Integrated Pest Management in Mango Orchards

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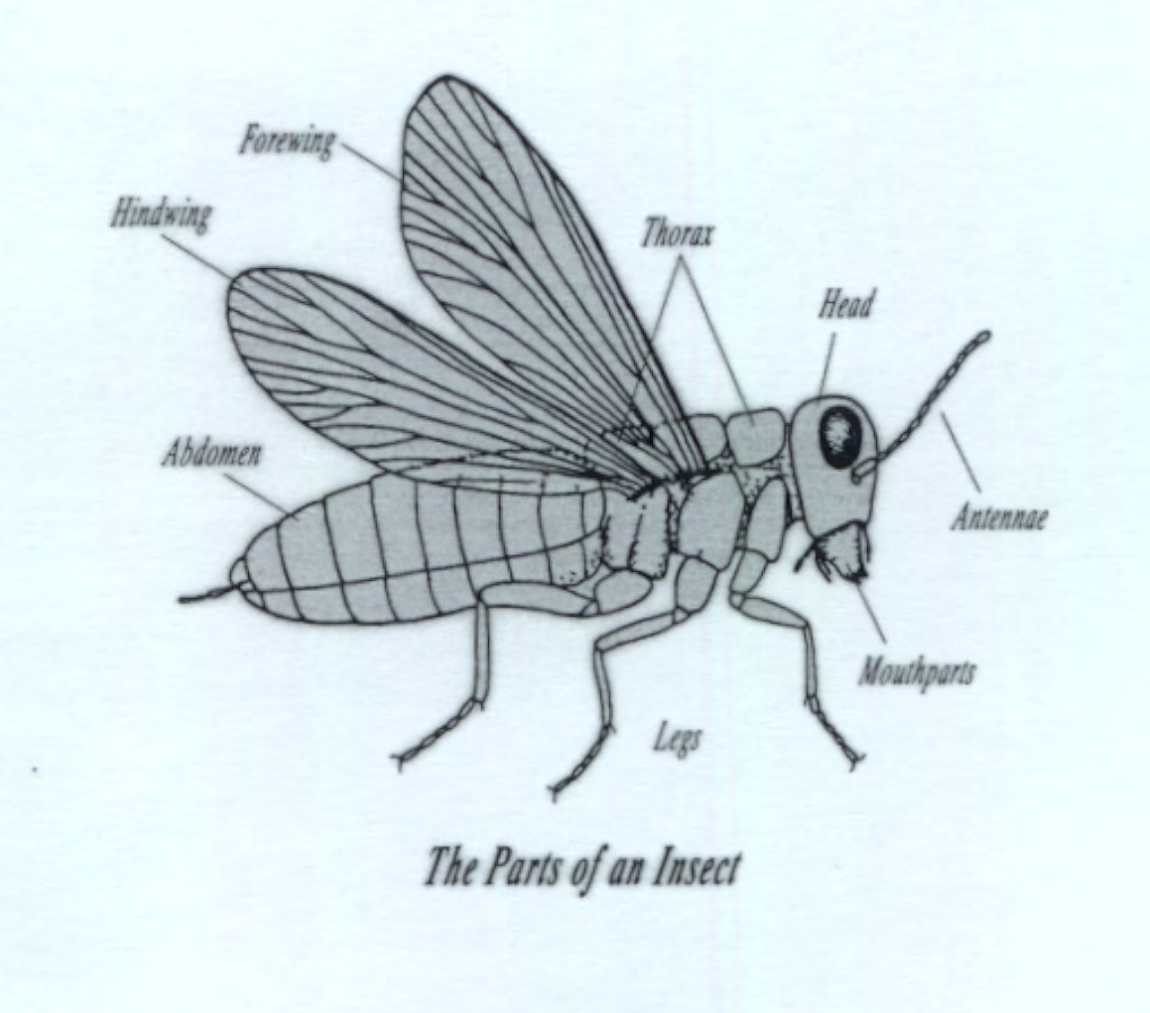
Workshop Outline

