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Relative Toxicity of New Molecules of Insecticides against Diamond Backmoth , Plutella xylostella L. infesting Cabbage.

KEYWORDS: Plutella xylostella, rynaxypyr, emamectin benzoate, Chlorfenapyr and fipronil.

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ABSTRACT *Among the various newer molecules of insecticides tested for their toxicity against various larval instars revealed that rynaxypyr 1.67 SC was found significantly most effective and was followed by emamectin benzoate 20 SC and chlorfenapyr 10 SC, fipronil 5 SC. The LC50 value recorded for rynaxypyr were 0.005, 0.005, 0.006 and 0.008, emamectin benzoate 0.055, 0.057, 0.070 and 0.095, chlorfenapyr 0.089, 0.104, 0.111 and 0.136 and fipronil 0.117, 0.120 0.136 and 0.156 µg/L, respectively against first, second, third and fourth instar larvae of P. xylostella.*

INTRODUCTION

Diamond back moth, *Plutella xylostella,* a cosmopolitan pest is a major defoliating caterpillar that hampers the successful cultivation of cabbage in the world. Now the pest has attained the status of international pest of crucifers (Talekar and Shelton, 1993, Anuradha,1997, Cardleron and Hare, 1986, Devi *et al.*, 2004). Now a days newer molecules of insecticides like Fipronil, Emamectin benzoate, Rynaxypyr, Chlorfenapyr have been developed, which are having novel modes of actions

(Ioriatti et.al., 2009,Ishaaya and Oshawa 2002). These are easily degradable in the environment and other biological systems. These are used at very low rates, which reduces the environmental loading, particularly when compared with conventional insecticides. These newer molecules have low mammalian toxicity as compared to conventional synthetic pyrethroids and carbamates and organophosphates. The added advantage of these newer molecules is the longer persistence in the pest and lesser chances of development of resistance in the pest, and hence they are ideal for Integrated Pest Management (IPM).

Increasing the seriousness of the losses caused by diamond back moth on one hand and relative paucity of the information on the toxicity of new compounds to different larval instars on the other hand, investigations were undertaken

MATERIAL AND METHODS

Mass rearing of diamond back moth

For conducting various laboratory experiments uninterrupted supply of larvae was essential hence the mass rearing of diamondback moth was carried out in the laboratory using mustard seedlings and cabbage leaves as the method suggested by Liu and Sun (1984) was adopted with slight modifications.

Larvicidal action of newer insecticide molecules

Larvicidal action was studied by feeding the treated cabbage leaves (leaf dip bioassay) to third instar larvae of diamondback moth with various concentrations of newer insecticide molecules. The feeding of leaves treated with distilled water was considered as control. Leaf disc of 6 cm diameter were cut from fully expanded cabbage leaves. The treated cabbage leaves were allowed to dry for half an hour under fan and then fed to desired instar of diamondback moth for 24 hrs. Before releasing larvae on the treated leaves they were subjected to 6 hrs starvation. Thereafter, fresh untreated cabbage leaves were fed which were replenished every day. Each treatment consisting of 10 larvae replicated three times. Observations on larval mortality during larval stages were recorded at interval of every 24 hrs and up to 72 hrs after the treatment. From the data, per cent larval mortality was worked out then mortality data were then subjected to probit analysis (Finney, 1971) and the LC50 values for different newer insecticide molecules on third instar larvae of *P. xylostella* were worked out in SPSS 7.5 software package.

RESULTS AND DISCUSSION

Larvicidal action of rynaxypyr

The data on larvicidal activity of rynaxypyr on various instars (Table. 1) revealed that the first, second, third and fourth instar larvae when fed with treated cabbage leaves, the per cent larval mortality in the various treatments ranged from 54.61 to 100.00, 32.43 to 97.42, 27.50 to 92.50 and 12.50 to 82.50, respectively as against 16.28, 2.98, 0.00 and 0.00 in untreated control, respectively. The LC50 values recorded for these progressive instars were 0.005, 0.005, 0.006 and 0.008 µg/L , respectively.

Larvicidal action of emamectin benzoate

The data on larvicidal activity of emamectin benzoate on various instars (Table. 2) revealed that the first, second, third and fourth instar larvae when fed with treated cabbage leaves, the per cent larval mortality in the various treatments ranged from 46.12 to 100.00, 30.93 to 91.23, 25.00 to 82.50 and 15.00 to 65.00, respectively as against 14.31, 2.75, 0.00 and 0.00 in untreated control, respectively. The LC50 values recorded for these progressive instars were 0.055, 0.057, 0.070 and 0.095 µg/L , respectively .

