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# Comparative Efficacy and Economics of Selected Chemicals with Neem Oil against Mustard Aphid, *Lipaphis erysimi* (Kaltenbench)

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***Authors' contributions***

*This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.*

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## ABSTRACT

The research was carried out at Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, Central Research Field, during *Rabi* season from november 2023- march 2024. The insecticide management experiment was conducted under Randomized Block Design (RBD) with the eight treatments and three replications by undertaking two spraying with fifteen-day intervals. The insecticides tested significantly reduced the pest population compared to control. Among the eight treatments evaluated for their efficacy in field condition against mustard aphids was recorded in treatment Neem oil 5% + Imidacloprid 17.8 SL (6.95) which was the minimum aphid population, followed by Imidacloprid 17.8 SL (8.46), Neem oil 5% +

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Acetamiprid 20% SP (9.78), Acetamiprid 20% SP (10.45), Neem oil 5% + Cypermethrin 10% EC (11.27), Cypermethrin 10% EC (11.55) and Neem oil 5% (12.01). The maximum aphid population was recorded in control plot (23.33 per 5 plant). Based on the results obtained in the investigation it is concluded that Imidacloprid 17.8SL with Neem oil and chemicals combined with neem oil could be utilized as a component in Integrated Pest Management of *Lipaphis erysimi* (Kalt.) on mustard. Similarly, the result revealed that the maximum C:B was recorded by treatment Neem oil 5%+ Imidacloprid 17.8% SL (1:2.77) followed by Imidacloprid 17.8% SL (1:2.67) and the minimum Cost Benefit Ratio was recorded in the control plot (1:1.27). The combination of Neem oil 5% and Imidacloprid 17.8 SL has offered cost-effective solutions that they effectively control aphid populations at lower costs. Thus, integrated pest management (IPM) approaches combining chemical treatments with cultural, biological, and mechanical controls may provide sustainable and cost-effective solutions in the long term.

*Keywords: Acetamiprid; imidacloprid; cypermethrin; mustard aphid; neem oil.*

## 1. INTRODUCTION

"Indian mustard (*Brassica juncea*) is an annual growing perennial herb and is one of the important oilseed crops in the world after soybean and palm" [1]. "It belongs to the family (*Brassicaceae*) Cruciferae. *Brassica juncea* is mostly cultivated for edible vegetable oil production and have a long list of history owing to their cultivation and varied use and a major contributor in World's agricultural economy. They are widely cultivated as spices as condiments throughout the world both for human consumption and also for livestock feedings. India comes third as in mustard production after Canada and China" [2].

*"Lipaphis erysimi* belongs to family Aphididae and is commonly known as mustard aphid. It is a cosmopolitan insect and found on both the leaf surfaces and in leaf folds of developing heads, on leaf stalks, and on leaf axils. They are found primarily on the growing points of the host plants, including tips, flowers and developing pods and cover the whole plant with high density" [3,4]. "They suck sap from the hosts and infested plants become stunted and distorted. Their infestation causes wilting, yellowing and stunting of plants" [5]. "On the other hand, aphid produces a good amount of honey dew which facilitates the growth of the fungus that makes the leaves and pods appear dirty black and also interferes in the photosynthetic activity of the leaves" [6]. It is predominant and capable of causing up to 96 % yield losses and 5-6per cent reduction in oil content [7].

"Mustard aphid causes significant yield losses in many crops in the family Brassicaceae, which includes mustards and crucifers. Continued feeding by aphids causes yellowing, wilting and stunting of plants. Severely infested plants become covered with a mass of small sticky aphids, which can eventually lead to death and decay. Mustard aphids feed on the underside of the leaves and on the centre of the mustard head. Many controlling measures are adopted to manage the mustard aphid population below economic injury level like chemical, mechanical, physical, cultural, host plant resistance and biological control. Among these, at severe attack, chemical control is very important and provides significant control" [8,9].

"Neem is the best botanical used to control the pest. Some chemicals like Imidacloprid, Acetamiprid, cypermethrin, etc also used as efficient pest management practices. Larvae will hatch from winter eggs attached to the undersides of plant leaves. As aphids grow, they will feed on the leaves similar to other predatory bugs like thrips. Once the first signs of browning or wilting leaves appear, you can apply neem oil to your plant. Additionally, you can introduce ladybugs, which are natural predators of aphids" [10,11].