- 1. IPM
  - Intro to arthropods and principles of IPM
- 2. Pests and Beneficials
- 3. Monitoring
- 4. Insect Sampling in Orchards (theory)
- 5. Control techniques
- 6. Quarantine Pests
- 7. Plant Pathology
- 8. Practical
- 9. Orchard walk

The Parts of an Insect



The Parts of an Insect

Metamorphosis

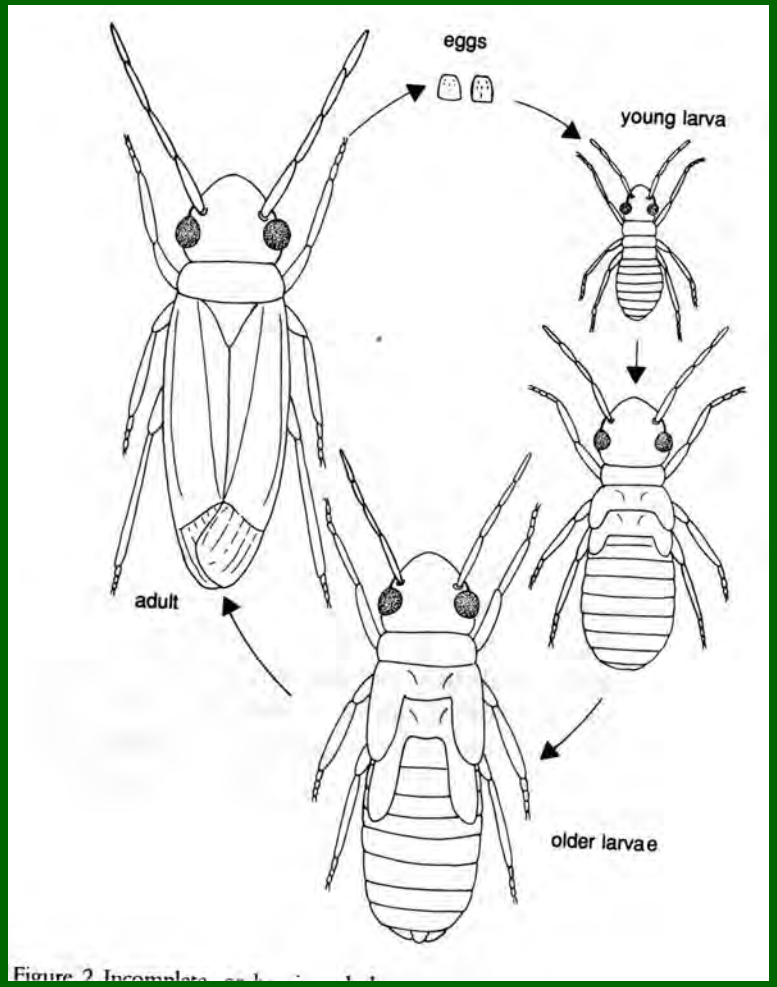
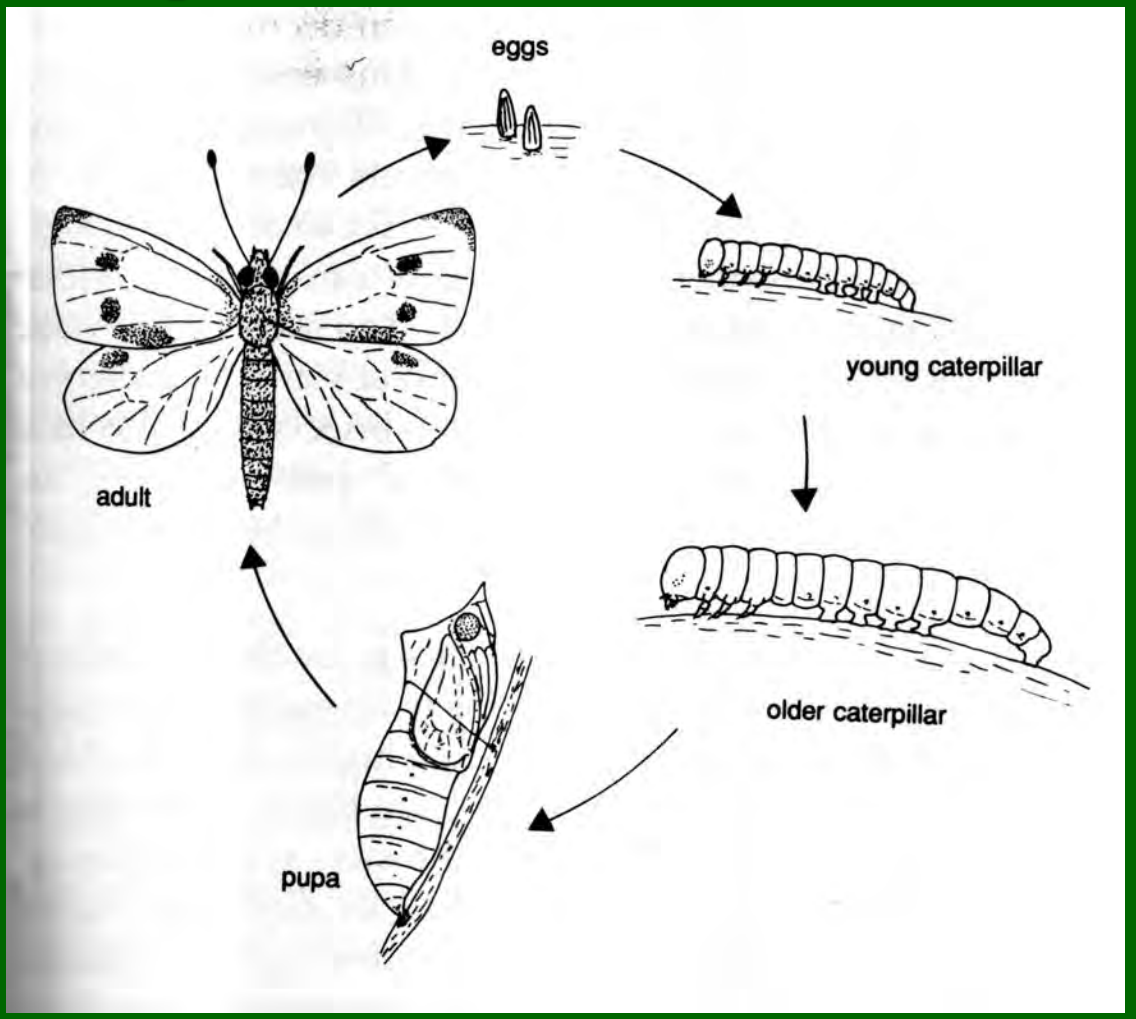


