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Vol. XVIII (1-4) 1981

STUDIES ON THE LIFE HISTORY AND HABITS OF CODLING MOTH *CYDIA (LASPEYRESIA) POMONELLA* (L.) TORTRICIDAE: LEPIDOPTERA IN THE MURREE HILLS

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The studies on bionomics of *Cydia (Laspeyresia) pomonella* (L.), were carried out in the Murree Hills during, 1980. The larva was observed to bore into the fruit and render it unfit for human consumption. The pest passes over two generations in one calendar year. Six larval instars of the pest have been observed and described.

INTRODUCTION

Codling Moth, *C. (Laspeyresia) pomonella* (L.) is the most serious pest of apples in the Murree Hills. Its original home is considered to be Southern Europe but now it has assumed a cosmopolitan status and is found practically in all the apple growing countries of the world. The first outbreak of the pest in Pakistan (Baluchistan) was recorded in 1923, and even today it is reckoned to be a major pest of apples. (Janjua *et al.*, 1958).

In fact, the pest renders severe damage to the fruit and has threatened the developing fruit industry in this area. The larva bores into the fruit, and renders it unfit for human consumption. Keeping in view the magnitude of the problem, preliminary investigations on the life-history and habits were carried out and some useful data were obtained for evolving a practicable strategy for its effective and economic control, particularly at the larval stage.

REVIEW OF LITERATURE

Janjua *et al.* (1958) observed six larval instars and noted two generations in one calender year, in Baluchistan. Suta (1969) found two generations a year in Rumania, the first took 32-149 days to develop and the second generation 19-118 days. Ivanov (1970) showed that the over-wintered larvae pupated between 6th and 29th April, at an average daily temperature of

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10°C. Haqley (1972) reported that the greatest mortality (18.2%) occurred in the third larval instar. Filimonov (1973) reported that the over-wintered larvae pupated in the first ten days of April at an average temp. below 10°C. Esteban (1975) studied that the average number of eggs laid per female was 47.13 and 78.33 in the first and second generations, respectively. Pristavko and Chernii (1976) observed that 40 to 50% R.H. decreased in the values for the length of adult life, mating activity and number and viability of eggs laid, whereas at 70–80% R.H; all values were at their highest.

Nowosielski and Suski (1977) found that the maximum mating activity occurred two days after emergence and the average duration of pairing for isolated pair was about 55 minutes. Sokolowski *et al.* (1978) concluded that the constant temperatures of 11°C or lower and 32°C or higher were harmful to developing embryos. Jackson (1979) reported that 57% of the eggs were found on upper-leaf surfaces, 35% on lower leaf-surfaces and 8% on apple fruits.

MATERIALS AND METHODS

Studies under the semi-natural conditions were carried out on some aspects of biology and habits of codling moth on apples. Four research stations viz., Aliot, Phagwari, Upper-Deval and Ghora Gali were selected with varying altitude ranging from 4000 ft. to 6000 ft. Studies were initiated with the over-wintering larvae/pupae in 1979–80.

Larvae and pupae were collected from the field and kept in the rearing field cages, measuring $2\frac{1}{2}' \times 2\frac{1}{2}' \times 3'$. Field cages were observed daily for pre-oviposition, oviposition, incubation, pre-pupal and pupal studies and also the prevailing temperature and relative humidity. In addition, larvae/pupae were placed in glass troughs ($10'' \times 6'' \times 5''$), glass tubes ($5'' \times 1\frac{1}{4}''$) and glass jars ($6'' \times 3''$) for supplementing information. The rearing containers were cleansed of any jaecal matter every morning (8.00 hours). Observations on the pupae were recorded daily up to the emergence of moths. The adult moths were each day placed in glass chimneys for oviposition. The moths were fed on sugar solution. Apple leaves were replaced by fresh ones daily. The leaves harbouring eggs were transferred to petri dishes (4" diameter) for incubation. An half inch layer of moist paper was placed at the bottom of each petri dish to provide adequate moisture. On hatching, apple fruits were provided as food for the immature larvae. The mature larvae, which had left the fruit for spinning cocoons, were at once removed to glass jars having corrugated cardboard sheets. Larval feeding period was also recorded.

