NEW RECORD OF DEFOLIATOR PESTS OF COCOA IN GODAVARI DISTRICTS OF ANDHRA PRADESH AND THEIR MANAGEMENT

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Abstract

The severity of various pest infestations and their damage to cocoa was explored in the cocoa gardens in East and West Godavari districts of Andhra Pradesh and their natural enemies were collected and categorized as per their feeding habitat. Amongst the defoliator pests, two leaf chaffer beetles viz., Brown leaf chaffer beetle, *Adoretus versutus* [Coleoptera: Scarabaedae:Rutelinae] and black leaf chaffer beetle, *Apogonia blanchardi* [Coleoptera: Scarabaedae:Melolonthinae] ; two Bagworm species, *Pteroma plagiophelps* and *Clania sp* (Lepidoptera: Psychidae) ; four tussock moth caterpillars viz., *Lymantria obfuscata, Euproctis subnotata, Euproctis fraterna, Dasychira mendosa,* one web worm *Acria sp* , two slug caterpillars *Parasa lepida, Macroplecta nararia* were identified and reported for the first time in cocoa crop in Andhra Pradesh. Natural enemies like *coccinellids, chrysopa* and spiders were observed during field visits .Amongst the various insecticides tested against the bagworm *[Pteroma plagiophelps]'*, 100 per cent reduction in the pest population at 1 day after spraying was caused by Carbaryl 50% WDP, Acephate 75% SP and Quinalphos 25% EC . Similar insecticidal efficacy patterns were observed against the tussock moth caterpillars, *Euproctis fraterna* and the web worm *Acria sp* .

Introduction

Cocoa (*Theobroma cacao* L.) is one of the commercial plantation crops of the world and it is largely grown as a mixed crop in coconut and areca nut plantations and under storey crop in partially cleared forests. At present, cocoa is being cultivated in an area of 17,800 hectares in India with a production of about 10,000 MT. Kerala accounts for 70 per cent of the area and 80 per cent of the production. Though Andhra Pradesh occupies second position in area, Karnataka ranks second in production. In Andhra Pradesh cocoa crop is being grown as an intercrop in coconut ecosystem to an extent of 13720 hectares. Most of the area being in East and West Godavari districts of Andhra Pradesh, 9512 and 2520 hectares respectively. In India cocoa is known to be attacked by about 50 insect and non insect pests comprising mealy bugs, tea mosquito bug, stem borer, aphids, stem girdler, leaf eating caterpillars and leaf eating beetles etc. among the insect pests . Recently, Emmanuel *et* a/.,(2010) have reported the occurrence of chaffer beetles *Adoretus versutus* and *Apogonia blanchardi* and bagworms *Pteroma plagiophelps Hamps and Clania sp* on cocoa crop. Nevertheless, the current paper focuses on prime information on status of the emerging pests of cocoa in cocoa-coconut inter-planted farming system in Godavari districts of Andhra Pradesh.

Materials and Methods

1. Studies on seasonal incidence of Cocoa pests:

The cocoa pest succession and intensity was determined in both fixed plot and rowing surveys at ten locations in Godavari districts of Andhra Pradesh .Various locations covered under rowing survey are Ambajipeta, Bandarulanka, Ralley, Ravulapadu, Munganda, Ravulapalem, Palevela,

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Isakapudi, Sakhinetipalli, whereas the HRS, Ambajipeta was considered for fixed plot survey. The total numbers of insects collected were sorted out and percentage of occurrence in the population was worked out. The leaf damaged by the defoliators was based on ten replications and number of observations per replication were 20 leaves for < 5 years and 50 leaves for 5-10 years crop age. Lower, middle and upper leaves were taken for defoliation intensity studies. Statistical analysis was performed using SAS Institute Inc. 9.2 version [2010] statistical software.

