

BIOLOGICAL STUDIES ON LEAF STITCHER OF POPLARS, *GYPSONOMA*
HAPALOSARCA MEYR IN PAKISTAN

by

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ABSTRACT

Gypsonoma hapalosarca Tortricidae (Lepidoptera) is a serious pest of Poplars in Pakistan. This leaf stitcher becomes active in the beginning of April and passes through 6-7 generations during growing season. The larvae stitch two or more leaves together with silken threads and feed on parenchyma tissues, leaving net work of veins and skeleton of leaves intact. It causes more than 90% leaf stitching when severe.

The moths from hibernating pupae emerge during March and copulate 10-20 hours after emergence. The duration of mating varies from 25 minutes to 8 hours. The moths start laying eggs 12 hours after mating. A single female on an average lays 163.5 eggs with a range of 71 to 264 eggs per female. The oviposition period varied from 3-5 days. Incubation period varied from 3 to 9 days. Larvae just after hatching start stitching leaves and feed inside. The larval duration lasts for 9 to 24 days during which they pass through 5-6 larval instars. Pupation takes place within the stitched leaves, in cracks and crevices on the bark and under leaves attached to the stem and branches of the trees. The insect remains under pupation for 6 to 14 days. A life cycle is completed in 21 to 52 days. The pest hibernates in pupal stage from December to February during winter.

Introduction:—Poplar trees are among the few very fast growing tree species with great potentials for the present and future needs of industries producing paper, pulp, matches, packing cases and sports goods etc. Considering the increasing demand for these articles in the country, a large scale planting of hybrid poplars is being done. But un-

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fortunately poplar trees are subjected to the attack of a leaf-stitcher, *Gypsonoma hapalosarca* Meyr., a serious pest of various poplar species in Pakistan. This pest becomes active in the beginning of April and passes through 6-7 generations in a year. The larvae stitch leaves together by silken threads and feed on the foliage, leaving mainly the net work of veins intact. During July the trees present an unusual look due to premature drying or fall of stitched leaves. This adversely affects the growth of the trees. In Pakistan the pest was first recorded by Beeson (1941) who mentioned it skeletonising and webbing the leaves of *Populus euphratica* in lower Indus valley from July to September. Chaudhry et al (1970) collected *Gypsonoma hapalosarca* from poplar trees from Peshawar, Mardan, Kohat, and Abbottabad areas and mentioned it as serious pest. No work on the biology or ecology of this pest has ever been done in the country. But in U.S.A. Morris (1967) studied the biology of another species *Gypsonoma haimbachiana* boring twigs of young poplars. This paper describes the biology of *G. hapalosarca*.

Material and Method:—The life history of *Gypsonoma hapalosarca* was studied in the laboratory at Peshawar and Abbottabad at temperatures ranging 72 °F to 82 °F. Rearing was done in glass chimneys. To find out the fecundity of moths counted number of moths were liberated in glass chimneys on uninfested poplar shoots. These moths were shifted to new chimneys after allowing them 24 hours for mating. The eggs laid were counted daily. For the determination of larval instars more than 1500 larvae reared in the laboratory as well as collected from the field were preserved in 70% Alcohol, out of which 956 larvae were measured. Measurements were taken across the widest part of the head capsule with an ocular micrometer (Magnification 32x). Larvae just after hatching from the eggs were preserved for measurement of first instar. Duration of different developmental stages of the pest was determined in the laboratory.

Results and Discussion. I. *Adult.* (Plate I Fig 1). Small, buff-coloured to ashy grayish moth having lighter transverse band in the middle of forewing with no other distinctive markings. Wing expanse of 13-15 mm. Body length 4.5 mm. Hind wings hidden in resting position.

(a) **Emergence of adults:**—The moths from hibernating pupae started emerging in laboratory in the middle of February and continued up to first week of April. The mass emergence of moths took place between 25th March to 3rd April which coincided with the natural emergence in the field. Moths emerging before 25th March laid very few eggs and hatching larvae did not survive due to no sprouting by that time. It was noted that 74 to 94% moths emerged from the overwintering pupae among dry stitched leaves in the laboratory during 1970-71. During 1971-72 on an average 90% moths emerged from the pupae, which comprised of 66% males. On an average only 54.5% moths emerged from the hibernating pupae kept naked in glass dishes.

