

Studies on the Hairy Caterpillar Pests of Cardamom in Kerala

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INTRODUCTION

Mat. *ELLETARIA CARDAMOMUM* constitutes one of the important cash crops of South India. In Kerala nearly 70,000 acres are under this crop in dense forests of the high ranges yielding an annual income of Rs. 200-250 lakhs. The State produces nearly sixty percent of the total output of cardamom in India. The chief use of cardamom is as a spice. In medicine it is used as a stimulant, aromatic and diuretic.

The plants are cultivated in evergreen "Cholas" of dense forests at altitudes ranging between 2500-4500 ft. Two varieties of cardamom are common in the State. One is the "Malabar", characterised by creeping panicles, plumose leaves, and spherical fruits. The other "Mysore" is characterised by erect panicles, smooth leaves, and oblong fruits. Varying number of hybrids between the two varieties are also common. They may have the dominant characters of either the Mysore or the Malabar variety.

Since cardamom is cultivated in dense forests far from larger centers of population where access is difficult and conditions of life not easy, very little is known about the insect pests affecting this valuable cash crop.

Historical Resume

Till the advent of thrips, *Taeniothrips cardamomi* Rmk., into the cardamom plantations, the hairy caterpillars were considered to be the most serious pests. The earliest recorded information is from Mysore, where a great deal of damage is reported to have been caused by the larva of a moth resembling *Eupterote minor* (Kunhikannan 1925). During the year 1937-39 serious outbreaks of hairy caterpillars were noticed in the cardamom hills of Kerala. A similar wide spread attack was also reported from Mysore (Anonymous 1939), though the identity of the pests was not established.

From the preceding resume it will be seen that previous work on hairy caterpillars of cardamom is rather scanty and no attempt seems to have been made to study the life history and bionomics of the various hairy caterpillars attacking cardamom and identify the different species responsible for the havoc. Therefore the present work was undertaken as part of a Research scheme sponsored by the University of Kerala.

Scope of Present Work

At the time of the commencement of the present work there existed a great confusion

regarding the identity of the different hairy caterpillar pests of cardamom and every hairy caterpillar found on cardamom was considered to be a serious pest. This confusion has been removed now and the economic status of each caterpillar has been determined by the present work. The life histories of seven hairy caterpillars attacking cardamom have been studied in detail with

special reference to their alternate hosts, feeding capacity, external differences between different instars, pupation, aestivation, number of broods in a year, longevity of the adult, sex ratio, natural enemies etc. The life histories of *Eupterote cardamomi*, (sp. nov.), *E. canarica* M., *Eupterote testacea* Wlk., and *Lenodora vittata* Wlk., have been worked out in detail for the first time.

Key for identification of the hairy caterpillar pests of Cardamom in Kerala.

1. Caterpillars with thick black bristles in the mid dorsal region of metathorax and abdominal segment; downwardly directed prominent ventrolateral tufts of setae *Lenodora vittata*.
2. Caterpillars with prominent erect setae and bristles arising from mid dorsal and dorsolateral regions (a-f)
 - (a) Head palebrown; body dark grey, setae white tipped; mid dorsal conical tufts light brown *Eupterote cardamomi*.
 - (b) Head dark red with black A mark on the middle *E. canarica*.
 - (c) Head black; setae long, grey at the tips, prolegs and ventral side red *E. fabia*.
 - (d) Head ochraceous with prominent black markings; mid dorsal silvery white line prominent *E. testacea*.
 - (e) Two prominent protuberances on the mid dorsal region of the 6th and 7th abdominal segments *Euproctis lutifacia*.
 - (f) Head body and setae black ventral side brown; eight to nine bundles of black setae on each abdominal segment *Alphaea biguttata*.

Fam. EUPTEROTIDAE (LEP.)

Eupterote cardamomi (Sp. nov) (Plate I, a)

Body ochraceous, collar yellow, a pair of

raised hair patches on the prothorax; costal margin of the forewing bent at the apex; double post median lines on the outer margin; Inner to them six highly waved lines of which those towards the base indistinct. Outer to

the post median lines a series of successive triangular greyish white patches; a black central area present on the second and eighth; apex greyish white. Hind wing with a double post median line and four wavy lines towards the outer margin. A black spot at the basal angle—Exp. 62-65 mm.

+ (Plate I, b) Double post median lines prominent, nearly straight on the forewing

close to the outer margin a reddish tinge; antennae with short branches. General colour of the wings ochraceous Exp.

70-80mm.)