2. **Insecticidal efficacy against the defoliator pests:**

The commercial formulations of various insecticides viz., Neem oil [Azadirachtin EC 1500 ppm], Carbaryl 50% WDP, Endosulfan35% LC, Quinalphos 25% EC, Profenophos 50% EC and Acephate 75% SP were tested against the defoliating pests [Bagworm, hairy caterpillars and Web worm] were tested a their recommended field concentrations. The pest population count was recorded at 24 hours before spraying and the morality count was recorded every 24 hours till 5 days after spraying. Statistical analysis was performed using SAS Institute Inc. 9.2 version [2010] statistical software.

Results and Discussion

During the course of exploration, periodical visits were made to the cocoa gardens and diverse pests and natural enemies were collected and categorized as per their feeding habitat. From the observations it is found that defoliator pests *viz.*, Brown leaf chaffer beetle, *Adoretus versutus* [Coleoptera: Scarabaedae:Rutelinae] and black leaf chaffer beetle, *Apogonia blanchardi* [Coleoptera: Scarabaedae:Melolonthinae], Bagworm *Pteroma plagiophelps* and *Clania sp* (Lepidoptera: Psychidae) were recorded. The adults of brown leaf chaffer beetle, *A.versutus* and black leaf chaffer beetle, *A. blanchardi* incidence were observed in two spells *viz.*, June [Max Temp : 40.4°C; RH:77.3 %] July [Max Temp : 35.6°C ; RH : 85.8 %] and October [Max Temp : 33.3°C; RH : 88%] - November [Max Temp : 30.4°C;RH:90.96%]. However, the bagworm *P. plagiophelps* was noticed all round the year whereas the hairy caterpillars *[Dasychira mendosa, Euproctis scintillans]*, semi-loopers were prevalent between September to April in lower intensities. Natural enemies like *coccinellids, chrysopa* and spiders were observed during field visits [Table 1 and Fig 1]

Alarmingly the brown leaf chaffer beetles *Adoretus versutus* is posing a threat to young cocoa crop with less than five years age [100 % foliage damage] in both the spells i.e July and October. However, in the older plantations [>15 years] its damage severity is at lower levels at 4.69 % in July and 4.44 % in October. The black leaf chaffer beetle *Apogonia blanchardi* damage to the cocoa crop is lesser than the brown leaf chaffer beetles with 22.49 % in July and 17.81 % per cent leaf damage in the crop age between three and five years, whereas in the older plantations [> 15 years] it is 2.81 in July and 2.67 % in October .The damage intensity of all the leaf eating caterpillars collectively [Hairy caterpillars *viz., Dasychira sp, Euproctis sp* and bag worm *Pteroma plagiophelps* and semiloopers] was maximum of 8.55 % [July] and 7.25 % [October] respectively recorded in the crop age between 5- 10 years [Table 2]

Biology and Ecology of the defoliator pests of Cocoa are given below:

Defoliator pests

1. **Brown leaf chaffer beetle/Indian Rose beetle / *Adoretus versutus]*:** Adults feed on cocoa plant foliage at night, creating a lace-like or shot with holes appearance on leaves by feeding on plant tissue between leaf veins. In severe cases most leaves are skeletonized. The life cycle (egg -adult) is completed in 6-7 weeks.

2. **Black leaf chaffer beetle** *[Apogonia Blanchardi]* : Black leaf chaffer beetle were observed feeding on the cocoa foliage during night times confirming to be nocturnal. Adults feeds on the cocoa leaf from the peripheral region. A adult is deep black species without metallic luster. Length is 9.5 to 11 mm, ovate, glabrous, shining black, the apex of the elytra and the two basal ventral segments, however, opaque ; the antennae and palpi pale ferruginous ; the under surface and legs sprinkled with pale coloured setae.