Larvicidal action of chlorfenapyr

The data on larvicidal activity of chlorfenapyr on various instars (Table.3) revealed that the first, second, third and fourth instar larvae when fed with treated cabbage leaves, the per cent larval mortality in the various treatments ranged from 49.63 to 100.00, 23.07 to 87.16, 23.07 to 87.16 and 12.50 to 65.00, respectively as against 12.34, 2.50, 0.00 and 0.00 in control, respectively. The LC50 values recorded for these progressive instars were 0.089, 0.104, 0.111 and 0.136 µg/L , respectively.

Larvicidal action of fipronil

The data on larvicidal activity of fipronil on various instars (Table 4) revealed that the first, second, third and fourth instar larvae when fed with treated cabbage leaves, the per cent larval mortality in the various treatments ranged from 43.58 to 94.84, 35.72 to 84.63, 25.00 to 75.00 and 12.50 to 65.00, respectively as against 18.62, 2.25, 0.00 and 0.00 in control, respectively. The LC50 values recorded for these progressive instars were 0.117, 0.120, 0.136 and 0.156 µg/L , respectively.

The present findings indicated that rynaxypyr exerted more effective chemical in causing mortality of third instar larvae of *P. xylostella* . The next best treatments in the order of their efficacies were emamectin benzoate, Chlorfenapyr and fipronil.

Kuttalam *et al*. (2008) tested field efficacy of emamectin benzoate 5 SG in four doses i.e., 9, 11, 13, and 15 g a.i./ha against fruit borer of okra and proved that emamectin benzoate 5 SG @ 13 and 15 g a.i./ha found effective in suppressing the larval population of the pest compared to other insecticides. Mishra (2008) evaluated rynaxypyr 20 SC in field against brinjal shoot and fruit borer and reported that the treatment with rynaxypyr 20 SC @ 40-50 g a.i./ha was most effective by recording 95-97 per cent reduction in the shoot damage and 87-90 per cent reduction in fruit damage on number basis and 88-90 per cent on weight basis.

Han *et al*. (2012) reported that chlorantraniliprole had a high level of toxicity against larvae of *P. xylostella,* and the 48 h LC50 values were 0.23 and 0.25 mg/lit for a susceptible and field strain respectively. The results are in consonance with the present findings.

Tiancai Lai *et al*. (2011) reported the 72 h LC50 value of chlortraniliprole to *S.exigua* as 12.747 µg/lit. A progressive larval mortality of 24.32 per cent for LC30 treatment and 42.61per cent for LC50 treatment was observed from 4th to 6th day after exposure.

Table 1. Median lethal concentration of f rynaxypyr for various larval instars of *P. xylostella*

Larval instar of	LC50 (µg/L)	Fiducial limits	Probit equation	X^2 value
P. xylostella				
First instar	0.005	0.001 – 0.007	Y = 3.634 X + 13.430	12.240
Second instar	0.005	0.005 - 0.006	Y = 4.745 X + 15.743	3.103
Third instar	0.006	0.005 – 0.006	Y = 4.204 X + 14.411	4.180
Fourth instar	0.008	0.007 – 0.011	Y = 4.031 X + 13.362	8.940

Table 2. Median lethal concentration of emamectin benzoate for various larval instars of *P. xylostella*

Larval instar of	LC50 (µg/L)	Fiducial limits	Probit equation	X^2 value
P. xylostella				
First instar	0.055	0.001 – 0.007	Y = 4.512 X + 10.236	13.111
Second instar	0.057	0.051 - 0.061	Y = 4.027 X + 10.023	0.614
Third instar	0.070	0.064 – 0.076	Y = 3.112 X + 8.595	3.733
Fourth instar	0.095	0.086 – 0.106	Y = 2.960 X + 8.032	1.254

Table 3. Median lethal concentration of chlorfenapyr for various larval instars of *P. xylostella*

Larval instar of	LC50 (µg/L)	Fiducial limits	Probit equation	X^2 value
P. xylostella				
First instar	0.089	0.080 – 0.094	Y = 7.421 X + 12.810	4.872
Second instar	0.104	0.098 - 0.109	Y = 5.978 X + 10.875	2.543
Third instar	0.111	0.106 – 0.117	Y = 5.821 X + 10.544	3.630
Fourth instar	0.136	0.129 – 0.146	Y = 5.082 X + 9.401	0.117

Table 4. Median lethal concentration of fipronil for various larval instars of *P. xylostella*

Larval instar of	LC50 (µg/L)	Fiducial limits	Probit equation	X^2 value
First instar	0.117	0.108 – 0.125	Y = 7.322 X + 11.815	1.394
Second instar	0.120	0.110 - 0.127	Y = 5.393 X + 9.967	0.249
Third instar	0.136	0.130 – 0.143	Y = 5.447 X + 9.712	0.625
Fourth instar	0.156	0.149 – 0.166	Y = 5.996 X + 9.835	0.095

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