

# The use of biocontrol agents in general horticultural practices

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# What is IPM?

Integrated pest management can be defined as:

“A philosophy/strategy of pest control that integrates all available tactics to reduce pest populations to an acceptable level in a cost-effective, environmentally rational manner”

# IPM Tactics include:

## ❖ Cultural Controls

- ❖ Crop hygiene
  - ❖ Removal of blown flowers
  - ❖ Removal of unsold stock
  - ❖ Selective pruning of infested plant material
- ❖ Weed control
  - ❖ Persistent weeds serve as refuges for pest populations
  - ❖ Some weeds can also host some plant viruses
- ❖ Cultivar resistances/susceptibility
- ❖ Environmental controls
  - ❖ Avoid overwatering practices
  - ❖ Eliminate damp areas or patches of standing water

# ❖ Physical controls

- ❖ Screening
- ❖ Quarantine
  - ❖ New plant material into the nursery





## ❖ Biological controls

- ❖ Parasitic wasps
- ❖ Predatory mites
- ❖ Predatory beetles/flies
- ❖ Biological sprays
- ❖ Predatory/parasitic nematodes

## ❖ Chemical controls

- ❖ Selective, targeted sprays
- ❖ Resistance management strategies
- ❖ Biorational products
  - ❖ Systemic acquired resistance

# Notes:



- ❖ IPM is not a quick fix
  - ❖ It is not implemented overnight
- ❖ IPM is not rigid
  - ❖ It may differ for every property
  - ❖ No one solution fits all
  - ❖ Every property, crop, grower is different with regards pest pressure, problems, inputs required, environment, costs, management practices and so each program is unique
- ❖ IPM does not exclude chemicals
- ❖ IPM does not mean total eradication of pests
- ❖ IPM means becoming proactive instead of reactive.
- ❖ IPM is not necessarily a cheap option – but it does not have to mean “I Pay More”

# Homework



- ❖ Which are my major pests?
  - ❖ Are there appropriate “soft” chemicals available?
  - ❖ Are there appropriate biological controls available?
  - ❖ Can they be controlled any other way?
- ❖ Who are my markets?
  - ❖ Local market, cut flower, foliage, direct to public, interstate/international?
  - ❖ What level of plant damage can be tolerated?
- ❖ Who are my neighbours?
  - ❖ What do they produce?

- ❖ What has been used to control pests in the past?
  - ❖ Previous heavy chemical usage may have resulted in harmful residues on structures and on floors/flooring materials (especially if growing indoors)
    - ❖ (On a new property)
- ❖ Which varieties are targeted by which pests?
- ❖ What time of year do which pests cause most problems?

# Implementation of IPM:



## 3 Key phases:

- 1) Get started and familiarise yourself with pest and disease **monitoring**

Be able to recognise all stages of pest and disease cycles

- 2) Incorporate **biological control** into the program using compatible sprays if/when required

Focus on your major pests first

# Monitoring ...

- ❖ Monitoring programs can be as simple or as complex as you want, but must be able to provide meaningful data.
- ❖ Monitoring allows “hotspots” to be identified before they become wide spread.
- ❖ Monitoring can directly impact the speed and efficiency of pest control programs and to a large extent – their cost.

- ❖ Monitoring of pest populations
  - ❖ Sticky cards
  - ❖ Crop inspections
  - ❖ Indicator plants
  - ❖ Historical data – use the past as a guide to the future
    - ❖ What/when/where
  - ❖ Understand and recognize all stages of pests/diseases biology



# Monitoring includes



- ❖ Which pests are present
  - ❖ Physical location
  - ❖ Plant variety
  - ❖ Life stages present
- ❖ Which (if any) beneficials are present?
  - ❖ Both introduced and naturally occurring
- ❖ Any signs of disease?
- ❖ Any problem with irrigation?
  - ❖ Plant stress may cause some plants to become more attractive/susceptible to some pests

- ❖ By having staff trained to be able to identify key pests/problems, you straight away increase your chances of identifying potential hotspots before they become major problems.

