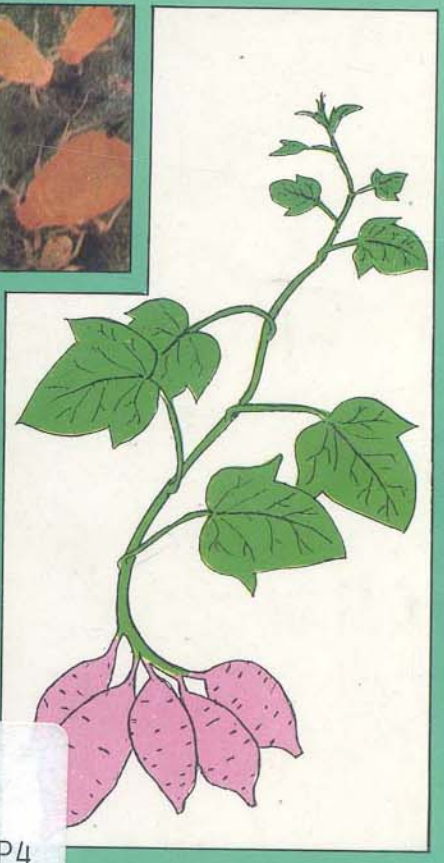
A HANDBOOK ON PHILIPPINE SWEET POTATO ARTHROPOD PESTS AND THEIR NATURAL ENEMIES

D.M. Amalin and E.A. Vasquez



TIONAL POTATO CENTER (CIP)
la, Philippines

College of Agriculture
PHILIPPINE ROOT CROP RESEARCH & TRAINING CENTER
City Address: 8 Lourdes Street, Pasay City,
3129 Philippines

A HANDBOOK ON PHILIPPINE SWEET POTATO ARTHROPOD PESTS AND THEIR NATURAL ENEMIES

Divina M. Amalin[1]
and
Erlinda A. Vasquez[2]

[1]CIP, Box 933, Manila
[2]PRCRTC-ViSCA, Bay

Correct citation:
D.M. Amalin and E.A. Vasquez. 1993. A Handbook on Philippine Sweet Potato Arthropod Pests and their Natural Enemies. International Potato Center, Los Baños, Laguna, Philippines. pp. 82.

ISBN 971-91361-0-3

CIPLB9302

Sponsored by:
International Potato Center (CIP) and the Philippine Root Crops Research and Training Center of the Visayas State College of Agriculture (PRCRTC-VISCA).

Published by:
International Potato Center, Los Baños, Laguna, Philippines.

Printed by:
VJ Graphic Arts, Inc.

FOREWORD

In 1990, the sweet potato area in the country was 136,685 ha with a production of 668,873 metric tons and a low average yield of 4.89 t/ha. A strategy to increase production is higher productivity. However, pest damages can adversely affect production resulting in high production losses.

This guide is helpful in identifying sweet potato arthropod pests with special reference to the most economically important pests (ie. sweet potato weevil, *Cylas formicarius* Fabr.). An important addition in this publication is the mention of pest natural enemies. Use of natural enemies is a promising alternative to use of chemicals in controlling pests. The number and species of natural enemies included here are from recent studies sponsored by the International Potato Center and the Philippine Root Crops Research and Training Center of the Visayas State College of Agriculture.

Reliable estimates of national production losses due to pest damage are difficult to find. A valuable form to report yield losses due to pests is included at the end of the guide. However lowland farmers usually harvest their sweet potato at 90 days to avoid weevil damage. A 120 days crop would have higher yields. This production loss needs attention in determining the economic importance of a pest.

Two young research scientists, Miss D.M. Amalin and E.A. Vasquez, have done a good job in preparing this guide. Congratulations!

I trust this publication will be useful to you reader.

E. Chujoy

ENRIQUE CHUJOY
CIP Representative-Phils.

TABLE OF CONTENTS

INTRODUCTION

Sweet potato, *Ipomoea batatas* Lamarck, is an economically important crop throughout the tropical and subtropical regions. It ranks seventh amongst the world's food crop. Asia accounts 92% of the total production (FAO, 1986). It is a widely adapted crop that grows even under marginal conditions. Despite its adaptability in diverse environments, sweet potato growers still encounter high yield losses due to insect pests. Worldwide at least 270 insect pest species attack sweet potato either by feeding directly on growing sweet potato plants or as vectors for many diseases (Talekar, 1987). A three-year survey (1988-1990) in major sweet potato growing areas in the Philippines (Figure 1) revealed a wide array of arthropod species including both pests and natural enemies. During the wet season, a total of 66 arthropod species belonging to 60 genera, under 41 families and 11 orders were encountered. Among these arthropods, 34 were pests, 28 were beneficials, , 1 was apollinator, 2 were scavengers and 2 of unknown ecological role. In contrast, the dry season had fewer arthropod species sampled and consisted of 52 species belonging to 51 genera, 33 families and 11 orders. Twenty seven of these were pest species and 22 were beneficial arthropods, 2 were scavengers and 1 of unknown ecological role. The decrease in the frequency of arthropod species could be attributed to changes in temperature and relative humidity. A total of 15 arthropod pests were found economically important. In both seasons, the dominant pest species were a root feeder, *Cylas formicarius* Fabr. and foliage feeders, namely: *Attractomorpha psittacina* de Haan, *Brachmia convolvuli* Wals., *Cassida circumdata* Herbst, *Halticus minutus* Reuter, *Helopeltis collaris* Stal, *Myzus persicae* (Sulzer) and *Phaneroptera furcifera* Stal. All of them had wide distribution, and were encountered in almost all of the sampling sites. Five pest species — *Eriophyes gastrotrichus* Nalepa, *Physomerus grosippes* (Fabricius), *Agrius convolvuli* Linnaeus, *Scymnus* sp., *Chaetocnema basalis* Baly — were encountered during the dry season only. Whereas, three species — *Ochyrotica concursa* Wals., *Psara hipponalis* Walker, and *Aciptilia niveodactyla* Pagenstetcher — were encountered during the wet season only. Updated record (as of April, 1990) of sweet potato pests in the Philippines consists of 60 species belonging to 57 genera under 28 families and 7 orders (Table 1).

Sweet potato ecosystem has also a rich community of natural enemies. Insect predators, parasites, predatory spiders, and entomogenous pathogens were encountered. A total of 40 species were recorded as beneficial arthropods and 2 as entomogenous pathogens. In both seasons, 5 species each of predatory spiders and insects were encountered. During the dry season, 3 species of predatory spiders, 11 predatory insects, and 6 parasites were found. Whereas, during the wet season, 3 species of predatory spiders, 2 predatory insects and 7 parasites were encountered. Out of the 40 species, 9 species were found dominant such as: 2 predatory spiders — *Oxyopes javanus* Thorell and *Thomisus* sp.; 3 predatory beetles — *Harmonia octomaculata* Fabricius, *Menochilus sexmaculatus* (Fabricius), *Micraspis hirashimai* Sasaji; 2 predatory orthopterans — *Anaxipha longipenis* de Haan and *Metioche vittaticolis* (Stal); 2 parasites — *Opius* sp. and 1 undetermined species under family Encyrtidae. *O. javanus, Thomisus* sp., *M. sexmaculatus* and *Opius* sp. have known pest association. Morover, two entomogenous pathogens — *Beauveria bassiana* (Bals) and *Bacillus thuringiensis* (Berliner) — were isolated from sweet potato weevil, a major pest of sweet potato. The diversity in natural enemies could help in regulating the geometric increase of arthropod pest population only if they are properly conserved and managed. For a succesful integrated pest management strategy, proper identification of pests and their natural enemies is fundamental. So far, most of these arthropods are still unknown to most sweet potato farmers and researchers.

The ultimate purpose of this handbook is to assist farmers and researchers easily identify the arthropod pests of sweet potato and their natural enemies. The handbook includes a checklist of arthropod pests and a pictorial guide to 25 important arthropod pests and their associated natural enemies. Fifteen of the arthropod pests were identified from the latest survey whereas the other 10 species were recorded from previous work (Vasquez and Sajise, 1989). Similarly included is a pest damage evaluation form necessary to guide farmers when and when not to apply control measure for effective pest management. This handbook complements the publication "Pests of Sweet Potato: Insects, Mites and Diseases" developed by Vasquez and Sajise (1989).

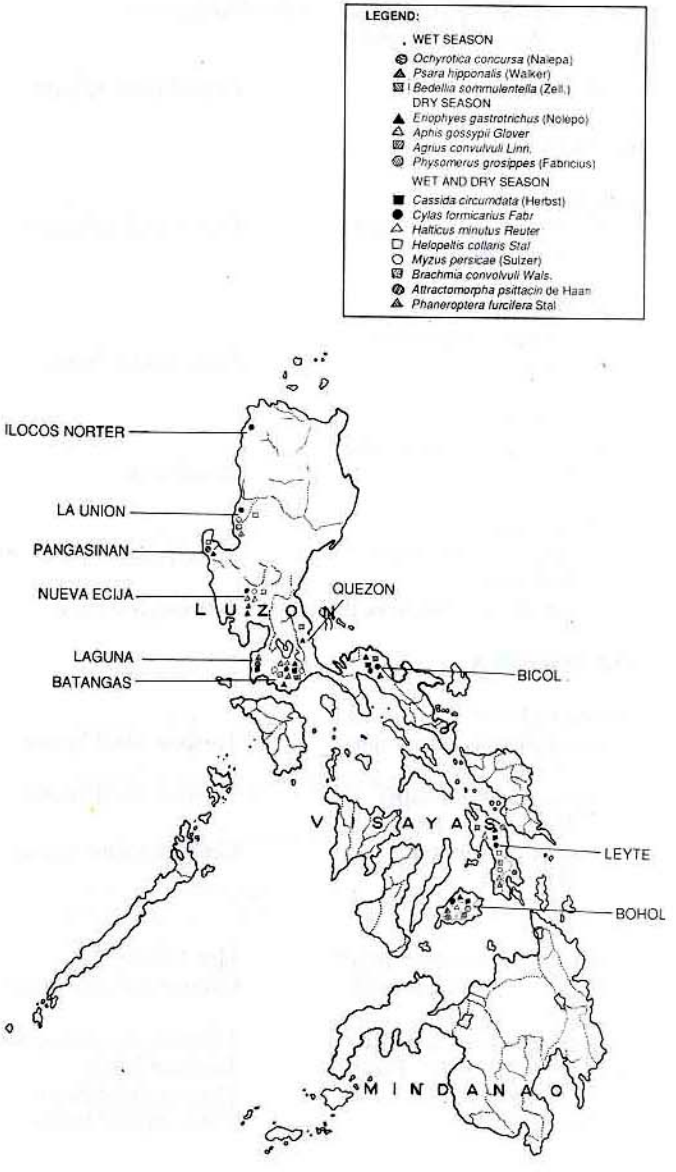


Figure 1. Sampling sites and distribution of 15 important arthropod pest of sweet potato in the Philippines after a three-year survey.

