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COMPARATIVE EFFICACY OF PESTICIDES AGAINST APHID (BREVICORYNE BRASSICAE *LIPAPHIS EYRSIMI*) ON RAYA (*BRASSICA JUNCEA*) CROP UNDER ARID CONDITIONS

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Abstract
The experiments were conducted to evaluate the efficacy of different insecticides for the control of aphids in the raya crop at the Adaptive Research Farm, Koror, District. Layyah, Punjab. Pakistan and a farmer's field, i.e. Chak no. 115/TDA, Tehsil. Karor, Layyah, Pakistan, under irrigated conditions during the rabi crop season 2023-24. The experiments were laid out in Randomized Complete Block. Design (RCBD) with three replications with a plot size of 5 m x 0.9 m, along with row spacing of 45 cm. The pesticide Legend (metrin) 20 EC @ 740 ml ha^{-1}found best against aphid and yield parameters on raya crop. Five different pesticides, including T1. Control. T2, Confidor (imidacloprid) 25 WP @ 500 g ha^{-1}, T3. Legend (metrin) 20 EC @ 740 ml ha^{-1}, T4. Plenum (pymetrozine) @ 200 g ha^{-1}, and T5. Talstar (bifenthrin) @ 370 ml ha^{-1} were applied. All insecticides significantly decreased aphid population over control and maximum grain yield 1860.16 kg ha^{-1} and 1562.10kgha^{-1} in both locations at AR farm Karor as well as the farmer's field, respectively, whereas Confidor (imidacloprid) 25 WP @ 500 g ha^{-1} was applied. Maximum mortality one day (24hours), two days (48 hours) and 3 days (72 hours) after spray was caused by Confidor (imidacloprid) 25 WP @ 500 g ha^{-1}. It is thus recommended that Confidor (imidacloprid) 25 WP @ 500 g ha^{-1}may be applied for offering control of aphid and increased grain yield of raya in both locations.

Keywords: *Brassica juncea*, *Brevicoryne brassicae*, *Lipaphis erysimi*, *Raya*

INTRODUCTION

Oil seed brassica is the most significant source of edible oil, after cotton seed as the traditional oilseed crops grown in Pakistan belong to the Brassiceae family. Among the species of this crop, the most frequent ones are *B.compestris, B. napus*and *B. juncea* (1). During the Rabi growing season, this crop is cultivated in both irrigated and rain-fed regions of Pakistan (2). It is one of the most significant edible oilseed crops and it is known as rai or raya. According to (3), oilseed brassica crops are cultivated extensively throughout all continents across the world. The consumption of mustard is an essential component of the human diet. Brassica are cultivated for a variety of uses, as food, fodder, and vegetables. The byproduct of these crops is oilseed cake, which is used for animal feed. Mustard seed have protein concentration ranging from 15 to 17 percent. Since 2000 B.C., these crops have been cultivated in the Indo-Pakistan subcontinent and occupy significant position in the economy of Indo-Pakistan. The raya productivity in Pakistan was 416 thousand tons on an area of 850.8 thousand acres during the rabi 2023-2024 period (4). It is also one of the most widely grown crops in the region. According to (5), the causes for such a low yield may be ascribed to a number of factors, one of which being the prevalent presence of insect pests. In Pakistan, it is believed that losses caused by insect infestations range from 70 to 80 percent. In contrast, if

