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A CASE STUDY

Toxicity of newer insecticides against *Leucinodes orbonalis* (Guen.)

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Efforts were made to study the LC_{50} values of newer insecticide against brinjal shoot and fruit borer (*Leucinodes orbonalis*) collected from different location of Vidarbha *viz.*, Akola, Amravati, Yavatmal, Washim and Buldhana by using direct spray method carried out in the toxicology laboratory, Department of Agricultural Entomology, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during 2011-12. Five insecticides *viz.*, rynaxypyr 20 SC, flubendiamide 480 SC, emamectin benzoate 5 SG, indoxacarb 14.5 SC and spinosad 45 SC were tested for their toxicity to third instar larvae of *Leucinodes orbonalis* (Guen.). The resultant toxicity in terms of LC_{50} values obtained for insecticide against different strain were ranged for rynaxypyr (0.127-0.157), flubendiamide (15.551-23.046), emamectin benzoate (0.277-0.351), indoxacarb (2.016-2.457) and spinosad (3.094-4.940) ppm. Rynaxypyr 20 EC and emamectin benzoate 5 SG were found most effective amongst the insecticides tested. Thus, rynaxypyr and emamectin benzoate could be used for management of *Leucinodes orbonalis* and to delay the development of insecticide resistance.

Key words : Insecticides, *Leucinodes orbonalis*, LC_{50}, Toxicity

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INTRODUCTION

The area under brinjal cultivation is estimated at 0.621 million ha with production of 10.806 million metric tones in 2011. This accounts for 7.5 per cent of area under vegetable cultivation with a contribution of 8 per cent to total vegetable production (Anonymous, 2011). As per vegetable production on the global scenario is concerned, India occupied the second largest position after china (Jena *et al.*, 2006).

Brinjal is prone to attack by many insect pest by far the most important of which is the fruit and shoot borer for which resistance has not been identified and thus, it causes significant losses of 60-70 per cent (Sharma, 2009).

The losses caused by this pest are reported by several workers *viz.*, ranges from 55.66 per cent to 80 per cent or even more (Lal *et al.*, 2004), 48.30 per cent (Singh *et al.*, 2000). In several infestations it causes upto 70 per cent yield loss of fruit in West Bengal (Singh *et al.*, 2008).

Brinjal fruit and shoot borer is not controlled by any insecticidal spray because it is an internal feeder and resistance to conventional insecticides. Pesticide resistance is emerging as one of key constraints to successful crop protection and public health problem worldwide (Dover and Croft, 1984). Insecticide resistance in brinjal shoot and fruit borer especially to pyrethroids is now wide spread in many brinjal producing countries high level of resistance to many carbamates and pyrethroids have been reported in field population of brinjal shoot and fruit borer (Prabhakar *et al.*,1995).

Therefore, the present investigation was planned to study the LC_{50} value and insecticide resistance in brinjal shoot and fruit borer population collected from major brinjal growing areas.

Research Methodology

Test insect population :

Brinjal shoot and fruit borer (*Leucinodes orbonalis* Guen.) population were collected from extensively brinjal growing area of Akola, Amravati, Washim, Yavatmal and Buldhana district for monitoring insecticide resistance. The third instar old larvae of brinjal shoot and fruit borer (*Leucinodes orbonalis* Guen.) having similar size and weighing 15-20 mg were used for conducting bioassay to study the level of resistance.

Determination of LC_{50} of different insecticides :

Insecticides treatment details :

Different insecticides belonging to different groups were used for studying the level of resistance in brinjal against shoot and fruit borer. The insecticides used were rynaxypyr 20 SC, flubendamide 480 SC, emamectin benzoate 5 SG, indooxacarb 14.5 SC and spinosad 45 EC.

Preparation of insecticide solutions :

Different concentrations of insecticides were made by using following formula :

$$V = \frac{C \times A}{a.i.}$$

where, V - volume of insecticides, C - concentration required, A - quantity of water required and a.i - percentage of active ingredient in commercial insecticide.

