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Studies on biology and behavior of *Earias vittella* (Lepidoptera: Noctuidae) for mechanisms of resistance in different cotton genotypes

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Abstract

Spotted bollworm, *Earias vittella* (Fab.), is one of the most important insect pests of cotton, and host plant resistance is an important component for the management of this pest. The antixenosis and antibiosis components of resistance to this pest in five *Gossypium hirsutum* (HS 6, HHH 81, PCHH 31, Somnath, SS 9) and one *Gossypium arboreum* (HD 107) genotypes were undertaken at 28 ± 2°C and 70 ± 5% relative humidity under laboratory conditions. The larval period ranged from 8.2 to 9.2 days on buds and 9.2–12.2 days on bolls of different cotton genotypes. The mean larval period irrespective of food was significantly shorter in *G. arboreum* as compared to *G. hirsutum* cultivars. Pre-oviposition period (2.42 days) was longer on *G. arboreum* genotype than on *G. hirsutum* genotypes (1.44–2.00 days), while the reverse was true for oviposition and post-oviposition periods. Larval survival, pupation, adult emergence, fecundity, incubation period, and egg hatchability were significantly lower on *G. arboreum* than on *G. hirsutum*. The first- and third-instar larvae of spotted bollworm preferred buds than bolls in both, *G. arboreum* and *G. hirsutum* genotypes. Multi-choice assays on larval preference for buds and bolls among different genotypes revealed that the preference for buds of *G. arboreum* was significantly higher by the first-instar and lower by the third-instar larvae than the *G. hirsutum* variety and hybrids. *G. hirsutum* cultivars were more preferred than the *G. arboreum* variety, and among the plant parts the lower leaf surface, buds and bolls were preferred over the other plant parts for egg laying by the female. The interactions between *E. vittella* larvae and cotton genotypes are quite diverse, and there is a distinct possibility for increasing the levels and diversifying the basis of resistance to this pest by intensive breeding program.

Keywords: Spotted bollworm; *Earias vittella*; Antixenosis; Antibiosis; Resistance mechanisms; Cotton; *Gossypium*

1. Introduction

Cotton (*Gossypium* spp.) is an important cash crop in India, and plays an important role in socio-economic well being of the people, but productivity is very low in comparison to other countries. Several biotic and abiotic factors contribute to low cotton yield, of which insect-pests are the major component. Of the 1326 species of insects on cotton listed by Hargreaves (1948), only a few are of economic importance. Bollworms, including the spotted bollworm, *Earias vittella* (Fab.) (Lepidoptera: Noctuidae) cause serious losses with a 50–60% reduction in cotton yield (Nagpal, 1948; Khan and Rao, 1960; Sohi, 1964). Spotted bollworm has been reported to attack 14.4% seedlings, 34–51% buds, 3.2% flowers, and 3.2–69.0% bolls resulting in nearly 20% loss in seedcotton yield (Patel, 1949; Kaushik et al., 1969). In one case 79–97% of the loculi of cotton were damaged by this pest (Sidhu and Sandhu, 1977). Application of insecticides is costly and led to development of resistance and adverse effects on the non-target organisms. One approach to combat this problem and reduce insecticide use could be through host plant resistance, to develop lines resistant to spotted bollworm, a thorough knowledge of the resistance mechanisms on different cotton genotypes is needed.

2. Materials and methods

Six cotton genotypes (*Gossypium arboreum*:-HD 107; *Gossypium hirsutum*:-HS 6 (variety), and HHH 81,

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PCHH 31, SS 9, and Somnath (hybrids)) released for cultivation in India, were grown at the Research Farm, Department of Entomology, CCS Haryana Agricultural University, Hisar, Haryana, India during the—1995 and 1996 summer crop seasons. The aim was to evaluate the performance of mechanisms of spotted bollworm resistance in *G. hirsutum* hybrids as compared with moderately resistant *G. hirsutum* variety, HS 6 and resistant *G. arboreum* variety, HD 107. Each genotype was grown on a 30 m^2 area, adopting normal package of practices recommended for cotton, except insecticide application.