the infestation is severe there is a possibility that there would be no grain formation at all (6, 7). Numerous insect pests, such as the cabbage butterfly, the pea leaf miner, the shield bug, and the mustard aphid, are among the factors that contribute to the reduction in production of the Brassica crop. According to the findings of comprehensive research that was carried out by (8), the cabbage aphid (*Brevicoryne brassicae* L) and the turnip aphid (*Lipaphiserysimi*) have been consistently detected as the most prevalent among all insects in Southern Punjab for around ten years. Both the cabbage aphid (*Brevicoryne brassicae* L.) and the mustard aphid (*Lipaphiserysimi* (Kalt.) are important pests of brassicas in Pakistan, and they cause substantial damage to crop. Because aphids feed on sap, plants suffer from stunted growth, deformation, withering, and yellowing as a consequence of their presence. According to (9-11), aphids are responsible for 70–80 percent of the documented yield losses and upto six percent drop in the oil content of the seeds. Both the nymph and adult stages are responsible for the harm that occurs because they are sucking the cell sap from the leaves, which causes the leaves to become yellow. Every part of the plant, including the leaves, stems, flowers and the inflorescence, may be affected by its attack. There have been reports of the presence of the Mustard Aphid, also known as Lipaphis erysimi, in Pakistan, India, Bangladesh, and the United States of America (12- 14). The life cycle of the mustard aphid is completed in a relatively short period of time, and it has the potential to result in significant yield losses, which may ultimately lead to financial losses (15, 16). The mustard aphid, also known as Lipaphis erysimi, has the potential to become a significant pest and result in significant losses, both in terms of the amount and quality of the product it consumes. According to (9, 17-22) these losses may range anywhere from 20 percent to 96 percent. Aphid of cabbage, also known as *Brevicoryne brassicae* L. While sawfly (Athalia proximia Klug) attacks oilseed brassicas before blooming in the early stage of crop development in NWFP and Sindh (6, 23), sawfly attacks also cause damage to oilseed brassicas throughout the flowering and pod formation phases. There are numerous regions of the globe that are experiencing major damage as a result of aphids and other insect pests. In the majority of nations where brassica crops are grown for commercial purposes, such as the United States of America (24), (3), Australia (25), India (26), and Pakistan (6), there is no other choice available other than the use of artificial pesticides. More efforts are being made to maintain the population of insect pests below the economic threshold level in order to have a healthy crop and a higher yield. Chemical control is more accurate than other methods since it eliminates around 90 percent of the aphid population (27, 28).

The mostly practiced method for control of Raya aphid is by use of insecticides. Keeping in view the importance of chemical control of Raya aphid, this study was carried out to identify the most effective pesticide, among some routinely used insecticides, for management of Raya aphids.

METHODOLOGY

The trials were carried out at the Adaptive Research Farm in Karor and farmer's field Chak no. 115/TDA in the Tehsil of Karor during the rabi season of 2023–2024. The raya variety 45-S-42 was used at a seed rate of 5 kg per hectare. The NPK fertilizer was administered in accordance with the advice, and normal agronomic techniques were implemented at the appropriate time throughout the year. During the month of November, the crop was planted using Randomized Complete Block Design (RCBD). The dimensions of the plot were 5 meters by 9 meters, and the row spacing was 45 centimeters. The treatments were spaced one meter apart. In the trials, there were five different treatments, including T1-T5. Following the completion of the necessary pest scouting conducted on the raya aphid, different treatments were used. Monitoring of pests and the recording of data at the top 10 centimeters of the central shoot of five randomly chosen plants was done. When the aphid population reached the Economic Threshold level (ETL), treatment with insecticide was carried out (29). For the study, five plants were chosen at random from each treatment, tagged, and the aphid population was recorded. It was determined how many aphids were gathered on a sheet of white plastic and then counted. Same approach to sample aphids was used by other researchers (30) and (26). This method has also been used internationally. By using this strategy, you will save time, labor, effort, and resources. Pest population was recorded at intervals of 24 hours, 48 hours, and 72 hours after the application of the spray.

STATISTICAL ANALYSIS

The data mean aphid population per 10 cm shoot was submitted to analysis of variance (ANOVA) by using M STATE. MSU 1982 computer program was used to distinguish the mean of the aphid population on various types using the Least Significance Difference Test at a significance level of 5%.

RESULTS AND DISCUSSION

AVERAGE APHID POPULATION BEFORE 24 HOURS SPRAY

Data pertaining to average aphid population (Table I and II) depicted non-significant difference among entire treatments at both sites. The analysis of data in Adaptive Research Farm Karor, concerning to maximum average aphid population before spray as indicated in (Table 1) was counted in T3 (56.66), where legend (metrin) 20 EC @ 740 ml ha^{-1} was applied followed by T2 (54.33), T4 (53.33) and T5 (51.66) where confidor (imidacloprid) 25WP @ 500 g ha^{-1}, plenum (pymetrozine) @ 200 g ha^{-1}, and talstar (bifenthrin) @ 370 ml ha^{-1}were applied respectively. Minimum average aphid population was recorded in check plot T_1 (50.66). Similar trend of results was also found in farmer's field, i.e. Chak no.115/TDA, Tehsil Karor as such in AR Farm Karor (Table II).

