

Survey of Arthropod Pests and Invasive Weeds in the Republic of the Marshall Islands



R. Muniappan and Dilip Nandwani
June 2002

Publication #1
College of the Marshall Islands
P.O. Box 1258 • Majuro, MH 96960



Survey of Arthropod Pests and Invasive Weeds in the Republic of Marshall Islands

by
R. Muniappan
Dilip Nandwani
July 2002

Publication # 1
Cooperative Research and Extension
College of the Marshall Islands
Majuro, Marshall Islands 96960

The College of the Marshall Islands offers its programs to all persons regardless of race, color, sex, national origin, age, disability and is an Equal Employment Opportunity employer. College of the Marshall Islands and the United States Department of Agriculture are cooperating in furtherance with the Cooperative Extension Work, Act of September 29, 1977 as amended. Diane C. Myazoe, Dean.

Authors

R. Muniappan, Emeritus Professor of Entomology, College of Agriculture and Life Sciences, University of Guam, Mangilao, Guam 96923, USA

Dilip Nandwani, Researcher (Agriculture), Cooperative Research and Extension, College of the Marshall Islands, P.O. Box 1258, Majuro, MH 96960, Republic of the Marshall Islands

Contents

Message from the President.....	1
Message from the Dean	2
Introduction.....	3
List of Plates	iv
Pests of Crops	4
Banana	
Banana aphid.....	4
Spiraling whitefly.....	4
Coconut scale.....	4
Oriental red mite.....	5
Bagworm.....	5
Beans	
Cowpea aphid.....	5
Bean leaf roller	5
Leafminer.....	5
Fleahopper.....	5
Broad mite.....	6
Bell pepper	
Broad mite.....	6
Leafminer.....	6
Urbicola soft scale	6
Breadfruit	
Breadfruit mealybug.....	6
Mango fruit fly.....	7
Coconut scale.....	7
Red wax scale	7
Spiraling Whitefly.....	7
Castor	
Castor semilooper	7
Cutworm	7
Chinese cabbage	
Blue moon, Great eggfly or Common eggfly.....	8
Fleahopper.....	8
Coconut	
Coconut leaf beetle.....	8
Red coconut scale	8
Coconut scale.....	9
Bagworm.....	9
Spiraling whitefly	9
Palm mealybug.....	9
Weevil	9
Leaf caterpillar.....	9
Corn	
Melon aphid.....	9
Cutworm	9

Cucumber	
Pumpkin caterpillar.....	10
Melon aphid.....	10
Eggplant	
Broad mite.....	10
Urbicola soft scale.....	10
Spiraling whitefly.....	10
Melon aphid.....	10
Striped mealybug.....	10
Grass	
Nutgrass armyworm.....	10
Guettarda	
Hornworm.....	10
Leucaena	
Leucaena psyllid.....	10
Lime	
Mite.....	11
Morinda	
Hornworm.....	11
Melon aphid.....	11
Oleander pitted scale.....	11
Oleander	
Oleander pitted scale.....	11
Oyster scale.....	11
Pandanus	
Pandanus leafminer.....	11
Mealybugs.....	11
Papaya	
Spider mite.....	11
Spiraling whitefly.....	11
Coconut scale.....	12
Plumeria	
Oriental red mite.....	12
Spiraling whitefly.....	12
Premna	
Breadfruit mealybug.....	12
Red wax scale.....	12
Radish	
Fleahopper.....	12
Rose	
Leaf cutter bee.....	12
Squash	
Pumpkin caterpillar.....	12
Fleahopper.....	12
Sweet potato	
Sweet potato weevil.....	12
Green tortoise beetle.....	12
Sweet potato hawk moth.....	13
Sweet potato flea beetle.....	13
Spider mite.....	13

Sweetsop	
Spiraling whitefly	13
Taro	
Taro planthopper	13
Tomato	
Urbicola soft scale	13
Spiraling whitefly	13
Leafminer	13
Melon aphid	13
Broad mite.....	13
Striped mealybug	13
Tournefortia	
Tiger moth.....	14
Tropical almond tree	
Brown awl.....	14
Semilooper	14
Spiraling whitefly	14
Vitex	
Leafroller.....	14
Wedelia	
Flea beetle.....	14
Eriophyid mite	14
Some Invasive Weeds.....	15
Chromolaena	15
Green citrus aphid.....	15
Urbicola soft scale	15
Ivy gourd	15
Dodder	15
Spanish Needle	16
Broad mite.....	16
References.....	16
Acknowledgements.....	17

List of Plates

Banana aphid	P1
Oriental red mite on banana	P1
Oriental red mite.....	P1
Cowpea aphid on beans	P1
Cowpea aphid on bean flowers.....	P1
<i>Lamprosema diamenalis</i> damage to bean leaf	P1
Leafminer damage to bean leaf	P2
Fleahopper damage to beans	P2
Broad mite damage to beans	P2
Broad mite damage to pepper.....	P2
Broad mite damaged pepper field	P2
Breadfruit mealybug	P2
Red wax scale	P3
Coconut scale	P3
Lady beetle, <i>Rodalia pumila</i> pupa.....	P3
Brontispa chalybeipennis adults	P3
Fruit fly.....	P3
Red coconut scale.....	P3
Red coconut scale on coconut.....	P4
Coconut scale on breadfruit leaf.....	P4
Spiraling whitefly on coconut leaf	P4
Bagworm damage to coconut	P4
Bagworm damage to coconut petiole	P4
Weevil damage to coconut petiole.....	P4
Weevil	P5
Coconut leaf caterpillar	P5
Caterpillar damage to coconut leaflet.....	P5
Caterpillar damage to coconut leaf.....	P5
<i>Achaea janata</i> caterpillar.....	P5
<i>Spodoptera litura</i> caterpillar.....	P5
<i>Hypolimnas bolina</i> adult.....	P6
<i>Hypolimnas bolina</i> caterpillar	P6
Fleahopper damage to Chinese cabbage	P6
Fleahopper damage to sweet potato leaves	P6
Melon aphid.....	P6
Parasitoid emergence hole in a melon aphid mummy	P6
Melon worm, <i>Diaphania indica</i>	P7
Broad mite damage to eggplant fruit.....	P7
Hornworm on Guettarda.....	P7
Hornworm damage to Guettarda	P7
Morinda hornworm.....	P7
Morinda hornworm pupa.....	P7
Oleander pitted scale on Morinda	P8
Melon aphid on Morinda leaf.....	P8
Oleander pitted scale on Oleander	P8
Oyster scale on Oleander.....	P8

Mealybug on pandanus.....	P8
Spider mite on papaya leaf.....	P8
Spiraling whitefly.....	P9
<i>Badamia exclamationis</i> caterpillar on <i>Terminalia</i>	P9
<i>Badamia exclamationis</i> pupa.....	P9
<i>Anua coronata</i> caterpillar.....	P9
Mealybugs on tomato.....	P9
Mite damage to plumeria.....	P9
Fleabeetle damage to sweet potato leaf.....	P10
Tortoise beetle on sweet potato.....	P10
Tiger moth caterpillar.....	P10
Tiger moth.....	P10
Vitex leaf roller caterpillar.....	P10
Vitex leaf roller damage.....	P10
Leucaena psyllid damage.....	P11
<i>Lantana camara</i>	P11
<i>Chromolaena odorata</i>	P11
Dodder.....	P11
<i>Cassytha</i> sp.....	P11
<i>Coccinia grandis</i>	P11

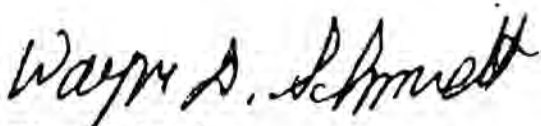
Message from the President

The College of the Marshall Islands is pleased to present the first in a projected series of technical publications designed to assist in the development of agriculture and aquaculture in the Republic of the Marshall Islands and throughout Micronesia and the tropical Pacific.