The initial stock culture of spotted bollworm was maintained from the field-collected larvae. The larvae were reared in glass jars ($15 \times 20\,cm^2$) covered with muslin cloth and all the experiments were done at $28 \pm 2°C$ and $70 \pm 5\%$ relative humidity in the laboratory. The first generation was reared on lady's finger, *Abelmoschus esculentus* (L.) Moench fruits, but further generations were reared on cotton buds and bolls. Adults were provided with cotton inflorescence for egg laying and fed on 5% honey solution soaked on a cotton swab.

Experiments were conducted to study the effect of food (buds and bolls from different genotypes) on the larval and pupal periods. Food was changed every day. Twenty-five larvae were used in each of five replications, and their weight recorded 7 days after releasing the neonate larvae on different genotypes. Pupae were weighed 24 h after pupation. The adults emerging from these experiments were used for further studies.

The effect of different genotypes on longevity, fecundity, and oviposition of spotted bollworm was studied under no-choice conditions. Cotton inflorescences were placed inside the jars. The cut ends of the inflorescences were wrapped in a cotton plug soaked with water to maintain leaf turgidity. Five pairs of adults in each of five replications were released on each genotype. The inflorescences were changed after every 24 h, and the eggs laid were counted daily. The egg incubation period and hatchability was studied with 50 eggs in each of five replications placed in a Petri dish and the numbers of larvae that emerged were recorded.

Studies on food preference were conducted with first-instar (0–24 h old) and third-instar (5–6 day old) larvae under laboratory conditions. The fruiting bodies (5–6 day old buds, and 8–10 day old bolls) from each genotype were placed equidistant from each other in a Petri-dish arena (diameter 16 cm). The Petri dishes were wrapped in a black paper because of the photopositive behavior of the neonate larvae. Fifteen larvae were released in the center of each of Petri-dish arena in each of five replications, and the number of larvae moving to the fruiting bodies of different genotypes, were recorded after 24 h of release. The flower buds and bolls were tested in following combinations; (1) dual-choice preference assay for buds versus bolls of each genotype, (2) multiple-choice assay for buds of all the test genotypes, (3) multiple-choice assay for bolls of all the genotypes, and (4) multiple-choice assay for buds and bolls of all the genotypes.

Oviposition preference of adults for different plant parts on different cotton genotypes was studied under no-choice conditions. Five pairs of adults were released in each of five replicate in glass jars. The adults were offered the inflorescences (having shoot, buds, bolls, flowers, and leaves) for egg laying. The inflorescences were changed daily, and the numbers of eggs laid on different plant parts were counted separately.

3. Statistical analysis

An analysis of variance was used with completely randomized and factorial designs. The significance of differences were tested by *F*-tests, while the significance of differences between the treatment means was judged by least significance differences (LSD) at $p < 0.05$. The data were transformed to angular values before analysis of variance.

4. Results

4.1. Antibiosis to E. vittella in different cotton genotypes

4.1.1. Embryonic and post-embryonic development and survival

The larval period on buds and bolls of *G. arboreum* variety, HD 107 was significantly shorter than that on the *G. hirsutum* hybrids (Table 1). There were no significant differences in the larval period on buds of *G. hirsutum* hybrids, but was significantly longer on SS 9 a *G. hirsutum* hybrid. Mean larval period, irrespective of source of food (buds or bolls) was significantly shorter (8.7 days) on *G. arboreum* than on the *G. hirsutum* variety, HS 6 (9.6 days) and the hybrids-HHH 81, PCHH 31, SS 9, and Somnath (10.3–10.7 days). The pre-pupal period on *G. arboreum* (19.8 h) was shorter than on the *G. hirsutum* cultivars, except HHH 81. Pupal period was significantly longer on *G. hirsutum* variety, HS 6 as compared to *G. hirsutum* hybrids. Larval weight was significantly greater on *G. hirsutum* hybrids than on the *G. arboreum* and *G. hirsutum* varieties. The pupal weights on *G. arboreum* (HD 107) and *G. hirsutum* variety (HS 6) were significantly lower (45.8–47.9 mg) as compared to the insects reared on HHH 81 and SS 9 (50.1–56.0 mg). Egg incubation period on *G. arboreum* (HD 107) and *G. hirsutum* (HS 6) varieties was shorter than on the hybrids HHH 81 and PCHH 31.

