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Efficacy of Different Insecticides Against *Plutella xylostella* under Field Conditions

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Abstract: In this study different insecticides were tested under field condition on cabbage, *Brassica oleracea capitata* and cauliflower, *Brassiaca oleracea botrytis* at vegetable fields of TandoAllhayar, Dist Hyderabad. Pretreatment observations were recorded one day before treatment and post treatment after 96 h and seven days interval in first and second sprays, respectively. Avermectin was most effective when applied on cabbage in first and second sprays against diamond back moth, where as, *Bacillus thuringiensis* and spinosad remained effective in both sprays after 96 h and seven days interval, on cauliflower compared with other insecticides. It was concluded that *Bacillus thuringiensis*, avermectin and spinosad were more effective compared with other insecticides tested in the present study.

Key words: Diamondback moth, brassica, cabbage, pest, insecticides

INTRODUCTION

Plutlla xylostella is one of the serious insect pests of crucifer crops through out the world. *P.xylostella* is particularly wide spread in Southeast Asia having 14-20 generations per year as compared to 2-7 generations in temperate regions. Frequent applications of pesticides on vegetable crops grown on vast areas have resulted in the development of resistance in *P. xylostella* to practically all categories of insecticides (Sun *et al*., 1986; Perng *et al*., 1988).

In the Indo-Pakistan sub-continent *P. xylostella* was first recorded in 1914 (Fletcher, 1914) on cruciferous vegetables. Ghouri (1960) described *P. xylostella* as a minor pest of cruciferous vegetables in Pakistan. Mohyuddin and Mushtaque (1983) conducted a survey and have collected *P. xylostella* from throughout the Pakistan. While Abro *et al.* (1992) have found *P. xylostella* a very serious pest on cruciferous vegetables in the Southern Sindh, Pakistan. Crucifers are most common vegetables in the diet of Asians and according to the Food and Agriculture Organization (FAO) of the United Nations figures of 1990, crucifer vegetable are grown on 2.2 x 10^6 ha worldwide with half of this area occurring (Talekar and Shelton, 1993) in Asia.

Cabbage and cauliflower are preferred hosts of *P. xylostella*, also favorite vegetables of people around the world. These vegetables are high value crops requiring high cosmetic standards, therefore, effective control of the pest is necessary. Chemical insecticides are mostly applied for the control of *P. xylostella* on vegetable crops. The general use pattern of insecticides vary widely over geographic locations and decades. The driving force behind these changing patterns are the development of new, more effective (toxic) insecticides and the loss of usefulness of older insecticides mostly because of development of resistance against them (Talekar and Shelton, 1993). *P. xylostella has* a long history of eventually becoming resistant to every insecticide used extensively against it. The first record of insecticide resistance in *P. xylostella* was reported as early as 1953 from Java, Indonesia (Ankersmith, 1953) which was incidentally also the first crop pest in the world to develop resistance to DDT (Talekar and Shelton, 1993). Subsequently, *P. xylostella* populations have been found resistant to all the major classes of insecticides from the different areas of its geographical distribution (Sudderuddin and Kok, 1978; Georghiou, 1981; Liu *et al*., 1981; Miyata *et al*., 1982; Sun *et al*., 1986; Tabashnik *et al*., 1987; Abro *et al*., 1988; Leibee and Savage, 1992). Therefore, insecticides with novel modes of action are being sought constantly as a means to cope with the problem of insecticide resistance in *P. xylostella*. Recently, *P. xylostella* has also been reported to show resistance to benzoyl phenyl urea, insect growth regulators (Perng and Sun, 1987; Perng *et al*., 1988) and biopesticide, *Bacillus thuringiensis* (Tabashnik *et al*., 1990, 1991, 1995). It has also a distinction of being the first insect to develop resistance in the field condition to *B. thuringiensis* (Talekar and Shelton, 1993; Shelton and Wyman, 1992). In the present study some recently introduced insecticides were used against it on cabbage and cauliflower crops.