Table 1. Sweet potato pests in the Philippines
As of April 1990

PEST SPECIES	COMMON NAME
ACARINA	
Eriophyiidae	
Eriophyes gastrotrichus *(Nalepa)**	Eriophyiid gall mite
Tenuipalpidae	
Brevipalpus californicus Banks	False spider mites
Tarsonemidae	
Polyphagotarsonemus latus Banks	Broad mite
Tetranychidae	
Tetranyhchus marianae McGregor	Sweetpotato spider mites
Tetranyhchus truncatus Ehara	Tetranychid mite
COLEOPTERA	
Chrysomelidae	
Aspidomorpha fusconatata (Boheman)	Tortoise shell beetle
Aspidomorpha miliaris Fabricius	Tortoise shell beetle
Cassida circumdata (Herbst)	Green tortoise beetle
Chaetocnema basalis Baly*	Flea beetle
Laccoptera philippinensis (Blanchard)	Orange tortoise beetle
L. tredecimpunctata (Fabr.)	13-spotted tortoise beetle
Metriona trivitata (Fabr.)	Tortoise beetle
Peionispa sp.	Chrysomelid beetle
Phytorus sp.	Chrysomelid beetle
Curculionidae	
Cylas formicarius Fabr.	Sweetpotato weevil
Pachyrrinchus sp.	Brown snout beetle
Scarabaeidae	
Anomala sp.	Root grub
Apogonia sp.	Root grub
Leucopholis irrorata (Chevrolat)	white grub

REFERENCES

Corpuz-Raros, 1989

Jularbal, 1981; Vasquez & Sajise, 1989

Corpuz-Raros, 1985

Corpuz-Raros, 1985; Vasquez & Sajise, 1989

Gabriel, 1975

Gabriel, 1975

Uichanco, 1920; Gabriel, 1975

Gabriel, 1975; Gonato, 1978;

Gapasin, 1980; Corey, 1981;
Amalin et. al., 1991;
Amalin et. al., 1991;
Uichanco, 1920; Gabriel, 1975

Gabriel, 1975; Gapasin, 1980
Uichanco, 1920
Gabriel, 1975
Esguerra & Gabriel, 1969

Uichanco, 1920; Gabriel, 1975; Burdeos, 1980;
Vasquez & Gapasin, 1980; Amalin et. al., 1991;
Vasquez & Sajise, 1989
Gapasin, 1980

Gabriel, 1975
Gabriel, 1975
Gabriel, 1975

PEST SPECIES	COMMON NAME
DIPTERA	
Agromyzidae	
Ophiomyia sp.*	Bean fly
HEMIPTERA	
Coreidae	
Anoplocnemis phasiana Fabricius	Coreid bug
Physomerus grosippes (Fabricius)	Sweet potato bug
Lygaeidae	
Malcus flavidipes Stal	Lygaeid bug
Pachybrachius inortatus	Lygaeid bug
Miridae	
Halticus minutus Reuter	Mirid bug
Helopeltis collaris Stal	Capsid bug
HOMOPTERA	
Aleyrodidae	
Aleurodicus dispersus Russel	White fly
Bemisia tabaci (Gennadius)	White fly
Aphididae	
Aphis gossypii Glover	Melon aphid
*Myzus persicae** (Sulzer)	Green peach aphid
Cercopidae	
*Clovia sp.**	Cercopid
Cicadellidae	
Bothrogonia ferruginea (Fabr.)	Leafhopper
Pseudococcidae	
Ferrisia virgata (Cokcerell)	Mealybug
Tropiduchiidae	
*Numicia sp.**	Hopper
LEPIDOPTERA	
Gelechiidae	
Brachmia convolvuli Wals	Black leaffolder
Lyonitidae	
Bedellia somnulentella (Zeller)	Leaf miner

REFERENCES

Amalin et. al., 1991;

Gapasin, 1980
Uichanco, 1920; Gapasin, 1980;
Amalin et. al., 1991;

Gabriel, 1975
Amalin et. al., 1991;

Gapasin, 1980
Vasquez & Sajise, 1989

Vasquez & Sajise, 1989
Gonato, 1978

Uichanco, 1920; Gabriel, 1975; Gapasin, 1980;
Amalin et. al., 1991; Vazquez & Sajise, 1989;
Amalin et. al., 1991;

Amalin et. al., 1991;

Gapasin, 1980

Gabriel, 1975; Amalin et. al., 1991

Amalin et. al., 1991;

Gonato, 1978; Gapasin, 1980; Corey, 1981;
Amalin et. al., 1991;

Gapasin, 1980; Vasquez & Sajise, 1989

PEST SPECIES	COMMON NAME
Lymantriidae	
Euchromia horsefieldi Moore	Tussock moth
Noctuidae	
Chrysodeixis chalcites Esper	Corn semi-looper
Helicoverpa armigera (Hubner)	Corn earworm
Homona coffearia Nietner	Homona leaffolder
Mythimna separata (Walker)	Cutworm
(=Pseudaletia separata) (Walker)	Cutworm
Spodoptera litura Fabr.	Cutworm
Pyralidae	
Anticrota ornatalis Duponchel	Pink striped leaf feeder
Ochyrotica concursa Wals.	Brown leaf folder
Omphisa anastomasalis (Guen.)	Sweet potato stemborer
Herpetogramma hipponalis (Walker)	
(=Psara) hipponalis (Walker)	Green leaffolder
Diaphania indica (Saunders)*	Pyraustid caterpillar
Pterophoridae	
Aciptilia niveodactyla Pagenstcher	White plume moth
Sphingidae	
Acherontia tachesis (Fabr.)	Sphinx moth
Agrius convolvuli Linnaeus	Sweet potato hornworm
ORTHOPTERA	
Tettigoniidae	
Phaneroptera furcifera Stal	Katydid
Acrididae	
Attractomorpha psittacina (de Haan)	Short-horned grasshopper
Gesonula zonocera mundata Navas	Taro grasshopper
*Heteropternis sp.**	Short-horned grasshopper
Locusta migratoria manilensis (Meyen)	Oriental migratory locust
Oxya chinensis (Thunberg)	Chinese grasshopper
*Stenocatantops sp.**	Short-horned grasshopper

* *New record in the Philippines.*

REFERENCES

Esguerra & Gabriel, 1969;
Amalin et. al., 1991;

Corey, 1981; Amalin et. al., 1991;
Corey, 1981; Bernardo, 1986
Corey, 1981

Uichanco, 1920; Gabriel, 1975;
Amalin et. al., 1991;
Uichanco, 1920; Gabriel, 1975;
Burdeos, 1980; Corey, 1981;

Gapasin, 1980; Vasquez & Sajise, 1989
Gapasin, 1980; Vasquez & Sajise, 1989
Gapasin, 1980; Vasquez & Sajise, 1989

Gapasin, 1980; Amalin et. al., 1991;
Amalin et. al., 1991;
Amalin et. al., 1991; Vasquez & Sajise, 1989

Gonato, 1978; Gapasin, 1980; Vasquez & Sajise, 1989

Esguerra & Gabriel, 1969; Amalin et. al., 1991;
Bernardo, 1986; Vasquez & Sajise, 1989;

Corey 1981, Amalin et. al., 1991

Gabriel, 1975; Gonato, 1978;
Burdeos, 1980; Amalin et. al. 1991;
Vasquez & Sajise, 1989
Vasquez & Sajise, 1989

Amalin et. al., 1991
Gabriel, 1975

Esguerra & Gabriel, 1969
Amalin et. al., 1991

SWEET POTATO ARTHROPOD PESTS

GREEN TORTOISE BEETLE
Cassida circumdata Herbst
(Coleoptera:Chrysomelidae)

Biology and Description - Egg enclosed in a pale green egg case is laid singly on the under surface of the leaf. Incubation period is 4-7 days. The flat larva is green. It has 32 marginal and 2 subanal light green spines and laterally marked with minute spinules and white stigmata. The larva undergoes 5 instars. The oval pupa is light green. Pupation occurs on both surfaces of a leaf, with all the larval skin attached to the pupa. Pupal period ranges from 3-7 days. The adult (Fig. 2) is greenish yellow marked with three irregular black longitudinal bands on the elytra, the middle one along the surface. Total life cycle is about 27 days.

Nature of Damage - The larvae and adults feed on the leaves producing rounded holes on the leaf blades (Fig. 3). During severe infestation, the larvae and adults can defoliate a whole plant leaving only the stalk and midribs.

Natural Enemies

1. Pupal parasitoid
   Tetrastichus sp.
   (Hymenoptera:Eulopidae)

Fig. 2 **E.A. Vasquez**

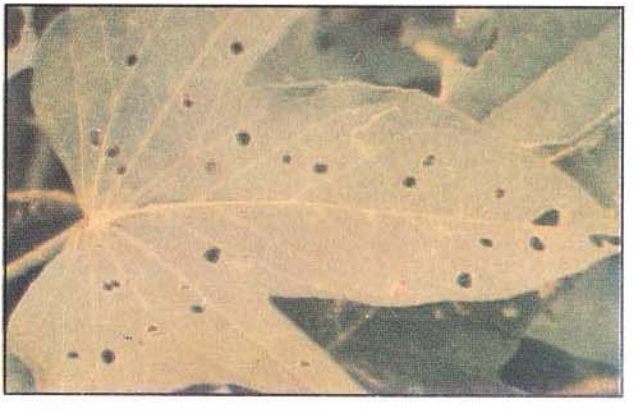


Fig. 3 **E.A. Vasquez**

Other Host Plants - Aside from sweet potato and other *Ipomoea* species — *I. triloba, I. purpurea, I. pescaprae, and I. aquatica* — it also attacks family Crucifereae — like cauliflower, mustard, pechay, and raddish.

Control Measures

1. Cultural control: Elimination of weeds belonging to the family Convolvulaceae.

2. Chemical control: Carbaryl at 1 kg a.i./ha and endosulfan at 500-700 g a.i./500 liters of water/ha have been found effective. Malathion and MIPC at manufacturers recommended rate applied at 7-14 days interval are similarly effective.

13-SPOTTED TORTOISE BEETLE

Laccoptera tredecimpunctata Fabricius
(Coleoptera:Chrysomelidae)

Biology and Description - The eggs are laid in brown parchment-like membrane of the leaf. The incubation period is 5-6 days. The golden brown to brownish orange larva is flat with fleshy and branching lateral spines. It undergoes 5 larval instars in 6-30 days. During each molt, the exuvium becomes attached to a pair of long fleshy subanal spines and appears as a black mass of dirt. The larva attaches itself firmly on the underside of the leaf when about to pupate. Pupal period is 3.7 days. A total life cycle of 14-46 days has been recorded. A female beetle (Fig. 4) lays 1-7 eggs during its entire oviposition period of 2.12 days.

Nature of Damage - Similar to that of *C. circumdata* but holes are bigger (Fig. 5).

Natural Enemies

1. Preying mantis
   Stalilia sp.
   (Mantodea:Mantidae)

Other Host Plants - Similar to that of *C. circumdata.*

Control Measures - Not available.

