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BIOLOGY OF DIAMOND BACK MOTH *PLUTELLA XYLOSTELLA* L. ON CABBAGE

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ABSTRACT

This study on the biology of diamond back moth revealed that the incubation period varied from 2 to 5 days (3.6± 1.34 days), while first, second, third and fourth instar larvae lived for 3± 1, 1.6± 0.54, 2.6± 0.54 and 4± 0.70 days, respectively with a total larval period of 11.4± 1.81 days. The prepupal and pupal stage lasted for 2± 0.70 and 4.4± 0.89 days, respectively. The adults lived for 5± 1.58 days and the life span of male and female varied from 22.6± 1.81 and 26.8± 1.92 days, respectively.

Key words: *Plutella xylostella*, cabbage, Kashmir, biology, morphometrics, egg, larva, instar, pupa, adult periods, lifespan

Vegetables are the important components of our daily diet, and among these crucifers (Genus: Brassica and Family: Brassicaceae) are the most commonly grown. Cabbage *Brassica oleracea* var. *capitat*a L. and cauliflower *B. oleracea* var. *botrytis* L. are amongst these. The diamond back moth (DBM) *Plutella xylostella* (L.) (Plutellidae: Lepidoptera) is the major pest of these crops causing significant economic losses up to 90% (Karlsson et al., 2013; Furlong et al., 2013). It is the most serious and widely distributed pest throughout the world (Bonnemaison, 1965), and in 1953 itself is known to have developed resistance to DDT (Ankersmit, 1953; Johnson, 1953). It has become difficult to control, primarily because of this resistance (Shelton et al., 2000). Single larvae of DBM feeds away 62 to 78% leaves, and plant growth is stunted resulting in the reduction of quantity as well as quality (Gangurde and Wankhede, 2009). The developmental time depends upon weather factors with rate of development being faster in warm and slower in cold conditions, and generations overlap during warm temperature (Zhu et al., 2018). The practicing of IPM requires knowledge on incidence, economic status and the population buildup. This study attempts its biology under Kashmir conditions.

MATERIALS AND METHODS

The initial culture of *P. xylostella* was made from larvae collected from nearby cabbage and cauliflower fields of the Faculty of Agriculture, SKUAST-Kashmir, India. The study was carried out under laboratory conditions (26± 5°C, 60± 5%RH) with larvae reared on fresh cabbage leaves in rearing cages. The experiment was replicated five times with five larvae/ replication, with fresh leaves provided as food till pupation, changed twice in a day. Pupae were sorted and transferred to rearing cages for adult emergence. The newly emerged adults were identified with their creamish-brown band on forewings which forms a diamond shaped pattern along its back (Capinera, 2000). These were transferred to rearing cages and honey solution (10%) soaked in cotton swabs provided as food. The freshly hatched larvae were transferred in petriplates provided with fresh leaves, and observations on the larval instars made on the basis of moulting, colour change and the apparent increase in size. The duration from hatching of eggs up to formation of pupa were taken as total larval period. Pupal period was recorded as the time elapsing between cessation of feeding by the last instar caterpillar and adult emergence. The total duration of adults from emergence till death was evaluated. The period between the egg laying and the mortality of the adult constituted the total lifecycle. Morphological details of lifestages were observed with ocular and stage micrometer scale in a microscope.

RESULTS AND DISCUSSION

Females laid their eggs mostly singly or in small groups on the ventral surface of the leaves and also on the walls of the container. Freshly laid eggs were pale yellowish and oval. These observations agree with those of Ramegowda et al. (2006), Dhaduk (2007), Gowri and Manimegalai (2016) on shape and colour. The incubation period had been reported earlier as 3

to 4 (Sharma et al., 1999; Gangurde and Wankhede, 2010; Jayarathnam, 2013), 3.0 to 5.25 (Ramegowda et al., 2006), 3.33± 0.42 (Dhaduk, 2007) and 2 days (Gowri and Manimegalai, 2016). The first instar larvae were small and pale white, with a dark brown head; these made small tunnels in leaves as leaf miners. As given in Table 1 the first instar occupies about 2 to 4 days; earlier, Dhaduk (2007), Jayarathnam (2013) and Harika et al. (2019) reported this as 2.50 ± 0.50, 3-5 and 2 to 3 days, respectively. The second instar was very active, larger, changed into third instar after 1 to 2 days; these were yellowish green and light brown, respectively. Sharma et al. (1999), Kumar et al. (1999), Dhaduk (2007), Jayarathnam 2013, Harika et al. (2019) observed the duration of second instar as 1.20± 0.25, 2-3 and 2 days, respectively. The third instar fed more vigorously and after 4-5 days changed into fourth instar, which were dark green with body covered with sparse, short, erect hairs. Fourth instar larva upon completion of feeding, constructed an open silken cocoon on the leaf surface and spent a two days in quiescence marking the prepupal stage. Similar results have been found by Jayarathnam, (2013) and Harika et al. (2019). Thus, the total larval period ranged from 9 to 13 days conforming the previous results of 9 to 10 (Kapadia and Koshiya, 1999), 10-15 (Devjani and Singh, 1999),7.58± 0.51 (Dhaduk, 2007) and 7 to 11 days (Gangurde and Wankhede, 2010).

The prepupal stage is contracted form of larva, sluggish, characterized by absence of feeding and lasted for 1 to 3 days; this entered into pupal stage by constructing a loosely woven cocoon around the body, with pupal period being 4 to 6 days. Earlier this pupal period had been noted as 6 to 7 (Kapadia and Koshiya, 1999), 3 to 5 (Sharma et al., 1999; Dhaduk, 2007; Gangurde and Wankhede, 2010), 3.50 to 4.75 (Ramegowda et al., 2006), 4.50 ± 1.11 (Ahmad et al., 2008), 4.6 ± 0.37 days (Ahmad et al., 2011) and 3 to 4 days (Gowri and Manimegalai, 2016). The mature caterpillar form a beautiful gauzy loosely spun cocoon (Lingappa et al., 2000). Similarly, Harika et al. (2019) observed that prepupal and pupal stage lasted for 1- 2 and 3 to 5 days, respectively. Moths were small, slender and greyish brown. The forewings were narrow, brownish grey and with a creamy coloured band along the posterior margin in the shape of a diamond. The hindwings were narrow and light grey. The adult longevity ranges between 3 to 7 days. Similarly, Harika et al. (2019) reported longevity of adults as 3 to 7 days. Chelliah and Srinivasan (1986) and Ramegowda et al. (2006) also found the longevity of the adults as 6 to 13 days and 3 to 4.27 days, respectively. The lifespan of male and female varied from 20 to 25 and 24 to 29 days, respectively. The findings are in agreement with Gunn (2008) who reported lifecycle of 25-30 days. Jayarathnam (2013) observed this as 19-27 days in different seasons, and Abro et al. (1992) and Gangurde and Wankhede (2010) observed this as 11.93 to 21.2 and 14 to 22 days, respectively.

Table 1. Lifecycle and morphometrics of *P. xylostella*

Stage	Head capsule size		Duration
Egg			3.6± 1.34
	Length (mm)	Breadth (mm)	
I Instar	1.47	1.59	3± 1
II Instar	3.19	2.78	1.6± 0.54
III Instar	4.23	4.03	2.6± 0.54
IV Instar	5.48	5.22	4± 0.70
Total larval period			11.4± 1.81
Prepupa			2± 0.70
Pupa			4.4± 0.89
Adult longevity			5± 1.58
Life span of male			22.6± 1.181
Life span of female			26.8± 1.92

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