MATERIALS AND METHODS

Insecticides: The organophosphorus insecticides, profenophos (Curacron 50EC, Novartis Pakistan, Ltd, test rate=500 ml acre^{-1}), methamidophos (Tamaron 60 SL, Syngenta Pakistan Ltd, test rate=500 ml acre^{-1}), chloroyriphos (Lorsban 40 EC, Syngenta Pakistan Ltd, test rate=500 ml $acre^{-1}$), pyrthroid insecticide, cyhalothrin (Karate 2.5EC, ICI. Pakistan Ltd, test rate = 350 ml $acre^{-1}$), benzoyl phenyl urea insect growth regulator (IGR), lufenuron (Match 50EC, Novartis Pakistan Ltd, test rate=150 ml $acre^{-1}$), naturalyte insecticide, spinosad (Tracer 480EC, Dow Agro Sciences Pakistan, Ltd, test rate=15 ml $acre^{-1}$), avermectins, abamectin (Agrimerk 1.8EC, Syngenta Pakistan, Ltd, test rate=250 ml $acre^{-1}$), biopesticide, *Bacillus thurigiensis* (B.t) subspecies Kurstaki (Agree50WP Novartis,Pakistan, Ltd,test rate 500 mg $acre^{-1}$), neem insecticides (Nimbokill 60EC, test rate = 500 ml $acre^{-1}$ and Biosal 0.32EC Universal Agrochemicals Ltd, test rate=1000 ml $acre^{-1}$ were tested in this study. Spraying was done in morning hours with knapsack hand compression air sprayer. Before spraying, sprayer was calibrated. After spraying of one insecticide, the sprayer was washed thoroughly with water twice before applying next insecticide.Insectiscide application against *P.xylostella* on cauliflower and cabbage were carried out on March 06 and 15, 19 99 and February 5 and 13, 2000, respectively.

Crops: Cauliflower, *Brassica oleracea botrytis* (cv.Snowdrift White mountain) and cabbage *Brassica olaracea capitata* (cv. Golden Acre) seeddling were transplanted into the field on December 10, 1998 and November 27, 1999, respectively. The plants for experiments were grown on ridges having row to row distance of 60cm. These experiments were laid out in a randomized complete block design with four replications. The replicate size was 56m nitrogen and phosphorus fertilizers were applied at the rate of 250 and 175 Kgs ha^{-1}, respectively. All the phosphorus plus 50% dose of nitrogen were applied during soil preparation and remaining 50% nitrogen was applied one day after the transplantation of seedling in the field.

Analysis of data: Five plants were randomly selected for recording of data per treatment. Number of larvae and pupae were counted for recording the data. Pretreatment observation was taken 24 hrs. before application of insecticides. Post treatment observations were recorded 4 an 7 days after application of insecticides. The data collected were statistically analysed by analysis of variance and mean population differences per treatment were compared by LSD test. (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

There was an outbreak of *P. xylostella* on cauliflower crop (Table 1), different insecticides were tested for their comparative efficacy against the pest. The results obtained after application of insecticides revealed that there was significant ($F=133.84$, $df=5, 15$; $P<0.01$) variation in the efficacy of insecticide against *P. xylostella*. B.t. var. Kurstaki was the most effective insecticide followed by Lufenuron and Spinosad with pest population of 3.55, 5.75 and 6.35 insets per plant, respectively at 96 h. after treatment interval. At 7 days interval Bt. var. Kurstaki was most effective insecticide followed by Spinosad. While cyhalothrin was significantly ($F=250.97$, $df=5, 15$; $P<0.001$), the least effective in controlling the pest population.

The second experiment carried out in an adjacent plot of cauliflower (Table 2) showed that B.t. var. Kurstaki and spinosad were significantly ($F=56$, $df=5,15$, $P<0.01$) effective compared with other insecticides in controlling *P. xylostella* population 96 h. after application of insecticides. At 7 days interval spinosad was most effective insecticide with minimum pest population followed by Bt var. Kurstaki. The overall mean of both experiments, it was found that Bt var. Kurstaki and Spinosad were more effective insecticides in suppressing the *P. xylostella* population on cauliflower crop. One outstanding observation in present study was almost total failure of cyhalothrin to suppress pest probably due to development of insecticide resistance against this insecticide by *P. xylostella.*

Population reduction of *P. xylostella* after first application of insecticides under field conditions on cabbage is shown in Table 3. At 96 h. after treatment interval minimum pest population was recorded in profenophos treated plot followed by avermectin. Population reduction in different treatments varied significantly ($F=40.62$, $DF=8, 24$, $P<0.01$). *P. xylostella* population at 7 days post treatment interval indicated that some of the insecticides had lost their toxic action against pest. Significantly ($F=48.25$, $df=8, 24$), $P<0.01$), the least *P. xylostella* was recorded in avermectin treated plot followed by spinosad with per plant population of 2.05 and 3.95 insects per plant.

After second spray again the minimum pest population was recorded in avermectin treated plot followed by spinosad at 96 hrs. and 7 days after treatment intervals (Table 4). Overall mean of two sprays indicated that the minimum pest population (1.86) was recorded in avermectin treated plots followed by Spinosad, profenophos and Bt. Kurstaki.

