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PERFORMANCE OF SOME INSECTICIDES AGAINST CANOLA APHIDS AND ASSOCIATED COCCINELLID PREDATORS UNDER FIELD CONDITIONS

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ABSTRACT

In agroecosystem of canola, high intensity of aphidicides is used for the management of canola aphids in Pakistan. In canola crops, large varieties of coccinellid predators along with other entomophagous insects play their role in reducing aphid's population to a significant level. These entomophagous insect fauna remain under the non-target effects of insecticides used on canola crop. These studies were carried out to investigate the effects of Pyramid®, Advantage®, Curacron®, Mospilon® and imidacloprid on population of canola aphids and associated coccinellid predators. The results revealed an exposure-interval dependent variation in the population reduction of canola aphids. Population reduction in aphid on treated canola gradually increased with an increase in exposure interval during 2010 and 2011. After an exposure interval of 24 hours, percent population reduction ranged from 15.6 to 42.3% and 16.6 to 45.3% in 2010 and 2011, respectively. However, percent population reduction of aphids on treated canola approached to 82.0-94.6% and 83.3-93.6% in 2010 and 2011, respectively after an exposure interval of 168 hours. After maximum exposure interval (168 hours), all of the evaluated insecticides induced more than 80% reduction in aphid's population; however, Mospilon® and Advantage® caused more than 90% reduction after 168 hour post treatment. The results regarding performance of insecticides against coccinellid predators showed that toxicity of insecticides residues persisted upto 72 hours as percent population reduction increased upto this exposure interval and then a decline in population reductions of coccinellid predators after 168 hours of post treatment was observed during both observation years. After an exposure period of 24 to 72 hours, Mospilon® was found comparatively more toxic to coccinellid predators as it caused very acute knockdown toxicity (90.2-93.7% and 80.9-91.9% during 2010 and 2011, respectively) for these interval followed by Curacron® with acute knockdown toxicity of 72.5-93.8% and 75.1-93.4% during 2010 and 2011, respectively. Pyramid®, Advantage® and imidacloprid showed chronic residual toxicity against coccinellid predators. These results show that Pyramid®, Advantage® and imidacloprid can be used in canola agroecosystem where integration of insecticides and coccinellid-predators based IPM strategy is to be implemented for aphid management on canola crops.

Keywords: Canola aphids, chemical control, biocontrol agents

INTRODUCTION

The canola crop is attacked by various invertebrate pests all over the world (Bhowmik, 2003). At least 30 species of invertebrates' pest have been found feeding on this crop. However, complex of pest species varies with crop growth stages and production area (Stanley and Marcroft, 1999; Micic, 2005). The plants of this crop have ability to withstand insect pest damage (Lamb, 1989), due to which only a few insects viz., lucern flea, mites, diamond back moth, wireworm, cabbage butterfly, armyworm, looper, mustard sawfly, pea leaf miner and aphids are regarded as major pests (Hainan, 2007). Among these, the aphids are regarded as the key pests causing great loss to canola crop. Three major aphid species are known to infest the canola crop, those are cabbage aphid, *Brevicoryne brassicae* (L.), the turnip aphid, *Lipaphis*

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erysimi Kalt and the green peach aphid, *Myzus persicae* (Sulzer) (Hemiptera: Aphididae) (Rehman *et al.*, 1987). These Cruciferous aphids mainly attack on flowers and pods of the crop across production regions. However, in warm, dry Autumn, some aphids may also develop their populations on crowns and undersides of the leaves at vegetative stage (Khattak *et al.*, 2002). In heavy aphids attack on canola, seedlings can cause wilting of the cotyledons and yellowing of the leaves. Heavy infestation of aphids on the podding and flowering parts leads to cessation and wilting of flowers (Berlandier, 2004). Normally aphids cause about 30-35% yield losses on brassica plants (Butin and Raymer, 1994); but under uncontrolled situations, the yield losses may exceed up to 70% (Parsad, 1992).