Larval survival, pupation, adult emergence, and egg hatchability were significantly lower on *G. arboreum* variety HD 107 than on the *G. hirsutum* variety HS 6 and the three hybrids, except for larval survival on Somnath, and percent pupation on HHH 81 and Somnath (Table 2). Among the *G. hirsutum* cultivars, larval survival on hybrids was at par with the variety HS 6, except that on hybrid Somnath. No significant differences were observed in percentage pupation, adult emergence, and egg hatchability between the *G. hirsutum* variety and hybrids. The growth index ranged from 2.7 to 3.8, being minimum on *G. arboreum* variety HD 107 and maximum on the *G. hirsutum* variety, HS 6.

The pre-oviposition period on *G. arboreum* variety HD 107 was significantly more than on the *G. hirsutum* cultivars (Table 3). Oviposition period was significantly shorter on the *G. arboreum* variety than on the *G. hirsutum* cultivars, except open pollinated variety HS 6

Table 1
Embryonic and post-embryonic developmental periods of *E. vittella* on different cotton genotypes

Genotypes	Egg incubation period (days)	Larval period on fruiting bodies (days)			Pre-pupal period (h)	Pupal period (days)	Larval wt. (mg)	Pupal wt. (mg)
		Buds	Bolls	Mean				
HD 107	2.8^{a*}	8.2^{a}	9.2^{a}	8.7^{a}	19.8^{a}	8.4^{b}	30.9^{a}	45.8^{ab}
HS 6	2.8^{a}	8.6^{ab}	10.6^{b}	9.6^{b}	23.1^{c}	8.8^{c}	28.1^{a}	47.9^{bc}
HHH 81	3.1^{ab}	8.9^{bc}	11.8^{c}	10.3^{c}	21.4^{ab}	8.4^{b}	42.9^{b}	50.1^{c}
PCHH 31	3.1^{ab}	9.2^{c}	12.2^{cd}	10.4^{c}	23.0^{bc}	8.0^{a}	53.2^{cd}	48.5^{bc}
Somnath	3.5^{b}	8.9^{bc}	11.9^{cd}	10.8^{d}	23.7^{c}	8.1^{ab}	48.5^{bc}	41.8^{a}
SS 9	3.4^{b}	9.2^{c}	12.3^{d}	10.7^{d}	22.1^{bc}	8.2^{ab}	58.0^{d}	56.0^{d}
LSD ($P<0.05$)	0.4	0.4	0.4	0.2	1.6	0.3	6.2	4.1

*The values following the different letters are significantly different.

Table 2
Survival and development of *Earias vittella* on different cotton genotypes

Genotype	Egg hatching (%)	Larval survival (%)	Pupation (%)	Adult emergence (%)	Growth index***
HD-107	68.4(55.9)$^{*\ a**}$	26.4(30.8)$^{*\ a}$	23.2(28.7)$^{*\ a}$	20.0(26.4)$^{*\ a}$	2.7
HS-6	82.8(65.7)^{b}	40.8(39.7)^{c}	36.0(36.8)^{b}	32.0(34.3)^{b}	3.8
HHH-81	84.0(66.5)^{b}	36.0(36.8)^{bc}	31.2(33.9)^{ab}	28.0(31.9)^{b}	3.0
PCHH-31	84.4(67.0)^{b}	36.0(36.8)^{bc}	34.4(35.8)^{b}	32.0(34.4)^{b}	3.2
Somnath	84.4(66.8)^{b}	30.4(33.3)^{bc}	29.6(32.8)^{ab}	29.6(32.8)^{b}	2.9
SS-9	80.0(63.7)^{b}	35.2(36.6)^{bc}	33.6(35.4)^{b}	31.2(33.9)^{b}	3.2
LSD ($P<0.05$)	(3.6)	(5.2)	(5.9)	(5.0)	—

*Figures in the parenthesis are angular transformed values.
**The values following the different letters are significantly different.
***Growth index = percent pupation/mean larval period.

