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Cassia tora (L.) Roxb.: An Alternate Host for Offseason Survival of Tobacco Caterpillar, *Spodoptera litura* (Fabricius, 1775)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Spodoptera litura (Fabricius, 1775) is a serious polyphagous pest causes serious damage to various crops like tobacco, cotton, cabbage *etc*. in Asia and other Indian subcontinents. Depletion in host plants may lead to adverse effect on the alternate host plants. During survey, observed *S. litura* larvae were feeding on *Cassia tora*, in this study third instar larvae of *S. litura* larvae were reared on the common and most preferred hosts like castor and tobacco. Larval, prepupal and

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pupal weight were compared with and other two common hosts. Percent pupation and adult emergence rate were also recorded. Among three hosts, insects which fed on *Cassia tora* have higher larval weight (0.825 mg) and also observed longer larval period compared to other two hosts. No differences were observed in prepupal, pupal (male and female) weight. Percent pupation was higher in *S. litura*, which were fed on castor and tobacco *i.e.,* 100 % and 96.67 % respectively, and on *C. tora* recorded lowest per cent pupation (20 %). Adult emergence rate was found to be non-significant on castor and tobacco fed larvae but the lowest adult emergence was recorded on cassia about 18 %. Feeding of newly hatched instars of *S. litura* confirms that, it uses *C. tora* as an alternate host during off-season survival and complete its life cycle. Longer larval duration on *C. tora* may prone larvae to expose more to the external environment, results in less pupation rate.

Keywords: Cassia tora; castor; tobacco and Spodoptera litura.

1. INTRODUCTION

Spodoptera litura (Fabricius, 1775) also known as the tobacco cutworm or cotton leafworm, is a nocturnal moth in family Noctuidae. It is a serious polyphagous pest in Asia, Oceania, and the Indian subcontinent that was first described by Johan Christian Fabricius in 1775. *S. litura* has over 112 host species belonging to over 40 plant families, making the species highly polyphagous. *Spodoptera litura* is a polyphagous pest [1-3]. It occurs worldwide because of its migration, higher reproductive rate and wide distribution. It feeds on 181 plant species belonging to 39 families; maize, sorghum, chick pea, pigeon pea, cotton, tobacco, okra, sunflower and groundnut are important economic crops attacked by this pest [4-6]. When the host plant in a particular area is depleted, big groups of larvae will migrate to find a new food source. Baskar and Ignacimuthu, [7] assessed the antifeedant, larvicidal, pupicidal and growth inhibitory effect of ononitol monohydrate isolated from *Cassia tora* against *S. litura and showed that,* strong antifeedant activity of 74.57%, 58.22% larvicidal activities, 56.66% pupicidal activities at 1000 ppm concentration. This article highlights the alternate hosts, migration and offseason survival of *S. litura* on weed hosts like *C. tora.*

2. MATERIALS AND METHOD

Cassia tora was grown in and around the fields of Agricultural College, Shivamogga, during field visit, observed tobacco caterpillar larvae were feeding on the *C. tora*. The larvae were collected and brought to the laboratory for identification, later based on the external morphology of larvae and adults confirms it with S*podoptera litura* by the key characteristics.

2.1 Set-I: On *Cassia tora*

Thirty larvae were collected which were feeding on *C. tora* plants and reared on the same host plants in the laboratory up to adult emergence at room temperature. Later, laboratory reared (on *C. tora*) final instar larvae, prepupae and pupae were weighed, per cent pupation and adult emergence rate was recorded.

2.2 Set-II: On Tobacco

Thirty larvae were collected from field and provided tobacco leaves for feeding in the laboratory up to adult emergence at room temperature. Later, laboratory reared final instar larvae and prepupae, pupae were weighed, per cent pupation and adult emergence rate was recorded.

2.3 Set-III: On Castor

Thirty larvae were collected from field and reared on the castor leaves in the laboratory at room temperature up to adult emergence. Later, laboratory reared final instar larvae and prepupae, pupae were weighed, percent pupation and adult emergence rate was recorded.

Later, comparison was made on the effect of different hosts plants on larval, prepupal and pupal (both male and female) weight and also calculated the percent pupation and percent adult emergence rate in *S. litura.*

2.4 Feeding Reconfirmation Study

After mating, newly hatched larvae were reared on young succulent plants of *C. tora* and observed for feeding of early instars on *C. tora* leaves up to third instars.

3. RESULTS AND DISCUSSION

3.1 Identification

Egg Mass: Eggs were spherical and slightly flattened with an orange-brown colour. These eggs were laid on the surface of leaves in big batches, with each cluster usually contained several hundred eggs. Egg batches were covered with hair scales provided by the female, which gives off a golden brown colour.

