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Effect of Conventional and Neonicotinoid Insecticides Against Aphids on Canola, *Brassica napus* L. at Multan and Dera Ghazi Khan

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Abstract.- Conventional (bifenthrin, carbosulfan and methamidophos) and neonicotinoid insecticides (thiamethoxam and imidacloprid) were sprayed once to test their toxicity to cabbage aphid, *Brevicoryne brassicae* L. and turnip aphid, *Lipaphis erysimi* (Kalt.) on canola. Insecticides were applied on 14th March, 2005 at Multan. After seven days of application all the insecticides proved to be similarly toxic to aphids but statistically higher numbers of both aphid species were observed in untreated plots. In another experiment split plot design was employed and four *B. napus* varieties, CON-I, CON-II, KS-75 and Abaseen were planted in sub-plots keeping insecticides (thiamethoxam, imidacloprid and carbosulfan) in main plots at Dera Ghazi Khan. Insecticides were applied on 2nd and 12th March, 2006. The interaction between varieties and insecticides at the Dera Ghazi Khan trial was non-significant when analyzed in split plot design. Therefore, population data of *B. brassicae* and *L. erysimi* were pooled for varieties. Densities of both the species were statistically lower after nine days of application in plots where insecticides were applied when compared to untreated plots. However, aphid numbers were too high even after three days of application particularly after first spray. Results of this study suggest that insecticides should not be applied at pod-filling stage (first week of March) to manage aphids on canola.

Key words: Aphids, *Brevicoryne brassicae*, *Lipaphis erysimi*, insecticides, *Brassica napus*

INTRODUCTION

Oilseed crops are very important for the economy of Pakistan because local production of edible oil in Pakistan currently accounts for 28% of total requirement while the remaining 72% is met through imports (Anonymous, 2007). *Brassica napus* L. is an important oilseed crop because seeds of this crop contain less than 2% erucic acid and $<30\mu Mg^{-1}$ of gulcosinolates in the oil free meal, and canola oil contains 5-8% saturated fats which is lower than any other vegetable oil (Raymer, 2002). Major threats for reduction in yield of *B. napus* are insect pests. The cabbage aphid, *Brevicoryne brassicae* L. and turnip aphid, *Lipaphis erysimi* (Kalt.) are devastating insect pests of canola, *Brassica napus* in Multan, Bahawlpur and Dera Ghazi Khan districts of Punjab, Pakistan (Aslam and Razaq, 2007). *L. erysimi* alone can cause 10–90% damage depending upon the severity of the infestation and crop stage (Rana, 2005). *B. brassicae* and *L. erysimi* are also insect pests in the USA, Australia and India. Management tactics in these countries often rely heavily on insecticides as other methods of control have not been very useful (Buntin and Raymer, 1994; Brown *et al*., 1999; Chattopadhyay *et al*., 2005; Hanain *et al.*, 2007). However, insecticides and their timing of application may differ from country to country, as insecticides use patterns change with introduction of new chemistries and development of resistance.

Currently available cultivars lack sufficient plant resistance to provide protection against aphids in Multan and Dera Ghazi Khan. Moreover, natural enemies appear in later stages when most of the damage has been done (Aslam *et al*., 2005; Aslam *et al.*, 2007; Aslam and Razaq, 2007; Amer *et al*., 2009). Therefore, insecticides application becomes necessary to reduce the damage caused by aphids. No literature reports efficacy of insecticides against *B. brassicae* and *L. erysimi* in Multan and Dera Ghazi Khan regions except that reported by Aslam and Munir (2000).They reported similar toxicity of imidacloprid and carbosulfan to *L. erysimi*. Conventional and neonicotinoid insecticides against *B. brassicae* and/or *L. erysimi* have been evaluated in USA (Buntin and Raymer, 1994; Brown *et al*.,

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1999), India (Kumar and Dikshit, 2001), New Zealand (Schroeder *et al*., 2001) and Pakistan (Khattak *et al.,* 2002; Sarwar *et al.,* 2003).