Insecticide bioassay :

Ten third instars larvae weighing (15-20 mg) were preconditioned and kept in Petri dish. 1 ml of each concentration of insecticides was directly spread with exact quantity of insecticide solution. The sprayed Petri dishes containing the larvae were dried for 5 minutes under fan, the treated insect then transferred to separate Petri dishes containing the fresh pieces of brinjal fruits as a food. The control was maintained by spraying 1ml of distilled water, after treatment Petri dishes containing the treated larvae was kept at constant temperature at 27 ± 2^{o} C and 70 ± 2 per cent relative humidity. The mortality of larvae was recorded after every 24 hrs of treatment. The mortality on 5^{th} day was considered as final mortality.

The corrected mortality was calculated by using Abbott's formula (Abbotts, 1925). The data were analyzed to determine LC_{50} values by probit analysis (Finney,1971).

$$\text{Corrected mortality} = \frac{T - C}{100 - C} \times 100$$

where, T - per cent mortality of treatment and C - per cent mortality in control

Similarly the LC_{50} values of these five insecticides against the susceptible population of *Leucinodes orbonalis* were also calculated and the LC_{50} value of resistance population was compared with the LC_{50} value of susceptible strain for the determination of the level of insecticides resistance in *Leucinodes orbonalis*

Data analysis :

The mortality data in the range of 20-80 per cent from each treatment were considered and subjected to probit analysis (Finney, 1971) after computation of corrected mortalities for respective treatment concentrations taking into account the mortalities recorded in control using Abbott's formula (Abbott, 1925) and verified using a software programme *i.e.* EPA available at Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola to know the LC_{50} and LC_{90} values.

Research Findings and Analysis

The present study was conducted to study the toxicity of newer insecticides in field population of *Leucinodes orbonalis* (Guen.) collected from five district of western Vidarbha region, *viz.*, Akola, Amravati, Buldhana, Yavatmal and Washim and results are presented in Table 1.

Toxicity of different insecticides against different strain of *L. orbonalis* (Guen.) :

Akola strain :

The toxicity data of different insecticides against brinjal shoot and fruit borer (*Leucinodes orbonalis* Guen.) in Akola strain showed that rynaxypyr 20 EC was found to be most toxic insecticide having the lowest LC_{50} value of 0.131 ppm. The order of toxicity based on LC_{50} was rynaxypyr > emamectin benzoate > indoxacarb > spinosad > flubendiaide, whereas, based on LC_{90} was also same. However, among the diamides the rynaxypyr was found more toxic than flubendiamide.

Amaravati strain :

The toxicity data of different insecticides against brinjal shoot and fruit borer (*Leucinodes orbonalis* Guen.) in Amaravati strain showed that rynaxypyr 20 EC was found to be most toxic insecticide having the lowest LC_{50} value of 0.156 ppm. The order of toxicity based on LC_{50} was rynaxypyr > emamectin benzoate > indoxacarb > spinosad > flubendiaide, whereas, based on LC_{90} was also same. However, among the diamides the rynaxypyr was found more toxic than flubendiamide.

Buldhana strain :

The toxicity data of different insecticides against brinjal shoot and fruit borer (*Leucinodes orbonalis* Guen.) in Buldhana strain showed that rynaxypyr 20 EC was found to be most toxic insecticide having the lowest LC_{50} value of 0.128 ppm. The order of toxicity based on LC_{50} was rynaxypyr > emamectin benzoate > indoxacarb > spinosad > flubendiaide, whereas, based on LC_{90} was also same. However, among the diamides the rynaxypyr was found more toxic than flubendiamide.

Yavatmal strain :

The toxicity data of different insecticides against brinjal shoot and fruit borer (*Leucinodes orbonalis* Guen.) in Yavatmal strain showed that rynaxypyr 20 EC was found to be most toxic insecticide having the lowest LC_{50} value of 0.157 ppm. The order of toxicity based on LC_{50} was rynaxypyr > emamectin benzoate > indoxacarb > spinosad > flubendiaide, whereas, based on LC_{90} was also same. However, among the diamides the rynaxypyr was found more toxic than flubendiamide.

Washim strain :

The toxicity data of different insecticides against brinjal shoot and fruit borer (*Leucinodes orbonalis*

Table 1 : Toxicity of different insecticides against different strain of *Leucinodes orbonalis* (Guen.)