In present study spinosad gave better control of *P. xylostella* on cauliflower and cabbage crops compared with some other insecticides. Similar observations were recorded by Porteous *et al.* (1996) who evaluated Spinosad for the control of cotton pests. Spinosad at

Table 1: Average Population per plant (larvae+ pupae) of *P. xylostella* on cauliflower in field (First spray)

		Population reduction after		
Treatments	Pre-treatment	96 h.	7 days	Mean
Profenophos	41.05a	9.80a	7.85b	8.82
Lufenuron	40.25a	5.75a	6.60ab	6.17
Bt.Kurstaki	39.00a	3.55a	1.40a	2.47
Spinosad	40.15a	6.35a	3.10ab	4.72
Cyhalothrin	40.95a	38.95b	20.65c	29.8
Control	40.85a	46.33b	42.65d	44.49
LSD0.05	-	8.35	5.919	-

Table 2: Average Population per plant (larvae+ pupae) of *P. xylostella* on cauliflower in field (Second spray)

		Population reduction after			
Treatments	Pre-treatment	96 h.	7 days	Mean	Overall
Profenophos	35.00a	14.65ab	9.40ab	10.42	10.42
Lufinuron	36.17a	11.05ab	6.10ab	8.57	7.37
Bt.Kurstaki	34.52a	0.85a	2.75ab	1.80	2.13
Spinosad	38.18a	1.10a	0.90a	1.00	2.86
Cyhalothrin	34.07a	24.85bc	22.30c	23.57	26.68
Control	35.21a	34.30c	32.80d	33.55	39.02
LSD0.05	-	13.92	9.05	-	-

Table 3: Average Population per plant (larvae+ pupae) of *P. xylostella* on cabbage in field (First spray)

		Population reduction after		
Treatments	Pre-treatment	96 h	7 days	Mean
Spinosad	8.28a	5.28c	3.95b	4.62
Bt.Kurstaki	9.80a	5.80c	4.80bc	5.30
Chlorpyrifos	9.35a	3.90b	12.05e	7.98
Lufenuron	9.55a	5.40c	9.80d	7.60
Nimbokil	9.65a	8.95e	11.05d	10.00
Chlorpyriphos methyl	9.75a	3.65ab	6.10c	4.88
Profenophos	8.20a	3.10a	4.70bc	3.90
Avermectin	9.20a	3.20a	2.05a	2.63
Control	8.95a	7.88d	11.40d	9.64
LSD0.05	-	0.611	1.702	-

Table 4: Average population per plant (larvae+ pupae) of *P. xylostella* on cabbage in the field (Second spray)

	Population reduction after			
Treatments	96 h.	7 days	Mean	Overall
Spinosad	2.50a	1.23a	1.87	3.24
Bt. Kurstaki	2.95a	2.55b	2.75	4.02
Chlorpyrifos	4.40a	2.45b	3.43	5.75
Lufenuron	3.25a	2.00b	2.63	4.83
Nimbokil	3.90a	2.30b	3.10	6.55
Chlorpyriphos methyl	3.05a	3.75c	3.40	4.14
Profenophos	2.95a	2.20b	2.58	3.65
Avermectin	1.45a	0.75a	1.10	1.86
Control	11.48b	7.05d	9.27	9.45
LSD 0.05	8.294	0.596	-	-

Figures followed by same letter are not significantly different from each other ($P<0.05$) by LSD test.

0.065 Lb/acre gave excellent control of *H. zea, H. virescens, S. exigua* and *T. ni.* Similarly, avermectin was most effective insecticide compared with other insecticides in controlling *P. xylostella* on cabbage. Ooi (1992) also found abamectin more effective than diflubenzuron for the control of *P. xylostella* on cabbage. Lufenuron at 25 g ha^{-1} applied at 14-days interval had lower damage scores and higher harvest quality than standard cyhalothrin (14 days) treatment and was comparable to a 7 day *B. thuringiensis* programme (Follas and Popay, 1995).

Andaloro *et al.* (1993) evaluated insecticide usage in pest management program of cabbage at New York and reported that methamidophos and pyrethroids consistently provided the most effective control of lepidoptera. Calderon and Hare (1986) reported that Profenofos effectively reduced the population of *P. xylostella* larvae in crucifers. In present study also, profenofos gave better control of *P. xylostella* than other OP compounds, but slightly lower than avermectin and spinosad on cabbage (Table 3 and 4).

Leibee and Savege (1992) evaluated different insecticides against *P. xylostella* under field and found that chlorpyrifos, endosulfan, mevinphos and B.t. var. Kurstaki were more effective than cypermethrin. Rai *et al.* (1992) conducted field studies to determine efficacy of 14 insecticides against *P. xylostella.* Results showed that cartap hydrochloride (Padan 4G) gave highest reduction in larval population (87%) followed by flufenoxuron (Cascade 10EC). Zhou and Ma (1993) tested field collected samples of *P. xylostella* to 10 insecticides in laboratory and reported that the pest was sensitive to chlorfluanzuron, B.t. var. Kurstaki and avermectin. The results of present study also show that *P. xylostella* was comparatively more sensitive to B.t. var. Kurstaki, avermectin and spinosad under field conditions compared with other insecticides.

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