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Bioassay Studies for Testing Toxicity of Novel Insecticides against *Spodoptera litura* (Fabricius.)

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A B S T R A C T

Bioassay studies were conducted in the Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad to determine the relative toxicity of selected novel insecticides *viz*., chlorfluazuron, chlorantraniliprole, spinetoram, indoxacarb, emamectin benzoate and spinosad against second instar larvae of*S. Litura* by topical application, residue method and surface diet method. The data on the toxicity of insecticides to *S. litura*, clearly indicated that among the six insecticides tested against the second instar, emamectin benzoate, spinetoram, indoxacarb, chlorfluazuron, chlorantraniliprole showed greater toxicity against *S. litura* compared to spinosad in all the three methods of application.

Introduction

Bioassay is defined as "the measurement of the potency of any stimulus which may be physical, chemical, biological, physiological or psychological etc. by means of the reactions which it produce in the living organism" (Finney, 1952). Bioassay helps in ascertaining the potency and relative toxicity of different insecticides. The bioassay methods commonly employed to insect toxicity evaluations are topical application by Potter's tower, injection method, leaf dip, contact or residue film method etc. The LC_{50} values serve as a ready reckoner for the selection of insecticides to work out strategy for the management of insect pest under field conditions. Also, such baseline data would provide a record for detecting resistance level of the insect pests to various insecticides at different periods.

The tobacco caterpillar, *Spodopteralitura* (Fabricius) (Lepidoptera: Noctuidae) is also an important polyphagous pest, infesting crops of major economic importance. It was reported to attack 112 species of plants belonging to 44 families (Moussa and Ketbey, 1960).

Materials and Methods

The present research work titled "Bioassay studies for testing toxicity of novel

insecticides against *S. litura* (F.)" was carried out in the Department of Entomology, College of Agriculture, Rajendranagar, Hyderabad during the year 2018-19. The materials used for the study and methods adopted are given here under.

Mass Rearing of *S. litura*

Collection of eggs/larvae

The eggs of *S. litura* were obtained from NBAIR, Bangalore and from ICRISAT, Hyderabad whereas the larvae were collected in polythene bags containing fresh red gram leaves from Students' farm and College farm, College of Agriculture, Rajendranagar, Hyderabad and also from farmer's fields in Ranga Reddy district, Hyderabad.

Rearing of *S. litura*

The eggs obtained from NBAIR, Bangalore and from ICRISAT, Hyderabad were kept separately in plastic jars. Upon hatching, the eggs were transferred to bigger petriplates containing modified semi-synthetic diet (Ahmad and McCaffery, 1991), the ingredients of which are given in Table.1.

Preparation of Insecticidal Solution

A total of six novel insecticides were used to carry out the bioassay studies. The details of the insecticides used in the study are furnished in Table.2.

Stock solution of one per cent of 100 ml was prepared for each insecticide by dissolving their respective formulations in distilled water.

The treatments were replicated thrice. Ten larvae of five days old (2^{nd} instar), were used for each replication. The concentrations used in the study are given in Table 2.3.

Bioassay Procedure

Topical application, residue film method and surface diet method (Paramasivam and Selvi, 2017) were followed to evaluate the toxicity of the test insecticides to the 2^{nd} instar larvae of *S.litura*.

Topical application method

Ten larvae of test insect were kept in a petri dish. The toxicant solutions were applied topically on the dorsum of second instar larvae (five days old) using Potter's tower at 760 mm Hg column difference air pressure. One ml of each insecticidal formulation was used for spraying. The petriplates were allowed to dry under fan and fresh diet was given to the larvae after treatment in Petri dishes. The Petri dishes were covered with Whatman's filter paper to maintain humidity. Three replications of each treatment were maintained and mortality was recorded after 24hours.

Residue film method

In a petri dish of 5 cm diameter 1 ml solution of desired concentration of insecticides was sprayed with the help of Potter's spray tower and allowed to dry under an electric fan to get residue film. Desired concentration of each insecticides were made and in each concentration ten larvae were exposed to residue film. Each treatment was replicated thrice. The mortality was recorded after 24 hours.

Surface diet method

Three ml of the diet was pipetted into cell well trays and allowed to cool at room temperature for approximately 1 hour. For each test insecticide, serial dilutions of formulated material (100 µl aliquots) were pipetted onto the diet surface and allowed to dry for approximately 30 minutes. Second

instar larvae were placed into a series of cell well trays that contained different concentrations of formulated insecticides. Each treatment was replicated thrice. Then mortality was recorded after 24 hours.

Analysis of the data

The corrected mortality was calculated by subjecting the observed mortality to Abbott's (1925) formula,

$$\text{Corrected mortality (\%)} = \frac{\text{Test mortality (\%)} - \text{Control mortality (\%)} \times 100}{100 - \text{Control mortality}}$$

Dose mortality regressions (LC_{50}) were computed by probit analysis (Finney, 1971) using BIOSTAT 2006 Software.

