Biological Control Programs in the Pacific

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acific Islands

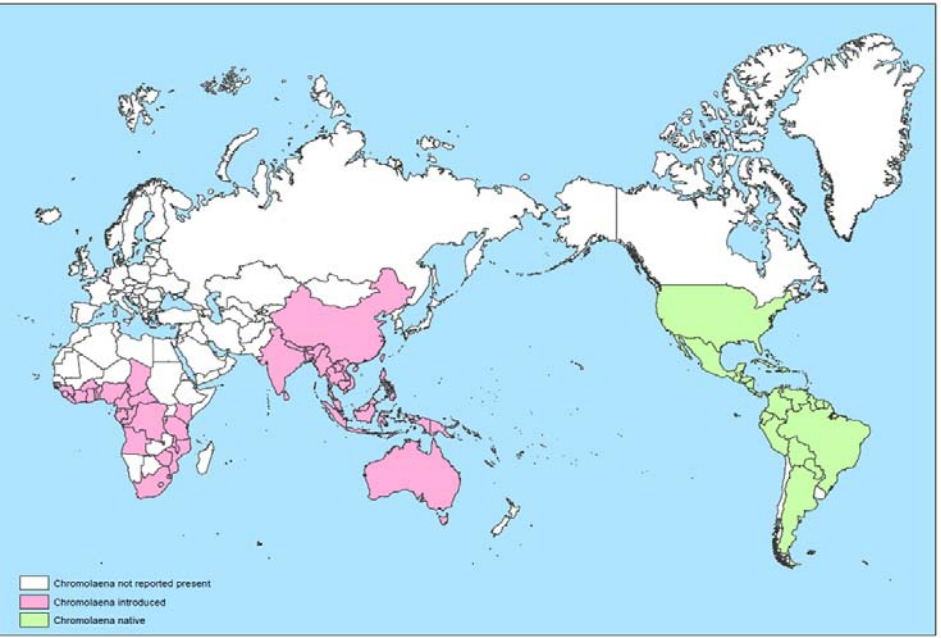
802615 (B00673) 11-98

Biological Control of Weeds Addressed

- ***Chromolaena odorata***
- ***Coccinia grandis***
- ***Lantana camara***
- ***Parthenium hysterophorus***
- ***Mimosa diplotricha***
- ***Mikania micrantha***
- ***Clidemia hirta***
- ***Eichhornia crassipes***
- ***Pistia stratiotes***
- ***Salvinia molesta***
- ***Sida spp.***
- ***Miconia calvescens***

Chromolaena odorata (Asteraceae)

- Origin – Neotropics
- Introduced to India – 1845
- Introduced to Guam – 1960s
- Current distribution: Humid tropics of Asia, Africa, Australia (Queensland), and Micronesia, PNG



Cashew plantation infested with *C. odorata*

Pareuchaetes pseudoinsulata

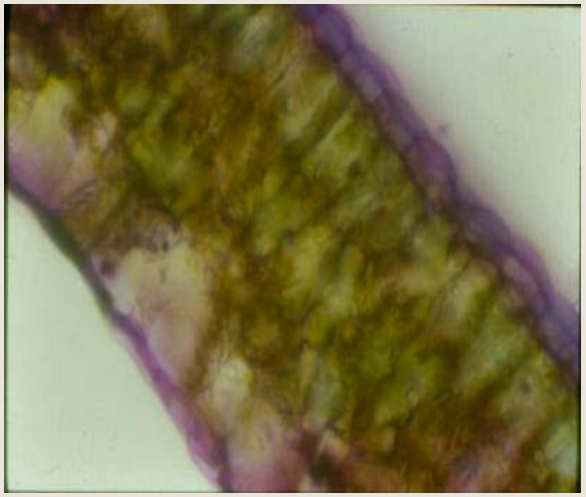
(Lepidoptera: Arctiidae)

- Introduced to Guam –1986.
- Cultures supplied to: Indonesia, South Africa, Ghana, PNG, and Micronesia .

Chormolaena Defoliated and Killed by *Pareuchaetes pseudoinsulata* in Rota

Insect Induced Defense – Yellowing of Leaves in Chromolaena

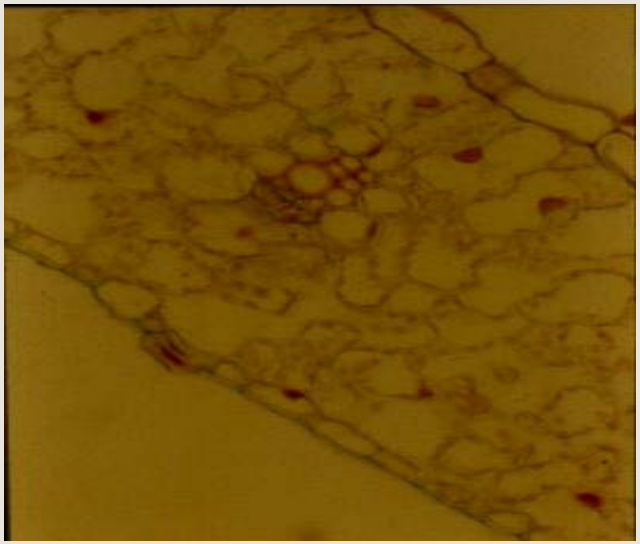
Insect Induced Defense Changes in the Chromolaena Leaves

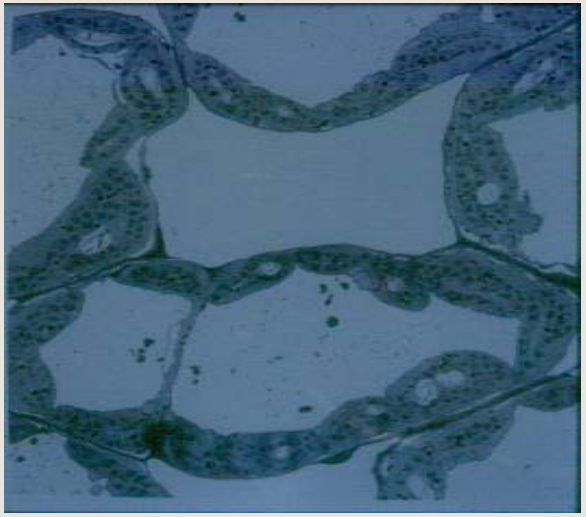


Section of leaves:

← Green

Yellow →

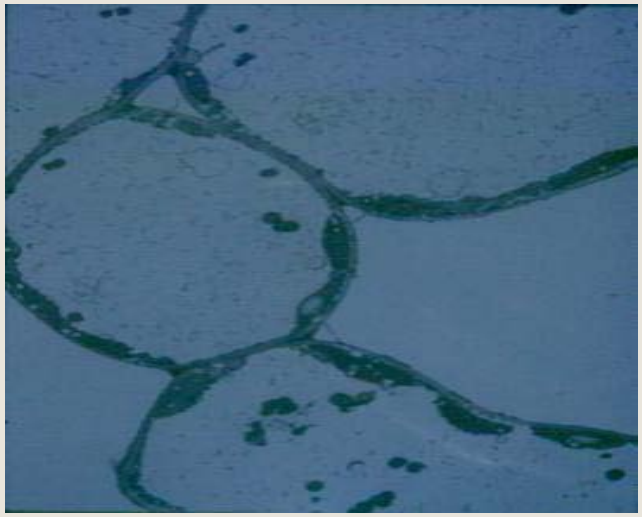




Electron Microscopic Section of leaves:

