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COMPARATIVE STUDY OF *ABELMOSCHUS ESCULENTUS* (L.) MOENCH METH, OKRA FRUIT AND COTTON LEAVES SUITABILITY FOR REARING AND BIOLOGY OF *EARIAS FABIA* STOLL

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Spotted bollworm *Earias fabia* Stoll was reared on okra, *Abelmoschus esculantus* (L.) Moench Meth fruits, as compared with cotton leaves, at 30 ± 5°C and 65 ± 5% R.H. The okra fruit was found to be as good as cotton leaves. No significant difference was observed, in incubation period, larval period, pupal period, adult life, numbers of eggs/female and total life cycle, amongst the insects developed on okra fruits or on cotton leaves. The larvae developed on okra fruits took a period of 18 ± 0.882 days and the adults emerged, therefrom showed longevity of a range of 5.5± 3.1456 days at 95% confidence limit, whereas the total incubation period and pupal period was observed at a range of 6.33 ± 0.9996 days and 11±3.3316 days, respectively, for three consecutive generations on okra.

Keywords: *Earias fabia* Rearing, *Abelmoschus esculentus* (L.).

Introduction

Being highly sensitive to pest attack [1] and having a significant position in the economy, cotton has required special attention from policy makers and scientists. Amongst a number of pests spp. cotton yield losses because of bollworm infestations is known for years in Pakistan [2,3].

Various workers have illuminated bollworm's importance with estimating the losses incurred by bollworms infestations [2-5]. Therefore, primafacie, development of an IPM programme for these pests became a prime importance. Recently, Stams an Elmosa [6] and Sur Ulivelu [7] report the significance of biology and related studies of *Earias* spp. for their work. A number of workers have discussed different life aspects of *Earias fabia* Stoll including food suitability [2-11], however, most of them used cotton leaves or bolls for their studies. The present work is on life cycle studies and rearing of *E. fabia* on okra fruit, to find out its suitability for this purpose in comparison with a usual cotton leaves diet. The okra fruits have an advantage over cotton leaves that the okra is available more easily than cotton; moreover, cotton leaves and bolls dry up more rapidy in comparison with okra pods. Further, being an edible vegetable, okra pods are available over a longer period throughout the year than cotton.

Materials and Methods

The spotted bollworm *E. fabia* (also known as *E. vittella* (F.) [12,13] larvae were collected from the host plant e.g. abutilon, okra, cotton and hollyhock etc. from Karachi University Campus and brought into the laboratory and reared on okra fruits and cotton leaves at 30± 5°C and 65 ± 5% R.H. Adults, developed therefrom, were paired and then released into plastic burneys provided with a branch of okra *Abelmoschus esculentus* (L.) Moench Meth plant bearing fresh leaves for oviposition. 5% sugar solution was supplied for adult feed *ad libatum.* Adults oviposited on cotton leaves as well. The burneys were covered with a muslin cloth attached by rubber bands. After every 24 hrs, the old leaves were taken out and examined for eggs then changed with fresh ones. Leaves showing egg masses were placed in petridishes separately and kept for hatching. The early first instars were provided with succulent leaves of respective plant for a day or two then transferred for feeding on either fresh okra fruits or cotton leaves. The observations were made at every 24 hrs. Feed i.e. cotton leaves and okra fruits, was intermittently changed. In order to keep the leaves or pods fresh and soft enough, during larval consumption, the diet was kept infolded in moisture muslin cloth. Biological and morphological features are presented in Table 1 and comparison of the time required for larval development, pupal formation, pre-oviposition and adult emergence of the insects on okra and cotton leaves are shown in Table 2. Record time for three consecutive generations on okra fruits are presented in Table 3.

Results and Discussion

In the present studies, okra leaves were suitable for oviposition, whereas okra fruit was found as good as cotton leave for *E. fabia* diet, at 95% confidence limits (Table 3). Mani *et al.* [14] already had pointed out the suitability of okra for *E. fabia.* They reported that okra provides mandatory requirements for *E. fabia* rearing and provides easy egg deposition for

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female as well. However, they had not done a comparative study.