Results and Discussion

Against *S. litura*, the LC_{50} values for chlorfluazuron, chlorantraniliprole, spinetoram, indoxacarb, emamectin benzoate and spinosad against *S. litura* were 0.0006, 0.0008, 0.0002, 0.0003, 0.0001 and 0.0102 per cent, respectively by topical application; 0.0011, 0.0011, 0.0006, 0.0005, 0.0002 and 0.0158 per cent, respectively by residue film method and 0.0007, 0.0008, 0.0003, 0.0003, 0.0001 and 0.0122 per cent, respectively by surface diet method of bioassay. Thus from these studies it was inferred that all the insecticides tested *viz.* emamectin benzoate, spinetoram, indoxacarb, chlorfluazuron, chlorantraniliprole showed greater toxicity against *S. litura* compared to spinosad in all the three methods of application.

However, spinosad was relatively more toxic against *S. litura* by topical application. Efficacy of insecticides based on different methods of application against *S.litura*is given in Table.4.

In conclusion against *S. litura*, emamectin benzoate, spinetoram, indoxacarb, chlorfluazuron, chlorantraniliprole showed greater toxicity while spinosad was less toxic.

Table.1 Diet composition for *S. litura*

Sl. No	Ingredients	Quantity
1	Chickpea flour	160g
2	Wheat germ	60g
3	Sorbic acid	1.7g
4	Dried yeast	53g
5	L- Ascorbic acid	5.3g
6	Methyl paraben	3.3g
7	Agar- agar	20g
8	Formaldehyde 10%	14ml
9	Antimould	2 ml
10	Distilled water	1200 ml

Table.2 Details of insecticides tested for relative toxicity against *S. litura*

Sl. No	Common Name	Trade Name	Formulation	Source of Supply
1.	Chlorfluazuron	Atabron	5.4 EC	UPL Limited
2.	Chlorantraniliprole	Coragen	18.5 SC	Dupont Chemicals (India) Limited
3.	Spinetoram	Delegate	11.7 SC	Dow Agrosciences
4.	Indoxacarb	Isacarb	14.5 SC	Isagro Asia Agrochemicals Pvt. Ltd.
5.	Emamactin benzoate	Reclaim	5 SG	Aegis Pvt. Ltd.
6.	Spinosad	Tracer	45 SC	Dow Agrosciences

Table.3 Concentration of insecticides used in bioassay studies against *S. litura*

TOPICAL APPLICATION	
Insecticides	**Concentration used**
Chlorfluazuron	0.005, 0.003, 0.001, 0.0007, 0.0005, 0.0003, 0.0001
Cholrantraniliprole	0.007, 0.005, 0.003, 0.001, 0.0007, 0.0005, 0.0003
Spinetoram	0.003, 0.001, 0.0007, 0.0005, 0.0003, 0.0001, 0.00007
Indoxacarb	0.005, 0.003, 0.001, 0.0007, 0.0005, 0.0003, 0.0001, 0.00007, 0.00005
Emamectin benzoate	0.0007, 0.0005, 0.0003, 0.0001, 0.00007, 0.00005, 0.00003
Spinosad	0.07, 0.05, 0.03, 0.01, 0.009, 0.007, 0.005, 0.003
RESIDUE FILM METHOD	
Insecticides	**Concentration used**
Chlorfluazuron	0.05, 0.03, 0.005, 0.003, 0.001, 0.0007, 0.0005, 0.0003, 0.0001
Cholrantraniliprole	0.007, 0.005, 0.003, 0.001, 0.0007, 0.0005, 0.0003
Spinetoram	0.05, 0.03, 0.01, 0.003, 0.001, 0.0007, 0.0005, 0.0003, 0.0001, 0.00007
Indoxacarb	0.005, 0.003, 0.001, 0.0007, 0.0005, 0.0003, 0.0001, 0.00007, 0.00005
Emamectin benzoate	0.003, 0.001, 0.0007, 0.0005, 0.0003, 0.0001, 0.00007, 0.00005, 0.00003
Spinosad	0.07, 0.05, 0.03, 0.01, 0.009, 0.007, 0.005, 0.003
SURFACE DIET METHOD	
Insecticides	**Concentration used**
Chlorfluazuron	0.005, 0.003, 0.001, 0.0007, 0.0005, 0.0003, 0.0001
Cholrantraniliprole	0.007, 0.005, 0.003, 0.001, 0.0007, 0.0005, 0.0003
Spinetoram	0.003, 0.001, 0.0007, 0.0005, 0.0003, 0.0001, 0.00007
Indoxacarb	0.005, 0.003, 0.001, 0.0007, 0.0005, 0.0003, 0.0001, 0.00007, 0.00005
Emamectin benzoate	0.0007, 0.0005, 0.0003, 0.0001, 0.00007, 0.00005, 0.00003
Spinosad	0.07, 0.05, 0.03, 0.01, 0.009, 0.007, 0.005, 0.003

Table.4 Efficacy of insecticides based on different methods of application against *S.litura*

Sl. No	Insecticides	LC_{50} values (%) in different methods of application		
		Topical application	Residue film method	Surface diet method
1	Chlorfluazuron	0.0006	0.0011	0.0007
2	Chlorantraniliprole	0.0008	0.0011	0.0008
3	Spinetoram	0.0002	0.0006	0.0003
4	Indoxacarb	0.0003	0.0005	0.0003
5	Emamectin benzoate	0.0001	0.0002	0.0001
6	Spinosad	0.0102	0.0158	0.0122

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