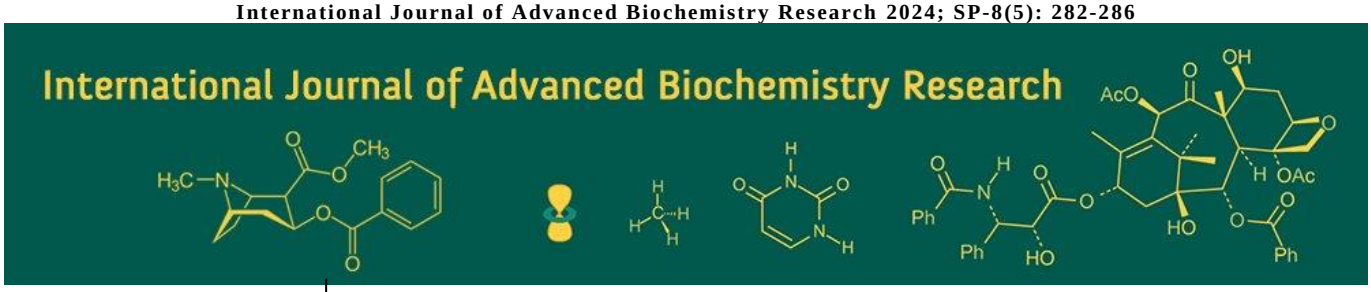

ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(5): 282-286
www.biochemjournal.com
Received: 14-02-2024
Accepted: 20-04-2024

Sakshi Rajawat
M.Sc. Scholar, Department of Entomology, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Usha Yadav
Assistant Professor, Department of Entomology, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Dayana R Mushinamwar
M.Sc. Scholar, Department of Entomology, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Corresponding Author:
Sakshi Rajawat
M.Sc. Scholar, Department of Entomology, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh, India

Efficacy of selected botanicals against mustard aphid, *Lipaphis erysimi* (Kaltenbach) on mustard (*Brassica juncea* L.)

Sakshi Rajawat, Usha Yadav and Dayana R Mushinamwar

DOI: https://doi.org/10.33545/26174693.2024.v8.i5Sd.1181

Abstract
Management of Mustard aphid *Lipaphis erysimi* (Kaltbach) using Botanicals in field condition was carried out during Rabi 2023-24 at central Research field SHUATS Prayagraj, UP., India. The management of Mustard aphid was done using 8 different treatments and benefit cost ratios of all the treatments were calculated. Total one sprays were applied to protect the crop from *Lipaphis erysimi* using randomized block design with three replications. The observations of *Lipaphis erysimi* 24 hours before (Pre-treatment) and 3th, 7th and 14th day after spraying (post-treatment) were recorded for computing the percent of pest reduction. The data were subjected to statistical analysis after appropriate transformation for interpretation. The treatment with recommended (T_4) Imidacloprid 17.8SL +NSKE5%Was of the most effective treatment followed By (T_7) Imidacloprid 17.8 SI and (T_3) Azadiractin the next best treatment were found to be (T_1) Neem oil 5% and (T_2) *NSKE5%*, (T_5) Castor oil and (T_6) cow urine were found to be least effective against *Lipaphis erysimi* (Kaltbach). The highest cost Benifit ratio was recorded with (T_4) Imidacloprid17.8SL+NSKE5% (1:5.4) followed by the (T_7) Imidacloprid 17.8SL (1:4.96), (T_3) Azadiractin ts, Neem oil 5% (1:3.97), (T_2) NSKE 5% (1:3.64), (T_5) Castor oil (1:3.52), (T_6) cow urine (1:2.3) as compared to untreated (T_8) control (1:1.75).

