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Bio Physical Basis of Resistance to Tobacco Caterpillar *Spodoptera litura* (Fab.) in Castor

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A B S T R A C T

Castor, (*Ricinus communis* L.) is one of the most important commercial, non-edible oilseed crop. Tobacco caterpillar, *Spodoptera litura* (Noctuidae: Lepidoptera), is a major defoliator of castor. The biophysical factors in castor play a major role in conferring resistance against *S.litura*. The present study was conducted with an objective, to study the biophysical basis of resistance against *S. litura*. Feeding preference of *S. litura* larvae to the leaves of IVHT-39 followed by Salem Local was minimum in the confinement test. Salem Local recorded minimum feeding preference of *S.litura* larvae in free choice test followed by DCS-107. Biophysical factors (Leaf length, Leaf breadth, Total leaf area, Leaf thickness, Petiole length and Leaf angle to stem) were analysed. In the present study, Leaf length, Leaf breadth and Total leaf area exerted a positive correlation with larval feeding and Leaf thickness, Petiole length and leaf angle to stem had significant negative correlation with larval feeding of *S. litura.*

Introduction

Castor, (*Ricinus communis* L.) is one of the most important commercial, non-edible oilseed crop in Euphorbiaceae family. India is the world's single largest producer contributing about eight lakh tonnes of castor seed. Castor oil and its derivatives, besides being used in Medicine, Agriculture, Paper industry, Textile industry, Plastic engineering, Veterinary medicines, Rubber and Pharmaceuticals (Chakkani Priya *et al.*, 2018). The yield loss due to insect pests has been estimated in the range of 35-40 per cent (Kolte, 1995). Tobacco caterpillar, *Spodoptera litura* (Fab.) (Noctuidae: Lepidoptera), is a major insect pest of castor. It is highly polyphagous and widely distributed in India (Sujatha *et al.*, 2009).

Indiscriminate use of pesticides leads to the development of resistance in insects, pest resurgence, toxic effect on natural enemies, pesticide residues on food, adverse effect on human beings and causes environmental pollutions.

Resistance in the form of plant defence is a biophysical characters of plant, which influence the insect oviposition, growth, development and feeding.

The management of *S. litura* often becomes difficult as there are no identified sources of resistance in castor against this pest. *S. litura* larvae are also less susceptible to insecticides. (Lakshminarayana and Raoof, 2005). Hence, development of insect resistant castor is one of the promising approaches for management of the major Lepidopteron defoliator like *S. litura*.

Materials and Methods

Relative leaf damage by confined feeding

Single third instar larva of *S.litura* was pre starved for six hours and then allowed into a specially designed screening cage on 45 days after sowing to feed individually on the leaves of castor plants.

The screening cage consisted of cylindrical major film sheet rolled tubular (10.5 cm dia and 25 cm long), open and were affixed with muslin cloth and nylon mesh cloth at each end. The cage was fixed on top of a wooden stick (70 cm high) three such replications were maintained per treatment and the area of the leaf infested by the larvae after 6, 12 and 18 hours was measured **(**Plate 1).

Relative leaf damage by free choice

Relative preference of *S.litura* larvae to leaves of the test plants was ascertained by leaf disc method (Kauffman and Kennedy, 1989). Leaf disc of 25mm^2 size was excised from second leaf beneath the terminal bud of 40 days old plants from each treatment and were placed at equal distant circularly on moist filter paper in a 150mm dia petridish **(**Plate 2). Third instar larvae @ one per replication, pre starved for hours were allowed to feed. The leaf area consumed by the larvae after 6, 12 and 18 hours was measured using graph sheet. This experiment was replicated three times.

Bio physical basis of resistance

From five randomly selected plants of each accessions Leaf length and breadth was measured by centimeter scale, from that leaf area of each accession sample were calculated. Transverse section of the leaf was made with a sharp blade and its thickness was measured by using micrometer. Length of the petiole of third, fifth and seventh leaf from the top of the plant in each castor accession was measured. Leaf angle between the petiole of the leaf and the stem was measured in third, fifth and seventh leaf from the top of the plant.

Results and Discussion

In the preliminary study evaluate the forty two castor accessions under field condition, based on leaf infestation and larval population of *S. litura*, the promising accessions were selected. The promising accessions *viz.*, IVHT-39, DCS-107, Salem Local, IVHT-29 and IVHT-38 were selected with one susceptible check IVHT-35 for further detailed studies.

By confining the larvae on the selected promising accessions, it was observed that the minimum feeding was recorded on IVHT-39 followed by Salem Local (Table-1). The maximum feeding was recorded on the accession IVHT-35. In contrast to confinement test, the third instar larvae of *S. litura* were allowed to select the castor accessions by free choice test and when observed for feeding preference of the larvae based on percentage of leaf infestation, it was observed that the accession Salem Local was least preferred when compared to other selected castor accession (Table. 1). IVHT-35 was highly preferred by *S. litura* larvae in both conditions. The accession Salem Local was collected from a hilly terrain in Salem District. Wild relatives or their derivatives have been reported to possess resistance against insect pests (Sankhyan and Verma, 1997).

Morphological factors of host plant are essential in offering resistance against insect pests. Among

them, Leaf length and Leaf breadth, Petiole length, Leaf angle are considered to influence the egg laying and subsequent larval feeding by insect pests species (Muthukumaran and Selvanarayanan, 2011).

In the present study, the accession Salem Local was least preferred when compared to other selected castor accessions. On studying the biophysical characters of selected castor accessions, maximum leaf area was observed in the accession IVHT-39 (Table.2). Khanam *et al.*, (2003) reported that higher leaf area decreased the infestation of fruit worm in tomato. In line with this, Peeters (2002) who reported that some feeding rate of chewing insects significantly positively correlated with Total leaf area of host plant.

