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Larval Development of *Spodoptera litura* Fabricius in Relation to Castor Varieties and Biochemical Constituents

K. V. Thanki, G. P. Patel, D. B. Sisodiya and J. R. Patel**

Department of Entomology, B. A. Collage of Agriculture, Gujarat Agricultural University, Anand Campus, Anand - 388 110

ABSTRACT

The study on effect of biotic (castor varieties) conditions on development and fecundity of *Spodoptera litura* showed higher mortality on GCH-4 and GCH-5 within two days, whereas on castor VI-9 and GAUCH-1 lower larval mortality was observed for the 1st instar larvae. None of the larvae could survive and complete its development on DCS-9, VP-1, Geeta, CO-1, JI-35, GCH-4 and GCH-5 as against 40 to 56% larval survival on VI-9, GAUCH-1, 48-1, SKI-73 and SH-72. The larval period of *S. litura* found longer on SKI-73 and SH-72 than GAUCH-1, VI-9 and 48-1, whereas pupal period was found longer on castor SH-72 as compared to VI-9 and GAUCH-1. The fecundity on VI-9 remianed higher than SH-72, SKI-73, 48-1 and GAUCH-1.

In biochemical analysis, higher content of total soluble sugars and amino acids in leaves of VI-9 and GAUCH-1 enhanced the feeding activity of *S. litura* larvae in comparision to GCH-4 and GCH-5. Higher quantity of peroxidase and polyphenol oxidase in leaves of GCH-4 and GCH-5 made them unfavourable to *S. litura* in comparision to VI-9 and GAUCH-1.

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INTRODUCTION

Castor *(Ricinus communis* L.) is grown in tropical and sub-tropical region of the world. Castor crop suffers heavily due to attack of various pests which reduce it yield. *S. litura* is a obiquitous, polyphagous multivoltine, lepidopterous pest feeds on 112 cultivated crops all over the world (Moussa *et al.*, 1960). The development and survival of *S. litura* larvae have been found vary with the plant species (Thobbi and Srihari, 1967). Considering the economic importance and polyphagous nature of *S. litura*, it is very necessary to study the effect of different castor varieties on development of *S. litura*.

MATERIALS AND METHODS

In order to have mass multiplication of *S. litura* in the laboratory for the developmental study, large number of larvae were collected from the castor fields of the Anand campus of Gujarat Agricultural University. Larvae were reared in round galvanized cage (36 x 12 cm), containing tender castor leaves. The petiole of each leaf was wrapped with cotton wool and dipped in water to maintain the turgidity of the leaf. The top of the cage was covered by using muslin cloth and rubber bands. Everyday morning sufficient number of fresh leaves of respective castor varieties were provided to *S. litura* larvae after

** Present address : Planning Officer, GAU, Ahmedabad.

removing excreta and uneaten leaves from cage. The full grown larvae were transferred to the galvanized cage containing 6 cm layer of moist soil on bottom surface for pupation. The pupae were collected three days after pupation and kept with petridish in wooden cage. The freshly emerged moths with wooden cage having plastic strips so that fresly emerged moths can rest and oviposit it. The urethane foam piece was soaked in 5% honey solution and placed in the cage as food for the moths. Freshly emerged male and female moths of *S. litura* were paired and confined in a glass chimney (10 x 17.5 cm) covered with a muslin cloth for oviposition. The bouquet prepared of tender terminal shoots wrapped in cotton lint at cut end was kept in plastic vial containing water. Pre-oviposition, oviposition, post-oviposition, incubation period, larval period, number of larvea survived, prepupa, pupa, sex, fecundity/adult were obeserved during the egg laying to mortality of adult.

To know the mechanism of resistance in castor varieties due to biochemicals viz., GCH-4, GCH-5, GAUCH-1 and VI-9 were selected and studied for their biochemical constituents at 10 weeks age of the crop. To determine the moisture content (Mehta and Lodha, 1979), sugars (Dubois *et al.* 1956), total amino acids (Lee and Takahashki, 1966), peroxidase activity (Guibault 1976) and polyphenol oxydase (ppo) were chosen samples by following standard techniques.

RESULTS AND DISCUSSION

The results of larval survival (%) on different castor varieties (Table 1) revealed 92 to 96% larval survival on SKI-73, VI-9 and GAUCH-1 as against 60 to 72% larval survival on GCH-4, GCH-5, DCS-9, JI-35 and Co-1 after one day of larval release. After 4 days of larval release, the larval survival found in the range of 80 to 84% on SKI-73, VI-9 and GAUCH-1 as against 4 to 28% larval survival in GCH-4, GCH-5 and CO-1. After one week of larval release, GCH-4 (2%), GCH-5(4%), Geeta (4%), DCS-9(12%), CO-1(16%), VP-1(16%), JI-35 (20%) had considerably lower larval survival in comparison to SH-72(56%), SKI-73(64%), 48-1(68%), VI-9(72%) and GAUCH-(72%).

