Original Research Article

Efficacy of chemical insecticides and neem products against mustard aphid, [*Lipaphis erysimi* (Kalt.)] on mustard *Brassica juncea* (L.)

Abstract

A field trail was conducted at Central Research Field, SHUATS, Naini, Prayagraj during *rabi* 2021 in Randomized Block Design (RBD). Seven treatments were evaluated against *Lipaphis erysimi i.e.,* Imidacloprid 17.8% SL @ 0.5ml/lit, Thiomethoxam 25%WG @ 4gm/lit, Neem oil 5ml/lit, Indoxacarb 14.5%SC@ 0.65ml/lit, Emamectin Benzoate 5% SG, Neem seed kernel extract (NSKE) 5% @ 5gm/lit, Spinosad 45% SC, were evaluated against mustard aphid *Lipaphis erysimi.* Results revealed that, among the different treatments Imidacloprid (41.61) proved to be the most effective treatment followed by thiomethoxam (45.49), Emamectin benzoate (51.78), Indoxacarb (62.67), Spinosad (69.98), Neem seed kernel extract (NSKE) (72.97), whereas Neem oil (78.99) was found to be least effective against this pest. The plot treated with Imidacloprid 17.8% SL show highest yield (1:5.98), Thiomethoxam 25%WG (1:5.37), Emamectin Benzoate 5% SG @ (1:5.25), Indoxacarb 14.5%SC (1:4.71), Spinosad 45% SC (1:4.45), Neem seed kernel extract (NSKE)5% (1:3.71), Neem oil (1:3.77), as compared to control plot (1:2.8)

Key words: Cost-Benefit ratio, Efficacy, Imidacloprid, Insecticides, *Lipaphis erysimi*,

Introduction

Mustard is a multipurpose crop and India holds a premier position in the global oil seed production accounting 19 percent of total area and 9 percent of production. Mustard is a member of Family- Brassicaceae and has been placed in the genus Brassica. Indian mustard plants which bear tiny round edible seed as well as tasty leaves. Mustard is locally called "Sarsoo" "Rai". "Raya" and "Laha". The oil obtained from the different types show slight variation in percentage. The oil content varies from 37 to 49 percent. The seed and oil are used as condiment in the preparation of pickles and for flavoring curries and vegetables. In the tanning industry, mustard oil is used for softening leather. It is also used in preparation of the

hair oil, medicine etc. **Jandial *et al.*, (2007).** Oilseeds come next to food grains in volume and value in the country. Among the oil seed crop, rape seed and mustard play a pivotal role in agricultural economy of the world. The important rapeseed and mustard growing countries of the world are India, Canada, China, Pakistan, Poland, Bangladesh and Sweden. Indian ranks first in the world in respect of acreage accounting for 31.8 per cent of world (**Khedkar *et al.*, 2012)** Large colonies can cause the plants to become deformed and the large colonies can cause the plants to become deformed and the leaves curled, shriveled and yellowed (METCALF, 1962). They also produce a large quantity of honey dew through anus which facilitates the growth of the fungus that makes the leaves and pods black, sooty in appearance which ultimately creates problem in photosynthesis **(Awasthi, 2002; Bakhetia and Arora, 1986; Bakhetia and Sekhon, 1989; Sahoo 2012; Mandal *et al.*, 2012).** Mustard aphids have the capability to increase their population and spread rapidly within a very short span of time in favourable environmental condition. For this, all control measures except, chemical control are time consuming **(Sahoo 2012)** But chemical insecticides are not only toxic to natural enemies of aphid such as *Diaeretiella rapae, Chrysoperla zastrowi arabica,* coccinellids and syrphid flies **(Nagar *et al.*, 2012)** but these are also responsible for environmental pollution, health hazards to human beings, toxic to pollinators, pest resurgence, development of resistance in insect-pests and residues in oil and cake **(Singh 2001).** Botanicals are, in general, more compatible with the environmental components than the synthetic pesticides, owing primarily to their susceptibility to degradation by light, heat and microorganisms. Moreover, there is no report of pest resurgence due to the use of botanicals pesticides. In view of these, sincere efforts were undertaken in this direction for assaying the insecticidal properties of different plant extracts against mustard aphid. **(Srivastava and Guleria 2003)**

Comment [U1]: Delect?

