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# Impact of Varied Insecticides and Biopesticides on the Fenugreek Aphid, *Myzus persicae* (Sulzer)

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## ABSTRACT

*The field evaluation was carried out to assess the performance of eight insecticides (Dimethoate 30 EC, thiamethoxam 25 WG, imidacloprid 17.8 SL, quinalphos 25 EC) and biopesticides (NSE 5 %, Azadirachtin 1 % and L. lecanii 1.15 WP) at MPKV, Rahuri in during both 2019-20 and 2020-21. A randomized complete block design (RCBD) with an individual plot size of 2 m × 1.5 m. The interval between the foliar applications was 10 days, the first application was given after the pest incidence was noticed, with the help of a knapsack sprayer. The treatment imidacloprid 17.8 SL @ 25 g a.i. ha$^{-1}$ and thiamethoxam 25 WG @ 25 g a.i. ha$^{-1}$ were found to be most effective in reducing the population of fenugreek aphids, Myzus persicae (Sulzer) pursued by dimethoate 30 EC @ 300 g a.i. ha$^{-1}$, and azadirachtin 1% @ 2 ml/l. The imidacloprid 17.8 SL @ 30 g a.i. ha$^{-1}$and thiamethoxam 25 WG @ 25 g a.i. ha$^{-1}$ treated plots obtained the highest yield of 7.44 t ha$^{-1}$ and 7.27 t ha$^{-1}$, respectively. The highest ICBR was recorded in the treatment of imidacloprid (1:30) and thiamethoxam (1:26) treated plots. Neonicotinoids are more effecive against aphids than other tested insecticides.*

***Keywords:*** *Fenugreek, green-peach-aphids, azadirachtin, Thiamethoxam, Imidacloprid, cyantraniliprole and chlorantraniliprole.*

## INTRODUCTION

Fenugreek (*Trigonella foenumgraecum* L.), is the oldest medicinal and leguminous crop belonging to the Fabaceae family, originating in central Asia in 4000 BC [1]. It is being commercially grown in India, Pakistan, Afghanistan, Iran, Nepal, Egypt, France, Spain, Turkey, Morocco, North Africa, the Middle East and Argentina [2]. India is marked by its dominant position in world production *i.e.,* 2.01 lakh tonnes and cultivated over an area of 1.29 lakh ha. However, Rajasthan is a leading producer of fenugreek in the country, with 99 % production [3]. Fenugreek is a richest source of carbohydrates, protein and fat, mineral-like calcium, phosphorus, iron, magnesium, manganese and zinc for human growth [4]. Insect pests are the crucial factor among the various constraints in the production of fenugreek. Several species of aphids that attack fenugreek, but the most common is the green peach aphid, *Myzus persicae* (Sulzer) [5]. They suck the sap from the lower side of leaves and stem causing leaf curling, discoloration of leaves and stunted plant growth [6]. Aphids secrete honeydew that is suitable for the growth of fungi and sooty mold and transmit diseases such as mosaic which reduce the photosynthetic activity and ultimately reduce the yield [3]. Insecticides are an integral part of the management of pest menace. Initial benefits regarding pesticide usage made the farmers mainly rely on this aspect. At present, there are no insecticide is registered and recommended by Central Insecticides Board and Registration Committee (CIB&RC) to control the pests of leafy green vegetables [7].

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Hence, this study was that these studies are framed to evaluate the efficacy of different insecticides for combating aphids in fenugreek.

## MATERIALS AND METHODS

**Experimental site:** The field trial was conducted at Post Graduate Institute Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra (19.34910N, 74.64610E). Fenugreek (Cv Phule Kasuri) was sown during the *Rabi*-2020 and 2021 *Rabi* season.

**Experimental treatments and design:** All agronomic activities (plowing, hoeing, land preparation, basal dose fertilizers, sowing, irrigation and weeding) were carried out in accordance with recommendations for growing of the fenugreek crops with individual plot sizes of 2 m × 1.5 m. An experiment was laid out in a randomized completely block design (RCBD) with four chemical treatments dimethoate 30 EC, thiamethoxam 25 WG, imidacloprid 17.8 SL, quinalphos 25 EC) and three biopesticides (NSE 5 %, *Azadirachtin* 1 % and *L. lecanii* 1.15 WP).

**Preparation of spray solution:** Prepared the spray solution by mixing a measured quantity of test insecticides with a small quantity of water and making desirable volume for the plot. The interval between the foliar applications was 10 days, first application was given after the pest incidence was noticed, with the help of a knapsack sprayer.

**Recording of observation:** The observations on a number of aphids were recorded three leaves of central leaflet of randomly selected and tagged five plants from each plot. Aphid number was counted one day before treatment as pre-count and one, three and seven days after the treatment during both years after application.