Cometalia (Plate VI, b) consists of a pair of claspers (uncus) a pair of paramers (valve) and intromissive muscular penis with a chitinous sheath. Claspers are broad, pointed and bent downwards. Paramers are sickle shaped, the tip blunt and well chitinized, side thrown out into a series of lateral folds with a few scattered hairs. Holotype ♂

allotype ♀ on pin in the collections of Entomology section, Agricultural College, Vellayani, Trivandrum reared from immature stages on cardamom. 27.V.1944, Pampadampara G. R. I. coll. Several paratype reared from immature stages on cardamom during May and June 1944.

Systematic position.

The species is closely related to *Eupterote undata* Blanch, from which it differs in the following respects. Triangular greyish white patches outer to the post median lines; second and eight patches with a black spot in the middle. The apex of the forewing greyish white. A reddish tinge close to the outer margin of the wings in the female.

LIFE HISTORY

Just after the commencement of south west monsoon in June and July the moths emerge, mate and begin to lay eggs on the tall shade trees. Eggs have been collected in large numbers from *Maccaranga indica*, one of the common shade trees in the cardamom hills.

Oviposition. Eggs are usually laid on the under surface in a flat mass of single tier, the number in each mass varying from 50-160. On an average a single moth lays about 400-500 eggs and the maximum number recorded is 837.

The egg. (Plate I, c) is yellowish, dome shaped, having an approximate basal diameter of 1.25 m.m. and a height of nearly 1 mm. The chorion is leathery translucent, and has a pitted appearance. The base of the egg fixed to leaf is usually flat but rarely concave. As development proceeds the egg develops a rather dark tint and when about to hatch, the head of the embryo is distinguishable through the chorion as a dark circular patch. The larva emerges by biting off a circular portion of the shell at the top and the incubation period lasts for 15-17 days.

Newly hatched caterpillar.

Approximate length 2 mm. Head width 0.5 mm. The hairs on the body are wet and glued together and the caterpillar remains close to the egg shell wriggling its body to dry the hairs. The caterpillar begins feeding on the leaves of the host plant only on the second day after which a greenish tinge appears over the body. The head is smooth, shining black and the body is greenish yellow. The prothoracic shield is black, narrow and well defined. On the dorsal side of each segment behind the prothorax, there is a pair of circular black spots, the dorsal spots, situated one on each side of the mid dorsal line and those on the last abdominal segment are close to each other. Just below the dorsal spot on each side of each segment there is black lateral spot

bearing white hairs. The prothoracic lateral spots are situated immediately behind the spiracles where as those on the first eight abdominal segments are situated just above the spiracles. In each segment there is also a series of ventro lateral spots of which those on the thoracic segments are larger. There are two kinds of setae on the dorsal spots, long white hairs and short black bristles. The hairs are plumose and nonirritant. The bristles are sharp stiff and easily detachable and on coming in contact with human skin they cause considerable irritation and pain. The lateral and ventrolateral spots bear short white hairs. First instar caterpillar grows to a length of about 8 mm in 12 days. On the 14th or 15th day it ceases to feed, and a yellowish tinge gradually appears over the body. The prothorax becomes paler and distended. The larva remains motionless and moulting takes place on the 13th or 14th day.

Moulting.

Immediately before moulting a longitudinal split occurs on the left side of the meso and meta thoracic segments. The middle portion of the body is then pushed out through this slit in a form which gradually straightens and the head is pulled out suddenly. Thoracic legs gain a grip on the ground and the rest of the body is drawn out leaving the exuvium fixed behind. The moulting is completed within 2-4 minutes and the process is similar in all instars.

Second instar caterpillar.

Approximate length just after moult 6 mm. Head width 0.7 mm. The head and body are pale white and after a day the head develops a black tint, thoracic legs turn black and prolegs turn white. The caterpillar resembles the first instar in the arrangement

of dorsal and venterolateral spots and an additional faint black spot is present close to each spiracle. The venterolateral spots are borne on tubercles except those of the proleg bearing segments. Active feeding begins only by the second day and within 12-13 days the caterpillar grows to a length of 10.5 mm. On the 14th day feeding gradually stops and body gets reduced to 8.5 mm. A yellowish tinge prevails over the body and the caterpillar moults on the 15th day.

Third instar caterpillar.