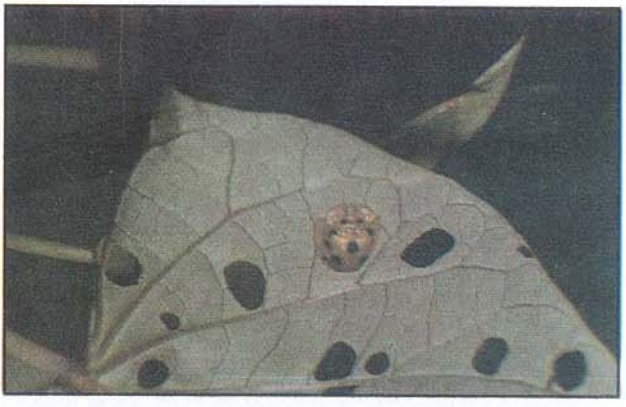


Fig. 4 E.A. Vasquez

Fig. 5 E.A. Vasquez

SWEET POTATO WEEVIL

Cylas formicarius Fabricius
(Coleoptera:Curculionidae)

Biology and Description - The eggs are laid singly in holes either in the storage roots or stems and sealed with gray to brown gelatinous substance. Individual ovoid egg (Fig. 6) measures 0.65mm long and 0.46mm wide. Newly laid eggs are transparent white and soft with rugose surface. The older eggs about to hatch are creamy with a small brown, irregular diffused speck. Egg hatch occurs within a week. After hatching, the neonate larva starts boring into the storage roots or stem depending upon the oviposition site. It feeds inside by making tunnels. It undergoes 5 larval instars in about 3 weeks. The white larva (Fig. 7) is legless with a reddish brown gut and a brown subglobular head. The abdomen is subconical for the first and second instars and subcylindrical from third to fifth instars. Pupation takes place within the tunnel and pupal period lasts for a week. The pupa (Fig. 8) is creamy white, exarate type and sub-ellipsoidal. The adult stays in the pupal chamber soon after emergence and then cuts its way through the plant tissue. Adult is ant-like with a distinct long snout, metallic blue head, forewings and abdomen. The legs and thorax reddish-brown. Females differ from males in antennal type and body size. Female (Fig. 9) has club-liked antenna whereas male (Fig. 10) has thread-like antenna. Usually, female is larger than the male. A female adult lays 90 to 340 eggs (average of 256 eggs) in 2-3 months. The total life cycle is about 38 days. There are 9 generations in a year.

Nature of Damage - The adult weevils feed on the tender buds, leaves, vines and storage roots while the larvae, the most destructive stage, feed and tunnel

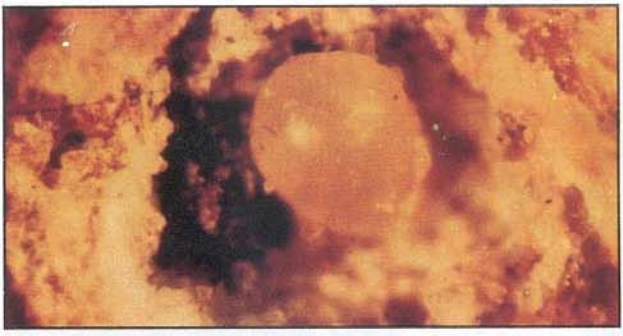


Fig. 6 N.S. Talekar

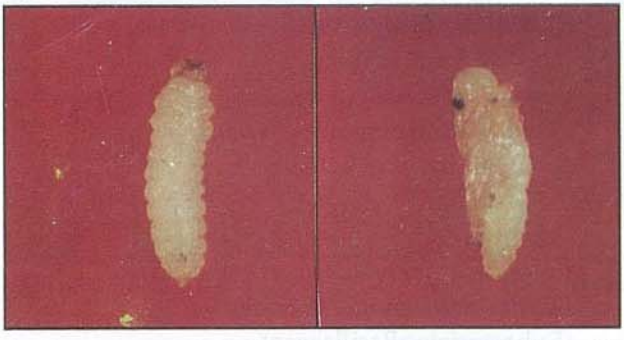


Fig. 7 D. M. Amalin Fig. 8 D. M. Amalin

Fig. 9 D. M. Amalin

Fig. 10 N.S. Talekar

into the vines (Fig. 11), and storage roots (Fig. 12). The damage is characterized by small feeding and ovipositional punctures on the surface and larval tunnels filled with frass in the tissues. The damage lead to secondary infection by bacteria and fungi. Damaged storage roots are bitter, emit terpene and unfit for human and animal consumption.

Natural Enemies

1. Earwig (Fig. 13)
   Euborellia philippinensis Srivastava
   (Dermaptera:Labiidae)

2. White muscardine fungus (Fig. 14)
   Beauveria bassiana Balsamo
   (Moniliales:Moniliaceae)

3. Entomopathogenic bacteria (Fig. 15)
   Bacillus thuringiensis (Berliner)
   (Eubacteriales:Bacillaceae)

4. Braconid wasp
   Microbracon cylasovorus Rohwer
   (Hymenoptera:Braconidae)

5. Braconid wasp
   Bassus cylasovorus Rohwer
   (Hymenoptera:Braconidae)

Other Host Plants - Wild species of *Ipomoea* are important host plants.

Control Measures

1. Cultural control: Cultural practices that reduce weevil damage are as follows:

a) *Selection of planting materials.* Planting materials are often the primary source of infestation in many situations. Since eggs of the weevil are rarely

Fig. 11 **N.S. Talekar**

Fig. 12 **N.S. Talekar**

Fig. 13 **D.M. Amalin**

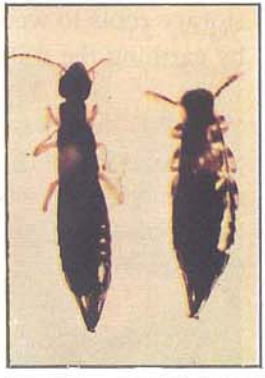


Fig. 14 **D.M. Amalin**

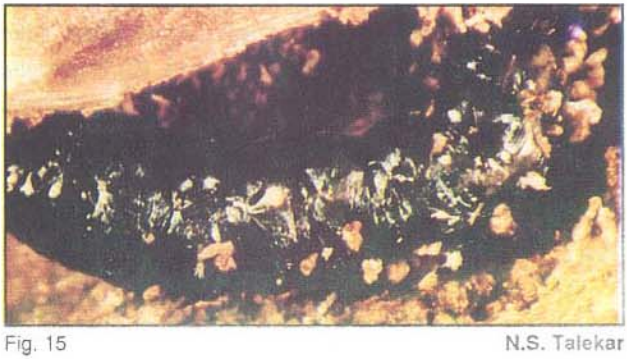


Fig. 15 N.S. Talekar

deposited on the tender portion of the vine, the use of terminal cutting is highly recommended (Fig. 16). If terminal cuttings are not sufficient for planting, the second or third cuttings dipped in insecticide (Carbosulfan or Carbofuran) with an a.i. of 0.05% for 10-15 minutes can be used (Fig. 17).

b) *Sanitation.* Plant residues commonly provide the source of weevil inoculum, thus proper disposal of residues after harvest is essential since the insect may survive in the plant parts and infest the succeeding or neighboring sweet potato crop. Removal of alternate hosts — *Ipomoea* wild species (Fig. 18) reduces the population build-up of weevils.

c) *Crop rotation.* Crop rotation, like sweet potato planted before or after vegetables or staples in the same field reduces weevil infestation.

d) *Hilling-up.* Soil cracking, which exposes storage roots to weevil infestation can be prevented by earthing the soil at least 30 cm high.

e) *Early harvesting.* Harvesting at 90 days after planting is ideal. This method prevents weevil build-up. Delayed harvesting for 30 days allows the weevil to complete one generation and even doubled after 60 days (Fig. 19).

f) *Mulching.* Covering the planting area with rice straw or plastic mulch also reduces weevil infestation.

A pre-planting mulch of organic materials like Mahwa cake (*Madhyka indica*) or *Callophyllum* cake (2000 kg/ha), leaves of lemon grass (*Cymbopogon flexosus*), *Clerodendron infortunatum* and *Chromolaena odorata* (5 t/ha) have been reported effective in reducing weevil infestation.

Fig. 16 **D. M. Amalin**

Fig. 17 **N.S. Talekar**

Fig. 18 **N.S. Talekar**

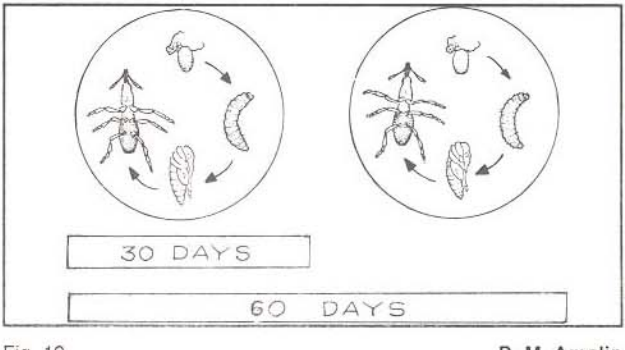


Fig. 19 **D. M. Amalin**

2. Use of resistant varieties: Resistant varieties should be chosen, if available. Deep rooting varieties with long necks between the storage roots and the stems can be used since they generally produce elongated or spindle-shaped storage roots which provide physical barriers for the entrance of sweet potato weevil to the storage roots.

3. Sex pheromone: The use of pheromone (2)-3-dodecen-101 (E)-2-butenoate of the female sweet potato weevil showed encouraging results. It attracts males and effective in mass trapping of *C. formicarius* (Fig. 20).

4. Chemical control: If insecticide application becomes necessary (more than 50 weevils caught per pheromone trap), the following unrestricted chemicals are recommended:

a) *Carbosulfan*. Dipping of the planting materials in a solution (0.05% a.i./ha) for 20 minutes before planting reduces the source of weevil.

b) *Fenthion or Fenitrothion*. Foliar spraying at 0.5% a.i./ha one month after planting and thrice at triweekly interval, thereafter or soil drenching using the same chemicals at 0.05% applied twice, at 50 and 70 DAP prevents weevil population build-up.

c) *Carbofuran and phorate*. Carbofuran and phorate granules at 1.5 kg a.i./ha each applied once at 45 DAP are effective for weevil control.

d) *Carbosulfan and Endosulfan*. Carbosulfan (0.025% a.i./ha) and endosulfan (0.10%) sprayed twice, at 59 and 78 DAP, afforded a benifit/cost value of 24.32 and 22.87, respectively.

Fig. 20 **D. M. Amalin**

INTEGRATED PEST MANAGEMENT

AVRDC developed an IPM package for sweet potato weevil (Talekar, 1990) consisting of:

1. **Sanitation**: Removal of the morning glory — *Ipomoeae* wild species (an alternate host of SPW).

2. **Use of clean cuttings**: Dipping the cuttings in insecticide solution for about 30 minutes or the use of apical cuttings.

3. **Use of sex pheromone.**

4. **Hilling-up**: Soil earthing to close land cracks.

5. **Crop rotation.**

6. **Flooding the field**: One or two weeks flooding cause the rotting of the left overs.

