

# Insect Pests of Stored Tapioca (*Manihot Utilissima* Pohl.) in Kerala: notes on the Biology of a New Pest, *Pyralis Manihotalis* Guen. (PYRALIDAE)

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## Introduction

Next to potato, tapioca, (*Manihot utilisima* Pohl.) is the most important tuber crop in India, both in acreage, and in total production of tubers. The tuber has several important uses. It forms the major article of food for a large section of the poor class of people in South India. It serves as a good feed for live stock. The textile industry utilises large quantities of tapioca starch for the sizing and finishing operations. Being a good form of starch, tapioca flour is used for various purposes for which pure starch is required, like the manufacture of glucose. It is also made use of in the preparation of biscuits. A considerable quantity of the flour (more than 25,000 tons) is taken up in the veneer wood industry and an equal quantity is consumed in the manufacture of adhesives and gums. Abraham (1) records that in Java and Malaya, large quantities of tapioca flour are converted into pearls and flakes for human consumption. Tapioca pearls are

now manufactured in Salem in Madras State. When mixed with benzene hexa-chloride, it is also used as a poison bait, Bredo (4) having obtained 98% kill of grass-hoppers in 48 hours.

Kerala occupies a unique position as the main tapioca producing area in India, with over 5,50,000 acres under the crop. A considerable quantity of the tuber grown in the state is cut into slices or chips, sun-dried as such or after parboiling and stored for a time. The material under storage is subjected to heavy attack by a number of insect pests, and a great deal of damage, is being done. In one instance, stocks kept in several godowns in Trivandrum, were rendered into mere powder by deprecations by the anthribid beetle, *Araecerus fasciculatus* Deg., and the material was found unfit even as cattle feed. As very little work has so far been done on the insect pests that infest stored tapioca, and as the damage done has been found to be of a very serious nature, the

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authors took up the problem for investigation. In the present paper a survey of the insect pests infesting stored tapioca is given, the biology of a caterpillar pest recorded for the first time on stored tapioca is described in detail, and a brief idea of the conditions of storage and the factors conducive to infestation are mentioned.

### Review of Literature

Ballou (2) found the anthribid beetle, *Araecerus fasciculatus* Deg. in abundance in the hold of a ship laden with cassava (*Manihot utilissima*) and cotton seeds, in West Indies. Zacher (II) recorded seven species of beetles in dried roots of cassava imported into Germany from various countries. They included, *Sinoxylon* sp., *Calandra oryzae* L., *Laemophloeus ferrugineus* Steph., *Latheticus oryzae* Waterh., *Necrobia rufipes* Deg., *Araecerus fasciculatus* and *Rhizopertha dominica* F. Frappa (7) noted sixteen pests, on stored cassava tubers, viz., *Tenebrioides mauritanicus* L., *Laphocateres pusillus* Klug., *Ahasverus* (*Cathartus*) *advena* Waltl., *Necrobia rufipes* Deg., *Rhizopertha dominica* F., *Dinoderus bifoveolatus* Woll., *Minthea obsita* Woll., *M. ragj'coWis* Walk., *Sinoxylon conigerum* Gerst., *Lyctus brunneus* Steph., *L. africanus* Lesne., *Tribolium castaneum* Hbst., *T. confusum* Duv., *Alphitobius laevigatus* F. (*Piceus* Ol.), *Calandra oryzae* L. and *Araecerus* (*Araecerus*) *fasciculatus* Deg.

Darling (6) recorded two additional pests, *Xyloperthodes* sp. and *Gnathocerus cornatus* F. on dried cassava roots.

In India no serious studies have so far been made of the insects infesting stored tapioca, the only work dealing with the problem being that of Nair and Jones (9). During a

preliminary survey they noticed *Calandra oryzae*, *Araecerus fasciculatus*, *Rhizopertha dominica*, *Gibbium* sp. and *Tribolium* sp. on stored chips and *Rhizopertha* sp. *Silvanus* sp. *Calandra* sp. and *Laemophloeus* sp., on tapioca starch, in government go-downs at Quilon. The life history of *Araecerus fasciculatus* on tapioca chips, was also worked out. Recently, Oommen and Joseph (10) recorded the occurrence of two caterpillar pests, *Setomorphu rutella* Zell. and *Erechthias zebrina* Butler., on stored tapioca in Kerala.

The Present work has therefore been taken up with a view to making a detailed survey of the pests affecting stored tapioca in Kerala.