Table I. Mean population of aphid top on 10 cm inflorescence per plant of raya (*brassica juncea)* at Adaptive Research Farm Karor, District Layyah during Rabi-2023-24

Treatments with description	P. Scouting before 24 hours spray	P. Scouting after 24 hours spray	P. Scouting after 48 hours spray	P. Scouting after 72 hours spray	Average plant height(cm)	Average no. of pods/plant	Average yield (kg ha^1)
T1. Control	51.66[a]	65.33[a]	59.0[d]	65.99[d]	93.33[a]	25.80[a]	1263.20[d]
T2.confidor (imidacloprid) 25 WP @ 500 g ha^{-1}	54.33[a]	0.33	0.66[b]	0.5[a]	94.0[a]	54.73[a]	1860.16[a]
T3. legend (metrin) 20 EC @ 740 ml ha^{-1}	56.66[a]	1.0[b]	01[b]	1.33[b]	98.45	48.85[a]	1750.48[a]
T4. plenum (pymetrozine) @200g ha^{-1}	53[a]	1.66[b]	1.66[b]	2.0[c]	95.83[a]	42.93[b]	1685.30[b]
T5. talstar (bifenthrin) @ 370 ml ha^{-1}	51.66[a]	1.33[b]	2.0[c]	2.33[c]	94.66[a]	41.50[b]	1437.34[c]

Means in the columns followed by different letters are significantly different at 5% level of probability, using LSD

AVERAGE APHID POPULATION AFTER 24 HOURS SPRAY

Data about average aphid population (Table I and II) exhibited non-significant difference among entire treatments as compared to control. The data in (Table I) showed that minimum aphid population was counted in T_2 (0.33) where confidor (imidacloprid) 25 WP @ 500 g ha^{-1} was applied followed by T3 (1.0) and T5 (1.33) and T4 (1.66) where legend (metrin) 20 EC @ 740 ml ha^{-1} and plenum (pymetrozine) @ 200 g ha^{-1}were applied respectively. The maximum aphid population was observed in T_1 (66.33). It is due to high infestation of aphid in check plot where no pesticide was applied. Similar trend of results was also found in farmer's field, a.i. Chak no.115/TDA, Tehsil Karor as such in AR. Farm Karor (Table II).

AVERAGE APHID POPULATION AFTER 48 HOURS SPRAY

Data pertaining to average aphid population after 48 hours' spray revealed significant difference among all treatments at both sites (Table I and II). The data revealed in (Table I) showed that minimum population of aphids was observed in T2 (0.66) where confidor (imidacloprid) 25 WP @ 500 g ha^{-1} was applied and is statistically significant. It is due to high efficiency of confider as compared to other treatments. The treatments T3 (01) and T4 (1.66) are statistically at par both with each other, where legend

(metrin) 20 EC @ 740 ml ha^{-1} and plenum (pymetrozine) @ 200 g ha^{-1} were applied respectively, the remaining treatment T5 (02) is statistically significant to all other treatments, where talstar (bifenthrin) @ 370 ml ha^{-1} was applied. The maximum average pest population (58.0) was found due to heavy infestation of aphid in T1 (check plot). The data regarding the average population of aphid after 48 hours spray in farmer's field depicted significantly different among the treatments. It was noted that the minimum population of aphids was found in T2 (0.33) followed by T3 (0.66) and statistically at par both with each other, where confidor (imidacloprid) 25 WP @ 500 g ha^{-1}and legend (metrin) 20 EC @ 740 ml ha^{-1} were applied respectively. The remaining treatments T4 (01) and T5 (1.33) were statistically significant to each other, where plenum (pymetrozine) @ 200 g ha-^{1} and talstar (bifenthrin) @ 370 ml ha-^{1}, were applied. Maximum aphid population was found in TI (61.66) control plot.