However, their heavy and extensive use has created various health and environmental problems. As we can't completely avoid chemical pesticides all of a sudden. So to avoid these problems, use of some of the environmentally safer botanicals and chemical pesticides is gaining momentum these days. In recent years various type of insecticides belonging to botanicals and chemical group were used as spray to manage pest complex. Sometimes we don't know about best insecticide for aphid control, so best one can be identified for the management of mustard aphid on mustard by potential evaluation of few selected chemicals and with neem oil through their comparative effectiveness.

## 2. MATERIALS AND METHODS

The field experiment was carried out at the Central Research Farm of Agriculture Technology and Sciences, Prayagraj, during the rabi season from November 2023 to March 2024. The trial was laid out in a Randomized Block Design with eight treatments, namely Neem oil 5%, Imidacloprid 17.8 SL, Acetamiprid 20% SP, Cypermethrin 10% EC, and these chemicals combined with neem oil, with three replications. For the research, the Black Gold mustard variety was used with a spacing of 45x30 cm and the recommended agronomic practices were followed. Foliar spray of different treatments was applied at 1000L/ha and the aphid counts were taken 24 hours before spraying on 5 tagged plants per treatment, which were then converted to per plant population. Subsequent observations were recorded at 3, 7, and 14 days after spraying on the same plants. The chemicals were sprayed at recommended doses when the ETL level reached 10%. The spray solution was applied using a hand compression sprayer. Spraying was done at dawn and dusk, ensuring minimal wind currents. The F-test was used to determine the significant difference between the recorded data.

The desired concentration of insecticidal spray solution for each treatment was freshly prepared at the site of the experiment, just before the start of spraying operations. The quantity of spray materials required for the crop was gradually increased as the crop advanced in age.

The spray solution of desired concentration should be prepared by adopting the following formula:

$$V=((C\times A) )/(\%\ a.i.)$$

Where,

V =Volume of a formulated pesticide required.
C = Concentration required.
A = Volume of total solution to be prepared.
% a.i. = Percentage of active ingredient in the formulation

### 2.1 Economics

The marketable yield obtained from different treatments was collected and weighed. Cost effectiveness of each treatment was assessed based on net returns. Net return of each treatment should be worked out by deducting total cost of the treatment from gross returns. Total cost of production includes both cultivation as well as plant protection charges [12].

Gross return = Marketable Yield x Market price
Net return = Gross return – Total cost
C: B Ratio = (Gross return) / (Total cost of cultivation)

## 3. RESULTS AND DISCUSSION

The present study was under taken at Central Research Field, SHUATS, Prayagraj U.P. The data so obtained through observation on various aspects were subjected to statistical analysis wherever necessary and the data was compiled. Results thus obtained are present aspects wise here undertaken at central Research Farm, SHUATS, Prayagraj, UP. The data obtained through observations on various aspects were subjected to statistical analysis wherever necessary, and the data were compiled. The results are presented as follows: The percentage of damage revealed that the minimum population of aphids (*Lipaphis erysimi*) was recorded in $T_5$ (Neem oil 5% + Imidacloprid 17.8 SL), with the lowest infestation of 6.95 aphids per plant. This was followed by $T_3$ (Imidacloprid 17.8 SL) with 8.46 aphids per plant, $T_7$ (Neem oil 5% + Acetamiprid 20% SP) with 9.78 aphids per plant, $T_2$ (Acetamiprid 20% SP) with 10.45 aphids per plant, $T_6$ (Neem oil 5% + Cypermethrin 10% EC) with 11.27 aphids per plant, $T_4$ (Cypermethrin 10% EC) with 11.55 aphids per plant, and $T_1$ (Neem oil 5%) with 12.01 aphids per plant. The yield among the treatments was significant. The highest yield was recorded in $T_5$ (Neem oil 5% + Imidacloprid 17.8 SL) with 17.95 q/ha, followed by $T_3$ (Imidacloprid 17.8 SL) with 16.84 q/ha, $T_7$ (Neem oil 5% + Acetamiprid 20% SP) with 16.04 q/ha, $T_2$ (Acetamiprid 20% SP) with 15.01 q/ha, $T_6$ (Neem oil 5% + Cypermethrin 10% EC) with 14.18 q/ha, $T_4$ (Cypermethrin 10% EC) with 12.64 q/ha, and $T_1$ (Neem oil 5%) with 12 q/ha. The minimum yield was recorded in the untreated plot, with 7.6 q/ha.