The present study was therefore conducted to determine the efficacy of conventional and neonicotinoid insecticides against aphids on *B. napus* at Multan and Dera Ghazi Khan.

MATERIALS AND METHODS

Experiments were conducted at two locations *i.e.*, Multan (32.2° N, 71.45° E) and Dera Ghazi Khan (30.05^{o} N, 70.63^{o} E) districts of Punjab province in Pakistan. At Multan, the experiment was conducted at the Experimental Farm, University College of Agriculture, Bahauddin Zakariya University during 2004-05. The experiment was laid out in a randomized complete block design with three replicates, *i.e.* blocks. Each plot consisted of four rows with row to row distance of 45 cm and plant to plant distance of 10 cm. Rows were 4.6 m long. There were about 46 plants in each row. Canola variety KS-75 was planted on 12 November 2004 by the hand drill method. Standard cultural practices were followed. Five insecticides from conventional (bifenthrin, carbosulfan and methamidophos) and neonicotinoid (thiamethoxam and imidacloprid) were used as the treatments (Table I).

Rates of insecticides *viz*., thiamethoxam (Actara 25WG @ 15g a.i/ha.), imidacloprid (Confidor 20SL @ 0.125 L. a.i/ha.), carbosulfan (Advantage 20EC @ 0.5 L. a.i/ha.), bifenthrin (Talstar10EC@ 0.0625 L. a.i/ha.) and methamidophos (Methamidophos 60SL @ 1.5L. a.i/ha.) recommended for application were used. Spray application of the insecticides was carried out on 14th March 2005 with hand operated knapsack sprayer at a pressure of 3 bars using a hollow cone nozzle.

Another experiment was conducted at the Experimental Farm, College of Agriculture, Dera Ghazi Khan during the crop season 2005-06. The trials were laid out in a split plot design with three replications. Four *B. napus* varieties, CON-I, CON-II, KS-75 and Abaseen were planted on 14th November 2005 in sub-plots keeping insecticides as the main plots. Net plot size was of 4.6 m long and 1.7 m wide. There were four rows in each treatment and row to row distance was 45.0 cm. Standard cultural practices were followed. Three insecticides, thiamethoxam, imidacloprid and carbosulfan were used for the treatments. All the plants were treated in each treatment. Calibration of sprayer was carried out with water to determine the volume of water required for each plot. Volume thus determined was then applied. Applications were carried out on 2nd March 2006 and repeated on 12th March 2006. A control was also included at both the locations where nothing was applied. Populations of both aphid species were recorded 1, 3 and 7 days after spray in Multan and 1, 3, 5, 7 and 9 days after spray in Dera Ghazi Khan trials. Aphid numbers (both nymphs and adults) were recorded from six plants in two middle rows of each treatment with three plants selected randomly from each row. For this purpose, the top 10 cm of the central inflorescence of plants was beaten gently ten times with a 15 cm stick of pencil thickness. This method has also been employed in sampling *L. erysmi* in India on *B. juncea* (Singh *et al.*, 1989; Chattopadhyay *et al*., 2005). Aphids were collected on a piece of white plastic sheet and counted. Aphids, *B. brassicae* are of ash colour and have waxy coating, whereas *L. erysmi* are of shiny green colour. The data of mean aphid numbers per 10 cm inflorescence of a plant was subjected to analysis of variance (ANOVA) using MSTATC computer software (MSU, 1982). Differences among the treatments were calculated by separating the means of population of aphids with least significant difference test at $p = 0.05$.

RESULTS AND DISCUSSION

In Multan, one day after application lowest numbers of aphids were observed in plots treated with bifenthrin or carbosulfan (Table I). Bifenthrin also proved to be the most effective treatment three days after application of insecticides. The lowest numbers of aphids were observed in plots where bifenthrin was applied as compared to carbosulfan, thiomethoxam and imidacloprid three days after application. All of the insecticides proved to be equally toxic seven days after application and were statistically better than the untreated plots.