← Green

Yellow →



Eriophyid Mite – *Acalitus adoratus*

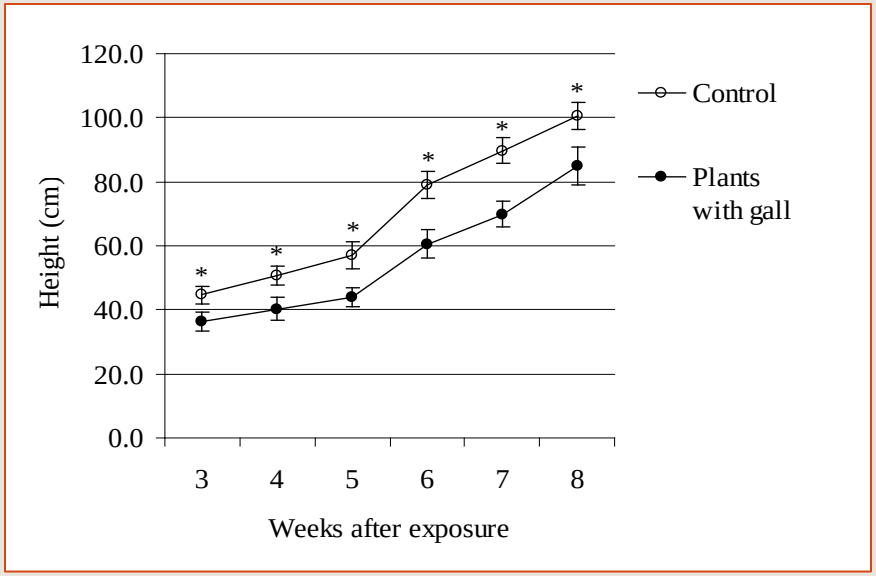
- Fortuitously introduced to – Malaysia – 1970s.

- Current distribution
- Micronesia – (Eastern border)
- India – (Western border)

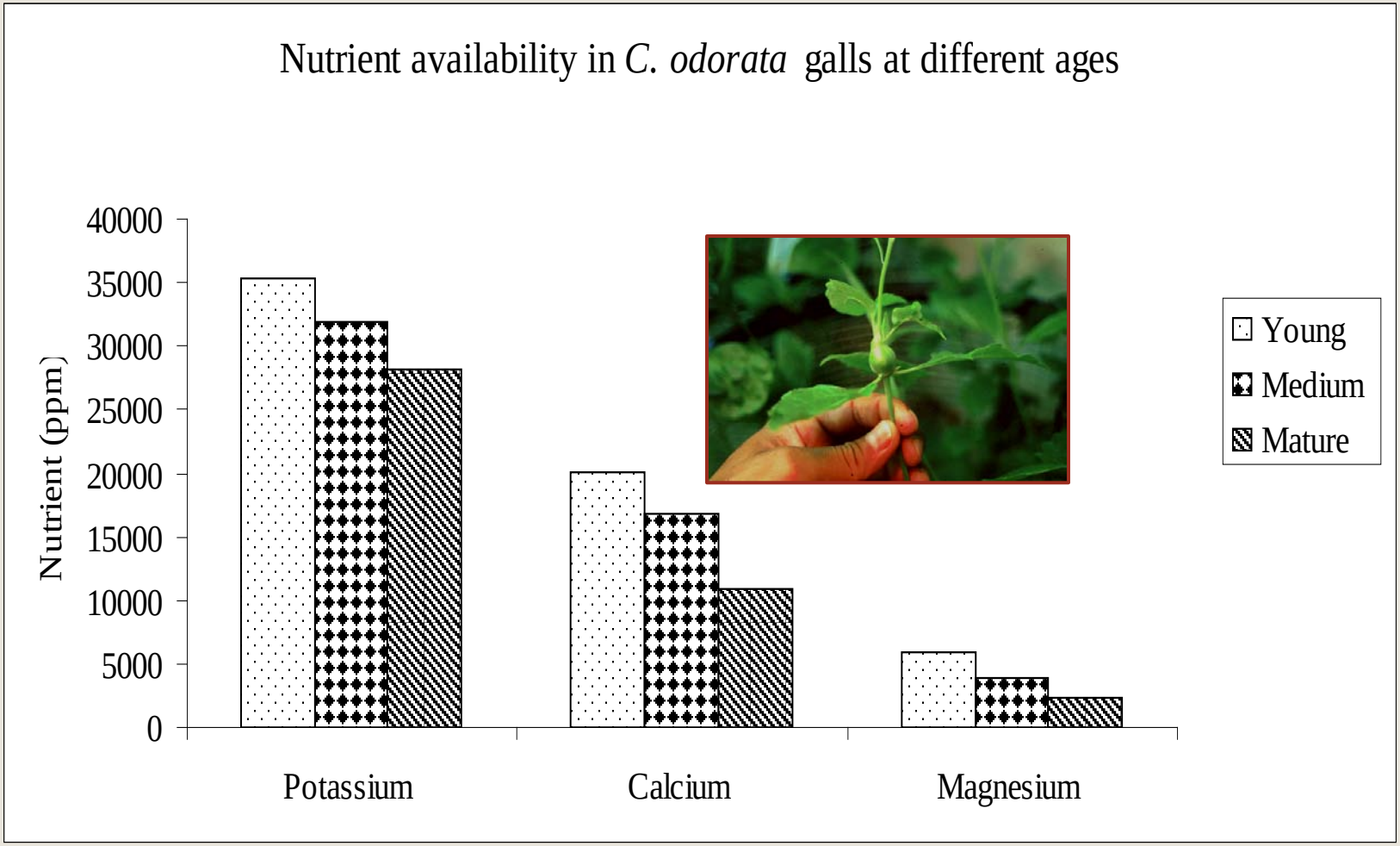
Cecidochares connexa

(Diptera: Tephritidae)

Origin : Neotropics (Colombia)
Introduced to Indonesia in 1993,
and Guam 1998.
Established in Micronesia, Indonesia,
PNG, East Timor, India.