A little knowledge can go a long way



# Monitoring: traps



# Preparation

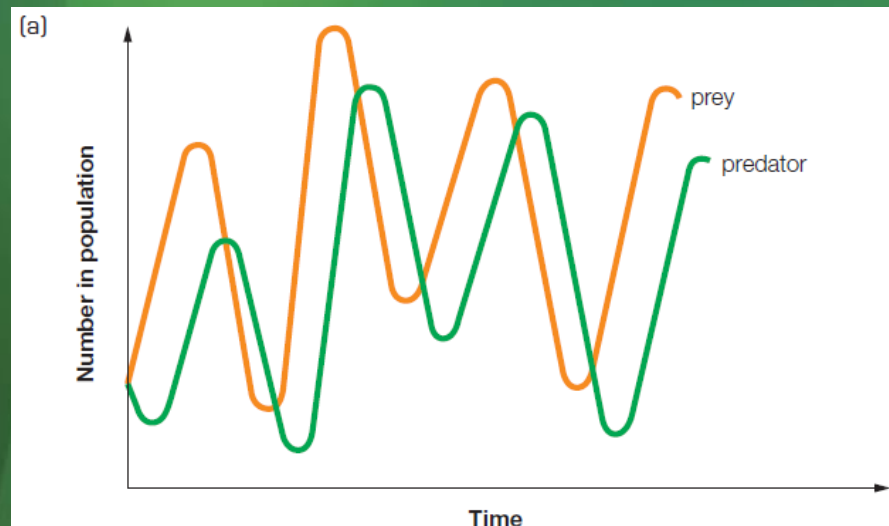


- ❖ What should be done whether choosing to start a program or not:
  - ❖ Remove all weeds and unnecessary plants from the property, to a distance of 10m from the nearest plant
    - ❖ Removes weed and virus refuges
  - ❖ Where possible, group together varieties of plants that have similar pest problems, ie. those that are more prone to whitefly, or aphids, or mites
    - ❖ Keeps pests more localised
    - ❖ Enables more accurate and effective placement of beneficials or of spray treatments – greater ability to “spot” treat areas
    - ❖ Can be used as indicator plants for pests
  - ❖ Check and calibrate all spray equipment
    - ❖ Replace worn nozzles
    - ❖ Ensure the correct nozzles are being used
      - ❖ Ensures correct and accurate coverage of chemical applications

# Basic Program



- ❖ Start with a preventative program, targeting the major pests encountered
  - ❖ Preventative programs help maintain lower pest levels
    - ❖ Natural predator/parasite populations tend to build up after pest populations have already reached high numbers
    - ❖ Can reduce overall costs by reducing the chances of major pest “explosions”