Approximate length 8 mm. Head width 1 mm. The body is comparatively stouter than the previous instar. The mid dorsal region of the meso and meta thoracic segments are swollen and intersegmental regions throughout the body have two shallow grooves. On the meso and meta thoracic segments close to each spiracle one more spot is present. Though under field condition the caterpillar feed on the leaves of the shade trees, cardamom leaves offered in the laboratory are devoured voraciously. The caterpillar grows to a length of about 10 mm. in 12-13 days after which it gradually abstains from food and the body shrinks to 9 mm. Moulting takes place on the 14th day.

Fourth instar caterpillar.

Approximate length 9 mm. Head width 1.2 mm. The dorsal spots on each side of the abdomen are joined together by a faint longitudinal black line. Between the line of spiracles and venterolateral spots, on each intersegmental region one black spot bearing short white hairs is present. In about 13-14 days the caterpillar grows to a length of 20.5 mm. As in the last instar a yellowish tinge appears over the body and the caterpillar gradually stops feeding. On the day

previous to moulting the body measures only 11 mm. and the line joining the dorsal spots on each side becomes almost indistinct. Moulting takes place on the 15th day.

Fifth instar caterpillar.

Approximate length 12.5 mm. Head width 1.5 mm. The lines joining the dorsal spots are thick and distinct. The intersegmental grooves are more prominent here and the disposition of the spots is as in the last instar. About 12 days the caterpillar grows to a length of 26 mm. and moulting takes place on the 13th or 14th day.

Sixth instar caterpillar.

Length after moult 15.6 mm. Head width 2.1 mm. Head turns light brown with dark brown streaks on the genae. The ventral side and thoracic legs turn black, while prolegs remain white. Encircling each dorsal spot is a narrow white ring and along the mid dorsal region is a narrow white line. Just below the dorsal spots on each side is a broad light yellow longitudinal band. The long white hairs from the dorsal spots measure 9 mm. while the short bristles measure about 2.5 mm. The caterpillars differ markedly from the previous instars. They remain close together in large colonies during day and spin a lot of silken webbing around themselves. When disturbed they readily fall off the leaf suspended by the silken threads. In about 12 days the caterpillars grow to a length of about 31.5 mm. On the 13th or 14th day moulting takes place.

Seventh instar caterpillar.

Approximate length 21 mm head width 3 mm. Head is light brown, thoracic legs are reddish brown and prolegs are pale white with brown streaks. Prothoracic

shield is pale brown and the narrow white ring encircling the dorsal spots is very clear and marked. Mid dorsal region is light brown due to presence of short brown hairs. Of the two spots present near each spiracle the upper one is red. The caterpillars remain in closely packed up colonies during day in some sheltered places as the bark of shade trees. In about 10 to 12 days the caterpillar grows to a length of 37 mm and moulting takes place on the 14th or 15th day.

Eighth instar caterpillar.

Approximate length 26 mm Head width 4 mm. On the mid dorsal line behind each pair of dorsal spots is a median tuft of short brown hairs. Setae rising from dorsal spots have white tips. The long hairs measure about 12 mm and the short bristles about 4 mm. Within 10-12 days the caterpillar grows to a length of 52 mm. and moulting takes place on the 14th day.

Ninth instar caterpillar.

Approximate length 42 mm. Head width 5 mm. The mid dorsal conical tufts of light brown hairs are now more conspicuous. The broad yellow lateral spots are now joined by an indistinct black line. The long white tipped hairs from the dorsal spots are now joined by an indistinct black line. The long white tipped hairs from the dorsal spots measure about 20 mm. and the short ones from the lateral spots measure about 9 mm. The light brown hairs from the mid dorsal conical tufts measure about 2.5 mm. and short black bristles from dorsal spots measure about 4 mm. Within 13-14 days the caterpillar grows to a length of 65 mm and moulting takes place on the 15th day.

Tenth instar caterpillar (Plate I, d).

Approximate length 62 mm. Head width 6 mm. Head is light brown, thoracic legs

are dark red and prolegs are pale brown. The lateral bands have a predominant reddish tinge. The dorsal conical tufts of hairs are distinctly separated from each other. The black white tipped hairs from the dorsal spots measure about 22 mm. and the short ones measure about mm. The hairs from the ventero lateral spots measure 4-6 mm. The crochets of the sucker feet are arranged in two rows of unordinal meseries and each of these from the outer row bear unidentate spine. Tenth instar caterpillar is a voracious feeder and in about 19 days the caterpillar grows to a length of 90 mm. After 20th day the caterpillar abstains from food and the body contracts to 34-39 mm bringing the mid dorsal conical tufts close to each other.