Comment [U2]: Update reference with recent references

Materials and methods:

The experiment was conducted at the experimental research plot of the Department of Entomology, Central Research Farm, Sam Higginbottom University of Agriculture Technology and Sciences, during the *Rabi* season of 2021, in a randomized block design with eight treatments replicated three times using variety Rohini kranti seeds in a plot size of 2m×2m at a spacing of 45cm×30cm with a recommended package of practices excluding plant protection. The soil of the experimental land was well drained and medium high. Research field situated at $25^0$27" North latitude $80^0$05" East longitudes and at an altitude of 98 meter above sea level the maximum temperature reaches upto 42^0C in summer and crops down to 4^0C in winter.

The observation on population of sucking pest were recorded visually using a magnifying lens early on top 10cm central apical shoot per plant from five randomly selected and tagged plants in each plot. The insecticides were sprayed at recommended doses when aphids reaches its ETL(25-150) level. Aphids count was taken 24 hours before spraying at tagged plant at 5 tagged plants per treatment, which was further converted into per plant population and subsequent observation was recorded at 3, 7 and 14 days after spraying on same plants.

The healthy marketable yield obtained from different treatments were collected separately and weighted. The cost of insecticides used in this experiment was recorded during *Rabi* season. The cost of botanicals used was obtained from nearby market. The total cost of plant protection consisted of cost of treatment, sprayer, rent and labour charges for the spray. There are two sprays throughout the research period and the overall plant protection expenses was calculated. Total income was realized by multiplying the total yield per hectare by the prevailing market price, while the net benefit is obtained by substracting the total cost of plant protection from the total income. Benefit over the control for each sprayed treatment was obtained by subtracting the income of the control treatment from that of each sprayed treatment.

Results and discussion

Efficacy of different insecticides on the population of mustard aphid showed that all the treatments were significantly superior in reducing the population of mustard aphid resulting in increasing the yield, significantly as compared to control. The population recorded 1DBS was in a range of 145.2 to 153.8 (Table 1). On third day after spray lowest population of 63.2 and 68.07 was recorded in Imidacloprid 17.8 SL and Thiamethoxam 25% WG treated plots, respective that difference significantly with other treatment plots but statistically at par with each other. The lowest population was recorded in Imidaloprid 17.8% SL (29.33) treated plots followed by Thiomethoxam 25% WG and Emamectin benzoate 5% SG with 31.73 and 35.06 respectively on 7th day after spray. Lowest population of *Lipaphis erysimi* was observed on 14DAS and mean (1^{st} spray) in Imidacloprid 17.8% SL (45.93 and 46.15, respectively) followed by Thiomethoxam 25% WG (48.86 and 49.55, respectively) and Emamectin benzoate 5% SG (53.60 and 55.59, respectively). (Table 1)

One day prior second spray, the mean population ranged from 45.93 to 135.46. Imidacloprid 17.8% SL treated plots recorded lowest mean population in all observations on 3^{rd}, 7^{th}, 14^{th} day after spray and mean with 43.73, 25.93, 41.60 and 37.08 followed by Thiomethoxam 25% WG (52.4, 27.86, 44.06 and 41.44). These results are support with **Singh *et al.* (2014) and Dostara *et al.* (2017),** reported that Imidacloprid 17.8% SL proved superior over other insecticides in reducinng population of Mustard aphid. **Vishvendra *et al.* (2018)** found Thiomethoxam as the most effective treatment.