Figure 2 Incomplete



Incomplete Metamorphosis e.g. the life cycle of a sucking bug

Complete Metamorphosis e.g. the life cycle of a butterfly or moth

Incomplete or Gradual Metamorphosis

- Less advanced or primitive insects
- Larvae resemble adults in appearance
- No pupal stage
- Larvae are referred to as nymphs
- The adults commonly occur in the same habitat as the nymphs and utilise the same food and resources

Complete Metamorphosis

- More advanced insects with a more complex life cycle
- Larvae and adults are different in appearance
- The last larval stage forms a pupa (resting stage in which the larval body changes to the adult form)
- Larvae and adults may feed on different food sources or have different adaptations. This Allows insects to exploit a greater range of resources
- Avoid competition between different growth stages of the same species, which is an important factor in leading to the success of insects

Life Cycles

- Incomplete Metamorphosis

e.g.

  - Hemiptera
  - Orthoptera

- Complete Metamorphosis

e.g.

  - Lepidoptera
  - Coleoptera
  - Hymenoptera
  - Diptera

Type of Feeding

- Chewing
  - beetles
  - grasshoppers
  - caterpillars
- Sucking
  - Bugs e.g.
    - Amblypelta
    - Helopeltis
- Sucking and rasping
  - thrips
  - mites

What makes an insect pest successful?

- Small size
- Short Life Cycle
- High Fecundity
- Adaptability
- Mobility
- Sex Ratio

Integrated Pest Management (IPM)

- IPM is a combination of methods of controlling or managing insect pests
- In an IPM program, orchards should be monitored regularly for insects, disease and damage (and/or symptoms)

Integrated Pest Management (IPM) cont.

