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Comparative Efficacy of Insecticides against Cabbage Aphid Brevicoryne Brassicae, A Pest of Oilseed Rape, Brassica napus (L.) under Controlled Conditions

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COMPARATIVE EFFICACY OF INSECTICIDES AGAINST CABBAGE APHID *BREVICORYNE BRASSICAE*, A PEST OF OILSEED RAPE, *BRASSICA NAPUS* (L.) UNDER CONTROLLED CONDITIONS

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ABSTRACT

Rapeseed and mustard is the same group of oilseed crops (*Brassica* sp.) as well as a significant source of edible oil in Pakistan. The cabbage aphid, *Brevicoryne brassicae* is considered a major insect pest of oilseed rape, *Brassica napus L*. and causes significant yield loss. An experiment was conducted in a completely randomized design (CRD) consisting of four insecticidal treatments i.e. Confidor 200 SL (imidacloprid), Mospilan 20 SP (acetamiprid), Arrivo (cypermethrin), Triazophos 40 EC (triazophos) at low to high concentrations along with control treatment to estimate the efficacy of canola leaves against aphid population. Among all insecticide applications of cypermethrin and acetamiprid were found highly effective applied at higher concentrations throughout the experiment as compared to imidacloprid and triazophos, indicating consistent mortality at high and medium concentrations. Taking together, insecticides cypermethrin and acetamiprid were recommended to control aphid infestation based on their residual activity, yield response, and rate of marginal return. This study gives directions to control aphid infestation on a quick basis at a larger scale.

Keywords: Brassica, cabbage aphid, insecticide, mortality.

Abbreviations: CRD: completely randomized design

INTRODUCTION

Rapeseed and mustard are important crops of *Brassica* family, has been considered as a major source of palatable oil paying about 13.76 % for national oil production but its requirement has been increased during the last few years (Anonymous, 2000). Rapeseed is an ironic source of oil and proteins. Its seed contains almost 48 % of oil contents. Its seed meal covers the maximum essential amino acids for making 43.6 % protein.

Aphid belongs to Aphidoidea (Homoptera), considered an economically important pest due to its devastating feeding behavior and rapid reproductive potential that makes it difficult to control below an economic threshold level (Bhatia et al., 2011; Ihsan et al., 2021). Aphid infestation mostly occurs at two growth stages of brassica life cycle; the winter phase (establishment phase) and spring

phase (flowering and podding phase). Early infestation can be caused by stress or viral transmission and later infestation can cause a higher impact in the dry season (moisture stress). Among all species of aphids, cabbage aphid is a major destructive insect pest of *brassica* plant species in comparison to turnip and peach aphid that leads toward poor growth and low yield. Thus recommended integrated pest management approaches such as early sowing, biological control, and a chemical spray of insecticides to control the aphid damage are very useful (Karazmoodeh et al., 2013; Nawaz et al., 2021).

The most prevalent insecticides used to control aphids were carbamates, organophosphates, and pyrethroids (Cameron and Fletcher, 2005; Bahlai et al., 2010). Farooq and Tasawar (2009) tested five insecticides included Advantage 20 EC (carbosulfan), Confidor 200 SL (imidacloprid), Actara 25 WP (thiomethoxan), Mospilan 20SP (acetamiprid), and Lannate 40SP (methomyl) to control the aphid and found that Lannate was significantly more effective against *Brevicoryne brassicae* on canola crop at all the post-treatment intervals as compared to the other. Liu et al., (2001) also reported the efficacy of primicar, lambda-cyhalothrin, imidachloprid and thiamethoxam against *L. erysimi* on Brassica but there is nothing clear about it. In Pakistan, there is no such research to recommend the particular pesticide to control such insects therefore our current study will be effective for future recommendations for choice of pesticides.

MATERIALS AND METHODS

Collection of Aphids

Aphids were identified based on their taxonomic characters (Nasir and Yousuf, 1995; Liu and Spark, 2003). Infested leaves of canola crop *Brassica napus* (rabi) were collected in crop growing season during the year 2019-2020. Infested, as well as healthy leaves were individually collected in plastic bags and transferred to the Entomological laboratory (Figure 1).

Experimental Layout

Cabbage aphids from leaves were collected in plastic petri dishes from leaves. Third nymphal stage aphids were released on fresh canola leaves to check efficacy of insecticides sprayed on fresh *Brassica napus* leaves. Experiment was laid down in completely randomized design of four insecticide treatments with 15 replicates of each insecticide (five petri dishes possessed canola leaves per concentration) and three concentration levels (high, medium and low) for each tested insecticide.