The indiscriminate use of pesticides has resulted in the development of resistance and resurgence in the pest besides environmental and health hazards. High intensity of insecticide sprays causes mortality of beneficial arthropods associated with predation or parasitism (Gogi *et al.*, 2006; Desneux *et al.*, 2007). Biological control of insect pests with predators and/or parasitoids is the most important and ecofriendly components of IPM (Naranjo, 2001; Sarfraz *et al.*, 2005; Gogi *et al.*, 2006). However, for selections and strategic application of insecticides, a comprehensive knowledge of their lethal residual effects on insect pest and associated biocontrol agents is required (Mgocheki and Addison, 2009; Mansour *et al.*, 2011). The present study was carried out to investigate the residual effects of Pyramid®, Advantage®, Curacron®, Mospilon® and imidacloprid on population of canola aphids and associated coccinellid predators in the field.

MATERIALS AND METHODS

Insecticides trial

Field study was carried out in 2010 and 2011 to determine the effects of five insecticides i.e., Pyramid®, Advantage®, Curacron®, Mospilon® and imidacloprid as foliar application on the population variation of aphids and associated coccinellid predators on canola (*Brassica napus*) crop. Calibration was done before the spray for measuring the quantity of water required for treatments' application. The crop was sprayed with power knapsack sprayer. The insecticides were sprayed at their recommended doses, whereas a check plot was also maintained for comparison. Data regarding the population of canola aphids and associated coccinellid predators were recoded before spray and 24, 48, 72 and 168 h after treatment. Performance of these insecticides was assessed on the basis of percent population reduction of aphids and associated coccinellid predators. Percent population reduction was calculated by the following formula:

$$\% \text{ Reduction} = \frac{\text{Population before spray - Population after spray}}{\text{Population before spray}} \times 100$$

Statistical analysis

The data regarding percent population reduction of aphids and associated coccinellid predators were subjected to ANOVA technique to determine the level of significance of evaluated treatment. The means of significant treatments were compared by Tukey HSD test.

RESULTS

Effect of insecticides on canola aphids

Percent reduction in population of aphids 24 hour after application

During first year, Advantage® induced maximum reduction in aphid population (45.0 %) followed by Mospilon® which caused 39.7% reduction in aphid population. Curacron® showed 16.6 % reduction and was found least effective. Imidacloprid and Pyramid®® showed intermediate results and were statistically similar in their performance (Table 1). During 2nd year of studies, same trend was found again and Advantage® proved highly effective with 42.3% reduction in aphid population; whereas, Curacron® with least population reduction (15.6%) was found less effective (Table 2).

Percent reduction in population of aphids 48 hour after application

During first year, maximum reduction in aphid population (74 %) was recorded in plot treated with Advantage® followed by Mospilon® (61.3%) and imidacloprid (61.0%), while Pyramid® caused least reduction in aphid population (51.6%) (Table 1). During 2nd year of studies, Advantage® again proved highly effective with maximum reduction in aphid population (74%) followed by Mospilon® and imidacloprid which caused 63.3 and 62.6 % reduction in aphid population, respectively. Pyramid® and Curacron® with 54 and 57.6% reduction in aphid population proved comparatively least effective (Table 2).

Percent reduction in population of aphids 72 hour after application

The results of first year experiment showed that Mospilon® and Advantage® caused highest reduction (97%) followed by Pyramid® (92.6%), while Curacron® and imidacloprid were found comparatively less effective with 82.6 and 81.3% reduction in population, respectively. However, all of the evaluated insecticides caused more than 80% reduction in aphid population after 72 hours of exposure (Table 1). During 2nd year of studies, similar results were obtained and all insecticides caused more than 80% reduction in aphid population. Advantage®, Mospilon®, Imidacloprid and Curacron® showed a significant reduction of 95, 95.6, 82.6 and 81.3%, respectively (Table 2).

Percent reduction in population of aphids 168 hour after application

After an exposure interval of 168 hours, all the evaluated insecticides caused more than 80% reduction in aphid population during 2010 and 2011. During both years,

Mospilon® and Advantage® proved to be highly effective against aphids with more than 90% reduction in population, while Imidacloprid and Curacron® with more than 80 but less than 90% reduction in aphid population were found comparatively less effective insecticides (Table 1 & 2).

