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Studies on the Biology of *Exelastis atomosa* Wlsm (Pterophoridae; Lepidoptera)

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Introduction : *Exelastis atomosa* Wlsm., the tur plume moth has been reported to be a destructive pest of *Cajanus cajan* (tur) by Fletcher (1917), Ayyar (1940), Kadam and Patel (1957), Lal (1959) and Shrivastava (1964). Besides Arhar it has also been reported feeding on Carposiriid, *Moridarchis roprobata*, fruits of *Eugenia jambolina*, olive, *Dolichos biflorus* and *Dolichos lablab*. The larvae feed on tender buds, flowers and tender developing pods by making holes and feeding voraciously on the developing seeds. In case of severe infestation 30% of the grains have been found damaged due to the attack of this pest alone in Gwalior region of Madhya Pradesh in the year 1966. The distribution of this pest has been reported from New Guinea (Fletcher, 1920) and East Pakistan (Hazarika and Sattar, 1961). In India this insect has been noted in Central provinces, Bihar and Madras (Lefroy, 1909), South India (Fletcher, 1914), Mysore (Krishnamurthy, 1936), erstwhile Bombay State (Trehan and Pingle, 1946), Uttar Pradesh (Lal, 1959), Madhya Pradesh (Gupta and Joshi, 1955) and Rajasthan (1964).

Information available on the biology and bionomics of this pest is fragmentory as evident from the review of literature, investigations were, therefore, undertaken during 1965-66 in the Agricultural College, Gwalior (Madhya Pradesh).

Materials and Methods : The pest was reared on tender shoots and buds. For maintaining the turgidity, shoots and flower buds were inserted in glass tubes (4" × 1") filled with water by making a hole in the cork. The twigs were changed on alternate days. The adults on their emergence were confined in pairs for oviposition inside glass chimneys and were fed on 10–15% glucose solution. Eggs laid were removed daily and kept in petridishes (2" × 1") for hatching and newly hatched larvae were transferred on fresh tender shoots and buds for development. Its natural enemies and percentage parasitisation were also studied by collecting the larvae from the fields.

Life history studies : The observations on the life history of *Exelastis atomosa* W., were taken from October to December 1965 in the laboratory. The different developmental periods are given below.

Mating : Copulation occurs one to three days after the emergence of adults. The whole sequence of mating requires five to eight minutes in an end to end manner. Female mates only once in her life time. Single act of copulation lasts for ten to fifteen hours.

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Pre oviposition and oviposition : Female lays eggs generally at night on the day of mating or on the next night. Prior to oviposition, female flies actively, it then settles, touches the plant surface by the tip of her abdomen and then lays eggs singly. Eggs are laid on tender pods, buds, flowers, calyx, petioles, lower surface of leaf, ridges of shoots and tender branches of the plant. The egg is glued to the surface firmly. The oviposition period ranges from 2 to 5 days.

Fecundity and Viability : The fecundity of the female varies from 60 to 139, and viability of eggs from 80 to 93%.

Incubation period and hatching : This period ranges from 2 to 9 days. Prior to hatching, two black dots become prominent on the anterior part of the egg indicating the site of eyes of the larva. During hatching the chorion breaks and allows the head to come out which is followed by the eclosion of thoracic appendages and abdomen. The whole sequence of hatching of an egg is accomplished within a minute's time.

Larval instars, duration and process of moulting : The developmental periods of four larval instars are 2 to 4, 3 to 4, 3 to 8 and 7 to 12 days respectively. The total duration of larval period ranges from 15 to 28 days both in males and females. The larva passes through three moults. Prior to each moult it becomes sluggish and stops feeding. The white grey coloured exuvium is cast off first of the head then that of rest of the body by gradual peristaltic movement. Freshly moulted larva looks uniformly green but later changes to brown. The process of moulting is completed within 6 to 10 minutes.

Pupal period : The duration of pupal period varies from 6 to 15 days. Before pupation the full grown larva stops feeding, remains stationary for one day, attaches itself to the pod by white silken threads and pupates there. Pupation also takes place on the upper surface of leaves, on buds and in damaged pods.

Life cycle and longevity of audults : The period required for one life cycle varies from 23 to 52 days. The longevity of male and female adults with food varies from 2 to 6 and 3 to 7 days respectively.

Sex ratio : On examining 20 laboratory bred specimens for their sex, in each month from October to December, it is found that males out number the females and it varies from 1:1 to 1:18 (Female : Male).

Description of the life history stages: Egg : Average of 10 eggs Length 0.46 mm, breadth 0 26 mm Oval, light green with bluish tinge when fresh, becomes yellow before maturity.