### Materials and methods

During 1957 to 1960, collections were made of infested materials from several places in Kerala, during different seasons in the year. Altogether 200 samples of sundried and 50 samples of parboiled tapioca chips and 7 samples of tapioca starch were collected during the above period, each sample weighing 8 ounces. A study was also made of the mode of storage and the conditions favourable for insect infestation. The samples were carefully examined in the laboratory at Vellayani, and the different species of insects found in them separated. The immature stages were reared in 4" x 1" specimen tubes closed with cotton plugs. The adult specimens, collected or reared out from immature stages in the samples were sent to specialists in India and abroad and got identified. The biology of a caterpillar pest, *Pyralis manihotalis* Guen., newly recorded on tapioca chips, was also worked out for the first time. During these studies, room temperature varied from 76° F, to 89° F. and humidity from 50 to 90 percent.

**The record of incidence  
of insects noted during the present survey**

1. The Coffee - bean weevil, *Araecerus fasciculatus* Deg. (Fig. I, 1-3).

- (i) Systematic position :-  
Family :- Anthribidae  
Order :- Coleoptera
- (ii) Distribution and Status :-  
Occurs all over the state : it is the most destructive pest of tapioca chips.
- (iii) Nature of damage :-  
The larva bores into the chips making small tunnels and pupates therein. Adult also causes considerable damage by boring into the chips,
- (iv) Seasonal occurrence :-  
Present throughout the year, severe infestation occurring from June to December.
- (v) Remarks :-  
Observed as a pest every year in Trivandrum District, infesting chips only. During 1959, ten pounds of slightly infested chips, kept in the laboratory in two jars, were rendered into powder in the course of three months. (plate I, Figure 1, 2)

2, The rice weevil, *Sitophilus (Calandra) oryze* L.

- (i) Systematic position :-  
Family: Curculionidae.  
Order :- Coleoptera
- (ii) Distribution and status :-  
Occurs all over Kerala, infesting chips only.

- (iii) Nature of damage :-  
Same as *A. fasciculatus* Deg, capable of causing heavy damage.
- (iv) Seasonal occurrence :-  
Same as *A. fasciculatus* Deg.
- (v) Remarks :-  
Caused serious damage to stored chips during 1957-58 in Trivandrum District.

\*3. The drug - store beetle, *Stegobium paniceum* L.

- (i) Systematic position :-  
Family :- Anobiidae  
Order :- Coleoptera
- (ii) Distribution and status :-  
Occurs in Trivandrum District. A minor sporadic pest \*
- (iii) Nature of damage :-  
The grubs bore into the chips and feed on them.
- (iv) Seasonal occurrence :-  
Throughout the year.
- (v) Remarks :-  
Noted as a minor pest.

\*4. The Cigarette beetle, *Lasioderma sericorne* F.

- (i) Systematic position :-  
Family :- Anobiidae  
Order :- Coleoptera
- (ii) Distribution and status :-  
Occurs all over Kerala as a minor pest.
- (iii) Nature of damage :-  
The grubs and adults bore into the chips and reduce it to mere powder.

Specimens marked \*recorded for the first time as pests on tapioca chips.

(iv) Seasonal occurrence :-  
Throughout the year.

(v) Remarks :-  
In one instance severe damage was noticed on parboiled tapioca chips collected from Central Travancore. The moisture content of the chips was from 10 to 15 percent.

5. The lesser grain borer, *Rhizopertha dominica* F.

(i) Systematic position :-  
Family :- Bostrychidae  
Order :- Coleoptera

(ii) Distribution and status :-  
Occurs all over Kerala as a minor pest.

(iii) Nature of damage :-  
Both adults and larvae cause severe damage to stored chips, reducing them to a tangled mass of flour, web and excreta. The adults can bore directly into the parboiled chips.

(iv) Seasonal occurrence :-  
Found active from July to October on tapioca chips

(v) Remarks :-  
Occurred as a minor pest in Trivandrum and Alleppey Districts during 1958-'59 and in Ernakulam district during 1959-'60.

6. The rust-red flour beetle, *Tribolium castaneum* Herbst.

(i) Systematic position :-  
Family :- Tenebrionidae  
Order :- Coleoptera

(ii) Distribution and status :-  
Occurs all over Kerala, as a major pest in tapioca flour and starch.

(iii) Nature of damage :-  
Both adults and grubs feed on tapioca starch and tapioca flour.

(iv) Seasonal occurrence :-  
Throughout the year.

(v) Remarks :-  
The incidence of this pest was very high in tapioca flour during December 1959, in Alleppey District.

