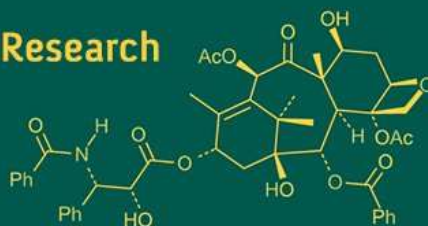
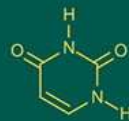
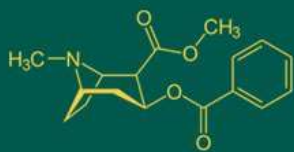


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Comparative efficacy of certain insecticides and biopesticides against *Aphis craccivora* (Koch) on *Vigna radiata* (L.) Wilczek

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Abstract

Green gram (*Vigna radiata* (L.) Wilczek) is an important pulse crop in India valued for its high nutritional quality, low water requirement, and ability to improve soil fertility through nitrogen fixation. However, its productivity is greatly affected by insect pests, especially the aphid *Aphis craccivora*, which damages the crop by sucking sap from tender plant parts, leading to reduced growth and yield. In view of this problem, the present investigation was conducted during the *Kharif* seasons of 2024 and 2025 at the Entomological Research Field, College of Agriculture, Gwalior (M.P.) The present study revealed that all insecticide and biopesticide treatments significantly reduced the aphid population compared to the untreated control plot during both years (2024 and 2025). Among the insecticides, Imidacloprid 17.8 SL was found to be the most effective, recording the lowest aphid population (1.65 aphids/three leaves/plant) with the highest reduction over control (69.69%), followed by Acetamiprid 20 SP (1.76 aphids/three leaves/plant; 67.78%), whereas Chlorantraniliprole 18.5 SC recorded the highest aphid population (3.14 aphids/three leaves/plant) with the lowest reduction (42.22%), indicating its least effectiveness among insecticides. Among the biopesticides, *Verticillium lecanii* (1×10^8 spores/ml) was found to be the most effective, recording the lowest aphid population (2.91 aphids/three leaves/plant) with the highest reduction (46.44%), followed by Azadirachtin (1500 ppm) (3.34 aphids/three leaves/plant; 38.88%), whereas *Metarhizium anisopliae* (1×10^8 spores/ml) recorded the highest aphid population (3.82 aphids/three leaves/plant) with the least reduction (29.63%), indicating the least effectiveness among biopesticides.

Keywords: Aphid, green gram, population, sucking insect pest

1. Introduction

Green gram (*Vigna radiata* L.), also known as mungbean, is one of the most important edible pulse crops cultivated in India and belongs to the family Leguminosae. It is considered a major pulse crop in the country after chickpea and pigeon pea ^[1] is widely grown due to its adaptability, high nutritional value, low water requirement, and environmental benefits such as reduced greenhouse gas emissions and improved carbon sequestration. As a legume, it also helps maintain soil fertility by fixing atmospheric nitrogen ^[2]. The nutritional value of mungbean is mainly due to its high content of easily digestible protein, making it an important component of human nutrition. On a dry weight basis, it contains about 25-28% protein, 1.0% oil, 3.5-4.5% fibre, 4.5-5.5% ash, and 62-65% carbohydrates. Amino acid analysis shows that Sulphur-containing amino acids such as methionine and cystine are present in relatively low amounts ^[3]. Mungbean seeds are also a good source of essential minerals and vitamins. Per 100 g of seeds, they contain minerals such as calcium (132 mg), iron (6.74 mg), magnesium (189 mg), phosphorus (367 mg), and potassium (1246 mg). They also provide important vitamins including ascorbic acid (4.8 mg), thiamine (0.621 mg), riboflavin (0.233 mg), niacin (2.251 mg), pantothenic acid (1.910 mg), and vitamin A (114 IU) ^[4]. India is the largest producer of green gram in the world, and the crop is grown in almost all major states of the country due to its adaptability to diverse agro-climatic conditions. It occupies an area of about 3.19 million hectares, with a total production of 1.51 million tons, and an average productivity of about 0.47 tons per hectare (473 kg/ha) ^[5].