SWEET POTATO BUG

Physomerus grossipes Fabr.
(Hemiptera:Coreidae)

Biology and Description - The eggs are laid in groups on the underside of the leaves or on the stem. The mother bug guard its eggs and the young gregarious nymphs. The incubation period is 15.8 days with 86.8% hatchability. The bug passes through 5 nymphal instars. Total developmental period is 85.4 days for males and 87.5 days for females. The brown adult (Fig. 21) is 20mm long and has enlarged thighs.

Nature of Damage - The nymphs and adults pierce the stem and suck the sap of sweet potato, causing the plants to stunt.

Natural Enemies - No record.

Other Host Plants - It also feeds on other Convolvulaceae — like *Ipomoea aquatica* and *I. triloba*.

Control Measures - Not available.

Fig. 21 **E. A. Vasquez**

JUMPING PLANT BUG

Halticus minutus Reuter
(Hemiptera:Miridae)

Biology and Description - The adult (Fig. 22) is blackish brown with a total body length of 2.1mm. Wing membrane has 2 closed cells. Antennae are long and slender with the second segment four or more times longer than the first segment. The tip of the antennal segment 3 and the apex of antennal segment 2 are light brown. Terminal antennal segment is dark brown. Eyes contiguous to pronotum. All femora dark brown to black with yellow apices. The biology is not yet studied.

Nature of Damage - Adults and nymphs suck the sap of the leaves producing white speckles on the surface of the leaves (Fig. 23).

Natural Enemies - No record.

Other Host Plants - Crops under family Leguminaceae are important alternate hosts.

Control Measures - Not available.

Fig. 22 **D. M. Amalin**

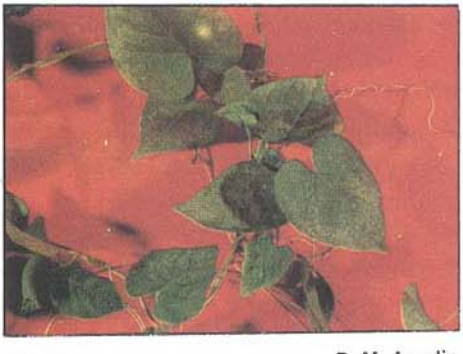


Fig. 23 **D. M. Amalin**

CACAO MIRID BUG

Helopeltis collaris Stal
(Hemiptera:Miridae)

Biology and Description - The eggs (Fig. 24) are laid singly or in groups on the soft tissues of the host. Egg incubation lasts 5-6 days with 89.9% hatchability. There are 5 nymphal instars with a total developmental period of 15.2 days for the males and 15.7 days for the females. The nymphs (Fig. 25) are orange in color with 2 pin-like projections arising from the middle mesothorax. The adults (Fig. 26) measure about 6 mm long. The male and female can be differentiated by its color. The male has black head, thorax and wings and white basal end of the pin-like projection of the thorax, while the female has black wings and yellow orange basal end of the pin-like projection.

Nature of Damage - Adults and nymphs feed on the young shoots of sweet potato. The damage is characterized by water soaked lesions, blackening or malformation of the feeding site and finally drying up of the shoots (Fig. 27). The insects are observed to be abundant during the rainy season.

Natural Enemies - Two species of spiders, one reduviid bug and one ant species were found associated with cacao mirid bug. All of them remains to be identified.

Other Host Plants - It also occurs in cacao, citrus, coffee, cotton, guava, guayabano, and some crops under family Lauraceae.

Control Measure - Not available.

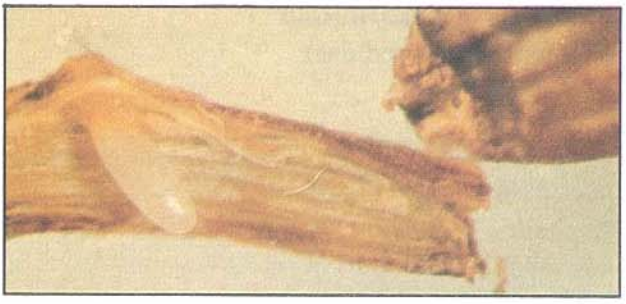


Fig. 24 E. A. Vasquez

Fig. 25 E. A. Vasquez

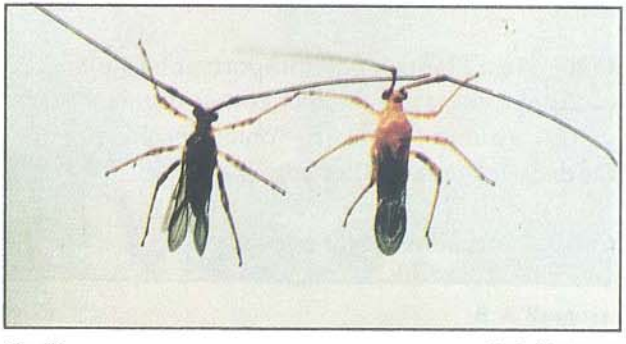


Fig. 26 E. A. Vasquez

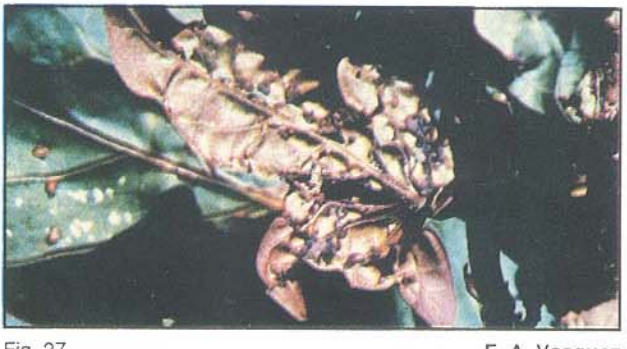


Fig. 27 E. A. Vasquez

WHITEFLIES

Aleurodicus dispersus Russell
(Homoptera:Aleyrodidae)

Biology and Description - The biology of *A. dispersus* has yet to be studied. As to description, pupa (Fig. 28) (has on its back fine wax threads about 12-15mm long and 6 pores which secrete wax.

Nature of Damage - High whitefly population (Fig. 29) causes yellowing and necrosis of infected leaf. Sooty molds growing on whitefly excretions may have diverse effect on photosysthesis. They transmit many virus diseases.

Natural Enemies

1. Aphelinid wasp
   Prospaltella clypealis Silvestre
   Prospaltella sp.
   (Hymenoplera: Aphelinidae)

Other Host Plants - Other important host plants are cabbage, cassava, cauliflower, cotton, eggplant, garlic, guava, legumes, mustard, onion, pechay, pepper, raddish, tobacco and tomato.

Control Measures - Not available.

Fig. 28 E. A. Vasquez

Fig. 29 E. A. Vasquez

WHITEFLIES

Bemesia tabaci Gennadius
(Homoptera:Aleyrodidae)

Biology and Description - The female of *B. tabaci* lays eggs on the underside of the leaves. Only the first larval stage bears legs; later, the larvae (each about 1mm long) develop into pale yellowish flattened oval and scale-like bodies on the leaves. Oval pupal case (1.16mm x 0.80mm) is pale or dark yellow with dorsal pores and markings and various ventral fringes. Adults (Fig. 30) have 2 pairs of wings, about 1mm long and slightly covered with white waxy bloom. Development of one generation takes 3-4 weeks.

Nature of Damage - Similar to *A. dispersus* (Fig. 31). It transmits virus diseases like sweet potato yellow dwarf disease, sweet potato leaf curl, sweet potato virus disease and sweet potato mild mottle virus.

Natural Enemies - Same as in *A. dispersus.*

Other Host Plants - Same as in *A. dispersus.*

Control Measures - Not available.

Fig. 30 D. M. Amalin

Fig. 31 D. M. Amalin

MELON APHID

Aphis gossypii Glover
(Homoptera:Aphididae)

Biology and Description - The nymphs are green to brown and molt four times before reaching the adult stage. Adults are yellowish to green or black, about 1.5mm long (Fig. 32). Females are parthenogenetic and viviparous, each producing 15-20 nymphs a day. *A. gossypii* transmits many virus diseases to various crops. Several generations occur in a year.

Nature of Damage - Aphids usually attack the growing shoots. They feed on the lower surface of the leaves and injure the plants by sucking the sap. The leaves curl down at the edges, become wrinkled and discolored. During heavy infestation, the vigor of the plant is greatly reduced. Aphid damage also stunts growth of the plant (Fig. 33). They transmit virus diseases such as sweet potato feathery mottle virus, cucumber mosaic virus, and sweet potato vein mosaic virus.

Natural Enemies

1. Lady beetles
   Menochilus sexmaculatus
   Coelophora inaequalis
   Scymnus sp.
   (Coleoptera:Coccinelidae)
2. Chrysopid predator
   Chrysopa oculata
   (Neuroptera:Chrysopidae)

Other Host Plants - Apart from sweet potato, it also damages citrus, cocoa, coffee, cotton, cucurbits, eggplant, okra, pepper, potato, and also ornamentals like *Hibiscus*.

Control Measures - *Chemical control.* Insecticides like carbaryl, diazinon, malathion, permethrin and decamethrin are recommended. Apply only if insecticide application becomes necessary.

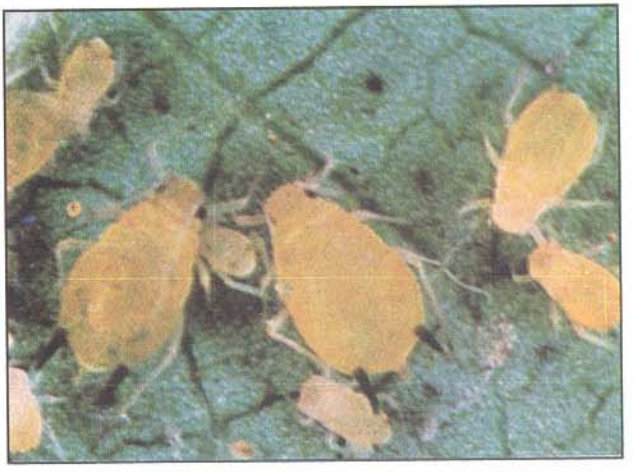


Fig. 32 M. Banziger

Fig. 33 E.A. Vasquez

GREEN PEACH APHID

Myzus persicae (Sulzer)
(Homoptera:Aphididae)

Biology and Description - The adult (Fig. 34) is small to medium-sized, 1.2-2.5mm long. It is usually green with a darker thorax. The antennae are two-thirds as long as the body. Siphunculi are clavate and fairly long. The face viewed dorsally has a characteristic shape.