Table.1 Feeding preference of *S. litura* larvae towards the selected castor accessions

S. No.	Accession	Mean leaf infestation (%)	
		Confinement test	Free choice test
1	IVHT-39	5.15	63.47
2	DCS-107	11.94	58.62
3	Salem Local	8.84	47.61
4	IVHT-29	15.73	81.37
5	IVHT-38	21.46	84.12
6	IVHT-35	36.68	92.59
C.D. (p = 0.05)			

Each value is a mean of three replications
Values in parentheses are arc sine transformed values

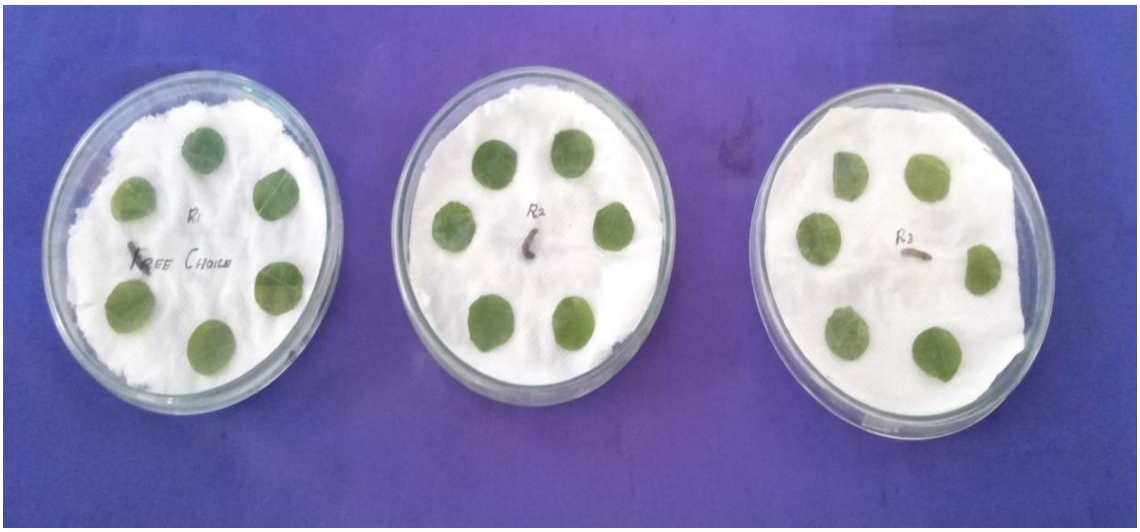
Table.2 Biophysical characters of the selected castor accessions

S. No.	Accession	Leaf Length (cm)	Leaf Breadth (cm)	Petiole Length (cm)	Leaf Angle (^{o})	Leaf Thickness (μ)	Total Leaf Area (cm)
1	IVHT-39	19.82±0.77	14.18±0.67	3.50±0.11	73.20±10.26	178.62±15.82	156.00±0.48
2	DCS-107	18.17±0.19	14.62±0.36	10.32±0.15	74.00±4.24	195.25±27.60	130.80±0.46
3	Salem Local	14.35±0.33	17.20±0.29	6.84±0.10	83.60±10.85	213.28±15.77	155.50±0.77
4	IVHT-29	13.80±0.25	10.75±0.61	6.70±0.09	60.80±2.44	133.27±13.59	108.50±0.87
5	IVHT-38	16.41±0.43	22.89±0.41	7.82±0.27	70.00±5.34	165.91±43.82	178.50±0.59
6	IVHT-35	15.16±0.32	15.81±0.28	13.70±0.08	71.00±4.53	133.54±33.29	125.75±0.34
C.D. (p = 0.05)		0.14	0.21	0.39	0.13	0.16	0.16

Each value is the mean of five replications
Mean values followed by standard deviation

Plate.1 Feeding preference of *S. litura* – Confinement test

Plate.2 Feeding preference of *S. litura* - Free choice test



The leaves were thicker in case of accession Salem Local in contrast to very thin leaves of accession IVHT-29. Similarly Meldau *et al.,* (2012) who reported that insect herbivores often prefer thin and young leaves, which are typically softer, often with higher nutrient concentrations. We also found that the leaves with thicker laminae were less succulent and less preferred for feeding by the *S.litura* than the leaves with thinner laminae. Similar results have been found in tomato (Muthukumaran, 2004) and higher leaf thickness was negatively correlated with *S.litura* feeding on tomato. Further, Ayyasamy and Baskaran, (2005) who reported that leaf thickness was negatively correlated with the occurrence of *B. tabaci* on eggplant.

In the present study, Leaf length (r = 0.826), Leaf breadth (r = 0.722) and Total leaf area (r = 0.652) exerted a positive correlation with larval feeding and Leaf thickness (r = -0.824*), Petiole length (r = -0.798*) and leaf angle to stem (r = - 826*) had significant negative correlation with larval feeding of *S. litura.* Feeding preference of *S. Litura* larvae to the leaves of IVHT-39 and Salem Local was

minimum in the confinement test and also the Salem Local recorded minimum feeding preference in free choice test. In this study it was observed that the Total leaf area was found maximum in IVHT-39 and the Leaf thickness was higher in Salem Local. From the present finding it can be inferred that, the accession IVHT-39 was found superior over all other 42 castor accessions screened, followed by Salem Local. Furthermore, biochemical studies need to be conducted to decipher the biochemical factors of resistance of those accessions.

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