Keywords: Benefit cost ratio, imidacloprid (novel insecticide), *Lipaphis erysimi*, mustard, mustard aphids

Introduction
Mustard, *Brassica juncea* (L.) Czern & Coss is an important oilseed crop belonging to family cruciferaceae (Syn. Brassicaceae). Indian mustard or brown mustard is natural amphidiploids shaving chromosome no (2n=36). It is self-pollinated but certain amount (2- 15%) pollination occur due to insects and other factors. The origin place of mustard is China, northeastern India from where it has extended up to Afghanistan via Punjab. Mustard *(Brassica spp*.) is one of the first domesticated crops which has wide dispersal, and has been grown as herb in Asia, North Africa, and Europe for thousands of years (Mandal *et al*., 2018) [19].

The estimated area, production, and yield of rapeseed-mustard in the world was 36.59 million hectares, 72.37 million tonnes and 1980 kg/ha, respectively, during 2018-19. Globally, India account for 19.8 and 9.8 percent of the total acreage and production. During the last eight years, there has been a considerable increase in productivity from 1840 kg/ha in 2010-11 to 1980 kg/ha in 2018-19 and production has also increased from 61.64 m t in 2010-11 to 72.42 m t in 2018-19. The productivity of India is the lowest among the major mustard growing countries. As against the Chile with highest productivity of 4.10 tonnes/ha, the Indian average yield was only 1.4 tonnes/ha during 2019-20.

In India mustard is predominantly cultivated in Rajasthan (50%), Uttar Pradesh (12.3%), Haryana (11.2%), Madhya Pradesh (9.8%), Gujarat (6.5%) and West Bengal (5.1%). Among these states, Rajasthan, Uttar Pradesh and Madhya Pradesh are the major rapeseed-mustard growing states and cover the 70 percent of the total national acreage and contribution around 72 percent of production. Uttar Pradesh is a leading mustard producing state of India. 60% of total mustard production is from this state. In Uttar Pradesh area (759 ha) and production (956.72tn), yield 1260 kg/ha.

The mustard crop is damaged at various stages of plant growth by a number of insect pests *viz*; mustard sawfly (*Athalia lugens proxima* Klug.), painted bug (*Bagrada cruciferarum* Kirk.), mustard aphid (*Lipaphis erysimi* Kalt.), cabbage leaf Webber (*Crocidolomia binotalis* Zeller), flea beetle (*Phyllotreta Cruciferae* Geoze) and leaf minor (*Phytomyza horticola* Meign) **(**Gautam *et al.,* 2019) [10]. *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 axles. 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. They suck sap from the hosts and infested plants become stunted and distorted. Their infestation causes wilting, yellowing and stunting of plants (Khan *et al.,* 2015) [16]. 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.

Objectives

1. To evaluate the efficacy of selected botanicals against mustard aphids on mustard crop.
2. To calculate the cost benefit ratio of the treatment.

Materials and Methods

The present investigation was conducted to the study entitled "Efficacy of selected Botanicals against Mustard Aphid, *Lipaphis erysimi* (Kaltenbach) on Mustard (*Brassica juncea L.*)" was carried out during *rabi* season 2023-24 at The Central Research Farm, Department of Entomology, SHUATS, Prayagraj, Uttar Pradesh, India. The survey was laid out in RBD having seven treatments and control in three replications with the plot size $2m^2$. The Research was fulfilled on Maize variety Sonal. one spray were given using a hand compression pump during dawn or dusk hours to avoid photo oxidation of insecticedes. The treatments details are: Neem Oil 5% (T_1), NSKE 5% (T_2), Azadiractin (T_3), Imidacloprid 17.8 SL + NSKE 5% (T_4), Castor Oil (T_5), Cow Urine (T_6), Imidacloprid 17.8 SL (T_7) and untreated control.

