BIOLOGY AND NATURAL ENEMIES OF PINE BAGWORM, *CRYPTOTHELEA CRAMERI* WESTWOOD, (*PSYCHIDAE: LEPIDOPTERA*)

by

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Abstract: *Bagworm, Cryptothelea (Clania) crameri Westwood caused whole sale defoliation of Pinus roxburghii in nine square kilometres in Mirpur forest during* 1970-71. *Study of biology revealed that moths appear from middle of May to middle of July. Males are active fliers but live for a day while females are apterous, apodous and live for* 3 *to* 10 *days with an average of* 7 *days. Females remain in the pupal shell inside the bags and are impregnated by males by inserting their long abdomen through posterior aperture of the bag. Oviposition takes place from end of May to middle of July with an average fecundity of* 1764 *eggs ranging from* 600 *to* 3900 *per female. Larvae after hatching disperse and construct their bags by uniting small bits of bark of twigs and pass through* 5 *larval instars during* 10.5 *to* 11 *months including* 5 *months of hibernation. The overwintering larvae pupate in May-June for a period of* 7-30 *days. The life cycle is annual.*

Brachycoryphus nursei Cam. (Ichneumonidae), Sturmia inconspicuella and Podomyia sp. (Tachinidae) were recorded parasitizing bagworms in the defoliated area. Gradual increase in parasite population over took pest population in few years and the insect outbreak was controlled by the natural enemies.

Introduction: Very fortunately coniferous forests in Pakistan are having a good complex of insect parasites and predators which keep a reasonable biotic equilibrium. The losses due to insects normally remain within the economic injury level. Though rarely yet one or the other pest erupts into enormous population taking a heavy toll of the forest trees. When population of insect pest due to various natural checks reaches the lowest ebb the population of its enemies is bound to fall to the same level. During favourable climatic conditions the pest having least resistance from its natural enemies multiplies rapidly to cause epidemics. The parasites finding plenty of food also multiply but being late starter take time to over take the pest population. Pine bagworm, *Cryptothelea (Clania) crameri* Westwood appeared in epidemic form and defoliated over 9 square kilometres of *Pinus roxburghii* in Mirpur pine forest of Azad Kashmir during 1970-71.

Review of literature: *Cryptothelea crameri* Westwood was first reported from Ceylon in the oriental region by Hampson (1892). Stebbing (1908) recorded it feeding on needles of *Pinus roxburghii* occasionally stripping the trees of their needles in northwest Himalayas. Beeson (1941) reported it as polyphagous insect found throughout Indo-Pakistan subcontinent. Qadri (1951) observed *Clania crameri* defoliating chirpine in lower regions of

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Murree hills. Arora and Dolla (1964) recorded a new bagworm, *Clania acacienta* sp. nov. from Chandigarh, India feeding on the leaves of *Acacia arabica, Populus nigra* and *Clerodendron inerme*. Stannard (1964) studied the secondary injury to *Juniperus virginiana* caused by bagworm, *Thyridopteryx ephemeraeformis* (Haw.). He found bagwom girdling responsible for additional injury with wind and twigs beyond the point of attachment of old bags were weakened or even killed. Removal of bags before the commencement of spring growth has been suggested for prevention of such secondary disfiguration. Ramdas and Prasad (1965) recorded *Clania crameri* seriously defoliating castor and also damaging bhang, rose and pomegranate plants in Delhi. Hamid (1966) recorded it on *Clerodendron* sp., *Zizyphus* spp., *Acacia arabica, Myrtus communis* and other plants in Karachi. Momoi et al (1966) reported *Atleute minusculae* as an important parasite attacking larval stage of *Clania minuscula* and studied its biology. Browne (1968) described *Cryptothelea crameri* as polyphagous on foliage and tender bark of dicotyledonous and conifer trees in Ceylon, India and Pakistan. He reported it as an important pest in plantations of *Casuarina equisetifolia* in southern India. Other recorded hosts include *Acacia catechu, A. nilotica indica, Albizzia* spp., *Bischofia javanica, Bombax malabaricum, Cassia* spp., *Hevea brasiliensis, Pinus roxburghii, Santalum album, Shorea robusta, Tamarindus indica*, and *Terminalia chebula*. Rajendra (1968) briefly discussed insect pests of sugarcane and their natural enemies at Kantalai, Ceylon and found *Cryptothelea crameri* Westw., particularly injurious to nurseries was parasitized by *Thelairosoma* sp. and *Brachymeria* sp. in pupal stage. Hamid et al (1969) found *Brachycoryphus nursei* (Cam.) parasitizing 14% larvae of the bagworm in Karachi area. Nakayama et al (1973) studying efficacy of several insecticides against larvae of three Psychid species, *Cryptothelea minuscula* Btlr., *C. formosicola* (Strand) and *Canephora asiatica* (Star.), found 0.044% and 0.05% emulsion sprays of Chlorpyrifosmethyl and Salithion, respectively very effective against *Cryptothelea minuscula* attacking plum trees. Qadri (1973) found *Cryptothelea crameri* as pest of cotton plants for the first time in Karachi, where heavy attack in experimental plots of cotton was observed in July, August and September.

Material and method. Pine bagworms were collected from Mirpur pine forest. Rearing in laboratory at Peshawar was carried out for study of life and seasonal histories in wooden wire gauze cages at room temperature and during hot summer in the months of June, July and August at controlled temperature ranging from 27° C to 35° C. For field observations bagworms were reared on a 9 feet tall pine tree caged in Botancial garden at the Pakistan Forest Institute from October to May. During hotter months they were transferred from the field cage to temperature controlled laboratory. Newly hatched larvae were supplied with pine twigs bearing soft green bark for preparation of bags out of bits of bark. Later on fresh twigs and shoots with leaves were given for feeding. For observations on pupation and emergence of females several bags were cut open and tightly closed by wrapping around a thread for subsequent observations.