Green gram productivity in the country is low due to several factors, among which insect pest damage is a major constraint. In India, around 60 insect pest species have been reported on green gram; however, only a few of these cause significant economic losses and are widely distributed across major growing regions [6, 7]. It has been estimated that, on average, about 2-2.1 million tonnes of pulses worth nearly ₹6, 000 crore are lost each year due to damage caused by insect pest complexes [8]. The aphid *Aphis craccivora* Koch (Homoptera: Aphididae) is a highly important, widely distributed, cosmopolitan, and polyphagous pest that infests a large number of host plants. It remains active throughout the year and is capable of completing approximately 31 overlapping generations. Both nymphs and adults feed by sucking sap from the underside of young leaves, tender shoots, flower stalks, and developing pods. In mungbean, it causes an estimated 25.6% damage during the vegetative stage and about 29.9% during the reproductive stage in the *Kharif* season. Under severe infestation, pod development is adversely affected, resulting in deformed pods and yield losses ranging from 20-40% in Asia, [9]. Keeping these facts in view the present study was conducted on green gram to evaluate the efficacy of certain insecticides and biopesticides against aphid to find an effective control of this pest.

2. Materials and Methods

The present investigation was carried out during the *Kharif* seasons of 2024 and 2025 at the Entomological Research Field, College of Agriculture, Gwalior, Madhya Pradesh, India, to evaluate the efficacy of certain insecticides and biopesticides against aphid, *Aphis craccivora* (Koch) in greengram (*Vigna radiata* L.). The greengram variety 'Shikha' was sown in a Randomized Block Design (RBD) with 10 treatments and 3 replications. The plot size was 3 × 1.25 m with a spacing of 30 cm × 10 cm, and sowing was done on 25 July 2024 and 25 July 2025, respectively. The treatments included Spinosad 45 SC (T₁), Imidacloprid 17.8 SL (T₂), Chlorantraniliprole 18.5 SC (T₃), Acetamiprid 20 SP (T₄), Emamectin benzoate 5% SG (T₅), *Beauveria bassiana* (1×10⁸ spores/ml) (T₆), *Metarhizium anisopliae* (1×10⁸ spores/ml) (T₇), *Verticillium lecanii* (1×10⁸ spores/ml) (T₈), Azadirachtin 1500 ppm (T₉) and untreated control (T₁₀). The insecticides and biopesticides were applied at recommended doses per hectare at appropriate crop stages based on pest incidence. The first spray was applied after the initiation of aphid infestation, and the second spray was applied 15 days after the first spray. Observations on aphid population were recorded from five randomly selected plants in each plot. The aphid population was assessed by counting individuals present on three compound leaves selected from the top, middle, and bottom canopy of each plant before spraying and at 3, 7 and 10 days after each spray. The data obtained were analysed to evaluate treatment efficacy and population reduction under field conditions.

3. Results

3.1 Effect of certain insecticides and biopesticides on the population of *Aphis craccivora* during *Kharif* 2024

The pre-treatment observation recorded one day before the first spray revealed that the aphid population ranged from 5.33 to 5.78 aphids/three leaves/plant and was statistically non-significant among all the treatments. At day after spray