Table 1
Percent reduction in population of canola aphids by different insecticides during 2010.

Insecticides				Percent Population Reduction			
Trade Name	Common Name	Dose/acre	Dose/plot	24 HPT	48 HPT	72 HPT	168 HPT
Advantage®	Carbosulfan	500 ml	35 ml	42.3a	71.6 a	97.0 a	92.3 ab
Mospilon®	Acetamaprid	125 g	9 g	38.0 b	61.3 b	97 a	94.6 a
Imidacloprid	imidacloprid	250 ml	17.5 ml	25.0 d	61.0 b	82.7 c	81.0 c
Pyramids®	nitanpyram	200 ml	14 ml	29.3 c	51.6 d	92.7 b	89.0 b
Curacron®	Profenofos	500 ml	35 ml	15.7 e	55.7 c	81.3 c	82.0 c
LSD				3.99	3.33	4.25	3.34

Means sharing similar letters column wise are not significantly different, by Tukey HSD test, at α = 0.05. HPT; Hours Post Treatment

Table 2
Percent reduction in population of canola aphids by different insecticides during 2011.

Insecticides				Percent Population Reduction			
Trade Name	Common Name	Dose/acre	Dose/plot	24 HPT	48 HPT	72 HPT	168 HPT
Advantage	carbosulfan	500 ml	35 ml	45.3 a	74. a	95 a	93 a
Mospilon®	acetamaprid	125 g	9 g	39.6 b	63.3 b	95.6 a	93.6 a
Imidacloprid	imidacloprid	250 ml	17.5 ml	26.3 c	62.6 b	82.6 b	81 c
Pyramids®	nitanpyram	200 ml	14 ml	30.6 c	54 c	90.6 a	90 b
Curacron®	profenofos	500 ml	35 ml	16.6 d	57.6 c	81.3 b	83.3 c
LSD				5.58	4.61	5.3	2.96

Means sharing similar letters column wise are not significantly different, by Tukey HSD test, at α = 0.05. HPT; Hours Post Treatment

EFFECT OF INSECTICIDES ON COCCINELLID PREDATORS

The data of population reduction of coccinellid predators during 2010 and 2011 showed nonsignificant variations for evaluated insecticides over four exposure intervals i.e. 24, 48, 72 and 168 hours (Table 3 & 4). After an exposure period of 24 hours, population reduction of coccinellid predators ranged from 57.3 to 90.2% and 63.4 to 80.9% during 2010 and 2011, respectively with highest reduction by Mospilon®. Percent reduction in population of coccinellid predators was found in the range of 72.5-93.7% and 83.0-96.6% during 2010; whereas, 75.1-86.1% and 87.2-94.5% during 2011 for an exposure interval of 48 and 72 hours, respectively. Population reduction of coccinellid predators ranged from 65.3 to 84.6% and 78.1 to 94% after 168 hours of post treatment for the year 2010 and 2011, respectively. These results showed that toxicity of insecticides residues persisted upto 72 hours as reduction increased for this exposure interval and then a decline in population reductions of coccinellid predators after 168 hours of post treatment was observed during both observation years that proved the degradation of insecticides residues and flare up of the coccinellid-predators population. After an exposure period of 24 to 72 hours, Mospilon® was found comparatively more toxic to coccinellid predators as it caused very acute knockdown toxicity (90.2-93.7% and 80.9-91.9% during 2010 and 2011, respectively) for these interval followed by Curacron® with acute knockdown toxicity of 72.5-93.8% and 75.1-93.4% during 2010 and 2011, respectively. Pyramid®, Advantage® and imidacloprid showed chronic residual toxicity against coccinellid predators (Table 3 & 4).

DISCUSSION

The main aim of the present studies was to determine the effectiveness of some selected insecticides against canola aphids and associated coccinellid predators under field conditions. All of the tested insecticides were found highly effective with more than 80% mortality in exposure period of 72 and 168 hour; however, it was noted that the treatment Advantage® and Mospilon® proved to be highly effective among all tested insecticides during 72 hour exposure period. These findings are in agreement with those of Marghub *et al.*

Table 3
Percent reduction in population of coccinellid predators by different insecticides during 2010.