The following publication, *Survey of Arthropod Pests and Invasive Weeds in the Republic of the Marshall Islands*, represents a real step forward for agriculture in our region. Put simply, pests and weeds are a problem, and the problem is only going to grow in the foreseeable future as the increased mobility of people and goods leads to the unwanted mobility of dangerous pests and weeds.

Developing agriculture is important to sustained economic growth and increasing the self-sufficiency of our people. When pests and weeds pose an obstacle to agriculture development, it is essential to identify them in order to combat them. That is the central value of this publication, which provides crucial information about every agricultural pest and weed identified in the Republic of the Marshall Islands.

I commend the fine agricultural researchers who produced this publication, Dr. R. Muniappan and Dr. Dilip Nandwani. I thank the United States Department of Agriculture, Dr. Singeru Singeo and the College of Micronesia for the funding necessary to support this research and publication. I urge all agricultural professionals in our region, farmers, researchers, and scientists, to study the contents of this publication carefully. I look forward to the next publication in this series of practical technical publications in the area of agriculture and aquaculture.



Wayne Schmidt
President
College of the Marshall Islands

Message from the Dean

Iokwe!

It indeed is an honor for me to present to you, our stakeholders, this publication entitled: *Survey of Arthropod Pests and Invasive Weeds in the Republic of the Marshall Islands*. It is highlighted in this publication, the results from the surveys that were conducted in Majuro and Likiep atolls.

I would like to take this opportunity to thank the following: Ministry of Resources and Development, Local Government councils and communities of the two visited atolls, UOG-CALS, Professor R. Muniappan, Dr. Dilip Nandwani and CRE Extension Agents for all their on-going support, hard work and dedications bestowed during the surveys, and especially during the writing up and reviewing of the draft copies, which enabled them to produce this publication.

This publication is to be used as an informational and educational tool. We anticipate more publications, similar to this first publication in the near future. If you have any questions regarding this publication, please don't hesitate to contact us.

Kommool tata!



Diane C. Myazoe
Dean, CRE

INTRODUCTION

The Cooperative Research and Extension of the College of the Marshall Islands is pleased to present this report of the Survey of Arthropod Pests and Invasive Weeds in the Marshall Islands. It contains information based on the results of an one week survey conducted in August 2001 in Majuro and Likiep atolls. In 1988, D. M Nafus conducted the insect pest survey of the Marshall Islands and published a technical paper of the South Pacific commission. This publication updates some of the pests established since 1998 and provides illustrations with color pictures to make it easy and convenient for the farmers and extension agents to identify them. Some of the new pests that got introduced and established are the Oriental red mite on banana and plumeria, bagworm and a leaf caterpillar on coconut, leucaena psyllid, leafminer and broad mite on vegetable crops, pumpkin caterpillar on melons, citrus green aphid, a mite on citrus and a flea beetle on wedelia. *Chromolaena odorata* is one of the serious invasive weeds that has established at Laura, Majuro. *Coccinia grandis* is grown as a vegetable crop at Laura. It could get out of cultivation and become an invasive weed.

This printed extension publication is intended for agricultural workers, extension agents, farmers, plant protection and quarantine officers, who are concerned with plant protection and insect pests in the Marshall islands. This publication is based on the survey of the Majuro and Likiep atolls and there is a definite need for survey of the rest of the Marshall Islands. As most of the new pests and weeds recorded in this report are from Majuro, interisland quarantine measures should be instituted to prevent their introduction to rest of the Marshall Islands.

Insect Pests of Crops

Banana, *Musa* spp. (Musaceae)

Banana aphid, *Pentalonia nigronervosa* Coquerel (Homoptera: Aphididae)

The banana aphid normally occurs in large colonies around the bases of tender leaves in the crown. Adults, which are all female, reproduce parthenogenetically, giving live birth without fertilization. Wingless adults are about 1.5 mm in length, vary in color from reddish to dark brown or almost black. Winged forms are produced when the colony becomes crowded or the host plant loses vigor and becomes nutrient poor. Winged banana aphid may be identified by dusky shading along the wing veins. There are four nymphal instars.

Banana aphid attacks tomato, taro and some ornamental plants, notably *Heliconia* spp. in addition to banana. It transmits Banana Bunchy Top Virus Disease from infected plants to healthy ones. Banana plants infected by this virus are severely stunted and do not bear fruit. Leaves show broken green streaks on secondary veins on the underside, on the midrib and the petioles. Leaves are normally dwarfed and curled. The resulting rosette nature of the crown gives the disease its name. By directly sucking the sap the aphid weakens the plants. The sooty mold that grows on the honeydew produced by the aphids spoils the market value of the fruits.

Control of aphids can be achieved with insecticides. General predators such as coccinellid beetles, syrphid flies, and lacewings and parasitoids help to reduce the aphid population in the field.

Spiraling whitefly, *Aleurodicus dispersus* Russell (Homoptera: Aleurodidae)

This whitefly is polyphagous, and also feeds on coconut, guava, plumeria, cassava, papaya, bell pepper, eggplants, breadfruit, some ornamental plants, and others. The spiraling whitefly lays eggs on the undersurfaces of leaves in a spiral pattern, hence its name. Eggs hatch about a week after being laid. There are four larval instars. Only the first instar is mobile, others are sessile. The last instar undergoes a pupal stage. The larvae are yellowish and covered with white waxy material.

Both larvae and adults of the whitefly suck sap from leaves and in heavy infestations may cover the underside of the leaf. Affected mature leaves appear yellowish-red on upper surfaces. The honeydew secreted by the whitefly favors the growth of sooty mold fungus, which turns the leaves black.

A parasitoid, *Encarsia haitiensis* Dozier (Aphelinidae) has been introduced to Majuro from Pohnpei in late 1998 and early 1999.

Coconut scale, *Aspidiotus destructor* Signoret (Homoptera: Diaspididae)

The coconut scale was introduced from the Philippines to Yap in 1892 and then to Palau in 1899 on kava plants. It is a well-known pest of tropical crops including coconut, breadfruit, papaya, plumeria, cassava, kava and banana.

Both nymphs and adults of this insect suck sap from the leaves and fruits of the host plants. Infested banana, coconut and papaya exhibit yellow areas on the upper surface of leaves, each spot marking the position of the scale on the undersurface of leaves. Heavily infected trees will bear fewer fruits and leaves.

Eggs are laid under the covering of the female scale. Eggs hatch into nymphs called crawlers and have well-developed legs and antennae. The crawlers move to a suitable spot and insert their mouthparts into the plant. They then begin feeding. The adult male is winged and will fly to locate and mate with nearby female scales. The total life cycle is about a month.

The lady beetles, *Chilocorus nigritus* and *Cybocephalus nipponicus* were quite common on this scale in Likiep and Majuro atolls.

Oriental red mite, *Eutetranychus orientalis* (Klein) (Acarina: Tetranychidae)

It is widely distributed except in Europe. It feeds on the contents of plant parenchyma and even low infestations can cause severe damage. Adult females are broadly oval, about 0.5 mm long, brownish green to dark green in color with dark blotches inside the body. The legs are yellow-brown. The males are smaller than the females and roughly triangular in shape. The eggs are spherical, translucent, and light brown. This mite is a web spinner. One generation is completed in 8 to 10 days. These mites are found on the upper surface of the leaves causing chlorotic stippling.

