are given in table 3.

The observations at 1 DAS showed that, in comparison to the untreated control, the application of botanical, biopesticides, and insecticides considerably decreased the incidence of aphids on Okra. The treatments flonicamid and diafenthiuron were found to be significantly superior by recording 0.84 and 1.27 aphids per leaf. Population density in other treatments ranged between 1.99 and 4.07 aphids per leaf, as against 9.08 aphids per leaf in the untreated control.

All the treatments recorded the aphid's population below ETL at 5 DAS, however, treatments flonicamid and diafenthiuron maintained their superiority by recording the least aphids' population of 0.96 and 1.47 aphids per leaf. The next best treatment was spinetoram (2.27 aphids per leaf) followed by azadirachtin (2.72 aphids per leaf), which was at par with broflanilide (2.73 aphids per leaf). Among the biopesticides the bioefficacy in the descending order was *V. lecanii*, *M. anisopliae* and *B. bassiana* with 3.13, 3.30 and 3.63 aphids per leaf as against 9.55 aphids in the untreated control.

Ten days following the application of the treatments, the treatments viz., flonicamid (1.08 aphids per leaf), diafenthiuron (1.57 aphids per leaf), spinetoram (2.35 aphids per leaf), and azadirachtin (2.47 aphids per leaf) recorded the least aphids population, followed by broflanilide (3.00 aphids per leaf) and *V. lecanii* (3.02 aphids per leaf), which were at par with each other. *B. bassiana* (3.53 aphids per leaf) was the least effective treatment when compared to other insecticides except the untreated control (9.82 aphids per leaf).

At 15 days after imposing the treatments, flonicamid (1.14 aphids per leaf) and diafenthiuron (1.71 aphids per leaf) continued to maintain their superiority and were found to be at par with each other. The treatments spinetoram (2.17 aphids per leaf), broflanilide (3.10 aphids per leaf), azadirachtin (3.17 aphids per leaf) and *V. lecanii* (3.42 aphids per leaf) were found to be the next best treatments. All the treatments were significantly superior to untreated control (10.57 aphids per leaf).

The average number of aphids during the third spraying showed that, out of all the treatments, flonicamid had the lowest aphid population (1.01 aphids per leaf) which was at par with diafenthiuron (1.50 aphids per leaf). In other treatments reduction in aphids' population was in the order of spinetoram (2.19 aphids per leaf) > broflanilide (2.80 aphids per leaf) > azadirachtin (2.83 aphids per leaf) > *V. lecanii* (3.23 aphids per leaf) > *M. anisopliae* (3.49 aphids per leaf) > *B. bassiana* (4.01 aphids per leaf).

Field bio-efficacy of botanical, biopesticides and insecticides against aphids *A. gossypii* on Okra during summer 2022

The data regarding the mean number of aphids on each leaf after treatment are presented in table 4 and Fig 1. The results indicated that the superior performance of flonicamid (1.44 aphids per leaf) and diafenthiuron (1.89 aphids per leaf) was observed to be the best. The next best treatments were spinetoram (2.33 aphids per leaf) and broflanilide (2.78 aphids per leaf). *B. bassiana* (4.64 aphids per leaf) was found to be the least effective.

Wawdhane *et al.* (2020) studied that the mean nymph population of aphids was highly reduced with the usage of Imidacloprid 17.8 SL, followed by Spiromesifen 22.9 SC after 5 and 10 days of all three sprayings respectively [7]. Palthiya (2014) studied the entomopathogenic fungi and their combinations against sucking pests of okra. They reported that *V. lecanii* 1.15 % WP + *M. anisopliae* 1.15 per cent WP proved to be highly effective in controlling aphid population [8]. Whereas, treatments with *V. lecanii* 1.15 % WP and *B. bassiana* 1.15 % WP + *M. anisopliae* 1.15 % WP + *V. lecanii* 1.15 % WP found equally effective against aphids. Similar results were also reported by various researchers [9,10,11,12,13,14,15,16].

Table 2: Efficacy of different botanical, biopesticides and insecticides for the management of aphid, *A. gossypii* on Okra after second spray during summer 2022