- Pest control methods should be chosen to minimise harm to beneficials and the environment

- A pesticide should only be used when necessary, based on monitoring results and local knowledge

IPM - What does it involve?

- Identification of pests, diseases and beneficials
- Life cycles - becoming familiar with insect life cycles and seasonal occurrences in the orchard
- Monitoring orchards regularly to record pests and beneficials and determine damage over time periods

- Low pest numbers can be tolerated. Control is only necessary when pests have or are likely to reach damaging levels

- Beneficial insects and mites are more common in mature orchards (5 years and older) that have had thoughtful spraying practices

Beneficials are more likely to build up in numbers if:

- orchards are not regularly sprayed with persistent chemical insecticides
- the property is located near non-sprayed refuges e.g. water bodies, dense woodland or monsoonal rainforest
- the property has a range of shady trees and crops (refuges) for beneficials to find suitable prey

- Healthy trees are less prone to attack by insects. Check that trees are obtaining adequate nutrients, irrigation, maintenance and growing conditions. Choose suitable varieties etc.

- Choose other control methods where possible e.g. biological control and physical control or “soft chemicals”

- When chemical sprays need to be applied, those more specific and less harmful (to beneficial organisms, the environment and humans) should be chosen e.g. *Bacillus thuringiensis* for flower caterpillars

Major Pests

(causing regular and/or extensive damage)

Major (causing regular damage)

- Redbanded thrips
- Mango leafhopper
- Flatid planthopper
- Amblypelta
- Tip borers
- Flower caterpillars
- Giant termite
- Mango seed weevil
- Fruit flies

Redbanded thrips (*Selenothrips rubrocinctus*)

Redbanded thrips damage

Nymph (left) and pupa (right)

Mango leafhopper, *Idioscopus nitidulus*

Leaf crinkling and sooty mould on leaves

Adults and nymphs

Damage to flower panicle

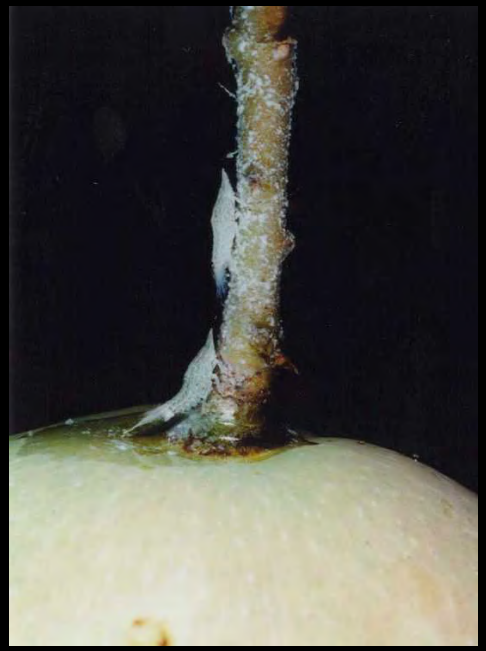
Flatid Planthopper, *Colgaroides acuminata*

Adult on flower panicle

Egg masses and nymphs

Flatid planthopper

Sucking damage to the skin of a mango



Nymphs on fruit stalk

Feeding at the stem end of fruit causing sap flow

Sap sucking insects excrete honeydew

Such as:

- mango leafhopper
- flatid planthopper
- mealybugs
- fluted scales
- mango scale
- pink wax scale

Sooty mould grows on leaves covered in honeydew

Fruit spotting bug, *Amblypelta*

Adult on guava

Nymph

Damage to mango shoot

Amblypelta damage to a mango tree canopy in a home garden

Large mango tip borer

Flower caterpillar

Giant termite, *Mastotermes*

Damage to mango trunks

Giant Termite, *Mastotermes*

Soldier

Workers and neotenics

Mango seed weevil

Adults on fruit

Feeding
damage to fruit

pupa larva adult

Qld fruit fly, *Bactrocera tryoni*

Adults

Adult laying eggs into fruit

"Sting marks" on fruit

Larvae

Infested fruit

Minor Pests
(causing irregular damage)