The differences in aphid populations and yield outcomes can be attributed to the varying efficacy of the treatments used. Imidacloprid, a highly effective neonicotinoid, resulted in the lowest aphid population when used alone ($T_3$) and even lower when combined with neem oil ($T_5$). Neem oil's insecticidal properties likely enhanced the effectiveness of synthetic insecticides, creating a synergistic effect that provided better pest control. This synergy was also observed with other combinations, such as

neem oil with Acetamiprid and Cypermethrin, which resulted in lower aphid populations compared to the individual treatments. Consequently, the improved pest control from these combinations led to higher yields, with the highest recorded in $T_5$ (Neem oil 5% + Imidacloprid 17.8 SL). The untreated plot had the highest aphid population and the lowest yield, demonstrating the importance of effective pest management.

Similar findings were also reported by [7] reported that NSKE+ Imidacloprid 17.8% SL treated plot shown lowest population of mustard aphid. Similarly, next lowest aphid population recorded in the plot treated with Imidacloprid 17.8 SL (8.46). These findings also reported by [13] that Imidacloprid 17.8 SL show lowest population of mustard. Next lowest aphid population of mustard aphid was recorded in Neem oil 5% + Acetamiprid 20%SP (9.78) treated plot. Similar findings were reported by [7]. Next lowest population of mustard aphid was recorded in Acetamiprid 20% SP (10.45) treated plot. Similar findings were also reported by [14]. Next lowest aphid population was recorded in

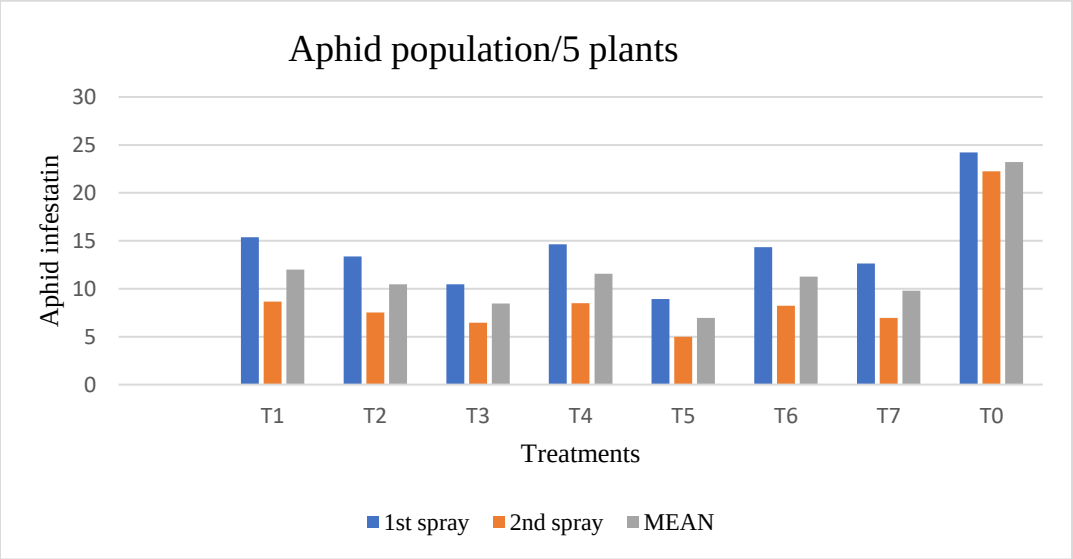


**Fig. 1. Graphical representation of efficacy of selected chemicals with neem oil against Mustard aphid (*Lipaphis erysimi*) population**