Sr. No.	Strain	Insecticide	LC_{50}	LC_{90}	Fiducial limit at 50 %	Slope	X^2
1.	Akola	Rynaxypyr	0.131	0.956	0.043- 0.193	1.48	0.204
		Fllubendamide	23.046	170.709	12.993- 33.71	1.47	1.532
		Emamectin benzoate	0.312	1.405	0.178-0.416	1.95	0.384
		Indoxacarb	2.457	15.678	1.529-3.529	1.59	1.618
		Spinosad	3.352	16.738	1.883-4.512	1.83	0.885
2.	Amravati	Rynaxypyr	0.156	1.039	0.068- 0.221	1.55	1.834
		Fllubendamide	15.551	106.233	6.612- 22.107	1.53	0.113
		Emamectin benzoate	0.333	1.701	0.184-0.450	1.80	3.128
		Indoxacarb	2.016	23.668	0.690-3.163	1.19	0.469
		Spinosad	4.940	27.662	3.224-6.888	1.71	0.445
3.	Buldhana	Rynaxypyr	0.128	0.530	0.068- 0.173	2.07	0.863
		Fllubendamide	19.553	220.980	6.665- 30.229	1.21	0.337
		Emamectin benzoate	0.277	1.551	0.125-0.388	1.71	0.084
		Indoxacarb	2.117	11.933	1.281-2.892	1.70	0.898
		Spinosad	3.112	32.442	0.802-4.718	1.25	0.126
4.	Yavatmal	Rynaxypyr	0.157	0.874	0.075- 0.213	1.69	1.413
		Fllubendamide	17.375	142.987	7.010- 25.215	1.40	1.201
		Emamectin benzoate	0.351	2.336	0.170-0.492	1.55	0.696
		Indoxacarb	2.245	11.718	1.438-3.040	1.78	1.297
		Spinosad	3.094	21.514	1.287-4.415	1.52	0.801
5.	Washim	Rynaxypyr	0.127	0.769	0.050- 0.183	1.64	0.415
		Fllubendamide	17.543	116.800	8.496-24.600	1.55	0.696
		Emamectin benzoate	0.320	2.923	0.103-0.474	1.33	0.805
		Indoxacarb	2.127	11.505	1.310-2.887	1.74	2.531
		Spinosad	3.429	22.224	1.661-4.794	1.57	0.340

Guen.) in Washim strain showed that rynaxypyr 20 EC was found to be most toxic insecticide having the lowest LC_{50} value of 0.127 ppm. The order of toxicity based on LC_{50} was rynaxypyr > emamectin benzoate > indoxacarb > spinosad > flubendiaide, whereas, based on LC_{90} was also same. However, among the diamides the rynaxypyr was found more toxic than flubendiamide.

The high LC_{50} values of rynaxypyr shows that, rynaxypyr is more toxic to all district strain of *Leucinodes orbonalis* followed by emamectin benzoate, indoxacarb, spinosad and flubendamide.

Rynaxypyr 20 SC and emamectin benzoate 5 SG were found most effective amongst the insecticide tested. Based on the toxicity of different insecticide against the field population of (*Leucinodes orbonalis* Guen.) it can be said that the insecticidal management strategies with the spinosad, indoxacarb and flubendiamide can be rotated with rynaxypyr and emamectin benzoate to delay the process of resistance development in (*Leucinodes orbonalis* Guen.).

The study will be helpful in understanding the insecticide resistance of *Leucinodes orbonalis* in brinjal. The data generated in this study could be used to monitor the insecticide resistance in brinjal fruit and shoot borer. The outcome of the present investigation will act as stepping stone to develop strategies to fight against the major pest of brinjal so that the insecticides use in this vegetable crop could be minimized (Yasodha and Natarajan, 2007 and Kavitha *et al.*, 2008).

Kang and Dhaliwal (2009) reported emamectin benzoate with LC_{50} values ranging from 0.00016 to 0.00056 per cent was found the most toxic than flubendiamide, indoxacarb and spinosad to *Plutella xylostella* which supported to the values obtained in present studies.

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