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Resistance of Cabbage Aphid, *Brevicoryne brassicae* (Linnaeus) to Endosulfan, Organophosphates and Synthetic Pyrethroids

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Abstract.- Laboratory bioassays were done to determine the level of resistance to endosulfan, cypermethrin, deltamethrin, methamidophos, profenofos and chlorpyrifos in field populations of cabbage aphid, *Brevicoryne brassicae* (L). Comparison between Multan and Kabirwala strains revealed that the level of resistance in Multan strain was comparatively higher to methamidophos, profenofos and chlorpyrifos as compared to that in Kabirwala strain. Results of endosulfan, cypermethrin and deltamethrin, which were tested only for Multan strain, revealed that resistance level was almost twice for cypermethrin as compared to deltamethrin. Overall resistance level in lethal concentration at 50% level was low.

Key words: Cabbage aphid, insecticide resistance, lethal concentration.

INTRODUCTION

Rapeseed and mustard are the traditional oilseed crops and the second most important source of edible oil after cotton seed in Pakistan (Rehman *et al.,* 1987). The total cultivated area under oilseed crops during 2001-2002 was 3.498 million hectares (Anonymous, 2002). Cabbage aphid, *Brevicoryne brassicae* (L.) (Aphididae: Homoptera) is a serious pest of cruciferous crops like raya, mustard and canola (Nasir and Yousuf, 1995). It is found on these crops from January to March with maximum population in March (Anwar and Shafique, 1999). Both the adults and nymphs of this pest suck plant juices, causing curling and yellowing of leaves and transmit viral diseases. The aphids produce honeydews which stick to leaves and causes sooty mould to develop, which ultimately affects photosynthesis. Under severe infestations, it may cause up to 80% reduction in yield (Atwal, 1976; Khattak and Hamed, 1993).

Due to its high reproductive potential and extensive application of insecticides, development of resistance has been observed in different parts of the world by Garg *et al.* (1987) and Sweeden and McLeod (1997). This resulted in the need to look for more effective insecticides for its better control (Halimie *et al*., 1992; Narkiewicz, 1995; Freuler *et al.,* 2001; Aslam and Ahmad, 2002). Little work has been reported to monitor the insecticides resistance against this pest. Thus, it was planned to study the resistance against some commonly used insecticides for its control.

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MATERIALS AND METHODS

Insects

Adults of *B. brassicae* were identified following the taxonomic characters (Nasir and Yousuf, 1995; Liu and Spark, 2003) and were collected from raya *(Brassica juncea)* from Multan and Kabirwala during 2003. These were treated as two strains based on location from where they were collected, *i.e*. Multan and Kabirwala, and were tested directly without rearing in the laboratory. Apterous adult aphids were used for the study.

Insecticides

Formulated endosulfan (Thiodon@ 35%, EC; Aventis), cypermethrin (Arrivo® 10%, EC; FMC), deltamethrin (Decis@ 2.5%, EC; Aventis), methamidophos (Tamaron® 60%, SL; Bayer Agrosciences), profenofos (Curacron® 50%, EC; Syngenta) and chlorpyrifos (Lorsban® 40%, EC; Bayer Agrosciences) used in this study were obtained from their respective manufacturers.

Table I.- Effect of insecticides against adult cabbage aphid, *Brevicoryne brassica,* (24 hours after treatment) during 2003.

Insecticide	Location	Number tested	LC_{50} (95% FL)	Slope	*CR
Endosulfan	Multan	450	28.7 (22.6-36.7)	1.47±0.13	--
Cypermethrin	Multan	500	9.77 (7.65-12.5)	1.27±0.10	1.75
Deltamethrin	Multan	400	5.59 (4.36-7.16)	1.39+0.13	1.00
Methamidophos	Multan	500	382 (297 -491)	1.37±0.ll	3.16
	Kabirwala	350	121 (89.2-165)	1.42±0.16	1.00
Profenophos	Multan	400	25.6 (20.9-31.4)	1.85±0.61	2.08
	Kabirwala	400	12.3 (9.25-16.4)	1.43±0.15	1.00
Chlorpyrifos	Multan	450	1.47(0.62-3.47)	1.24±0.21	5.44
	Kabirwala	450	0.27(0.06-1.18)	1.80±0.41	1.00

*CR = Comparative ratio of Multan strain with Kabirwala strain, in Multan strain for pyrethroids

Bioassay

Leaf-dip bioassay were conducted per insecticide concentration with five replicates each and 7 to 10 serial concentrations were made for each insecticide tested. Leaf discs (5 cm diameter) of raya were dipped into insecticide solution and allowed to air dry on tissue papers. These were placed in plastic Petri dishes with adaxial side upward with a moist filter paper beneath them. Ten apterous adult aphids were placed on the treated leaf surface with a fine camel hair brush. The Petri dishes were then covered with plastic lids and placed under controlled conditions, *i.e.* at 25±2°C temperature and 50±10 % relative humidity with 14h: 10h light: darkness ratio. Same number of adults were placed in five Petri dishes on leaf discs, treated with distilled water and air-dried, as check.

Data analysis

Adults failing to show movement after a gentle touch were considered dead. Mortality at serial concentration levels of each insecticide was recorded after 24 hours of insecticide exposure which was corrected by Abbott's (1925) formula. Data were analyzed by probit analysis (Finney, 1971) using the software POLO-PC (LeOra Software, 1987).

RESULTS AND DISCUSSION

Among the organophosphates, chlorpyrifos proved most toxic to *B. brassicae* adults with the lowest LC_{50} (0.27-1.47 ppm (parts per million)) followed by profenofos (12.3-25.6 ppm) and methamidophos (121-382 ppm) for Kabirwala and Multan strains, respectively (Table I). LC_{50} of deltamethrin was 5.59 ppm which was about half that of cypermethrin (9.77 ppm) of Multan strain. Dose-response relationship was generally steeper for both strains for all insecticides tested showed a good fit of data. LC_{50} of endosulfan was 28.7 ppm of Multan strain. Field trials proved that all organophosphates, pyrethroids and endosulfan are effective tools to control it (Khattak *et al.,* 2002; Aslam and Ahmad, 2002). However, organophosphates proved more toxic than others. Present results revealed that organophosphates were more effective than pyrethroids and endosulfan. The higher LC_{50} against methamidophos may be due to its extensive and indiscriminate use for its field control of *B. brassicae.*

The comparison between Multan and Kabirwala strains revealed that the level of resistance in Multan strain was higher to methamidophos, profenofos and chlorpyrifos. It was 3.16-fold for methamidophos, 2.08-fold for profenofos and 5.44-fold for chlorpyrifos. Endosulfan, cypermethrin and deltamethrin were tested only for Multan strain and resistance to cypermethrin was 1.75-fold to deltamethrin. This showed that deltamethrin was more effective than cypermethrin among the pyrethroids tested, while in organophosphates, chlorpyrifos and profenofos were found more lethal to *B. brassicae* than that of

methamidophos. The overall comparison between Multan and Kabirwala strain revealed that the level of resistance in Multan strain was comparatively more against organophosphates. This may be attributed to more use of insecticides in Multan than Kabirwala. The effective management of *B. brassicae* can be achieved with early season population control (Anwar and Shafique, 1999) with use of organophosphates and pyrethroids as their LC_{50} were low.

The use of conventional and new chemistry insecticides have proved lethal and effective for aphid control as reported by Aslam and Ahmad (2002). However, present results revealed that LC_{50} values of organophosphates and pyrethroids have proved their effectiveness against this pest.

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