3. *Bag worms [Pteroma plagiophelps and Clania spj:* The self enclosing bags of *P. plagiophelps* is 1.8 to 2 cm long and 5 to 6mm wide .In the rowing survey , the *P. plagiophelps* larvae with enclosing bags were collected and were reared on cocoa leaves in the laboratory. The caterpillar builds silky bag in narrow cone shape with plant materials live in this mobile case and rest by sticking top opening of the case to the cocoa leaves and hang their bag vertically. Whereas the self enclosing bags of *Clania sp* is 3.5 to 4.4 cm long and 8 to 9mm wide .This species uses sticks of similar size and there are about 9-13 sticks arranged parallel around the silk case except one or two of their sticks used are much longer than the other. The caterpillar lives inside the case and feeds on the cocoa foliage. Both the *P. plagiophelps and Clania sp* feeds the cocoa leaves from the central leaf lamina in a circular to irregular holes.

4. **Tussock caterpillar [** *Dasychira mendosa]:* The larvae of this moth feed on foliage of many plants including cocoa. Therefore, due to this large host range, the breeding continues throughout the year during which there are probably 5 or 6 generations. The moth, which has pale yellow, hind wings and forewings are irregularly patterned with various shades of brown, lays large masses of eggs. The feeding by larvae results in defoliation and the larval period lasts for 21 -28 days. The fully-grown hairy larva has a reddish head; the body greyish or yellowish, is striped with red and with long dense dorsal tufts of whitish hairs. They pupate in loose cocoons made of silk and hairs and the pupal period lasts for 11-12 days.

5. ***Euproctis subnotata*** *:* Laboratory studies with *Euproctis subnotata,* reared on Cocoa leaves, showed that the average incubation period was 6.7 days, larval period 23.57 days, pupal period 11 days, total life cycle 35.77 days and .Male adult longevity was 6 days, while the female adult longevity was 8 days. Females laid an average of 155 eggs and the larvae underwent 6 instars.

6. ***Euproctis fraterna*** : The development of *Euproctis fraterna* was studied on cocoa leaves .The mean incubation period was 6.93 days. The larvae passed through 6 instars and completed development in 23.25 days. The pupal stage occupied 11 days. The total life cycle was completed in 41.18 days. Male adult longevity was 6 days, while the female adult longevity was 8 days. Females laid an average of 146 eggs .

7. ***Lymantria obfuscate*** : Laboratory studies with *Lymantria obfuscata,* reared on Cocoa leaves, showed that the average incubation period was 8.7 days, larval period 26.57 days, pupal period 11 days, total life cycle 36.77 days and .Male adult longevity was 5 days, while the female adult longevity was 7 days. Females laid an average of 158 eggs and the larvae underwent 6 instars

8. ***Euproctis scintillans*** : The larvae of this species feed voraciously on leaves. Initially the larvae scrape the green matter resulting in skeletonization. Later the larvae move into the other parts of the plant and defoliate. This hairy caterpillar larval stage lasts for 13-29 days and the pupal period lasts for 9-20 days. The total life cycle lasts for 6-7 weeks.

9. **Slug caterpillar** ***[Parasa lepida]*** : Eggs *ofParasa lepida* are laid on leaves which hatch in 3-5 days. Young larvae feed on the leaf epidermis and as they develop, chew up leaves. There are 7 larval instars (often 8 instars for females) which are completed in 35-42 days. Pupation occurs in cocoons often attached to stem or bark and the pupal stage lasts 21-24 days.

10. **looper caterpillar** ***[Thalassodes* spp]:** This looper is found feeding on developing leaves. The larval period lasts for 17-18 days. The larva possessing the color of new shoots and assuming a characteristic pose on the twig is often mistaken for a leaf petiole. The pupal period lasts for 7-8 days. The total life cycle was completed in 33.18 days.

Table-1: Pests on cocoa crop observed during the study period [2009-10 & 2010-11]

