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Ashithosh Mohanan
Department of Entomology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Gajendra Chandrakar
Department of Entomology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Chetna Khandekar
Department of Entomology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Beerendra
Department of Entomology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

SM Ali Humayun
Department of Entomology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Corresponding Author:
Ashithosh Mohanan
Department of Entomology, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh, India

Acute toxicity of different spinetoram doses against 3rd instar larvae of lepidopteran pest *Spodoptera litura* Linn. Of cabbage under laboratory condition

Ashithosh Mohanan, Gajendra Chandrakar, Chetna Khandekar, Beerendra and SM Ali Humayun

Abstract
Laboratory experiments were conducted in the Department of Entomology, College of Agriculture, and IGKV. Raipur, Chhattisgarh, during year 2020, to study the acute toxicity of six doses (0.2, 0.4, 0.6, 0.8, 1.0 and 1.2 ml/L) of spinetoram insecticides along with one control (distilled water) against third larval *S. litura* on cabbage. The results of the insecticidal action of spinetoram on *S. litura* after 24 hrs of exposure indicated that spinetoram at 1.20 ml/L caused maximum mortality (66.66%). LC50 value of spinetoram after 24 hrs exposure was 0.86 ml/L. The results of the insecticidal action of spinetoram on *S. litura* after 48hrs of exposure indicated that spinetoram at 1.20 ml/L caused maximum mortality 70.00% in year 2020. After probit analysis of data it was found that LC50 value of spinetoram after 48 hrs exposure was 0.76 ml/L in year 2020. The results of the insecticidal action on *S. litura* after 72hrs of exposure indicated that spinetoram at 1.20 ml/L caused maximum mortality 73.33% in year 2020. After probit analysis of data it was found that LC50 value of spinetoram after 72 hrs exposure was 0.62 ml/L in year 2020.

Keywords: Indian mustard, path coefficient analysis

Introduction
Among all vegetables crops cole crops are superior to other winter vegetables and are grown all around the country. Cabbage, cauliflower, Knol-khol, Brussels sprouts, sprouting broccoli, and Chinese cabbage are examples of cole crops. They are members of the Cruciferae family and the genus Brassica. Cabbage (*Brassica oleracea* var. capitata Linn.) is a popular cole vegetable that is grown on around 0.39 million hectares and produces 8.80 million tonnes. It is grown for the edible expanded terminal buds known as head, which are high in vitamins A, B1, and C, as well as minerals like phosphorus, potassium, salt, calcium, and iron. Tobacco caterpillars, diamondback moths, painted bugs, cabbage semiloopers, aphids, flea beetles, and other pests cause damage to the crop. The diamondback moth, *Plutella xylostella* Linneaus, cabbage butterfly, *Pieris brassicae* Linneaus, and mustard aphid, *Lipaphis erysimi* Kaltenbach, are the most serious threats to the crop's profitability in India, with the diamondback moth, *Plutella xylostella* Linneaus, cabbage butterfly, *Pieris brassicae* Linneaus, and mustard aphid, *Lipaphis erysimi* are a common crucifer pests. Insecticides are commonly used to manage pests on cabbage because of their effectiveness, and quick control. The indiscriminate and illogical application of insecticides at high levels has resulted in insect pest recurrence and resistance, as well as residues in food. The indiscriminate use has increased the expense of cultivation and has resulted in certain irreversible biosphere alterations. As a result, novel pesticide molecules with high toxicity to insect pests at low dosages are needed, which should also be safer for natural enemies in the agro-ecosystem as well as the customer.

Material and Method
Mass rearing of *Spodoptera litura*
The egg masses of *S. litura* collected from fields were kept separately in petridishes. Tender cabbage leaves were provided for enabling the young larvae to feed immediately after hatching and to prevent mortality of larvae. Larvae that hatched from egg masses and those collected directly from field were reared on cabbage leaves.

The feed was changed daily. The rearing space was increased regularly using more number of glass jars for avoiding overcrowding of larvae and enabling uniform growth and development of larvae. The full grown larvae were transferred into glass jars for pupation, which were lined on the bottom and circumference with butter paper. Adult moths that emerged from the pupae were transferred into oviposit ion cage, which was also lined with butter paper on all sides. Cotton swab soaked in two percent sugar solution was provided as feed to adult moths. The diet was changed daily. The eggs laid by moths on butter paper were removed using camel hairbrush and used for multiplication of the culture. The larvae of equal stage were utilized for the experimentation.

Methodology: The laboratory culture pests was initiated in the Ph.D laboratory, college of agriculture, IGKV, Raipur by collecting egg mass and larvae from experimental field. For acute toxicity experiments leaf-dip method is used, Fresh leaves of uniform size were thoroughly washed with water. Then leaves was dipped into the serial doses of insecticide solutions (0.2, 0.4, 0.6, 0.8, 1.0 and 1.20 ml/L) for 60 seconds and air dried at room temperature for removing surface water. The treated leaves were transferred to clean plastic containers lined with moistened filter paper at the bottom. In each container 10 laboratory reared larvae of third instar was released and kept under the normal rearing conditions for observation. For the control, leaves treated with water alone were used. The larvae were considered dead when they became desiccated with shortened body and dark cuticle, and/ or unable to move in a coordinated manner when disturbed with a needle. In this acute toxicity experiment, observations on larval mortality was fixed till 72 hours of exposure as spinetoram 12 SC tested is lepidoptericide characterized by stomach action showing slower mortality. The cumulative mortality data was observed till 72 h at 24 h intervals.