7. The flour beetle, *Alphitobius piceus* Olivier.

(i) Systematic position  
Family : Tenebrionidae,  
Order :- Coleoptera.

(ii) Distribution and status :-  
Noted in Trivandrum, Quilon and Alleppey districts as a minor pest.

(iii) Nature of damage :-  
Same as *T. castaneum*.

(iv) Seasonal occurrence :-  
Throughout the year.

(v) Remarks :-  
Noted during 1956-'60, but only in few numbers.

8. *Alphitobius laevigatus* F.

(i) Systematic position :-  
Family :- Tenebrionidae.  
Order :- Coleoptera.

(ii) Distribution and status :-  
Same as *A. piceus*

(iii) Nature of damage :-  
Same as *T. Castaneum*

FIGURE 1

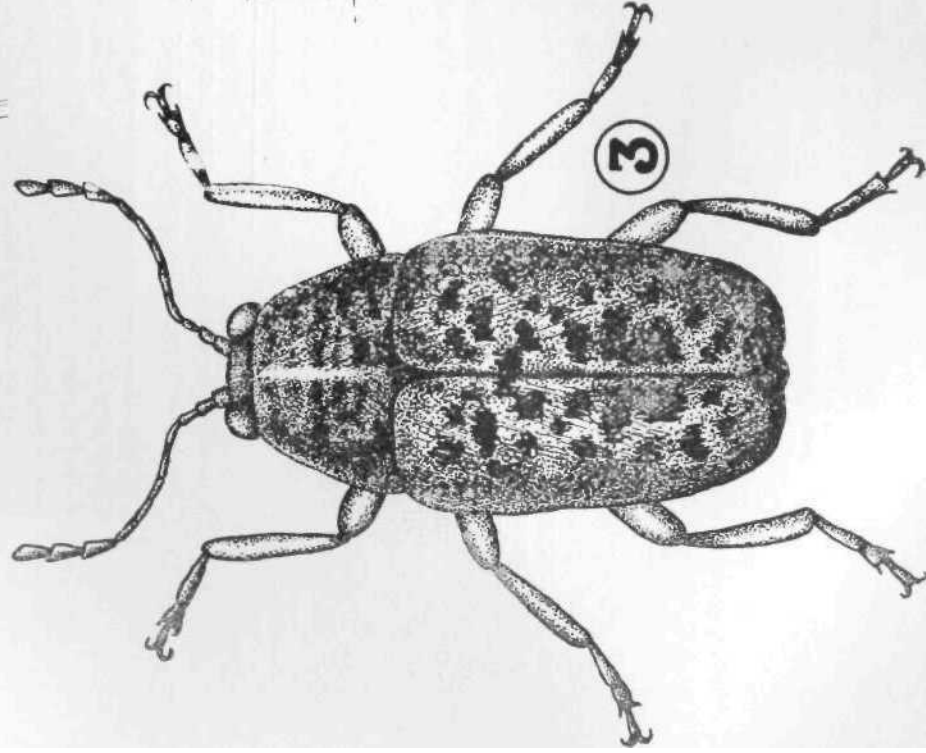
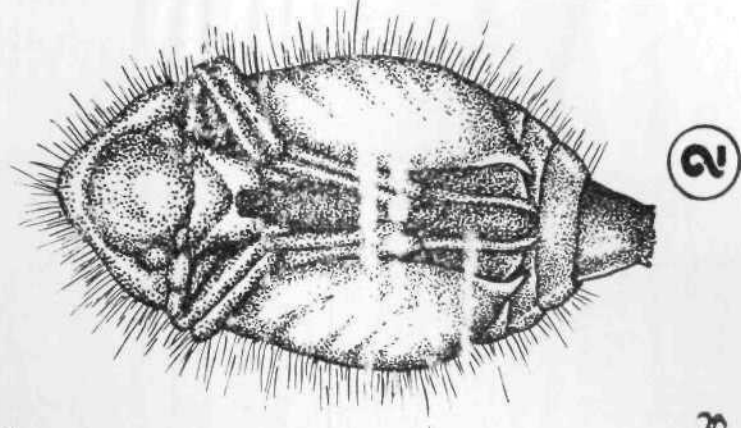
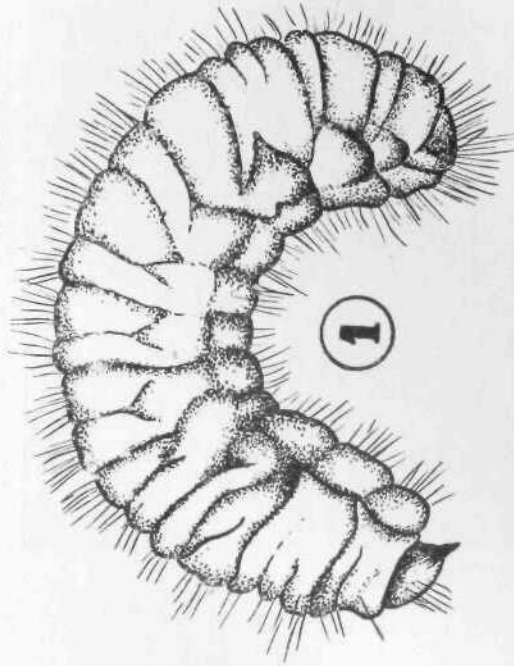