**Calculation:** Per cent reduction of aphids was calculated after each spray. The cumulative mean of two sprays in first and second season trials with pooled mean were calculated for recording pests by using formula. At the end, the crop was harvested from each plot, and the yield was computed as t/ha

$$\text{Per cent reduction} = \frac{\text{No. of aphids in control plots- No. aphids on treated plots}}{\text{No. of aphids in control plots}} \times 100$$

$$\text{Yield (kg ha}^{-1}\text{)} = \frac{\text{Yield per plot (kg)}}{\text{Net area of the plot (m}^2\text{)}} \times 10000$$

**Statistical analysis:** The data obtained on the pest infestation and leaf yield was subjected to statistical analysis [8] and R-studio for statistics at a 0.05 level of significance.

## RESULTS AND DISCUSSION

### First year (*Rabi*-2020)

The perusal of the data in Table 1 revealed that all selected insecticides evaluated in this study proved their level of significance over the untreated control throughout the first years (*Rabi*-2019-20) of experimentation. The data obtained after the first application irrespective of the post-application intervals indicated a minimum number of aphids in imidacloprid 17.8 SL @ 25 g a.i. ha$^{-1}$ (4.78 aphids/three leaves). However, it was at par with thiamethoxam 25 WG @ 25 g a.i. ha$^{-1}$ (6.44 aphids/three leaves) and dimethoate 30 EC @ 300 g a.i. ha$^{-1}$ (8.51 aphids/three leaves). The next in the order of efficacy was quinalphos 25 EC @ 250 g a.i. ha$^{1}$ (11.56 aphids/three leaves), *Azadirachtin* 1% @ 2 ml/l (16.02 aphids/leaf) pursued by NSE 5 % (16.53 aphids/three leaves) and *L. lecanii* 1.15 WP (17.66 aphids/three leaves). A greater number of aphids was observed in the untreated control (23.69 aphids/three leaves).

The effectiveness of selected insecticides after second application was more or less similar to the first application indicating that the least number of aphids in imidacloprid was 17.8 SL @ 25 g a.i. ha$^{-1}$ (2.24 aphids/three leaves). The next treatment in the order of effectiveness, is thiamethoxam 25 WG @ 25 g a.i. ha-1 (3.82 aphids/three leaves), dimethoate 30 EC @ 300 g a.i. ha$^{-1}$ (5.69 aphids/three leaves) and quinalphos 25 EC @ 250 g a.i. which were at par with each other. Among the biopesticides the *Azadirachtin* 1 % @ 2 ml/l (11.27 aphids/three leaves) pursued by NSE 5 % (11.56 aphids/three leaves) and *L. laccani* 1.15 WP @ 5g/l (12.51 aphids/three leaves) with untreated control showed highest number of aphids (25.18 aphids/three leaves).

The mean population of aphids during the first season (*Rabi*-2019-20) indicated that the imidacloprid 17.8 SL @ 25 g a.i. ha$^{-1}$ (3.51 aphids/three leaves) recorded the lowest aphids amongst the insecticides and biopesticides treatments. The next treatment after that is thiamethoxam 25 WG @ 25 g a.i. ha$^{-1}$ (5.13 aphids/three leaves) pursued by dimethoate 30 EC @ 300 g a.i. ha$^{-1}$ (7.10 aphids/three leaves) and quinalphos 25 EC @ 250 g a.i. ha$^{-1}$ (9.36 aphids/three leaves). Among the selected biopesticides *Azadirachtin* 1% @ 2 ml/l (13.56 aphids/three leaves) pursued by NSE 5 % (14.04 aphids/three leaves) and *L. lecanii* 1.15 WP @ 5 g/l (15.09 aphids/three leaves) with the highest number of aphid population in the untreated control (24.44 aphids/leaf).

### Second year (*Rabi*-2021)

The findings in Table 1 revealed that the chosen pesticides evaluated in these studies experimented with insecticides level of significance above untreated controls throughout the second season (*Rabi*-2020-21) of investigation. The mean data obtained after the first application irrespective of the pre-count application indicated the least number of aphids in imidacloprid 17.8 SL @ 25 g a.i. ha$^{-1}$ (2.36 aphids/leaf) which was at par with thiamethoxam 25 WG @ 25 g a.i. ha$^{-1}$ (3.28 aphids/leaf), dimethoate 30 EC @ 300 g a.i. ha$^{-1}$ (5.17 aphids/three leaves) and quinalphos 25 EC @ 250 g a.i. ha$^{-1}$ (8.56 aphids/three leaves). The next in the order of effectiveness was biopesticides *Azadirachtin* 1% @ 2 ml/l (13.35 aphids/three leaves) pursued by NSE 5 % (13.91 aphids/three leaves) and *L. lecanii* 1.15 WP (14.42 aphids/three leaves). The maximum number of aphids was observed in untreated control (20.68 aphids/leaf).