Bagworm (see under coconut)

Beans, *Phaseolus* spp. (Leguminosae)

Cowpea aphid, *Aphis craccivora* Koch (Homoptera: Aphididae)

It is a cosmopolitan pest and it occurs in temperate, subtropical and tropical regions. It is polyphagous, but prefers legumes. Cowpea aphids also attack cucurbits, citrus, mango and breadfruit. This aphid is parthenogenetic and its life cycle is completed in two weeks. Colonies of aphids consisting of winged and wingless adults and nymphs feed on the leaves, flowers and pods of beans. In severe infestations, leaves and fruits get contaminated with honeydew, leading to the growth of sooty mold. Ants attend aphids to feed on the honeydew produced. This aphid is a vector of legume viruses.

There are a number of natural enemies of aphids that include lacewings, syrphid flies, coccinellid beetles and parasitic wasps.

Bean leaf roller, *Lamprosema diemenalis* (Guenee) (Lepidoptera: Pyralidae)

The larva is green in color and feeds on the leaves by remaining inside the folded leaves. The wings of the moth are yellow in color with black lines. The infestation may be heavy on soybeans.

Leafminer, *Liriomyza trifolii* (Burgess) (Diptera: Agromyzidae)

The fly is small with a length of about 2 mm. The female fly lays eggs on the leaves. Upon hatching the maggot mines the tissue between the upper and lower surfaces of the leaves. The mines appear as blotches of irregular winding tunnels. Damage to leaves may result in their premature desiccation and early fall from the plant. The fly has a wide host range, including beans, onions, eggplant, tomato, cucurbits and cabbage.

Several species of parasitoids have been introduced and established in Hawaii and Guam to suppress this pest.

Fleahopper, *Halticus tibialis* Reuter (Hemiptera: Miridae)

Nymphs and adults of the fleahopper use their piercing-sucking mouthparts to feed on leaves of the host plants. As a result of their sucking the sap, small whitish spots occur on the leaves. The fleahopper has many host plants, including crucifers, cucurbits, beans and sweet potato. Newly transplanted seedlings or newly emerged seedlings are very susceptible to their attack, and often exhibit stunted growth.

The adult fleahopper is shiny black and has characteristic orange lines on the fore-wings. The hind legs are large and strong thereby allowing them to jump when disturbed. During early morning hours or during rainy days they are less active and can be seen feeding on the upper leaf surface. Eggs are inserted in leaf tissues. The life cycle takes about six weeks.

Broad mite, (see under bell pepper)

Bell pepper, *Capsicum annuum* L. (Solanaceae)

Broad mite, *Polyphogotarsonemus latus* (Banks) (Acarina: Tarsonemidae)

The nymphs and adults of this mite congregate on the underside of young leaves, where they feed by lacerating tissues with their chelicerae and sucking the oozing sap. The leaves become distorted, ragged, cupped and sometimes silvery in appearance. Broad mite is polyphagous and feeds on plants such as beans, tomato, papaya, tobacco, soybean, sweet potato and various ornamentals.

This mite is very small, measuring less than 0.25 mm in length. It is translucent and pale. The eggs are laid singly on the underside of young leaves and on the protected sides of fruits. A whitish pear shaped larva, possessing three pairs of legs, hatches from the eggs. The larva feeds on the leaf near the eggshell and turns into a quiescent nymph. A male mite usually is seen carrying a developed female nymph on his back.

The life cycle takes about 7-10 days. Affected leaves are cupped and the underside of the leaf turns corky brown. Often the growing tip is scorched and the affected buds of flowers fall off.

Some phytoseiid mites such as *Phytoseiulus persimilis* are considered to be predators on spider mites and have been used for broad mite control in some countries.

Leaf miner (see under beans)

Urbicola soft scale, *Pulvinaria urbicola* Cockerell (Homoptera: Coccidae)

It is distributed in the Caribbean, West Africa, the Pacific Islands, Australia, and South and Southeast Asia. It is a polyphagous species preferring the members of the family Solanaceae. Heavy infestations cause premature defoliation and dieback of branches. Honeydew excreted by this insect gives rise to growth of sooty mold.

Breadfruit, *Artocarpus communis* Forst. (Moraceae)

Breadfruit mealybug, *Icerya aegyptiaca* (Douglas) (Homoptera: Margarodidae)

It is probably of Indian subcontinent origin. It is widespread in tropical Asia, Africa, Australia, and Micronesia. It has a large host range of breadfruit, avocado, citrus, taro and many other plants. Only females are found in the field and are known to be parthenogenetic. Females lay 70 to 200 eggs in an egg sac. Eggs hatch in about 10 days. The crawlers settle within a day and cover themselves with wax. There are three nymphal instars. Both nymphs and adults produce honeydew. On breadfruit, this mealybug settles on the lower surface of the leaves along the midrib and larger veins. Heavy infestations cause the leaves and twigs to dry up and die. Honeydew produced by this mealybug serves as substrate for the growth of sooty molds which cover the upper surface of leaves and reduce the photosynthetic surface. Heavy infestations of this mealybug are observed in the dry season indicating prolonged dry weather to favor buildup of the heavy population. Basically no chemicals are used for control of this mealybug in the Marshalls. Beardsley (1955) recorded the lady beetles, *Harmonia octomaculata* in Likiep and Jaluit and *Coelophora inaequalis* in Likiep feeding on this mealybug.

A number of shipments of four different species of lady beetles were introduced to Marshalls since 1948 to suppress the populations of this mealybug. *Rodolia breviucula* was introduced to Majuro in 1948. *Rodolia cardinallis* was introduced to Kwajalein and Likiep in 1958 but its origin was not known. *Rodolia pumila* was introduced in 1949 to Alingalaplup and Kwajalein from Guam. Also, several shipments of this beetle were

sent from Palau to the Marshall Islands: Jaluit in 1953, 1954, 1958, 1961, 1964; Kwajalein in 1953, 1965, 1980s; Lae in 1953; Majuro in 1964, 1971, 1972, 1980s; and Rongelap in 1972, 1973. It was also transferred from Majuro to Kwajalein in 1963. *Rodolia limbata* was introduced from Pohnpei to Majuro in 1999.

In the 2001 survey we found the lady beetle, *R. pumila* and a lacewing *Chrysopa* sp. on *I. aegyptiaca* infested leaves in the Likiep atoll. Introduction of *R. limbata* from Majuro to other islands whenever necessary should lead to a stable management of *I. aegyptiaca* in the Marshalls.

Mango fruit fly, *Bactrocera frauenfeldi* Schine (Diptera: Tephritidae)

This fruit fly has a wide host range. Susceptible fruits are tropical almonds, Surinam cherry, avocado, Polynesian chestnut, mountain apple, Java plum, water and rose apples, breadfruit, soursop, Malay apple, tangerine, carambola, mango and oranges.

The adult female fly lays her eggs in batches under the skin of the fruit with a needle like ovipositor. The egg is creamy white, spindle-shaped and about 1 mm long. Bacteria entering the wound causing the fruit to decay. The larva is a creamy white maggot that feeds on the flesh of the fruit. Fully-grown maggots drop to the ground and form a brown puparium in the soil. The total life cycle requires about three weeks. The adult is predominantly black, about the size of a housefly, and has dark bands on its wings with a narrow band along the wing margin.

Protein bait sprays are effective in reducing fruit fly populations and fruit damage. The adult flies are attracted to cue lure traps. These traps may be set up at different locations to attract and kill the flies, thereby reducing their populations in the field.

Heat treatment by blowing hot air or vapor heat over fruit or by dipping fruit in hot water can also be used.

Coconut scale (see under banana)

Red wax scale, *Ceroplastes rubens* Maskell (Homoptera: Coccidae)

It is a native of Africa. It occurs in India, Australia, China, Japan, Hawaii and in the Pacific Islands. It attacks mango, citrus, palms, Ficus, and gardenia. It is found on the stems, branches and leaves of its host. Once the crawler is settled, the remaining instars stay in the same spot.