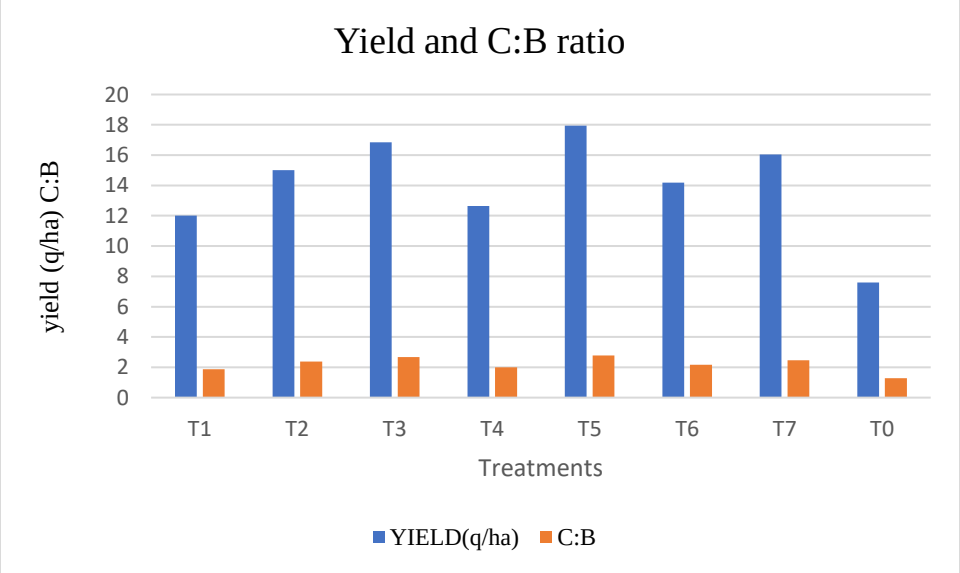


**Fig. 2. Graphical representation of Yield and Cost Benefit Ratio of different treatments against Mustard aphid (*Lipaphis erysimi*)**

**Table 1. Efficacy of selected chemicals with neem oil against Mustard aphid (*Lipaphis erysimi*) population during *rabi* season 2023 -2024(1st and 2nd spray)**

| Tr. No. | Treatment | Dose | Population of Mustard aphid/ 5 selected plants | | | | | | | | | | Overall Mean population | Yield (q/ha) | C:B Ratio |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | First spray | | | | | Second spray | | | | | | | |
| | | | 1DBT | 3DAT | 7DAT | 14DAT | Mean | 1DBT | 3DAT | 7DAT | 14DAT | Mean | | | |
| $T_1$ | Neem Oil 5% | 1.5ml/L | 23.13 | 15.73 | 14.93 | 15.47 | 15.37 | 15.60 | 11.16 | 8.80 | 6 | 8.65 | 12.01 | 12 | 1:1.88 |
| $T_2$ | Acetamiprid 20% | 0.05g/L | 23.47 | 14.67 | 12.53 | 12.93 | 13.38 | 13.28 | 10.11 | 7.55 | 4.93 | 7.53 | 10.45 | 15.01 | 1:2.37 |
| $T_3$ | Imidacloprid 17.8 SL | 0.3ml/L | 23.87 | 10.47 | 9.46 | 11.46 | 10.46 | 11.68 | 9.06 | 6.43 | 3.93 | 6.47 | 8.46 | 16.84 | 1:2.67 |
| $T_4$ | Cypermethrin 10% EC | 0.2ml/L | 23.20 | 15.53 | 13.93 | 14.40 | 14.62 | 15 | 10.93 | 8.66 | 5.86 | 8.48 | 11.55 | 12.64 | 1:1.99 |
| $T_5$ | Neem Oil 5% + Imidacloprid 17.8 SL | 1.5ml+ 0.3ml | 23.33 | 8.73 | 7.86 | 10.13 | 8.93 | 10.25 | 7.45 | 4.95 | 2.56 | 4.97 | 6.95 | 17.95 | 1:2.77 |
| $T_6$ | Neem Oil 5% + Cypermethrin 10% EC | 1.5ml+ 0.2ml | 23.93 | 15.07 | 13.66 | 14.26 | 14.33 | 14.46 | 10.63 | 8.38 | 5.68 | 8.22 | 11.27 | 14.18 | 1:2.17 |
| $T_7$ | Neem Oil 5% + Acetamiprid 20% SP | 1.5ml+ 0.05g | 22.07 | 13.33 | 12.47 | 12.06 | 12.62 | 13.15 | 9.38 | 6.95 | 4.53 | 6.95 | 9.78 | 16.04 | 1:2.46 |
| $T_0$ | Control | - | 23.53 | 23.93 | 24.13 | 24.53 | 24.20 | 24.78 | 25.23 | 22.70 | 18.87 | 22.26 | 23.23 | 7.6 | 1:1.27 |
| **F test** | | - | **NS** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | **S** | - |
| **C.D (P=0.05)** | | - | **---** | **0.54** | **0.47** | **0.56** | **1.15** | **0.63** | **0.79** | **0.90** | **1.11** | **0.48** | **2.69** | **2.76** | - |
| **CV** | | - | **---** | **2.09** | **2.01** | **2.21** | **4.62** | **2.43** | **3.84** | **5.57** | **9.70** | **3.03** | **9.71** | **14.72** | - |
| **S. Ed (±)** | | - | **---** | **0.25** | **0.22** | **0.26** | **0.54** | **0.24** | **0.37** | **0.42** | **0.52** | **0.23** | **1.14** | **-** | - |

Neem oil 5%+ Cypermethrin 10% EC (11.27). Similar results also reported by [15]. Next lowest aphid population was recorded in Cypermethrin 10% EC (11.55). Similar findings also reported by [16]. Neem oil (12.01) treated plot showed minimum aphid population survivability similar with the findings [14].