Insecticides Treatment under Laboratory Conditions

After separating the fresh canola leaves for insecticides sprayed, formulated insecticide concentrations according to the recommended doses to check the comparative efficacy of insecticide treatments against aphids damaged canola leaves. Imidacloprid solution in three required concentrations as 0.2 5ml/liter (low), 0.5 ml/liter (stand/med) and 0.75 ml/liter (high) were prepared and then used knapsack sprayer to evenly sprayed on the front side of *Brassica napus* leaves in five replication of each concentration and allowed to dry for two hours. Aphid third nymph (2 nymph/ leaf) in plastic Petri dishes possessed treated canola leaves. Covered Petri dishes with plastic lid and tape them to prevent aphid escape and contamination then collected data after every 6 h interval to check aphid mortality ratio. The same procedure was repeated for three other insecticides while each insecticide formulated according to dose rate such as acetamiprid (Mospilan) concentrations were 100 µl, 125 µl, and 175 µl; Triazophos was used in three

treatments 100 µl, 125 µl and 175 µl whereas cypermethrin (Arrivo) used in 2 µl, 2.5 µl and 3 µl concentrations.

Figure 1: Insecticide treatments on *Brassica napus* leaves under laboratory conditions.

Statistical Analysis

The recorded data including the mortality ratio of aphids at three concentrations of each insecticide was subjected to statistical 8.1 software to find out the mortality ratio of aphids in each treatment as well as compared treatment means for statistical significance ($P < 0.05$) using ANOVA and Duncan's Multiple Range Test.

RESULTS

Efficacy of Cypermethrin Treatments

Cypermethrin was applied in three treatments as high, medium, and low concentration on canola leaves to check the mortality ratio of aphids in three treatments at 6 h, 12 h, 18 h, 24 h, 30 h, 36 h intervals. Recorded from the graph, no aphid mortality was noted in high and medium concentrations but the least aphid mortality (0.06) was observed in low concentration after 6 h of its spray (Figure 2). High aphid mortality (0. 6) was recorded after 36 h of its spray. The insecticide exposure time increase increases aphid mortality. Statistical analysis indicates a significant effect ($P < 0.05$) of cypermethrin concentration in induced aphid mortality after 12 h and 1.5 days after its spray was observed. Although there was a non-significant difference observed between concentrations at any interval but aphid mortality significantly differed at high concentration and control after 36 h of its spray.

Table 1: Insecticidal application with different dose/ha.

Sr. No.	Trade name	Active ingredient	Dose/ha
1	Confidor 200SL	Imidachloprid	370ml
2	Mospilan 20SP	Acetamaprid	198g
3	Arrivo	Cypermethrin	300ml
4	Triazophos 40 EC	Triazophos	1400 ml

Efficacy of Acetamaprid Treatments

Recorded from the graph, the least mortality ratio (0.1333) of aphid was noted at low concentration after 6 h of acetamiprid spray-on canola leaves whereas, after 36 hours of its spray, high aphid mortality (0.86) was recorded at high and low concentrations. Statistical analyses indicate that a highly significant effect ($P < 0.01$) of acetamiprid concentration in aphid mortality was recorded at 1.5 days after its spray whereas no significant difference was observed between concentrations at any interval but aphid mortality significantly differed at medium concentration and control after 36 h of its spray (Figure 3).

Efficacy of Imidacloprid Treatments

Recorded from the graph, the least mortality ratio (0.06) of aphid was noted at low concentration after 6h of imidacloprid spray-on canola leaves whereas, after 36 hours of its spray, high aphid mortality (1) was recorded at high and medium concentrations. Statistical analyses indicate that a significant effect ($P < 0.01$) of imidacloprid concentration was recorded at 1 day after its spray in aphid mortality followed by a highly significant effect recorded at 30 h and 1.5 days after its spray whereas there was no significant difference observed between concentrations after 18h of its spray but noted significantly differed aphid mortality at 24-36 h period after its spray (Figure 4).

Efficacy of Triazophos Treatments

Recorded from the graph, the least mortality ratio (0.2) of aphids was noted at medium and low concentration after 6 h of triazophos spray-on canola leaves whereas, after 36 hours of its spray, high aphid mortality (0.93) was recorded at medium concentration. Statistical analyses indicate that a significant effect ($P < 0.01$) of triazophos concentration in aphid mortality was recorded at 12h after its spray followed by a highly significant effect recorded at 18 h-1.5 day duration after its spray whereas there was no significant difference observed between concentrations after 12 h of its spray but noted significantly differed aphid mortality at 18-36 h period after its spray (Figure 5).