Larva: The larva was variable in colour based on age. Younger larvae were lighter green while older ones develop to a dark green or brown colour. A bright yellow stripe along the dorsal surface was a characteristic feature of the larvae. The larvae also had no hairs on their body.

Pupa: Pupa was red-brown in colour. A characteristic feature was the presence of two small spines at the tip of the abdomen.

Adult: The body was a grey-brown in colour. The forewings were patterned with dark gray and brown colours. The hindwings are greyish-white with a gray outline. The orbicular spot on the forewing was also more pronounced in the males.

3.2 Effect of *Cassia tora* on *S. litura*

Insects which were reared on the *C. tora* recorded highest larval weight with 0.825 mg and also showed longer larval duration compared to the other two hosts. There were no differences were observed in the third instar, prepupal and male and female pupal weight. There was gradual reduction of larval population at every instar. In total insects, only nine pupae were emerged as adults and it was about 18 % (Table 1 & Fig. 3).

3.3 Effect of Tobacco on *S. litura*

Insects reared on tobacco leaves recorded lowest final instar larval body weight with 0.644 mg. Recorded 96.67 % pupation and 100 % adult emergence (Table 1, Figs. 2 and 3).

3.4 Effect of Castor on *S. litura*

Larvae reared on castor leaves recorded intermediate larval body weight with 0.744 mg. Recorded highest per cent pupation and adult emergence *i.e*., 100 % each (Table 1, Figs. 2 and 3).

3.5 Feeding Reconfirmation Study

After mating, egg masses were collected and incubated for hatching. Later, newly hatched larvae were released on the young succulents leaves of *Cassia tora.* Observed most of the hatched in stars were started feeding on *C. tora* (Fig. 5). So, reconfirmation study confirmed that, not only later instars, early instars of *S. litura* can also feed and complete it life cycle on *C. tora.*

Fig. 1. Different life stages of *Spodoptera litura*

Spodoptera litura is a widespread polyphagous species and regarded as a pest particularly of cotton and tobacco [8]. Although it is a very general phytophagous on many agricultural, garden and forest trees and shrubs like *Artocarpus integra*, *Cassia tora*, *Casuarina equisetifolia etc* [9,8]. Earlier studies recorded the *S. litura* on *C. tora*, present study confirmed latter as an alternate host for *S. litura*. Here, first time we studied comparative biology and effect of host plants like tobacco, castor and *C. tora* on *S. litura*. In the present study, all the instars of *S. litura* were fed on *Cassia tora* plants and completed its total life cycle. In field condition, when the main host plant in a particular area is depleted, big groups of larvae will migrate and find a new alternate hosts like *C. tora* for their off season survival. Gradual reduction of larval population at every instar confirms that, the presence of unknown compounds in *C. tora* plants.

Baskar and Ignacimuthu, [7] assessed the antifeedant, larvicidal, pupicidal and growth inhibitory effect of ononitol monohydrate isolated from *Cassia tora* against *S. litura and showed that,* strong antifeedant activity of 74.57%, 58.22% larvicidal activities, 56.66% pupicidal activities at 1000 ppm concentration. So, this study confirms that, presence of varied concentration chemical compound in *C. tora* acts as both antifeedant and feeding stimulant for *S. litura* during its offseason survival.

Divakar et al. [10] studied an effect of nonhost *Cassia tora* seed-based diet (Ct) on growth, development, and molecular responses in *Helicoverpa armigera*. They employed a comparative approach to investigate the proteomic differences in gut, hemolymph, and frass of *H. armigera* reared on a normal (chickpea seed-based, Cp) and Ct diet. In this study, a total of 46 proteins were identified by nano-LC–MSE. Among them, 17 proteins were up-regulated and 29 proteins were down-regulated when larvae were exposed to the Ct diet. Results revealed that gut proteases engrossed in digestion, proteins crucial for immunity, adaptive responses to stress, and detoxification were down-regulated in the Ct fed larvae. So, there is possible that, *S. litura* larvae would be adapting these above-mentioned characteristics in order avoid forthcoming stress, buildup of proteins responsive for immunity by feeding on *C. tora* plants during off season. So, further detailed study about this is needed to draw an accurate conclusion.