Insecticides				Percent Population Reduction			
Trade Name	Common Name	Dose/acre	Dose/plot	24 HPT	48 HPT	72 HPT	168 HPT
Advantage	carbosulfan	500 ml	35 ml	59.9a	87.9a	83.0 a	69.4 a
Mospilon	acetamaprid	125 g	9 g	90.2a	93.7a	92.0a	84.7a
Imidacloprid	imidacloprid	250 ml	17.5 ml	57.3a	78.2a	92.0a	65.3a
Pyramids	nitanpyram	200 ml	14 ml	75.3a	74.4a	96.6a	80.0a
Curacron	profenofos	500 ml	35 ml	81.4a	72.5a	93.8a	80.0a
LSD				45.6	22.6	23.6	28.0

Means sharing similar letters column wise are not significantly different, by Tukey HSD test, at α = 0.05. HPT; Hours Post Treatment

Table 4
Percent reduction in population of coccinellid predators by different insecticides during 2011.

Insecticides				Percent Population Reduction			
Trade Name	Common Name	Dose/acre	Dose/plot	24 HPT	48 HPT	72 HPT	168 HPT
Advantage	Carbosulfan	500 ml	35 ml	63.4a	86.1a	87.2a	78.1a
Mospilon	Acetamaprid	125 g	9 g	80.9a	85.2a	91.9a	87.8a
Imidacloprid	imidacloprid	250 ml	17.5 ml	63.8a	79.2a	90.8a	83.1a
Pyramids	nitanpyram	200 ml	14 ml	68.9a	76.1a	94.5a	89.8a
Curacron	profenofos	500 ml	35 ml	80.2a	75.1a	93.4a	94.0a
LSD				33.1	13.6	14.2	20.8

Means sharing similar letters column wise are not significantly different, by Tukey HSD test, at α = 0.05. HPT; Hours Post Treatment

(2010) and Aslam and Munir (2000). The insecticide advantage® showed highest reduction in aphid population during all four exposure interval of 24, 48, 72 and 168 hour during both year of studies, while Mospilon® was found highly effective in exposure period of 72 and 168 hour post treatment and less effective during exposure of 24 and 48 hour. Similar findings were reported by Khattak *et al.* (2002) and Sarwar *et al.* (2003). The findings of present studies are also in confirmation to the observations of Kumar *et al.* (1996), who reported that all insecticides tested significantly reduced aphid population. The insecticide Imidacloprid and Pyramid® showed the intermediate results against aphids during four post treatment interval and both year of studies, while the insecticide Curacron® proved to be comparatively less effective against aphids during all four exposure intervals of 24, 48, 72 and 168 hour post treatment. These findings are partially different from the Schroeder *et al.* (2001) due to different experimental materials.

The studies were also carried out to determine the toxicity of tested insecticides against coccinellid predators. The results revealed that all tested insecticides were found highly toxic to coccinellid predators as all showed quick knock down effect. However, it was observed that Mospilon® showed acute toxicity against coccinellid in exposure of 24 hour post treatment interval followed by Curacron® with 2nd highest population reduction of coccinellids predator. The present findings are in confirmation with that of Echegaray (1999), who concluded that Coccinellid predators are vulnerable to insecticides over most of its life. The insecticide Imidacloprid was found relatively less toxic against coccinellid predator among all other tested insecticides in 24 hour post treatment interval. These results are partially in agreement to those of He *et al.* (2012), who concluded that imidacloprid systemically applied at the recommended field rate showed less toxicity against coccinellid predators. Collectively it was found that all insecticide showed highest population reduction in 72 hour post treatment interval and then showed a decline in population reduction of predator during the exposure period of 168 hour. This shows that these insecticides have residual toxixcity upto 72 hours against predators after which their toxicity reduces. It can, therefore, be concluded that these insecticides should be applied three days before the introduction of coccinellid predators. Pyramid®, Advantage® and imidacloprid can be used in canola agroecosystem where integration of insecticides and coccinellid-predators based IPM strategy is to be implemented for aphid management on canola crops.

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