EFFICACY AND ECONOMICS OF SELECTED CHEMICALS AND BIO-PESTICIDES AGAINST MUSTARD APHID [*LIPAPHIS ERYSIMI* (KALTENBACH)] IN PRAYAGRAJ (U.P.)

ABSTRACT

The study was carried out at central research farm in *rabi* season at Sam Higginbottom University of Agriculture Technology and Sciences. The efficacy of treatments was measured in terms of the reduction in aphid population. Imidacloprid 17.8 SL exhibited the highest population reduction (95.210), followed by Dimethoate 30 EC (82.887), Acetamiprid 20 SP (69.350), Neem oil 5% (48.767), N.S.K.E. (42.040), *Verticillium lecanii* 1.15 WP (39.95), *Beauveria bassiana* 1.15 WP (30.707), with the untreated plot showing the minimum reduction. The cost-benefit analysis of treatments revealed that. Imidacloprid 17.8 SL demonstrated the highest return (1:5.23), followed by Dimethoate 30 EC (1:4.26), Acetamiprid 20 SP (1:4.16), Neem oil 5% (1:3.67), N.S.K.E (1:3.45), *Verticillium lecanii* (1:2.77), and *Beauveria bassiana* (1:2.61). The control plot yielded the lowest return (1:1.56).

Key words: Bio-pesticides; Chemicals; Cost benefit ratio; Economics; Efficacy; Mustard Aphid; *Lipaphis erysimi*; Population reduction; *Rabi* season; Treatments.

INTRODUCTION

Brassica oilseed crops are the major rabi oilseed crops grown in India, which is collectively referred to as rapeseed-mustard. It constitutes the second largest agricultural product in the country next to food grains. Mustard is the second most important oilseed crop in India and constitutes the major source of edible oil for human consumption and cake for animals. India holds first position as a grower, producer, importer, and exporter of vegetable oils in the world scenario **(Maurya *et al.*, 2018)**. Mustard seeds are composed of approximately 29-40% oil, 23-30% protein, and 12-18% carbohydrates. Mustard seeds are rich in essential nutrients, notably Vitamin A, iron, and calcium, while serving as abundant sources of protein and oil[17,18,19,20]. Mustard seed oil is characterized by its high content of unsaturated fatty acids, particularly linoleic acid, linolenic acid, and oleic acid. It contains lower levels of saturated fatty acids and a notable proportion of erucic acid. Among vegetable oils, mustard oil ranks third in importance after soybean oil and palm oil. Sinigrin, the primary glucosinolate in brown/oriental mustard, produces allyl isothiocyanate (AITC) upon hydrolysis by the enzyme myrosinase, contributing to the pungency and flavor of mustard. Glucosinolates and isothiocyanates, including AITC, are associated with antibacterial, anticancer, and antifungal properties **(Sharma *et al.*, 2018)**. In India, the total area under rapeseed-mustard cultivation is 8.06 million hectares in 2021-22 and that of production is 11.75 million tonnes. The total yield of rapeseed-mustard in 2021-22 is 1458 kilogram per hectare. Rajasthan dominates in area with 33.7 million hectares which is 41.77% of all over India rapeseed-mustard cultivated area with the yield of 1627 kilogram per hectare in 2021-22 followed by Madhya Pradesh, Haryana, Uttar Pradesh, West Bengal, and Gujrat are major producers of rapeseed-mustard in India **(Anonymous, 2023)**. Mustard aphid emerges as a major threat, responsible for yield losses of up to 96% and a reduction in oil content by 5-6%. in India are vulnerable to over 43 species of insect pests, with significant impact from sawfly (*Athalia lugens proxima*), aphid (*Lipaphis erysimi*), painted bug (*Bagrada hilaris*), and leaf miner (*Phytomyza horticola*). **(Lal *et al.*, 2018)**. The mustard aphid, *Lipaphis erysimi* (Kaltenbach) (Homoptera: Aphididae), inflicts severe damage to rapeseed-mustard plants by sucking sap from tender shoots, flowers, and later, pods. This feeding weakens the plant, causing stunted growth. Excessive honeydew excretion by the aphids promotes the growth of black sooty mould on leaves, disrupting photosynthetic activity. While systemic insecticides effectively manage the pest, they also harm natural predators and parasitoids. Consequently,

the mustard aphid has emerged as a key pest of rapeseed-mustard in India **(Gautam *et al.*, 2019)**.