Pupation :- After selecting a suitable place in the ground the caterpillar enters into the loose soil to a depth of 2 to 2½", for pupation. It constructs a silken cocoon to which particles of sand, debris, and short urticating hairs, adhere closely and when finished the cocoon looks like a globular mass of sand particles cemented together.

Cocoon (Plate I, e).

The cocoon is composed of two layers of silken webbing, the outer one is compactly spun to which sand particles, debris, and short urticating hairs adhere. The inner layer is formed by a loose silken webbing and the short urticating hairs derived from the mid dorsal conical tufts are compactly arranged on the inner surface.

Pupa (Plate I, f) is dark shining brown measuring about 24 x 11 mm. The last segment bears about 80 cremaster hooks arranged in concentric circles. The spiracles are oval with brown raised rims and the pupal period lasts for 7-8 months. Adults have been found attracted to lights. Sexes

appear to be equal in numbers and under captivity the moths have been found to live upto 20 days.

Larval Habits.

The larvae hatch out in swarms from the egg mass and remain in close congregation. Upto the 6th or 7th instar they remain on the shade trees feeding on the leaves. The attainment of 6th or 7th instar usually coincides with cessation of the monsoon and the on-set of sunny weather. Perhaps to escape the increasing heat of the sun the caterpillars feeding on the leaves of the shade trees fall down in large numbers suspended by fine silken threads, on to cardamom plants the leaves of which they begin to devour voraciously; Thus defoliation over a large area occurs in short time. It may be of interest to mention here that usually the plantations facing either west or east is severely attacked. Feeding is usually done in night and during day the caterpillars remain in closely packed up colonies on the barks the shade trees.

Extent of Damage.

A single caterpillar during the 6th to 10th instar stage consumes about 290-320 square inches of leaf and the brood of a single moth can destroy as many as 6 clumps. Therefore the caterpillars of 30 to 35 moths can completely defoliate all the plants in one acre. The defoliation results in the shrivelling of the plant which affects the yield considerably. The attacks on nursery plants almost prove fatal.

Economic Status This is one of the two major caterpillar pests of cardamom that caused heavy damages during the years, 1918-19, 1937-39, and 1952-53. On all these occasions nearly 10,000 acres south east of Vandamettu Pakuthy situated in the cardamom hills suffered heavy defoliation.

Though the caterpillars are found in small numbers every year, serious outbreaks are, sporadic.

Parasites and Natural Enemies.

Sturmia sericariae corn. This tachinid is noted to attack the caterpillars and about 10-15% are killed.

Aphanistes eupterote. This Ichneumonid parasitises the caterpillar occasionally. During rainy season a white mould attacks the caterpillars and chokes them to death.

Alternate host plants. In the jungle the caterpillars are found feeding on the following plants.

Polygonum Chinese Lin., *Solanum giganteum* Jacq. and *Maccaranga indica* Wt.

Eupterote canarica M. (Plate II a). After the heavy south west monsoon in June and July moths, these emerge in large numbers, mate and begin to lay eggs on the shade trees of cardamom. Eggs have been collected from *Erythrina indica* Lam., and *cinnamomum lanicum* Breyr. Eggs are laid in flat masses, the number in each varying from 40-120. The oviposition lasts for 9-12 days and on an average a moth lays about 480 eggs.

Description of the stages.

The egg (Plate II b, b') is light yellow hemispherical with a diameter of 1.5 mm and a height of 1 mm. As development proceeds the yellow attenuates and a light brown sets in. One or two days before hatching the head of the embryo becomes visible through the chorion as a black circular disc and the body is seen as a pair of pale white streaks with setae arranged in 8 to 9 bundles. Before hatching the top portion of the egg shell becomes thin and fragile and the larva hatching process takes about an hour and the incubation period lasts for 20 days.

First instar caterpillar.

Length about 3 mm. Head width 0.5 mm. Head shining black with a few scattered short hairs, and body is dull white with a pair of dorsal spot on each segment. The prothoracic shield and thoracic legs are black while the prolegs are dull white. Lateral and venterolateral spots are situated below each dorsal spot and, the caterpillar begins feeding on the second day as a result of which the body develops a greenish tint. In about 15 days the caterpillar grows to a length of 8 mm. and moulting takes place on the 18th or 19th day.

Second instar caterpillar.

Approximate length 8 mm. Head width 1 mm. The head is black and the body is pale green. Thoracic legs are black and prolegs are dull white. Encircling each dorsal spot is a faint halo of white and the last pair of dorsal spots are coalesced together. Arising from the dorsal spots are short glassy white bristles and long plumose hairs, which on coming in to contact with human body cause considerable irritation and pain. Within 10 days the caterpillar grows to a length of 15 mm. and moulting takes place on the 16th or 17th day.