(b) **Mating.**—Mating of moths commenced 10 to 20 hours after emergence mostly during the night. The moths released in chimneys for mating showed preference for chimneys covered with black paper over uncovered ones during day time. The females lived for 4 to 12 days and the males survived for 2 to 5 days only. An average longevity of females was 8 days while that of males was 3.5 days. The egg laying females lived longer than non-layers. For copulation a female sitting on poplar shoot in a cage was approached by a male moving its antennae up and down. The male suddenly became active, took position on the side of the female and united the tip of its abdomen with that of female keeping its head in the same direction. It was noticed that in some cases the males lost their wings during the course of mating and died soon after. The duration of mating period varied from 25 minutes to 8 hours.

TABLE I

AVERAGE DURATION OF LIFE CYCLE OF *G. HAPALOSARCA*
DURING VARIOUS YEARS AT PESHAWAR.

Year	1967-68	1968-69	1969-70	1970-71	1971-72	Average
<i>Temperature:</i>						
Maximum (°F)	83.0	81.3	82.5	80.5	81.0	
Minimum	65.0	60.3	60.3	65.3	59.0	
Oviposition period	3.3	3.2	3.1	3.3	3.3	3.2
Range (days)	2-4	1-6	1-5	1-6	2-5	
Incubation period	4.1	4.9	4.7	4.3	5.0	4.6
Range (days)	2-8	2-9	2-10	2-10	2-9	
Larval period	12.1	16.0	15.6	16.2	16.8	15.3
Range (days)	9-16	11-24	12-20	11-22	13-21	
Pupal period	9.0	8.3	8.5	9.6	9.5	9.0
Range (days)	7-11	6-13	6-13	6-14	7-13	
Duration of generation	32.8	33.2	31.7	33.9	34.3	33.0
Range (days)	20-39	20-52	21-48	20-52	24-48	

(c) **Oviposition:**—The moths started laying eggs 2 hours after mating. In the laboratory the eggs were laid singly as well as in groups mostly along the mid-rib, sometimes alongside smaller veins, usually on the upper side of the leaves. The eggs laid in masses ranged from 12 to 31 in each group with an average of 19.5 eggs. The oviposition period varied from 1 to 6 days with an average of 3.2 days. A single female on an average laid 163.5 eggs with a range of 71 to 264 eggs per female. The maximum number of eggs were laid in the month of July/August in the laboratory, the minimum number of eggs were recorded in the moth of June, 1971.

II. **Egg:**—(Plate I, Fig. 2.)

Egg is oval flattened, 0.5-0.6 mm, shining, creamy white when laid, changes to redish light brown when about to hatch. The egg shell is thin and transparent.

(a) **Incubation:**—The average incubation period was 4.6 days. It varied from 2 to 9 days during different months. Counted number of eggs were kept under close observations to note the viability of eggs under various temperatures during different months. The data are given in Table II.

TABLE II
VIABILITY OF EGGS OF *G. HAPALOSARCA* IN THE LAB.

Date	Temperature Mean	No. of eggs	Larvae hatched	Viability %
3-4-1971	.. 77.5	40	37	92.5
18-5-1971	.. 79.5	52	46	88.4
14-6-1971	.. 84.7	31	22	70.9
15-7-1971	.. 81.2	113	101	89.3
11-4-1972	.. 77.7	50	45	90.0
12-5-1972	.. 80.00	55	49	89.1
8-6-1972	.. 81.5	120	100	83.0
14-7-1972	.. 84.2	100	72	72.0