Nutrient sink

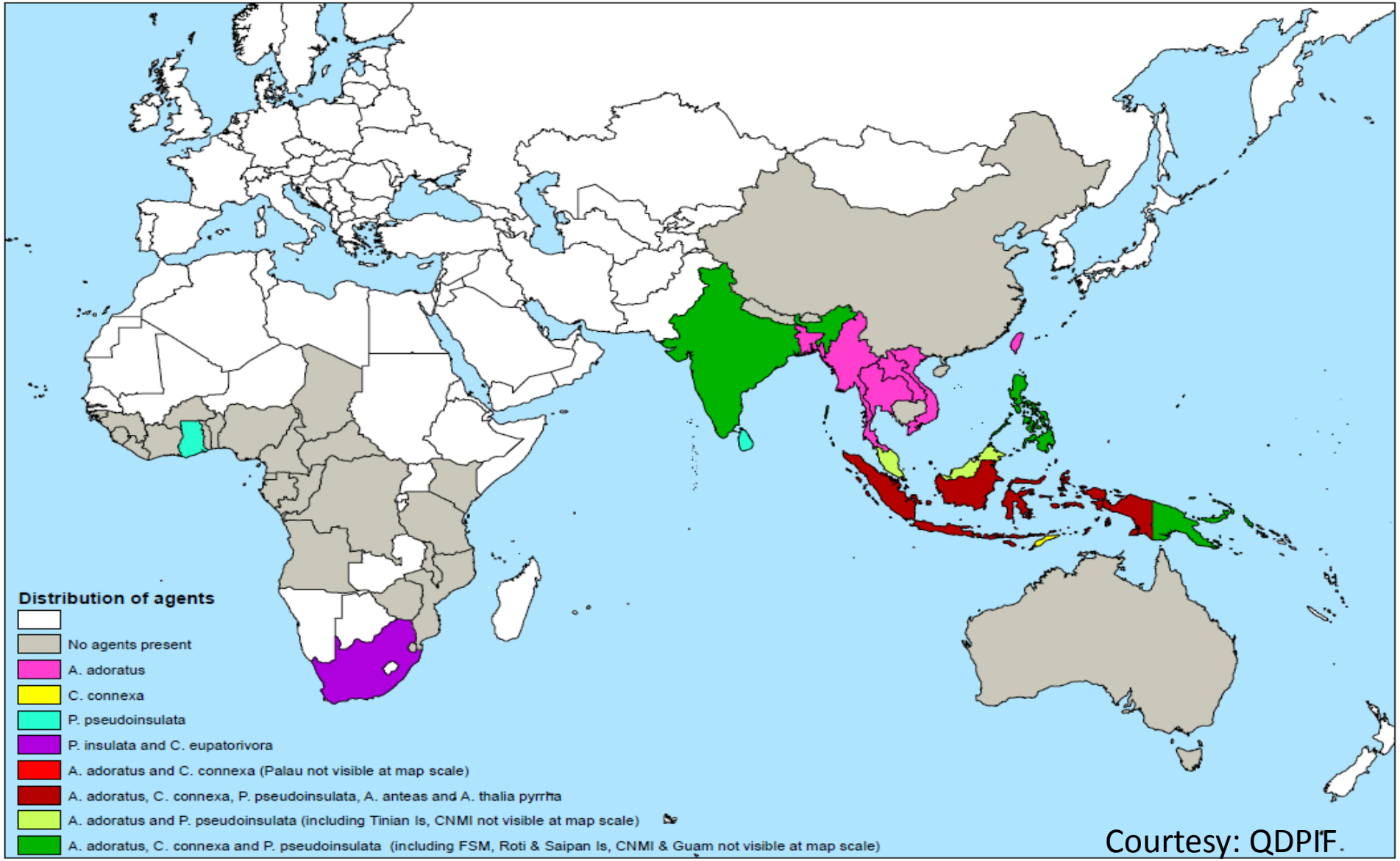


Native Vegetation Returning After Chromolaena Control

Pareuchaetes and *Cecidochares*

- *Pareuchaetes* proven to be partially effective in countries where it has been established.
- Insect induced defense in *Chromolaena* reduces its effectiveness.
- *Cecidochares connexa* - Easy to establish
- Effective in reducing seed production
- Effectiveness may be affected by local parasitoids in some countries

Natural Enemies Established



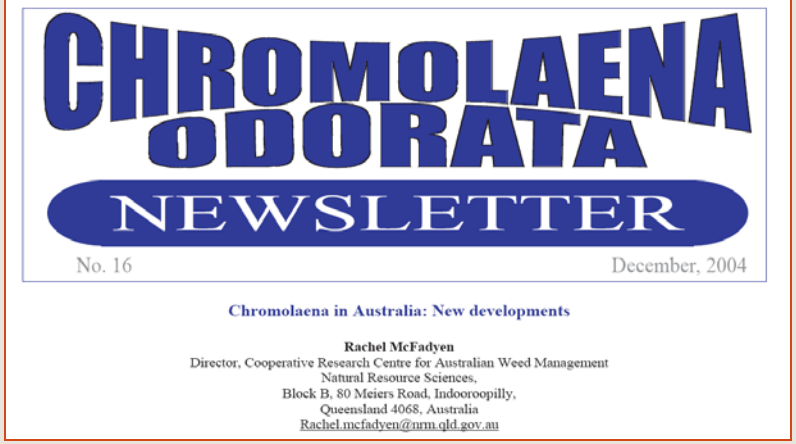
Courtesy: QDPIF.

International Organization for Biological Control – Working Group on Chromolaena

International workshops held

- 1988 - Bangkok, Thailand
- 1991 - Bogor, Indonesia
- 1993 - Abidjan, Ivory Coast
- 1996 - Bangalore, India
- 2000 - Durban, South Africa
- 2003 - Cairns, Australia
- 2006 - Pingtung, Taiwan
- (2010 - Nairobi, Kenya)

18 News letters published since 1988


CHROMOLAENA ODORATA
NEWSLETTER
No. 16 December, 2004

Chromolaena in Australia: New developments

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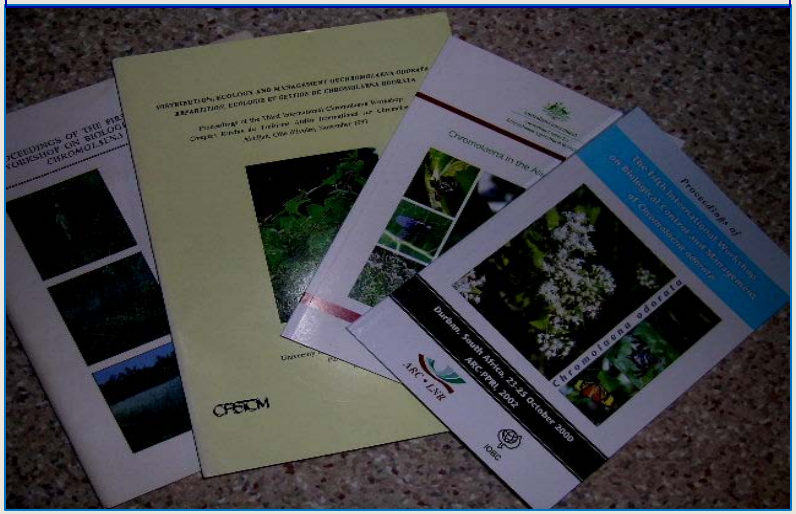
Proceedings published- 7



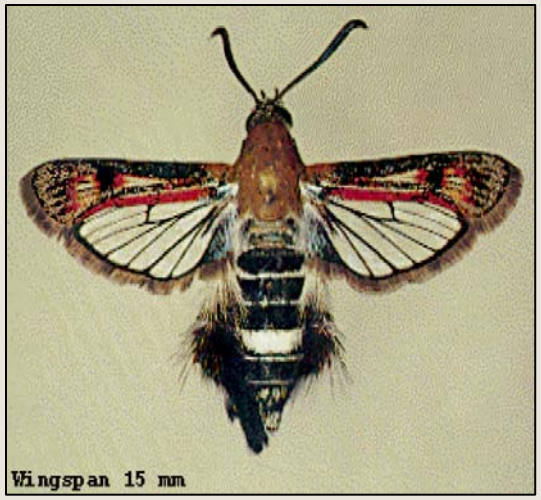
Ivy gourd, *Coccinia grandis*

C. grandis in Saipan

- Origin – Africa
- Introduced as vegetable
- Invasive – Hawaii and Mariana Islands
- Birds spread the seeds
- Vines touching soil will take root
- Resistant to herbicides

C. grandis in Guam

Stem boring moth, *Melittia oedipus* (Lepidoptera: Sesiidae)



Origin – Kenya, Africa
Introduced:
Hawaii – 1996
Guam – 2007
Saipan – 2007

Leaf mining weevil, *Acythopius cocciniae* (Coleoptera: Curculionidae)

Origin – Kenya, Africa
Introduced:
Hawaii – 1999
Guam – 2003
Saipan – 2003

Acythopeus burkhartorum (Curculionidae)

Adult

Gall in the tendril

Pupal chamber

Coccinia grandis – Before and after introduction of natural enemies

(slides – Hawaii Dept of Agriculture)