all insecticidal and biopesticidal treatments significantly reduced the aphid population over control. At 3 DAS, Among the insecticides, T₂-Imidacloprid 17.8 SL recorded the lowest aphid population (2.44 aphids/three leaves/plant) followed by T₄-Acetamiprid 20 SP (2.56 aphids/three leaves/plant) and T₃-Chlorantraniliprole 18.5 SC (3.82 aphids/three leaves/plant) were found to be the least effective insecticides. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) was the most effective (3.64 aphids/three leaves/plant) followed by T₉-Azadirachtin (1500 ppm) (3.74 aphids/three leaves/plant), while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) recorded the highest aphid population (4.29 aphids/three leaves/plant). Similar trends were observed at 7 DAS and 10 DAS, where T₂-Imidacloprid 17.8 SL recorded the lowest aphid population of 2.33 and 2.11 aphids/three leaves/plant, respectively, followed by T₄-Acetamiprid 20 SP with 2.44 and 2.22 aphids/three leaves/plant, whereas T₃-Chlorantraniliprole 18.5 SC recorded the highest aphid population among insecticides with 3.56 and 3.19 aphids/three leaves/plant, respectively. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) remained the most effective with 3.33 and 2.93 aphids/three leaves/plant at 7 and 10 DAS, respectively, followed by T₉-Azadirachtin (1500 ppm) with 3.57 and 3.39 aphids/three leaves/plant, while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) remained the least effective with 4.00 and 3.87 aphids/three leaves/plant, respectively. The mean aphid population after the first spray indicated that T₂-Imidacloprid 17.8 SL was the most effective treatment with the lowest population (2.29 aphids/three leaves/plant) followed by T₄-Acetamiprid 20 SP (2.41 aphids/three leaves/plant), whereas T₃-Chlorantraniliprole 18.5 SC (3.52 aphids/three leaves/plant) was the least effective insecticide. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) recorded the lowest mean population (3.30 aphids/three leaves/plant) followed by T₉-Azadirachtin (1500 ppm) (3.57 aphids/three leaves/plant), while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) recorded the highest mean population (4.05 aphids/three leaves/plant). The highest reduction over control after the first spray was recorded in T₂-Imidacloprid 17.8 SL (58.72%) followed by T₄-Acetamiprid 20 SP (56.62%), whereas T₃-Chlorantraniliprole 18.5 SC recorded the lowest reduction (36.58%) among insecticides. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) recorded the maximum reduction over control (40.60%) followed by T₉-Azadirachtin (1500 ppm) (35.80%) while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) recorded the minimum reduction (27.04%). Following the second spray, all treatments significantly reduced the aphid population over control. At 3 DAS, T₂-Imidacloprid 17.8 SL recorded the lowest aphid population (1.93 aphids/three leaves/plant) followed by T₄-Acetamiprid 20 SP (2.00 aphids/three leaves/plant) whereas T₃-Chlorantraniliprole 18.5 SC (2.93 aphids/three leaves/plant) was the least effective insecticide. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) was the most effective (2.57 aphids/three leaves/plant) followed by T₉-Azadirachtin (1500 ppm) (3.22 aphids/three leaves/plant) while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) was the least effective (3.67 aphids/three leaves/plant). A similar trend was observed at 7 and 10 DAS, where T₂-Imidacloprid 17.8 SL recorded the lowest aphid population of 1.07 and 0.37 aphids/three leaves/plant,

respectively, followed by T₄-Acetamiprid 20 SP with 1.11 and 0.47 aphids/three leaves/plant. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) remained the most effective with 2.57 and 2.22 aphids/three leaves/plant, followed by T₉-Azadirachtin (1500 ppm) with 3.00 and 2.78 aphids/three leaves/plant, whereas T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) remained the least effective with 3.57 and 3.33 aphids/three leaves/plant, respectively. The mean aphid population after the second spray showed that T₂-Imidacloprid 17.8 SL recorded the lowest aphid population (1.12 aphids/three leaves/plant) followed by T₄-Acetamiprid 20 SP (1.19 aphids/three leaves/plant), whereas T₃-Chlorantraniliprole 18.5 SC (2.68 aphids/three leaves/plant) was the least effective insecticide. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) was the most effective with a mean population of 2.40 aphids/three leaves/plant followed by T₉-Azadirachtin (1500 ppm) (3.00 aphids/three leaves/plant) while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) was the least effective with

3.52 aphids/three leaves/plant. The highest reduction over control after the second spray was recorded in T₂-Imidacloprid 17.8 SL (79.08%) followed by T₄-Acetamiprid 20 SP (77.78%), whereas T₃-Chlorantraniliprole 18.5 SC recorded the lowest reduction (50.10%) among insecticides. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) recorded the highest reduction over control (55.23%) followed by T₉-Azadirachtin (1500 ppm) (44.14%) while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) recorded the lowest reduction (34.39%). Overall, T₂-Imidacloprid 17.8 SL proved to be the most effective insecticidal treatment against aphid by recording the lowest aphid population and highest reduction over control, whereas T₃-Chlorantraniliprole 18.5 SC was found to be the least effective insecticide. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) was the most effective biopesticide, while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) was found to be the least effective treatment against aphid. (Table 1 and Fig 1)

Table 1: Efficacy of Insecticide and Biopesticide against Aphid (*Aphis craccivora*) during Kharif 2024