Nature of Damage - The direct damage is typically distortion of young leaves and shoots (Fig. 35). Excessive damage leads to leaf curling. This species generally produces little honey dew. It transmit virus diseases similar to *A. gossypii.*

Natural Enemies

1. Lynx spider (Fig. 36)
   Oxyopes javanus Thorell
   (Araneae:Oxyopidae)
2. Crab spider (Fig. 37)
   Thomisus sp.
   (Araneae:Thomisidae)
3. Tortoise shell beetle (Fig. 38-adult; Fig. 39-egg)
   Menochilus sexmaculatus Fabricius
   (Coleoptera:Coccinelidae)
4. Braconid wasp
   Opius sp.
   (Hymenopteral: Braconidae)

Other Host Plants - It is polyphagous. It can occur on bitter gourd, cabbage, cauliflower, condol, chayote, eggplant, lemon, lettuce, loofah melon, mustard, pechay, pomelo, potato, raddish, squash, tomato, tobacco, watermelon, and on weeds like *Prunus persica, P. migra, P. tanella, P. serotina.*

Control Measures - Similar to *A. gossypii*

Fig. 34 H. Banziger

Fig. 35 D.M. Amalin

Fig. 36 D. M. Amalin

Fig. 37 D. M. Amalin

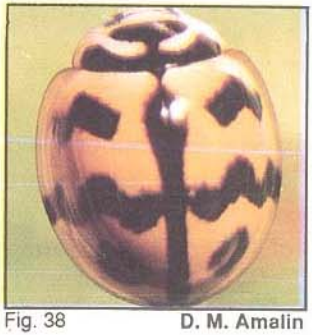


Fig. 38 D. M. Amalin

Fig. 39 D. M. Amalin

BLACK LEAF FOLDER

Brachmia convolvuli Wals
(Lepidoptera: Gelechiidae)

Biology and Description - Yellowish white oval eggs are laid singly on the leaf. Incubation period is about 3-5 days. The insect undergoes 5 larval instars for a period of 2-5 days each instar. The average total larval period is 10.18 days. The larva (Fig. 40) has prominent black and white markings on the thorax and the abdomen. The pupal period is 4-7 days. The adult leaf folder moth is grayish black. A female moth lays an average of 44 eggs in her life-span of 5 days.

Nature of Damage - Damage can occur at all stages of plant growth. The larvae feed inside the folded leaves leaving the lower surface intact. Only one larva is found per leaf fold. The larva folds the leaf margin only once (Fig. 41). The damage results in a lace-like appearance of the leaf with the main leaf veins remaining intact.

Natural Enemies

1. Braconid wasp
   Macrocentrus sp.
   (Hymenoptera:Braconidae)

2. Entomogenous fungus
   Fusarium sp. nr. larvarum
   (Moniliales:Stilbellaceae)

Other Host Plants - *Ipomoea triloba* and *I. aquatica*

Control Measures

1. Chemical control: Carbaryl, fenitrothion and triclorphon in high and low volume sprays are recommended.
2. Cultural control: Use of insect-free planting materials.

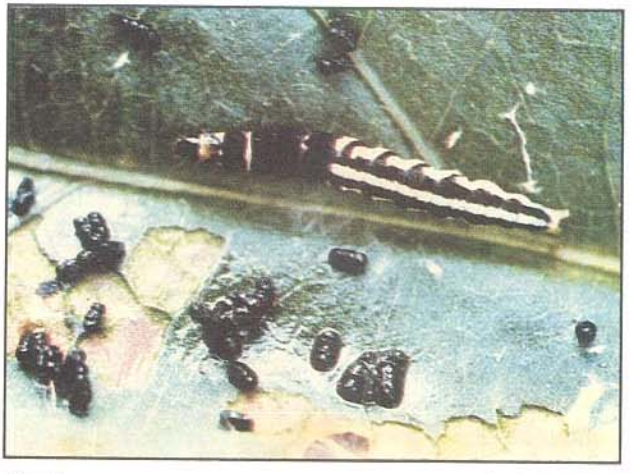


Fig. 40 E. A. Vasquez

Fig. 41 D.M. Amalin

LEAF MINER

Bedellia somnulentella (Zeller)
(Lepidoptera: Lyonitidae)

Biology and Description - The eggs are laid singly or in groups usually on the lower surface of the leaf near the midrib, veins or at the base of the leaf blade. Incubation period lasts for 5-6 days. Larva (Fig. 42) undergoes 5 instars. It has a yellowish body with paired pink spots on the dorsolateral side of the thorax which later disappear and are replaced by red tubercles in all segments. During the fifth instar, the larva undergoes a short prepupal period, comes out of the mine and produces numerous silken threads which fix and support the pupae on the under surface of the leaf. The total larval period ranges from 6-20 days. Pupation (Fig. 43), which lasts for 3-6 days, occurs a day after the larva comes out of the mine. The adult is a very small moth with a body length of 3.5-4.0mm. It is grayish to brown body with light brown scales. A female adult lays 1-67 eggs with an average of 20 eggs in 1-2 days.

Nature of Damage - The young larva enters the leaf and forms a serpentine mine. As the larva matures, it forms blotch mines. The larva feeds inside the mine leaving the leaf surface. During severe damage, the leaf becomes brown and shrivelled and later shows numerous holes as the mine tissues are destroyed. The lower surfaces of the heavily infested leaves become dirty and blackish, and show silken webbings where the insect pupates. A serious outbreak can reduce the yield (Fig. 44).

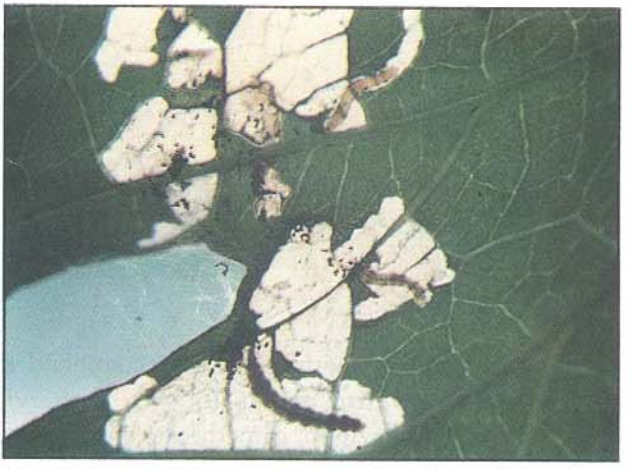


Fig. 42 **E. A. Vasquez**

Fig. 43 **E. A. Vasquez**

Fig.44 **E. A. Vasquez**

Natural Enemies

1. Wasp
   Apanteles sp.
   (Hymenoptera:Braconidae)

Other Host Plants - No record.

Control Measures

1. Chemical control: The insecticides recommended for leaf miner control are as follows: carbaryl, chlorfenvinphos, diazinon, dimethoate, endosulfan, malathion and trichlophon.

2. Cultural control: Use of insect-free planting materials.

COMMON CUTWORM

Spodoptera litura Fabricius
(Lepidoptera:Noctuidae)

Biology and Description - Eggs laid in mass (up to 500 eggs) are covered with short, fine light brown hairs. Incubation period is 3 days. Newly hatched larva is greenish and gradually turns brownish black as it matures (Fig. 45). A transverse band appears on each side of the body. Total larval period ranges from 12-20 days. The obtect pupa is dark brown. Total life cycle is 27-32 days. Adult moth is brown with silvery and wavy markings on forewings (Fig. 46).

Nature of Damage - The cutworm feeds on young and mature leaves making large holes on the blades. During severe infestation the plant is totally defoliated.

Natural Enemies

1. Entomogeneous fungus (Fig. 47)
   Nomurae sp.
   (Moniliales:Moniliaceae)

Other Host Plants - Cutworm is polyphagous. Apart from sweet potato, it attacks asparagus, banana, cacao, corn, cotton, citrus, garlic, jute, kenaf, mulberry onion, passion fruit, rice, roselle, sesame, sorghum, sugarcane, tabacco, taro, wheat, white potato, and a number of crops under family Cruciferae and Cucurbitaceae.

Control Measures

1. Light trapping: Light is hung on a bamboo tripod over a basin containing water to trap the adults at night. The trap can be set in various parts of the field.

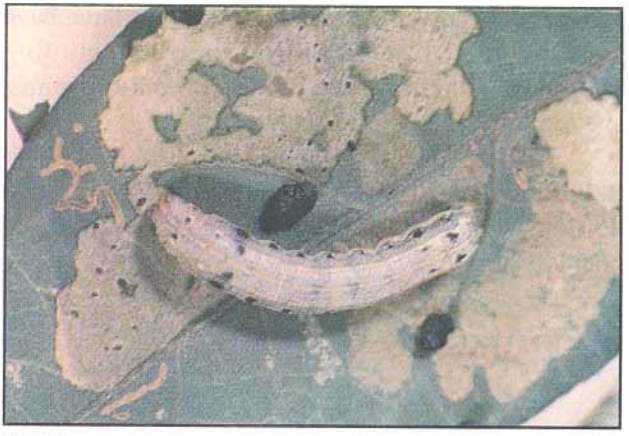


Fig. 45 **E. A. Vasquez**

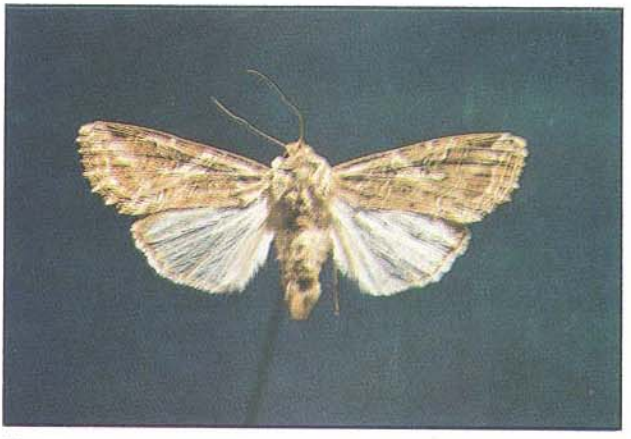


Fig. 46 **D. M. Amalin**

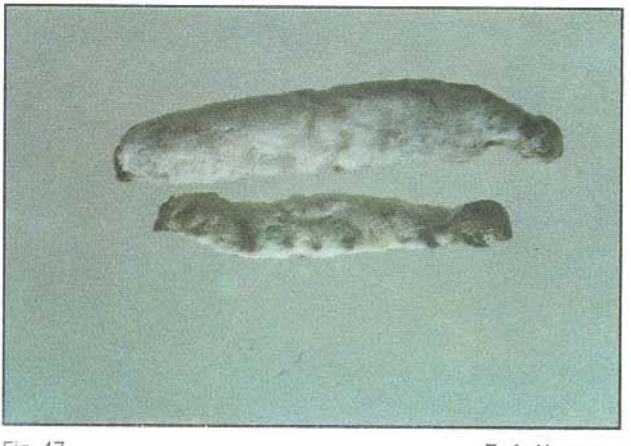


Fig. 47 **E. A. Vasquez**

2. **Chemical control**: Several insecticides have been recommended for cutworm control including acephate, diazinon, malathion, metamidiphos, mevinphos, phentoate.

3. **Baiting**: Baits using 10 kg of bran or sawdust, 8 to 10 liters of water, 1 liter of molasses and 100 g of trichlorphon.

WHITE PLUME MOTH

Aciptilia niveodactyla Pagenstecher
(Lepidoptera: Pterophoridae)

Biology and Description - Hemispherical greenish white eggs are laid on either surface of the leaf and hatch in 4-5 days after oviposition. Neonate larval instars (Fig. 48) are green with long white hairs arising from tubercles. Old instars have alternating black white hairs. The larva pass 5 instars in 6-18 days. The pupal period lasts 3-6 days. The adult (Fig. 49) is a small moth (7-8mm) with white body and feather-like wings. A female is capable of laying 25-129 eggs during an oviposition period of 2 days.