Third instar caterpillar.

Approximate length 16.5 mm. Head width 1.5 mm. Head is light brown and the body is pale green. The dorsal spots have a light yellow tinge and the white halo encircling them are now more conspicuous. In about 8 to 10 days the caterpillar grows to 20-21 mm. It is during this stage that the caterpillars usually descend on to the cardamom from the shade trees. • Moulting takes place on the 13th or 14th day.

Fourth instar caterpillar.

Approximate length 19 mm. Head width 2 mm. The head is pale brown and the body

is pale green. On the mid dorsal region of the body conspicuous short yellow hairs are present and the ventral side is light yellow. Between the line of spiracles and the ventrolateral spots is a row of intersegmental spots. The dorsal spots on each side are joined together by a black line. In about 13 days the caterpillar grows to a length of 30 mm. and moulting takes place on the 15th or 16th day.

Fifth instar caterpillar.

Approximate length 15 mm. Head width 2.7 mm. Head is brown with a prominent dark mark and the body is pale green. Prothoracic shield and mandibles are dark brown. On the last segment behind the paired dorsal spots is a black transverse line. The yellow hairs on the mid dorsal region are now conspicuous. The caterpillar grows to a length of 34 mm. in about 16-17 days and moulting takes place on the 19th or 20th day.

Sixth instar caterpillar.

Length 32 mm. Head width 3.2 mm. Head is dull red with a narrow black streak just above the labrum and the body is pale green with yellowish tinge. Prothoracic shield is dark brown. The yellow hairs on the mid dorsal region extend around the paired dorsal spots almost encircling them. In about 12 to 13 days the caterpillar grows to a length of 49 mm. and moulting takes place on 20th or 21st day.

Seventh instar caterpillar (Plate II, c).

Length 32 mm. Head width 4.1 mm. Head is dull red and the body is dark brown. Thoracic legs and prolegs have a pale reddish tint. The hairs on the mid dorsal region encircling the dorsal spots are ashy grey. Behind each pair of dorsal spots is a black median patch of velvety hairs. On the dorsal side of the first abdominal segment there

are three small orange spots and on each side below the line of spiracles is an intermittent orange line. The crochets of the sucker feet are arranged in two rows in a uniordinal series and each of the outer row has a serrated edge. Within 20 or 21 days the caterpillar grows to a length of 62 mm. By about 29 days the caterpillar enters into the loose soil among debris for pupation. In rare cases the caterpillar is found to pass through another instar before pupation.

Cocoon (Plate II, d). Consists of a tough inner layer and a loose outer layer to which sand particles debris and short irritating hairs of the caterpillars adhere. The cocoon resembles a globular mass of sand particles and measures about 29 x 9 mm.

Pupa (Plate II, e) is shining dark brown measuring about 20 x 6 mm. The last segment bears about 86 cremaster hooks arranged in concentric circles. Pupal duration lasts for 7-8 months and moths usually emerge during July-August. During day time the adults remain inside some crevices and they have occasionally been found attracted to light. The adults have been found to live upto 30 days under captivity.

Economic status.

This is the second species of *Eupterote* that periodically attains the status of a serious pest though small numbers of caterpillars are seen every year. The caterpillars along with *E. cardamomi* were responsible for the wide spread damages referred to earlier.

Alternate host plants. The caterpillars have been found feeding on the following plants.

Erythrina indica Lam.,

Tectonagrandis Lin.,

Solarium giganteum Jacq.,

Maccaranga indica.

Trema orientalis.

Natural enemies.

Sturmia sericariae corn., is found occasionally parasitising the caterpillar. Like *E. ardamomi* these caterpillars are also found attacked by a white mould which causes heavy mortality.

Eupterote testacea Wlk. (Plate III; a, b.)

During south west monsoon (June and July) eggs are laid in clusters on the underside of the leaves of *Erythrina indica* Lam. The number of eggs in a cluster varies from 62 to 90 and a single female lays about 300-350 eggs in a period ranging from 8-9 days.

The egg (Plate III, c) is pale yellow, hemispherical, having an approximate diameter of 1 mm. and height of 0.5 mm. The chorion is smooth, leathery, and translucent. As development proceeds the egg becomes black and the incubation period lasts for 13-15 days.

First instar caterpillar.