Minor (causing irregular damage)

- Swarming beetles
- Fluted scales and mealybugs
- Mango scale
- Pink wax scale
- Mango stem miner
- Helopeltis
- Mites
- Dimpling bug
- Flower thrips
- Longicorn borer

Swarming beetle

Rhyparida beetle damage

Swarming beetles

Leaf surface chewing damage

Chewing damage (skeletonising) to leaves caused by *Agetinus* beetle

Fluted scale, *Icerya aegyptiaca*

Mango scale, *Pseudaulacaspis cockerelli*

Pink wax scale

Mango stem miner

Damage to young shoot

Larva

Helopeltis

Adult

Recent damage to small young fruit

Old damage seen as circular scars on larger fruit

Mango bud mites, Family Eriophyidae

Three main species. One species affects the new developing leaf "buds".

Two other species affect the leaves -symptoms are silvery-white wax or "webbing" on the surface of leaves.

Dimpling bug damage on fruit

Ants

- Some are pests when they:
  - farm sap sucking insects such as scales, fluted scales, mealybugs or leafhoppers
  - chew the margin of leaves
- Ants may be beneficial by:
  - attacking pests
  - pollinating flowers

If you are not sure of which ants do what ….watch them

Ants

Green ants attack some insects such as caterpillars and tend others such as mealybugs and scales

On stressed trees

Longicorn borer, *Acalolepta mixtus*

Other Animals

Possum damage may resemble bud mite damage

Other swarming bugs

- These insects may be present in large numbers but are not pests of mangoes
  - *Graptostethus*
  - *Gralliclava horrens*

Other sap suckers but not pests of mangoes or fruit trees

Graptostethus

- Sucking bugs that feed on seed pods of some field crops and native plants such as *Hibiscus* and *Solanum*.

- Swarms may occasionally cause scratches to leaves

Monitoring

Monitoring

- What do we mean ?
- What is required ?
- How do we do it ?
- Benefits of monitoring

Concept of monitoring

To gain an understanding of the pest and disease status in a particular orchard in relation to:

- Crop (mangoes)
- Age of trees and tree phenology
- Season
- Weather conditions and time of day
- Interrelationships between pests and beneficials
- Orchard location

Monitoring requirements

- Know how to identify pests, diseases and beneficials
- Learn how to sample and record
- Know how frequently to sample

Monitoring requirements

- Learn to identify pests and beneficials
- Insects and mites are generally attracted to the new leaves, flowers or fruit. These are the sample points to concentrate on when monitoring

Monitoring requirements

- Monitor regularly - at weekly or fortnightly intervals.
- During the flowering and fruiting period it may be necessary to monitor more frequently i.e. every two or three days

Benefits of regular insect monitoring

- Familiarity with the fauna of the orchard, their lifecyles and associations with tree phenologies
- First record of potential pest outbreaks
- Obtain seasonal trends for pests in your orchard (info to make an annual chart)
- To observe the effectiveness of native predators and parasites on pest populations
- Form the basis for control decisions

Control Methods

Management Options

- Chemical
- Cultural
- Biological

Chemical Control

- ESSENTIAL DECISIONS
- OPERATIONAL ASPECTS

Essential Decisions

- Pesticides are a useful component of IPM
- Is a treatment necessary?
- What to use?
- How to apply
- Timing
- Evaluate the effectiveness of treatment

Choosing a Pesticide

- Consider “softer” option(s) first
- Select a specific pesticide where possible
- Be aware of different chemical groups
- choose an option recommended by DBIRD

Caution Required

- Use of some synthetic chemicals can cause disruption to natural enemies and pest upsurges
- It is the grower's responsibility to ensure that the chemicals are registered, compatible, applied and disposed of correctly

General Comments

- *Bacillus thuringiensis* (Bt) used against caterpillars only - specific
- Potassium soaps are soft options for small pests such as thrips and mealybugs
- Horticultural spray oils are effective against scales and mealybugs
- Systemic chemicals are necessary against fruit flies