Lantana camara

(Verbenaceae)

Efforts to biocontrol started in 1902

41 agents have been released on lantana

Effective agents:

- *Teleonemia scrupulosa*
- *Ophiomyia lantanae*
- *Uroplata girardi*
- *Epinotia lantana*
- *Lantanophaga pusillidactyla*

Uroplata girardi
(Coleoptera: Chrysomelideae)

Adults feed on the leaves and larvae mine the leaves

Performs well under semi-shaded conditions

Established in Cook Islands, FSM, Fiji, Guam, Hawaii, New Caledonia, Niue, CNMI, Palau, PNG, Samoa, Solomon Islands, Vanuatu

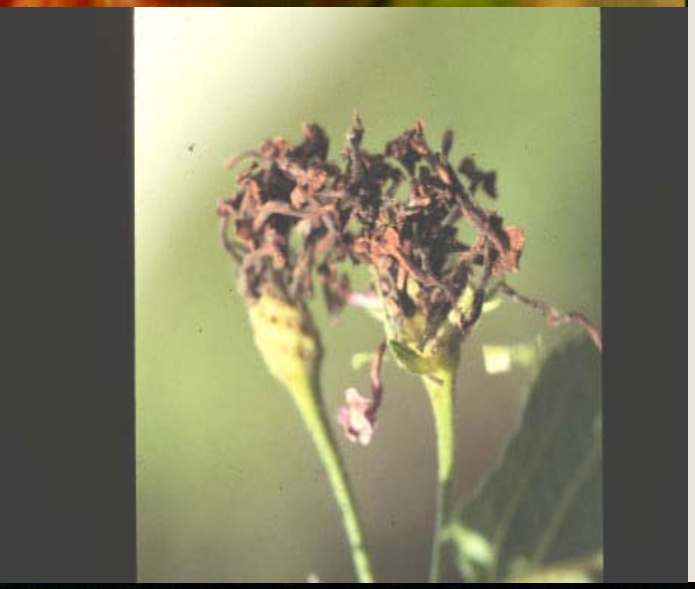
Adult beetle

Leaf mined by larva

Damage by adult beetles

***Teleonomia scrupulosa* (Tingidae)**

Established in most of the Pacific Islands.
Effective in dry season and not in wet season.
Egg parasitoids recorded in India.
Severe defoliation causes displacement of other natural enemies present.



***Epinotia lantana* (Tortricidae)**

Established in FSM, Guam, Hawaii, CNMI, Marshall Islands, Palau, PNG

***Hypana laceratalis* (Noctuidae)**

Established in CNMI, Fiji, Guam, New Caledonia, Palau, Yap

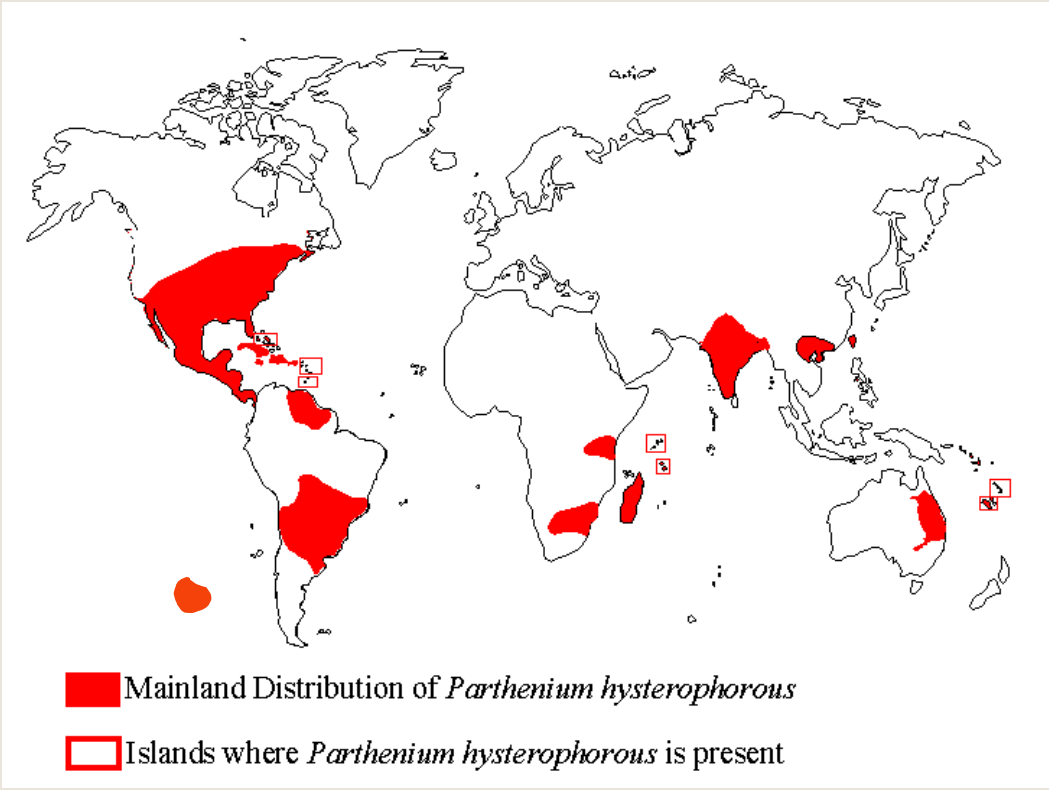
Parthenium hysterophorus

(Asteraceae)

Origin –Tropical North and South America

Distribution in the Pacific – PNG, New Caledonia Vanuatu and Hawaii

Natural enemies: 11 insect species and 2 fungi were introduced to Australia



Source: Modified from University of Queensland's Centre for Biological Information Technology

Zygogramma bicolorata (Coleoptera: Chrysomelidae)

- Introduced to Australia in 1980
- Introduced to India in 1984
- Under quarantine – South Africa and Ethiopia
- Failed in quarantine – Sri Lanka and PNG

Parthenium defoliated by *Zygogramma*

8th International Workshop on Biological Control and Management
of *Chromolaena odorata* and Other Eupatorieae

and

Workshop on Biological Control and Management of *Parthenium hysterophorus*

Nairobi, Kenya, 1-5 November 2010

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Mimosa diplotricha

Origin: Tropical America

Distribution: Most of the Pacific Islands except Marshall Is., Tonga, Kiribati, Tokelau, and Tuvalu

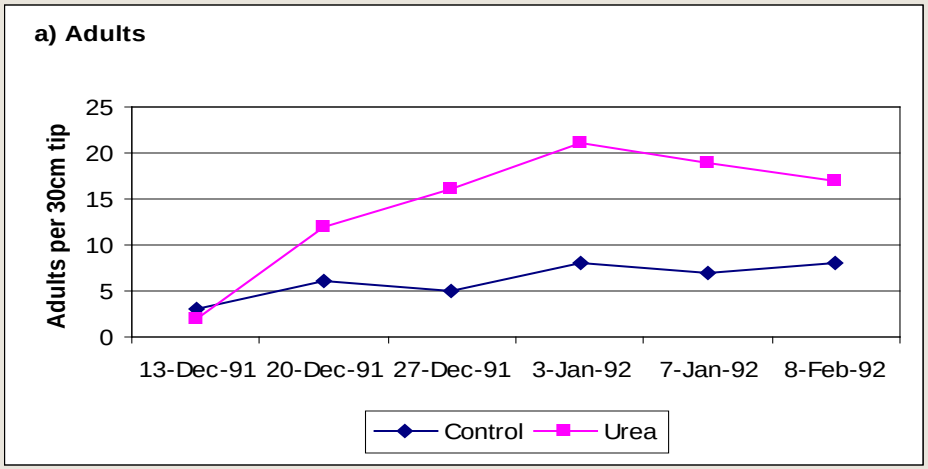
Natural enemy: *Heteropsylla spinulosa* – Effective – Established in Guam, CNMI, FSM, Cook Is., Samoa, Fiji, PNG, and Solomon Is.