PLATE I

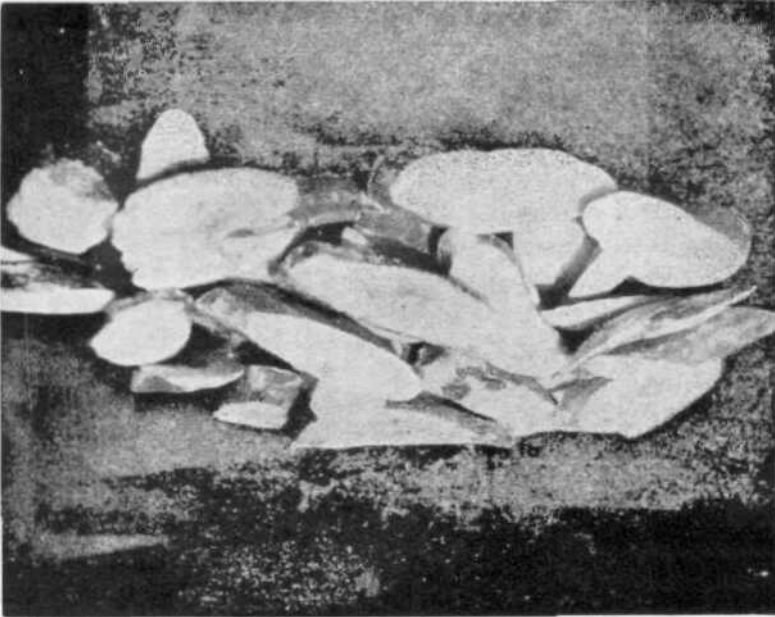
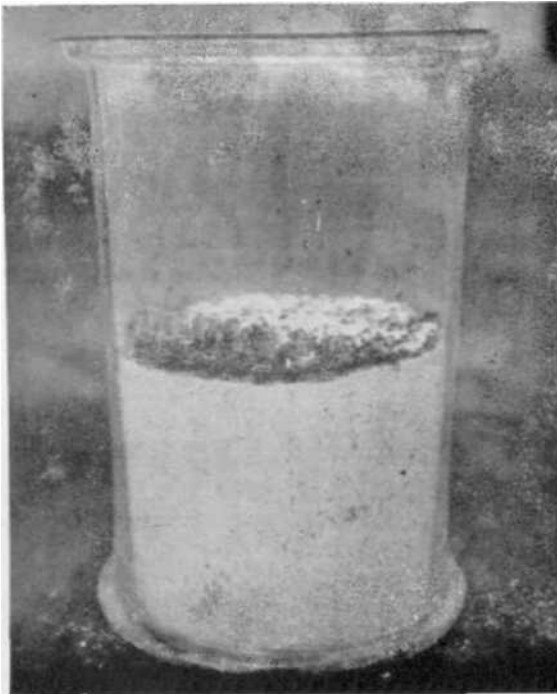


FIG. I Sundried tapioca chips-initial stage of infestation by *A. Fasciculatus*.



Breeding jar containing sun dried tapioca chips reduced to powder by the attack of *A fasciculatus* (A good number of adults also could be seen within the jar).