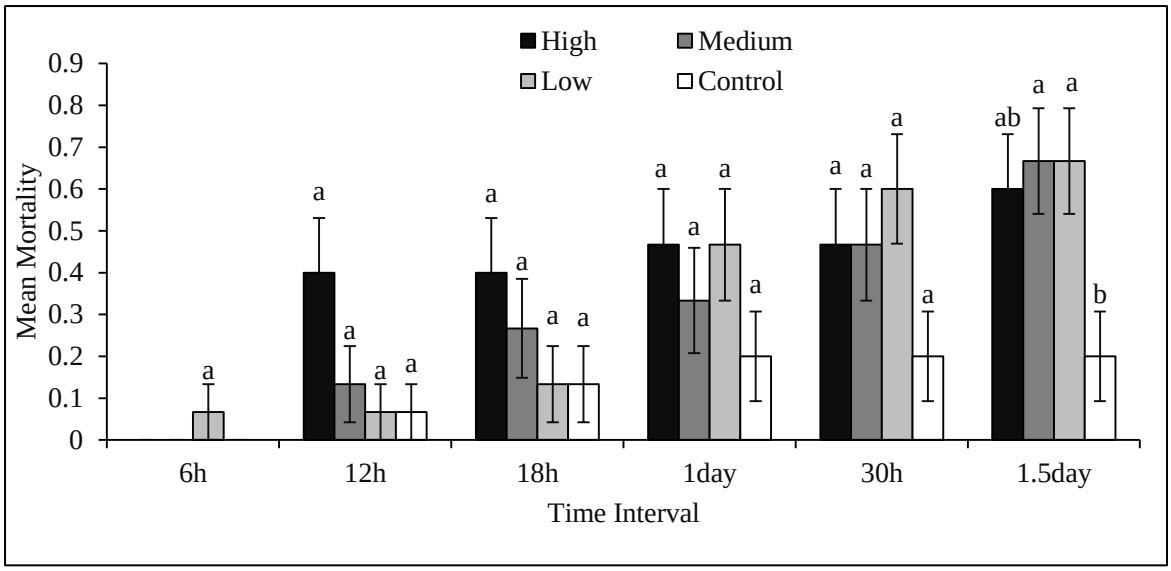

Figure 2: Mean mortality (Mean ± SE) of aphids at three concentrations of cypermethrin and control at different time intervals. Mean sharing similar letters in each treatment are not differ significantly at P= 0.05 %.

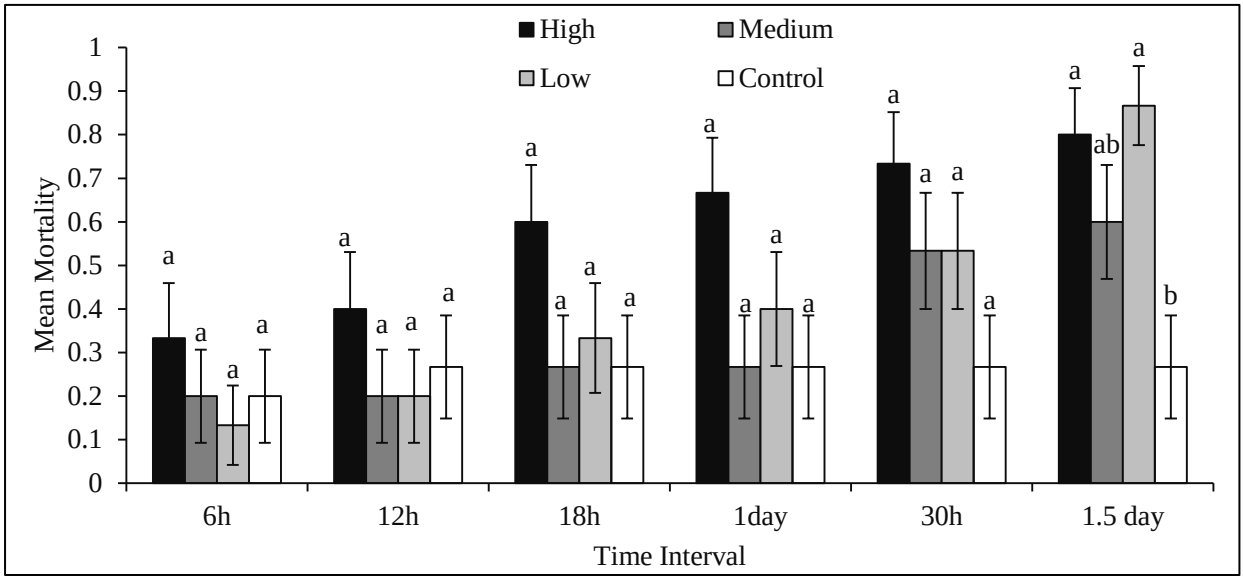

Figure 3: Mean mortality (Mean ± SE) of aphids at three concentrations of acetamaprid and control at different time intervals. Mean sharing similar letters in each treatment are not differ significantly at P= 0.05 %.