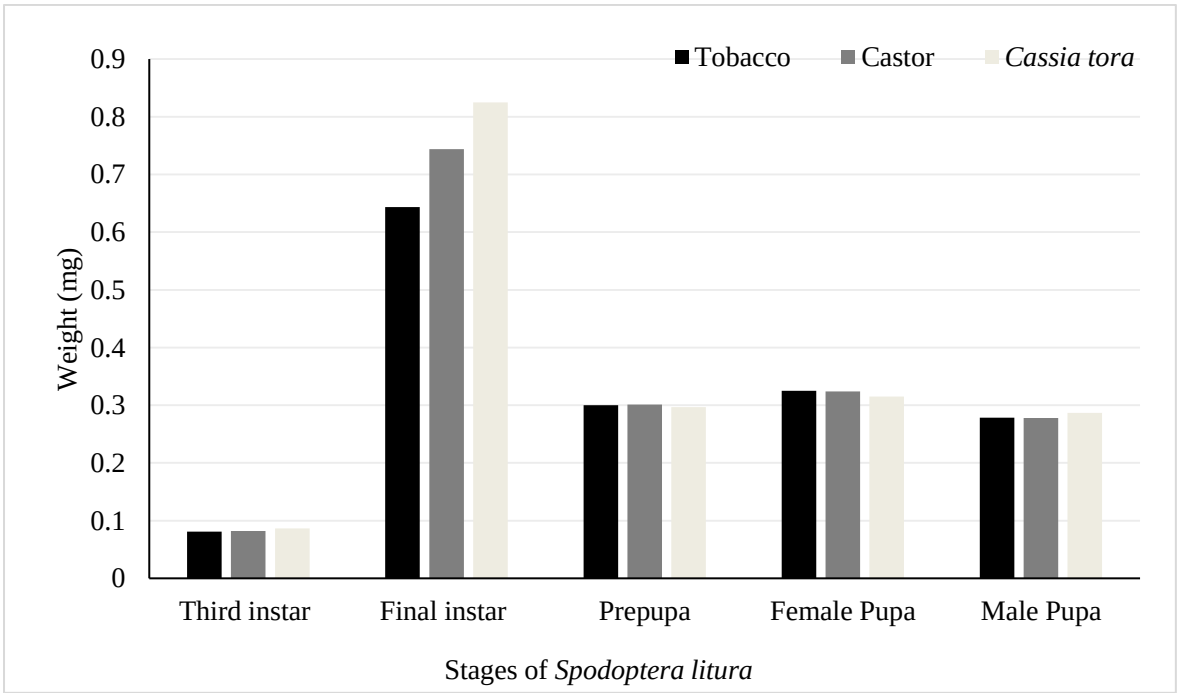

Fig. 2. Effect of three host plants on different stages of *Spodoptera litura*

Table 1. Effect of different host plants on larval, pupal and adult stages of *Spodoptera litura*

Sl. No	Hosts	Third instar (mg)	Final instar (mg)	Prepupal (mg)	Pupal weight (mg)		Pupation (%)	Adult emerged (%)
					Female	Male		
1	Tobacco	0.081±0.003	0.644±0.021	0.299±0.005	0.325±0.004	0.278±0.004	96.67±5.77	100
2	Castor	0.082±0.002	0.744±0.021	0.301±0.003	0.324±0.003	0.278±0.004	100	100
3	*Cassia tora*	0.086±0.002	0.825±0.005	0.297±0.003	0.315±0.012	0.288±0.003	20	18