Approximate length 2.5 mm. Head width 0.5 mm. The head and thoracic legs are black and the body and prolegs are pale white. The caterpillars are gregarious and feeding begins late in the second day. On the dorsal side of each segment there is a pair of black circular spots joined together by a faint black transverse line. immediately below each dorsal spot is a lateral spot and a ventro lateral spot. In about 10 days the caterpillar grows to a length of 6 mm. and moulting takes place on the 12th or 13th day.

Second instar caterpillar.

Approximate length 5 mm. head width 0.8 mm. The head is black and the body is

pale green. In addition to the faint transverse lines noticed in the previous instar the dorsal spots on each side are joined together by a longitudinal line. Within 6 or 7 days the caterpillar grows to a length of 9.5 mm and moulting takes place on the 10th day.

Third instar caterpillar.

Approximate length 8.5 mm. Head width 1.3 mm. The head is dark brown with an irregular white patch on the frons. The longitudinal line joining the dorsal spots become thick and prominent. On the mid dorsal region is a faint white line and below each spiracle there are two additional spots. Within 6 to 7 days the caterpillar grows to a length of 16.5 mm. and moulting takes place on the 10th or 11th day.

Fourth instar caterpillar.

Approximate length 12 mm. and head width 2 mm. The head is dark brown with seven irregular white patches. Ventrolateral sides and prolegs are black. Mid dorsal region is yellow due to the presence of large number of short yellow hairs and on each side just above the line of lateral spots is a broad dull white band on which is a black wavy interrupted line. Within 8 to 9 days the caterpillar grows to a length of 24 mm. and moulting takes place on the 13th day.

Fifth instar caterpillar,

Approximate length 17 mm. Head width 3 mm. Head is dark brown with prominent black lines. Mid dorsal region of the abdomen is bright yellow and that of the thorax is black. The setae arising from the dorsal spots are white tipped. On either side of the mid dorsal line is a faint interrupted white line. By about 10 days the caterpillar grows to a length of 45 mm. and moulting takes place on 12th or 13th day.

Sixth instar caterpillar.

Approximate length 26 mm. Head width 4 mm. Head is pale yellow with prominent black transverse streaks. Thoracic legs and prolegs are rosy red. In each intersegmental region there is a pair of transverse rows of black bristles. Of the two spots behind each abdominal spiracle the upper one is dark red. Within 8 or 9 days the caterpillar grows to a length of about 53 mm. and moulting takes place on the 15th day.

Seventh instar caterpillar (Plate III, d).

Approximate length 42 mm. Head width 5 mm. Mid dorsal region of the body has an interrupted silvery white line on either side of which there are two red lines. Encircling the dorsal spots are prominent ashy grey conical tufts of hairs. The broad lateral band has now a reddish tinge. The long hairs are white tipped. The crochets of the sucker feet are arranged in two rows in a uniordinal meso-series and each from the outer row has a unidentate spine. By about 18-19 days the caterpillar grows to a length of 72 mm. By about 25th day feeding stops and the body gradually shrinks to 48 mm. Pupation takes place inside a cocoon in the soil and the pupal period lasts for 4 to 6 days.

Cocoon as in the case of other Eupterotids is made of loose silk mixed with sand particles debris and urticating hairs derived from the body (Plate III, e).

Pupa (Plate III, f) is shining dark brown measuring approximately 23 x 10 mm. About 90 cremaster hooks are present in the last abdominal segment and the pupal duration lasts for 7 to 8 months.

Usually the moths emerge after the heavy showers of south west monsoon and the

sexes appear to be equal in numbers. The moths have been found attracted to light.

Alternate host plants

In Kerala, the caterpillars have been noticed feeding on the following plants. *Erythrina indica*. *Dolichos lablab* and *Polygonum chinense*.

Status :- Though the caterpillars are found in large numbers neither serious damages nor wide spread attacks have been noticed so far.

Eupterotefabia cram. (Plate IV, a).

The caterpillars are found in small numbers during August to October on cardamom.

Full grown caterpillar (Plate IV b,).

Approximate length 75 mm. Head width 5.5 mm. Head is smoky with an yellowish white mark on the vertex and genae. The ocelli are dark red. The prothoracic shield is black with a row of greyish white hairs. On the dorsal side of each segment there are two pairs of black spots bearing ashy grey hairs and bristles. The lateral spots are situated just above the spiracles and on each intersegmental region in between the lateral spots is a tuft of black bristles and hairs. The ventrolateral spots are situated below the lateral spots and the spiracles are dark brown with black rims. The long hairs arising from dorsal and lateral spots measure about 12 to 16 mm. and have greyish white tips. The crochets of the sucker feet are arranged in two rows in a uniordinal meso-series and those on the outer circle have serrated edge. Ventral side is dark red.