Table II. Mean population of aphid top on 10 em inflorescence per plant of raya (*brassica juncea)* at Chak No 115/TDA, Tehsil Karor Distt, Layyah during Rabi-2023-24

Treatments with description	P. Scouting before 24 hours spray	P. Scouting after 24 hours spray	P. Scouting after 48 hours spray	P. Scouting after 72 hours spray	Average plant height (cm)	Average no. of pods/plant	Average yield (kg ha^{1})
T1. Control	53.66^{a}	56.0^{a}	61.33 d	64^{d}	81.50 ^{a}	30.20 d	1165.27^{d}
T2. confidor (imidacloprid) 25 WP @ 500 g ha^{-1}	49.33^{a}	0.33^{b}	0.33 ^{a}	0.30 ^{a}	83.66 ^{a}	53.65 ^{a}	1562.10^{a}
T3. confidor (imidacloprid) 25 WP @ 500 g ha^{-1}	46.33	0.66 ^{b}	0.66 ^{a}	1.33 ^{b}	87.90 ^{a}	47.20 ^{b}	1445.40^{b}
T4. plenum (pymetrozine) @200g ha^{-1}	47.66^{a}	2.0 ^{b}	1^{b}	1.66 ^{b}	87.13 ^{a}	45.50 ^{b}	1383.6^{b}
T5. talstar (bifenthrin) @ 370 ml ha^{-1}	50.33^{a}	1.66 ^{b}	1.33^{c}	2.00 ^{c}	83.20 ^{a}	40.54 ^{c}	1240.25^{c}

Means in the columns followed by different letters are significantly different at 5 % level of probability using LSD

AVERAGE APHID POPULATION AFTER 72 HOURS SPRAY

Data pertaining to average aphid population after 72 hours' spray revealed significant difference among the treatments in both sites (Table I and II). The analysis of data revealed in (Table -1) showed that minimum population of aphid was recorded inT2 (0.5), where confidor (imidacloprid) 25 WP @ 500 g ha^{-1} was applied and is statistically highly significant to all other treatments. The reason for this is that the effectiveness in this insecticide was higher as compared to all other treatments. The treatment T4 (02) and T5 (2.33) are statistically at par with both each other, where plenum (pymetrozine) @ 200 g ha^{-1}and talstar (bifenthrin) @ 370 ml ha^{-1} were applied, respectively. The treatment T3 (1.33), is statistically Significant to all other treatments, where legend (metrin) 20 EC @ 740 ml ha^{-1} was applied. Maximum population of aphid was recorded in T1 (65.66) check plot where none of insecticide was applied. Data regarding average population of aphids after 72 hours of spray at farmer's field expressed significantly different from rest of treatments (Table. 2). The results in (Table 2) showed that minimum population of aphid was recorded in T2 (0.30), where confidor (imidacloprid) 25 WP @ 500 g ha^{-1} was applied, which is statistically significant to other treatments. Likewise, at site 1 efficacy of confidor as site 11 was high as compared to rest of treatment. The treatments T3 (1.33) and T4 (1.66) were statistically at par both with each other where legend (metrin) 20 EC @ 740 ml ha^{-1} and Plenum (pymetrozine) @ 200 g ha^{-1} were applied respectively. It has been shown that the treatment T5 (2.0) is statistically significant to all other treatments where, talstar (bifenthrin) @ 370 ml ha^{-1} was applied. The maximum average pest population (63.33) was recorded in T1 (control plot) due to high infestation of aphıd and none of chemical was applied.

PLANT HEIGHT (cm)

The analyzed data presented in (Table 1 and 2) showed non-significant difference among the treatments regarding the plant height of raya in both locations at A R Farm Karor and farmer's field a. i Chak no. 115/TDA, Tehsil Karor. The data recorded at AR Farm Karor as revealed in (Table1) that maximum plant height (98.45 cm) was recorded in T3 where legend (metrin) 20 EC @ 740 ml ha^{-1} was applied, which is statistically significant and followed to T4 (95.83cm) and T5(93.66 cm) and T2 (94.0 cm), where plenum (pymetrozine) @ 200 g ha^{-1}, talstar (bifenthrin) @ 370 ml ha^{-1}, and confidor (imidacloprid) 25 WP @ 500 g ha^{-1} were applied, respectively. It is due to high efficacy of confidor as compared to other insecticides. Plant height remains stunted (93 cm) in T1 (control plot) is due to high infestation of aphid because no pesticide was sprayed in check plot.