MATERIALS AND METHODS

The study on "Efficacy and economics of selected chemicals and bio-pesticides against mustard aphid, [*Lipaphis erysimi* (Kaltenbach)] in Prayagraj (U.P.)" was done at Central Research Farm, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Prayagraj in *rabi* season of 2023-2024. Mustard seed variety Kala Sona was sown with 85% germination rate, 97% physical purity, 98% genetic purity and 8% moisture. The seed was sown at a depth of 4-5 cm in line in a plot size of 2m x 1m = $2m^2$. Five randomly chosen plants from each plot were examined for aphid populations in the field one day prior to spraying as well as three, seven and fourteen days afterwards. The number of aphids per plant was transformed into a percentage of the aphid population under the control.

Population reduction: $\frac{\textbf{\textit{Population in control plot} - \textbf{\textit{Population after spray}}}}{\textbf{\textit{Population in control plot}}}$

Eight treatments evaluated along with untreated control with 3 replications. The treatments were imidacloprid 17.8 SL (0.2 ml/l), *Beauveria bassiana* (5 g/l), *Verticilium lecanii* (5 g/l), Neem oil (5ml/l), NSKE (5 ml/l), Acetamiprid 20 SP (0.15 g/ml) and Dimethoate 30 EC (1.32 ml/l). Results of each treatment per replication analysed as population reduction over untreated plot. Yield obtained from each plot is then converted to quintal/ha for evaluating cost benefit ratio. Cost-Benefit ratio used as to compare the performance of different treatments.

$$\textbf{\textit{C:B Ratio}} = \frac{\textbf{\textit{Gross returns}}}{\textbf{\textit{Total Cost}}}$$

RESULTS AND DISCUSSION

In the experiment, eight treatments consisting application of Imidacloprid 17.8 SL (T_1), *Beauveria bassiana* (T_2), *Verticillium lecanii* (T_3), Neem oil 5% (T_4), N.S.K.E (T_5), Acetamiprid 20 SP (T_6) and Dimethoate 30 EC (T_7) and control (T_0) were tested to compare the efficacy against *Lipaphis erysimi* and their influences on the yield of mustard. The order of efficacy is Imidacloprid 17.8% SL > Dimethoate 30 EC > Acetamiprid 20 SP > Neem Oil 5% > N.S.K.E. > *Verticilium lecanii* > *Beauveria bassiana*. The data on the mean (3rd ,7th and 14th DAS) per cent reduction over control on mustard aphid after spray revealed that insecticide Imidacloprid 17.8 SL (95.210) recorded the maximum percent reduction of aphid, followed by Dimethoate 30 EC (82.887), Acetamiprid 20 SP (69.350), Neem oil 5% (48.767), N.S.K.E. (42.040), *Verticillium lecanii* 1.15 WP (39.95), *Beauveria bassiana* 1.15 WP (30.707) and minimum reduction percent of aphid recorded in untreated plot. **Sreeja and Kumar (2022)** evaluated that Imidacloprid 17.8SL is superior among all treatments followed by Spinosad 45SC. **Kumar and Singh (2013)** founded that Imidacloprid 17.8SL superior as compared to Dimethoate 30 EC. **Patel *et al.* (2020)** concluded that Dimethoate 30EC is more effective in controlling aphids than Imidacloprid 17.8SL and Acetamiprid 20SP. **Lal et al. (2018)** also evaluated Imidacloprid 17.8 SL most effective followed by Acetamiprid 20 and NSKE 5%. **Mishra *et al.* (2023)** evaluated that Imidacloprid 17.8SL superior followed by Acetamiprid 20 SP and Neem Oil 3% in aphid management. **Sen and Kumar (2023)** evaluated Imidacloprid 17.8 SL (superior) followed by Neem oil 5%. Sairam and Kumar (2022) reported Neem oil 5% effective in controlling aphids followed by *Beauveria bassiana*. **Shinde *et al.* (2021)** evaluated Dimethoate 30 EC superior over entomopathogenic fungi (*Beauveria bassiana* and *Verticilium lecanii*). **Vishal *et al.* (2019)** founded after 1st spray that Imidacloprid 17.8SL followed by *Beauveria bassiana* and Neem oil are efficient in reducing aphid population.