The effectiveness of selected insecticides and biopesticides after the second application during the second season (*Rabi*-2020-21) are presented in Table 1. The results is more or less similar to the first application indicating that the least number of aphids in imidacloprid is 17.8 SL @ 25 g a.i. ha$^{-1}$ (1.50 aphids/three leaves). The next treatment in order of effectiveness, is thiamethoxam 25 WG @ 25 g a.i. ha$^{-1}$ (2.46 aphids/three leaves) and dimethoate 30 EC @ 300 g a.i. ha$^{-1}$ (3.36 aphids/three leaves) which were at par with each other, pursued by quinalphos 25 EC @ 250 g a.i. ha$^{-1}$ (4.47 aphids/three leaves). Amongst the biopesticides the *Azadirachtin* 1 % @ 2 ml/l (9.05 aphids/three leaves) pursued by NSE 5 % (9.68 aphids/three leaves) and *L. leccanii* 1.15 WP @ 5g/l (10.49 aphids/three leaves) with untreated control showed highest number of aphids (22.41 aphids/three leaves). The mean population of aphids during the second season (*Rabi*-2020-21) indicated that the imidacloprid 17.8 SL @ 25 g a.i. ha$^{-1}$ (1.93 aphids/three leaves) which was the lowest amongst the insecticides and biopesticides treatments. Next treatment after thiamethoxam 25 WG @ 25 g a.i. ha$^{-1}$ (2.87 aphids/three leaves) pursued by dimethoate 30 EC @ 300 g a.i. ha$^{-1}$ (4.26 aphids/three leaves) and quinalphos 25 EC @ 250 g a.i. ha$^{-1}$ (6.51 aphids/three leaves). Amongst the selected biopesticides *Azadirachtin* 1% @ 2 ml/l (11.20 aphids/three leaves) pursued by NSE 5 % (11.79 aphids/three leaves) and *L. lecanii* 1.15 WP @ 5 g/l (12.46 aphids/three leaves) with the highest number of aphid population in untreated control (21.55 aphids/three leaves).

### Pooled data over two seasons 2020 and 2021

The pooled data after two seasons 2019-20 and 2020-21 presented in Table 2 showed almost the same or similar order of effectiveness. All selected insecticides and biopesticides proved significant over untreated control. The least number of aphids was observed in imidacloprid 17.8 SL @ 25 g a.i. ha$^{-1}$ (2.76 aphids/three leaves) in the effectiveness, next to that was thiamethoxam 25 WG @ 25 g a.i. ha$^{-1}$ (3.97 aphids/three leaves) pursued by dimethoate 30 EC @ 300 g a.i. ha$^{-1}$ (5.68 aphids/three leaves) and quinalphos 25 EC @ 250 g a.i. ha$^{-1}$ (7.94 aphids/three leaves) which were at par with imidacloprid 17.8 SL @ 25 g a.i. ha$^{-1}$. Amongst the selected biopesticides *Azadirachtin* 1 % @ 2ml/l, proved best for controlling the aphid's number (12.43 aphids/three leaves) pursued by NSE 5 % (12.91 aphids/three leaves) and *L. leccanii* 1.15 WP @ 5 g/l (13.77 aphids/three leaves) and the highest number of aphids was observed in untreated control (22.97 aphids/three leaves).

The data from (Table 2 & fig. 1) shows a reduction over control of aphids on fenugreek for each treatment. When compared to the untreated control, all of the selected treatments dramatically reduced the aphid population. The best treatment amongst the selected insecticides was found imidacloprid 17.8 SL @ 25 g a.i. $ha^{-1}$ and observed 87.98 per cent reduction over control. Next to that was thiamethoxam 25 WG @ 25 g a.i. $ha^{-1}$, dimethoate 30 EC @ 300 g a.i. $ha^{-1}$ and quinalphos 25 EC @ 250 g a.i. $ha^{-1}$ and observed an 82.71, 75.27 and 65.43 per cent reduction over control, respectively. Amongst the biopesticides *Azadirachtin* 1 % @ 2 ml/l was found best to reduce aphids' population (45.88%) reduction over control pursued by NSE 5%, (43.79%) per cent reduction over control and *L. lecanii* 1.15 WP @ 5 g/l (40.05%) per cent reduction over control.