The yields among the treatments were significant. The highest yield was recorded in Imidacloprid 17.8% SL (22.0 q/ha), followed by Thiomethoxam 25% WG (19.75 q/ha), Emamectin benzoate 5% SG (19.75 q/ha), Indoxacarb 14.5% SC (18.33 q/ha), Spinosad 45% SC (17.16 q/ha), Neem seed Kernel Extract (NSKE) (14.58 q/ha), Neem oil (13.75 q/ha), as compared to control plot (10.16 q/ha). When cost benefit ratio was worked out, interesting result was achieved. Among the treatments studied, the best and most economical treatment was Imidacloprid 17.8% SL (1: 5.98) followed by Thiomethoxam 25% WG (1: 5.37), Emamectin benzoate 5% SG (1: 5.25), Indoxacrb 14.5% SC (1: 4.71), Spinosad (1: 4.45), Neem seed Kernel Extract (NSKE) (1: 3.79), Neem oil (1: 3.77), as compared to Control (1: 2.80). The present results are similar with **Awaneesh *et al.* (2014)** observed highest C:B ratio in Imidacloprid**. Mokal *et al.* (2018)** concluded that in terms of higher cost benefit ratio Thiomethoxam was found superior. **Yadav *e al.* (2018)** found Emamectin benzoate as the economical treatment.

TABLE 1. "Efficacy of chemical insecticides and neem products against mustard aphid, [*Lipaphis erysimi* (Kalt.)]

S.No.	Treatments	Population of *Lipaphis erysimi* / 10cm apical shoot							Overall mean	Yield (q/ha)	B:C ratio
			First spray			Second spray					
		1DBS	3DAS	7DAS	14DAS	3DAS	7DAS	14DAS			
T_1	Imidacloprid 17.8% SL @ 0.5ml/lit	153.8	63.2^{e}	29.33^{e}	45.93^{f}	43.73^{f}	25.93^{f}	41.6^{f}	41.61	22	1:5.98
T_2	Thiamethoxam 25% WG @ 0.25g/lit	149.73	68.07^{d}	31.73^{e}	48.86^{ef}	52.4^{e}	27.86^{ef}	44.06^{ef}	45.49	19.75	1:5.37
T_3	Neem oil 1500 ppm	145.2	88.2^{b}	84.2^{b}	79.53^{b}	73.73^{b}	75.2^{b}	73.13^{b}	78.99	13.75	1:3.7
T_4	Indoxacarb 14.5% SC @0.65ml/L	152.73	81.86^{c}	63.8^{c}	55.26^{d}	64.93^{cd}	58.73^{d}	51.46^{d}	62.67	18.33	1:4.71
T_5	Emamectin benzoate 5%SG @ 0.4gm/L	149.73	78.13^{c}	35.06^{d}	53.6^{de}	64^{d}	30.33^{e}	49.6^{de}	51.69	19.75	1:5.251
T_6	Spinosad 45% SC @ 0.25ml/lit	152.46	86.46^{b}	83.93^{b}	64.06^{c}	69.4^{bc}	75.06^{b}	58.93^{c}	72.97	14.58	1:3.79
T_7	Neem seed kernel extract(NSKE) @ 5gm/L	148.4	85.86^{b}	83.46^{b}	58.4^{cd}	67.33^{cd}	71.46^{c}	53.4^{cd}	69.98	17.16	1:4.45
T_0	Control	146.53	127.2^{a}	130.73^{a}	135.46^{a}	140.8^{a}	145.33^{a}	151.3	138.47	10.16	1:2.8
	F-test	NS	S	S	S	S	S	S	S		
	S. Ed (±)	--------	1.75	1.20	2.83	2.43	1.57	3.18	1.35		
	C.D. (P = 0.5)	--------	3.76	2.58	6.08	5.22	3.390	6.83	2.901		

References:

Awasthi, V. B. (2002). Introduction to General and Applied Entomology. *Scientific publisher.*,66- 71 P P**.**

Awaneesh., Malik, Chandra, Y. P. and Kumar, A. (2014). Efficacy and economics of new insecticides for management of aphid (Lipaphis erysimi) in Indian mustard. *Current Advances in Agricultural Sciences.,* **6**(1):88-90.