The data on Table 1, respect of C:B ratio revealed that the maximum return was recorded by treatment Neem oil 5% + Imidacloprid 17.8 SL ie,1:2.77 followed by Imidacloprid 17.8 SL ie,1:2.67 , Neem oil 5% +Acetamiprid 20% SP ie, 1:2.46 and Acetamiprid 20% SP *i.e,* 1:2.37. Secondly good return was received by application of Neem oil 5%+ Cypermethrin 10%EC ie,1:2.17 followed by Cypermethrin 10% EC 1:1.99. Neem oil 5% recorded less return *i.e,* 1:1.88. The return on investment (C:B ratio) varies among the different treatments due to several factors, including the effectiveness of the treatment in controlling aphid populations, the associated input costs, and the resulting increase in mustard yield. In the case of the treatment Neem oil 5% + Imidacloprid 17.8 SL, it likely achieved the highest return due to its effectiveness in managing aphids, which led to a significant increase in mustard yield compared to the input costs of the treatment. Similarly, Imidacloprid 17.8 SL alone showed a favorable return due to its efficacy against aphids. The combination of Neem oil 5% + Acetamiprid 20% SP and Acetamiprid 20% SP alone also resulted in favorable returns, indicating their effectiveness in controlling aphids and improving yield. On the other hand, treatments with lower returns, such as Neem oil 5% alone, may have been less effective in managing aphid populations or may have had higher input costs relative to the increase in mustard yield. Overall, the variations in return on investment among the treatments reflect differences in their efficacy, input costs, and resulting yield increases, highlighting the importance of evaluating both effectiveness and economic feasibility when selecting pest management strategies [17,18].

The results obtained in the present experiment were found to be in accordance with the findings of [14], investigating the control of mustard aphid through the use of Imidacloprid 17.8 SL on mustard during the Rabi season, 2012 and the results revealed that Imidacloprid achieved the maximum grain yield of 17.95 q/ha. Also the findings of this study are consistent with the study [7] conducted during the Rabi season, 2009; aiming to control the mustard aphid using insecticides and a combination of NSKE 5% + Imidacloprid 17.8 SL and the combination recorded the maximum grain yield and the highest cost-benefit ratio [19].

## 4. CONCLUSION

From the present research, it is concluded that among the treatments used, Neem oil 5% combined with Imidacloprid 17.8 SL proved to be the best treatment for managing Lipaphis erysimi infestation and achieved the highest yield. The sole use of Neem oil did not show significant results. The sole usage of Cypermethrin 10% EC, Acetamiprid 20% SP, and Imidacloprid 17.8 SL showed varying results; however, Imidacloprid 17.8 SL alone showed better results than Neem oil alone. It is important to examine the compatibility of botanicals and chemicals for their efficacy. The combination of chemical insecticides with neem oil has been shown to result in efficient management of aphid populations. Therefore, it can be concluded that the combination of Neem oil 5% with Imidacloprid 17.8 SL yields better results compared to sole applications. Based on the results obtained, it is suggested that Imidacloprid 17.8 SL combined with Neem oil 5% could be utilized as a component in Integrated Pest Management (IPM) of Lipaphis erysimi (Kalt.) on mustard. Future research should focus on long-term field trials across different regions and seasons to validate the effectiveness of Neem oil 5% and Imidacloprid 17.8 SL combinations. Investigating resistance management, environmental impacts, and the integration of biological controls will enhance sustainability. Economic analyses to assess cost-effectiveness and exploring alternative botanicals for pest control are also crucial. Improving formulations, educating farmers on IPM strategies, and adapting practices to climate change will further refine mustard aphid management and improve crop yields.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