Spiraling whitefly, (see under banana)

Castor, *Ricinus communis* L. (Euphorbiaceae)

Castor semilooper, *Achaea janata* (L.) (Lepidoptera Noctuidae)

In addition to castor, it feeds on rose, pomegranate, and euphorbiaceous weeds. The eggs are round, blue-green in color. Eggs are laid singly on the under surface of the leaves. Fully grown larvae measure 60 to 65 mm. The head is black, apex of the loop is black with a red spot and the anal tubercles are red. There is color variation in the larvae. Some are grey and others are black. Pupation takes place in the soil.

Cutworm, *Spodoptera litura* (F.) (Lepidoptera Noctuidae)

It is a polyphagous pest. It attacks tomato, cabbage, legumes and many vegetable crops. It is mainly a leaf-eater and rarely acts like a cutworm on seedlings. Eggs are laid in groups. Early instar larvae are gregarious and in the later stages they disperse. Pupation takes place in the soil. This pest is widely distributed in Asia, Australia and Micronesia. Eggs and larval parasitoids of this insect have been recorded in Guam.

Chinese cabbage, *Brassica chinensis* (Brassicaceae)

Blue moon, Great eggfly, or Common eggfly, *Hypolimnas bolina* (L.) (Lepidoptera: Nymphalidae)

This butterfly occurs throughout Micronesia. Its geographical distribution ranges from India to the Pacific Islands. It is a polyphagous insect. Eggs are green in color and laid singly or in clusters. The larvae were found feeding on Chinese cabbage at Laura, Majuro. It has also been reported feeding on *Wollastonia biflora* in Majuro. Larvae are spiny, dark, purplish brown or black with two long erect black bristly spines on the orange brown head, six orange-yellow branched spines on segments and lateral yellow lines on the body. There is sexual dimorphism in the adult coloration. It is a strong flier and takes part in migratory flights.

Fleahopper (see under beans)

Coconut, *Cocos nucifera* L. (Palmae)

Coconut leaf beetle, *Brontispa chalybeipennis* (Zacher) (Coleoptera: Chrysomelidae)

This beetle attacks palms of all ages although it is most damaging to young and newly transplanted palms. Both adults and larvae damage the leaflets of young unopened fronds. They scrape away the surface in streaks, which are typically parallel to the midrib. The narrow feeding scars enlarge to form irregular brown blotches as the frond opens, giving the appearance of burns scorched by fire.

Eggs are laid singly or in-groups in folded tender leaflets of the coconut palm. Grubs feed inside folded leaflets or in between leaflets. The grub has a sclerotized plate at the anal end, bearing a pair of backwardly projecting pincer like protuberances. Pupation takes place between folded leaflets. The life cycle takes about two months. Adult beetles have a life span of several months. The adult beetle is bronzy green, sometimes tinged blue, red, or purple.

The predatory earwig, *Chelisoche morio* was common on coconut trees in Marshalls. A parasitoid, *Tetranychus brontispae* was introduced and established in the Marianas, Palau, Yap and Chuuk to control *Brontispa* beetles.

Red coconut scale, *Furcaspis oceanica* Lindinger (Homoptera: Diaspididae)

It is endemic to Caroline Islands. It was first described by Lindinger in 1909 from the material collected at Jaluit, Marshall Islands. Green redescribed the same species in 1910 from specimens collected in Yap. It is mostly a pest of the coconut. It infests older leaves and in severe cases the leaves dry and fall. This scale is reddish purple in color. Females give birth to live young ones known as crawlers. These crawlers settle within a day after leaving the parent scale.

The parasitoid, *Anabrolepis oceanica* is effective in controlling this scale.

Coconut scale, (see under banana)

Bagworm, Unidentified (Lepidoptera: Psychidae)

An unidentified bagworm was found infesting coconuts in Majuro and Likiep. The case was brown in color, cylindrical, one cm in length and 0.3 cm wide. At Majuro the infestation was heavy. This bagworm scrapes outer green paranchimatous layer on petioles and green nuts. Affected portions of the nuts appear brown with cracking.

Spiraling whitefly (see under banana)

Palm mealybug, *Palmicultor palmarum* (Ehrhorn) (Homoptera: Pseudococcidae)

This mealybug is widely distributed in the Pacific. It is common on coconut but also found on various species of palms. Heavy infestations were seen on the leaves at the crown region.

Weevil (Coleoptera: Curculionidae)

An unidentified small weevil was found boring in the petioles of coconut in Likiep.

Leaf caterpillar (Lepidoptera)

An unidentified caterpillar was found feeding on the leaflets. The caterpillars remain in the folded leaflets with sparse webbing and feed by scraping. Affected portions dry up.

Corn, *Zea mays* L. (Poaceae)

Melon aphid, *Aphis gossypii* Glover (Homoptera: Aphididae)

It is a polyphagous pest. It infests cucurbits, citrus, corn, eggplant, beans, guava, mango, okra, taro and numerous ornamentals. Adults and nymphs of melon aphid suck the sap from the undersurface of leaves. Severely attacked leaves curl. It transmits a wide range of virus diseases of plants. Reproduction is mostly by parthenogenesis, however, reproductive forms are known to occur in this aphid. The life cycle is completed in two weeks. Color of this aphid varies from light green to black and in overcrowded conditions even yellow to white forms occur.

A parasitoid, *Lysiphlebus sp* (Hymenoptera: Braconidae, Aphidiinae) was found parasitizing this aphid in Majuro.

Cutworm (see under castor)

Cucumber, *Cucumis sativus* L. (Cucurbitaceae)

Pumpkin caterpillar, *Diaphania indica* (Saunders) (Lepidoptera: Pyralidae)

It is distributed in West Africa, South and Southeast Asia, Australia, Marianas and Palau. It is new introduction to the Marshalls. It is considered as one of the important pests of cucurbits in Asia.

The adult has pearly white wings with a broad brownish-black band on wing edges. Eggs are laid singly or in-groups on undersides of leaves. Larva feeds on the leaves by rolling up leaf edges and sometimes it attacks flowers and young fruits. The larva is green with white median stripes. Pupation takes place inside rolled leaves.

Melon aphid (see under corn)

Eggplant, *Solanum melongina* L. (Solanaceae)

Broad mite (see under bell pepper)

Urbicola soft scale (see under bell pepper)

Spiraling whitefly (see under banana)

Striped mealybug (see under tomato)

Grass

Nutgrass armyworm, *Spodoptera exempta* (Walker) (Lepidoptera: Noctuidae)

This insect is distributed in Africa, Asia and Australia. In the Pacific it occurs in Hawaii and Marshalls. Host plants include corn, sugarcane and grasses. Eggs are laid in masses ranging from 10 to 300. Egg masses are covered with hairs from the body of the female. Egg stage lasts for 2 to 5 days. Larvae mostly feed on graminaceous plants and drop to the ground when disturbed. Pupation takes place in the soil in a delicate cocoon. The adult is grey-brown with pale hind wings and a conspicuous kidney shaped whitish mark on the forewings.

***Guettarda speciosa* L. (Rubiaceae)**

Hornworm, *Cephanodes armatus* Rothchild and Jordan (Lepidoptera: Sphingidae)

This hornworm has been reported from Marshalls. Eggs are laid singly on the leaves. Caterpillars cause defoliation in certain seasons. Pupation takes place in the soil.

Leucaena, *Leucaena leucocephala* (Lam) De wit (Mimosaceae)

Leucaena psyllid, *Heteropsylla cubana* Crawford (Homoptera: Psyllidae)

It is a native of Central America. It arrived to Hawaii in 1984 and later on it has spread to most of the Pacific Islands, Asia and Africa. Marshalls has been its latest invasion.