AVERAGE NO OF PODS/PLANT

Data presented in (Table I and II) showed significant differences among the treatments regarding average no of pods/plant. The analysis of data at Adaptive Research Farm Karor concerning to maximum no. of pods/plant as indicated in (Table I) was found (54.70) in T2 where confidor (imidacloprid) 25 WP @ 500 g $ha^{-1}$was applied, which is statistically at par with T3 (48.85) where legend (metrin) 20 EC @ 740 ml ha^{-1} was applied. The treatments T4 treated with plenum (pymetrozine) @ 200 g ha^{-1} and T5 treated with talstar (bifenthrin) @ 370 ml ha^{-1} were statistically at par to both with each other, having 42.93 and 41.50 pods per plant, respectively. The least no of pod/plant (27.66) were found in check plot which is due to a high infestation of aphids where no pesticide was applied. While maximum number of pods per plant at farmer's field was observed in T2 (54.65), where confidor (imidacloprid) 25 WP @ 500 g ha-^{1} was applied which is significant difference to other treatments. The treatments T3 legend (metrin) 20 EC @ 740 ml ha^{-1} and T4 plenum (pymetrozine) @ 200 g ha^{-1} having 46.20 and 45.76 no. of pods/plant at par both with each other and statistically similar, when compared to other treatments, the average number of pods/plant was recorded in T5 (40.25) treated with talstar (bifenthrin) @ 370 ml ha^{-1} which is significantly difference to other treatments. The minimum no of pods/plant was recorded in T1 (30.20), where no pesticide was applied.

AVERAGE YIELD (Kg ha^{-1})

The data pertaining to the raya yield at both locations showed significantly differences among the treatments. The analysis of data (Table1) regarding the raya yield in A.R.Farm Karor as indicated in (Table-1) showed that treatment T2 treated with confidor (imidacloprid) 25 WP @ 500 g ha^{-1} was found (1864.16 kg ha^{-1}) which is statistically at par to treatment T3 (1752.48 kg ha^{-1}) where legend (metrin) 20 EC @ 740 ml ha^{-1} was applied. The yield of treatment T4 (1685.30 kg/ha) treated with plenum (pymetrozine) @ 200 g ha^{-1} and T5 (1437.34 kg ha^{-1}) treated with talstar (bifenthrin) @ 370 ml ha^{-1} were statistically difference to each other. The minimum yield 1263.18 kg ha^{-1} was recorded in T1 (control plot), where no pesticide was applied. While the data regarding average raya yield at farmer's field a.i Chak no. 115/TDA, Tehsil Karor as indicated in (Table 2) showed highly significantly difference among the treatments. Maximum grain yield was recorded (1562.10 kg ha^{-1}) in T2, where Confidor (imidacloprid) 25 WP @ 500 g ha^{-1} was applied followed by T3 (1445.40 kg ha^{-1}), T4 (1382.6 kg ha^{-1}) and T5 (1237.25 kg ha^{-1}), where legend (metrin) 20 EC @ 740 ml ha^{-1}, Plenum (pymetrozine) @ 200 g ha^{-1} and Talstar (bifenthrin) @ 370 ml ha^{-1} were applied respectively. The minimum yield of 1165.27 kg ha^{-1} was recorded in T1 (control plot), where no pesticide was applied.

The present results support the finding of (31) who found the 0.0178 percent imidacloprid and 0.005 percent thiamethaxam proved to be most effective against mustard aphid and increasing yield. Studies carried out by (32), although does not show the similar result, however, he also acknowledges the supremacy of Advantage (carbosulfan) and imidacloprid in controlling mustard aphid. Our finding demonstration that new insecticide confidor (imidacloprid) 25 WP @ 500 g ha^{-1} was highly effective against aphid shown in Table-l and Il. So, this insecticide confidor (imidacloprid) 25 WP @ 500 g ha^{-1} can be

recommended to the growers in arid zone to manage the population of aphid on raya crop below Economic Threshold Level (ETL).

CONCLUSION

The present study represents that maximum mortality one day (24hours) two days (48 hours) and 3 days (72 hours) after spray by use of confidor (imidacloprid) 25 WP @ 500 g ha^{-1} followed by legend (metrin) 20 EC @ 740 ml ha^{-1}, plenum (pymetrozine) and talstar (bifenthrin). It is evident from table-1 and 2 that the insecticide, confidor (imidacloprid) 25 WP @ 500 g ha^{-1} was most effective against aphid on raya crop and increased the yield and yield components of raya crop.

Authors' contribution:

IH conceived idea and supervised research, GA supervised study and management, MA collected data, SK data collection, MA did write up, JH did statistical analysis, MTM did interpretation of data and correspondence, MAA grammar check and review, ZH collected farmer trial data, HMSA plagiarism check and correction, AA completed result discussion portion, AAK did citation in text and revision.

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