Nature of Damage - The larva prefers young unopened shoots. In open leaves, it folds together both sides of the blade and feeds inside the fold. The young larva feeds on the upper surface only, leaving the lower surface intact. The older larva feeds right through the leaf surface producing numerous holes. In some cases, it eats the entire leaf blade leaving only the petiole. The damaged leaf does not turn brown unlike that attacked by the brown leaffolder. Severe infestation shows heavily defoliated plants.

Natural Enemies

1. Braconid wasp
   Apanteles sp.
   (Hymenoptera:Braconidae)

Other Host Plants - *Ipomoea triloba* and *I. aquatica.*

Control Measure - Not available.

Fig. 48 E. A. Vasquez

Fig. 49 E. A. Vasquez

PINK-STRIPED LEAF FOLDER

Anticrota ornatalis Duponchel
(Lepidoptera:Pyralidae)

Biology and Description - Flat disc shaped eggs are laid around the leaf margin or along the veins, arranged in an overlapping manner. Incubation period lasts from 3-6 days. The larva has 5 instars with a total development period of 7-22 days. Pupal period ranges from 3-7 days. A life cycle of 14-29 days has been recorded.

Newly hatched larva is transparent white and turns yellow as it matures. The third instar larva has a middorsal greenish brown stripe. It turns pink in the fourth instar. The adult is small brown moth with wide dark brown band on its wings.

Nature of Damage - The larva feeds on the shoots leaving irregular holes on the leaves. A mature larva can eat the entire leaf blade leaving only the petiole.

Natural Enemies - No record.

Other Host Plants - Not known.

Control Measure - Not available.

GREEN LEAF FOLDER

Herpetogramma (=Psara) hipponalis (Walker)
(Lepidoptera:Pyralidae)

Biology and Desription - The eggs are usually laid in groups on the upper surface of the leaf near the midrib. Eggs are shiny green, oblong and covered with scale-like gelatinous material. Incubation period takes 3-6 days. It undergoes 5 larval instars which lasts from 6-31 days. The larva (Fig. 50) is greenish yellow with sparse brown setae and dark brown head and prothoracic plate. The pupal period lasts from 4-8 days. The adult is a yellow brown moth with dark brown markings on its wings. The female moth lays an average of 90 eggs in its 3-day life span.

Nature of Damage - Similar to black leaffolder except that the larva folds the leaf margin twice with the folded area showing some webbings (Fig. 51). Also, the holes produced by the green leaffolder are smaller than the holes made by the black leaffolder.

Natural Enemies

1. Wasp
   Brachymeria sp.
   (Hymenoptera:Chalcididae)

Other Host Plants - It also attacks *Ipomoea* wild species and found also in tobacco.

Control Measures - Similar to black leaf folder.

Fig. 50 E. A. Vasquez

Fig. 51 E. A. Vasquez

BROWN LEAFFOLDER

Ochyrotica concursa Wals.
(Lepidoptera:Pyralidae)

Biology and Description - Oblong and brownish yellow eggs are laid singly along the veins of the shoots, especially the very young unopened leaves. Incubation period is about 4-5 days. The insect undergoes 5 larval instars with a total larval period ranging from 8-17 days. The larva (Fig. 52) is green becoming brown as it matures. Pupal period is 5-6 days. The adult (Fig. 53) is a dark brown moth. The total life cycle is 17-28 days.

Nature of Damage - The brown leaffolder attacks the shoots and prefers young unopened leaves. The larva feeds between the folded leaf blades on the upper surface leaving the lower surface intact so the feeding area appears silvery from a distance. As the larva matures, it eats right through the leaf blade producing large irregular holes on the young unopened shoot. The feeding area turns brown and is littered with blackish excreta (Fig. 54).

Natural Enemies - Unidentified hymenopterous parasite.

Other Host Plants - *Ipomoea triloba* and *I. aquatica*.

Control Measures - Not available.

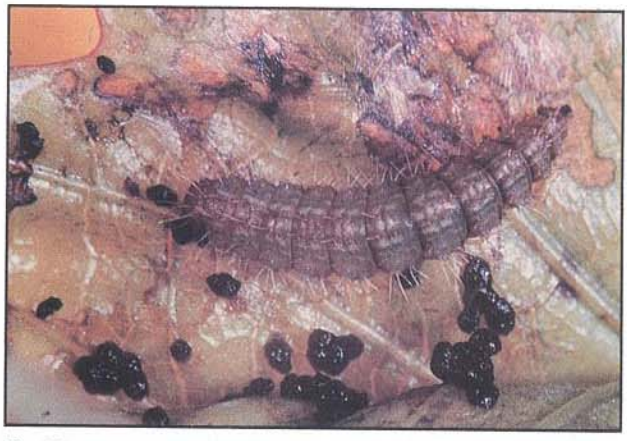


Fig. 52 E. A. Vasquez

Fig. 53 E. A. Vasquez

Fig. 54 E. A. Vasquez

SWEET POTATO STEM BORER

Omphisa anastomosalis Guenee
(Lepidoptera:Pyralidae)

Biology and Description - The eggs are laid singly or in groups of 2-3 eggs in crevices on the stem or in a single row of 6 or more eggs along the midrib of the leaf. The larva emerges after an incubation period of 3-8 days. Newly hatched larva (Fig. 55) has black head and reddish tinge on its body. After a few days, it turns creamy with blackish markings on both the dorsal and lateral sides of the body. Setae are sparse and brown. Full grown larva reaches 30mm long. There are 5 larval instars with total developmental period of 12-50 days. Pupal period ranges from 3-4 days. The adult measures 15mm long. It has a reddish brown head and body with very light brown wings.

Nature of Damage - The larva bores into the main stem and sometimes penetrates the storage roots. Larval feeding produces large tunnels causing hollow cavities in the stem resulting to wilting and eventual death of infested plants. Pupation takes place in a thin cocoon within the tunnel (Fig. 56). Attack at early stages of plant growth prevents storage roots formation since translocation of food and its storage in the roots become severely affected. Further damage occurs when the larva tunnels into the storage roots making them non-marketable.

Natural Enemies - Undetermined hymenopteran species under family Encyrtidae.

Other Host Plants - It also occur in another Convolvulaceae — *Ipomoea pescaprae* (L.).

Fig. 55 E. A. Vasquez

Fig. 56 D. M. Amalin

Control Measures

1. Cultural control: Crop hygiene and crop rotation.

2. Chemical control: If insecticide becomes necessary the following insecticide are recommended:

a) Carbaryl or BHC at 0.1% a.i./ha sprayed every two weeks

b) Biweekly spraying of deltamethrin at the rate of 0.025 kg. a.i./ha.

c) Broadcasting of carbofuran at the rate of 2 kg a.i./ha around the stem can give excellent pest control but not very economical.

SWEET POTATO HORNWORM

Agrius convolvuli Linn.
(Lepidoptera:Sphingidae)

Biology and Description - Spherical eggs are laid singly on the under surface of the leaves. Egg hatching takes place 4 days after oviposition. There are 5 larval instars with an average of 2-6 days per stadium. The larva matures within 13-25 days. The larva (Fig. 57) has a prominent posterior horn. Its color varies from green to brown with distinct patterns. It reaches a maximum length of 95 mm. Pupation takes place in the soil. The reddish brown pupa (Fig. 58) is characterized by its prominent proboscis which is curved downward. Pupal period is from 5-10 days. The adult (Fig. 59) is a large greyish brown hawkmoth with black lines on the wings and pink markings on the abdomen. The total life cycle ranges from 22-39 days.

Nature of Damage - The larva defoliates the plant. It feeds on the leaf blade causing large irregular holes and may eat the entire leaf blade leaving only the petiole.

Natural Enemies - No record.

Other Host Plants - Apart from sweet potato, it also attacks eggplant, grapes, legumes, pepper, tomato, and taro.

Control Measures

1. Cultural control: Plowing the field to expose the pupae reduces infestation. Handpicking of the larvae may be quite effective in small areas.
2. Chemical control: If insecticide application becomes necessary, contact insecticide like malathion, can effectively control this pest.

Fig. 57 E. A. Vasquez

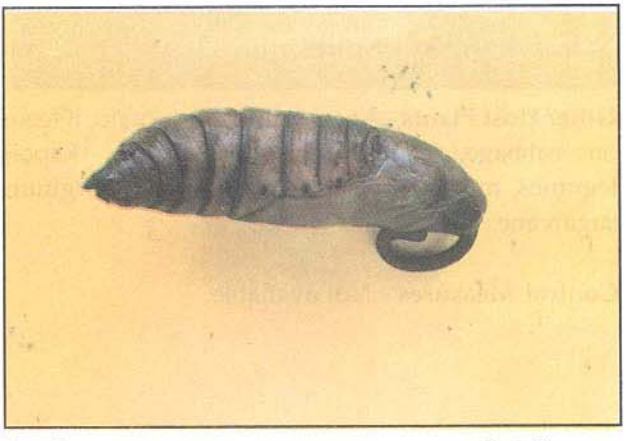


Fig. 58 E. A. Vasquez

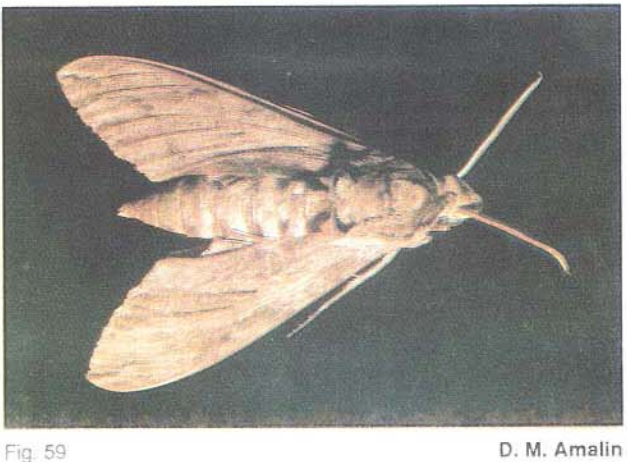


Fig. 59 D. M. Amalin

SLANT-FACED GRASSHOPPER

Attractomorpha psittacina de Haan
(Orthoptera:Acrididae)

Biology and Description - The adult of *A. psittacina* is characterized by a pointed conical head (Fig. 60). It measures about 30-40mm long. The upper part of the female body is greenish while that of the male is brownish. The hindwings are hyaline with pinkish base.

The biology is not yet completed.

Nature of Damage - Similar to *P. furcifera.*

Natural Enemies - No record.

Other Host Plants - Apart from sweet potato, it feeds on cabbage, cauliflower, coconut, corn, kapok, legumes, mustard, pechay, raddish, rice, sorghum, sugarcane, tabacco and wheat,

Control Measures - Not available.