Month & Year	Intensity of the pest		
	High	**Medium**	**Low**
June '09	Brown Leaf chaffer beetle	Black Leaf chaffer beetle	Bagworm
July '09	Brown Leaf chaffer beetle	Black Leaf chaffer beetle	Bagworm
August '09	Bagworm	Brown Leaf chaffer beetle	*Mealy bug*
September '09	Hairy caterpillars	*Semi loopers*	*Mealy bug*
October '09	Brown Leaf chaffer beetle	Black Leaf chaffer beetle	*Aphids*
November '09	Brown Leaf chaffer beetle	Black Leaf chaffer beetle	Hairy caterpillar
December '09	Hairy caterpillars	Bagworm	*Aphids*
January'10	Bagworm	Hairy caterpillars	*Aphids*
February '10	Bagworm	Hairy caterpillars	*Semi loopers*
March'10	Bagworm	Hairy caterpillars	*Semi loopers*
April '10	Bagworm	Hairy caterpillars	Hairy caterpillars
May'10-Dec '10	No major pests were observed due to heavy rains and inundation of the cocoa gardens which submerged and killed the leaf chaffer beetles in the soil. However, the bag worn-incidence was observed all through the year.		
January '11	Bagworm	Hairy caterpillars	*Mealy bug, Aphids*
February '11	Bagworm	Hairy caterpillars	*Mealy bug, Aphids*
March'11	Bagworm	Hairy caterpillars	*Mealy bug, Aphids*
April'11	Bagworm	Hairy caterpillars	Hairy caterpillars

High = > 50 % leaf damage; Medium = 25- 50 % leaf damage; Low < 25 % leaf damage

Table-2 : Damage assessment of cocoa crop due to various defoliators

Crop age [Yrs]	[Yrs]Mean leaf damage [%]					
	Adoretus versutus		*Apogonia blanchardii*		Leaf eating caterpillars	
	July 09	Oct09	July 09	Oct09	July 09	Oct09
1 - 2	100.00 A	100.00 A	7.45 D	6.85 D	0.00 E	0.00 E
3-5	100.00 A	100.00 A	22.49 A	17.81 A	5.04 B	3.65 C
5-10	28.56 B	26.58 B	16.56 B	13.03 B	8.55 A	7.25 A
10-15	14.65 C	13.47 C	10.21 C	9.92 C	4.23 C	4.11 B
>15	4.69 D	4.44 D	2.81 E	2.67 E	2.43 D	1.85 D
CD [a =0.05]	0.606	0.495	0.151	0.294	0.107	0.155

Management of Defoliator pests of Cocoa pests

Amongst the various insecticides tested against the bagworm *[Pteroma plagiophelps]*, 100 per cent reduction in the pest population at 1 Day after spraying was caused by Carbaryl 50% WDP, Acephate 75% SP and Quinalphos 25% EC while, 5.88, 60.00 and 61.54 per cent reduction was achieved through the Endosulfan 35% EC , Neem oil Azadirachtin EC 1500 ppm and Profenophos 50% EC .However, to achieve the 100 per cent reduction in the pest population the Neem oil [Azadirachtin EC 1500 ppm] and Endosulfan 35% EC required three and two days after spraying. Similar insecticidal efficacy patterns were observed against the tussock moth caterpillars, *Euproctis fraterna* and the web worm *Acria sp*

Future Scope

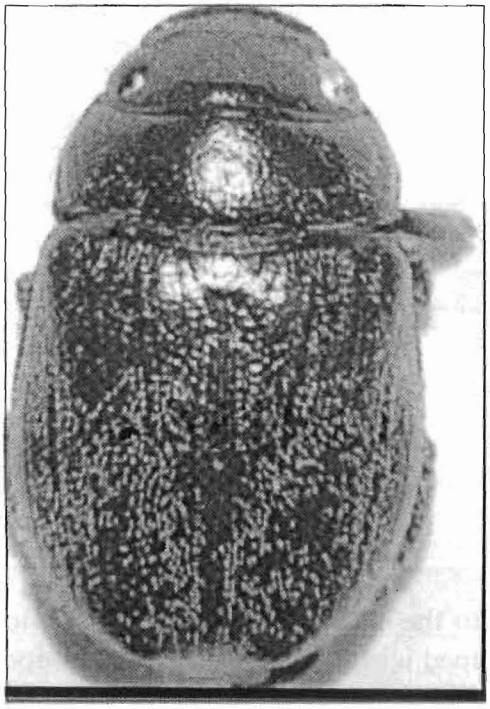
Currently the Cocoa crop in Andhra Pradesh , especially in the Godavari districts is increasing at much exponential rate. However, the potential threats to the crop by the pests should not be undermined which would retard the production and productivity of the cocoa crop. Further to explore and manage the new and existing pests require infrastructure facilities for laboratories and research facilities in the dimensions of finding ecologically safe molecules *viz.*, botanicals, entomo-pathogenic fungus, parasites and predators etc., for the crop to minimize the pesticide sprays and better remuneration to the farming fraternity.