It lays eggs on the tender terminal shoots. Eggs are laid on young unopened leucaena leaflets. A female

lays about 400 eggs. Egg stage lasts for 2 to 3 days and the nymphal period is 8 to 9 days. There are five nymphal instars. Adult females live for about 11 days and the males for about 6 days. Both adults and nymphs feed on the foliage of *L. leucocephala* and cause severe defoliation and dieback of young shoots.

Lime, *Citrus* sp (Rutaceae)

Mite, (unidentified) (Acarina)

An unidentified mite was causing the fruits turn brown in Majuro.

***Morinda citrifolia* L. (Rubiaceae)**

Hornworm, *Chromis erotus* (Boisduval) (Lepidoptera: Sphingidae)

This hornworm was common in Likiep and Majuro. It is known to occur from Indonesia to Tahiti. Eggs are laid singly on the leaves. In severe infestations the caterpillars defoliate the trees. Pupation takes place in the soil.

Melon aphid (See under corn)

Oleander pitted scale (see under oleander)

Oleander, *Nerium indicum* Miller (Apocynaceae)

Oleander pitted scale, *Asterolecanium pustulans* (Cockerell) (Homoptera: Asterolecaniidae)

It has been reported on breadfruit and plumeria in the Marshalls. Around the edges of this insect the plant tissue proliferates and when the specimen is removed it leaves a deep pit. Infected stems and midribs are distorted.

Oyster scale, (Homoptera: Coccidae)

An unidentified oyster scale was commonly found on oleander in Likieup island.

Pandanus, *Pandanus* sp. (Pandanaceae)

Pandanus leafminer, *Trissordoris* sp. (Lepidoptera: Cosmopterigidae)

This leafminer is very common in the Marshalls and it occurs throughout Micronesia. The larvae feed within the tissue of the leaves and pupate between the upper and lower epidermis. Often more than three or four caterpillars are found in the mine causing a large part of the leaf to dry up. The epidermis in an oval area around the pupa is cut cleanly so that it may fall out and leave oval holes in the affected leaves.

Mealybugs: Infestation by mealybugs was common but they were not identified.

Papaya, *Carica papaya* L. (Caricaceae)

Spider mite, *Tetranychus* sp. (Acarina: Tetranychidae)

Spider mites are widely distributed throughout Micronesia. There are more than one species occur in this region. Eggs are laid on the leaves. Larvae have three pairs of legs and adults with four pairs. In general, they complete the life cycle in about two weeks.

Spiraling whitefly (see under banana)

Coconut scale (see under banana)

Plumeria, *Plumeria rubra* L. (Apocynaceae)

Oriental red mite (see under banana)

Spiraling whitefly (see under banana)

Premna, *Premna obtusifolia* R. Br. (Verbanaceae)

Breadfruit mealybug (see under breadfruit)

Red wax scale (see under mango)

Radish, *Raphanus sativus* Cruciferae

Fleahopper (see under beans)

Rose, *Rosa* spp. (Rosaceae)

Leaf cutter bee, *Megachile* sp. (Hymenoptera: Megchilidae)

This bee species cuts sections from leaves and brings them to its nest. Its life history and habit are not yet known in Micronesia.

Squash, *Cucurbita moschata* Poir. (Cucurbitaceae)

Pumpkin caterpillar (see under cucumber)

Fleahopper (see under beans)

Sweet potato, *Ipomoea batatas* (L.) and Kangkung, *Ipomoea aquatica* Forsk. (Convolvulaceae)

Sweet potato weevil, *Cylas formicarius* (Fabricius) (Coleoptera: Curculionidae)

The grubs of this weevil damaged the roots and stems. They tunnel into tuber and feed inside. Microorganisms grow on the damaged part and produce a disagreeable odor and bitter taste. Adult beetles are metallic blue with red thorax and legs. Female beetles lay eggs in the holes on tubers. The legless whitish grubs feed inside tubers. The larval period lasts 15-25 days. Pupation takes place inside the tubers and lasts from 4-10 days. The complete life cycle requires 26-44 days.

Some cultural practices can be employed to reduce weevil damage to tubers, such as crop rotation, removal of plant residues after harvest, hilling to cover tubers, watering plants to prevent soil cracking and dipping terminal cuttings to be used as planting materials in an insecticide solution to kill weevils.

Green tortoise beetle: *Metriona circumdata* (Herbst) (Coleoptera: Chrysomelidae)

The adult beetle is about 6 mm long and 4.5 mm wide and it is greenish-yellow in color. Eggs are laid singly on the upper or lower surface of the leaves. Larvae are green in color and carry the molted skin at the caudal end covering the dorsal side of the body like a shield. Pupation takes place on the leaves. Both the adults and larvae feed on the leaves.

Sweet potato hawk moth, Sweet potato hornworm, *Agrius convolvuli* (L.) (Lepidoptera: Sphingidae)

It is a pest of sweet potato and other plants belonging to the family Convolvulaceae. It has also been reported on pulses. It is distributed throughout Africa, Asia, Australia and the Pacific Islands.

Eggs are laid singly on stems and leaves. The caterpillars have a horn at the posterior end and hence the name hornworm. There are five larval instars and the color of the larvae may be green, brown, or black. Pupation takes place in the soil. Adult moths are large, greyish with a heavy body. The abdomen has pink bands.

Sweet potato flea beetle, *Chaetocnema confinis* Crotch (Coleoptera: Chrysomelidae)

It is a North American species, occurs in Hawaii, Marianas and Marshalls in the Pacific. Adult is a small black beetle and feeds on the leaves by making narrow track which resemble mines. Larvae tunnel into the roots. It was found on kangkung in addition to sweet potatoes.

Spider mite (see under papaya)

Sweetsop, *Annona squamosa* L. (Annonaceae)

Spiraling whitefly (see under banana)

Taro, *Colocasia esculenta* (L.) (Araceae)

Taro planthopper, *Tarophagus proserpina* (Kirkaldy) (Hemiptera: Delphacidae)

It is one of serious and widely distributed pests of taro. Adults and nymphs of the leafhopper aggregate on the underside of leaves, especially on the outer side of leaf stalks near the ground. Feeding may cause yellowing and stunting of the plants. Eggs are laid into slits cut with the ovipositor in the midrib and on petioles of the taro leaf. It undergoes five nymphal instars. For most of the year, adults are short winged and cannot fly. It is a vector of the large and small bacilliform viruses of taro.

Cyrtorhinus fulvus, a mired bug is an effective predator actively feeds on the eggs of *T. proserpina*.

Tomato, *Lycopersicon esculentum* Mill. (Solanaceae)

Urbicola soft scale (see under bell pepper)

Spiraling whitefly (see under banana)

Leafminer (see under bell pepper)

Melon aphid (see under corn)

Broad mite (see under beans)

Striped mealybug, *Ferrisia virgata* (Cockerell) (Homoptera: Pseudococcidae)

Adult female is covered with white wax and two purple stripes are found on the dorsal side. It also has two long waxy tails. This mealybug is polyphagous and has a wide host range. It feeds on leaves, stems, shoots and fruits.

***Tournefortia argentea* L.f. (Boraginaceae)**

Tiger moth, *Utetheisa pulchelloides* Hampson (Lepidoptera: Arctiidae)

The moth is 35 to 40 mm across the wings. Forewings are creamy white with numerous red and black quadrangular spots. Hind wings are white with a black border along the outer margin. Eggs are laid singly. Caterpillars are black with a yellow dorsal stripe and red and white spots on the lateral sides. Caterpillars feed on the leaves and flowers. Pupation takes place on the leaves.