Tr. No.	Treatments	Dose (l or kg or g a.i./ ha)	Mean no. of aphids/leaf				
			1 DAS	5 DAS	10 DAS	15 DAS	Mean
T_1	Azadirachtin	1.5 l	2.97 (1.86)*	2.67 (1.78)	2.37 (1.69)	3.13 (1.91)	2.78 (1.81)
T_2	*Verticillium lecanii*	2.5 kg	3.27 (1.94)	3.00 (1.86)	2.83 (1.83)	3.80 (2.07)	3.23 (1.93)
T_3	*Metarhizium anisopliae*	2.5 kg	3.70 (2.05)	3.33 (1.96)	3.03 (1.88)	4.13 (2.15)	3.55 (2.01)
T_4	*Beauveria bassiana*	2.5 kg	5.47 (2.44)	5.17 (2.38)	4.57 (2.25)	4.93 (2.33)	5.03 (2.35)
T_5	Diafenthiuron	300 g	1.77 (1.50)	2.06 (1.60)	2.23 (1.65)	2.47 (1.72)	2.13 (1.62)
T_6	Broflanilide	25 g	2.27 (1.66)	2.57 (1.75)	2.67 (1.78)	2.77 (1.81)	2.57 (1.75)
T_7	Spinetoram	46.8 g	2.03 (1.59)	2.13 (1.62)	2.33 (1.68)	2.63 (1.76)	2.28 (1.66)
T_8	Flonicamid	75 g	1.26 (1.33)	1.60 (1.45)	1.97 (1.57)	2.13 (1.61)	1.74 (1.49)
T_9	Untreated control	-	8.06 (2.93)	8.49 (3.00)	8.73 (3.04)	9.02 (3.09)	8.58 (3.01)
	S.E.m ±	**-**	**0.04**	**0.05**	**0.05**	**0.06**	**0.02**
	C.D. at 5%	**-**	**0.12**	**0.16**	**0.14**	**0.19**	**0.06**
	P-value	**-**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

*figures in the parenthesis are $\sqrt{x + 0.5}$ transformed values; DBS- Day Before Spraying; DAS- Days After Spraying

Table 3: Efficacy of different botanical, biopesticides and insecticides for the management of aphid, *A. gossypii* on Okra after third spray during summer 2022

Tr. No.	Treatments	Dose (l or kg or g a.i./ ha)	Mean no. of aphids/leaf				
			1 DAS	5 DAS	10 DAS	15 DAS	Mean
T_1	Azadirachtin	1.5 l	2.97 (1.86)*	2.72 (1.79)	2.47 (1.72)	3.17 (1.91)	2.83 (1.82)
T_2	*Verticillium lecanii*	2.5 kg	3.33 (1.96)	3.13 (1.90)	3.02 (1.88)	3.42 (1.98)	3.23 (1.93)
T_3	*Metarhizium anisopliae*	2.5 kg	3.50 (2.00)	3.30 (1.95)	3.25 (1.94)	3.93 (2.10)	3.49 (2.00)
T_4	*Beauveria bassiana*	2.5 kg	4.07 (2.14)	3.63 (2.03)	3.53 (2.01)	4.80 (2.30)	4.01 (2.12)
T_5	Diafenthiuron	300 g	1.27 (1.33)	1.47 (1.40)	1.57 (1.44)	1.71 (1.49)	1.50 (1.41)
T_6	Broflanilide	25 g	2.38 (1.70)	2.73 (1.80)	3.00 (1.87)	3.10 (1.90)	2.80 (1.82)
T_7	Spinetoram	46.8 g	1.99 (1.58)	2.27 (1.66)	2.35 (1.68)	2.17 (1.63)	2.19 (1.64)
T_8	Flonicamid	75 g	0.84 (1.16)	0.96 (1.21)	1.08 (1.26)	1.14 (1.28)	1.01 (1.23)
T_9	Untreated control	-	9.08 (3.10)	9.55 (3.17)	9.82 (3.21)	10.57 (3.33)	9.75 (3.20)
	S.E.m ±	**-**	**0.03**	**0.02**	**0.03**	**0.03**	**0.01**
	C.D. at 5%	**-**	**0.09**	**0.05**	**0.10**	**0.08**	**0.03**
	P-value	**-**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