Table 1: Treatment details

Treatment	Treatment Combination
T_0	Control
T_1	Neem Oil 5% @ 5ml/lit
T_2	NSKE 5% @ 5ml/lit
T_3	Azadirachtin @ 5ml/lit
T_4	Imidacloprid 17.8% SL + NSKE 5% @ 0.6ml+ 6ml/lit
T_5	Castor Oil @ 2ml/lit
T_6	Cow Urine @ 100ml/lit
T_7	Imidacloprid 17.8 SI @ 0.5ml/ha

The insect population was counted from randomly selected plants in every plot and population per 5 plants was noted. After that mean of three replications was calculated for each treatment and the same was done with the untreated plot. The population of *Lipaphis erysimi* was recorded before 1 day spraying and on 3rd day, 7th day and 14th day after insecticidal application.

Observations

Aphid count was taken 24 hours before spraying at 5 tagged plants per treatment, which was further converted in to per plant population and subsequent observation was recorded at 3, 7 and 14 days after spraying on same plants. Percent population reduction was worked out by using formula.

The formula used for the calculation of percentage reduction of pest population over control using following formula giving referring it to be modification.

$$\%\text{population reduction} = \left(1 - \frac{\text{Post treatment population in treatment} \times \text{Pretreatment popultion in control}}{\text{Pretreatment pupulation treatment} \times \text{Post treatment population in control}}\right) \times 100$$

$$\text{Percent population reduction} = \left(1 - \frac{Ta}{Ca} \times \frac{Cb}{Tb}\right) \times 100$$

Where,

Ta = Number of insects on treated plots after insecticidal application

Tb = Number of insects in treated plots before insecticidal application

Ca = Number of insects in untreated plots after insecticidal application

Cb = Number of insects in untreated plots before insecticidal application

The percentage population reduction value was duly transformed in to the corresponding angular value and it was subjected to analysis variance. Critical difference (CD) was applied for comparing treatment means.

Cost benefit ratio

Incremental benefit was calculated by taking the difference in Gross returns from the respective treatments over the control. Further the IBC ratio was obtained by taking the ratio of incremental benefit to the cost of insecticide.

Gross return = Marketable Yield × Market price Net return = Gross return – Cost of cultivation

$$\text{B: C Ratio} = \frac{\text{Gross returns Rs/ha}}{\text{Cost of plant cultivation Rs/ha}}$$

$$\text{BCR} = \frac{\text{Net returns}}{\text{Cost of treatment}}$$

Results and Discussion

In the experiment, eight treatments consisting appilication of Neem Oil 5% (T_1), NSKE 5% (T_2), Azadiractin (T_3), Imidacloprid 17.8 SL + NSKE 5% (T_4), Castor Oil (T_5), Cow Urine (T_6), Imidacloprid 17.8 SL (T_7) Were tested to compare the efficacy against *Lipaphis erysimi* and their influences on the yield of mustard. The results obtained are discussed in the light of available relevant literature in this chapter as before.

Infestation of Mustard aphid *(Lipaphis erysimi)* 3 DAS

The post treatment data on nymph and adult population (Table 2) of *Lipaphis erysimi* on 3rd day after 1st spray revealed that all the treatments were significantly superior

over control. The lowest population was recorded in Imidacloprid 17.8% SL + NSKE 5% (55.80) followed by Imidacloprid 17.8 SI (88.87), Azadirachtin (152.40) and Neem Oil (156.60), Neem seed kernel extract (173.13), Castor Oil (190.07) and Cow Urine (238.33).

Infestation of Mustard aphid (*Lipaphis erysimi)* after 7DAS

The post treatment data on nymph and adult population (Table 2) of of *Lipaphis erysimi* on 7th day after 1st spray revealed that all the treatments were significantly superior over control. The lowest population was recorded in Imidacloprid 17.8% SL + NSKE 5% (40.13) followed by Imidacloprid 17.8 SI (46.87), Azadirachtin (52.73) and Neem Oil (68.67), Neem seed kernel extract (78.20), Castor Oil (86.87) and Cow Urine (91.60).