**Yield and cost economic of selected treatments**

The data revealed that the average yield and cost economics of two years are presented in Tables 3, 4. All the treatments were found significantly higher than the untreated control (4.88 t $ha^{-1}$). The plot was treated with imidacloprid 17.8 SL @ 25 g a.i. $ha^{-1}$ registered the highest yield of 7.44 t $ha^{-1}$ with a maximum (52.45%) increase in yield over control. This was pursued by thiamethoxam 25 WG @ 25 g a.i. $ha^{-1}$ (7.27 t $ha^{-1}$ with 48.97% increase), dimethoate 30 EC @ 300 g a.i. $ha^{-1}$ (6.69 t $ha^{-1}$ with 37.09% increase yield) and quinalphos 25 EC @ 250 g a.i. $ha^{-1}$ (6.68 t $ha^{-1}$ with 36.88 % increase yield). Next best treatments with higher yield were, *Azadirachtin* 1 % @ 2 ml/l (6.02 t $ha^{-1}$ with 23.36% increase yield), NSE 5 % (6.08 t $ha^{-1}$ with 24.59% increase yield) and *L. lecanii* 1.15 WP @ 5 g/l (5.86 t $ha^{-1}$ with 20.08% increase yield). The cost-effectiveness of the different insecticides used during the study was assessed. The ICBR in respect of different treatments ranged between 1:30.49 to 1:3.65 The highest ICBR was recorded (1:30.49) in the treatment of imidacloprid 17.8 SL @ 25 g a.i. $ha^{-1}$. It was pursued by thiamethoxam 25 WP @ 25 g a.i. $ha^{-1}$ (1:26.79). The dimethoate 30 EC @ 300 g a.i. $ha^{-1}$ (1:13.67), quinalphos 25 EC @ 250 g a.i. $ha^{-1}$ and NSE 5 %, were recorded 1:13.16 and 1:13.12, respectively. Whereas, *L. lecanii* 1.15 WP @ 5 g/l (1:7.91) and *Azadirachtin* 1 % (10000 PPM) @ 2 ml/l were recorded (1:3.65) ICBR which is lowest among the all treatments.

The overall order of effectiveness of selected insecticides and biopesticides against aphids on fenugreek was: imidacloprid 17.8 SL @ 25 g a.i. $ha^{-1}$ > thiamethoxam 25 WP @ 25 g a.i. $ha^{-1}$ > dimethoate 30 EC @ 300 g a.i. $ha^{-1}$ > Azadirachtin 1 % @ 2 ml/l > NSE 5 % followed by *L. lecanii* 1.15 WP @ 5 g/l > control. [9] stated that commercially available imidacloprid effectively reduced the number of green peach aphids in spinach which is also indicated in this investigation found superior by reducing aphids' population very effective in fenugreek. As smiler trend of results was reported by [10] who observed approximately 96% of the nymphs and adults were killed by 3 ml/L of imidacloprid. [11] also reported that imidacloprid proved highly toxic to chili aphids. [12] showed that the imidacloprid and thiamethoxam were found superior to reducing aphids, *Myzus persicae* population. This treatment also recorded the highest yield as compared to other treatments.

Similar, result was recorded in potatoes; in cluster bean; in cowpeas; and in okra [13-16]. In the present finding, imidacloprid, thiamethoxam among the insecticides and *Azadirachtin* among the biopesticides were found best by reducing aphids' population in fenugreek, which is also stated by earlier research workers thus it can be inferred that the results obtained in this research are said to be in line with earlier research.

## CONCLUSION

On the basis of two years of summary, it is concluded that the imidacloprid 17.8 SL @ 25 g a.i. $ha^{-1}$ was the most effective treatment against aphids, *Myzus persicae* of fenugreek with recording highest yield and ICBR, pursued by thiamethoxam 25 WG @ 25 g a.i. $ha^{-1}$, dimethoate 30 EC @ 300 g a.i. $ha^{-1}$. Among the biopesticides the *Azadirachtin* 1% @ 2 ml/l was found to be effective in reducing aphid population and recorded the highest yield and ICBR amongst biopesticides. Quinalphos 25 EC @ 250 g a.i. $ha^{-1}$, NSE 5% and *L. lecanii* were the least effective treatments against aphid population, yield and ICBR in this experiment.

## FUTURE SCOPE

The finding of this research is helpful to those marginal farmers who grow fenugreek as the main crop to strengthen their family. This research finding maximized the fenugreek leaf yield by avoiding yield loss caused by insect pests by applying specific chemicals for controlling this pest. The efficacy testing of insecticides against pests of minor vegetables and leafy vegetables is, unfortunately, an often-overlooked area of research. It is crucial to suggest some insecticides that can protect minor vegetables by testing new molecules against the insect pests of these crops.