FIG. 2

- (iv) Seasonal occurrence :-  
Throughout the year.
- (v) Remarks :-  
Observed during 1958 & 1959  
as a minor pest on tapioca  
flour.
9. Saw-toothed grain beetle, *Oryzaephilus surinamensis* L.
- (i) Systematic position :-  
Family: Cucujidae  
Order: Coleoptera
- (ii) Distribution and status :-  
Found in Trivandrum, Quilon  
and Alleppey districts as a  
minor pest,
- (iii) Nature of damage :-  
Both adults and grubs feed  
on tapioca
- (iv) Seasonal occurrence :-  
Throughout the year.
- (v) Remarks :-  
Noted only as a minor pest.
- 10 The flat grain beetle, *Laemophloeus minutus* Oliv.
- (i) Systematic position :-  
Family :- Cucujidae.  
Order :- Coleoptera.
- (ii) Distribution and status :-  
Not a primary pest of stored  
tapioca, but found as minor  
pest, after infestation by other  
insects. Noted in Trivandrum  
and Alleppey districts.
- (iii) Nature of damage :-  
Feed on the tapioca flour da-  
maged by other insects.
- (iv) Seasonal occurrence :-  
Throughout the year.
- (v) Remarks :-  
Noted only occasionally, as a  
minor pest.
- \*11. The tapioca moth, *Pyralis manihotalis* Guen,**
- (i) Systematic position :  
Family :- Pyralidae.  
Order :- Lepidoptera
- (ii) Distribution and status :-  
Noted in Trivandrum as a  
major pest
- (iii) Nature of damage :-  
Mentioned under section on  
biology.
- (iv) Seasonal occurrence :-  
Throughout the year.
- (v) Remarks :-  
Noted for the first time as a  
major pest on stored tapioca  
in Trivandrum.
- \*12. *Pyralis pictalis* Curt.**
- (i) Systematic position :-  
Family :- Pyralidae.  
Order :- Lepidoptera.
- (ii) Distribution and status :-  
Found in Central Travancore  
as a minor pest.
- (iii) Nature of damage  
Same as *P. manihotalis*.
- (iv) Seasonal occurrence :-  
Occurred only once in July 1958
- (v) Remarks :-  
Not observed in pest form.
- \*13. The Fig moth, *Ephestia cautella* Wlk.**
- (i) Systematic position :-  
Family :- Pyralidae,  
Order :- Lepidoptera.
- (ii) Distribution and status :-  
Occurs all over Kerala as a  
minor pest.

- (iii) Nature of damage :-  
The larvae spin silken threads, webbing and matting the flour particles together, and bore into the chips.
- (iv) Seasonal occurrence :-  
The pest is active during July-October.
- (v) Remarks :-  
Recorded for the first time as a pest of tapioca chips and starch. During the period of survey, these caterpillars were not observed in pest form, but invariably they were found in small numbers every year.

\*14. The tobacco moth, *Setomorpharutella* Zell.

- (i) Systematic position :-  
Family :- **Tineidae.**  
Order :- Lepidoptera.
- (ii) Distribution and status :-  
Found as a major pest of sun-dried tapioca chips, all over **Kerala.**
- (iii) Nature of damage :-  
The caterpillar bores into the chips, spins a loose gallery and feeds from within.
- (iv) Seasonal occurrence :-  
Throughout the year. Infestation severe in the months June to August.
- (v) Remarks  
In one of the starch factories at Changanacherry, seven bags of tapioca chips, kept in storage for about six months during 1959, were found to be severely infested.

\*15. *Erechthias zebrina* Butler.

- (i) Systematic position :-  
Family : Lyonetiidae.  
Order :- Lepidoptera.
- (ii) Distribution and status :-  
Occurs as a minor pest of tapioca starch and flour in South Kerala.
- (iii) Nature of damage :-  
The caterpillar webs together, particles of tapioca flour with a silken thread, constructs a small tubular gallery and feeds from within.
- (iv) Seasonal occurrence :-  
Throughout the year ; infestation severe from June to October.
- (v) Remarks :-  
Occurs every year as a minor pest.

BIOLOGICAL STUDIES

*Pyralis manihotalis* Guen. (PYRALIDAE).

Beeson (3) found *Pyralis manihotalis* Guen. breeding in decaying *Opuntia monacantha*, and Corbet and Tarns (5) give the distinguishing characters of *Pyralis manihotalis* Guen. with records of its distribution. However the biology of the insect is now worked out for the first time.

In Kerala, the insect was noted infesting rice, wheat, green gram, gingelly, coriander, pepper (poor quality), sago, dried coffee beans and tapioca chips, at Trivandrum, Kayamkulam, Changanacherry & Kottayam.

*The adult.* (Fig. II, 6.)

Hampson's (8) description of the moth is given below :-

"Differs from *elongalis* in the ground colour being pale rufous suffused with fuscous



Fore wing with the basal patch dark **rufous**; the **postmedial** line much less excurved beyond the **cell**; the outer area not darker than the medial area. Hind wing pale rufous suffused with fuscous and with fuscous inside the pale dentate medial line. **Exp., O** 16, **O** 22mm."