Table I.- Mean density of aphids (*B. brassicae* and *L. erysimi*) on top 10 cm inflorescence per plant of canola with different insecticides treatments at Multan during March 2005.

Insecticides	Rate/Hectare	Aphids per plant (days after treatment)		
		One	Three	Seven
Thiamethoxam*	60gm	49.33 bc	29.00 bc	13.33 b
Imidacloprid*	0.625L	39.67 c	14.00 bc	14.00 b
Bifenthrin**	0.625L	12.00 d	5.66 c	6.66 b
Carbosulfan**	2.5L	14.33 d	11.00 bc	12.00b
Methamidophos**	2.5L	61.67 b	33.33 b	11.00 b
Control		101.00 a	66.33 a	26.33 a
LSD Value		20.60	23.54	8.70

Means not sharing common letters are significantly different at P=0.05.
*Neonicotinoid insecticides.
** Conventional insecticides.

Table II.- Mean density of *B. brassicae* and *L. erysimi* on top 10 cm inflorescence per plant recorded at different time intervals after first spray at Dera Ghazi Khan during 2006.

Insecticides	Aphids per plant (days after treatment)*				
	One	Three	Five	Seven	Nine
B. brassicae					
Thiamethoxam	16.29b	33.0b	53.35b	58.10b	105.8ab
Imidacloprid	16.75b	34.13b	55.73b	50.16bc	87.22b
Carbosulfan	7.63b	24.91b	34.48b	35.22c	116.3ab
Control	63.56a	94.52a	118.1a	98.4a	146.4a
LSD value	12.55	29.65	22.10	14.19	32.01
L. erysim*i*					
Thiamethoxam	12.40b	32.17b	67.76b	39.26b	92.53b
Imidacloprid	11.95b	34.88b	39.48c	37.98b	95.30b
Carbosulfan	7.53b	25.89b	39.92c	37.30b	96.19b
Control	65.39a	103.0a	124.1a	98.97a	135.6a
LSD value	12.55	29.65	22.10	14.19	32.01

Means in columns not sharing common letters are not significantly different at P=0.05.
*****Density of aphids pooled for four varieties as interaction between varieties and insecticides was non-significant.

At Dera Ghazi Khan, the interaction between *B. napus* varieties and insecticides was non-significant when analyzed as a split plot regarding densities of *B. brassicae* and *L. erysimi* after both the sprays. Therefore, population data of both the aphid species were pooled for four varieties. Effect of varieties was also non-significant for densities of *B. brassicae* and *L. erysimi*.

All of the insecticides proved to be equally toxic to *B. brassicae* 1, 3 and 5 days after application (Table II), and significantly better than the control after first spray. The lowest population of aphids was observed seven days after application in the carbosulfan treatment. All of the insecticides proved to be equally toxic against *L. erysimi* 1, 3, 7 and 9 days after application of first spray, but significantly better as compared to the control. However, the lowest and statistically similar densities of *L. erysimi* were observed five days after application of carbosulfan and imidacloprid (Table II).

Thiamethoxam, carbosulfan and imidacloprid proved to be equally toxic to *B. brassica* 1, 3, 7 and 9 days after application of second spray However, significantly lowest densities of *B. brassica* were observed five days after application in the plots where carbosulfan and thiamethoxam were sprayed (Table III). All the insecticides showed similar

Table III.- Mean density of *B. brassicae* and *L. erysimi* on 10 cm inflorescence per plant recorded at different time intervals after second spray at Dera Ghazi Khan during 2006.