References:

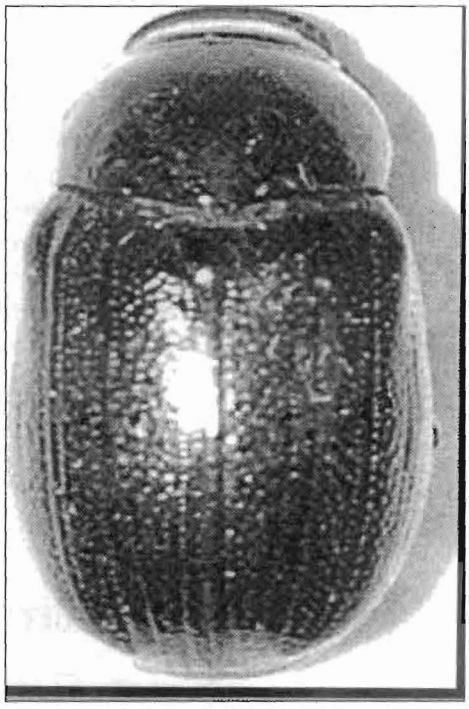
Emmanuel.N, Sujatha.A, Gautam.B.2010.Record of leaf chaffer beetles *Adoretus versutus* Harold and *Apogonia blanchardi* Ritsema on Cocoa *(Theobroma cocoa* L.) in Andhra Pradesh. Insect Environment .Vol.16 (1), April-June.pp:23.

Emmanuel.N, A. Sujatha and B. Gautam. 2010. Occurance of Bag Worms Pteroma plagiophelps Hamps and Clania sp. on Cocoa Crop. Insect Environment, Vol.16 (2) pp: 60-61.