Tropical almond tree, *Terminalia* sp. (Combretaceae)

Brown awl, *Badamia exclamationis* (F.) (Lepidoptera: Hesperidae)

This butterfly has brown wings with two small yellow or white markings in the forewings. Eggs are laid singly on the tender leaves. Larvae fold the leaves and feed from within. The head of the larva is yellowish red with black markings and the body is green with yellow stripes. Pupation takes place in the leaf roll.

It is host specific to *Terminalia* species and it is distributed in Southeast Asia, Australia, Guam, Palau, and Marshalls.

Semilooper, *Anua coronata* (Fabricius) (Lepidoptera: Noctuidae)

This large moth is distributed from India to French Polynesia. Eggs are laid singly on the leaves. Larvae feed on leaves and pupation takes place in the soil or in dried leaves webbed together. Adult is a secondary fruit piercer.

Spiraling whitefly (see under banana)

***Vitex trifolia* L. (Verbenaceae)**

Leafroller (Lepidoptera)

Vitex trifolia is grown as a hedge plant in Likiep and Majuro. Leaves are heavily attacked by a leafrolling caterpillar.

Wedelia, *Wollastonia biflora* (Asteraceae)

Flea beetle, *Spheroderma wedeliae* Gressitt (Coleoptera: Chrysomelidae)

This flea beetle is common on wedelia in the Central and Eastern Caroline Islands. Now it has established at Majuro in the Marshalls. Larva is a leafminer. Adults also feed on the leaves.

Eriophyid mite, *Nothopoda wollastoniae* Mohanasundaram and Muniappan (Acari: Eriophyidae)

This mite was described from the specimens collected in Yap, however, it seems to be widespread throughout Micronesia. It produces small erineum closer to the veins on the under surface of the leaf.

WEEDS

Chromolaena, or Siam weed, *Chromolaena odorata* (L.) R.M.King and H. Robinson (Asteraceae)

This weed is of neotropical origin. It was introduced into the Marianas in the early 1960s. By the 1980s it has spread to Yap, Palau, Pohnpei and Kosrae and by the late 1990s to Chuuk. In this survey we observed a small but well established patch of chromolaena at Laura, Majuro.

Chromolaena is an upright or scrambling perennial shrub, which forms thickets. It is usually found on roadsides, vacant lands and pasture areas. It flowers during December and January and the seeds are dispersed by wind in February and May. Many seeds are produced by this plant and are carried long distances by wind. It is highly allelopathic and it suppresses the vegetation adjacent or underneath it. Also it is highly fire prone during the dry season but the fire does not kill the stubble. The stubble readily sprouts immediately after the rains.

A natural enemy of this weed, *Pareuchaetes pseudoinsulata* (Arctiidae) has been introduced and established in the Marianas, Pohnpei and Kosrae. Another natural enemy, *Cecidochara connexa* (Tephritidae) has been established in Palau and Guam.

Green citrus aphid, *Aphis spiraecola* Patch (Homoptera: Aphididae)

This aphid was collected on *Chromolaena odorata* in Majuro. It is a native of the Far East. As its common name implies citrus species are the most important hosts of this aphid. It also attacks plants belonging to the families Asteraceae, Rosaceae, Rubiaceae and Rutaceae.

Urbicola soft scale (see under bell pepper)

Ivy gourd, *Coccinia grandis* (Cucurbitaceae)

It is a native of East Africa and has spread to the Hawaiian Islands, Saipan and Guam. It is a dioecious (male and female plants are separate) perennial vine. It covers the existing vegetation along the roadsides and fence lines. Fruits are about 3 cm wide and 10 long and pink in color. Birds that eat the fruits spread the seeds. In addition the vines readily root at the nodes when they touch soil.

To control this weed, three natural enemies, *Melittia oedipus* Oberthur (Sessidae), *Acythopeus cocciniae* O'Brien and Pakaluk (Curculionidae) and *Acythopeus burkhartorum* O'Brien and Pakaluk (Curculionidae) were introduced to the Hawaiian Islands from East Africa. These natural enemies are being cultured at the Quarantine Laboratory in Guam.

Dodder, *Cuscuta* sp. (Convolvulaceae)

It is a slender twining parasitic vine. Stems are yellowish or orange. Leaves are reduced to scales. Flowers are small and occur in clusters. Fruit is a capsule. Seeds are muricate and dark brown in color. When the seedling comes in contact with a host it establishes connection by attaching numerous sucking organs known as haustoria. Often dodder kills its host by depleting nutrients. Dodder is common on roadsides, in gardens, fences and abandoned fields.

Spanish Needle, *Bidens pilosa* L. (Asteraceae)

It is a tropical American annual that has established in most of the Micronesian Islands. It is common on road sides, waste lands. Seeds are black and 0.7cm long and tipped with two or three barbed bristles. Seeds are spread by sticking to clothing of people or hair of animals.

Broad mite (see under bell pepper)

References

- Baker, E.W. 1987. Oriental red mite, *Eutetranychus orientalis* (Klein). Pests not known to occur in the United States or of limited distribution, No.41, APHIS, USDA. 6 pp.
- Gressitt, J.L. 1955. Coleoptera: Chrysomelidae. Insects of Micronesia 17:1-60.
- Hill, D. 1975. Agricultural Insect Pests of the Tropics & Their Control. Cambridge University Press. 516 pp.
- Howard, F.W., D. Moore, R.M. Giblin-Davis and R.G. Abad. 2001. Insects on Palms. CABI Publishing, Oxon. 400 pp.
- Nafus, D.M. 1996. An insect survey of the Marshall Islands. South Pacific Commission Technical Paper No. 208, 35 pp.
- Plant Pest Control Division. 1960. Egyptian fluted scale (*Icerya aegyptiaca* (Dougl.)). Insects not known to occur in the United States. Agricultural Research Service, USDA. 10: 3-4.
- Plant Pest Control Division. 1960. Nutgrass armyworm (*Spodoptera exempta* (Walker)). Insects not known to occur in the United States. Agricultural Research Service, USDA. 10: 13-14.
- Schreiner, I. 1989. Biological control introductions in the Caroline and Marshall Islands. Proceedings, Hawaiian Entomological Society, 29: 57-69.
- Waterhouse, D.f. 1998. Biological Control of Insect Pests: Southeast Asian Prospects. Australian Centre for International Agricultural Research, Canberra. 546 pp.
- Whittle, K. and D.C. Ferguson. 1987. Pumpkin caterpillar, *Diaphania indica* (Saund.). Pests not known to occur in the United States or of limited distribution No. 84, APHIS, USDA. 6 pp.

Acknowledgments

This publication was made possible by funding from the United States Department of Agriculture under a Smith-Lever grant through College of Micronesia to the Department of Cooperative, Research and Extension of the College of the Marshall Islands.

We wish to acknowledge the invaluable contributions and support received from individuals and institutions that had put together necessary help and assistance. Kommool and thanks to former President Alfred Capelle for the support and encouragement, Dean CRE, Ms. Diane Myazoe and colleagues in the department for the help. We wish to thank the Executive Director of the College of Micronesia (COM), Dr. Singeo Singeru, Secretary of the Ministry of Resources and Development (R&D), Mr. Fred Muller, Chief, Agriculture division, Mr. Jimmy Joseph and RMI Government for their continued and generous support for the Land Grant programs. Mr Ah-Tien Hung, Director, Laura Experiment Farm for the access and permission to conduct survey in Laura Experimental farm.

J.H. Martin, D. Quicke, A. Baker, R. Booth and G. Watson of the National History Museum in London identified some of the insect and mite pests of this survey.