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## AUTHORS' CONTRIBUTION STATEMENTS

Conceptualization: performed the field and laboratory workload, data collection, Formal analysis, writing - original draft preparation [**Sojwal Shinde & Chidanand Patil**] and designed and supervised the field experiment, Methodology, review & suggestion manuscript. [**Chidanand Patil, Somnath Pawar & Bhaidas Deore**].

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.


## FUNDING

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*Table 1 Bio-efficacy of insecticides and biopesticides against aphids on fenugreek (Pooled data, Rabi-2020 & 2021)*

| | Treatment with Doses (g a.i. ha$^{-1}$) | Number of survival aphids per leaf | | | | | | | | | | Pooled over 2019-2020 | Number of survival aphids per leaf | | | | | | | | | | Pooled over 2019-2020 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | First Application | | | | | Second Application | | | | | | First Application | | | | | Second Application | | | | | |
| | | Pre-Count | Post treatment observation at | | | First spray Mean | Pre-Count | Post treatment observation at | | | Second spray Mean | | Pre-Count | Post treatment observation at | | | First spray Mean | Pre-Count | Post treatment observation at | | | Second spray Mean | |
| | | | 1 DAA | 3 DAA | 7 DAA | | | 1 DAA | 3 DAA | 7 DAA | | | | 1 DAA | 3 DAA | 7 DAA | | | 1 DAA | 3 DAA | 7 DAA | | |
| $T_1$ | Dimethoate 30 EC @ 300 | 19.80 (4.50) | 10.08 (3.25) | 9.10 (3.10) | 6.33 (2.60) | 8.51 (3.00) | 10.80 (3.34) | 8.67 (3.03) | 5.07 (2.35) | 3.33 (1.93) | 5.69 (2.48) | 7.10 (2.74) | 16.80 (4.15) | 7.08 (2.75) | 5.10 (2.36) | 3.33 (1.96) | 5.17 (2.38) | 8.47 (2.98) | 5.67 (2.48) | 2.07 (1.60) | 2.33 (1.68) | 3.36 (1.96) | 4.26 (2.17) |
| $T_2$ | Thiamethoxam 25 WG @ 25 | 20.33 (4.56) | 9.50 (3.16) | 6.17 (2.58) | 3.67 (2.04) | 6.44 (2.63) | 10.77 (3.34) | 5.47 (2.43) | 3.33 (1.95) | 2.67 (1.77) | 3.82 (2.08) | 5.13 (2.36) | 17.33 (4.22) | 6.50 (2.64) | 2.17 (1.63) | 1.17 (1.29) | 3.28 (1.94) | 7.43 (2.78) | 3.97 (2.11) | 1.76 (1.50) | 1.67 (1.47) | 2.46 (1.68) | 2.87 (1.81) |
| $T_3$ | Imidacloprid 17.8 SL @ 25 | 22.73 (4.82) | 7.33 (2.80) | 4.67 (2.27) | 2.33 (1.68) | 4.78 (2.29) | 11.40 (3.39) | 3.67 (2.04) | 2.00 (1.56) | 1.07 (1.25) | 2.24 (1.65) | 3.51 (1.97) | 19.73 (4.49) | 4.33 (2.20) | 1.67 (1.47) | 1.08 (1.26) | 2.36 (1.69) | 7.40 (2.79) | 2.17 (1.63) | 1.33 (1.35) | 1.00 (1.22) | 1.50 (1.46) | 1.93 (1.58) |
