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## SOME ASPECTS OF MATING AND OVIPOSITION BEHAVIOUR OF THE SPOTTED BOLLWORM OF COTTON, *EARIAS VITTELLA* (F.)

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**Abstract.** Investigations were made on the mating and oviposition behaviour of the spotted bollworm of cotton, *Earias vittella* (F.) in the laboratory. The field-collected larvae when reared on natural diet showed a sex ratio of 49 males to 51 females. The females generally mated once and the maximum mating was observed on the fourth night after emergence. The mating was maximum between 2-3 a.m. and the duration of mating ranged from 30-105 min. It was also observed that males mate more often when confined with several females than with one.

The females started laying eggs on the second night after emergence or the first night following mating. The most active oviposition period was in the range of 2-7 days post-emergence. A mated female laid on an average 159 eggs. The majority of oviposition occurred during night hours.

The spotted bollworm of cotton, *Earias vittella* (F.) [*fabia* (Stoll)] is among the major destructive pests of cotton in Indo-Pakistan subcontinent. The damage is done by the caterpillars boring into the tender portions of the plant viz. the growing shoots, buds, flowers and bolls. In 1905 and 1906, there was a failure of the cotton crop in the Punjab and Sind, respectively, due to bollworms attack.<sup>1</sup> Experiments carried out by Deshpande and Nadkarny<sup>2</sup> in Punjab and Bombay Presidency showed that a crop protected against the attack of *E. fabia* yielded 15-80% more seed cotton than the control. Patel<sup>3</sup> reported that the spotted bollworm (*E. fabia*) was mainly responsible for damage to the cotton crop and low yields in Baroda. According to Naqvi<sup>4</sup> the spotted bollworms cause 10-15% loss in cotton yield in Sind.

Some information on the general habits of bollworm moths and oviposition behaviour has been reported by Deshpande and Nadkarny<sup>2</sup> and Ahmad and Ghulamullah.<sup>5</sup> The study reported here on the reproductive biology of this pest is necessary for a better understanding of the population dynamics when sterile-insect release technique is being considered for control purposes.

### Materials and Methods

The larvae were collected from cotton crop and also from okra (*Hibiscus esculentus* L.) which is an alternate host of this pest. They were reared on buds, immature bolls of cotton and okra in the laboratory maintained at  $27 \pm 2^\circ\text{C}$ , 70-80% R.H. and a photoperiod of 12 hr per day. The light was provided artificially through daylight fluorescent tubes.

The pupae were kept individually in glass vials until emergence to obtain virgin adults. On emergence one male was confined with one female in each oviposition cage. Food was continually available

to the adults in the form of 10% sucrose solution provided in a bottle equipped with a wick made of rolled cotton. Glass chimneys, the mouths of which were covered with muslin cloth, were used as cages in the current investigations. The fecundity and fertility was calculated by counting all the eggs laid during the life of each female and by incubating a portion of eggs for viability, respectively.

### Results and Discussion

**Emergence of Moths.** Under laboratory conditions, adult emergence was recorded daily at 7 a.m. and 7 p.m. from a total of 1750 pupae. It was observed that a total of 1640 adults emerged, out of which 40 (2.4%) emerged in the day time (7 a.m.-7 p.m.) and 1600 (97.6%) during the night (7 p.m.-7 a.m.). Callahan<sup>6</sup> found that in another Noctuid, *Heliothis zea* (Boddie) 94.6% of emergence occurred between 7 p.m. and midnight.

**Sex Ratio.** Larvae collected in the field during the months of June to September 1971, and reared in the laboratory yielded males and females in the ratio of 49:51. Out of 1926 pupae 944 were males and 982 females.

### Mating Behaviour

The observations on the mating behaviour of individual pairs were made during a period of almost equal darkness and daylight in the last week of September and first week of October. Similar photoperiod of 12-hr day and 12-hr night was created in the laboratory. Inspections were made at 15 min intervals through the day and night. During night a torch, the beam of which was subdued by means of a dense red filter over the lens, was used for observations. These inspections did not seem to disturb the

activities of the moths in any way. The male and female were placed in a cage the morning after their emergence and all the activities observed from the time of pairing until death.

**Precopulation Period.** The observations were made on 125 pairs caged individually after emergence. Twenty five females were dissected daily in order to note whether or not the females had mated. It was observed that 36, 48, 72, 88 and 84% females mated on first, second, third, fourth and fifth night respectively (Fig. 1). The maximum mating (88%) was recorded on the fourth night after emergence.