N=30, Spodoptera litura larvae

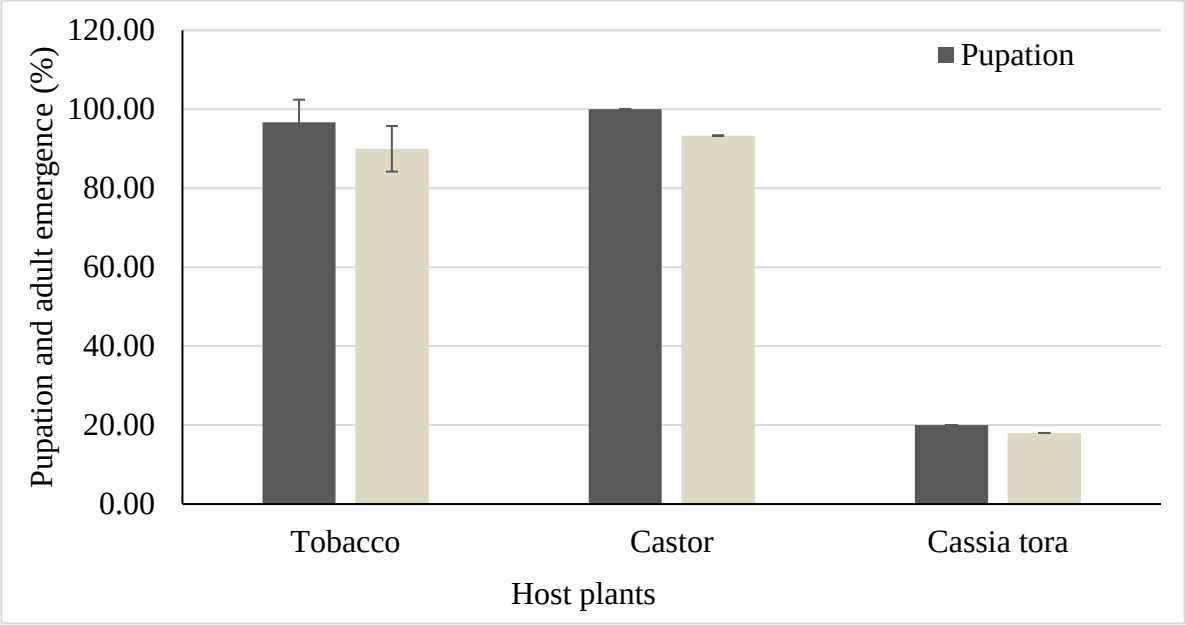

Fig. 3. Effect of three host plants on per cent pupation and adult emergence in *Spodoptera litura*

Fig. 4. Laboratory reared *Spodoptera litura* on *Cassia tora*, showing both final instar larvae and prepupal stages (left); *S. litura* larva feeding on *Cassia tora* and their feeding symptoms during field visit (middle and left)

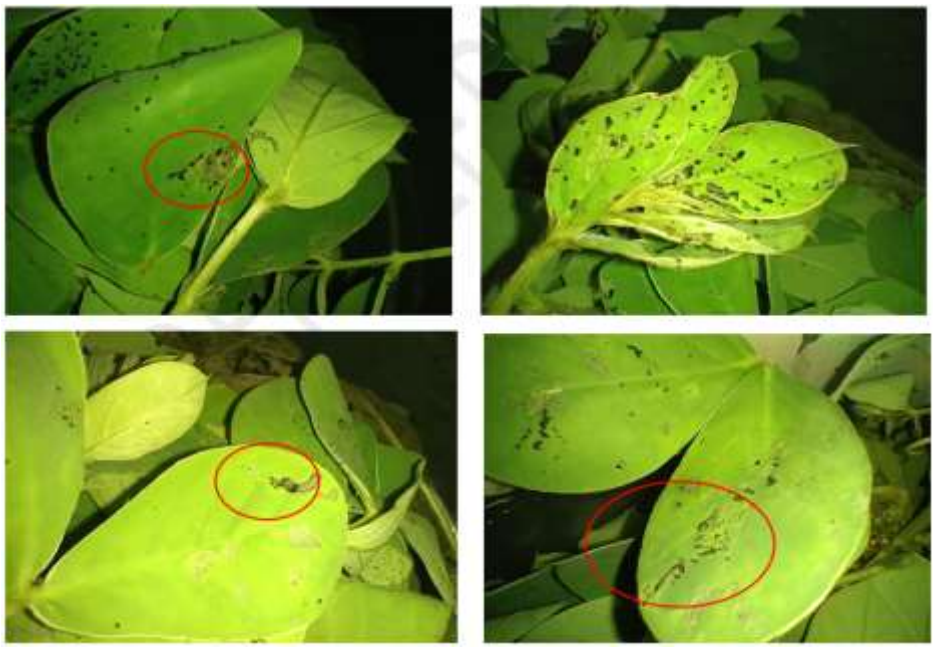

Fig. 5. Feeding reconfirmation study, Early instars of *S. litura* larvae feeding on young leaves of *Cassia tora* (top left); Symptoms feeding damage by *S. litura* (top right); Grown up second instar larvae of *S. litura* on *Cassia tora* (bottom left); Feeding larvae of *S. litura* and its excreta on *Cassia tora*

4. CONCLUSION

Spodoptera litura is major polyphagous pest on agricultural, horticultural, forest and weed crops. when the main host plant in a particular area is depleted, big groups of larvae will migrate and find a new alternate hosts for its off-season survival. They start its next generation when main host plants are available by adopting short term migration and feeding on the other alternative plants. Feeding of *S. litura* larvae on *C. tora* plants during off season may regulate its protein level in order avoid forthcoming stress, buildup of proteins responsive for immunity. So, further detailed study on insecticidal activity of *C. tora*, effect of *C. tora* on the different growth stages of *S. litura* and adoption of proteins responsible for avoiding forthcoming stess, buildup of immunity and detoxification is needed.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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