Bakhetia, D. R. C. and Arora, R. (1986). Control of insect pests of toria, sarson and rai. *Indian Farming.*,**36**(4):41-44.

Bakhetia, D. R. C. and Sekhon, B. S. (1989). Insect pests and their management in rape seed mustard. *Journal of Oilseeds Research.,* **6**:269-73.

Dotasara, S. K., Agrawal, N., Singh, N., and Swami, D. (2017). Efficacy of some newer insecticides against mustard aphid *Lipaphis erysimi* Kalt. in cauliflower. *Journal of Entomology and Zoology Studies.,* **5**(2),654-656.

Jandial, Anil Kumar, V. K. and Parihar, S. B. S. (2007). Efficacy of different insecticides against mustard aphid, *Lipaphis erysimi* (*Kalt.)* on mustard under field conditions. *International Journal of Agricultural Sciences.,* **3**(2):90-91.

Khedkar, A., Bharpoda, T., Patel, M., and Sangekar, N. (2012). Evaluation of different botanical insecticides against aphid, *Lipaphis erysimi* (Kaltenbach) infesting mustard. AGRES – *An Internation e-Journal.,* **35**(3): 140-233.

Mandal, D., Bhowmik, P. and Chatterjee, M. L. (2012). Evaluation of new and conventional insecticides for the management of mustard aphid, *Lipaphis erysimi* Kalt. (Homoptera: Aphididae) on rapeseed (Brassica juncea L.) *The Journal of Plant Protection., Sciences* **4(**2):37-42.

Mokal, A. J., Shinde, B.D., Naik, K. V., Sanap, P. B., Mehendale, S.K and Golvankar, G. M. (2018). Bio-efficacy of insecticides against aphids infesting chilli. *International Journal of Chemical Science.*, **6**(5):2821-2824.

Nagar, A., Singh, S. P., Singh, Y. P., Singh, R., Meena, H. and Nagar, R. (2012). Bio efficacy of vegetable and organic oils, cakes and plant extracts against mustard aphid *Lipaphis erysimi* (Kalt.). *Indian Journal of Entomology.,***74**(2): 114-119.

Sahoo, S.K. (2012). Incidence and management of mustard aphid (*Lipaphis erysimi* Kaltenbach) in West Bengal. *The Journal of Plant Protection Sciences*, **4**(1): 20-26.

Singh, P. K. (2001). Control of mustard aphid, *Lipaphis erysimi* (Kalt.) (Homoptera: Aphididae) with minimum insecticide use. *Journal of Aphidology.*,**15**: 139-142.

Singh, D., Kumar, V. and Kumar, D. (2014). Inheritance of mustard aphid, *Lipaphis erysimi (Kalt.)* tolerance in Indian mustard *(Brassica juncea (L.) Czern&Coss). Annals of Biology.*,**16** (2): 145- 148.

Srivastava, A., and Guleria S. (2003). Evaluation of botanicals for mustard aphid, *Lipaphis erysimi (Kalt.)* control in Brassica. *Himachal Journal of Agricultural Research.*, **29** (4): 116-118.

Vishvendra, S. K., Sachan, S. K., Singh, G., and Singh. (2018). Bio-Efficacy of insecticides and biorational against Lipaphis Erysimi (KALT.) in mustard crop. *Journal of Pharmacognosy and Phytochemistry.*, ***5***: 58-61.