The zero per cent larval survival was obeserved on GCH-4, GCH-5 and DCS-9 after 8, 10 and 11 days of release, respectively, whereas on VP-1, Geeta, Co-1 and JI-35 after 12 days of release as against 40 to 56% larval survival on SH-72, 48-1, SKI-73, VI-9 and GAUCH-1.

The relative rate of decline in survival percentage/day with respect to varieties.

$$y = a.e. - c X$$

Where, y = larval survival (%)

x = larval survival period (days)

c = relative rate of decline in survival (%)

a = constant.

The R^2 values for all the twelve equations were more than 0.82 suggesting that a very higher degree of variability in survival (%). The relative rate of decline remained the lowest in GAUCH-1 (0.049) followed by SKI-73 (0.058), VI-9 (0.058), SH-72 (0.060), 48-1 (0.060), JI-35 (0.294), CO-1 (0.339), VP-1 (0.386), GCH-4 (0.395), Geeta (0.396), GCH-5 (0.422) and DCS-9 (0.433).

The results (Table 2) showed significantly shorter incubation period of the *S. litura* eggs on GAUCH-1 (3.19 days) and SKI-73 (3.52 days) and SH-72 (3.63 days), whereas for VI-9 (3.27 days) and 48-1 (3.36 days) incubation period remained at par to those three varieties.

The larval period of *S. litura* found longer on SKI-73 (15.10 days) and SH-72 (15.67 days) than GAUCH-1 (14.15 days) and VI - 9 (14.35 days). The larvae reared on SH-72 had significantly longer larval duration than GAUCH-1, VI-9 and

TABLE 1

Survival (Z) of *S. litura* lervae on different castor varieties.

After days	*Geeta*	*48-1*	*VP-1*	*VI-9*	*GCH-5*	*Co-1*	*GAUCH-1*	*SKI-73*	*JI-35*	*SH-72*	*GCH-4*	*DCS-9*
0	100	100	100	100	100	100	100	100	100	100	100	100
	(28)	(12)	(28)	(4)	(36)	(28)	(4)	(8)	(38)	(16)	(40)	(32)
1	72	88	72	96	64	72	96	92	72	84	60	68
	(16)	(8)	(8)	(8)	(24)	(16)	(4)	(8)	(12)	(4)	(36)	(8)
2	56	80	64	88	40	56	91	84	60	80	24	60
	(16)	(4)	(12)	(0)	(12)	(16)	(4)	(4)	(16)	(8)	(8)	(12)
3	40	76	52	88	28	40	88	80	44	72	16	48
	(4)	(4)	(4)	(4)	(8)	(12)	(8)	(0)	(4)	(4)	(12)	(8)
4	36	72	48	84	20	28	80	80	40	68	4	40
	(8)	(0)	(8)	(0)	(8)	(8)	(4)	(4)	(8)	(0)	(2)	(8)
5	28	72	40	84	12	20	76	76	32	68	2	32
	(12)	(4)	(20)	(4)	(0)	(0)	(0)	(4)	(4)	(4)	(0)	(8)
6	16	68	20	80	12	20	76	68	28	64	2	24
	(12)	(0)	(4)	(8)	(8)	(4)	(4)	(4)	(8)	(8)	(0)	(12)
7	4	68	16	72	4	16	72	64	20	56	2	12
	(0)	(8)	(12)	(4)	(2)	(4)	(8)	(0)	(0)	(0)	(0)	(10)
8	4	60	4	68	2	12	64	64	20	56	0	2
	(0)	(4)	(0)	(8)	(0)	(0)	(0)	(8)	(4)	(4)	(0)	(0)
9	4	56	4	60	2	12	62	56	16	52	0	2
	(20)	(4)	(0)	(4)	(2)	(8)	(4)	(0)	(4)	(4)	(0)	(0)
10	2	52	4	56	0	4	60	56	12	48	0	2
	(0)	(4)	(2)	(4)	(0)	(2)	(0)	(4)	(8)	(0)	(0)	(2)
11	2	48	2	51	8	2	60	52	4	48	0	0
	(2)	(4)	(2)	(0)	(0)	(2)	(4)	(4)	(4)	(8)	(0)	(0)
12	0	44	0	52	0	0	56	48	0	40	0	0
Relative : rate of decline	0.396	0.060	0.386	0.058	0.422	0.339	0.049	0.058	0.294	0.060	0.395	0.433
R^2	0.96	0.97	0.94	0.96	0.97	0.93	0.98	0.99	0.84	0.82	0.84	0.93

Figures in parenthesis are per cent decline.