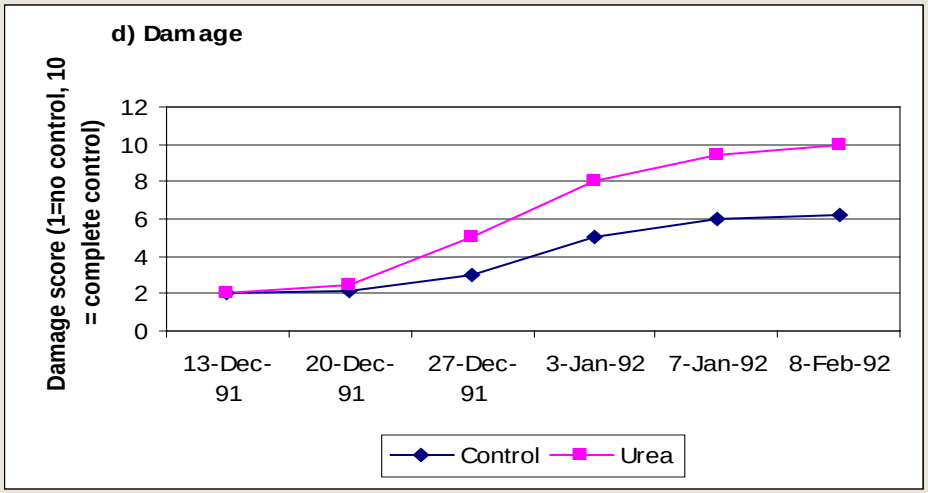
Giant sensitive plant, *Mimosa diplotricha* (Mimosaceae)

Pictures: L. Kuniata

- *M. diplotricha* infested area in Papua New Guinea

- *Heteropsylla spinosa* – Effect of nirogen application





Water hyacinth, *Eichhornia crasssipes*

Origin – Neotropics
World's worst aquatic weed

Neochetina eichhorniae (Coleoptera: Curculionidae) introduced to Fiji, PNG, Solomon Islands and Vanuatu.
Neochetina bruchi introduced to PNG.

Waterhyacinth in PNG

Photos: J.A. Coetzee et al.

Waterhyacinth in a lake before and after release of *Neochetina eichornieiae* and *N. bruchi* Photos: J.A. Coetzee et al.

Salvinia molesta contol by *Cyrtobagous salviniae*

Photos **: P. Room and S. Bauer**

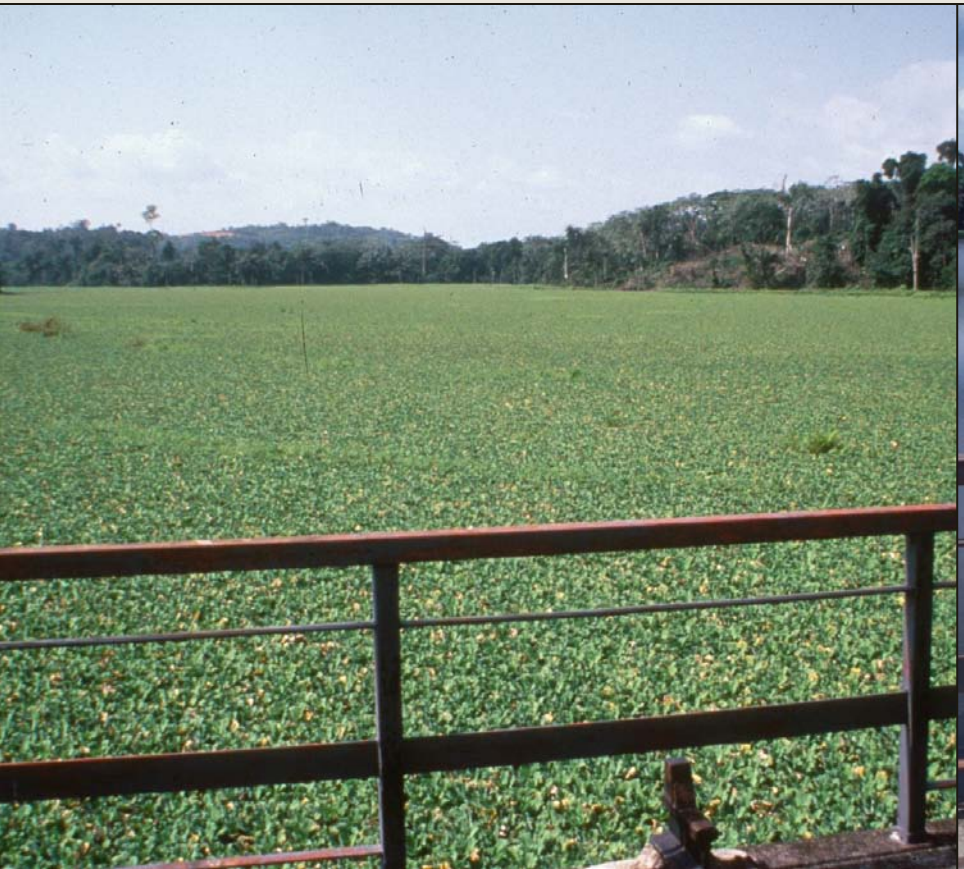
Introduced – Fiji 1991, PNG

(Before and after in Australia)

Pistia stratiotes (Araceae) before and after introduction of *Neodronomus affinis* in a lake in Ivory Coast

(Photos: M. Julien)

Introduced: PNG – 1985, Vanuatu 2006



Mikania micrantha

Liothrips mikaniae – Solomon Islands – 1988 (NE)

Puccinia spegazzinii – Fiji and PNG (2007)

Clidemia hirta

Liothrips urichi – Fiji (1930), Hawaii (1953), Palau (1972), Solomon Is. (1938, 73, 75), Samoa

Miconia calvescens

Colletotrichum gloeosporioides – Tahiti

Sida spp.

Calligrapha pantherina – Fiji (2002), Vanuatu (2004)

Biocontrol of Insect Pests Addressed

Papaya mealybug, *Paracoccus marginatus*
Pink hibiscus mealybug, *Maconellicocus hirsutus*
Orange spiny whitefly, *Aleurocanthus spiniferus*
Coconut hispine beetle, *Brontispa* spp.
Coconut rhinoceros beetle, *Oryctes rhinoceros*
Spiraling whitefly, *Aleurodicus dispersus*
Red coconut scale, *Furcaspis oceanica*
Fruit Piercing moth, *Eudocima phalonia*
Cycad aulacaspis scale, *Aulacaspis yasumatsui*
Mango tip moth, *Penicillaria jocosatrix*
Philippine lady beetle, *Epilachna philippinensis*

Papaya mealybug, *Paracoccus marginatus* (Hemiptera: Pseudococcidae)

- **Origin:** Mexico
- **Polyphagous**
- Papaya more susceptible and die out in 3 to 4 months after infestation
- **Spread:**
  - **1990s** – Caribbean, Florida and South America
  - **2002-5** –Guam, Palau, Hawaii
  - **2008-9** – India, Indonesia, Malaysia, Thailand, Sri Lanka, Bangladesh, Maldives, Cambodia
  - 2010 – Ghana, Reunion

