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Biology and efficacy of insecticides against tobacco caterpillar, *Spodoptera litura* (Fabricius) on Castor leaves

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ABSTRACT
Experiments were conducted at the Department of Agricultural Entomology, College of Agriculture, PJTSAU, Hyderabad to study the biology of tobacco caterpillar, Spodoptera litura (Fabricius) on castor leaves. The results revealed that the duration of incubation, larval, prepupa, pupal, adult male and adult female longevities were recorded with an average of 3.875 ± 0.38, 12.67 ±0.72, 1.66 ± 0.14, 7.8 ±1.095, 3.16 ± 0.29 and 5.50 ± 0.50 days respectively. The egg laying capacity of female ranged from 200 to 220 eggs/female with an average of 210 ±10 eggs/female. The results also confirmed the presence of five instars in larval stage, which are key elements in damaging the crops, and the remaining egg, prepupa and adult stages are non damaging stages to the crops. Flubendiamide and indoxacarb insecticides were found most toxic to 3rd in Spodoptera litura larva at 72 hours after treatment with 100 per cent mortality at 120ppm and 18.75ppm respectively.
Keywords: *Biology, flubendiamide, indoxacarb and mortality*

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INTRODUCTION

The tobacco caterpillar, *S. litura*, is one of the most important insect pests of agricultural crops in the Asian tropics. It is widely distributed throughout tropical and temperate Asia, Australasia and the Pacific Islands [1] with wide host range of more than one hundred plants [2]. The outbreak of this pest generally occurs with a good rainfall after a long dry spell [3]. The newly hatched larvae feeds gregariously from lower surface of the leaves and causing heavy damage to the leaves, shoots, stems and capsules. The grown up larvae consume almost whole castor leaf leaving behind only hard veins [4].A single larva per square metre is reported to cause average pod yield loss of 27.3% in groundnut through damage to various plant parts like leaves, flowers and pods [5]. Although it had been a sporadic pest in India, Recently an outbreak of this pest has been reported on soybean in Kota (Rajasthan), Marathwada and Vidharba (Maharashtra) regions of India causing greater yield loss [6]. *S. litura* has developed resistance to most of the conventional insecticides including organophosphate (Profenofos), carbamate, pyrethriods (deltamethrin), and some selected new chemistry insecticides (spinosad and indoxacarb) in South Asia [7]. There is a latent need to know the biology of the pest and also to find out the best insecticide, as it will helpful in the subsequent research to know the ecological adaptations of *S. litura* in recent days due to global warming and also the resistance problems and for the development of pest forewarning system and management.

MATERIALS AND METHODS

Maintenance of culture

The larvae of *S. litura* collected from the unsprayed castor crop grown in plots at Entomology Greenhouse, College of Agriculture, Rajendranagar, PJTSAU, Hyderabad. The collected larvae were brought to laboratory (Department of Agricultural Entomology) and reared in glass jars. The larvae were fed on fresh and tender leaves of castor variety Jwala. The feed was changed daily and the rearing space was increased regularly using more number of jars to avoid overcrowding of the larvae and to enable uniform growth and development of the larvae. The fully grown larvae were transferred into glass jars containing a layer of 15- 20 cm thick moist soil at the bottom for pupation. Adult moths emerged from the pupae were transferred into glass jars, which were lined on the bottom and circumference with butter paper.

Cotton swab soaked in honey solution (2%) was provided as feed to adult moths which were changed daily. The eggs laid by the moth on the butter paper were removed daily and used for further multiplication and use.

In order to determine the larval instars, the individual larva was observed daily for the exuviae [8]. Observations on number of instars, instar duration and total larval period were recorded. Full grown larvae stopped feeding, become sluggish and darken in colour before entering into the pupal stage, these are characteristics of the pre-pupal stage. Pupal period was calculated from the date of light green colour pupae to the date of emergence of imago. Observations on duration of various life stages i.e. egg, larva, pre-pupa, pupa and adult were recorded wisely. During the period of study, the insects were reared at the average temperature of 25± 2 and average relative humidity of 75 per cent.