Analysis of Data

The mortality count of insects in three replication of each concentration was recorded and the average percent mortality in each concentration was calculated. The percent mortality in control, if any was corrected using Abbott's formula (1925).

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

The dose mortality regressions were computed by probity analysis (Finney, 1971) using SPSS 7.5 version (Statistical package for social science) software.

Result and Discussion

Acute toxicity of spinetoram 12 SC against *S. litura* after 24hrs of exposure

The results of the insecticidal action of spinetoram on larvae after 24 hrs of exposure indicated that spinetoram at 1.2% caused maximum mortality *i.e.* 66.66% followed by spinetoram at 1.0, 0.8, 0.6, 0.4 and 0.2 ml/L in descending order, the recorded mortality was 53.33%, 43.33%, 36.66%, 26.66% and 20.00%, respectively. The data revealed no mortality in control (Distilled water) *i.e.* 0.00%. After probit analysis of data it was found that LC50 value of spinetoram after 24 hrs. Exposure was 0.86 ml/L similarly the LC95 value came as 0.957 ml/L, overall it was observed that with increase in concentration of spinetoram there was increase in mortality percent of third instar larvae of *S. litura* after 24 hrs. of exposure.

Acute toxicity of spinetoram 12 SC against *S. litura* after 48hrs of exposure

The results of the insecticidal action of spinetoram on larvae after 48hrs of exposure indicated that spinetoram at 1.2 ml/L caused maximum mortality *i.e.* 70.00% followed by spinetoram at 1.0, 0.8, 0.6, 0.4 and 0.2 ml/L in descending order, the recorded mortality was 53.33%, 46.66%, 43.33%, 30.00% and 23.33% respectively. The data revealed that mortality in control (Distilled water) was 13.33%. After probit analysis of data it was found that LC50 value of spinetoram after 48 hrs. Exposure was 0.76 ml/L similarly the LC95 value came as 0.996 ml/L, overall it was observed that with increase in concentration of spinetoram there was increase in mortality percent of third instar larvae of *S. litura* after 48 hrs. of exposure.

Acute toxicity of spinetoram 12 SC against *S. litura* after 72hrs of exposure

The results of the insecticidal action on larvae after 72hrs of exposure indicated that spinetoram at 1.20 ml/L caused maximum mortality of 73.33% followed by spinetoram at 1.0, 0.8, 0.6, 0.4 and 0.2 ml/L in descending order, the recorded mortality was 60.00%, 53.33%, 46.66%, 36.66% and 26.66%, respectively. The data revealed that mortality in control (Distilled water) was 16.66%. After probity analysis of data it was found that LC50 value of spinetoram after 72 hrs exposure was 0.62 ml/L similarly the LC95 value came as 0.801 ml/L, overall it was observed that with increase in concentration of spinetoram there was increase in mortality percent of third instar larvae of *S. litura* after 72 hrs. of exposure.

Table 1: Acute toxicity of spinetoram 12 SC against third instar larvae of *S. litura* in cabbage during year 2020

Dose ml/l	After 24 hours			After 48 hours			After 72 hours		
	Mean dead larvae	Mortality %	Corrected mortality	Mean dead larvae	Mortality %	Corrected mortality	Mean dead larvae	Mortality %	Corrected mortality
0.2	2.00 (8.12)	20.00	20.00	2.33 (8.74)	23.33	11.53	2.66 (9.35)	26.66	12.00
0.4	2.66 (9.35)	26.66	26.66	3.00 (9.97)	30.00	19.23	3.66 (11.01)	36.66	24.00
0.6	3.66 (11.01)	36.66	36.66	4.33 (11.99)	43.33	34.61	4.66 (12.45)	46.66	36.00
0.8	4.33 (11.99)	43.33	43.33	4.66 (12.45)	46.66	38.46	5.33 (13.33)	53.33	44.00
1.0	5.33 (13.33)	53.33	53.33	5.33 (13.33)	53.33	46.15	6.00 (14.14)	60.00	52.00
1.2	6.66	66.66	66.66	7.00	70.00	65.38	7.33	73.33	68.00

	(14.94)			(15.31)			(15.67)		
0.00	0.00	0.00	0.00	1.33 (6.53)	13.33	0.00	1.66 (7.33)	16.66	0.00
C.D.	1.26			1.65			1.91		
SE(m)	0.412			0.539			0.624		
LC50 and Fiducial limit	0.86	0.6-0.13		0.76	0.5-0.11		0.62	0.4-0.8	
LC95 and Fiducial limit	0.957	0.38-13.20		0.996	0.37-18.28		0.801	0.32-10.96	
Slope	1.675			1.648			1.787		
Regression equation	Y=1.64+1.54x			Y=1.64+1.46x			Y=1.79+1.48x		

Conclusion

In present investigation it was found that with increase in dose there was increase in mortality of third instar larvae of *S.litura*. LC50 value of spinetoram also decreased with time of exposure of spinetoram with third instar larvae of *S.litura*. When the treatments were assessed at 24, 48 and 72 hours, LC50 values against larvae were 0.86, 0.76 and 0.62. The slopes of the probit lines for larvae assessed at 24, 48 and 72 hours after application of spinetoram were 1.675, 1.648 and 1.787.

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