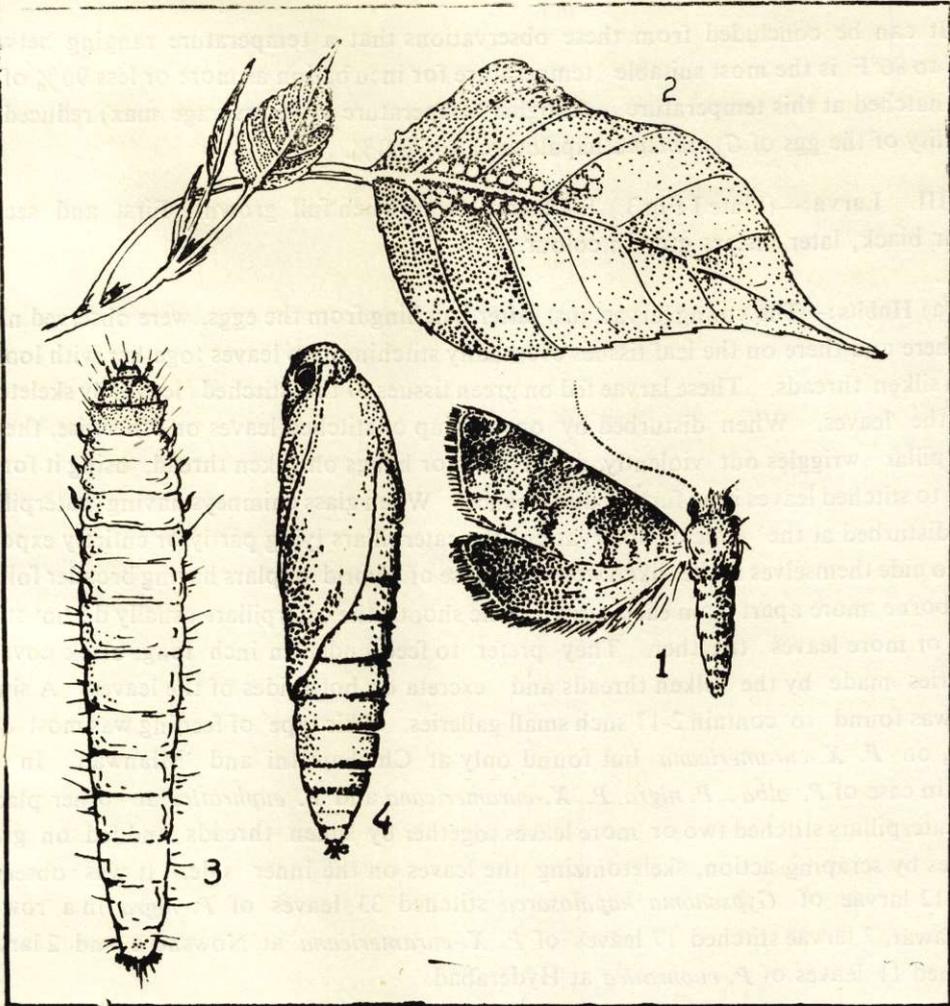


PLATE I Different stages of *G. hapalosarca* Meyr.

1. Adult x 7

3. Fullgrown larva x 10

2. Eggs on leaf x 8

4. Pupa x 12

The viability of eggs during 1971 was 92.5%, 88.4%, 70.9 and 89.3% at mean temperature of 77.5°F, 79.5°F, 84.7°F and 81.2°F, respectively in the laboratory. During 1972 it was 90%, 89.1, 83.0 and 72% at mean temperature of 77.7°F, 81.5°F and 84.2°F, respectively, with relative humidity ranging from 49% to 80%.

It can be concluded from these observations that a temperature ranging between 77°F to 80°F is the most suitable temperature for incubation as more or less 90% of the eggs hatched at this temperature. A higher temperature of 86 (average max) reduced the viability of the eggs of *Gypsonoma hapalosarca* to 70.0%.

III. Larva:—(Plate I Fig 3.) 9/12 mm. long when full grown. First and second instar black, later instars grey in colour.

(a) **Hnbits:**—The young larvae, just after hatching from the eggs, were observed nibbling here and there on the leaf tissues eventually stitching two leaves together with loosely spun silken threads. These larvae fed on green tissues of the stitched leaves by skeletonizing the leaves. When disturbed by opening up of stitched leaves or otherwise, the caterpillar wriggles out violently, drops down or hangs on silken thread, using it for return to stitched leaves if no further disturbance. When glass chimneys having caterpillars are disturbed at the time of observations the caterpillars lying partly or entirely exposed run to hide themselves in the silken webs. In case of hybrid poplars having broader foliage and borne more apart from each other on the shoots, the caterpillars usually do not stitch two or more leaves together. They prefer to feed under an inch long, black covered galleries made by the silken threads and excreta on both sides of the leaves. A single leaf was found to contain 2-17 such small galleries. This type of feeding was most common, on *P. X.-euramericana* but found only at Chichawatni and Mianwali. In the field in case of *P. alba*, *P. nigra*, *P. X.-euramericana* and *P. euphratica* at other places, the caterpillars stitched two or more leaves together by silken threads and fed on green tissues by scraping action, skeletonizing the leaves on the inner side. It was observed that 12 larvae of *Gypsonoma hapalosarca* stitched 33 leaves of *P. nigra* in a row at Peshawar, 7 larvae stitched 17 leaves of *P. X.-euramericana* at Nowshera and 2 larvae stitched 11 leaves of *P. euphratica* at Hyderabad.