Tr. No.	Treatments	Dose (a.i./ha)	Population of Aphid/three leaves/plant										
			At day after First spray					% ROC due to 1 st spray	At day after Second spray				% ROC due to 2 nd spray
			DBS	3	7	10	Mean		3	7	10	Mean	
T ₁	Spinosad 45 SC	200 ml	5.78 (2.40)	3.67 (1.92)	3.41 (1.85)	3.00 (1.73)	3.36 (1.83)	39.52	2.57 (1.60)	2.46 (1.57)	2.27 (1.51)	2.43 (1.56)	54.69
T ₂	Imidacloprid 17.8 SL	250 ml	5.56 (2.36)	2.44 (1.56)	2.33 (1.53)	2.11 (1.45)	2.29 (1.51)	58.72	1.93 (1.39)	1.07 (1.03)	0.37 (0.61)	1.12 (1.06)	79.08
T ₃	Chlorantraniliprole 18.5 SC	200 ml	5.44 (2.33)	3.82 (1.95)	3.56 (1.89)	3.19 (1.79)	3.52 (1.88)	36.58	2.93 (1.71)	2.69 (1.64)	2.42 (1.56)	2.68 (1.64)	50.10
T ₄	Acetamiprid 20 SP	120 gm	5.33 (2.31)	2.56 (1.60)	2.44 (1.56)	2.22 (1.49)	2.41 (1.55)	56.62	2.38 (1.41)	1.11 (1.05)	0.47 (0.69)	1.19 (1.09)	77.78
T ₅	Emamectin benzoate 5% SG	200 gm	5.56 (2.36)	3.78 (1.94)	3.52 (1.88)	3.13 (1.77)	3.48 (1.86)	37.42	2.87 (1.69)	2.64 (1.62)	2.33 (1.53)	2.61 (1.62)	51.34
T ₆	<i>Beauveria bassiana</i> 1×10 ⁸ spores/ml	1500 ml	5.67 (2.38)	4.11 (2.03)	3.93 (1.98)	3.74 (1.93)	3.93 (1.98)	29.32	3.57 (1.89)	3.42 (1.85)	3.13 (1.77)	3.37 (1.84)	37.19
T ₇	<i>Metarhizium anisopliae</i> 1×10 ⁸ spores/ml	1500 ml	5.56 (2.36)	4.29 (2.07)	4.00 (2.00)	3.87 (1.97)	4.05 (2.01)	27.04	3.67 (1.92)	3.57 (1.89)	3.33 (1.82)	3.52 (1.88)	34.39
T ₈	<i>Verticillium lecanii</i> 1×10 ⁸ spores/ml	1500 ml	5.67 (2.38)	3.64 (1.91)	3.33 (1.82)	2.93 (1.71)	3.30 (1.82)	40.60	2.57 (1.60)	2.42 (1.56)	2.22 (1.49)	2.40 (1.55)	55.23
T ₉	Azadirachtin (1500 ppm)	2000 ml	5.78 (2.40)	3.74 (1.93)	3.57 (1.89)	3.39 (1.84)	3.57 (1.89)	35.80	3.22 (1.79)	3.00 (1.73)	2.78 (1.67)	3.00 (1.73)	44.14
T ₁₀	Control (Water Spray)		5.33 (2.31)	5.44 (2.33)	5.56 (2.36)	5.67 (2.38)	5.56 (2.36)		5.56 (2.36)	5.33 (2.31)	5.22 (2.29)	5.37 (2.32)	
SE(m)±			-	0.038	0.033	0.046	0.039		0.031	0.063	0.064	0.053	
CD at 5%			NS	0.11	0.10	0.13	0.11		0.092	0.18	0.19	0.15	
CV%			-	3.87	3.44	4.79	4.03		3.25	6.83	6.97	5.68	

3.2 Effect of certain insecticides and biopesticides on the population of *Aphis craccivora* during Kharif 2025

The pre-treatment observation recorded one day before the first spray indicated that the aphid population ranged from 5.22 to 5.67 aphids/three leaves/plant and was statistically non-significant among all the treatments. All insecticidal and biopesticidal treatments significantly reduced the aphid population over control. Among the insecticides, at 3 DAS, T₂-Imidacloprid 17.8 SL recorded the lowest aphid population (2.39 aphids/three leaves/plant) followed by T₄-Acetamiprid 20 SP (2.44 aphids/three leaves/plant), whereas T₃-Chlorantraniliprole 18.5 SC (3.89 aphids/three leaves/plant) was found to be the least effective insecticide. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) was the most effective (3.72 aphids/three leaves/plant) followed by T₉-Azadirachtin (1500 ppm) (3.84 aphids/three leaves/plant), while T₇-*Metarhizium anisopliae*