Infestation of Mustard aphid (*Lipaphis erysimi)* after 14DAS

The post treatment data on nymph and adult population (Table 3) of of *Lipaphis erysimi* on 14th day after 1st spray revealed that all the treatments were significantly superior over control. The lowest population was recorded in Imidacloprid 17.8% SL + NSKE 5% (10.20) followed by Imidacloprid 17.8 SI (16.07), Azadirachtin (32.0) and Neem Oil (43.53), Neem seed kernel extract (52.60), Castor Oil (58.80) and Cow Urine (69.0)

The data of the mean (3,7 and 14) nymph and adult population of first spray revealed that all treatments except untreated control are effective and par with each other Among all the treatments lowest nymph and adult population of mustard aphid was recorded in Imidacloprid 17.8% SL + NSKE 5% (35.40) followed by Imidacloprid 17.8 SL (50.60), Azadirachtin (79.04), Neem oil 5% (89.60), NSKE 5% (101.31), Castor Oil (112.58), Cow Urine (132.98) as compared to control plot (249.20) is found to be effective but comparatively superior over the control.

The data on mean nymph and adult population of first spray, overall mean revealed that the all treatment except untreated control is effective and par with each other. Among all the treatments least nymph and adult population of mustard aphid was recorded in Imidacloprid 17.8% SL+NSKE 5% (35.40) treated plot. Similar findings were also reported by Lal *et al.* (2018) [18] reported that Imidacloprid 17.8% SL+NSKE 5% treated plot shown lowest population of Mustard aphid. Similarly, next lowest aphid population is recorded in the plot treated with Imidacloprid 17.8% SL (50.60). These findings were also reported by Patel *et al.* (2017) [21], Sreeja and Kumar (2022) [27] that Imidacloprid 17.8% SL shown lowest population of Mustard aphid. Next lowest population of Mustard aphid was recorded in Azadirachtin (79.04).

Next lowest population of Mustard aphid was recorded in Neem oil 5% (89.60) treated plot. Similar findings were also reported by Kumar and Kumar (2012) [27] reported that Neem oil 5% treated plot shown lowest aphid population of Mustard aphid. NSKE 5% (101.31) and Castor oil (112.58) treated plots showed low aphid population survivability which were also reported with the findings of Yadav *et al.* (2021) [34] and Yadav *et al*. (2018) [13]. Cow urine (55.88) treated plot showed minimum aphid population survivability similarly with the findings of Malla *et al*. (2017) [6].

Table 2: Effect of different Botanicals treatments on the incidence mustard aphid (*Lipaphis erysimi) infestation* after first spray.

Treatment		Population of mustard aphid /5 plants				
		1DBS	3DAS	7DAS	14DAS	MEAN
T_1	Neem oil 5%	254.66	156.60c	68.66c	43.53de	89.60bc
T_2	NSKE 5%	251.00	173.13bc	78.20bc	52.60cd	101.31bc
T_3	Azadirachtin	253.40	152.40c	52.73d	32.00e	79.04bcd
T_4	Imidacloprid 17.8% SL + NSKE 5%	261.60	55.80e	40.20d	10.20f	35.40d
T_5	Castor Oil	253.13	190.06b	88.87b	58.80bc	112.58b
T_6	Cow Urine	264.66	238.33a	91.60b	69.00b	132.98b
T_7	Imidacloprid 17.8 SL	258.73	88.86d	46.87d	16.07f	50.60cd
T_8	Control	245.93	246.20a	249.33A	251.80as	249.20a
F-TEST		NS	S	S	S	S
C.V		3.285	2.182	1.852	1.976	6.408
CD (5%)		--	3.065	2.885	2.496	8.960