**Time and Duration of Mating.** Twenty six pairs that had mated were kept under continuous observation in order to note the time and duration of mating. The time when mating was initiated by different pairs was noted as follows: 2-3 a.m., 12 pairs; 3-4 a.m., 4 pairs; 4-5 a.m., 6 pairs; 5-6 a.m., 2 pairs; 6-7 a.m. 1 pair; 7-8 a.m., 1 pair.

All the copulations were observed after 2 a.m. Among the pairs under observation the earliest copulation was observed at 2 a.m. and latest at 7 a.m. The mating was maximum between 2-3 a.m. Squire<sup>7</sup> reported that moths of pink bollworm, *Pectinophora gossypiella* (Saunders), were active from 1-5 a.m. and that matings were largely restricted to the last 2 hr of this period. Ouye *et al.*<sup>8</sup> observed that first mating of the pink bollworm occurred between midnight and 6 a.m. Callahan<sup>6</sup> found that all copulations of *H. zea* occurred after 1 a.m. Shorey *et al.*<sup>9</sup> reported that the time of initiation of copulation of *Trichopulsia ni* (Hübner) observed in confinement was 2.10 a.m.

The time in copulation of 26 pairs was recorded from the time of initial attachment until separation. The pairs remained in copulation for an average of 68 min with a range of 30-105 min.

**Number of Matings.** The number of times a female mated successfully was determined by removing the bursa copulatrix, carefully dissecting it and counting the number of spermatophores. To find out whether or not more than one spermatophore ever resulted from a single mating, 30 pairs of the newly emerged males and females kept separately were confined (single pair) in the cages. They were watched continuously day and night and as the pair mated, it was kept under observation till separation. The females were then dissected. It was observed that one spermatophore was transferred at each mating.

In order to determine the number of matings a female could accomplish, 25 individual pairs of newly emerged moths were kept in oviposition cages. Upon death the females were dissected to record the number of spermatophores present in the bursa copulatrix. The data thus collected revealed that 22 pairs had mated once and only 2 pairs mated twice. These behavioural observations showed that females mate no more than once if a normal spermatophore is received from the male. Anwar *et al.*<sup>10</sup> reported that the females of another species of spotted bollworm, *E. insulana* Bois, generally mate once during their life span.

**Shape of Spermatophore.** The newly formed spermatophore is white, oval-shaped with a small sinuous tube attached to it. It measured an average  $2.2 \pm 0.3$  mm in length and  $1.7 \pm 0.2$  mm in width.

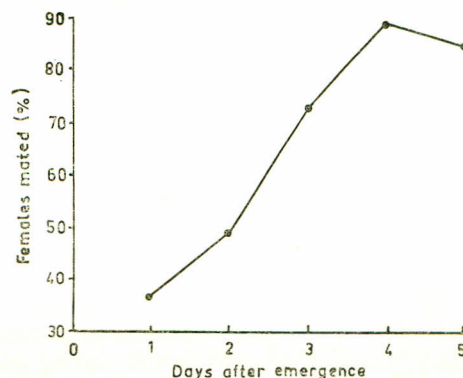


Fig. 1. Accumulated per cent of mated females of spotted bollworm.

**Effect of Sex Ratio on Number of Matings.** To determine the effect of sex ratio on number of matings, virgin females and males were caged together in different ratios in 10 replicates. The females were dissected after death and the number of spermatophores produced were recorded.

	Total	Average per male
5 Males and 1 female	14	0.28
1 Male and 1 female	9	0.9
1 Male and 5 females	18	1.8

The data showed that when a single female was confined with 5 males, an average of 0.28 spermatophore was produced per male. With a single male and 5 females, an average of 1.8 spermatophores was recorded per male. The results of spermatophore counts in this species agree closely with those of Gehring and Madsen<sup>11</sup> for the codling moth, *Carpocapsa pomonella* (L.), showing that males mate more often when confined with several females than with one. This is probably because the sex attraction of a mated female is less than of a virgin or the mated female refuses the male.

#### Oviposition Behaviour

**Preoviposition Period.** The females began egg laying on the second night after emergence or the first night following mating. As the mating took place in the first to fourth night after the emergence of moths, the preoviposition period under laboratory conditions was 2-5 days. Desphande and Nadkarny<sup>2</sup> noted that some moths of spotted bollworm, *E. fabia*, began laying eggs in the first night after mating and great majority of them commenced oviposition about the fourth night. They mentioned that the preoviposition period was 3-7 days under conditions in Bombay and 3-3.5 days at a temperature of 25-35°C.

**Time of Oviposition.** The results indicated that the ovipositing females were active mainly during nocturnal periods and majority of the eggs were laid during night hours. Our studies on 14 pairs kept in



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