Table 3
Longevity of *E. vittella* adults emerging from larvae reared on different cotton genotypes

Genotypes	Pre-oviposition period (days)	Oviposition period (days)	Post-oviposition period (days)	Longevity		Fecundity (eggs/female)
				Male (days)	Female (days)	
HD 107	2.4^{c**}	4.2^{a}	1.9^{a}	6.4^{ab}	8.5^{a}	269.2(16.4)$^{*\ a}$
HS 6	2.0^{b}	4.7^{ab}	3.1^{bc}	5.9^{a}	9.8^{c}	344.6(18.5)^{c}
HHH 81	1.9^{b}	5.3^{c}	5.2^{d}	7.2^{bc}	11.2^{e}	286.4(16.9)^{ab}
PCHH 31	1.4^{a}	4.9^{bc}	3.8^{c}	7.3^{c}	10.4^{d}	309.2(17.8)^{bc}
Somnath	1.6^{a}	4.7^{ab}	3.6^{c}	7.1^{bc}	9.2^{b}	308.4(17.6)^{abc}
SS 9	1.4^{a}	5.3^{c}	2.2^{ab}	6.9^{bc}	8.8^{ab}	292.0(17.1)^{ab}
LSD ($P<0.05$)	0.2	0.5	1.0	0.8	0.5	(1.2)

*Figures in the parenthesis are square root transformed values.
**The values following the different letters are significantly different.

and the hybrid Somnath. Post-oviposition period was significantly longer on *G. hirsutum* cultivars, except on the hybrid SS 9. Male life span ranged from 5.9 to 7.3 days, which was significantly longer on *G. hirsutum* hybrids as compared to that on the variety HS 6. Female life span was significantly longer on *G. hirsutum* cultivars as compared to that on *G. arboreum*. Fecundity ranged from 269.2 to 344.6 eggs per female on different cotton genotypes. Significantly more number of eggs were laid by the females where the larvae were reared on the *G. hirsutum* variety, HS 6 as compared to that on the *G. arboreum*.

4.2. Antixenosis to E. vittella in different cotton genotypes

4.2.1. Relative feeding preference by the first-instar larvae

The first-instar larvae of spotted bollworm showed greater preference towards buds (13.0%) as compared to the bolls (8.6%). There were no significant differences in the larval preference for the buds and bolls of *G. hirsutum* variety and hybrids (Table 4). When the first-instar larvae were offered a choice between buds and bolls of the same variety, the preference for buds was significantly greater than for the bolls in all the genotypes tested (Table 5). Maximum difference (28.0%) in relative preference for buds and bolls was observed in case of HD 107.

When the buds and bolls of different genotypes were offered to the larvae in a multi-choice assay, the larvae showed greater preference for the buds of *G. hirsutum* hybrid HHH 81 than for the buds and bolls of other genotypes (Table 6). In a comparison among buds or bolls of the test genotypes under multi-choice conditions, no significant differences were observed in larval preference for the buds, while the bolls of *G. arboreum* variety were significantly less preferred than the bolls of *G. hirsutum* variety HS 6.

4.2.2. Relative feeding preference by the third-instar larvae

There was a significant variation in larval response towards buds and bolls of different genotypes. The buds of *G. arboreum* variety HD 107 were significantly less preferred than those of the *G. hirsutum* cultivars (Table 4). In a dual-choice assay for larval response towards buds and bolls of the same genotype, the larval preference was significantly greater for the buds than for the bolls in case of *G. hirsutum* variety HS 6 and the hybrid SS 9. There were no significant differences in larval preference for buds and bolls of the other genotypes tested (Table 5). Under multi-choice conditions, the third-instar larvae preferred buds of HS 6 than the buds of other genotypes tested, but the reverse was true in case of bolls. In general, the third-instar larvae showed greater preference for bolls than for the buds, while the reverse was true in case of first-instar larvae.

The relative feeding preference by the third-instar larvae for buds or bolls of different genotypes suggested that the third-instar larvae had greater preference for the bolls than the buds (Table 6), except in case of *G. hirsutum* variety HS 6 and hybrid Somnath. The buds and bolls of *G. arboreum* variety HD 107 were significantly less preferred than the buds or bolls of *G. hirsutum* cultivars. The larvae showed greater preference for the bolls of HHH 81 and PCHH 31 than the buds and bolls of other test genotypes.