Fig. 60 **E. A. Vasquez**

TARO GRASSHOPPER

Gesonula zonocera mundata Navas
(Orthoptera:Acrididae)

Biology and Description - Using its ovipositor, the female *G. zonocera mundata* bores through the petiole of the host plant where it lays eggs in eggs are covered with reddish brown gummy substance for protection. Nymphs are sometimes semi-aquatic. The pale brown to green adult (Fig. 61) measures 30mm long. It has black stripes running from eyes to tips of wings. The legs have black hind legs and bluish tibiae with white-tipped spines.

Nature of Damage - Same as in *P. furcifera* and *A. psittacina.*

Natural Enemies - No record.

Other Host Plants - It also damages taro and water hyacinth.

Control Measures - Same as in *P. furcifera* and *A. psittacina.*

Fig. 61 **E. A. Vasquez**

KATYDID

Phaneroptera furcifera Stal
(Orthoptera:Tettigonidae)

Biology and Description - Eggs of *P. furcifera* are inserted by females singly or in linear groups into tissues of the host at the woody portion of the twigs. Incubation period is about 20 days. There are 4 nymphal instars lasting from 30-41 days. Nymphs are grass green and measure about 17mm (male) and 14mm (female) long. Adult is foliage green with brownish red veins on hindwings (Fig. 62). Adult longevity is about 28 days. The female is capable of laying as many as 149 eggs.

Nature of Damage - The polyphagous nymphs and adults feed on the foliage (Fig. 63). They are voracious and consume the entire leaf.

Natural Enemies - No record.

Other Host Plants - It is polyphagous. It occurs in ampalaya, cabbage, cauliflower, chayote, citrus, coconut, condol, corn, cotton, cucumber, kapok, kenaf, legumes, loofah, melon, mustard, okra, pechay, raddish, rice, roselle, sorghum, sugarcane, squash, tabacco, watergourd, white potato, watermelon, and wheat.

Control Measures - Not available.

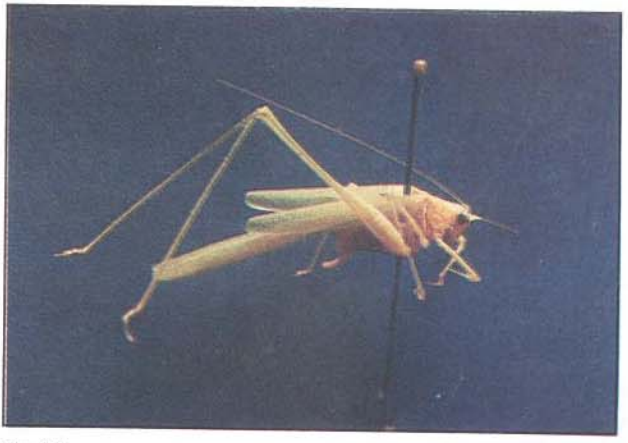


Fig. 62 D. M. Amalin

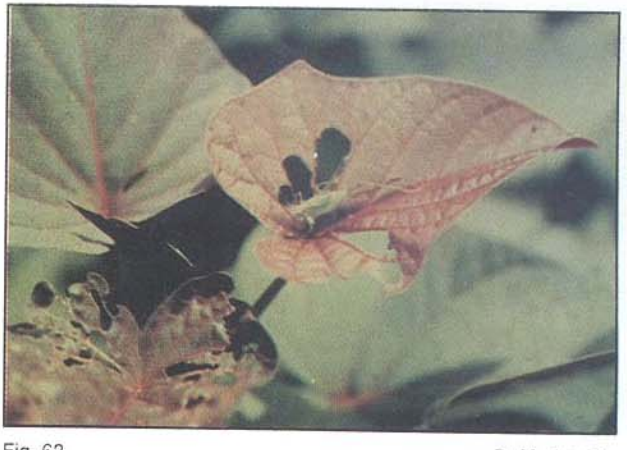


Fig. 63 D. M. Amalin

ERIOPHYIID MITE

Eriophyes gastrotrichus Nalepa
(Acarina:Eriopyiidae)

Biology and Description - The worm-like body is white and cylindrical which tapers posteriorly (Fig. 64). The entire body surface has a large number of closed-set fine, discontinuous lines giving the shield a wrinkled appearance. Forelegs are moderately arched and the hindlegs are shaped like the foreclaw. Forecoxae has a very fine oblique striations. Abdomen has about 67 rings. Dorsally, the microtubules are close-set, elongate-oval and occupy almost the entire width of the rings. The microtubules are smaller, roundish and arrange along the middle of the rings and tend to elongate progressively on the rear half viewed ventrally and also microstriated on the last 2-3 rings. Total body length is 148-160 and 46 thick.

Nature of Damage - This mite induces formation of extensive galls, irregular in shape and size, on stem and leaf surfaces (Fig. 65). Mites in all stages of development live inside the same gall.

Natural Enemies - No record.

Other Host Plants - It also occur on another Convolvulaceae — *Ipomoea staphylina*.

Control Measures - Not available.

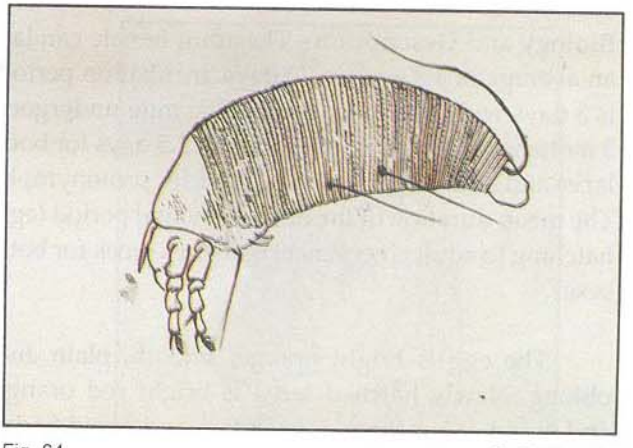


Fig. 64 **D. M. Amalin**

Fig. 65 **E. A. Vasquez**

FALSE SPIDER MITE

Brevipalpus californicus Banks
(Acarina:Tetranychidae)

Biology and Description - The adult female can lay an average of 4.3 eggs in 20 days. Incubation period is 3 days with 97% hatchability. The mite undergoes 3 molts with an average duration of 2.5 days for both larva and deutonymph and 1.7 days for protonymph. The mean duration of the developmental period (egg hatching to adult emergence) is about a week for both sexes.

The egg is bright orange, smooth, plain and oblong. Newly hatched larva is bright red orange and ovoid. It has three pairs of legs and ovoid body. Nymphs are 3 times larger than the larva and its appendages are more slender, tapering and colorless. A prominent dark reddish area appears on the dorsum while the rest of the body becomes almost colorless as it grows. The deutonymph is similar to protonymph but is larger and more slender. The adult (Fig. 66), although bigger, is similar in shape to the deutonymph. The dorsal spot is brighter. The legs and chelicerae are distinct.

Nature of Damage - *B. californicus* is a polyphagous feeder attacking many plant species other than sweet potato. The mites suck the sap from the petioles and leaves causing the lower surface to become scorched and dotted with whitish feeding punctures. The entire leaf curls, turns yellowish brown, and drops prematurely to the ground (Fig. 67).

Natural Enemies - No record.

Other Host Plants - It is common in citrus.

Control Measures - Acaricides under various trade names can be used to control sweet potato spider mites. Apply only if necessary.

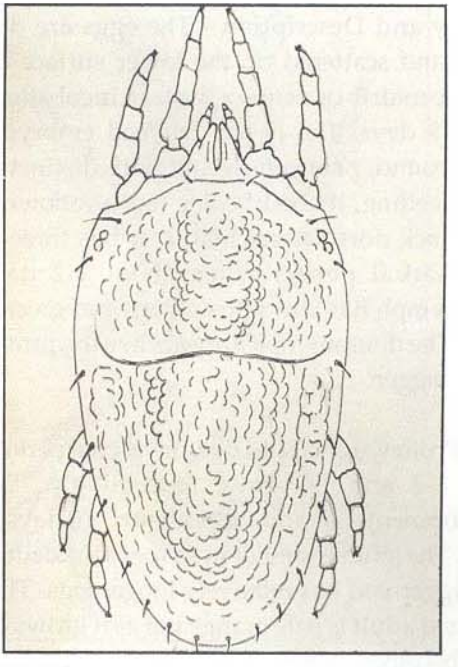


Fig. 66 **D. M. Amalin**

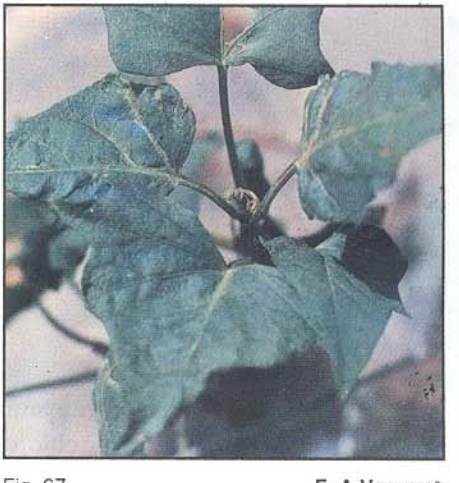


Fig. 67 **E. A Vasquez**

SWEET POTATO SPIDER MITE

Tetranychus marianae McGregor
(Acarina:Tetranychidae)

Biology and Description - The eggs are deposited singly and scattered on the lower surface along or near the midrib or veins of the leaf. Incubation period lasts 3-5 days. The newly hatched embryo is very small, round, pale yellow and with distinct red eye. Upon feeding, its body color turns yellowish green with black dorsolateral marks. It has three pairs of legs. Larval period takes about 1-2 days. The protonymph has four pairs of legs and greenish oval body. The deutonymph appears like the protonymph but is bigger.

Protonymphal and deutonymphal period ranges from 1-2 and 1-3 days, respectively. The total developmental period takes about 7-10 days for both sexes. The adult is similar in shape to the deutonymph but bigger and has relatively longer legs. The newly emerged adult is pale orange but as it grows older, its color becomes carmine red with lateral dark markings (Fig. 68). The male remains yellowish green like the immatures. Females are capable of parthenogenetic reproduction with unfertilized eggs developing into males exclusively. Mated females are more fecund than the immatures. The former laying an average of 133.7 and the latter 60.8 eggs during their entire life time. The colony seems to produce little webbings located on the lower surface of the leaves.

Nature of Damage - Adults and nymphs of spider mites suck the leaf sap, causing damaged leaves to become white and appear as conspicuous stipplings on the lower surface (Fig. 69). Under heavy infestation, photosynthesis is greatly reduced. The chlorotic areas coalesced, the leaves eventually turn yellow and later brown, become scorched and drop prematurely.