(1×10⁸ spores/ml) recorded the highest aphid population (4.33 aphids/three leaves/plant). Similar trends were observed at 7 DAS and 10 DAS, where T₂-Imidacloprid 17.8 SL recorded the lowest aphid population of 2.21 and 2.00 aphids/three leaves/plant, respectively, followed by T₄-Acetamiprid 20 SP with 2.29 and 2.22 aphids/three leaves/plant, whereas T₃-Chlorantraniliprole 18.5 SC recorded the highest aphid population among insecticides with 3.64 and 3.29 aphids/three leaves/plant, respectively. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) remained the most effective with 3.00 and 3.00 aphids/three leaves/plant at 7 and 10 DAS, respectively, followed by T₉-Azadirachtin (1500 ppm) with 3.64 and 3.47 aphids/three leaves/plant, while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) remained the least effective with 4.11 and 4.00 aphids/three leaves/plant, respectively. The mean aphid population after the first spray indicated that T₂-

Imidacloprid 17.8 SL was the most effective treatment with the lowest population (2.20 aphids/three leaves/plant) followed by T₄-Acetamiprid 20 SP (2.32 aphids/three leaves/plant), whereas T₃-Chlorantraniliprole 18.5 SC (3.61 aphids/three leaves/plant) was the least effective insecticide. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) recorded the lowest mean population (3.38 aphids/three leaves/plant), followed by T₉-Azadirachtin (1500 ppm) (3.65 aphids/three leaves/plant), while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) recorded the highest mean population (4.15 aphids/three leaves/plant). The highest reduction over control after the first spray was recorded in T₂-Imidacloprid 17.8 SL (59.59%) followed by T₄-Acetamiprid 20 SP (57.45%), whereas T₃-Chlorantraniliprole 18.5 SC recorded the lowest reduction (33.76%) among insecticides. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) recorded the maximum reduction over control (37.92%) followed by T₉-Azadirachtin (1500 ppm) (32.96%), while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) recorded the minimum reduction (23.84%). Following the second spray, all treatments significantly reduced the aphid population over control. At 3 DAS, T₂-Imidacloprid 17.8 SL recorded the lowest aphid population (1.79 aphids/three leaves/plant) followed by T₄-Acetamiprid 20 SP (1.93 aphids/three leaves/plant), whereas T₃-Chlorantraniliprole 18.5 SC (3.00 aphids/three leaves/plant) was the least effective insecticide. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) was the most effective (2.78 aphids/three leaves/plant) followed by T₉-Azadirachtin (1500 ppm) (3.33 aphids/three leaves/plant), while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) was the least effective (3.78 aphids/three leaves/plant). Similar trends were observed at 7 and 10 DAS, where T₂-Imidacloprid 17.8 SL recorded the lowest aphid population of 0.86 and 0.33 aphids/three leaves/plant, respectively, followed by T₄-Acetamiprid 20 SP with 1.00 and 0.39 aphids/three leaves/plant. Among the biopesticides,

T₈-*Verticillium lecanii* (1×10⁸ spores/ml) remained the most effective with 2.57 and 2.33 aphids/three leaves/plant, followed by T₉-Azadirachtin (1500 ppm) with 3.11 and 2.93 aphids/three leaves/plant, while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) remained the least effective with 3.57 and 3.33 aphids/three leaves/plant, respectively. The mean aphid population after the second spray showed that T₂-Imidacloprid 17.8 SL recorded the lowest aphid population (0.99 aphids/three leaves/plant) followed by T₄-Acetamiprid 20 SP (1.11 aphids/three leaves/plant), whereas T₃-Chlorantraniliprole 18.5 SC (2.75 aphids/three leaves/plant) was the least effective insecticide. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) was the most effective with a mean population of 2.56 aphids/three leaves/plant followed by T₉-Azadirachtin (1500 ppm) (3.12 aphids/three leaves/plant), while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) was the least effective with 3.56 aphids/three leaves/plant. The highest reduction over control after the second spray was recorded in T₂-Imidacloprid 17.8 SL (81.38%) followed by T₄-Acetamiprid 20 SP (79.25%), whereas T₃-Chlorantraniliprole 18.5 SC recorded the lowest reduction (48.44%) among insecticides. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) recorded the highest reduction over control (52.00%) followed by T₉-Azadirachtin (1500 ppm) (42.63%), while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) recorded the lowest reduction (33.25%). Overall, T₂-Imidacloprid 17.8 SL proved to be the most effective insecticidal treatment against aphid by recording the lowest aphid population and highest reduction over control, whereas T₃-Chlorantraniliprole 18.5 SC was found to be the least effective insecticide. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) was the most effective, while T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) was found to be the least effective treatment against aphid. (Table 2 and Fig 1).