**Copulation :-**

Copulation takes soon after the moths emerge, and lasts for 20 to 30 minutes.

**Longevity :**

Below is given a record of the longevity of moths.

Average longevity in days of 27 moths.

	Mated	Unmated.
Males	4.5	5.8
Females	3.9	5.5

**Oviposition :-**

Eggs laid in batches, gummed on to chips of dried tapioca. In the laboratory they are gummed on the sides of glass rearing cages also. The number of eggs in a mass **varies**; the maximum observed being 120. Maximum number of eggs laid by a female moth was found to be **291**, laid in three days. Egg-laying **usually** takes place at night,

**The egg :-** (Fig. II, 1.)

Egg is more or less elliptical, with bluntly rounded ends and measures 0.5 to 0.6 mm. in length and 0.4 to 0.46 mm. in width. When freshly laid it is dirty-white in colour. Slight changes in colour take place as the egg develops. The chorion, which is at first soft becomes hard and rigid and the basal region of the egg, gummed on the substratum, becomes slightly flat. On the fourth day the colour becomes dim and later turns light yellow, which assumes a slightly dark

shade on the fifth day. As the time of hatching approaches the egg becomes slightly distorted in shape. In the process of hatching the darkish mandibles of the larva can be seen working rhythmically and a ragged hole is bitten in the side of the egg through which the head is forced out. The larva takes nearly a quarter of an hour to work its way out. Incubation period is six days.

**The larva :-**

Freshly hatched larva (Fig. II, 2.) is cream-white, 1.0-1.25 mm. long and 0.15-0.20 mm. broad; head and thoracic region slightly broader than abdomen. Head light brown; prothoracic shield not distinct but seen as a light yellowish area measuring 0.22 to 0.24 mm. in breadth. Body sparsely clothed with short whitish hairs. Anal plate inconspicuous.

The full-grown caterpillar (Fig. II, 3.) measures on an average 16 mm. in length and 1.8 mm. in breadth. It is roughly cylindrical in shape, slightly tapering anteriorly and posteriorly. General colour dirty-white. Head-capsule 0.9 mm. to 1.1 mm. in breadth; reddish-brown in colour. Head distinctly less broad than the prothoracic shield, beneath which it can be partly retracted. Prothoracic shield yellowish brown, bordered with an anterior dark-brown band and divided by a narrow median whitish line. The **mesothorax** dark gray, **metathorax** grey in colour. Abdominal segments dirty white. Setae with a brownish tinge, vary in length from 0.4 to 1.1 mm. and placed on minute brownish tubercles. Thoracic legs **whitish-yellow**. Prolegs on the 3rd to 6th abdominal segments crowned with brownish crochets arranged in **multiserial circle**. Anal prolegs different, the crochets not arranged in a complete circle. Spiracles more or less circular, prominent, with a dark edge.

There is considerable variation in the length of the larval period when reared on different foods. On tapioca, the larval period ranged between 33-69 days with an average of 51 days, though some larvae had an abnormally long period lasting for 94 days. For larvae bred on rice and wheat, the length of larval life ranged from 27 to 46 days, with an average of 36 days.

#### Larval habits :-

On emerging from eggs, caterpillars actively wander about in search of food, on finding which they start feeding almost immediately. They settle down in silken shelters which they rapidly make by webbing together small particles and frass. They find some difficulty in feeding on whole hard grains, hence in the course of rearing they had to be supplied with broken and powdered chips. They grow more quickly and damage is more severe when feeding on material already infested by beetle borers like, *Rhizopertha dominica*, *Araecerus fasciculatus* and *Stegobium panicium*. From fourth instar onwards, the caterpillar is found to bore whole chips also. An idea of the nature and extent of damage caused by the larva to stored tapioca and to stored wheat can be had from Figs. 2 and 3 respectively (plate II). Entire chips and grain were completely reduced to masses of webbing of pupal cases, cocoons, frass, excreta and powdered material within a period of 90 days.

#### Pupation :

Pupation takes place in a light transparent grey silken cocoon inside the galleries, overlaid by food grains and excrement.