| $T_4$ | Quinalphos 25 EC @ 250 | 21.67 (4.71) | 14.67 (3.89) | 11.67 (3.49) | 8.33 (2.97) | 11.56 (3.47) | 10.80 (3.34) | 9.80 (3.21) | 6.33 (2.60) | 5.33 (2.41) | 7.16 (2.77) | 9.36 (3.12) | 18.67 (4.37) | 11.67 (3.49) | 8.67 (3.02) | 5.33 (2.41) | 8.56 (3.01) | 13.07 (3.64) | 6.80 (2.70) | 4.27 (2.18) | 2.33 (1.68) | 4.47 (2.23) | 6.51 (2.62) |
| $T_5$ | NSE 5 % | 20.07 (4.53) | 19.67 (4.49) | 16.73 (4.15) | 13.08 (3.69) | 16.53 (4.13) | 14.40 (3.82) | 13.78 (3.78) | 11.08 (3.40) | 9.80 (3.21) | 11.56 (3.47) | 14.04 (3.80) | 17.07 (4.19) | 16.65 (4.14) | 13.73 (3.77) | 11.33 (3.44) | 13.91 (3.79) | 13.07 (3.64) | 11.00 (3.39) | 9.33 (3.13) | 8.71 (3.03) | 9.68 (3.19) | 11.79 (3.49) |
| $T_6$ | *Azadirachtin* 1 % @ 2ml/l | 20.93 (4.63) | 19.20 (4.44) | 16.33 (4.10) | 12.52 (3.61) | 16.02 (4.06) | 15.26 (3.94) | 13.47 (3.74) | 10.69 (3.34) | 9.67 (3.19) | 11.27 (3.43) | 13.56 (3.74) | 17.93 (4.29) | 16.20 (4.09) | 13.53 (3.75) | 10.33 (3.29) | 13.35 (3.72) | 13.26 (3.68) | 10.54 (3.32) | 9.13 (3.10) | 7.47 (2.82) | 9.05 (3.09) | 11.20 (3.41) |
| $T_7$ | *L. lecanii* 1.15 WP @ 5g/l | 21.60 (4.70) | 21.08 (4.64) | 17.23 (4.21) | 14.67 (3.89) | 17.66 (4.26) | 16.94 (4.12) | 14.53 (3.88) | 12.67 (3.63) | 10.33 (3.29) | 12.51 (3.60) | 15.09 (3.93) | 18.60 (4.37) | 17.66 (4.26) | 19.94 (3.80) | 11.67 (3.49) | 14.42 (3.86) | 13.27 (3.66) | 12.17 (3.56) | 10.05 (3.25) | 9.26 (3.12) | 10.49 (3.31) | 12.46 (3.59) |
| $T_8$ | Untreated control | 22.33 (4.78) | 23.20 (4.87) | 23.53 (4.90) | 24.33 (4.98) | 23.69 (4.92) | 24.94 (4.99) | 25.05 (5.05) | 25.17 (50.07) | 25.33 (5.08) | 25.18 (5.18) | 24.44 (4.99) | 19.33 (4.45) | 20.38 (4.57) | 20.79 (4.61) | 20.87 (4.62) | 20.68 (4.60) | 20.91 (4.59) | 21.99 (4.74) | 22.40 (4.79) | 22.85 (4.83) | 22.41 (4.78) | 21.55 (4.69) |
| | S. Em ± | 0.69 | 0.91 | 0.50 | 0.60 | 0.53 | 1.16 | 3.30 | 0.51 | 0.42 | 0.43 | 0.48 | 0.57 | 1.22 | 0.54 | 0.52 | 0.50 | 1.20 | 2.96 | 0.39 | 0.37 | 0.33 | 0.42 |
| | CD @ 5% | - | NS | 1.51 | 1.81 | 1.62 | - | NS | 1.54 | 1.27 | 1.30 | 1.40 | - | NS | 1.63 | 1.57 | 1.51 | - | NS | 1.19 | 1.12 | 0.99 | 1.22 |
| | CV (%) | - | NS | 5.55 | 7.87 | 7.02 | - | NS | 7.45 | 7.59 | 7.50 | 8.65 | - | NS | 7.39 | 8.89 | 8.46 | - | NS | 7.31 | 8.50 | 7.15 | 10.00 |