Natural Enemies

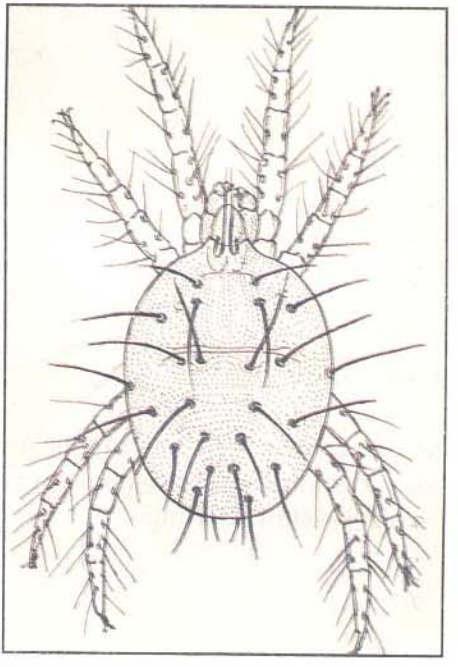


Fig. 68 D. M. Amalin

Fig. 69 V. A. Vasquez

Natural Enemies

1. Coccinelid
   Stethorus sp.
   (Coleoptera:Coccinellidae)

2. Staphylinid
   Oligota sp.
   (Coleoptera:Staphylinidae)

Other Host Plants - Apart from sweet potato, it also occurs on kadyos, squash, and on weeds like - *Aclypha vilkesiana, Centrosema pubescens, Ipomoea triloba, Merremia vitifolia, and Passiflora edealis.*

Control Measures

1. Chemical control: If spraying is necessary, acaricides under various trade names can be used to control sweet potato spider mite.

PEST DAMAGE EVALUATION

A. General Information

Place: _____
Date: _____
Reporter: _____
Survey ☐ Casual ☐
Crop: _____
Cultivar: _____
Growth Stage: _____
Area Planted (ha): _____
Area Planted (ha): _____

B. Identification		C. Field Evaluation (% Plant Damage)	D. Yield Lost (%)
Pests	Natural Enemies	Subjective/ Quantitative	Subjective estimates/ Quantitative evaluation
1. Foliar Damage			
a. common name:			
scientific name:			
b. common name:			
scientific name:			
c. common name:			
scientific name:			
d. common name:			
scientific name:			
2. Stem Damage			
a. common name:			
scientific name:			
b. common name:			
scientific name:			
c. common name:			
scientific name:			
3. Storage root Damage			
a. common name:			
scientific name:			
b. common name:			
scientific name:			
c. common name:			
scientific name:			

E. Additional Information _____
4.Pesticides Used _____
5.Other Remarks _____

PEST DAMAGE EVALUATION

INSTRUCTIONS

This form is adopted from the Pest Damage Evaluation Form released by CIP with some modifications. It will give pertinent information necessary to effectively manage the pests.

A. General Information (Section A). Growth stages of plants mark with letters from A to D according to the following scale: A = planting to half ground cover, B = half ground cover; C = full ground cover to yellowing of lower leaves; D = yellowing of lower leaves to harvest. Check either "survey" or "casual visit". A survey is one of a series of evaluations with a monitoring program. A casual visit can produce an occasional evaluation.

B. Identification (Section B). Report only important pests and natural enemies with known pest association. Write the common name and if possible the scientific name.

C. Field evaluation (Section C). This refers to insect damage to plants in the field as a result of a quantitative evaluation or a subjective estimate (Check one only).

— % PlantDamage: Insect damage is expressed as percentage.

For quantitative evaluations follow these procedures:

1. Foliar damage: work with 25 plants at random throughout the crop. Inspect 4 leaves (or leaflets) from upper and lower half of each plant. Record the total number of injured leaves.
2. Stem damage: Work with 25 plants at random in groups of 5 consecutive plants. Multiply the total number of damaged stems by 4.
3. Storage root damage: Take at random 5 groups of 20 storage roots each. Record the number of infested storage roots.

For subjective estimate follow this procedure:

For subjective estimate assess the plant damage (foliar, stem, and storage root damages) using a two row filed plot technique with four levels of stress incidence (Figure 70).

— Persistence/Spread (of the pest): Use the following code to indicate pest categories.

Category code	Persistence	Category Code	Spread
A	Occasional	A	Patchy
B	Seasonal	B	Gradient
C	Persistent	C	Uniform

D. Yield loss (%) (Section D). Yield losses attributed to a pest or group pests are reported in this section. Quantitative evaluations are based on experimental results comparing infested plots vs. pest- free plots. Subjective estimates can be made by experts and be reported independently of previous field evaluations.

E. Additional information (Section E). Provide any other relevant information. If you desire you may add extra pages with additional information on pests including pictures.

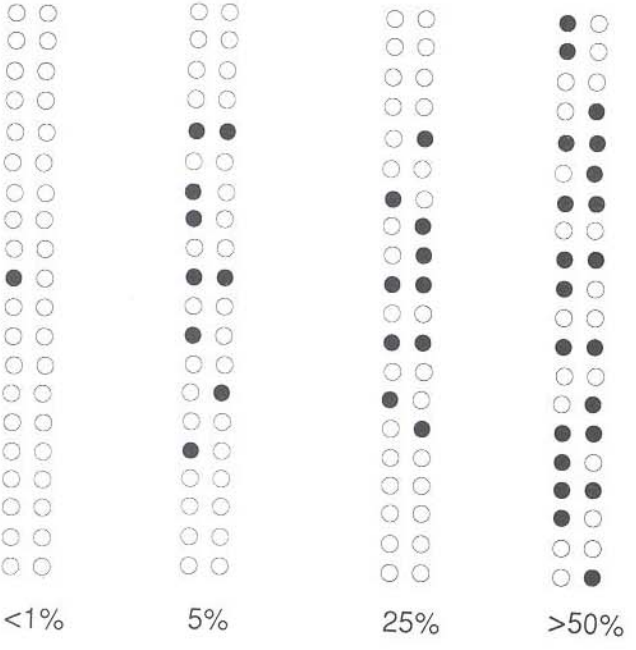


Figure 70. Two-row filed plot technique for damage assessment with four levels of stress incidence (shaded circle represent damaged plants).

REFERENCES

AMALIN, D.A., E.A. VASQUEZ AND P. VANDER ZAAG. 1991. Note: Arthropods of Sweet Potato in the Philippines. Philip. Agric. 74(1):39-50.

BERNARDO, E.N. 1986. Sweet potato arthropod pests and their control. In: State of the Art. Sweet Potato Research. Crops Research Series #9 pp.21-24.

BURDEOS, A.T. 1980. Effect of soil depth on the degree of sweet potato weevil infestation. Ann. Trop. Res. 2(4):224-231.

CHANNABASAVANNA, G.P. 1966. A contribution to the knowledge of Indian Eriophyiid mites. University of Agricultural Sciences. Hubbal, Bangalore. India pp. 154.

COREY, F.M. 1981. Effect of weevil [*Cylas formicarius* (Fabr.)] and other insect pests on the yield of sweet potato. MS Thesis, University of the Philippines, Los Baños, Laguna, pp. 123.

CORPUZ-RAROS, L. 1985. Survey, identification and biology of natural enemies of spider mites attacking cassava and sweet potato. Terminal Report. PARRS Proj. 0900-80-00-31, ViSCA, Baybay, Leyte.

CORPUZ-RAROS, L.A. 1989. Hosts, Geographic Distribution and Predatory Mite Associations of Philippine Phytophagous mites (Acari). Philip. Agric. 72(3):303-322.

ESGUERRA, N.M. and B.P. GABRIEL. 1969. Insect pests of vegetables. U.P. College of Agriculture, College, Laguna. Tech. Bull. 25:84-95.

FAO. 1986. Vegetable production in Asia and the Pacific regions: Past trend and future prospects. FAO Regional Office for Asia and the Pacific, Bangkok, Thailand.

GABRIEL, B.P. 1975. Insects and mites injurious to Philippine crop. U.P. College of Agriculture, College, Laguna. pp. 64-66.

GAPASIN, D.P. 1980. Biological studies of sweet potato insect pests and their natural enemies. Terminal report of project funded by PCARRD. Dept. of Plant Protection. ViSCA, Baybay, Leyte. pp. 270.

GONATO, R.C. 1978. Insect pests attacking the above-ground parts of sweet potato at different stages of growth. BSA Thesis, Visayas State College of Agriculture, Baybay, Leyte.

GONZALES, S.S. 1925. The sweet potato weevil [*Cylas formicarius* (Fabr.)]. Philip. Agric. 14: 259-281.

JULARBAL, C.L. 1981. Biology of sweet potato false spider mite, *Brevipalpus californicus* Banks (Tenuipalpidae:Acarina). BSA Thesis, Visayas State College of Agriculture, Baybay, Leyte.

TALEKAR, N.S. 1987. Insect pests of sweet potato in the tropics. In: Abstracts of the 11th International Congress of Plant Protection. Oct. 5-9, 1987. Manila, Philippines. pp. 108-109.

TALEKAR, N.S. 1990. Integrated pest management of sweet potato weevil. A Training Guide. AVRDC. Taipei. pp. 10.

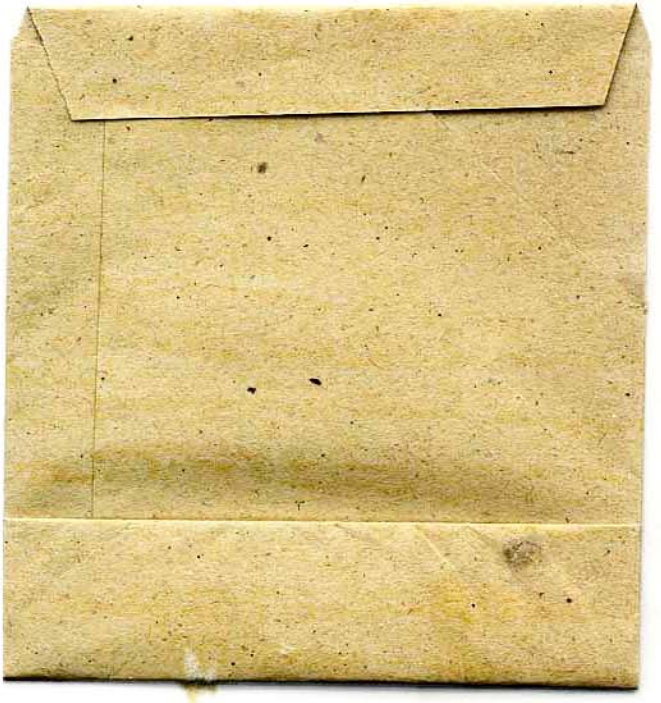
UICHANCO, L.B. 1920. Pests of sweet potato. Philip. Agric. 19:446-448.

VASQUEZ, E.A. and D.P. GAPASIN. 1980. Stems and tubers for rearing sweet potato weevil. Ann. Trop. Res. 2(2): 80-88.

VASQUEZ, E.A. AND C.E. SAJISE. 1989. Pests of sweet potato: Insects, mites and diseases. PRIS and PRCRTC. ViSCA, Baybay, Leyte, pp. 65.

Acknowledgment

The authors wish to thank the following: Mr. Alberto T. Barrion for confirming the arthropod identification, Dr. Adelina A. Barrion for editing, Ms. Cristy Isip for lay-outing and Mr. Ruel D. Medina for the illustration.



Disclaimer

Mention of trade names in this publication is solely for the purpose of providing specific information and does not endorse products named nor imply criticism of similar ones not mentioned.

ISBN 971-91361-0-3