#### The Pupa: (Fig. II, 4.)

Pupa when fresh, is light brown, turning deep brown to black subsequently. Female and male pupae differ in size and measure

9.5 X 2.8 and 6.5 X 2.2 mm. respectively. A slight longitudinal middorsal ridge is present on the thoracic region. The wing cases extend upto the posterior end of 4th abdominal segment. Spiracles circular and dark brown. Tenth abdominal segment ends in four pin-shaped cremasters, each 0.25 mm. long, grouped together; another pair of hooklets (each 0.18 mm. long) separated from the above group seen projecting posteriorly each on the subdorsal side of the same segment (Fig. II, 5). Pupal period 11-12 days in July-August.

#### Natural enemies :

*Apanteles* sp. (ater group) (Braconidae) was seen parasitising the larvae of *Pyralis manihotalis* Guen.

### ECONOMIC IMPORTANCE

Serious damage is caused to tapioca chips and starch, by the above mentioned pests resulting in heavy loss. Of the various insects involved, *A. fasciculatus*, and *Pyralis manihotalis* are the most destructive in Kerala; the material, when severely infested, being unfit for any useful purpose. It may generally be stated that about 15 percent of the total products under storage is destroyed by these pests, resulting in a gross annual loss of Rs. 7,500,000.

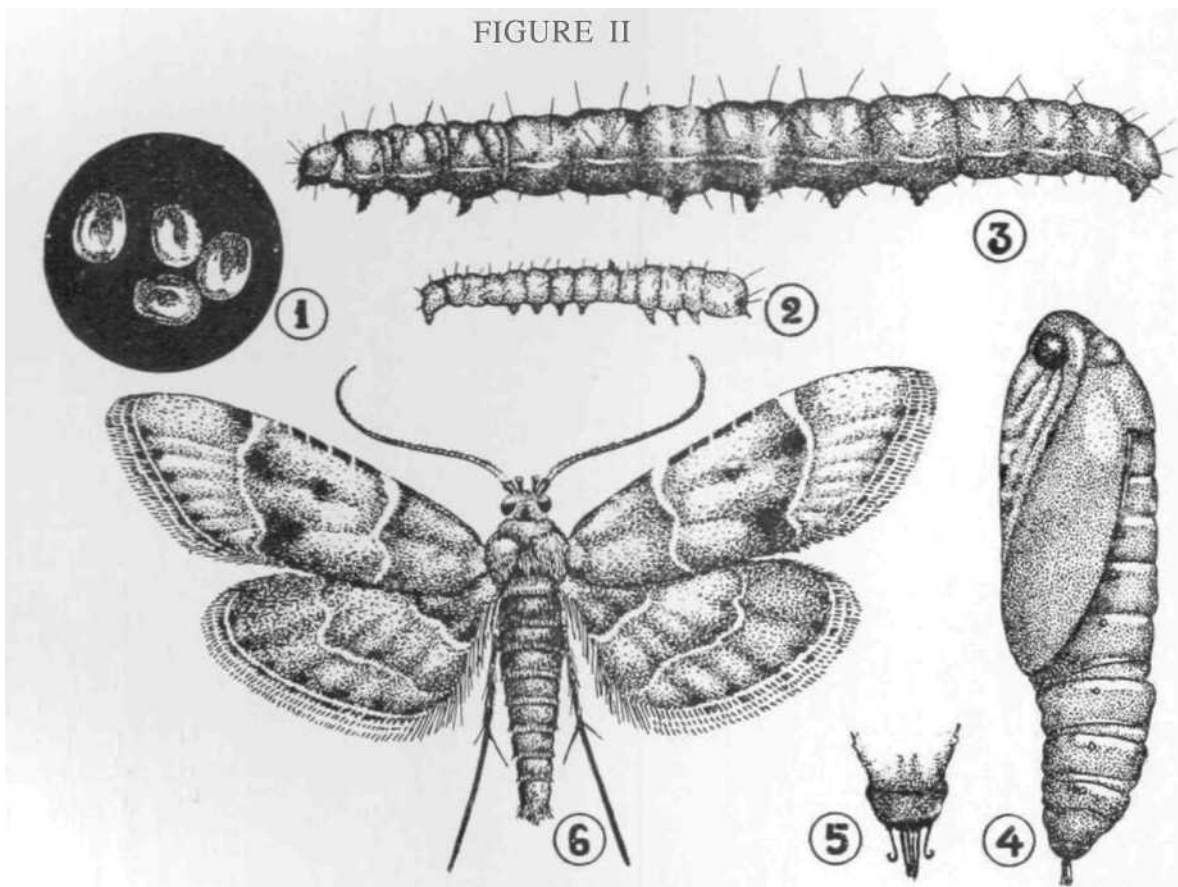
### CONDITIONS RESPONSIBLE FOR INFESTATION

The following conditions may be considered responsible for the attack of pests :-

- (i) The unsanitary condition of the godowns in which the product is stored.
- (ii) Insufficient drying.
- (iii) Insufficient methods of storing and packing.