Fig 1. New Report of Defoliator Pests of Cocoa in AP

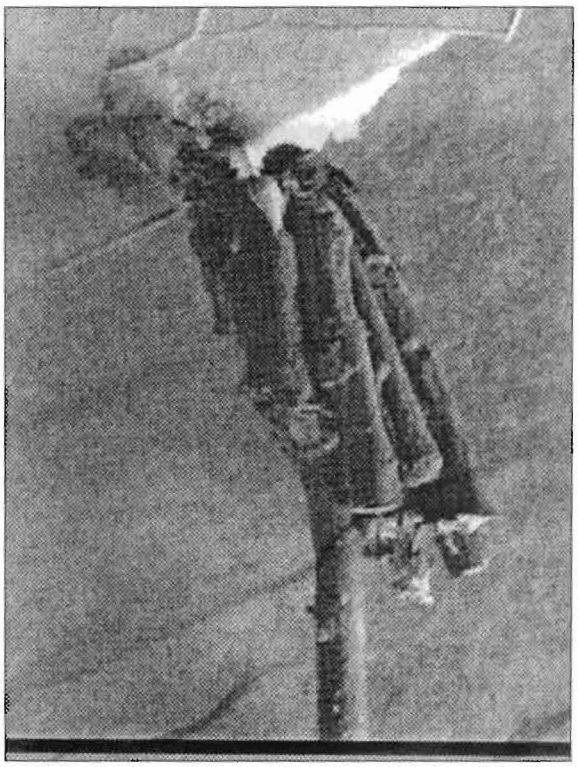


Brown leaf chaffer beetle Adoretus versutus

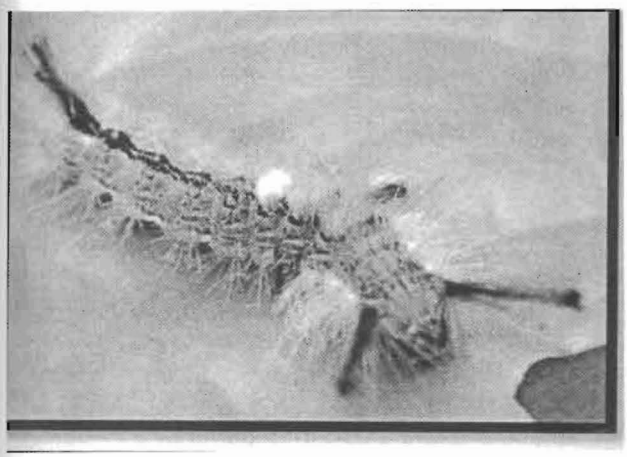


Black leaf chaffer beetle Apogonia blanchardii

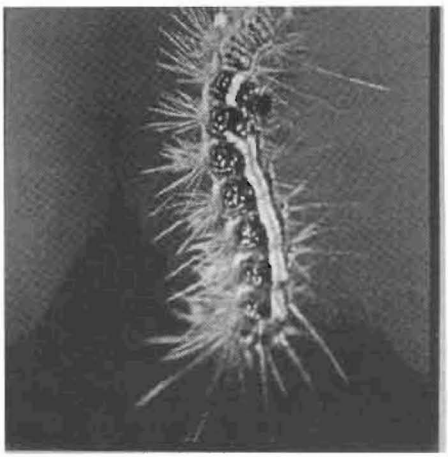
Bag worm Pteroma plagiophelps



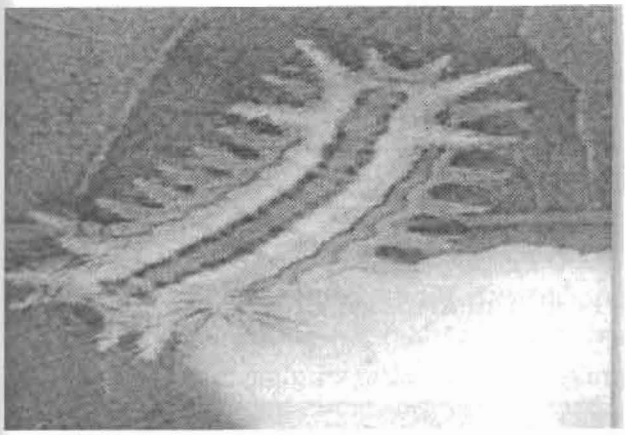
Bag worm Clania sp



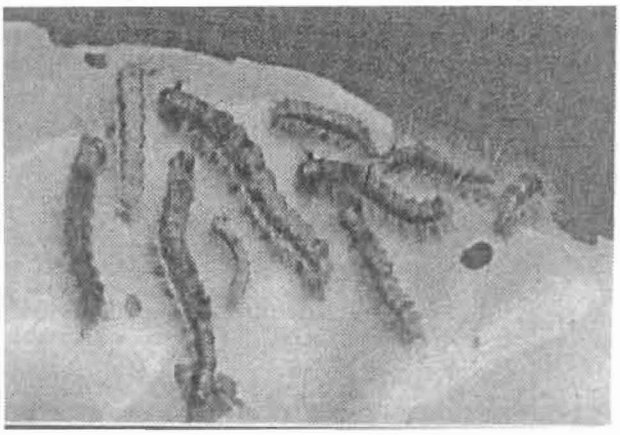
Tussock caterpillar
Dasychira mendosa



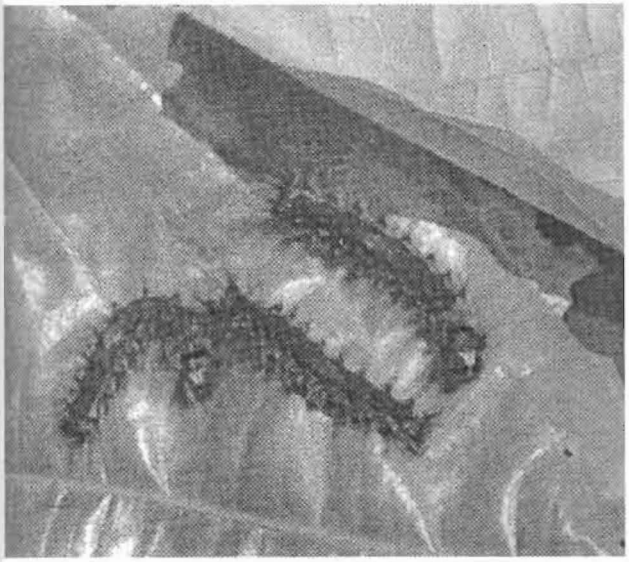