Biological control of Papaya mealybug

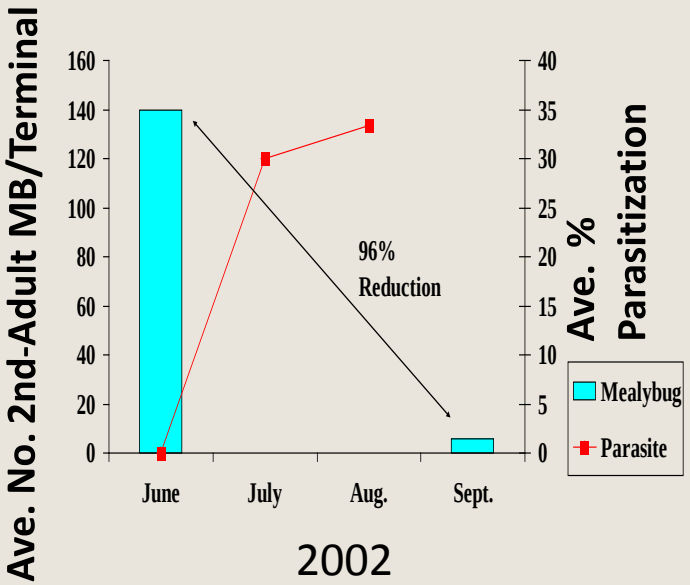
Papaya trees killed by mealybug

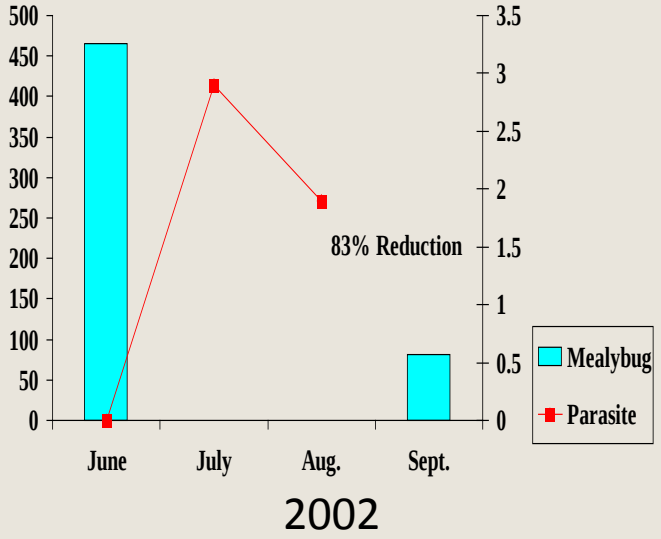
Parasitoids Introduced :

- *Anagyrus loecki*
- *Acerophagous papayae*
- *Pseudleptomastrix mexicana*
- (Hymenoptera: Encyrtidae)

Papaya mealybug parasitoid

Impact of Parasites on Papaya Mealybug – Guam (Hibiscus and Plumeria)





Courtesy: Dale Meyerdirk

Pink hibiscus mealybug, *Maconellicoccus hirsutus*

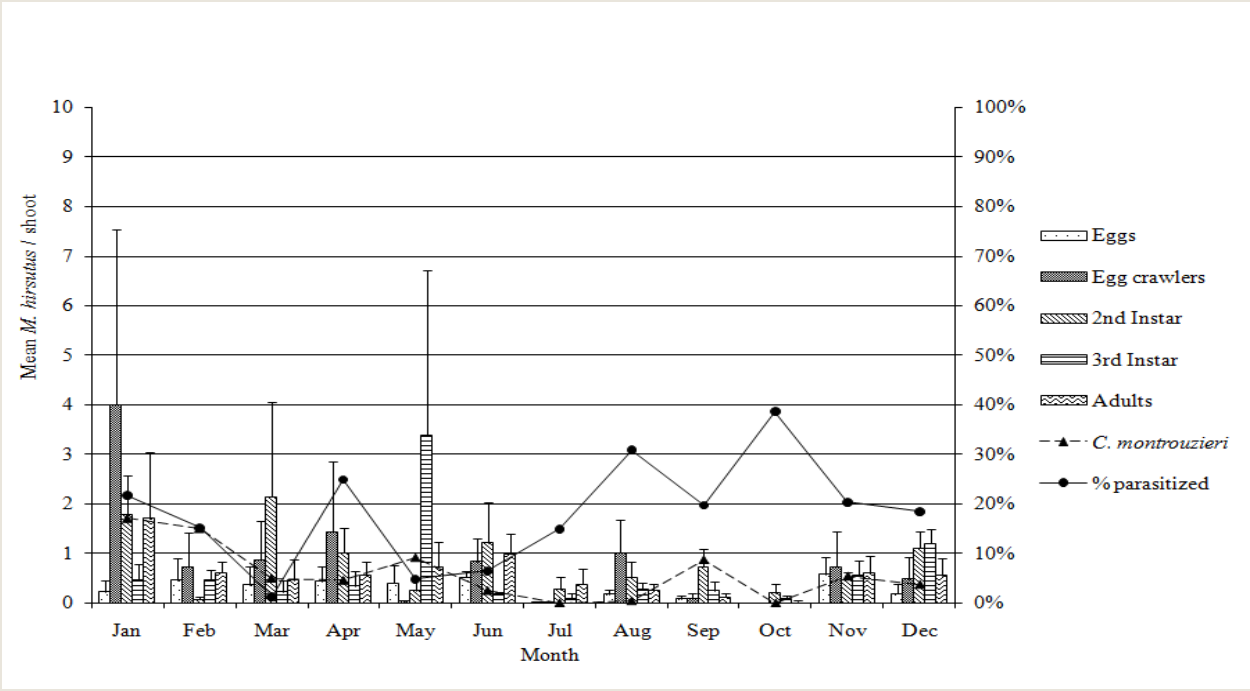
(Hemiptera: Pseudococcidae)

- Native to Asia
- Found in Hawaii 1983 and Guam 1984
- Present in CNMI and FSM
- In 1993, reported in Grenada, now it has spread all over the Caribbean, Florida, California and S. America

Natural Enemies of PHMB

Anagyrus kamali female and an ovipositing female (Photos: Dr. Lance Osborne)

Anagyrus kamali
Allotropa sp. near mecrida
Cryptolaemus montrozieri (Coccinellidae)



Population dynamics of PHMB and its natural enemies in Guam

Orange spiny whitefly (OSW), *Aleurocanthus spiniferus*

(Hemiptera: Aleurodidae)

Orange spiny white fly (OSW)

- **OSW was first recorded on Guam in 1951**
- **1952 – Five parasitoids were introduced to Guam from Mexico**

***Encarsia smithi* (Aphelinidae)–**

Established on Guam, Kosrae, Pohnpei, Chuuk, Yap, and Hawaii (1980s and 1990s)

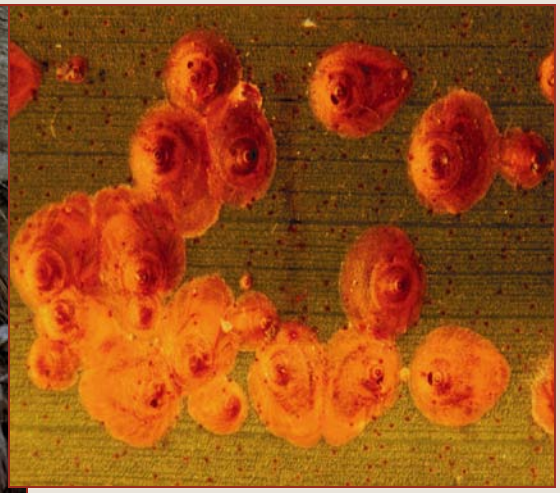
Aleurodicus dispersus -Spiraling whitefly