Cocoon as in other species of Eupterotids consists of two layers of silk mingled with urticating hairs and sand particles. The *pupa* (Plate IV, c) is dark brown measuring 31 x 12 mm. On the last abdominal segment

there are about 60-70 cremaster hooks. The pupal duration lasts for 7-8 months.

Alternate host plants: The caterpillars have been recorded as a defoliator of *Erythrina indica* and *Michelia champaca* in Ceylon. Beesone (1941) and Gardner (1944) mentions the occurrence of these caterpillars on cardamom in Coorg. In cardamom hills of Travancore they have been noted feeding in large numbers on *Tectona grandis*.

Natural enemies: *Sturmia sericariae* (Plate IV, e) parasities the larva occasionally.

Status: The caterpillars are found only in small numbers. Serious damages have not been reported so far.

Fam. LASSIOCAMPIDAE.

Lenodera vittata wik (Plate V, a)

Just after the early showers of southwest monsoon in June moths emerge, mate, and begin to lay eggs on the cardamom leaves.

Eggs (Plate V, b) are laid in a row either on the upper or under surface of the leaf. Oviposition commences two or three days after emergence and continues for a period of 6 to 9 days. A single moth lays in all 100-130 eggs. The egg is cream coloured, dome shaped, having an approximate diameter of about 2.9 mm. and a height of 1.6 mm. Chorion is smooth leathery and translucent. After about 5 days the developing embryo is visible through the chorion as a dark circular patch. During the time of hatching a circular portion on the top of the shell is bitten off as a result of which the apex of the dome comes off as a thin lid and the larva wriggles out. The incubation period lasts for 10-13 days.

First instar caterpillar.

Approximate length 7.3 mm. Head width 1.5 mm. Head is shining black with a few

scattered hairs. On the dorsal side of each segment except prothorax there is a pair of black spot one on either side of the mid dorsal line. The spots on the meso and metathoracic segments are larger and those on the last abdominal segments are coalesced together. Between the dorsal spots on each side there are a few inconspicuous lines and spots. Below each dorsal spot is the lateral and ventrolateral spots. There are 3 kinds of setae on the dorsal spots. (1) Long white flexible hairs about 10 mm. long (2) short white hairs about 4 mm. long and (3) short black bristles about 1.5 mm. long. The hairs are flexible, serrated and non irritant. The bristles are short, sharp, smooth and easily detachable and they are capable of causing considerable irritation and pain on coming in contact with human skin. In about 16 days the caterpillar grows to a length of 17 mm. and moulting takes place on the 20th or 21st day.

Second instar caterpillar.

Approximate length 14.5 mm. Head width 2.3 mm. The head is dark brown with prominent mandibles; and body is pale green. Thoracic legs and prolegs are pale white. The arrangement of the spots is similar to that of the previous instar and below the line of lateral spots is a pale white wavy line. Arising from the mid dorsal region of the metathoracic segment and first abdominal segment is a tuft of small yellow bristles measuring about 1.5 mm. Short yellow clothing bristles cover the body uniformly, each measuring about 2.5 mm. From the mesothorax, metathorax, and last abdominal segments pencils of long yellow hairs arise. In about 12 days the caterpillar grows to a length of about 30 mm. and moulting takes place on the 18th or 19th day.

Third instar caterpillar.

Approximate length 22 mm. Head width 3.4 mm. Head is dark brown with a narrow but prominent transverse white streak just above the clypeus. Long pencils of hairs, arising from meso and meta thoracic segments almost cover the head. The mid dorsal tuft of bristles on the meta thoracic segment and first abdominal segment is now black. The dorsal spots become inconspicuous due the dark ground colour of the body. The cloathing bristles measure approximately 2.5 mm. and they are arranged in two transverse rows one on each segment. In about 12 days the caterpillar grows to a length of 46 mm. and moulting takes place on the 18th or 19th day.

Fourth instar caterpillar.

Approximate length 36 mm. Head width 4.5mm. Head is dull yellow with a broad brown band outlining the border of vertex and mandibles which are reddish brown. Thoracic legs are pale white with brown tips and prolegs are pale brown. The dorsal spots are oval, dark brown, and in front of each pair there is an additional pair of spots. Some of the hairs arising from the lateral spots of thoracic segments have capitate hairs which measure 5-8mm. The caterpillar feeds voraciously and grows to a length of 60-62 mm. in 17 days and moulting takes place on the 18th or 19th day.