Insecticides	Aphids per plant (days after treatment)*				
	One	Three	Five	Seven	Nine
B. brassicae					
Thiamethoxam	19.62b	40.28b	48.34c	46.17b	38.71b
Imidacloprid	29.72b	41.55b	59.33b	48.27b	37.12b
Carbosulfan	13.14b	48.95b	47.94c	52.92b	43.53b
Control	118.3a	131.7a	123.8a	103.4a	95.12a
LSD value	29.20	32.93	10.53	19.27	26.92
L. erysimi					
Thiamethoxam	13.71b	39.57b	46.28b	46.01b	35.40b
Imidacloprid	24.16b	34.31b	51.75b	47.63b	35.40b
Carbosulfan	13.28b	34.72b	45.22b	42.75b	35.97b
Control	100.3a	89.43a	127.6a	114.4a	93.62a
LSD value	44.53	39.20	16.18	20.46	15.65

Means in columns not sharing common letters are not significantly different at P=0.05.
*****Density of aphids pooled for four varieties as interaction between varieties and insecticides was non-significant.

toxicity against *L. erysimi* at each evaluation interval following the second spray at Dera Ghazi Khan (Table III).

Imidacloprid, and carbosulfan were found to be equally toxic to *L. erysimi* in Pakistan (Aslam and Munir, 2000). Thiamethoxam (8.0g a.i /Kg) and imidacloprid at registered rate in New Zealand significantly lowered adult aphid's survival compared to the untreated seed (Schroeder *et al*., 2001). Imidacloprid provided good control of *L. erysimi* under field conditions in India and there was no residue of this insecticide in the harvested grains (Kumar and Dikshit, 2001).

Bifenthrin was the most effective at Multan trials three days after application of insecticides. Pyrethroids have been found effective against aphids on canola in Pakistan (Khattak *et al.* 2002; Sarwar, *et al.*, 2003). Neither species of aphids (*B. brassicae* or *L. erysimi*) has been exposed frequently to insecticides in the past in Pakistan. Insecticides are applied to control *B. brassicae* on cabbage but no published data is available from Multan and Dera Ghazi Khan regarding efficacy of insecticides or development of resistance. Populations of both the aphids were too high even on third day after first spray at Dera Ghazi Khan because insecticides were applied on 2nd March and this week was found usually to be very favorable for multiplication of aphids in these areas (Aslam and Razaq, 2007). Populations of aphids did not increase after second spray due to warm weather and maturity of crop. Similarly populations of aphids declined in Multan trials after three days of spray in plots where no insecticides were applied because aphids naturally start decreasing after mid March due to rising temperatures (Amer *et al*., 2009).

No uniform results of aphid mortality were observed in all the trials. However, bifenthrin was observed effective at Multan whereas thiamethoxam, and imidacloprid were found effective at Dera Ghazi Khan. Populations of aphids were too high even after application of insecticides. Economic threshold level (ETL) and timings of application of insecticides to manage *B. brassicae* and *L. erysimi* have not been determined in Pakistan. The ETL of *L. erysimi* on *B. juncea* is reported to be 23-25 aphids per plant or 50-60 aphids/10 cm terminal shoot in India (Bhowmik, 2003). Densities of both the species of aphids after application of first spray at Dera Ghazi Khan were well above ETL followed in India but started to decline naturally after first spray at Multan and second spray at Dera Ghazi Khan. Therefore, reduction in aphids due to application insecticides was not sufficient. This study has proved that first or second week of March is not proper time to apply the insecticides. Oilseed *Brassicas* are minor crops and no proper recommendations have been made for

application of insecticides in Pakistan particularly against aphids. It has been argued that degree of aphid damage is often related to time of infestation rather than the severity of the infestation on oilseed *Brassicas* (Weiss, 1983). Insecticides applied to control *B. brassicae* and *L. erysimi* at pod filling stage did not increase yield of canola in Georgia, USA (Buntin and Raymer, 1994). The highest benefit was obtained when insecticides were applied at flowering and/or pod initiation stage (Bhowmik, 2003). These insecticides can be applied to manage the aphids on oilseed Brassicas. Moreover, timing of application is still to be investigated. It is also not possible to avoid the application of insecticides for managing insect pests in Pakistan like other canola growing countries like USA, Australia and India.

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