*DBT: Day before treatment, DAT: Days after treatment, NS: Non-significant. Figures in the parentheses are square root transformed values.*

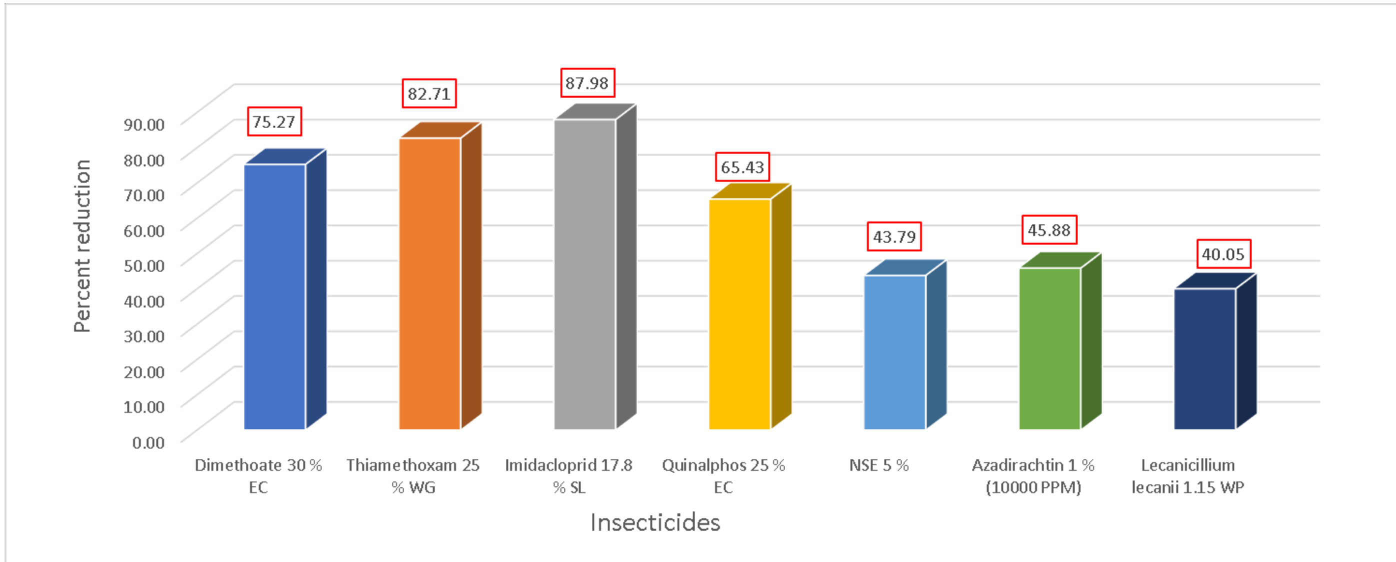


*Fig. 1 Percent reduction of fenugreek aphids over control during Rabi-2020-2021*

***Table 2. Overall efficacy of insecticides and biopesticide against aphids on fenugreek during Rabi-2020-21***

| Sr. No. | Treatment with Doses (g. a.i. ha$^{-1}$) | Number of survival aphids per leaf | | | Per cent reduction over control |
|---|---|---|---|---|---|
| | | Post treatment observation | | | |
| | | 2019-20 | 2020-21 | Overall Pooled | |
| $T_1$ | Dimethoate 30 EC @ 300 | 7.10 (2.74) | 4.26 (2.17) | 5.68 (2.47) | 75.27 |
| $T_2$ | Thiamethoxam 25 WG @ 25 | 5.13 (2.36) | 2.87 (1.81) | 3.97 (2.09) | 82.71 |
| $T_3$ | Imidacloprid 17.8 SL @25 | 3.51 (1.97) | 1.93 (1.58) | 2.76 (1.79) | 87.98 |
| $T_4$ | Quinalphos 25 EC @ 250 | 9.36 (3.12) | 6.51 (2.62) | 7.94 (2.89) | 65.43 |
| $T_5$ | NSE 5 % | 14.04 (3.80) | 11.79 (3.49) | 12.91 (3.66) | 43.79 |
| $T_6$ | *Azadirachtin* 1 % @ 2ml/l | 13.56 (3.74) | 11.20 (3.41) | 12.43 (3.59) | 45.88 |
| $T_7$ | *Lecanicillium lecanii* 1.15 WP @ 5g/l | 15.09 (3.93) | 12.46 (3.59) | 13.77 (3.77) | 40.05 |
| $T_8$ | Untreated control | 24.44 (4.99) | 21.55 (4.69) | 22.97 (4.84) | - |
| S. Em ± | | 0.48 | 0.42 | 0.45 | - |
| CD @ 5% | | 1.40 | 1.22 | 1.31 | - |
| CV (%) | | 8.65 | 10.00 | 9.25 | - |

***Table 3. Effect of insecticides and biopesticides against aphids on yield of fenugreek during Rabi 2020-2021***

| Treatmentdetails | | Dose (g. a.i. ha$^{-1}$) | Yield (t ha$^{-1}$) | | | % Increase in yield over control |
|---|---|---|---|---|---|---|
| | | | 1st year (2020) | 2ed year (2021) | Average of two years | |
| $T_1$ | Dimethoate 30 EC | 300 | 6.94 | 6.44 | 6.69 | 37.09 |
| $T_2$ | Thiamethoxam 25 WG | 25 | 7.33 | 7.20 | 7.27 | 48.97 |
| $T_3$ | Imidacloprid 17.8 SL | 25 | 7.49 | 7.39 | 7.44 | 52.45 |
| $T_4$ | Quinalphos 25 EC | 250 | 6.78 | 6.58 | 6.68 | 36.88 |
| $T_5$ | NSE 5 % | --- | 6.11 | 6.06 | 6.08 | 24.59 |
| $T_6$ | *Azadirachtin* 1 % (10000 PPM) | 2ml/l | 6.06 | 5.98 | 6.02 | 23.36 |
| $T_7$ | *L. lecanii* 1.15 WP | 5g/l | 5.92 | 5.80 | 5.86 | 20.08 |
| $T_8$ | Untreated control | --- | 5.01 | 4.74 | 4.88 | --- |
| S.Em ± | | | 0.31 | 0.34 | 0.32 | --- |
| CD @ 5% | | | 0.93 | 1.03 | 0.94 | --- |
| CV (%) | | | 8.19 | 9.39 | 8.51 | --- |