Fifth instar caterpillar.

Approximate length 45 mm. Head width 5.2 mm. The spots in front of the dorsal spots are now more distinct and the lateral spots bear black hairs measuring about 4 mm. The hairs arising from the ventrolateral spots are capitate measuring about 9.5 mm. Within 11 or 12 days the caterpillar grows to a length of 80-81 mm. and moulting takes place on the 20th or 21st day.

Sixth instar caterpillar (Plate V, c).

Approximate length 50 mm. Head width nearly 6 mm. Transverse rows of black bristles on each segment are now prominent. Almost all the cloathing hairs on the body are capitate and they measure about 18 mm. The black bristles from dorsal, ventral and ventrolateral spots measure about 5 mm. The crochets of the sucker feet are arranged in biordinal meso series. Within 18 or 19 days the caterpillar grows to 106-110 mm.

Pupation: On the 24th or 25th day the caterpillar stops feeding and the body gradually shrinks to 35-40 mm. At this stage the larva enters into the loose soil for pupation within an earthen cell. Pupae are usually seen 2 to 2½" below the soil.

Pupa (Plate V, d) is dark brown measuring about 32 x 14 mm. On the ventral side of the 6th and 7th abdominal segments there are small tubular protuberances and the last segment bears two sets of cremaster hooks. The pupal duration lasts for 5 to months.

Natural enemies:- A tachinid fly, *Carcelia kockiana* has been found to parasitise the caterpillar occasionally.

Status:- The caterpillars are usually seen in large numbers during August to December. During severe attacks heavy defoliation of the clumps are noticed leaving only the pseudostems and mid ribs. Since the attack is noticed only in widely scattered patches and no wide spread damages have been reported so far it cannot yet be considered as a major pest.

Fam. LYMANTRIDAE*Euproctis lutifacia* Hmps.

These caterpillars are found in small numbers feeding on cardamom leaves during December to January.

Full grown caterpillar.

Approximate length 29 mm. Head width 3 mm. Head is ochraceous and prothorax is broad with a slight prolongation on either side from which arise tufts of black hairs measuring about 7 mm. Dorsal region of the body is pale brown bordering a pale yellow tinge on either side. A mid dorsal black line divides the dorsal region into two halves, and on each segment there is a pair of dorsal spots bearing brown bristles. From the mid dorsal region of the 1st and 2nd abdominal segments a conspicuous tuft of brown hairs arise. Just below each abdominal dorsal spot is a tuft of white hairs and below each tuft is a lateral spot surrounded by a white ring. Below the lateral spots are the spiracles and ventrolateral spots, the latter bearing white plumose hairs. On each of the mid dorsal region of the sixth and seventh abdominal segments there is a glandular pouch. The crochets of the sucker feet are arranged in uniordinal meso-series.

Larva! habits: The caterpillars prefer tender foliage and feed by night. Two or three days before pupation the caterpillars abstain from food and gradually the length is reduced to 14-15 mm. Pupation takes place in the soil within a silken cocoon to which soil debris and leaf bits adhere. Pupa is dark brown measuring about 11 x 3 mm. and pupal duration lasts for 16 to 18 days.

The adult is a vinous brown moth with an antemedial orange red maculate line on the forewing. The moths have been found attracted to light occasionally.

Status: The caterpillars are found in small numbers and the damage done is not serious.

Fam. ARCTIIDAE***Alphaea biguttata.***

These black hairy caterpillars are found on cardamom during June to December.

Full grown caterpillar.

Approximate length 60-65 mm. Head width 5 mm. The head, body, and setae are black. The prothoracic segment is narrow with a well developed black shield from which arise four transverse bundles of setae. Thoracic legs and prolegs are dark brown and the crochets on the prolegs are heteroides. On each segment behind the prothorax there are 8-9 transverse bundles of black setae and each consists of two kinds of plumose setae; a short one measuring about 4 mm. and a long one measuring about 11 mm. Pupation takes place in the loose soil inside a silken cocoon to which sand particles and debris adhere. Pupa is dark brown measuring about 16 x 6 mm. and the last abdominal segment bears ten to twelve cremaster hooks.

The pupal duration lasts for 20-23 days and the adults have been found attracted to light.

Status:- The caterpillars are found only occasionally and the damage done is not serious.

SUMMARY AND CONCLUSIONS

Life histories of various hairy caterpillars attacking cardamom have been studied in detail. A key for identification of different hairy caterpillar pests have been worked out.

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