Table 1 Efficacy of selected chemicals and bio-pesticides on reduction per cent over control during *rabi* season 2023-2024 (1st spray)

Treatments	Name of treatments	DBS	3rd DAS	7th DAS	14th DAS	Mean	Yield q/ha	C: B Ratio
T_0	Untreated	59.40	0	0	0	0.00	6.5	1:2.62
T_1	Imidacloprid 17.8 SL	52.20	90.83	96.10	98.70	95.21	15.66	1:5.96
T_2	*Beauveria bassiana* 1.15 WP	51.80	32.43	29.38	30.31	30.71	8	1:2.98
T_3	*Verticillium lecanii* 1.15 WP	47.40	40.34	42.10	37.41	39.95	8.5	1:3.17
T_4	Neem oil 5%	51.27	50.98	48.17	47.15	48.77	11.91	1:4.21
T_5	NSKE 5%	57.67	50.86	41.35	33.91	42.04	10.66	1:3.83
T_6	Acetamiprid 20 SP	54.07	64.35	67.99	75.71	69.35	12.41	1:4.75
T_7	Dimethoate 30 EC	47.33	70.67	81.23	96.76	82.89	13.16	1:4.84
Overall Mean			50.06	50.79	52.49	51.11		
F- test			S	S	S	S		
S. Ed. (±)			3.70	2.84	2.36	5.29		
C. D. (P = 0.05)			7.927	6.085	5.050	11.343		

DBS=Days before spray, DAS=Days after spray, C.D.=Critical difference

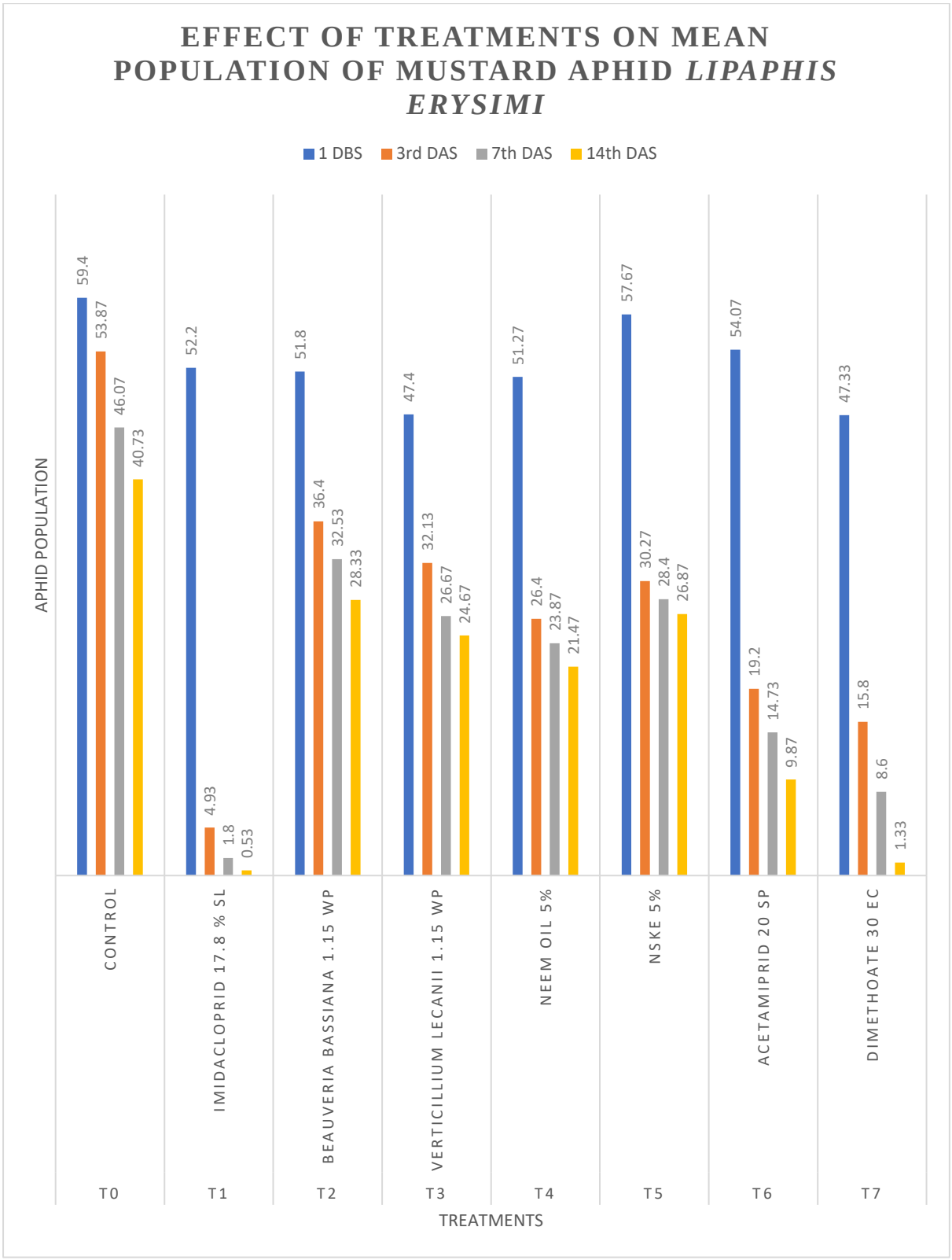
EFFECT OF TREATMENTS ON MEAN POPULATION OF MUSTARD APHID LIPAPHIS ERYSIMI
1 DBS
3rd DAS
7th DAS
14th DAS
APHID POPULATION
59.4
53.87
46.07
40.73
52.2
4.93
1.8
0.53
51.8
36.4
32.53
28.33
47.4
32.13
26.67
24.67
51.27
26.4
23.87
21.47
57.67
30.27
28.4
26.87
54.07
19.2
14.73
9.87
47.33
15.8
8.6
1.33
CONTROL
IMIDACLOPRID 17.8 % SL
BEAUVERIA BASSIANA 1.15 WP
VERTICILLIUM LECANII 1.15 WP
NEEM OIL 5%
NSKE 5%
ACETAMIPRID 20 SP
DIMETHOATE 30 EC
T0
T1
T2
T3
T4
T5
T6
T7
TREATMENTS