In Kerala the store rooms at the tapioca storing centres are generally thatched sheds

FIGURE II



Stages of *Pyralis manihotalis* Guen

- (1) Egg. (2) First instar larva. (3) Full-grown larva (4) Pupa. (5) Anal segment of pupa (magnified) showing cremasters. (6) Moth.

PLATE II

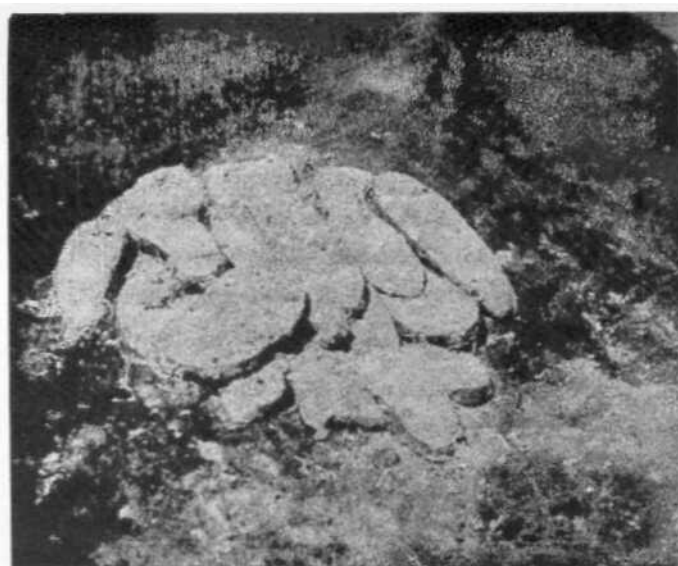


FIG. I



FIG. 2

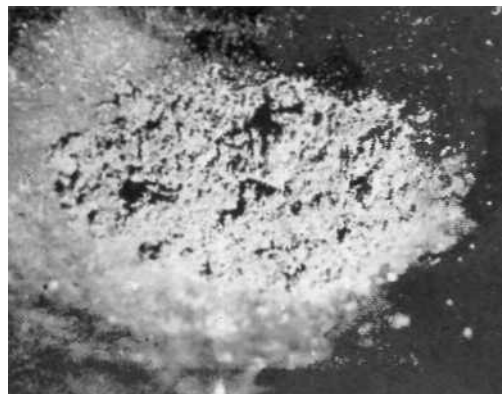


FIG. 3

Fig. 1.— Initial stage of attack on tapioca chips by *Pyrallis manihotalis* Guen.

Fig. 2. Tapioca chips damaged by *P. manihotalis*, showing numerous cocoons and nature of damage.

Fig. 3. Stored wheat infested with *P. manihotalis*, showing clusters of cocoons (matted together)

with mud floor. The debris & the powdered remnants of tapioca, very often accumulate on the floor white crevices in the floor and walls provide excellent hide-outs for the pests. In these godowns the dried chips are generally heaped up where they remain exposed to the risk of infestation till they are finally packed and despatched. At the production centres the chips are packed in ordinary jute gunny bags. These packing materials are in-effective in preventing infestation. The pests can easily gain access through the gunny bag into the products.

Most of the tapioca chips manufacturers do not take any precaution to ensure proper drying. The excess moisture and other remnants provide optimum conditions for the growth and multiplication of the pests within the product.

It is distressing to note that no precautions whatever are taken in the packing of storage of dried tapioca chips in Kerala at present.

#### SUMMARY

The Literature on the insect pests of stored tapioca is reviewed. A detailed list of the insects infesting stored tapioca in Kerala is given and the pests are classified as major and minor: seven species are recorded for the first time on stored tapioca, these being, *Stegobium paniceum* L., *Lsiaoderma serricorne* F., *Pyralis manihotalis* Guen, *P. pictalis* Curt, *Setomorpharutella* Zell, *Ephestiacautella* Walk, and *Erechthias zebrina* Butler. The biology of *Pyralismanihotalis* Guen, is

worked out, and all stages of the insect, are described. A preliminary survey of the methods of tapioca storage in Kerala is made and conditions favourable for insect infestation are also mentioned,

#### ACKNOWLEDGEMENTS

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