Table 4
Preference of first-instar (0–24 h old) and third-instar (5–6 days old) larvae of *E. vittella* for buds/bolls of all cotton genotypes under multi-choice conditions

Genotypes	First-instar larvae		Third-instar larvae	
	Buds	Bolls	Buds	Bolls
HD-107	13.0(21.0)* a**	8.6(15.8)* a	6.7(13.4)* a	13.8(21.9)* ab
HS-6	18.5(25.7) b	15.3(23.0) b	14.7(22.4) bc	20.5(27.1) cd
HHH-81	18.5(25.7) b	21.0(27.5) c	12.0(20.1) b	16.5(24.1) bc
PCHH-31	17.0(24.3) ab	18.2(25.4) bc	22.7(28.8) d	26.0(30.8) d
Somnath	14.4(22.4) ab	18.4(25.5) bc	26.7(28.7) d	16.5(24.1) bc
SS-9	18.6(25.8) b	18.6(25.7) bc	17.3(24.6) cd	11.0(17.7) a
Mean	16.7(24.1)	16.7(23.8)	16.7(23.5)	17.4(24.3)
LSD ($p<0.05$) *for comparing*				
Genotypes	(3.4)		(4.3)	
Buds/bolls	(2.8)		(3.5)	
Genotypes × buds/bolls	(6.8)		(8.6)	

*Figures in parentheses are angular transformed values.
**The values following the different letters are significantly different.

Table 5
Preference of first-instar (0–24 h old) and third-instar (5–6 days old) larvae of *E. vittella* for buds and bolls of different cotton genotypes under dual-choice conditions

Genotypes	First-instar larvae		Third-instar larvae	
	Buds	Bolls	Buds	Bolls
HD-107	64.0(53.3)* b**	36.0(36.9)* a	53.3(47.1)* b	46.7(43.1)* a
HS-6	61.4(51.7) b	38.7(38.4) a	60.0(51.1) b	40.0(39.3) a
HHH-81	58.7(50.2) b	41.3(40.1) a	52.0(46.3) a	48.0(44.0) a
PCHH-31	60.0(51.0) b	40.0(39.3) a	52.0(46.3) a	48.0(44.0) a
Somnath	57.3(47.0) b	42.7(41.0) a	50.7(45.6) a	49.3(44.8) a
SS-9	53.3(47.0) b	46.7(43.3) a	54.7(47.8) b	45.3(42.4) a
Mean	59.3(50.5)	40.9(39.8)	53.8(47.4)	46.2(42.9)
LSD ($p<0.05$) *for comparing*				
Genotypes	(3.4)		(4.3)	
Buds/bolls	(2.8)		(3.5)	
Genotypes × buds/bolls	(6.8)		(8.6)	

* Figures in parentheses are angular transformed values.
** The values following the different letters are significantly different.

Table 6
Relative preference of first-instar (0–24 h old) and third-instar (5–6 days old) larvae of *E. vittella* for buds and bolls of different cotton genotypes under multi-choice conditions

Genotype	Larval preference for fruiting bodies (%)			
	First-instar larvae		Third-instar larvae	
	Buds	Bolls	Buds	Bolls
HD-107	10.9(17.8)* bc**	1.5(4.8)* a	1.3(4.5)* a	5.2(11.0)* ab
HS6	9.4(18.0) bc	8.0(14.9) b	6.6(13.8) bc	7.9(16.5) bcde
HHH-81	20.1(26.8) c	4.7(10.8) ab	10.6(19.1) cde	14.4(22.3) de
PCHH-31	9.3(18.0) bc	6.2(13.6) ab	9.2(17.7) bcde	15.8(23.5) e
Somnath	9.1(16.3) b	7.6(13.4) ab	7.9(15.1) bcd	6.6(13.8) bc
SS-9	7.6(14.9) b	6.0(13.5) ab	4.0(10.0) ab	10.5(17.5) bcde
Mean	11.1(18.6)	5.7(11.8)	6.6(13.4)	10.1(17.4)
LSD ($p<0.05$) *for comparing*				
Genotypes	(6.6)		(5.7)	
Buds/bolls	(3.8)		(3.3)	
Genotypes × buds/bolls	(9.3)		(8.0)	

* Figures in parentheses are angular transformed values.
** The values following the different letters are significantly different.