TABLE 2

Development and fecundity of *S. litura* on different castor varieties.

Variety	*Incubation period (days)*	*Larval period (days)*	*Pre-pupal period (days)*	*Pupal period (days)*	*Pre-oviposition period* (days)	*Oviposition period (days)*	*Post-oviposition period* (days)	*Fecundity (Eggs/ Female)*	*Sex Ratio (M : F)*
VI-9	3.27	14.35	1.31	6.23	1.38	7.50	2.50	808.38	1 : 1.36
SKI - 73	3.52	15.10	1.48	6.48	1.25	7.00	2.25	737.13	1 : 1.10
48-1	3.36	14.59	1.45	6.36	1.13	7.38	2.38	743.00	1 : 1.20
SH-72	3.63	15.67	1.54	6.63	1.00	7.13	2.13	721.75	1 : 1.18
GAUCH -1	3.19	14.15	1.19	6.11	1.38	7.63	2.63	742.63	1 : 1.45
S.Em. ±	0.09	0.23	0.09	0.09	0.15	0.23	0.17	20.50	-
C. D. 0.005	0.26	0.65	NS	0.28	NS	NS	NS	58.59	-
C. V. %	13.82	7.69	34.55	7.66	34.15	8.82	20.29	7.52	-

48-1 (14.59 days). The pupal period remained significantly longer for the pupae formed from the larvae reared on SH-72 (6.63 days) as compared to VI-9 (6.23 days) and GAUCH-1 (6.11 days). SKI-73 (6.48 days) had significantly longer pupal period than GAUCH-1 (6.11 days). *S. litura* female moths obtained from the larvae reared on VI-9 (808.38) showed significantly higher fecundity than SH-72 (721.75), SKI-73 (73.13), GAUCH-1 (742.33) and 48-1 (743.00) which remained at par in fecundity.

The present observations are corroborate with Mondal and Bhattacharya (1998), Balasubramanian *et al.* (1984), Sankarperumal *et al.*, (1989).

TSS : Total soluble sugar present in the leaves of GAUCH-1 and VI-9 revealed higher (6.32± 0.005% and 6.05 ±0.03%), whereas GCH-4 and GCH-5 found with 5.63± 0.79 and 5.75± 0.92 % of TSS (Table 3).

Total amino acids

Total amino acids on dry weight basis in the leaves of GAUCH-1, VI-9, GCH-4 and GCH-5 was 0.307 ± 0.0025, 0.281 ± 0.007, 0.234 ± 0.002 and 0.241 ± 0.017 mg/g, respectively.

Moisture content

The moisture content avilable in the leaves of GAUCH-1, VI-9, GCH-4 and GCH-5 was 72.37, 61.16, 71.05 and 69.92 per cent, respectively.

Peroxidase specific activity

The peroxidase specific activity in the leaves of GAUCH-1, and VI-9 remained lower (0.29 ± 0.035 and 0.22 ± 0.01) than GCH-4 and GCH-5 (0.36 ± 0.005 and 0.30 ± 0.06).

Polyphenol oxidase specific activity

It is in leaves of GAUCH-1 and VI-9 found considerable lower (0.003 ± 0.012 and 0.013 ± 0.0049), whereas in GCH-4 and GCH-5 it was 0.11 ± 0.035 and 0.014 ± 0.0035.

Dodia (1992) had also reported the positive influence of amino acids and sugars on feeding behaviour of first and second instar larvae of *H. armigera.* The higher peroxidase activity has been reported in *H. armigera* tolerant chickpea genotype (ICC-1245) than susceptible (L-550) genotype (Anonymous, 1995). Polyphenolic compounds present in pigeonpea adversely affected the activity of digestive enzymes which subsequently affected the nutrient utilization (Singh, 1984).

TABLE 3

Biochemical analysis of castor leaves.

Sr. No.	*Variety*	*Moisture (%)*	*Dry weight basis*		*Peroxidase change in OD/minute/mg protein*	*Polyphenol oxidase change in OD/minute/mg protein*
			Soluble Sugar (%)	*Amino acid (mg/g)*		
1.	GAUCH-1	72.37	6.32 ± 0.005	0.307 ± 0.0025	0.29 ± 0.035	0.003 ± 0.0012
2.	VI-9	68.16	6.05 ± 0.03	0.281 ± 0.007	0.22 ± 0.01	0.013 ± 0.0049
3.	GCH-4	71.05	5.63 ± 0.79	0.234 ± 0.002	0.36 ± 0.005	0.11 ± 0.0035
4.	GCH -5	69.92	5.75 ± 0.92	0.241± 0.017	0.30 ± 0.06	0.014 ± 0.0035

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