## REFERENCES


1. Kumar P, Kumar A, Kumar S, Kumar P. Effect of zinc and iron application on yield and acquisition of nutrient on mustard crop (*Brassica juncia* L.). J. Plant Develop. Sci. 2014;6:413-416.
2. GOI (Government of India) .Agriculture statistics at a glance. Agriculture statistics division, department of agricultural and cooperative, ministry agriculture, GOI, New Delhi; 2009.
3. Nelson EH, Rosenheim JA. Encounters between aphids and their predators: the relative frequencies of disturbance and consumption. Entomologia Experimentalis et. Applicata. 2006;118(3):211-219.
4. Singh A, Yadav RS, Anshuman K, Kumar A, Patel VK, Singh AP, Singh RP. Effect of weed management practices on yield and economics in Indian mustard. International Journal of Chemical Studies. 2020;8(2):1364-1367.
5. Khan IA, Ahmad M, Akbar R, Hussain S, Saeed M, Farid A, Din MMU. Study on Aphids density and yield components of 12 brassica genotypes under field conditions in Peshawar, Pakistan. J. Ent. Zool. Stud. 2015;3:11-15.
6. Sharma N, Upadhyaya SN, Singh UC, Dubey M, Ahmad A. Bio efficacy of insecticides against mustard aphid. Journal of Entomology and Zoology Studies. 2020;8(4):97-102.
7. Lal B, Nayak MK, Tomar DS, Thakur SR. Efficacy of newer insecticides against mustard aphid, *Lipaphis erysimi* (Kalt.) in Indian mustard under Bundelkhand Agro-climatic zone of Madhya Pradesh. Journal of Entomology and Zoology Studys. 2018;6(6):400-403.
8. Chaudhary RF, Patel JR, Chaudhary M. Evaluation of new and conventional insecticides for the management of mustard aphid (*Lipaphis erysimi* (kalt). Journal of Pharmacognosy and Phytochemistry. 2020;9(6):1738-1741.
9. Khandelwal R, Kumar A. Evaluation of chemical insecticides along with cypermethrin and biopesticides against mustard aphid [*Lipaphis erysimi*](Kalt.) in mustard (*Brassica juncea*). The Pharma Innovation Journal. 2022;SP-11(10):375-378.
10. Nicoletti M, Petitto V, Gallo FR, Multari G, Federici E, Palazzino G. The modern analytical determination of botanicals and similar novel natural products by the HPTLC fingerprint approach. Stud. Nat. Prod. Chem. 2012;37:217–258.
11. Venkateswarlu B, Pirat M, Kishore N, Rasul A. Mycorrhizal inoculation in neem (*Azadirachta indica*) enhances azadirachtin content in seed kernels. World Journal of Microbiology and Biotechnology. 2008;24:1243-1247.
12. Zorempuii R, Kumar A. Efficacy of certain chemicals and botanicals against aphid, *Lipaphis erysimi* (Kaltenbach) on cabbage (*Brassica oleracea* L.). Journal of Entomology and Zoology Studies. 2019;7(5):89-93.
13. Vishal HS, Kumar A. Efficacy and economics of some newer insecticides against mustard aphid, *Lipaphis erysimi* (Kalt). Journal of Pharmacognosy and Phytochemistry. 2019;8(3):785-788.
14. Mishra SK, Kumar R, Singh AP, Tiwari DKYB. Bio-efficacy of novel insecticides against mustard aphid (*Lipaphis erysimi* Kalt.) in mustard crop (*Brassica campestris* L.); 2023.
15. Khandelwal R, Kumar A. Evaluation of chemical insecticides along with cypermethrin and biopesticides against mustard aphid [*Lipaphis erysimi*] (Kalt.) in mustard (*Brassica juncea*); 2022.
16. Sreeja S, Kumar A. Field efficacy of selected chemicals and biopesticides against mustard aphid [*Lipaphis erysimi* (Kaltenbach)] on mustard[*Brassica juncea* (L.)] at Prayagraj (UP). The Pharma Innovation Journal. 2022;11(5):1706-1710.
17. Baidoo PK, Baidoe-Ansah D, Agbonu I. Effects of Neem (*Azadirachta indica* A. Juss) Products on Aphis craccivora and its Predator Harmonia axyridis on Cowpea. J. Exp. Agric. Int. [Internet]. 2012 Mar. 2;2(2):198-206. [cited 2024 May 16]
    Available:https://journaljeai.com/index.php/JEAI/article/view/1040
18. Sen MK, Kumar A. Comparative efficacy and economics of biopesticides and imidacloprid against mustard aphid [*Lipaphis erysimi* (Kalt.)] (*Hemiptera: Aphididae*). Int. J. Plant Soil Sci. [Internet]. 2023 Jun. 2;35(14):201-8. [cited 2024 May 16].

Available:https://journalijpss.com/index.php/IJPSS/article/view/3037

19. Cantó-Tejero M, Pascual-Villalobos MJ, Guirao P. Aniseed essential oil botanical insecticides for the management of the currant-lettuce aphid. Industrial Crops and Products. 2022 Jul 1;181: 114804.



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