4.2.3. Relative oviposition preference towards different cotton genotypes

The preference for egg laying on buds, bolls and lower surface of leaves of HD 107 (13.2%, 11.9%, and 12.6%) and HS 6 (19.0%, 19.0%, and 17.8%) was significantly greater as compared to the other plant parts (Fig. 1). There were no significant differences in oviposition on buds, bolls and lower leaf surface of HD 107 and HS 6. Among the hybrids tested, the females laid more eggs on lower leaf surface, except on HHH 81 where more eggs were laid on buds (25.1%) and bolls (22.8%) than on the lower surface of leaf (15.8%). Maximum number of eggs were laid on the lower leaf surface (19.1%), followed by buds (18.4%), bolls (17.3%), stalks (7.2%), leaf petiole (6.9%), stem (6.7%), flowers (5.4%), and upper surface of leaf (4.0%). A few eggs were also laid on the sides of the glass jar and muslin cloth covering the oviposition cage.

5. Discussion

The significant variation in embryonic and post-embryonic developmental periods of spotted bollworm on different cotton genotypes might be due to antibiotic effects of growth inhibiting factors in cotton buds and bolls such as gossypol, hemigossypoline, and tannins, or reduced nutritional quality and non-availability of

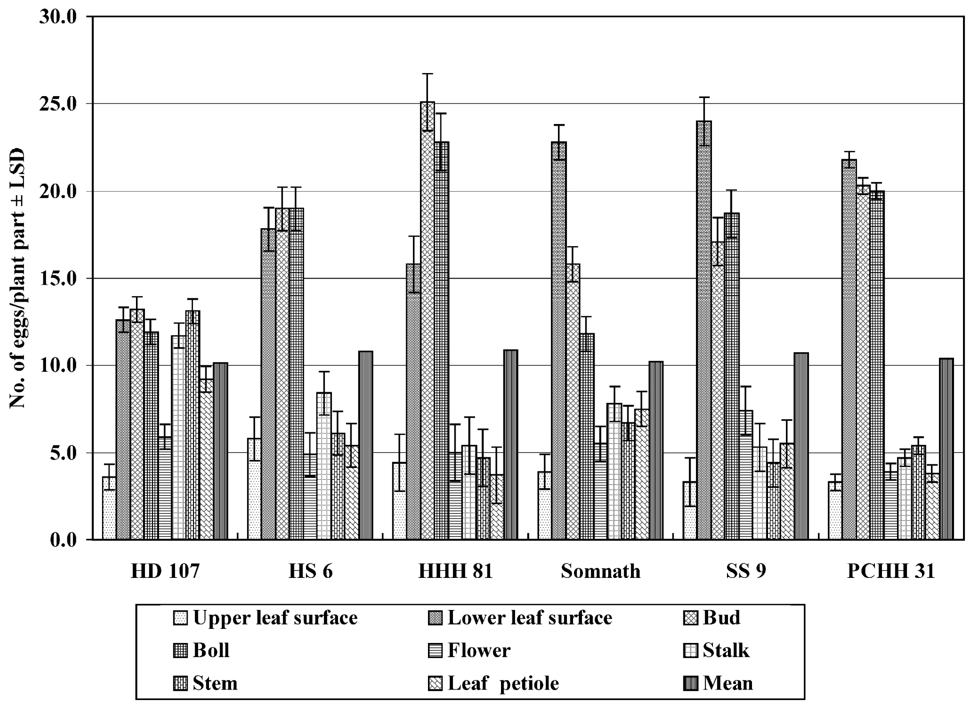

Fig. 1. Oviposition preference by the *E. vittella* females towards different cotton genotypes.