Measurements of length and width of head capsule of larvae, selected at random from the lot were made after every four to five days throughout the duration of larval stage and their instars determined. These measurements were made by stage and ocular micrometer under the microscope and a pair of fine dividers. The eggs, larval instars and pupae were also measured.

RESULTS AND DISCUSSION

Moths emerged from the hibernating pupae in the end of April and beginning of May. It has been concluded that the pupal period, pre-oviposition period, oviposition period, incubation period, and larval feeding period of second brood, 1979-80 and first brood, 1980 on an average being 30.77, 5.00 14.58, 8.07, 53.98, days and 18.49, 6.49, 15.40, 12.53, 34.39, days, respectively, in Aliot; 34.00, 5.25, 14.41, 8.56, 51.43 days and 16.00 5.21, 17.42, 12.25, 35.71 days respectively, in Phagwari; 35.80, 3.50, 14.58, 7.21, 47.98, days and 18.69, 4.58, 13.50, 32.28 days, respectively, in Upper Deval; 34.69, 3.50, 14.82, 8.10, 44.96, days and 19.38, 6.50, 15.33, 12.90, 29.03 days, respectively, in Ghora Gali.

Copulation started 1-2 days after the emergence of adults. The pairs have been observed, mostly, to copulate once only. Survival in the first instar larvae was recorded to be 60% to 80%. The incubation period was inversely proportional to temperature but directly proportional to the relative humidity. The shortest duration was 8 days at 30°C and the longest duration of 18 days at 19°C. No egg hatching was observed below 10°C and above 85% relative humidity. Larvae fed only the seeds. The mean temperature during the pre-pupal and pupal development was 24°C and 27°C, respectively. With the increase in temperature the pupal duration was shortened but it was lengthened with the increase in relative humidity.

The data about the sex-ratio revealed that out of 1538 adults emerged in the field cages, there were 793 males and 745 females, giving a male and female ratio of 51.50, 48.40. On the whole, 23 eggs per female were laid, during the span of their life. The length of life was reduced with the increase in temperature but lengthened with the increase in relative humidity. The males often lived one day shorter than the females.

The average duration of complete life-cycle of first, generation (1980) was found as 76.93 days in Aliot, 78.90 days in Phagwari, 76.67 days

in Upper Deval and 79.23 days in Ghora Gali. The second over-wintering brood lasted for 280.00 days, from the last week of July up to mid May of the next year. This evidence also leads to the conclusions that there are two generations (broods) in nature during the course of one calender year in this area. Emergence of moths took place soon after dusk and majority of them emerged between 7–9 p.m.

Male moths lived for 3–16, 5–18, 7–16, 4–13 days and the female moths lived for 3-17, 5-20, 7-15 and 4-14 days in Aliot, Phagwari, Upper Deval and Ghora Gali, respectively.

Table. 1 shows the observations on the biology of *C.* (*Laspeyresia*) *pomonella* (L.) in the Murree Hills.

The head-width of the larvae was measured, thus according to Dyer's Law, the larvae passed through six instars to reach maturity.

DESCRIPTION OF STAGES:

Different life stages of *C.* (*Laspeyresia*) *pomonella* (L.) have been described as below:

Egg:

The eggs were laid singly but occassionally two or three may be found together. The egg was nearly flat, slightly oval in shape. The average length was 1.12 mm, width 0.76 mm. A freshly laid egg was semi-transparent, greyish white in colour. A day or two before hatching, a black spot appeared.

First Instar Larva.

Width of head 0.23 mm; length when newly hatched 1.8 to 2.1 mm; length when full fed about 2.7 mm. The larva was dirty white in colour and turned creamy white. Head and thoracic shield dark brown and body with sparse long white hairs.

Second Instar Larva.

Width of head 0.3 to 0.43 mm; average 0.41 mm. Length soon after moulting 3.5 mm, when full fed 4.0 to 4.3 mm. Body colour creamy white; head dark brown and thoracic shield has a deeper shade than the head.

Third Instar Larva.