When full-grown larva is about to pupate, it usually constructed a thin white, elongate cocoon attached to the leaves between the stitched leaves. In some cases the larvae pupated without spinning cocoons in the laboratory.

(b) **Larvae period:**—The larval period varied from 9 to 24 days with an average of 15.3 days. The shortest larval duration of 9 days was observed during the month of June 1968 and the longest of 24 days during November, 1969.

(c) **Natural mortality of larvae:**—To find out natural mortality of *G. hapalosarca* larvae, counted number of larvae were kept under close observations and number of pupae formed were recorded. The data are given in Table III.

TABLE III
NATURAL MORTALITY OF LARVAE IN THE LABORATORY

Month	Larvae under observation	No. of pupae formed.	Percent mortality.
April	100	93	7
May	66	61	7.5
June	44	38	13.6
July	29	28	3.4

It was observed that the natural mortality of *Gypsonoma* larvae was highest during June and lowest during July.

Larval instars:—For the determination of larval instars width of the head capsule of 107 larvae spinning pupal cocoons were measured to find out the size of the head capsule of the last larval instar. The data are given in Table IV.

TABLE IV.
HEAD-CAPSULE WIDTHS OF LARVAL INSTARS OF *GYPSONOMA HAPALOSARCA* MEYR.

Instars	Total No. of larvae measured	Range of head-capsule measurements in m.m.	Mean
Firs	102	0.10—0.23	0.16
Second	167	0.24—0.43	0.33
Third	211	0.44—0.63	0.53
Fourth	144	0.64—0.76	0.69
Fifth	225	0.77—0.90	0.83
Sixth	107	0.91—1.06	0.9k

It may be seen from these data that there is clear indication of six larval instars.

IV. Pupa:—(Plate 1 Fig 4).

Light brown, smooth, shiny about 6.5 mm long. Pupation was usually observed within the stitched leaves, in cracks and crevices of the bark and under leaves attached to the stem and branches of the trees. The larvae when full-grown pupated by spinning loose silken cocoons. The pupae when taken out of their cocoons rarely survived. On an average the pupal period was 9.0 days. The pupal period varied from 6 to 14 days. The pest passes through 7 generations in the laboratory from April to December.

V. *Seasonal history*:—In the field cages the emergence of moths from the overwintering pupae was observed in the month of March. The mass emergence of moths occurred in the last week of March. Pupae of the first generation were formed in third week of April. First generation was completed in the first week of May. The moths of the first generation laid eggs in the second week of May. Second generation was completed by the end of second week of June. Overlapping occurred in the third generation which completed in the third week of July. Fourth generation of the pest was completed by the end of second week of August. Eggs of 5th generation were laid in the third week of August. The fifth generation was completed by the beginning of third week of September. Eggs of the sixth generation were laid in the end of September and 6th generation of the pest was completed by the end of October. The moths of 4th generation laid eggs in the first week of November. The larvae of the 4th generation pupated for hibernation in the second week of December. The pest remained under hibernation from second week of December to third week of February.

ACKNOWLEDGEMENTS

The financial help received from the U.S.D.A. under Project No. A-17-FS-11. Grant No. FG-Pa-130 for these studies is gratefully acknowledged. We are greatly indebted to Dr. R. C. Morris of the Southern experiment station, Mississippi, U.S.A. for offering valuable suggestions during the course of these studies. The assistance rendered by O.Z. Moller N.D.P. Expert, Mr. Bashir Hussain Shah, Assistant Entomologist and Mr. I. A. Hafiz, Field Assistant is gratefully acknowledged. Our thanks are also due to Dr. Ghulam Ullah Chaudhry retired Director who worked as Principal Investigator of the Project from 1st September, 1967 to 11th January, 1971.

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