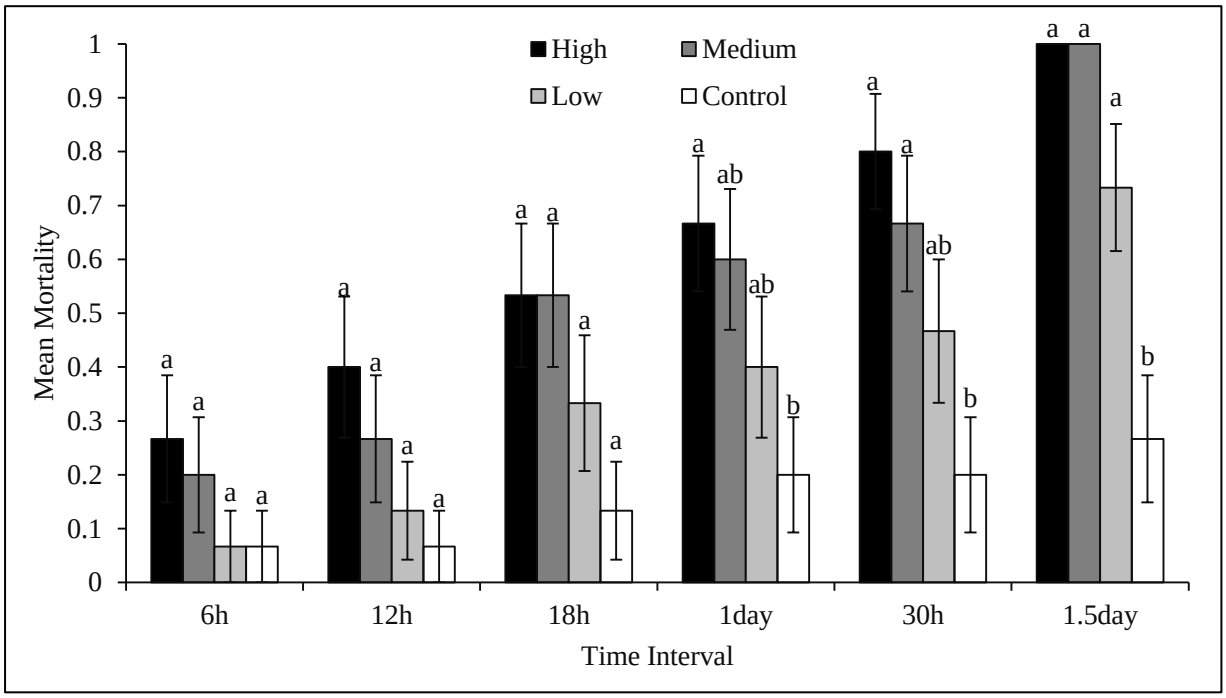

Figure 4: Mean mortality (Mean ± SE) of aphids at three concentrations of imidachloprid and control at different time intervals. Mean sharing similar letters in each treatment are not differ significantly at P= 0.05 %.