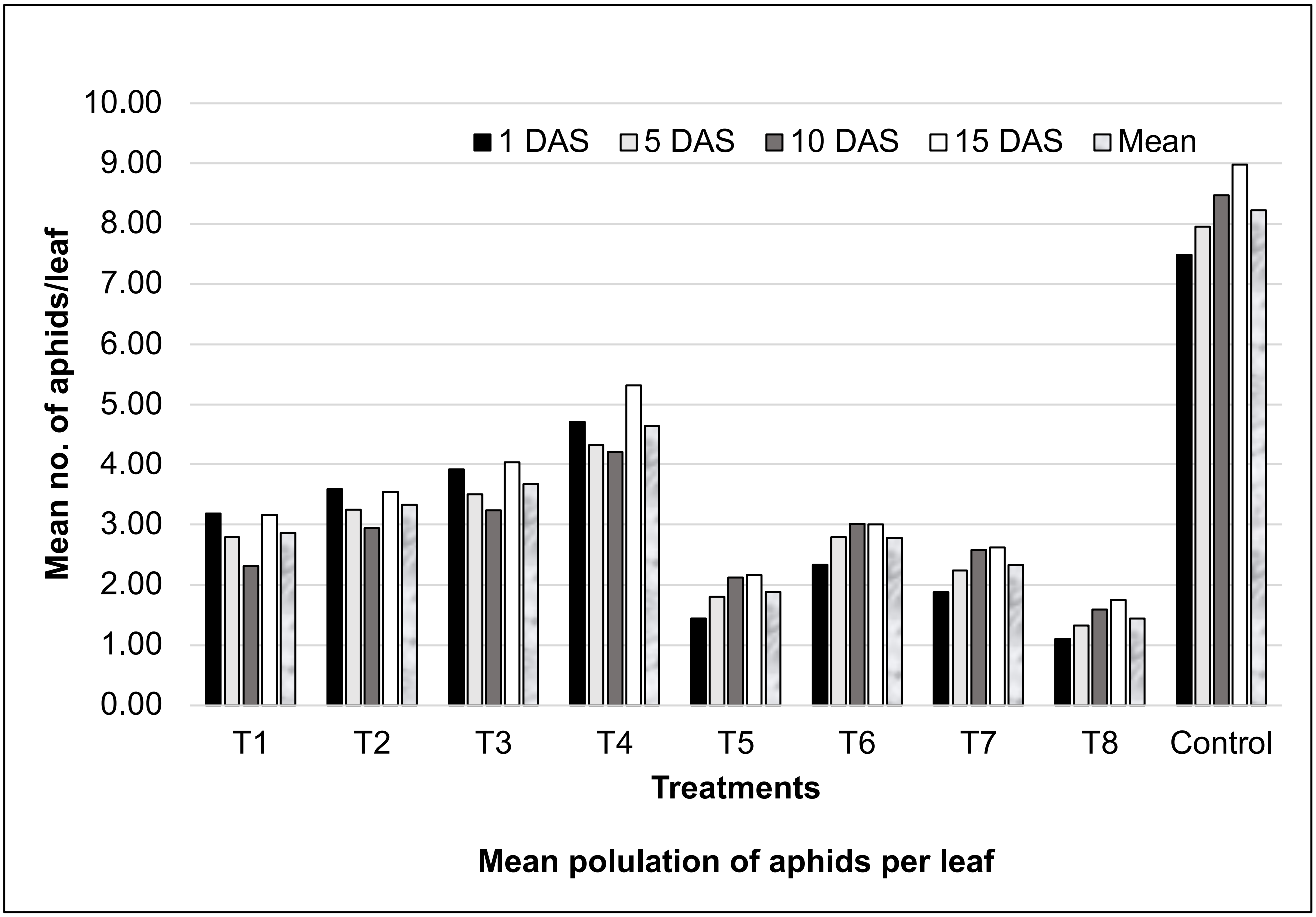
*figures in the parenthesis are $\sqrt{x+0.5}$ transformed values; DBS- Day Before Spraying; DAS- Days After Spraying

Table 4: Efficacy of different botanical, biopesticides and insecticides for the management of aphid, *A. gossypii* on Okra after all three sprays during summer 2022

Tr. No.	Treatments	Dose (l or kg or g a.i./ ha)	Mean no. of aphids/leaf				
			1 DAS	5 DAS	10 DAS	15 DAS	Mean
T_1	Azadirachtin	1.5 l	3.19 (1.92)*	2.80 (1.82)	2.31 (1.68)	3.17 (1.92)	2.87 (1.83)
T_2	*Verticillium lecanii*	2.5 kg	3.59 (2.02)	3.25 (1.94)	2.94 (1.85)	3.54 (2.01)	3.33 (1.96)
T_3	*Metarhizium anisopliae*	2.5 kg	3.92 (2.10)	3.50 (2.00)	3.24 (1.93)	4.03 (2.13)	3.67 (2.04)
T_4	*Beauveria bassiana*	2.5 kg	4.71 (2.28)	4.33 (2.20)	4.21 (2.17)	5.32 (2.41)	4.64 (2.27)
T_5	Diafenthiuron	300 g	1.44 (1.39)	1.81 (1.52)	2.12 (1.62)	2.16 (1.63)	1.89 (1.54)
T_6	Broflanilide	25 g	2.33 (1.68)	2.79 (1.81)	3.01 (1.87)	3.00 (1.87)	2.78 (1.81)
T_7	Spinetoram	46.8 g	1.88 (1.54)	2.24 (1.66)	2.58 (1.75)	2.62 (1.77)	2.33 (1.68)
T_8	Flonicamid	75 g	1.11 (1.27)	1.33 (1.35)	1.59 (1.45)	1.75 (1.50)	1.44 (1.39)
T_9	Untreated control	-	7.49 (2.83)	7.96 (2.91)	8.47 (3.00)	8.99 (3.08)	8.23 (2.95)
	S.E.m ±	**-**	**0.03**	**0.02**	**0.02**	**0.02**	**0.01**
	C.D. at 5%	**-**	**0.09**	**0.07**	**0.06**	**0.07**	**0.03**
	P-value	**-**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

*figures in the parenthesis are $\sqrt{x+0.5}$ transformed values; DBS- Day Before Spraying; DAS- Days After Spraying

Fig 1: Efficacy of different botanical, biopesticides and insecticides for the management of aphid, *A. gossypii* on Okra after all three sprays during summer 2022



DAS- Days After Spraying
T- Treatment

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