Table 2: Efficacy of Insecticide and Biopesticide against aphid (*Aphis craccivora*) during Kharif 2025

Tr. No.	Treatments	Dose (a.i./ha)	Population of Aphid/three leaves/plant										
			At day after First spray					% ROC due to 1 st spray	At day after Second spray				% ROC due to 2 nd spray
			DBS	3	7	10	Mean		3	7	10	Mean	
T ₁	Spinosad 45 SC	200 ml	5.56 (2.36)	3.74 (1.93)	3.47 (1.86)	3.11 (1.76)	3.44 (1.85)	36.82	2.87 (1.69)	2.57 (1.60)	2.47 (1.57)	2.64 (1.62)	51.57
T ₂	Imidacloprid 17.8 SL	250 ml	5.44 (2.33)	2.39 (1.55)	2.21 (1.49)	2.00 (1.41)	2.20 (1.48)	59.59	1.79 (1.34)	0.86 (0.93)	0.33 (0.57)	0.99 (1.00)	81.38
T ₃	Chlorantraniliprole 18.5 SC	200 ml	5.33 (2.31)	3.89 (1.97)	3.64 (1.91)	3.29 (1.81)	3.61 (1.90)	33.76	3.00 (1.73)	2.78 (1.67)	2.47 (1.57)	2.75 (1.66)	48.44
T ₄	Acetamiprid 20 SP	120 gm	5.33 (2.31)	2.44 (1.56)	2.29 (1.51)	2.22 (1.49)	2.32 (1.52)	57.45	1.93 (1.39)	1.00 (1.00)	0.39 (0.62)	1.11 (1.05)	79.25
T ₅	Emamectin benzoate 5% SG	200 gm	5.44 (2.33)	3.84 (1.96)	3.57 (1.89)	3.21 (1.79)	3.54 (1.88)	34.98	2.93 (1.71)	2.67 (1.63)	2.39 (1.55)	2.66 (1.63)	51.08
T ₆	<i>Beauveria bassiana</i> 1×10 ⁸ spores/ml	1500 ml	5.67 (2.38)	4.21 (2.05)	4.00 (2.00)	3.87 (1.97)	4.03 (2.01)	26.04	3.67 (1.92)	3.52 (1.88)	3.21 (1.79)	3.47 (1.86)	35.00
T ₇	<i>Metarhizium anisopliae</i> 1×10 ⁸ spores/ml	1500 ml	5.33 (2.31)	4.33 (2.08)	4.11 (2.03)	4.00 (2.00)	4.15 (2.04)	23.84	3.78 (1.94)	3.57 (1.89)	3.33 (1.82)	3.56 (1.89)	33.25
T ₈	<i>Verticillium lecanii</i> 1×10 ⁸ spores/ml	1500 ml	5.33 (2.31)	3.72 (1.93)	3.42 (1.85)	3.00 (1.73)	3.38 (1.84)	37.92	2.78 (1.67)	2.57 (1.60)	2.33 (1.53)	2.56 (1.60)	52.00
T ₉	Azadiractine (1500 ppm)	2000 ml	5.44 (2.33)	3.84 (1.96)	3.64 (1.91)	3.47 (1.86)	3.65 (1.91)	32.96	3.33 (1.82)	3.11 (1.76)	2.93 (1.71)	3.12 (1.77)	42.63
T ₁₀	Control (Water Spray)		5.22 (2.29)	5.33 (2.31)	5.44 (2.33)	5.56 (2.36)	5.44 (2.33)		5.56 (2.36)	5.33 (2.31)	5.11 (2.26)	5.33 (2.31)	
	SE(m)±		-	0.33	0.035	0.048	0.039		0.035	0.063	0.077	0.058	
	CD at 5%		NS	0.10	0.10	0.14	0.11		0.10	0.18	0.23	0.17	
	CV%		-	3.45	3.69	5.01	4.05		3.73	6.84	8.69	6.42	