Tussock caterpillar
Euproctis subnotata



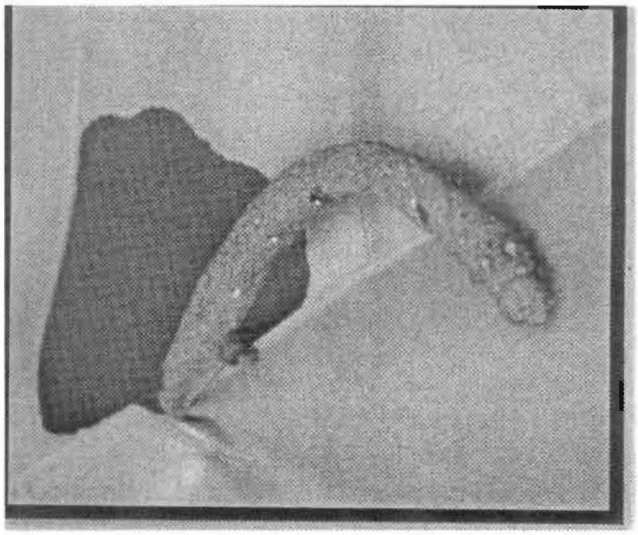
Slug caterpillar
Parasa lepida



Hairy caterpillar
Euproctis fraterna

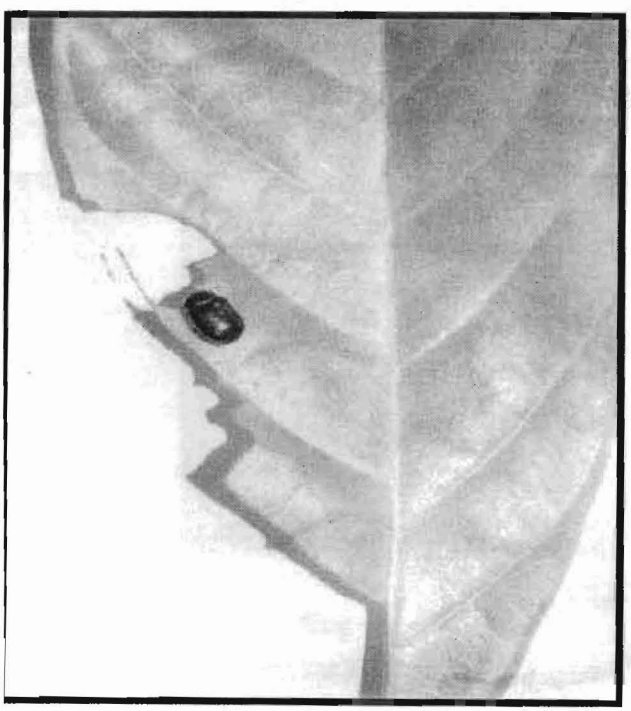


Tussock caterpillar
Lymantria obfuscata



Semilooper
Thallasododes sp

Cocoa leaf Damage by brown leaf chaffer beetle (Adoretus versutus) adults



Cocoa leaf Damage by black leaf chaffer beetle *(Apogonia blanchardii)* adults

Cocoa leaf Damage by bagworm *(Pteroma plagiophelps)* larvae