Fig. 1 - Banana aphids

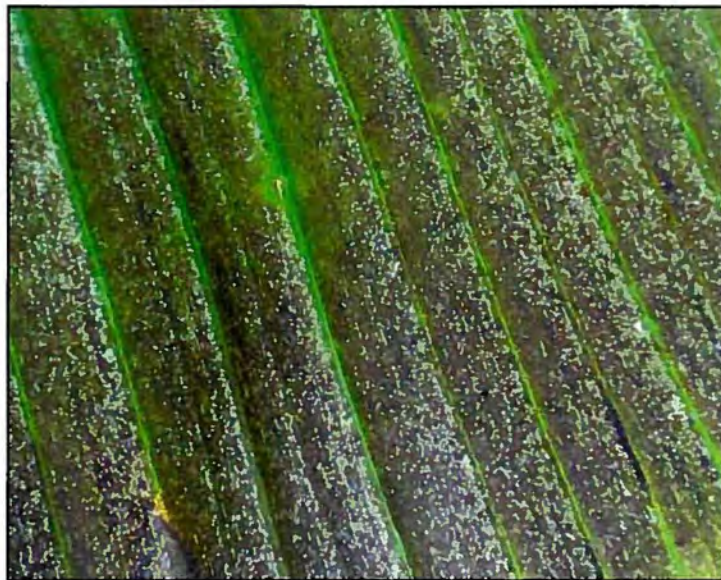


Fig. 2 - Oriental red mite on banana

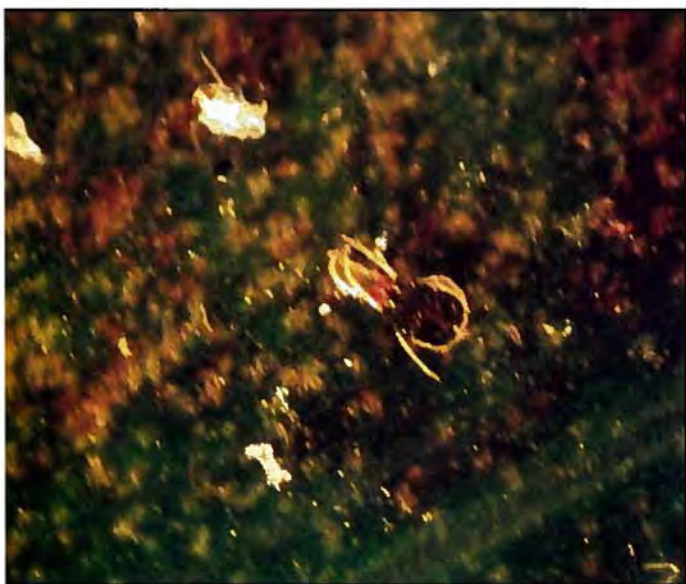


Fig. 3 - Oriental red mite (close up)