Insect and Insecticides

3rd larval instar of F_2 generation were used in the experiment under Completely Randomized Design (CRD). Three insecticides Spinosad 480 SC, Indoxacarb 14.5 SC and Flubendiamide 480 SC along with various concentrations and distilled water as a control treatment were applied on *S. litura* larvae by using leaf dip bioassay method [9] to study the lethal effects. Different lethal field concentrations of the insecticides were used for the experiment under standard constant environment conditions (25± 2^{o}C, 75 ± 5 RH and L: D 16:8 h).

Leaf Dip Bioassay Method

Fresh castor leaves were collected from the fields and washed under available tap water. Leaf disks were prepared of 2 inches of diameter with the help of disk cutter, then disks dipped in the prepared insecticides concentration (5 leaves per concentration per insecticide) for 9-10 seconds and then air dry. Disk leaves for controlled treatment were dipped on in distilled water.

Data Analysis

Leaves were observed to check the feeding behaviour on treated as well controlled experiment, in addition, adults and larvae were examined to check the lethal effects of insecticides after 24, 48 and 72 hours of treatments. Abbott's formula [10]was used to correct the mortality on untreated leaves where it was necessary. Data was analysed by using Probit Analysis two-way analysis of the variance (ANOVA).

RESULTS AND DISCUSSION

Eggs were spherical, somewhat flattened, laid in batches and covered with hair scales from the tip of the abdomen of the female moth. Usually pale orange-brown or pink in colour. The incubation period of the eggs under laboratory conditions ranged between 3.50 to 4.25 days with an average of 3.875 ± 0.38. The larva passed through five instars and a prepupal quiescent stage before becoming pupa. The duration of the first, second, third, fourth, fifth and prepupa varied with average of 1.00-1.25 and 1.08 ± 0.14, 1.75-2.25 and 2.00 ± 0.25, 2.75-3.00 and 2.83 ± 0.14, 3.00-3.25 and 3.17± 0.14, 3.50-3.75 and 3.58 ± 0.14, and 1.50-1.75 and 1.66 ± 0.14 days, respectively. The total larval period completed in 12.25-13.50 days with an average of 12.67 ±0.72 days (Table 1). The tip of the pupal abdomen had two small spines and the pupae were reddish brown in colour. The total pupal period completed in 7.50 to 8.00 days with an average of 7.66 ±0.29 days. The results are in line with the findings of Promod et al. [8] who reported that The total pupal period completed in 7 to 9 days with an average of 7.8 ±1.095 days. Moths were grey-brown in colour. The forewings were grey to reddish-brown with a strongly variegated pattern and paler lines along the veins. The adult female period was 5 to 6 days and male period was 3.00 to 3.50 days, with an average of 5.50 ± 0.50 and 3.16 ± 0.29 days respectively. The female fecundity ranged between 200 to 220 eggs/female with an average of 210 ± 10 eggs/female. The total life period from egg to death of male adult varied from 24.50 to 26.00 days with an average of 25.17 ± 0.76 days but Incase of female insect from egg to death of adult, th period ranged from 27.00 to 28.00 with an average of 27.50 ± 0.50 days.

Incase of bioassay test, the data regarding the per cent mortality of *Spodoptera litura* larvae was subjected to statistical software and the results revealed that (Table. 2), spinosad shows 76.67, 60.00, 46.67, 30.00 and 20.00 per cent mortality after 72 hours of insecticide application at 112.5, 56.25, 28.12, 14.06 and 7.03 ppm respectively. After 72 hours of insecticide application 73.33, 60.00 and 43.33 per cent mortality were recorded at 9.37, 4.68 and 2.34ppm concentration of indoxacarb respectively, eventually at 37.50 and 18.75ppm concentration it showed cent per cent mortality. Flubendiamide at 60, 30, 15, 7.50ppm concentrations recorded with 93.33, 90.00, 61.67 and 40.00 per cent mortality of larvae, where as the treatment at 120ppm concentration showed 100 per cent motality of *Spodoptera litura* larva. The results were confirmed that flubendiamide and indoxacarb were most toxic to 3rd in *Spodoptera litura* larva at 72 hours after treatment, on the other hand spinosad shown poor results in mortality of test insect. These results are in agreement with the finding of Saini et al. [11] tested the different insecticides included thiodicarb, chlorpyriphos, endosulfan, indoxacarb, profenophos, spinosad, cypermethrin, deltamethrin and Neem extract against tobacco caterpillar, *Spodoptera litura* in laboratory and concluded that spinosad