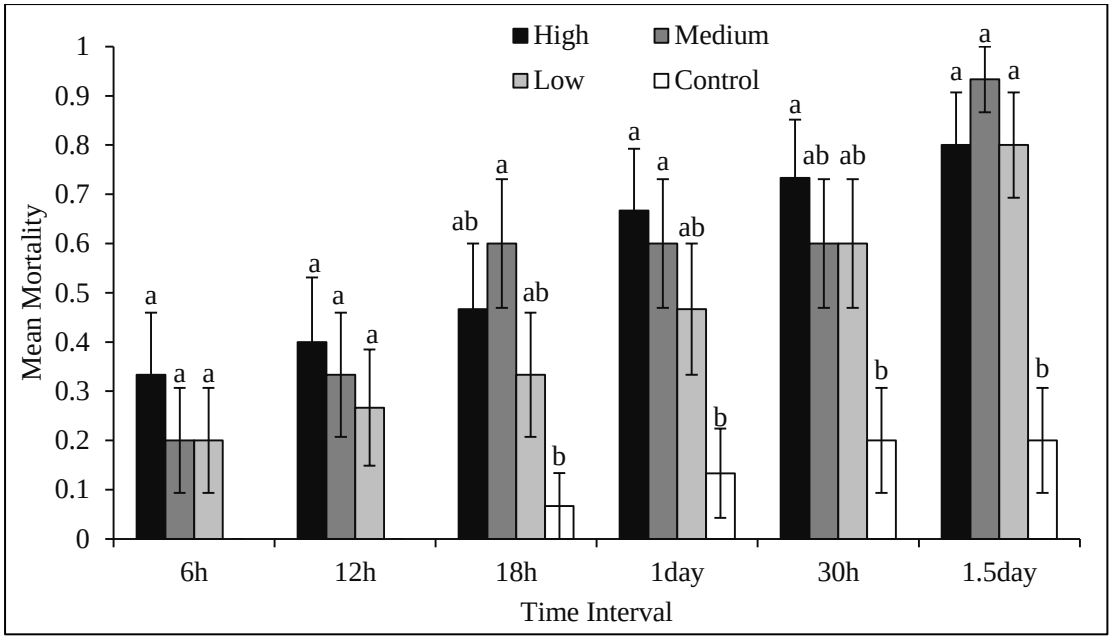

Figure 5: Mean mortality (Mean ± SE) of aphids at three concentrations of triazophos and control at different time intervals. Mean sharing similar letters in each treatment are not differ significantly at P= 0.05.

DISCUSSION

The present experimental study was conducted to compare the efficacy of insecticide spray on cabbage aphids which severely damage canola leaves and pods and to check which insecticide concentration is more effective to control rapidly reproducing aphid population on canola crop. Present findings were not in agreement with Sinha et al., (2001), and Devi et al., (2002) result that spray different insecticides for aphid control on canola crop**.** Different insecticides belong to organochlorides (Bakhetia et al., 1986; Nawaz et al., 2020; Fiaz et al., 2021) and organophosphates (Mustafa, 1998) have been used to control aphids (Kalt) on *Brassica* but most of them were associated with undesirable traits such as failure in controlling aphid attack or persistence in the environment and resistance adaptation by the aphid.

In present findings, it was noted that two of the four insecticides (acetamiprid and imidacloprid) showed more than 80 % mortality during an exposure period of 30-36 hours that confirmed with Mustafa (2000) findings who reported Confidor was most effective with 92.28 % *L. erysimi* mortality after 72 hours of post-treatment. Cypermethrin spray show the lowest mortality (60%) whereas triazophos show 93 % aphid mortality was following the results reported by Devi et al., (2001) and Choudhury and Pal (2005) that compare the efficacy of these insecticides against aphids on *Brassica.*

In present results, cypermethrin and acetamiprid show consistent high mortality at high concentrations during the exposure period whereas triazophos and imidacloprid show consistent high mortality at high and medium concentrations during the exposure period that was similar to results reported by Aslam et al., (2001) studied insecticides Imidachloprid 25 WP, Triazophos 40 EC, Advantage 20 EC, and Confidor have effective control over aphids (*L. erysimi* and *Brevicoryne brassicae*) on canola crop up to nine days after treatment exposure but Triazophos show consistent effectiveness throughout the experiment.

Statistically concluded that the most significantly effective insecticides were cypermethrin and acetamiprid which

showed significant aphid mortality than imidacloprid and triazophos. These findings were in agreement with results reported by Sahoo (2012) who has compared the effectiveness of different insecticides against aphids on canola. The imidacloprid spray used to show less significant effectiveness that was not following the results reported by Ali and Ansari (2008) because they revealed that imidacloprid was more effective than other insecticides used and this contrast to the present study may be due to experimental error.

CONCLUSION

Study results concluded that the most significant ($P < 0.05$) insecticide used for aphid control was cypermethrin. A high concentration of this insecticide gave the highest toxicity against cabbage aphid, *B. brassicae*. The second highly effective insecticide was acetamiprid ($P < 0.05$) against aphid (*B. brassicae)* control followed by least control indicate by imidacloprid and triazophos concentration while in control experiment least mortality of aphid was observed.

ETHICAL STATEMENT

Not applicable.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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AUTHORS' CONTRIBUTIONS

AI, HA, conducted experiment, recorded the data and interpreted the results. FM, SK, MWM, MAQ and ANS recorded the data and interpreted the results. All authors read and approved the final manuscript.

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