Fig. 4 - Cowpea aphid on beans



Fig. 5 - Cowpea aphid on bean flowers



Fig. 6 - *Lamprosema diamenalis* damage to bean leaf



Fig. 7 - Leafminer damage to bean leaf



Fig. 8 - Fleahopper damage to beans



Fig. 9 - Broad mite damage to beans



Fig. 10 - Broad mite damage to pepper



Fig. 11 - Broad mite damaged pepper field



Fig. 12 - Breadfruit mealybug



Fig. 13 - Red wax scale



Fig. 14 - Coconut scale



Fig. 15 - Lady beetle, *Rodalia pumila* pupa



Fig. 16 - *Brontispa chalybeipennis* adults

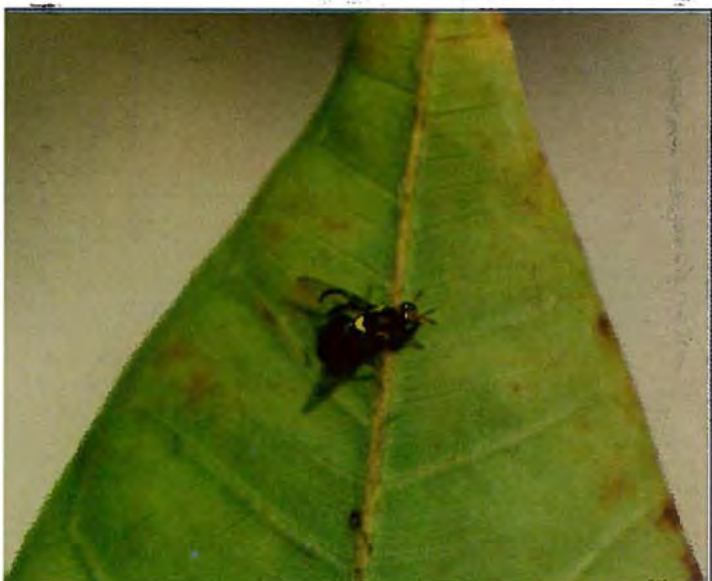


Fig. 17 - Fruit fly

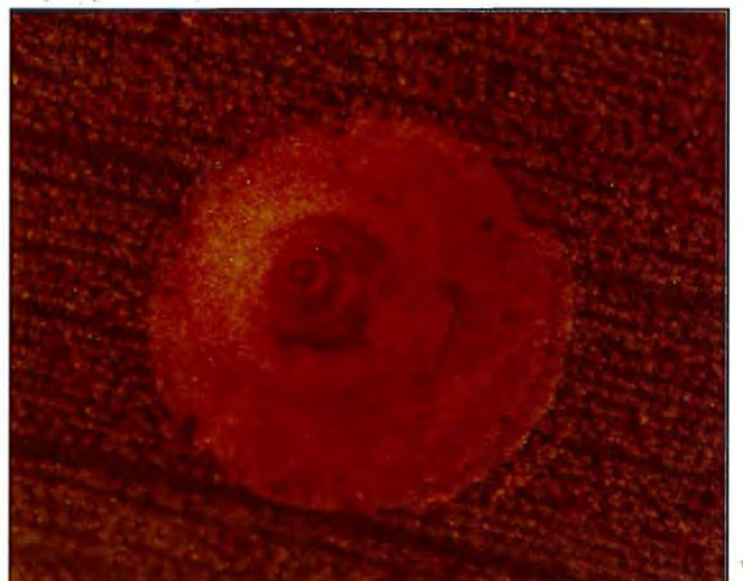


Fig. 18 - Red coconut scale



Fig. 19 - Red coconut scale on coconut

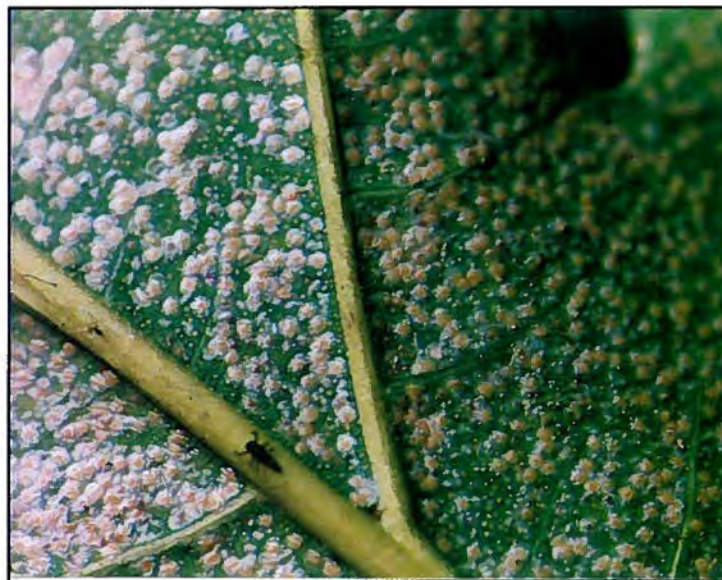


Fig. 20 - Coconut scale on breadfruit leaf



Fig. 21 - Spiraling whitefly on coconut leaf



Fig. 22 - Bagworm damage to coconut



Fig. 23 - Bagworm damage to coconut petiole



Fig. 24 - Weevil damage to coconut petiole



Fig. 25 - Weevil on coconut

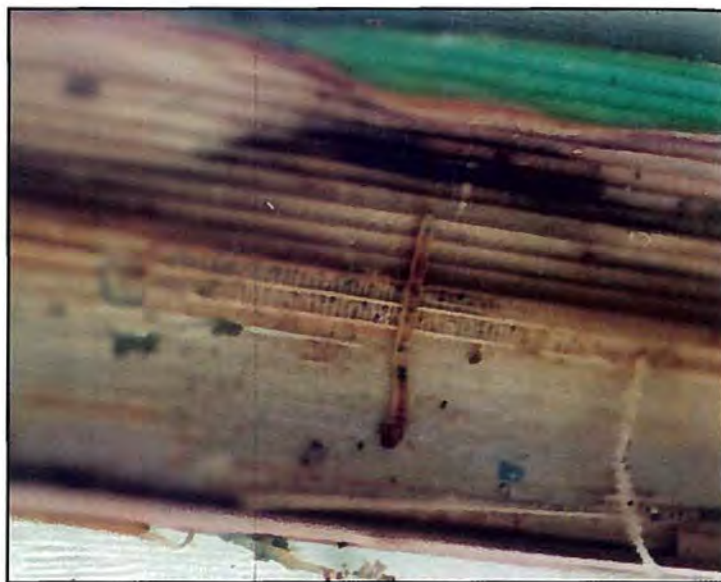


Fig. 26 - Coconut leaf caterpillar



Fig. 27 - Caterpillar damage to coconut leaflet



Fig. 28 - Caterpillar damage to coconut leaf



Fig. 29 - *Achaea janata* caterpillar



Fig. 30 - *Spodoptera litura* caterpillar



Fig. 31 - *Hypolimnas bolina* adult



Fig. 32 - *Hypolimnas bolina* caterpillar



Fig. 33 - Fleahopper damage to Chinese cabbage



Fig. 34 - Fleahopper damage to sweet potato leaves



Fig. 35 - Melon aphid



Fig. 36 - Parasitoid emergence hole in a melon aphid mummy



Fig. 37 - Melon worm



Fig. 38 - Broad mite damage to eggplant fruit



Fig. 39 - Hornworm on *Guettarda*



Fig. 40 - Hornworm damage to *Guettarda*



Fig. 41 - *Morinda* hornworm



Fig. 42 - *Morinda* Hornworm Pupa



Fig. 43 - Oleander pitted scale on *Morinda*



Fig. 44 - Melon aphid on *Morinda* Leaf



Fig. 45 - Oleander pitted scale on oleander



Fig. 46 - Oyster scale on oleander

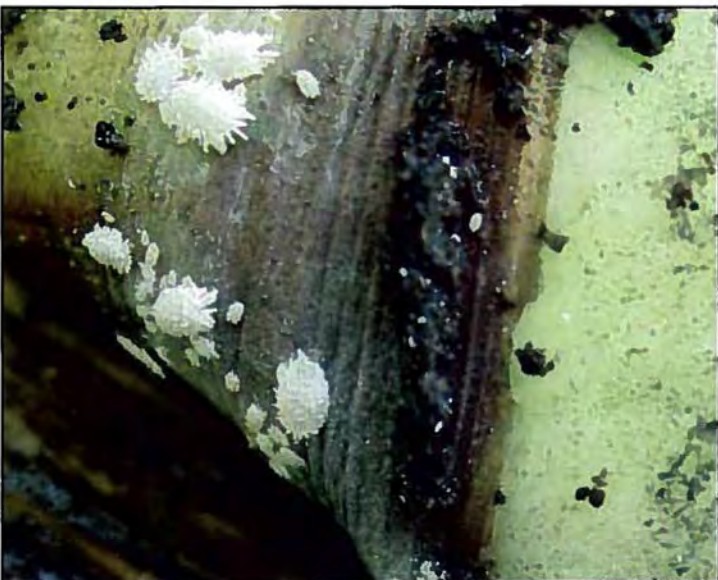


Fig. 47 - Mealybugs on pandanus



Fig. 48 - Spider mite on papaya leaf



Fig. 49 - Spiraling whitefly



Fig. 50 - *Badamia exclamationis* caterpillar on *Terminalia*



Fig. 51 - *Badamia exclamationis* pupa



Fig. 52 - *Anua coronata* caterpillar



Fig. 53 - Mealybugs on tomato



Fig. 54 - Mite damage to plumeria



Fig. 55 - Fleabeetle damage to sweet potato leaf

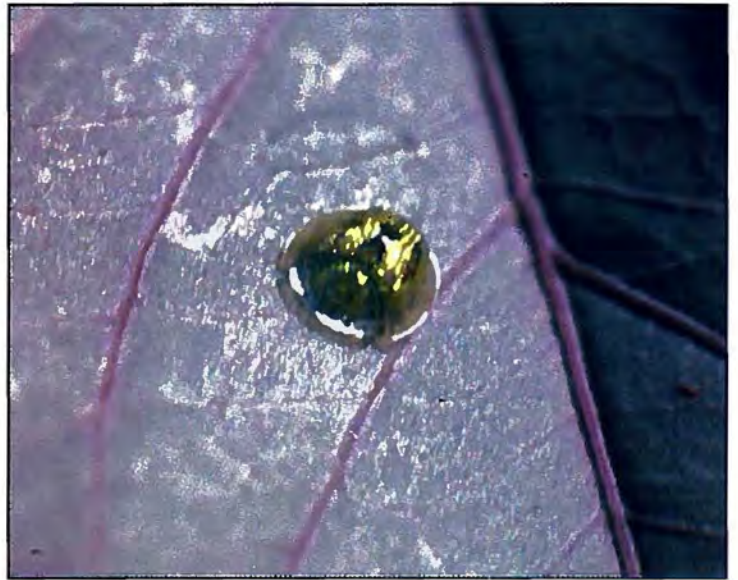


Fig. 56 - Tortoise beetle on sweet potato



Fig. 57 - Tiger moth caterpillar



Fig. 58 - Tiger moth



Fig. 59 - *Vitex* leaf roller caterpillar

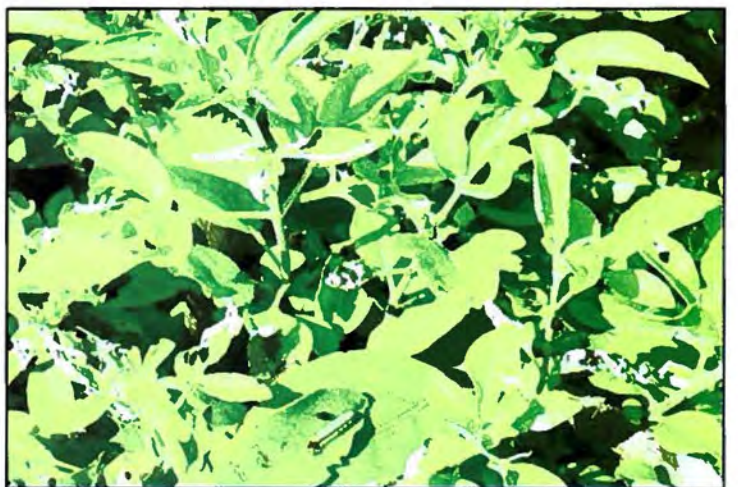


Fig. 60 - *Vitex* leaf roller damage



Fig. 61 - Psyllid damage to *Leucaena*



Fig. 62 - *Chromolaena odorata*



Fig. 63 - *Lantana camara*



Fig. 64 - Dodder



Fig. 65 - *Cassytha* sp



Fig. 66 - *Coccinia grandis*