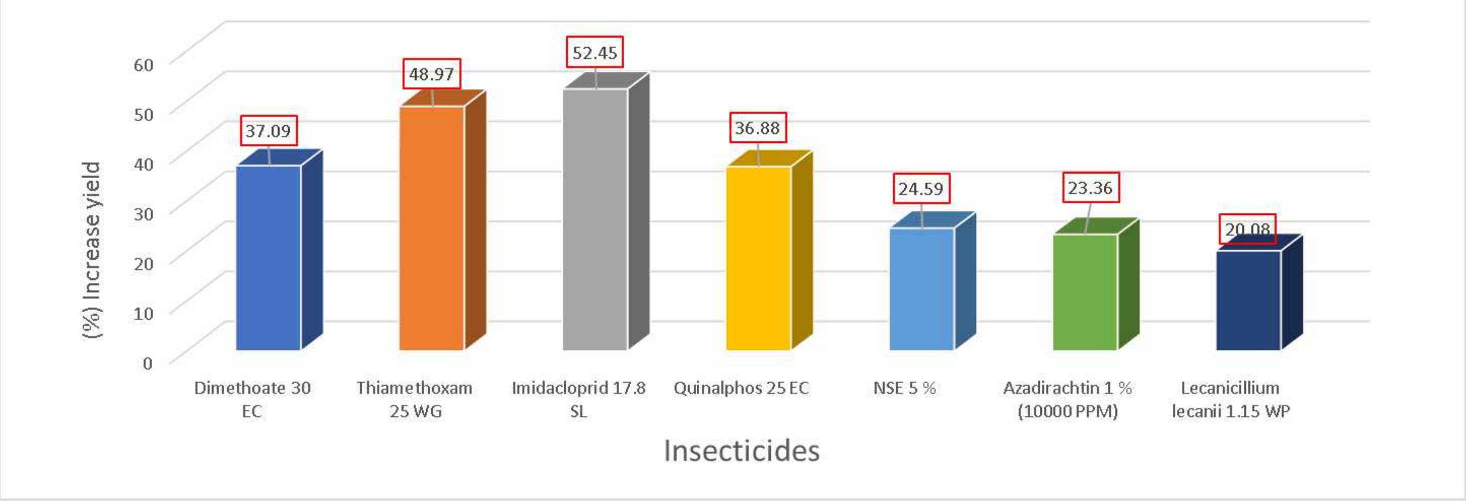


***Fig. 2 Effect of insecticides and biopesticides against aphids on yield of fenugreek during Rabi 2020-2021***

 

*Table 4. Cost economics of insecticides & biopesticides against fenugreek aphids during Rabi 2020-2021.*

| | Treatment details | Dose (g a.i. ha$^{-1}$) | Yield (t ha$^{-1}$) A | Increased yield over control (t ha$^{-1}$) C | Increased returns over control (Rs.) D | Additional cost of insecticide and spraying (Rs. ha-1) E | Net returns (Rs. ha$^{-1}$) F=D-E | ICBR G= F/E |
|---|---|---|---|---|---|---|---|---|
| $T_1$ | Dimethoate 30 EC | 300 | 6.69 | 1.81 | 36200 | 2440 | 33760 | 1:13.84 |
| $T_2$ | Thiamethoxam 25 WG | 25 | 7.27 | 2.39 | 47800 | 1720 | 46080 | 1:26.79 |
| $T_3$ | Imidacloprid 17.8 SL | 25 | 7.44 | 2.56 | 51200 | 1580 | 49574 | 1:30.49 |
| $T_4$ | Quinalphos 25 EC | 250 | 6.65 | 1.77 | 35400 | 2500 | 32900 | 1:13.16 |
| $T_5$ | NSE 5 % | --- | 6.08 | 1.20 | 24000 | 1700 | 22300 | 1:13.12 |
| $T_6$ | Azadirachtin 1 % (10000 PPM) | 2g/l | 6.02 | 1.14 | 22800 | 4900 | 17900 | 1:3.65 |
| $T_7$ | *Lecanicillium leccani* 1.15 WP | 5g/l | 5.86 | 0.98 | 19600 | 2200 | 17400 | 1:7.91 |
| $T_8$ | Untreated control | --- | 4.88 | --- | --- | --- | --- | --- |
| Dimethoate 30EC-Rs. 620/l. | | | Thiamethoxam 25 WG- Rs. 260/100 g | | | NSE 5 %- Rs. 250 per 25 Kg/ha | | |
| Quinalphos 25 EC- Rs. 650/l. | | | Imidacloprid 17.8SL-Rs. 190/125ml | | | *L. lecanii* - Rs. 200 Kg/ha | | |
| Azadirachtin 1 % -Rs. 1850/l. | | | Spinach-Rs. 20,000/- tonne | | | Total cost of labour - Rs. 1200/ha | | |

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