- Neotropical origin
- Established in Hawaii – 1978
- Spread throughout the world

Natural enemies introduced:

- *Encarsia haitiensis* (Aphelinidae)
- *Nephaspis bicolor* (Coccinellidae)

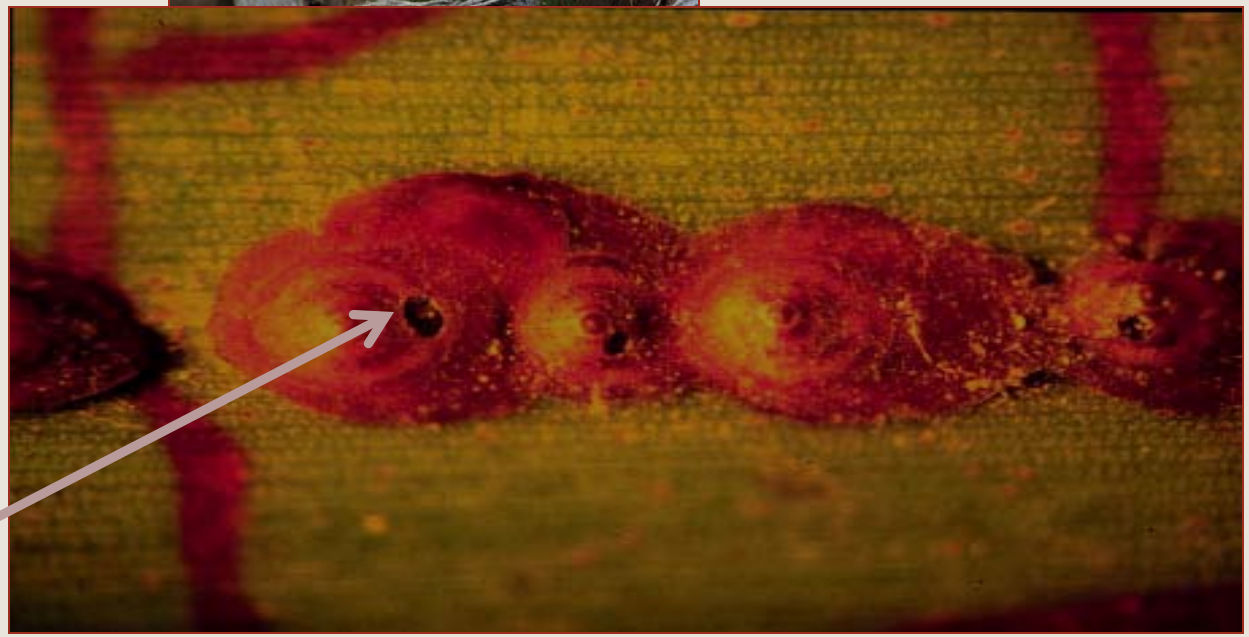
Red coconut scale, *Furcaspis oceanica*



Red coconut scale – Endemic to Caroline Islands. Established in Guam in the 1970s

Parasitoid, *Adelencyrtus oceanicus* introduced to Guam from Ulithi (Yap) in 1988.

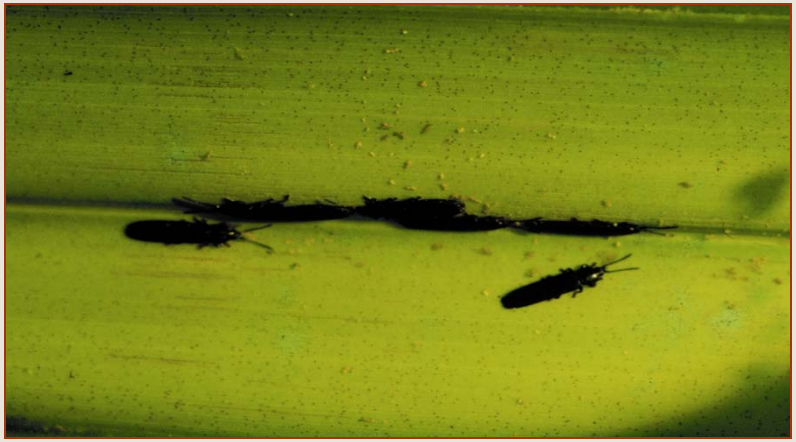
Parasitoid emergence hole



Brontispa spp.

- *Brontispa longissima* – South pacific
- *Brontispa palauensis* – Palau and Guam
- *Brontispa marianensis* – Saipan, Rota, Tinian
- *Brontispa chalybeipennis* – Pohnpei, Marshalls and Hawaii
- Natural enemies: *Tetrasticus brontispae*, *Asecodes hispinarum*, *Chrysonotomyia* sp.,