nutrients (Lukefahr et al., 1974; Gray et al., 1976; Sharma et al., 1982). Tsai and You (1962) reported a wide variation in larval duration (10–28 days) due to food type, i.e., buds or bolls of *G. hirsutum* cotton. The first- and third-instar larvae take more time to enter inside the cotton bolls as compared to buds (Dhillon et al., 1997), which might delay the larval development on bolls as compared to buds. Larvae fed on *G. hirsutum* cultivars took longer time to pupate than insects fed on *G. arboreum*, which might be because of some antibiotic effects or poor nutritional quality of the food. Pre-pupal stage is longer on *G. hirsutum* cultivars (Hafeez-Ur. Rehman and Ali, 1981; Dhillon et al., 1997). Nanthagopal and Uthamasamy, (1989) reported low larval survival on *G. arboreum* entry K 8 than on *G. hirsutum* cottons. Fecundity of the females whose larvae were reared on *G. hirsutum* was greater than those reared on *G. arboreum*, which might be due to the variation in nutritional quality of the food, and the antibiosis components of resistance (Hafeez-Ur. Rehman and Ali, 1981; Singh and Bichoo, 1989). Egg hatchability was also low on *G. arboreum* than on *G. hirsutum* cottons, which also showed that *G. arboreum* may be of inferior nutritional quality (Samraj and David, 1988). The pupal mortality was very low (0.8–4.8%), while the larval mortality was very high (60.0–73.6%), irrespective of the genotypes tested indicating that the antibiosis mechanism is highly significant for larval survival and development. The larval survival, pupation, adult emergence, egg hatchability and growth index were significantly lower on *G. arboreum* that on the *G. hirsutum* genotypes. The variation in survival and development on different genotypes might be due to the antibiotic effects, poor nutritional quality of the food, pericarp thickness and secondary plant substances (Singh et al., 1965; Sharma et al., 1982; Samraj and David, 1988). Observations on egg incubation period on different genotypes are similar to those reported by Senapati et al. (1978). Post-embryonic development was faster on *G. arboreum* than on *G. hirsutum* genotypes, while adult longevity, oviposition, and post-oviposition periods were shorter on *G. arboreum* than on *G. hirsutum* genotypes.

Chakravarthy and Sidhu (1986) reported that the first- and fourth-instar larvae preferred buds than bolls, while Sharma and Agarwal (1981) observed that the third-instar larvae preferred the bolls of *G. hirsutum* than those of *G. arboreum*. Such differences in food preference between different larval-instars might be because of their nutritional requirement, since the older larvae of Lepidoptera have increased appetite (Raubenheimer and Barton-Browne, 2000) and greater need for proteins (Simpson et al., 1988). Better development of the mouthparts may also result in differences in food preference among instars. Green et al. (2002) reported that different instars of *Helicoverpa armigera* (Hub.) have a differential preference for flowers and pods of pigeonpea. The young larvae (1st and 2nd instars) congregated inside flowers of ICPL 87 in preference to other plant parts, and the later instars (3rd–5th instars) showed an increasing tendency to feed upon pods. The differences in egg laying behavior on different plant parts might be influenced by the size of the plant parts, number, size and thickness of hairs, and volatile substances in *G. arboreum* and *G. hirsutum* genotypes (Sharma and Agarwal, 1983; Dass et al., 1993).

The larval period, irrespective of food source, was shorter on *G. arboreum* than on the *G. hirsutum* genotypes. Among *G. hirsutum* cultivars, the larval period was significantly longer on hybrids than on the variety, HS 6, which may be because of the antixenosis and/or antibiosis mechanisms of resistance and hardness of bolls and bolls. There was an increase in mean pupal weight over mean larval weight in HD 107, HS 6, and HHH 81 which might be because of slow development of spotted bollworm in early instars on these genotypes (Dhillon, M.K., unpublished work). Larval preference for buds and bolls of different genotypes by the first- and third-instar larvae indicated that the *G. hirsutum* were more attractive than the *G. arboreum*. The lower preference for *G. arboreum* genotypes may be due to the hardness of the fruiting body or the presence of secondary plant substances. First-instar larvae preferred buds to bolls, but the third-instar larvae preferred bolls than buds. The females preferred lower leaf surface, buds and bolls for oviposition than the other plant parts, which may be because of morphological and/or biochemical characteristics of the plant parts.

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