Operational Aspects

- Hygiene / decontamination
- Coverage of affected plant parts
- Equipment
- pH
- Combining chemicals
- Feeding enhancers / adjuvants
- Health / environmental /disposal issues

Cultural Controls

- Tree husbandry
- Hygiene
- Pruning
- Tree architecture
- Cultivar susceptibility
- Resistant clones
- Time of harvest

Orchard Factors

- Location of property
- Planting pattern - orientation, access
- Alternate hosts
- Diversity

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Predators available from commercial suppliers

- Green lacewing, *Mallada signata*
- Mealybug ladybird, *Cryptolaemus montrouzieri*

(Also refer to information sheets written by Bugs for Bugs - included in your folder)

Beneficials and Biological Control

Native beneficial insects

- Pollinators
- Ladybird beetles, Coccinellidae
  - *Cryptolaemus montrouzieri*
- Lacewings
- Praying mantids
- Spiders e.g. Argiopidae and Salticidae
- Predatory sucking bugs
- Wasp parasites
- Predatory caterpillar e.g. Epipyropidae
- Insect pathogens e.g. fungal infections, viruses and bacteria

Pollinators


Blowfly


Bush fly


Hover fly


Bush bee

Predatory ladybird

Rodolia limbata in search of fluted scales

Praying mantid

- General predator - feeds on a large range of insects….their role as biological control agents are limited as they are “non-specific predators” and will also feed on other beneficial insects

A praying mantid (naturally upside down in this photo) catching pollinators

Spiders - These spiders are harmless to humans but are good general predators of insects

Araneus sp

St-Andrew's Cross

Orb-weavers build webs to trap insects

Flower Spiders

Flower spiders are often found in flowers where they feed on small insects such as thrips and small caterpillars

Biological Control with Commercial Predators

Biological Control…. a few hints

On the release of *Cryptolaemus* beetles and green lacewing larvae:

- *Cryptolaemus* and green lacewing larvae establish well in orchards that are at least 4-5 years old. In younger orchards, a nearby dense stand of vegetation is required as a refuge

Predators - Available from Bugs for Bugs

Cryptolaemus adults and larvae feed on:

- mealybugs
- fluted scales
- soft green scales
- flatid eggs
- other insect eggs and immobile immature stages

Predators - Available from Bugs for Bugs…cont.

Green lacewing larvae feed on:

- redbanded thrips
- mites
- aphids
- moth eggs
- small caterpillars

Mealybug ladybird - *Cryptolaemus montrouzieri* (this is a native beetle but is also available from commercial suppliers)

Cryptolaemus adult and larva

adult larva soft green scale

Cryptolaemus adults feeding on mango scale

Cryptolaemus larvae

Can you tell them apart from mealybugs and fluted scales?

Cryptolaemus larva on rambutan fruit feeding on soft green scale

Fluted scale

Green lacewing

Lacewing egg mass

Lacewing larva - predator of redbanded thrips

Lacewing adult

Biocontrol of Planthoppers

- Egg masses (see photo in practical)
  - parasites: epipyropid moth, small wasps, predatory beetles
- Nymphs
  - predators: spiders, lacewing larvae
- Adults
  - predators: praying mantids, spiders, fungal pathogens

Flatid Planthopper

Adult infected with a fungal pathogen

Release Rate

- Release rate for *Cryptolaemus* and green lacewing larvae:
- Release at a rate of 20 punnets per ha
- *Cryptolaemus*: 1 punnet contains 40 adult beetles (20 punnets = 800 beetles per ha)
- Lacewing larvae (20 punnets = 2000 lacewing larvae per ha)

The best time of year to establish predators

- March to June (at the end of the wet season is ideal)
- Predators should be established before mango flowering

Cost

Cryptolaemus:

- $9.00 for 40 beetles or $ 180 per ha
- only 1-2 treatments required per year
  ….or repeat when necessary e.g. after insectide treatments to replenish populations

Green lacewing larvae:

- $22.00 for 500 larvae or $100 per ha
- requires 2-3 treatments per year

Benefits of Biological Control

- Economical when compared to the cost of spraying
- Environmentally friendly
- Controls a range of pests
- Long term benefits