In the present findings as shown in Table 2, the insects developed on okra have incubation period of 6.33 ± 0.99 days whereas those fed on cotton showed 5.33± 0.98 days. There was no significant difference between the mean of incubation periods at 95% confidence limits. Larval period, pupal period and preoviposition periods were determined as 18 ±0.882, 11 ± 3.33 and 4.33 ± 0.65 days, respectively, for those developed on okra fruits whereas, 19.33 ± 1.6, 10.16 ± 1.94, 4.16 ± 0.96 days larval period, pupal period, and preoviposition periods were observed for the insects developed on cotton. There was no significant difference in these periods due to the two diets. The adult life and total life cycle was estimated as 5.5± 3.15 and 40.83 ± 7.21 days in case of okra as compared with cotton in which case it was 6.83 ± 3.41 and 41.83 ± 7.64 days at 95% confidence limits. There was no significant differnce among these estimations on two diets as well. Okra exerted no significant effect on oviposition and total life period as compared with cotton. Therefore, on the basis of these findings it can be concluded that the okra is as suitable as cotton for rearing and life cycle studies of *E. fabia.*

As presented in Table 1 adults were smaller in size of 10 mm in body length with 20 mm wing expanse. There was a narrow longitudinal green band in the middle of each forewing in light background as reported by earlier workers also [15,16]. They pointed out length 25 mm and 17.71 mm across the wings, respectively. The minor difference might be due to differences in nutrition.

TABLE 1. OBSERVATIONS OF BIOLOGY OF E. *FABIA* ON OKRA FRUITS.

Life stage	Morphology	Average duration in days
Eggs	Bluish green in colour, bearing strips all over the shell and crown at the tip.	6.27
Larvae	(a) FULL GROWN LARVAE: Greenish brown full grown larvae have yellow spots at the base of tubercles and a series of longitudinal black spots through out the body with the average length of 18 mm. (b) EARLY STAGE: Newly hatched larvae are light brown in colour with an average length of 1.2 mm.	18.05
Pupae	Silken, off-white have exploid shape with the average length of 11 mm.	11.33
Adult	An average of 10 mm in body length with 20 mm wing expanse. There are narrow longitudinal green bands in the middle of each forewing in a light background.	7.16

TABLE 2. COMPARATIVE LIFE CYCLE DURATIONS OF E.FABIA ON COTTON AND OKRA.

	Okra				Cotton				*Difference of two means at 95% confidence limits
	X1	SD	SE	Range	X2	SD	SE	Range	
Incubation period	6.33	1.25	0.54	x ± 00.9996	5.33	1.23	0.50	x ± 00.98	1.27<t
Larval period	18	1.09	0.45	x ± 00.882	19.33	2.01	0.82	x ± 01.60	-1.29>-t
Pupal period	11	4.195	1.71	x ± 03.3516	10.16	2.44	0.99	x ± 01.9404	0.385<t
Pre-ovi position	4.33	0.82	0.33	x ± 00.6468	4.16	1.195	0.49	x ± 00.9604	0.26 <t
Adult life	5.5	3.94	1.61	x ± 03.1456	6.83	4.27	1.74	x ± 03.41	-0.51>-t
Life cycle	40.83	9.02	3.68	x ± 07.2128	41.83	9.56	3.90	x ± 07.644	-0.17>-t
No. egg/Female	185.5	113.46	46.32	x ± 90.7872	195.33	113.06	46.16	x ± 90.4736	-0.14>-t
No. emergence/100 eggs	77.17	13.07	5.33	x ± 10.4468	77.5	12.81	5.23	x ± 10.2508	-04>-t

* $t = xa - xb/[Na\ SD^2a + Nb\ SD^2\ b/Na + Nb-2]^{0.5}$

TABLE 3. LIFE CYCLE DURATION OF BOLLWORM IN THREE CONSECUTIVE GENERATIONS.