3.3 Effect of certain insecticides and biopesticides on the population of *Aphis craccivora* during Kharif 2024-2025 (pooled mean)

On the basis of pooled data of two years (Kharif 2024 and 2025) presented in Table 4.50, it was observed that all the treatments differed significantly from the control, which recorded a mean aphid population of (5.43 aphids/three leaves/plant). The minimum and significantly lowest aphid population was recorded in the treatment T₂-Imidacloprid 17.8 SL (1.65 aphids/three leaves/plant), followed by T₄-Acetamiprid 20 SP (1.76 aphids/three leaves/plant), while T₃-Chlorantraniliprole 18.5 SC (3.14 aphids/three leaves/plant) was found to be the least effective among insecticides. Among the biopesticides, T₈-*Verticillium lecanii* (1×10⁸ spores/ml) was the most effective (2.91 aphids/three leaves/plant), followed by T₉-Azadirachtin

(1500 ppm) (3.34 aphids/three leaves/plant), whereas T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) recorded the highest aphid population (3.82 aphids/three leaves/plant), indicating the least effectiveness among biopesticides. percent reduction over control in both the years indicated that T₂-Imidacloprid 17.8 SL was the most effective treatment with 69.69% reduction in aphid population over control, followed by T₄-Acetamiprid 20 SP (67.78%), while T₃-Chlorantraniliprole 18.5 SC recorded the lowest reduction (42.22%) among insecticides. Among the biopesticides, maximum reduction was observed in T₈-*Verticillium lecanii* (1×10⁸ spores/ml) (46.44%), followed by T₉-Azadirachtin (1500 ppm) (38.88%), whereas T₇-*Metarhizium anisopliae* (1×10⁸ spores/ml) recorded the least reduction (29.63%). (Table 3 and Fig 1)

Table 3: Efficacy of Insecticide and Biopesticide against Aphid (*Aphis craccivora*) during Kharif 2024 and 2025 (Pooled mean)

Tr. No.	Treatment	Dose (a.i./ha)	Aphid/three leaves/plant			(%) Reduction over control		
			2024	2025	mean	2024-25	2025-26	mean
T ₁	Spinosad 45 SC	200 ml	2.90 (1.70)	3.04 (1.74)	2.97 (1.72)	47.10	44.19	45.65
T ₂	Imidacloprid 17.8 SL	250 ml	1.71 (1.31)	1.60 (1.26)	1.65 (1.28)	68.90	70.49	69.69
T ₃	Chlorantraniliprole 18.5 SC	200 ml	3.10 (1.76)	3.18 (1.78)	3.14 (1.77)	43.34	41.10	42.22
T ₄	Acetamiprid 20 SP	120 gm	1.80 (1.34)	1.72 (1.31)	1.76 (1.33)	67.20	68.35	67.78
T ₅	Emamectin benzoate 5% SG	200 gm	3.05 (1.74)	3.10 (1.76)	3.07 (1.75)	44.38	43.03	43.70
T ₆	<i>Beauveria bassiana</i> 1×10 ⁸ spores/ml	1500 ml	3.65 (1.91)	3.75 (1.94)	3.70 (1.92)	33.25	30.52	31.89
T ₇	<i>Metarhizium anisopliae</i> 1×10 ⁸ spores/ml	1500 ml	3.79 (1.95)	3.85 (1.96)	3.82 (1.95)	30.72	28.54	29.63
T ₈	<i>Verticillium lecanii</i> 1×10 ⁸ spores/ml	1500 ml	2.85 (1.69)	2.97 (1.72)	2.91 (1.71)	47.92	44.96	46.44
T ₉	Azadiractine (1500 ppm)	2000 ml	3.28 (1.81)	3.39 (1.84)	3.34 (1.83)	39.97	37.80	38.88
T ₁₀	Control (Water Spray)		5.46 (2.34)	5.39 (2.32)	5.43 (2.33)	-	-	-
SE(m)±			0.046	0.049	-			
CD at 5%			0.13	0.14	-			
CV%			4.85	5.23	-			

