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GROWTH AND DEVELOPMENT OF *HELICOVERPA ARMIGERA* (HUBNER) ON DIFFERENT HOSTS

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ABSTRACT

The development of *H. armigera* on cotton, pigeonpea, chickpea and artificial diet were studied at Department of Entomology, Dr. PDKV, Akola and the results revealed that the incubation period in laboratory cultured eggs was high on chickpea. However, the larvae from the field-collected eggs required highest 17.52 days on cotton over chickpea and pigeonpea, which were also showed similar type of sequence in laboratory, cultured eggs. The larval duration recorded on artificial diet was more than pigeonpea and chickpea except cotton. The highest pupal duration was found on chickpea (15.10 days) as compared to pigeonpea and cotton in field collected egg population study, while it was maximum 14.50 days on cotton in laboratory-cultured eggs. However, the pupal development on artificial diet in both study revealed the higher developmental period than the natural host. The male and female generation life span recorded on cotton was found higher *i.e.* 43.65 and 45.35 days, respectively followed by chickpea and pigeonpea. The life cycle period completed on artificial diet comprised the maximum duration over natural host. The highest fecundity was recorded on pigeonpea (field collected eggs) *i.e.* 405 eggs/female. The growth of *H. armigera* on artificial diet was more than natural hosts, while pigeonpea was found most suitable than chickpea and cotton among natural hosts. The egg stage recorded highest mortality percentage in generation, followed by first, second instar and pupal stage.

Key words: Biology, Mortality, *Helicoverpa armigera*

Helicoverpa armigera (Hubner) is considered to be the most important and dynamic insect species in India, which attacks more than 181 host plants belonging to 45 botanical families in the Indian subcontinent, out of which 21 species are important (Manjunath, *et al.*, 1989). The reproductive organs of cotton, corn and legumes are the most suitable foods for *H. armigera* larvae (Fitt, 1989). Every year, the larvae of this species cause substantial economical losses to cotton, corn, tomato, legumes and other vegetable crops. Different host plants are known to affect insect development, survivorship, reproduction and life table parameters. However, few life table studies of *H. armigera* on its various host plants have been published and only a few studies have examined the effect of host plants on larval and post-larval development or on overall performance of development (Mullick and Singh, 2001). In polyphagous insects, the availability of different host plants plays an important role in triggering population increase and outbreaks.

Hatching larvae feed on tender leaves near the site of egg oviposition. The later instars feed on fruit and flowers of the host and can infest several fruits and flowers over the course of larval development. Determination of whether a plant is a true host requires either for rearing insects to the adult stage on the plant or collecting pupae (of larvae completing development on the plant) from field and testing the fertility of the subsequent adults. Therefore, we chose to test host suitability and potential contribution of overall population sizes for cotton, pigeonpea and chickpea.

MATERIALS AND METHDOS

Life cycle of field collected egg population and laboratory-cultured eggs of *H. armigera* were studied on cotton, (Var.- PKV Hy 2), pigeonpea (var.- C-11), chickpea (var.- ICCV-2) and artificial diet during two consecutive years of 2004-05 and 2005-06. About 100 egg of *H. armigera* were collected from an unsprayed field cultivated on 500 sq. m. plot and reared under laboratory condition of Department of Entomology, Dr. PDKV, Akola at room temperature.

Larvae of *H. armigera* were reared on fresh cotton (squares, flower and bolls), pigeonpea (buds and pods) and chickpea. Fresh food material collected from isolated unsprayed field crops were used to feed the larvae daily. Similarly, the artificial diet was used with respective natural food to feed the larvae, which was prepared by method given by Armes *et al.* (1992).

The eggs obtained from field crops and these laboratory cultured were reared individually in the plastic vials on natural host and artificial diet separately in two groups.

The observations were recorded on the egg, larval, pre-pupal and pupal duration on respective host. Eggs were collected from field; hence egg period could not be assessed. After pupation, all the pupae were sexed and male: female ratio was noted. Also adult duration and fecundity (eggs/female) after successful emergence on respective hosts were recorded.

RESULTS AND DISCUSSION

Biology of *H. armigera*

The average life period at each stage of *H. armigera* during a generation is presented in Table-1. The period for egg hatching required was maximum on artificial diet over cotton, pigeonpea and chickpea in laboratory cultured eggs. The larval developmental period was 17.52 days on cotton in both studies higher than pigeonpea, chickpea and artificial diet. Pigeonpea showed lowest larval period (15.40 and 14.83 days) in both studies. The differences between the larval duration on natural hosts and artificial diet showed that the larval period was higher on cotton than the artificial diet, whereas the artificial diet showed more larval periods than pigeonpea and chickpea.