Width of head 0.13 to 0.54 mm; average 0.50 mm. Length soon after moulting 5.4 mm; when full fed 5.59 to 6.2 mm. General body colour, creamy

Table 1 : *The Observations on the Biology of C. (Laspeyresia) pomonella (L.) in the Murree Hills*

Sr. No.	Name of Research Stations.		I Incubation period		II Feeding Period		III Pre-pupal period		IV Pupal Period		V Pre-oviposition period	
			Range	Average	Range	Average	Range	Average	Range	Average	Range	Ave.
1.	Aliot	(1st)	9-15	12.53	16-42	34.39	9-19	14.40	10-24	18.49	5-9	6.49
		(2nd)	6-12	8.07	40-60	53.98	—	—	26-34	33.77	4-7	5.00
2.	Phagwari	(1st)	8-16	12.25	18-43	35.71	8-21	14.54	11-23	16.00	2-8	5.21
		(2nd)	6-10	8.56	41-59	51.43	—	—	32-38	34.00	3-7	5.25
3.	Upper-Deval	(1st)	10-18	13.50	15-48	32.28	7-23	14.39	12-23	18.69	2-8	4.58
		(2nd)	5-10	7.21	39-55	47.98	—	—	29-40	35.80	3-5	3.50
4.	Ghora-Gali	(1st)	10-17	12.90	12-40	29.03	8-20	15.06	10-25	19.38	5-8	6.50
		(2nd)	7-10	8.10	36-56	44.96	—	—	31-39	34.69	3-5	3.50

Sr. No.	Name of Research Station.		VI Oviposition period		VII Life-span of adults		VIII Total life-cycle	
			Range	Average	Range	Average	Range	Average
1.	Aliot	(Ist)	9–20	15.40	3–16 M 3–17 F	9.12 8.60	45–93	76.93
		(2nd)	7–19	14.58	5–17 M 5–11 F	8.92 9.25	—	—
2.	Phagwari	(Ist)	11–22	17.42	5–20 M 5–22 F	10.15 9.22	46–94	78.90
		(2nd)	9–19	14.41	4–19 M 4–18 F	9.20 8.85	—	—
3.	Upper Daval	(Ist)	7–22	15.58	7–16 M 7–15 F	9.30 8.74	50–103	76.67
		(2nd)	9–18	14.58	6–19 M 6–20 F	9.65 9.32	—	—
4.	Ghora Gali	(Ist)	11–20	15.33	4–13 M 4–14 F	7.38 8.25	43–97	79.23
		(2nd)	9–19	14.82	4–17 M 14–18 F	8.60 7.75	—	—

Pre-mating period: 1-2 days 1.30 days (average)
Copulation period: 55 min. to 1 hr. & 40 min. 55.00 min. ,,
No. of eggs laid by a female : 12-56 eggs 23.00 eggs ,,

white but gradually acquired a pinkish tinge. Head some what pale brown; thoracic shield dark brown and hairs moderately long and white.

Fourth Instar Larva.

Width of head 0.64 to 0.5 mm; average 0.66 mm. Length soon after moulting 7.3 mm; when full fed 7.91 mm; General body colour, creamy white with a pinkish tinge; head very dark brown; thoracic shield much darker than the head; thoracic legs, brown bearing many bristle like hairs; head, thoracic shield and anal plate beared silky hairs.

Fifth Instar Larva.

Width of head 0.75 to 0.79 mm; average 0.77 mm. Length soon after moulting 8.3 mm; full fed 9.1 mm; General body colour pinkish white, head dark brown, shiny; mouth parts brown; thoracic shield darker than the head; thoracic legs creamy white bearing many bristle-like hairs.

Sixth Instar Larva.

Width of head 0.85 to 0.92 mm, average 0 89 mm. Length soon after moulting 9.4 mm, when full fed, 9.8 mm; General body colour light greyish-white with a pinkish tinge. The body beared short hairs arising singly. After the larva was full grown, it stopped feeding. Having found a suitable place, the larva first usually hollowed out, with its mandibles a little oval cavity and then started spinning its cocoon. Before pupating, the larva excavated a short passage for the pupae to wriggle out.

The pupa measured on the average about 8.7 mm in length and 2.6 mm in breadth across the third abdominal segment. The general body colour was light brown, the abdomen being a shade lighter than the rest of the body, and tapering gradually towards the posterior end and terminating in a rounded segment. The spiracles were prominent, rounded, raised, pimple-like and darker than abdomen. The maxillary palpi were about twice as long as the labial palpi. Antennae were comparatively longr.

Adult, (The Moth).

Moth with sub-median groove from base containing hair pencil. Fore-wings of the moth, beneath with elongate dark fuscous patch below middle of disc.

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