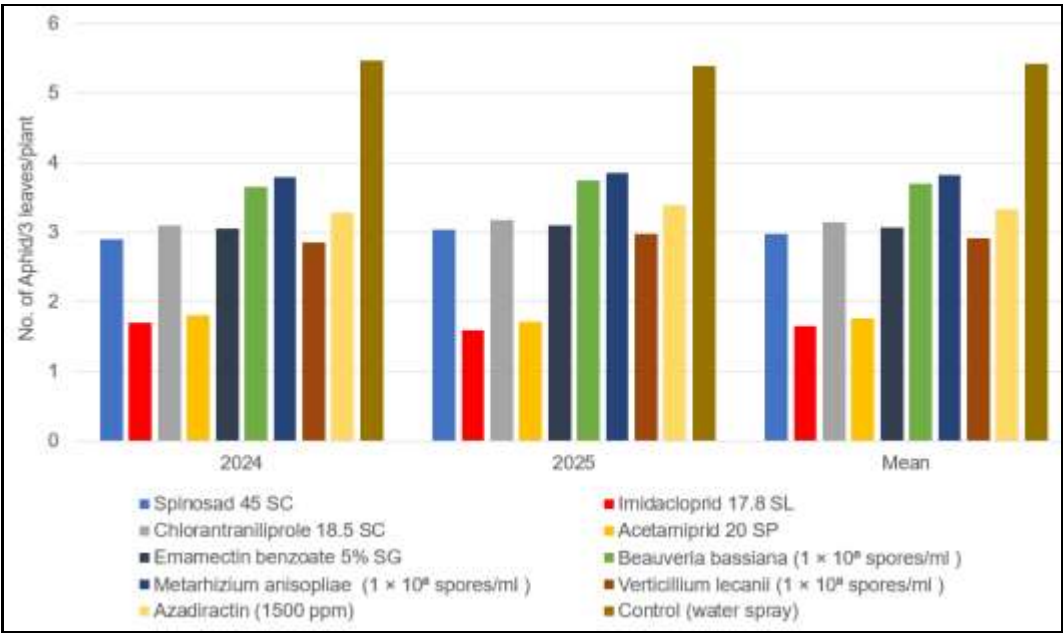


Fig 1: Efficacy of insecticides and biopesticides against Aphid (*A. craccivora*) during Kharif 2024 and 2025

4. Discussion

The present investigation showed that all insecticide and biopesticide treatments effectively reduced the aphid population in comparison to the untreated control plot in both years (2024 and 2025). Among the insecticides, Imidacloprid 17.8 SL was found to be the most effective, recording the lowest aphid population with the highest reduction followed by Acetamiprid 20 SP whereas Chlorantraniliprole 18.5 SC recorded the highest aphid population indicating its least effectiveness among insecticides. Among the biopesticides, *Verticillium lecanii* (1×10^8 spores/ml) was found to be the most effective, recording the lowest aphid population with the highest reduction followed by Azadirachtin (1500 ppm) whereas *Metarhizium anisopliae* (1×10^8 spores/ml) recorded the highest aphid population with the least reduction indicating the least effectiveness among biopesticides. The present findings are in close agreement with ^[10] who reported that Imidacloprid 17.8 SL was the most effective insecticide against *Aphis craccivora* in greengram, recording the lowest aphid population among all the treatments evaluated. This result is also supported by ^[11] who reported that *V. lecanii* caused the highest mortality against aphid among biopesticides, confirming its strong potential for aphid management in green gram.

5. Conclusion

From the present study, it can be concluded that among the insecticides, Imidacloprid 17.8 SL was the best treatment, while Chlorantraniliprole 18.5 SC was found to be the least effective. Among the biopesticides, *Verticillium lecanii* (1×10^8 spores/ml) was found to be the best treatment, whereas *Metarhizium anisopliae* (1×10^8 spores/ml) was found to be the least effective. The efficacy of Spinosad, Emamectin benzoate and Chlorantraniliprole was observed to be comparable or close to that of *Verticillium lecanii*. Overall, insecticides were more effective than biopesticides in reducing aphid population; however, biopesticides also showed effectiveness but to a lesser extent compared to insecticides.

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