Goyal and Rathore (1988), Valand and Patel (1993) and Ameta and Bhardwaj (1996) found nearer egg duration on cotton and pigeonpea. Similar results on larval period were reported by Bilapate (1988), Goyal and Rathore (1988), Venkataiah *et al.* (1994) and Ameta and Bhardwaj (1996) found longer larval developmental period on cotton over pigeonpea, while Kulkarni *et al.* (2004) estimated higher larval duration on artificial diet. Sarode *et al.* (1999) and Bantewad and Sarode (2000) showed longer larval duration on artificial diet than pigeonpea, which is similar to the present observations.

The pre-pupal period recorded on cotton and pigeonpea with their respective artificial diets did not show significant differences among themselves. However, the pre-pupal period on artificial diet was higher in both studies over natural food.

The pupae formed on cotton recorded minimum duration of 13.88 days and maximum on artificial diet (15.88 days) in field-collected eggs. While, it was minimum of 14.21 days on chickpea and maximum of 15.23 days on artificial diet (cotton) in laboratory cultured egg study.

The longer pupal developmental period on cotton over other host was reported by Ameta and Bhardwaj (1996), while higher pupal longevity on artificial diet than other hosts were reported by Bantewad and Sarode (2000) and Kulkarni *et al.* (2004), which is similar with the present observations.

The adult longevity found on cotton, pigeonpea, chickpea and artificial diet did not show much difference in their adult life span. However, male and female generation life span recorded on cotton was higher *i.e.* 43.65 and 45.35 days, respectively over pigeonpea and chickpea. The life cycle completed on artificial diet showed comparatively more life period over their respective natural hosts.

Earlier, Ameta and Bhardwaj (1996) recorded higher adult duration on cotton. Higher life span of *H. armigera* on cotton than pigeonpea was found similar with the results of Goyal and Rathore (1988), while Bilapate (1988) reported longer life period on pigeonpea.

Sexual determination revealed that the female population was always higher than the male in all food except in field collected eggs reared on pigeonpea that showed more male sex ratio of 1:0.97. The fecundity results showed highest egg laying (405 and 386.5 eggs/female) on pigeonpea in both studies than on cotton, chickpea and artificial diet.

The maximum fecundity on pigeonpea was similar with the observations of Valand and Patel (1993). Bilapate (1988), Goyal and Rathore (1988), Ameta and Bhardwaj (1996) and Kulkarni *et al.* (2004) found highest fecundity on natural hosts over artificial diet, which are also in support of the present findings.

Mortality percentage of *H. armigera*

The cumulative reduction in population levels of *H. armigera* at each stage on cotton, pigeonpea, chickpea and artificial diet for field collected egg and laboratory cultured egg population is presented Table-2. The mortality in eggs (16.56%) was found to be high on artificial diet. In filed collected egg, the mortality was higher on cotton (11.64%) than other food in laboratory cultured eggs.

The first and second instar larval suppression was maximum over late larval instar on all the food. The mortality of first instar larvae on cotton observed was very high (15.81%) in field collected eggs and 12.50 per cent in laboratory-cultured eggs. The population suppression of second instar larvae was found to be the highest on cotton (8.73 and 8.11%) in field collected and laboratory cultured eggs study, respectively. These results showed that the mortality was high at egg and first instar larval stages, followed by that in the second instar. Among three natural hosts, lowest mortality of *H. armigera* was observed on pigeonpea, likewise lower mortality was found on artificial diet than natural host.

Table 1: Biology of *H. armigera* on cotton, pigeonpea, chickpea and artificial diet (Pooled of 2004-05 and 2005-06)