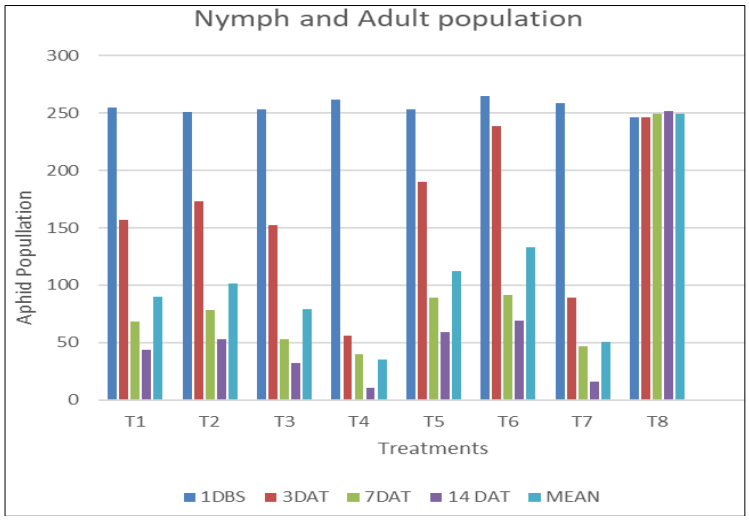

Fig 1: Graph showing effect of different Bio-pesticide treatments on the incidence mustard aphid (*Lipaphis erysimi) infestation* after first spray.

To calculate the cost benefit ratio of treatments: The data presented in below Table in respect of CBR revealed that the maximum returns was recorded by treatment Imidacloprid 17.8 SL + NSKE 5% (1:5.4) followed by Imidacloprid 17.8 SL (1:4.96), Azadiractin (1:3.97), Neem Oil 5% (1:3.90), NSKE 5% (1:3.64), Castor Oil (1:3.52), Cow Urine (1:2.3), as compared to control plot (1:1.75).

The results obtained in the present experiment was found in accordance with the findings. An experiment was conducted to control of mustard aphid through insecticide and NSKE 5% combination in mustard crops. The result revealed that Imidacloprid 17.8% SL+NSKE 5% combination recorded maximum grain yield (19.88 q/ha) and highest Benefit ratio (1:5.4)

Table 3: Economics of treatments and Benefit: cost ratio taken up for the management of mustard aphid during rabi season 2023-2024

Sr. No.	Treatment	Yield of q/ha	Cost of yield (₹)	Total cost of yield (₹)	Common cost (₹)	Treatment cost (₹)	Total cost (₹)	C:B ratio
T_1	Neem Oil 5%	14.22	6500	92430	21749	1900	23649	1:3.90
T_2	NSKE 5%	13.32	6500	86580	21749	2020	23769	1:3.64
T_3	Azadiractin	14.56	6500	94640	21749	2050	23799	1:3.97
T_4	Imidacloprid 17.8% SI + NSKE 5%	19.88	6500	129220	21749	2180	23929	1:5.4
T_5	Castor Oil	12.67	6500	82355	21749	1588	23337	1:3.52
T_6	Cow Urine	12.33	6500	80145	21749	9700	31449	1:2.3
T_7	Imidacloprid 17.8% SI	17.33	6500	112645	21749	960	22709	1:4.96
T_8	Control	5.88	6500	38220	21749	-	21749	1:1.75

Conclusion

From the critical analysis of the present findings, it can be concluded that amongst the treatments used in the present study, treatment Imidacloprid 17.8% SL+NSKE 5% was found to be the most superior in controlling the mustard aphid. Followed by Imidacloprid 17.8% SL, followed by Azardiractin, Neem oil 5% NSKE5%, Castor oil. The least effective treatment found was Cow urine. The highest yield and cost benefit ratio was registered in Imidacloprid 17.8% SL+NSKE 5% (19.88 q/ha) and (1:5.4), followed by Imidacloprid 17.8% SL (17.33 q/ha) and (1:4.96), Azardiractin (14.56 q/ha) and (1:3.97), Neem oil (14.22 q/ha) and (1:3.90), NSKE 5% (13.32 q/ha) and (1:3.64), Castor oil (12.67) and (1:3.52), Cow urine (12.33 q/ha) and (1:2.3) as compared to untreated plot (5.88 q/ha) and (1:1.75).