is poor insecticide as control agent against *S. litura* while indoxacarb gives 73.3% mortality at 72 hours. Gmail *et al.* [12] concluded as 2nd instar larvae of S. litura is more susceptible to indoxacarb as compare to 4th instar larvae. And also Dhawan *et al*. [13] reported that flubendiamide was most toxic compound to the larvae of *S. litura.*

CONCLUSION

The study on biology of *Spodoptera litura* on castor leaves provides information on different life stage parameters and which confirmed the presence of egg, larval, prepupal and adult stages in its life cycle. There are five instars are present in larval stage, these are key elements in damaging the crops, and the remaining egg, prepupa and adult stages are non damaging stages to the crops. In bioassay, the insecticides flubendiamide and indoxacarb were found to be more toxic, although spinosad insecticide shown very poor mortality against 3rd in *Spodoptera litura* larva.

Table 1: Life – stage parameters of *Spodoptera litura* (in days)

Sl. No.	Stage of the insect	Minimum	Maximum	Average ± S.d.
1.	**Egg period**	3.50	4.25	3.875 ± 0.38
2.	**Larval period**			
	1st instar	1.00	1.25	1.08 ± 0.14
	2nd instar	1.75	2.25	2.00 ± 0.25
	3rd instar	2.75	3.00	2.83 ± 0.14
	4th instar	3.00	3.25	3.17± 0.14
	5th instar	3.50	3.75	3.58 ± 0.14
3	**Total larval period**	12.25	13.50	12.67 ±0.72
4	**prepupa**	1.50	1.75	1.66 ± 0.14
5	**Pupal period**	7.50	8.00	7.66 ±0.29
6	**Adult period**			
	Male	3.00	3.50	3.16 ± 0.29
	Female	5.00	6.00	5.50 ± 0.50
7	**Total life period**			
	Male	24.50	26.00	25.17 ± 0.76
	Female	27.00	28.00	27.50 ± 0.50
8	**Fecundity** (per female)	200	220	210 ± 10

Table 2: Percentage mortality (means ± SE) of Spodoptera litura against different insecticide's concentration

Treatment	Insecticides	Dose (ppm)	Mortality (%) (means ± SE)
T1	**Spinosad 45 SC**	112.5	76.67±0.58
T2	**Spinosad 45 SC**	56.25	60.00±0.50
T3	**Spinosad 45 SC**	28.12	46.67±1.15
T4	**Spinosad 45 SC**	14.06	30.00±0.50
T5	**Spinosad 45 SC**	7.03	20.00±0.25
T6	**Indoxacarb 14.5% SC**	37.50	100±0
T7	**Indoxacarb 14.5% SC**	18.75	100±0
T8	**Indoxacarb 14.5% SC**	9.37	73.33±0.58
T9	**Indoxacarb 14.5% SC**	4.68	60.00±1.00
T10	**Indoxacarb 14.5% SC**	2.34	43.33±0.58
T11	**Flubendiamide 480 SC**	120	100±0
T12	**Flubendiamide 480 SC**	60	93.33±0.57
T13	**Flubendiamide 480 SC**	30	90.00±0.50
T14	**Flubendiamide 480 SC**	15	61.67±0.87
T15	**Flubendiamide 480 SC**	7.50	40.00±0.25
T16	**Control**	-	-

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