	1st Generation				2nd Generation				3rd Generation			
	X	SD	SE	Range*	X	SD	SE	Range*	X	SD	SE	Range*
Incubation period	7	0.89	0.36	x ± 0.7056	6.5	0.55	0.22	x ± 0.4312	5.33	0.56	0.23	x ± 0.45088
Larval period	19	0.89	0.36	x ± 0.7056	17.66	0.74	0.30	x ± 0.588	17.5	0.55	0.22	x ± 0.4312
Pupal period	15.5	1.39	0.56	x ± 1.0976	9.83	2.25	0.92	x ± 1.8032	8.66	1.27	0.52	x ± 1.0192
Pre-ovi position	4.0	0.89	0.36	x ± 0.7056	4.33	0.55	0.22	x ± 0.4312	4.5	0.55	0.22	x ± 0.4312
Adult life	6.33	1.88	0.77	x ± 1.5092	8	3.03	1.24	x ± 2.4304	7.17	3.12	1.27	x ± 2.4892
Life cycle	47.83	4.87	1.99	x ± 3.9004	42	6	2.45	x ± 4.802	38.66	4.99	2.04	x ± 3.9984
Egg laid/female	160.5	88.05	35.95	x ± 70.462	225	75.83	30.96	x ± 60.6816	216.66	81.67	33.34	x ± 65.3464

* at 95% confidence limits, range = $[3D^2/n]^{0.5}$ x 1.96± x.

Eggs were bluish green with strips and have a crown at tip. Newly hatched larvae were light brown in colour and average of 1.2 mm in length that is in accordance with Ahmed's findings [3]. He described the length with an average of 1.3 mm. Full grown caterpillars were greenish brown in colour, having a series of longitudinal black spots on the body and around 12 mm long. Similar findings are reported by Atwal [15]. He measured full grown Larvae as 20 mm long. Pupae were formed in a off-white silken cocoon with the average length of 11 mm, formed outside the fruit either affixed with the host pod or made on attachment with adjacent part e.g. underneath the plant leaves, over the covering muslin cloth etc., as exhibited in the natural environment, as reported by Ahmed [3]. As evident from Table 2 for three consecutive generations on okra fruits, the, preoviposition was observed as 4.33 ± 0.65 days. In the present findings females laid 185.5 ± 90.79 eggs which confirms the findings of previous workers i.e. Rehman [2], Atwal [15] and Deshpande and Nadkary [17]. They reported 163-420, 63-697 and 88-399 eggs/female, respectively and also confirms the report of Rehman and Ali [16] who found 82-378 eggs per female. Very minor difference between these findings and previous reports could be due to difference in geographical variations or difference in rearing conditions.

The adult life was found in a range of 5.5 ± 3.15 days at 95% confidence limit i.e., lesser than the findings of Entwistle [18] and Megahed *et. al* [19]. They reported male and female life as 17 and 18 days for *E. plaga* Wlk. and 16-17 days for male and 22-23 days for female of *E. insulana,* respectively. Quite obviously the difference between present findings and reports of Entwistle [18] and Megahed *et. al.* [19] is due to difference in species. They reported life period of *E. plaga* and *E. insulana,* respectively while the present study was related with *E. fabia.* It was reported [16] that the male and female life in *E. vittella* was 4-13 and 8-18 days respectively. Their findings are in agreement with the present studies with minor differences. Differences in provided food and other circumstances may exert such type of deviations.

The incubation period was observed in a range of 6.33 ± 0.9996 days at 95% confidence limit. Previous investigation [2,8,16,20], reported incubation periods 3 - 4 days. This difference is probably due to the difference in temperature and humidity etc. The larval period was found in range of 18 ± 0.882 days that is near about the previous findings [2,10,13,15,16,20]. They reported 7-18, 13-20, 10-12, 10-16, 5-16 and 12-18 days, respectively. The pupal period was observed in a range of 11 ± 3.3516 days at 95% confidence limit that is in accordance with the reports of previous authors as well [15 - 17, 21]. They found the pupal period as 8-22, 6-13, 14-18 and 7-10 days. The total life cycle of the insect was completed in range of 40.83 ± 7.2128 days at 95% confidence limit that is within the range as described by Haq [8] and Rehman and Ali [16] who reported this period as 18-34 days an 24-45 days, respectively.

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