References

1. Ahlawat P, Singh R, Singh SP, Sachan SK, Singh DV, Spoorthi GS, *et al*. Efficacy of bio pesticides and novel insecticides for control of *Lipaphis erysimi* (Kalt) on mustard crop in western U.P. J Pharmacogn Phytochem. 2018;SP1:1814-1820.
2. Aswitha C, Yadav Y. Comparative efficacy of botanicals, imidacloprid and cow urine against mustard aphid (*Lipaphis erysimi* Kalt.) on mustard (*Brassica juncea* L.). The Pharma Innovation Journal. 2023;12(7):1275-1278.
3. Awaneesh C, Malik YP, Anoop K. Efficacy and economics of new insecticides for management of aphid (*Lipaphis erysimi*) in Indian mustard. Curr Adv Agric Sci. 2014;6(1):88-90.
4. Bandral RS. Field-weathered toxicity of insecticides to aphid predator, Coccinella septempunctata Linnaeus. J Biol Control. 2006;20(1):65-68.
5. Blackman RL, Eastop VF. Aphids on the World's crops: An identification and information guide. Chichester, New York, Brisbane, Toronto, Singapore: John Wiley and Sons; 1984. 466 p.
6. Chouraddi, Mallapur CP. Assessment of crop loss and economic injury level of maize stem borer, Chilo partellus (Swinhoe). J Entomol Zool Stud. 2017;5(4):1530-1535.
7. Dotasara SK, Agrawal N, Singh N, Swami D. Efficacy of some newer insecticides against mustard aphid *Lipaphis erysimi* Kalt. in cauliflower. J Entomol Zool Stud. 2017;5(2):654-656.
8. Deshpande VG. Cabbage aphid – Siphocoryneindo brassicae - and its Control with home-made nicotine spray. Agric Live-Stock India. 1937;7(6):756-762.
9. Dharavat N, Mehera B, Nath S, Patra SS, Rout S. Effect of sowing dates on population dynamics of mustard aphid (*Lipaphis erysimi*) in mustard (*Brassica juncea*) under Allahabad climatic condition. Adv Life Sci. 2016;5(20):2278-3849.
10. Gautam MP, Singh SN, Kumar P, Yadav SK, Singh DP, Pandey MK. Mustard aphid, *Lipaphis erysimi* (Kalt) (Hemiptera: Aphididae): The Pharma Innovation Journal. 2019;8(9):90-95.
11. Hegde MM, Kalleshwaraswamy SC, Adarsha SK. Effect of Application of Bio pesticides and Insecticides. Int J Pure App Biosci. 2017;5(1):42-47.
12. Kumar JVK, Parihar SBS. Efficacy of different insecticides against mustard aphid, *Lipaphis erysimi* (Kalt.) on mustard under field conditions. Int J Agric Sci. 2007;3(2):90-91.
13. Janu A, Yadav GS, Kaushik HD, Jakhar P. Bioefficacy of Verticillium lecanii and Beauveria bassiana against mustard aphid, *Lipaphis erysimi* under field conditions. Plant Arch. 2018;18(1):288-290.
14. Kafle K. Management of Mustard Aphid *Lipaphis erysimi* (Kalt.) (Homoptera: Aphididae). Int J Appl Sci Biotechnol. 2015;3(3):537-540.
15. Kawada K, Murai T. Short Communication. Entomol Exp Appl. 1979;26:343-345.
16. Khan IA, Ahmad M, Akbar R, Hussain S, Saeed M, Farid A. Study on Aphids density and yield components of 12 brassica Geno. J Entomol Zool Stud. 2015;3(6):11-15.
17. 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;11(10):375-378.
18. 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. J Entomol Zool Stud. 2018;6(6):400-403.
19. Mandal D, Bhowmik P, Chatterjee ML. Evaluation of new and conventional insecticides for the management of mustard aphid, *Lipaphis erysimi* Kalt. (Homoptera: Aphididae) on rapeseed (*Brassica juncea* L.). J Plant Prot Sci. 2012;4(2):37-42.