Results and discussion.

Life stages of *Cryptothelea crameri*

	Developmental stages				Adult stages			
	Incubation Period (days)	Larval Period (Months)	Pupal period (days)		Oviposition Period (days)	Postoviposition Period (days)	Longevity of adults (days)	
			Male	Female			Male	Female
R	10—15	10.5—11	15—30	7—15	1—4	1—4	1	3—10
A	13.7	10.8	23	10	3	3	—	7

R — Range A — Average.

Emergence of the moths occurs from middle of May to middle of July. The male moths having reddish brown wings with black streaks (26-32.5 mm. wing expanse) and body clothed with dark brown hairs emerge from the posterior aperture of the bags, generally at dusk. Females 24-26 mm long, creamy white having a band of yellow hairs at the anal end do not leave their bags or pupal shells and lie upside down throughout their life. Its body is vermiform, elliptical, devoid of wings, legs, antennae, eyes and mouth parts, looking like an egg-filled sac. Mating usually takes place at night for 1-4 hours when male inserts its long extensile abdomen into the pupal shell through the posterior aperture of the female bag. A male living for a day can impregnate two females. Egg laying occurs 1-2 days after emergence and a female lays an average of 1764 eggs ranging from 600 to 3900 per female packing them tightly in two third of the pupal shell. After oviposition female body reduces by 11-12 mm. It either wriggles out or adheres to the opening of the bag and dies after a life span of 3-10 days. Sex ratio was 4:3 in favour of males.

Eggs are smooth, spherical, creamy yellow which become blackish with in 10-15 days and hatch during 2nd week of June to last week of July.

Larvae on hatching stay for a day within the pupal shell in the mother bag and then crawl out in groups through the posterior opening of the bag keeping their abdomens lifted up and walking by means of thoracic legs very actively. Soon after dispersal larvae construct their bags with small bits of soft bark of twigs. First of all a ring around the thorax is made by uniting small bits of bark and then more pieces are added to the ring and slowly pushed backward till whole body is covered which takes about 40 minutes. Young worms carry their bags upright but in later instars the bags are carried in a pendent position as the size of larvae and bags increase from an average of 2 mm to 40 mm. Newly

hatched larvae feed for 12-14 days on green soft bark by making small holes but the second stage larvae shift to foliage and feed on needles. Larvae take three months to mature. A grown up larva during feeding ties its bag to a twig and protrudes its head and thoracic legs from the bag, hold a needle by thoracic legs and eat it completely starting from tip to base. Full grown larvae, 25-38 mm long in 30-46 mm long bags having reddish head and black abdomen, consume 3-12 needles (average 5) a day in 3-4 intervals. Larval period consisting of 5 instars lasts for 10.5 to 11 months, (June/July to May/June) with 5 months of hibernation from November to March. The caterpillar keeps its body inside its bag throughout its life, taking out its head and thoracic legs only for walking and feeding. The abdominal prolegs keep the bag gripped in hooks particularly when thoracic legs are used for walking and the bag covering the abdominal portion is dragged behind. When at rest it attaches the rim of the bag to a twig by means of a silken cord so as to hang in the air and closes the mouth of the bag from inside. Hibernating larvae fasten their bags tightly to twigs and retire inside the bags and close both apertures tightly. Female and male larvae can be distinguished from their bag size as bags of female larvae are larger and more bulky than those of males.

Hibernating larvae start feeding on needles again in March and pupate in last week of April to end of June. During pupation bags are fastened on twigs and both apertures are closed once again. The larvae turn round to hang head downwards inside the bag and transform to brownish pupae. Male and female pupae are quite different in shape, size and appearance. Male pupa elliptical in shape measures 13-16.5 mm while female pupa oval in shape measures 21-31 mm in length. Females emerge after a pupal period of 7-15 days while males come out in 15-30 days leaving pupal shell sticking out of the bag. Thus the pest has only one generation in a year.

Natural enemies of the bagworm were studied. *Sturmia inconspicuella* and *Podomyia* sp. (Tachinidae) were found parasitizing mature bagworms in active season. Being endoparasites their larvae feed inside the body of the host and come out to pupate on the dead body of the host inside the bag. Five to 15 parasites of *Sturmia inconspicuella* were recorded feeding on a single host larva for a week. Pupation lasts for 6-8 days and a life cycle is completed in 2-3 weeks.

Brachycoryphus nursei Cam. (Ichneumonidae) parasitizes mature larvae in active season and is an ectoparasite. One to two parasite larvae were found on a single host larva. Larvae feeding externally pupate on the body of the host within the bag. After a pupal period of 6 days adults emerge by making small holes in the wall of the bag.

Extent of parasitism was studied in the defoliated area as follows:

Year	Months of collection	Total No. of larvae collected	No. of parasitized larvae	Percent Parasitism
1974	October	250	21	8.4%
1975	October	540	65	12.0%
1976	October	450	40	9.0%
1977	June	846	660	77.8%

A parasitism of 8.4 to 12% was recorded in the month of October just before hibernation of the pest. In the following spring the parasite population developed and a maximum parasitism of 77.8% of host larvae was recorded. With the high potency of 600 to 3900 eggs per female the surviving 22% population of the pest multiply tremendously and the parasites having 3-4 times more population but low fecundity of 50-100 eggs per female lag behind in the initial stages. The multiplication of parasites in several successive generations during the annual life cycle of the host catches up the pest population. The race between the pest and its natural enemies continues. Any adverse conditions against parasites allow the host to breed freely to enormous population.

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