Life stages		Field collected eggs (Duration in days)						Laboratory reared collected eggs (Duration in days)					
		Cotton		Pigeonpea		Chickpea		Cotton		Pigeonpea		Chickpea	
		N. H.	A. D.	N. H.	A. D.	N. H.	A. D.	N. H.	A. D.	N. H.	A. D.	N. H.	A. D.
Egg		*	*	*	*	*	*	2.84	2.98	3.12	3.12	3.20	3.22
Larvae		17.52	15.87	15.40	15.98	15.99	16.42	17.52	16.28	14.83	16.40	15.50	15.92
Pre-pupal larvae		2.05	2.22	1.95	2.08	2.11	2.12	1.89	2.06	2.00	2.06	2.29	2.20
Pupae		13.88	5.13	14.69	15.88	15.10	15.47	14.50	15.23	14.40	14.95	14.21	15.17
Adult	Male	8.40	8.60	8.60	8.00	8.00	8.30	6.90	7.30	8.00	7.70	7.70	7.40
	Female	10.00	10.40	10.40	10.30	9.40	10.10	8.60	9.40	9.60	9.60	9.10	9.10
Total life period	Male	-	-	-	-	-	-	43.65	43.84	42.34	44.22	42.89	43.91
	Female	-	-	-	-	-	-	45.35	45.94	43.94	46.12	44.29	45.61
M:F ratio		1:1.46	1:1.56	1:0.97	1:1.13	1:2.07	1:1.70	1:1.48	1:1.28	1:1.15	1:1.41	1:1	1:1.20
Fecundity (egg/female)		386	368	405	385	383	386.5	374.5	365.5	386.5	363.5	375.5	359

* The egg period could not be studied as the study was carried out by collecting the eggs from the field.
Note: N.H. = Natural host and A.D. = Artificial diet.

Table 2: Mortality percentage of *H. armigera* on cotton, pigeonpea, chickpea and artificial diet (Pooled of 2004-05 and 2005-06)

Life stages	Field collected eggs (Duration in days)						Laboratory reared collected eggs (Duration in days)					
	Cotton		Pigeonpea		Chickpea		Cotton		Pigeonpea		Chickpea	
	N. H.	A. D.	N. H.	A. D.	N. H.	A. D.	N. H.	A. D.	N. H.	A. D.	N. H.	A. D.
Egg	15.00	16.56	13.47	13.47	13.47	13.06	11.64	10.75	10.19	10.94	10.00	11.11
I instar	15.81	12.36	9.91	8.96	9.43	8.92	12.50	9.36	9.66	7.63	9.47	7.50
II instar	8.73	5.98	6.28	4.66	7.81	4.64	8.11	6.64	7.44	5.96	7.73	5.41
III instar	7.18	3.64	3.35	2.72	4.52	4.32	6.30	4.74	5.03	3.90	4.93	4.29
IV instar	5.15	2.83	2.83	2.79	3.55	2.82	5.83	4.15	3.70	2.54	3.11	2.99
V instar	4.35	2.43	2.98	1.72	3.07	1.74	4.76	3.03	2.75	2.08	3.21	2.56
Pre-pupal larvae	5.11	4.48	4.29	3.51	3.80	4.14	6.50	3.57	3.39	3.19	3.87	2.63
Pupal	10.18	8.33	7.05	7.88	9.87	6.79	8.02	8.80	6.43	6.04	6.90	5.41
Adult	8.00	6.82	4.83	4.61	3.65	5.30	7.56	6.09	4.38	4.09	4.94	4.57
Generation Survival (SG)	0.43	0.51	0.57	0.59	0.54	0.58	0.47	0.55	0.58	0.62	0.57	0.62

Note: N.H. = Natural host and A.D. = Artificial diet.

The pre-pupal larvae reared on cotton was found more susceptible for death. The pupal mortality was high on cotton (10.18%) in field collected eggs, while the pupal reduction maximum in artificial diet (cotton) *i.e.* 8.80% in laboratory cultured eggs. The pupal mortality found on all food was comparatively higher than the late larval instars of *H. armigera*. The pupal survival was higher on pigeonpea as compared to cotton and chickpea in natural host study, while it was lower in case of artificial diet over cotton and chickpea except pigeonpea. The generation survival was highest on artificial diet than natural host, where the lowest population generation survival was recorded on cotton.

It was concluded from these observations that pigeonpea was most preferred by *H. armigera* for survival, followed by chickpea and cotton, while population development on artificial diet of respective crops were higher than natural hosts. Also, the egg stage estimated higher population reduction in a generation, followed by first instar larvae, pupal stage and second instar larvae. Exceptional condition occurred in cotton, where first instar larvae recorded higher mortality than egg stage. The life period of laboratory-cultured eggs was shorter than field collected egg population with higher generation survival.

Similar results were recorded by Nanthagopal and Uthamasamy (1989) with highest mortality in first instar larvae on cotton. Likewise, Raja Sekhar *et al*. (1995) and Reddy *et al.* (2004) stated that the early instar larvae of *H. armigera* were more vulnerable to mortality as well as Singh and Mullick (1997) observed the highest mortality of larvae in the first instar on pigeonpea, which confirms the present findings.

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