20. Meena H, Singh SP, Nagar R. Evaluation of microbial agents and bio-products for the management of mustard aphid, *Lipaphis erysimi* (Kalt.). The Bioscan. 2013;8(3):747-750.
21. Patel S, Singh CP, Hasan W. Relative efficacy of certain insecticides against mustard aphid in mustard ecosystem. Int J Agric Appl Sci. 2020;1(1):46-48.
22. Pippal SS, Sharma ML, Jatav PK, Mahore P. Efficacy of newer insecticides against mustard aphid *Lipaphis erysimi* (Kalt.). The Pharma Innovation Journal. 2022;11(7):1070-1074.
23. Rahul, Singh RS, Yadav N. Integrated management of mustard aphid, *Lipaphis erysimi* Kaltenbach in mustard crop. J Entomol Zool Stud. 2020;8(6):873-877.
24. Raju CEP, Tayde AR. Field Evaluation of Selected Insecticides and Botanical against Mustard Aphid, *Lipaphis erysimi* (Kalt.) on Mustard, *Brassica juncea* L. Int J Plant Soil Sci. 2022;34(22):1188-1193.
25. Rashid S, Mir SH, Yaqoob M, Ashraf S. Efficacy of insecticides against mustard aphid Brevicoryne brassicae and their safety to coccinellid predators. Indian J Entomol. 2022;84(4):872-874.
26. Sachan JN, Bansal OP. Influence of Different Host Plants on the Biology of Mustard Aphid, *Lipaphis erysimi* Kalt. Indian J Entomol. 1975;37(4):420-424.
27. Sreeja S, Kumar A. Field efficacy of selected chemicals and biopesticides against mustard aphid [*Lipaphis erysimi* (Kaltenbach)] on mustard [*Brassica juncea* (L.)] at Prayagraj (U.P.). The Pharma Innovation Journal. 2022;11(5):1706-1710.
28. Thaochan N, Ngampongsai A, Prabhakar CS, Hu Q. Beauveria bassiana PSUB01 simultaneously displays biocontrol activity against *Lipaphis erysimi* (Kalt.) (Hemiptera: Aphididae) and promotes plant growth in Chinese kale under hydroponic growing conditions. Biocontrol Sci Technol. 2021;31(10):997-1015.
29. Tomar M, Yadav HS, Kumar A. Efficacy of Some Insecticides and Biopesticides Against Mustard Aphid *Lipaphis erysimi* (Kalt). Indian J Entomol. 2023;ref. No. e22845.
30. United States Department of Agriculture. Rapeseed area, yield and production Table No. 15. 2010. Available from: http://www.fas.usda.gov/psdonline/psdreport.aspx
31. Vishal, Singh H, Kumar A. Efficacy and economics of some newer insecticides against mustard aphid, *Lipaphis erysimi* (Kalt). J Pharmacogn Phytochem. 2019;8(3):785-788.
32. Vishvendra, Kumar S, Sachan SK, Singh G, Singh R. Bio-Efficacy of insecticides and biorational against *Lipaphis erysimi* (Kalt.) in mustard crop. J Pharmacogn Phytochem. 2018;SP5:58-61.
33. Yadav S, Singh SP. Bio-intensive integrated management strategy for mustard aphid *Lipaphis erysimi* Kalt. (Homoptera: Aphididae). J Appl Nat Sci. 2015;7(1):192-196.
34. Yadav SP, Singh B, Satyajeet, Kumar H. Eco-friendly management of aphid (*Lipaphis erysimi* Kalt) in Indian mustard variety RB-50 under late sown conditions. J Entomol Zool Stud. 2021;9(1):1882-1886.
35. Yadav PR, Yadav LS, Dashad SS. Comparative efficacy of some insecticides against the aphid, *Lipaphis erysimi* Kalt. On Cabbage crop. Indian J Entomol. 1988;50(1):61-68.