Brontispa palauensis



Coconut beetle, Oryctes rhinoceros

Occurs in Guam, Palau and South pacific Islands

Baculovirus oryctes used in the Pacific Islands

Larvae, Pupae and Adult

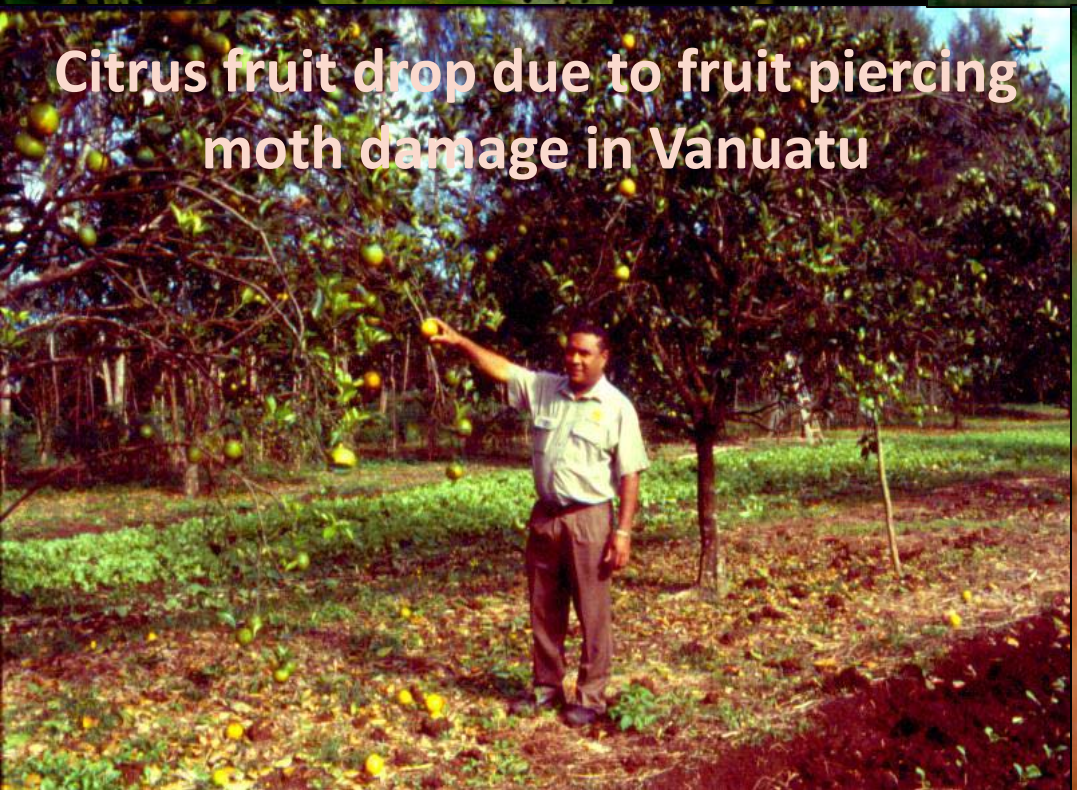
Metarhizium application to coconut logs

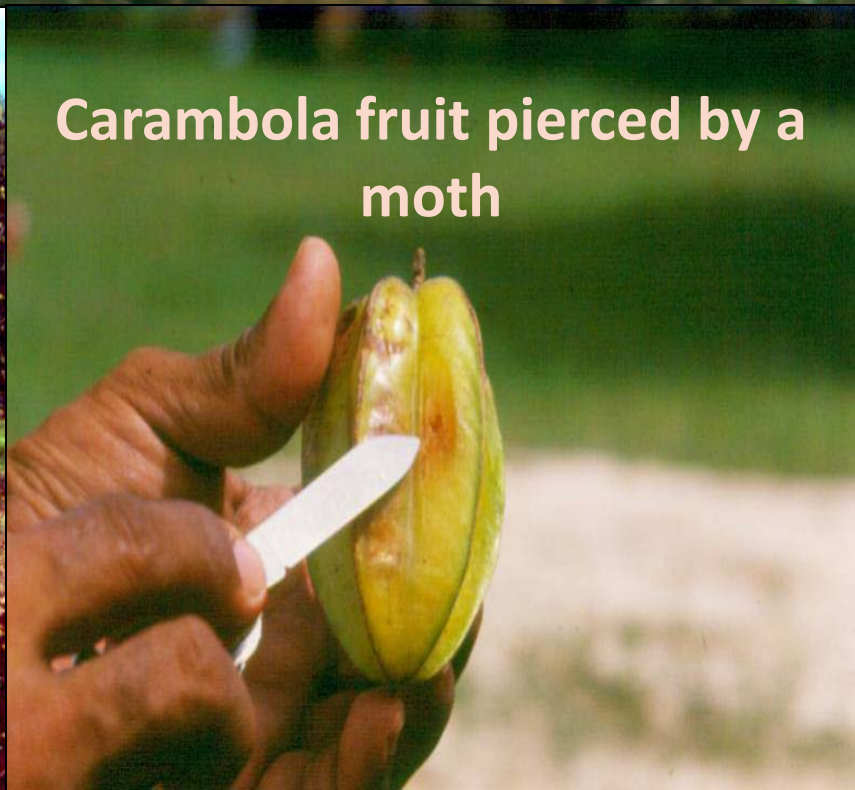
Fruit Piercing moth, *Eudocima phalonia* (Noctuidae)

Proboscis (of fruit piercing moth)

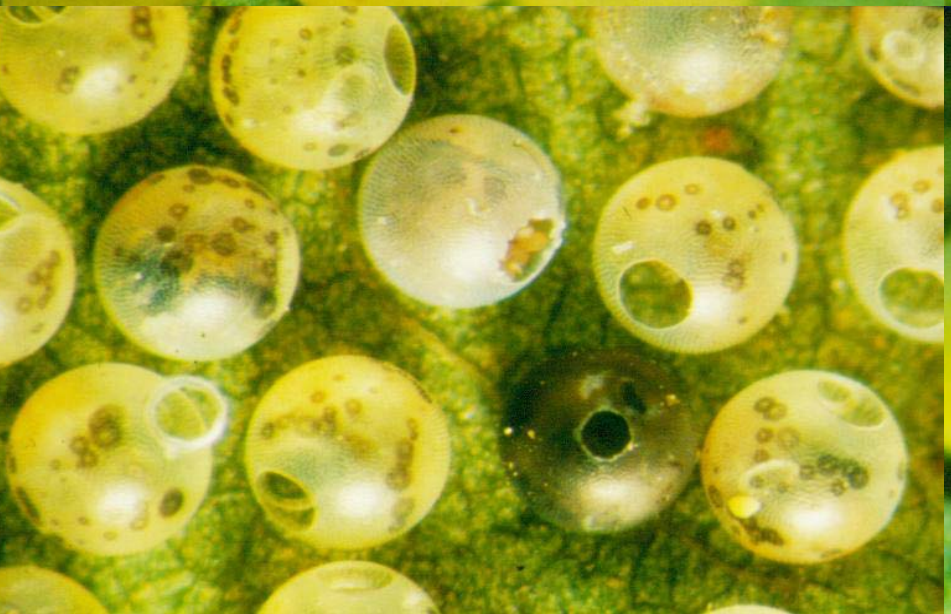

Moths feeding on Guava


Citrus fruit pierced by a moth


Citrus fruit drop due to fruit piercing moth damage in Vanuatu


Carambola fruit pierced by a moth

Egg parasitoids *Trichogramma, Ooencyrtus* and *Telenomus* of *Eudocima phalonia*



Euplectrus maternae

(larval ectoparasitoid of *Eudocima spp.*)

- Collected in India and introduced in Guam but did not establish

Cycad aulacaspis scale, *Aulacaspis yasumatsui* damage in Guam

Courtesy: Tom Marler

Cycad aulacaspis scale

Natural enemies introduced to Guam:

Rhizobius lophathae (coccinellidae)

Cocobius fulvus

Mango tip moth, *Penicillaria jocostrix* (Noctuidae)

Euplectrus sp. near *parvulus* (Eulophidae) and *Blepharella lateralis* (Tachinidae) were introduced from India to Guam in 1986-87.

P. Jocosatrix population was reduced by 90%

Courtesy: M. Shepard

Philippine lady beetle: *Epilachna philippinensis*

Pediobius foveolatus introduced from Philippines to Guam in 1954 to control *Epilachna philippinensis*

Courtesy: Maryland Dept. of Agrl.

Grubs of *Epilachna on eggplant*

Eucanthecona, a pentatomid bug feeding on the grub →

Pests that are threat to the Pacific Islands

- **Asian citrus psyllid** – *Diaphorina citri* (Hawaii)
- **Coconut eriophyid mite** - *Aceria guerreronis*
- **Mango fruit borer** – *Citripetis sp.* (Saipan)
- **Mango fruit fly** – *Bactrocera invadens*
- **Melon fly** – *Bactrocera cucurbitae* (Marianas)
- **Other fruit flies**
- **Papaya fruit fly** – *Bactrocera papayae*

- **Papaya mealybug** – *Paracoccus marginatus* (Guam, Tinian, Palau, Hawaii)
- **Red palm weevil** – *Rhynchophorus ferrugineus*
- **Solenopsis mealybug** – *Phenacoccus solenopsis* (New Caledonia)

Pests that are threat to the Pacific Islands, cont.

- **Banana leaf roller** – *Erionota thrax* (Marianas, Hawaii)
- ***Chromolaena*** – (Micronesia, PNG, New Caledonia)
- **Cassava mealybug** – *Phenacoccus manihoti*
- **Cycad aulacaspis scale** – *Aulacaspis yasumatsui* (Hawaii, Marianas, Palau)
- **Eggplant fruit and shoot borer** – *Leucinodes orbonalis*
- **Mango leafhoppers** – *Idiocopus* spp. (Palau)
- **Parthenium** – (Hawaii, PNG, Vanuatu, New Caledonia)
- ***Orthezia insignis* - (Guam)**
- **Western flower thrips** – *Frankliniella occidentalis* (Hawaii)


Thank You