Larva: First Instar: Average length is 1.62 mm, breadth is 0.10 mm light greenish yellow when fresh; head round, pinkish with brown coloured trophic; organs Eyes black; Thorax greenish with pads; a pair of black spines on the posterior side of pads; Black dots present all over the body; Abdomen ten segmented. *Scond Instar:* Average length 2.26 mm and breadth 0.32 mm general colour of the body and head pinkish, eyes brown, trophic organs with white hairs; mid dorsal line of the abdomen brown with brown coloured bands on its side; Many brown and green stripes present on the abdomen; On either side of brown stripes are present two green dots bearing one pair of black spines and three white hairs, while three other dots one after another bearing white hairs and two small dots on the sides bearing small white hairs. In all seven dots are present in each abdominal segment. Segmentation clear; Three pairs of thoracic legs and five pairs of prolegs present which are yellowish; Abdominal segments 3rd, 4th, 5th, 6th and 10th each bearing a pair of prolegs; Body fringed with white short hairs. *Third Instar:* Average length, 3.40 mm and breadth 0.51 mm, head green, eyes black and mouth parts brown; Thorax green with scattered white hairs; Body densely haired; Other details same as in second instar. *Fourth Instar:* Average length 5.06 mm and breadth 0.99 mm. A whitish band covered with white hairs appears across the body in between thorax and abdomen.

Pupa: Average length 7.50 mm and breadth 1.70 mm, colour brown, long, cylindrical tapering posteriorly; two brick red ridges present on the dorsal side; dorsal surface of newly formed pupa has greenish tinge which changes to uniform brown afterwards. Hairs seem to arise from the inter-segmental areas. Ventral surface devoid of hairs. Thoracic appendages reach the middle of 5th abdominal segment. First to seven abdominal segments distinct, segments 8 to 10 fused together. Spiracles round, slightly raised and present on second to seventh abdominal segments.

Adult: Average length of 7.09 and 8.0, length of antenna 3.1 and 4.4 and wing expanse of 20.11 and 22.02 mm for male and female respectively. Head grey with dark brown eyes. Antenna setaceous, long with white hairs held diagonally upward inward; Thorax red with white hairs; Abdomen brownish with whitish hairy patches. Legs pale white with bifurcations at two points, one point having one spur and other having two spurs each ending into blunt points. Wings deep brown with whitish hairy patches. Fore wing with one or two dark brown spots, divided into two lobes (plumes) which are surrounded with pale brown hairs. Hind wing is longitudinally divided into three lobes and provided with a fringe like border. Male is smaller in size than the female.

Natural Enemies: The only natural enemy of this pest recorded during the present studies was a larval parasite, *Apanteles paludicolae* cameron.,

(Braconidae; Hymenoptera). 7 to 18 per cent parasitisation of the third instar larvae of the pest was recorded during the months of December and October 1965 respectively. The longevity of adult parasites was found to vary from 2 to 5 days.

Discussion: The life cycle of the tur plume moth was studied earlier by many workers. The present findings regarding the pre-copulation period of 1–3 days is in quite agreement with that of Lefroy (1909) but Fletcher (1917) has reported it to be of one day. Single mating has been observed during the present study against multiple matings reported by Anonymous (1964). Oviposition period is 2–5 days against 1–5 days reported by Fletcher (1917). Fecundity per female ranges from 60–139 against 94, 94 and 35–75 reported by Lefroy (1909), Fletcher (1917) and Anonymous (1964). Incubation period ranges from 2–9 days against 4, 3–6, 5 and 2–5 days reported by Lefroy (1909), Fletcher (1917), Kadam and Patel (1957) and Anonymous (1964). Larval period ranges from 15–28 days against 14–28, 16–30, 28 and 10–25 days reported by Lefroy (1909), Fletcher (1917), Kadam and Patel (1957), and Anonymous (1964) respectively. Pupal period ranges from 6–15 days against 3–7, 14 and 3–12 days reported by Lefroy (1909), Kadam and Patel (1957) and Anonymous (1964). Period required for single life cycle varies from 23–52 days against 22–43, 21–28, 47 and 15–42 days reported by Fletcher (1917), Trehan and Pingle (1946), Kadam and Patel (1957) and Anonymous (1964). Longevity of adults varies from 2–7 days against 10. 10 and 1–10 days reported by Lefroy (1909), Fletcher (1917) and Anonymous (1964).

Bhatnagar (1948) and Usman and Puttarudriah (1955) have reported *Apanteles exelastisae* and *Apanteles Sp.* (*Glomeratus* group) (Braconidae; Hymenopletra) as the larval parasites of the pest from Bihar and Mysore respectively but did not mention about their activities and extent of parasitisation. During the course of current studies, the third instar larvae of the pest were found to be parasitised by the braconid parasite, *Apanteles paludicolae* C., maximum and minimum to the extent of 18 and 7% during the months of October and December '65 respectively.

Summary: The biology and bionomics of *E. atomosa* has been studied in detail. Mating occurs 1–3 days after the emergence of imagines. Eggs are laid singly on various parts of the plant. The oviposition period ranges from 2–5 days. Fecundity and viability vary from 60–139 eggs and 80–93% respectively. The incubation, larval and pupal periods vary from 2–9, 15–28 and 6–15 days respectively. Period required for completion of one generation varies from 23–52 days. Adults live for 2–7 days. Sex ratio studies carried out reveal that males dominate the females. Brief morphological description of the different life history stages are given. One larval braconid parasite and

its extent of parasitisation has also been recorded during the course of present study.

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