Yadav, A.K., Singh, H., and Yadava, T.P. (2018). Virulence of Verticillium lecanii (Z.) against cereal aphids; does timing of infection affect the performance of parasitoids and predators. *Pest Management Science.*, **69**(4):493-498

International Journal of Plant & Soil Science [Ms_IJPSS_90691]

Review Comment 14/08/2022

The decision is: ACCEPTED after major revision

Reviewer #1: I read carefully the manuscript entitle "**Efficacy of chemical insecticides and neem products against mustard aphid, [*Lipaphis erysimi* (Kalt.)] on mustard *Brassica juncea* (L.)**" needs major revision before publishing. This research aims to create a space to generate dialogue important in shaping and responding to questions about the ***Efficacy of chemical insecticides and neem products against mustard aphid***. The manuscript offers a very interesting and important theme. The abstracts of the papers however, vary in the level of detail they each provide regarding their focus, methods and aims.

- This is an engaging article with robust methodology that purposefully question our knowledge of the subject. However, the article title is appropriate.

- Rewrite the “Abstract” with following information in subheadings:

  Background and objective (**2-3 lines** about context and purpose of the study)
  Materials and methods (brief over view of complete methodology in **3-4 lines**)
  Results (**3-4 lines** about the main findings of the study)
  Conclusion (Core outcomes in **1-2 lines** only)

- Keywords is appropriate.
- **Introduction** - First of all present the background studies about the topic in a manner that set a foundation to **understand the research problem** with **proper reference citations**. Provide the **rationale behind the study and main objective of this work (in 3-4 lines) in its last portion without reference citation.**
- **literature gaps should be identified in order to support the innovativeness of the study.**
- The purpose or purported significance of the article is explicitly stated.
- Table is necessary and place appropriately.
- Mention the total time duration of research work with specific months and year in the start of “Materials and Methods”. – Your methodology need o be improved upon.
- In **MATERIALS AND METHODS**, just state about the Method you applied. Interpretation of these methods will be discussed in **RESULT** section.
- What statistical software did the author use for analysis?

Results

- Results section does not show the important and key findings of the study. It includes material which does not belong to the results section such as interpretation and discussion. Author is requested to rewrite the Result section by incorporating the following modifications to make this section understandable for the readers:
- Provide a brief and proper description of the given tables.
- Cite tables in their respective descriptions in ascending order.
- Please give direct values descriptions which are mentioned in the tables. Never add indirect results, it may cause confusion for the readers. Synchronize all the values in theoretical descriptions with their respective tables.

Tables

- Provide each and every abbreviation and unit in the footnote of all the Tables respectively.

Discussion

- The discussion needs to be framed and focus. Discussion" is poorly written some statements are given without references. Please provide the proper references of all statements and summarize the findings of current study which are already given in Results. Rewrite it as:
  - In the start discuss your own results in 2 -3 lines only.
  - Correlation of your results with previous literature is essential. So co-relate this study with at least 5 recent previous publications either in support or in contradiction for justification of results.

- Add 2-3 lines about future recommendation or implications of research in last portion.
- **Use transitional words mindfully to highlight clear and thoughtful connections among ideas.**
- There are grammatical and spelling mistakes. **Avoid using personal pronounces and the use of "we" and "our" in the article. Use third person pronoun and past tense in the write up of the article. Reread this article for typographical, grammar and spelling errors.**

Conclusion and Recommendation

They are both absent. Hence, Author should work on them.

Significance Statement

- Please write the Significance statement as follows: "This study discovered the ---- that can be beneficial for ---- and last sentence of this statement could be as: this study will help the researchers to uncover the critical areas of ---- that many researchers were not able to explore. Thus, a new theory on ----- may be arrived at"

References

- References according to the requirement of journal format. However, I believe that most of the references are valuable, but it is a pity that we have not seen relatively new references. Try to supplement some of the latest literature as a reference.

This suggestion would strengthen the study further and when addressed will improve the manuscript.

Best regards,

Raimi Morufu O
ORCID ID: https://orcid.org/**0000-0001-5042-6729**
https://publons.com/**a/1479339/**
https://ssrn.com/author=2891311
International Journal of Plant & Soil Science