Figure 1 Efficacy of selected chemicals and biopesticides on the incidence of mustard aphid, *L. erysimi* during *rabi* season 2023-2024 (1st spray)

Among cost-benefit analysis, chemicals outperformed botanicals and bio-pesticides in giving the maximum output. The cost-benefit analysis across all treatments showed that the highest monetary return was achieved with Imidacloprid 17.8% SL, with a ratio of (1:5.96). This finding aligns with previous observations made by **Sen and Kumar (2023)** (1:5.20) and **Sreeja and Kumar (2022)** (1:5.20). Dimethoate 30 EC with cost benefit ratio (1:4.84), closely supported by findings of **Vishal et al. (2019)** with (1:3.98). Acetamiprid 20 SP with (1:4.75) is closely supported by **Bhati and Sharma (2014)**. Among Neem based pesticides, the benefit cost ratio with Neem oil 5% is (1:4.21) and N.S.K.E. is (1:3.83). Both findings are almost similar. Findings with Neem oil and N.S.K.E. is supported by **Aswitha and Yadav (2023)**. **Khandelwal and Kumar (2022)** evaluated (1:2.61) benefit cost ratio which is similar to the findings with Neem oil 5% (1:2.63). Finding with Neem oil is also supported by **Sairam and Kumar (2022)**. Among Entomopathogenic Fungi *Verticilium lecanii* (1:3.17) and *Beauveria bassiana* (1:2.98) gives almost similar benefit cost ratio. Findings with *Beauveria bassiana* are close with the findings made by **Sairam and Kumar, 2022**. Least benefit cost ratio is seen in *Beauveria bassiana.* Both fungi are so low in giving benefit to farmers. Hence it is concluded that Imidacloprid 17.8 SL emerges as the most effective treatment in both efficacy and giving a high-cost benefit ratio followed closely by Dimethoate 30 EC and Acetamiprid 20 SP.

CONCLUSION

Chemicals had given a good reduction in aphid population after spraying. Neem derived products and entomopathogenic fungi had also given a good result and can be used to avoid indiscriminate use of pesticides. Chemicals can lead to pest resurgence, pest resistance and can cause harm to beneficial insects. More researches have to be done to maximize the efficacy of bio-pesticides so that we can lower the use of chemicals.

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