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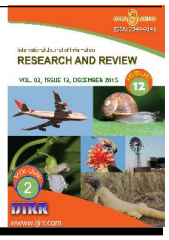

Research Article

TOXICITY OF NEW MOLECULES OF INSECTICIDES AGAINST DIAMOND BACKMOTH, *PLUTELLA XYLOSTELLA* L. INFESTING CABBAGE

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ABSTRACT

Among the various newer molecules of insecticides tested for their toxicity against various larval instars revealed that flubendiamide was found to be most effective, followed by, indoxacarb, spinosad, and fipronil. The LC50 values recorded for flubendiamide 0.009, 0.009, 0.010 and 0.013, indoxacarb 0.013, 0.014, 0.015 and 0.017, spinosad 0.029, 0.030, 0.036 and 0.060, 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*. The flubendiamide exerted more effective chemical in causing mortality of third instar larvae of *P. xylostella*. The treatment with indoxacarb, spinosad, and fipronil were in the order of their efficacy.

INTRODUCTION

Diamond back moth, *Plutella xylostella,* a cosmopolitan pest is a major defoliating caterpillar that hampers the successful cultivation of cabbage in the world. In India it was recorded on cruciferous vegetables in 1914 (Fletcher, 1914). Now the pest has attained the status of international pest of crucifers (Talekar and Shelton, 1993). The management of diamond back moth with insecticides has been widely used because of its easy adaptability, effectiveness, and quick knock down effect. Since high control is incurred in the cultivation of cabbage, farmers have relied upon the insecticides to get high income. Presently the management of diamond back moth with conventional insecticides often failed because of their indiscriminate and irrational use at higher doses which resulted in resistance, resurgence, and residue problems (Chandrasekaran and Regupathy, 1996; Ferre and Van Rie, 2002; Mohan and Gujar, 2003). One of the important control measures suggested to combat the problem of insecticide resistance in insect pests is to switch over to alternate, safe and more potent insecticides with novel modes of action.

MATERIALS 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

Larvicidal action of fipronil

The data on larvicidal activity of fipronil on various instars (Table 1) revealed that the first, second, third and fourth instar

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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.

Table 1. 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
P. xylostella				
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

Larvicidal action of flubendiamide

The data on larvicidal activity of flubendiamide 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 59.16 to 100.00, 42.32 to 96.34, 27.50 to 92.50 and17.50 to 74.40, respectively as against 18.34, 3.14, 0.00 and 0.00 in Untreated control, respectively. The LC50 values recorded for these progressive instars were 0.009, 0.009, 0.010 and 0.013 µg/L, respectively.

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

Larval instar of *P. xylostella*	LC50 (µg/L)	Fiducial limits	Probit equation	X^2 value
First instar	0.009	0.008 – 0.009	Y = 6.661 X + 18.783	6.184
Second instar	0.009	0.008 - 0.010	Y = 5.886 X + 17.057	2.573
Third instar	0.010	0.009 – 0.010	Y = 6.689 X + 18.424	3.284
Fourth instar	0.013	0.012 – 0.014	Y = 5.377 X + 15.170	4.505

Larvicidal action of spinosad

The data on larvicidal activity of spinosad 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 47.50 to 100.00, 42.50 to 94.84, 30.93 to 84.63 and 27.50 to 72.50, respectively as against 14.21, 5.21, 0.00 and 0.00 in untreated control, respectively. The LC50 values recorded for these progressive instars were 0.029, 0.030, 0.036 and 0.060 µg/L, respectively.

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

Larval instar of	LC50 (µg/L)	Fiducial limits	Probit equation	X^2 value
P. xylostella				
First instar	0.029	0.004 – 0.046	Y = 2.619 X + 9.038	11.413
Second instar	0.030	0.024 - 0.034	Y = 2.403 X +8.689	4.687
Third instar	0.036	0.030 – 0.042	Y = 2.039 X + 7.939	1.224
Fourth instar	0.060	0.050 – 0.072	Y = 1.545 X + 6.892	7.578

Larvicidal action of indoxacarb

The data on larvicidal activity of indoxacarb 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 42.50 to 100.00, 30.93 to 92.34, 27.50 to 87.50 and 15.00 to 74.41, respectively as against 14.26, 2.25, 0.00 and 0.00 in untreated control, respectively. The LC50 values recorded for these progressive instars were 0.013, 0.014, 0.015 and 0.017 µg/L, respectively.

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

Larval instar of	LC50 (µg/L)	Fiducial limits	Probit equation	X^2 value
P. xylostella				
First instar	0.013	0.013 – 0.014	Y = 10.001 X + 23.711	6.675
Second instar	0.014	0.013 - 0.014	Y = 8.748 X + 21.240	0.412
Third instar	0.015	0.014 – 0.015	Y = 7.612 X + 18.944	3.142
Fourth instar	0.017	0.016 – 0.017	Y = 6.990 X + 17.427	2.390

DISCUSSION

The present findings indicated that flubendiamide 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 indoxacarb, spinosad, and fipronil. Hirooka *et al.* (2007), reported that flubendiamide is more effective on the first instar larvae of *P. xylostella* followed by the third and fifth instar larvae with LC50 values of 0.033, 0.19 and 0.51 mg a.i./L respectively. The results are inline with the present findings. This may be due to the variations in susceptibility among the population. Liu *et al*. (2003) and Gamil *et al*. (2011) postulated that indoxacarb was highly toxic to *P.xylostella* larvae through food ingestion, with LC50 and LC90 values were 0.63 and 3.1 ppm for second instar larvae and 2.0 and 18.75 ppm for 4th instar larvae, respectively which is much less than the LC50 value obtained during the present studies. High toxicity of indoxacarb has also been reported by Mohammad Mahmoudvand *et al*. (2011). Shaban Ranjbari *et al.* (2012) reported the LC50 values of spinosad as 0.276, 0.343, 0.514 and 0.514 ppm for 1st, 2nd, 3rd and 4th larval instars, respectively at 72 hours after treatment. Toxicity spinosad against larvae of *P. xylostella* was also reported by Yin *et al*. (2011) however these results are in contrast with the present findings. Population variation with respect to their susceptibility to the chemical may be the reason for it.

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