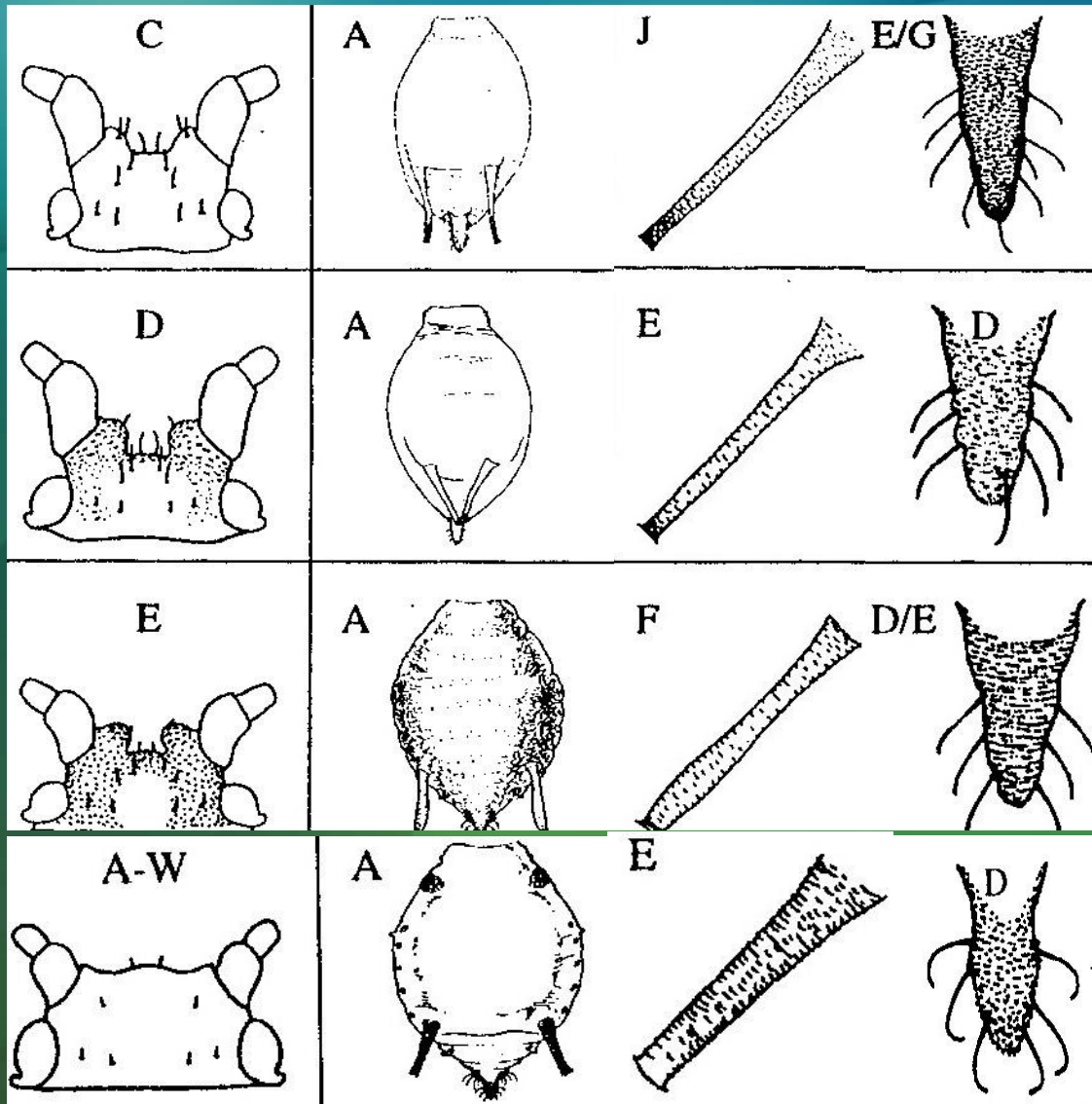


- ❖ Important initially to keep close contact with your consultant
  - ❖ Can provide advice on pest/beneficial identification
  - ❖ May be able to provide monitoring service - depending on location
  - ❖ May be able to offer staff training – depending on location
  - ❖ Can provide advice regarding compatible sprays
    - ❖ not harmful to beneficials
    - ❖ effective against disease

# Aphids



- ❖ More than 4000 species worldwide
  - ❖ Females give birth to live females which may already have developing young in them when they are born
  - ❖ Each female produces 50-200 young which can begin reproducing in 6-10 days depending on temperatures
  - ❖ When populations become very high, they start producing winged offspring
- ❖ Damage
  - ❖ Direct – due to toxins in saliva causing plant distortion
  - ❖ Indirect – vector viruses
  - ❖ Cosmetic – honey dew, (resulting in sooty moulds) and shed skins
- ❖ Identification – best carried out by experts
  - ❖ Need to look at head profile between antennae and “butt” shape



Potato aphid

Foxglove aphid

Green peach  
aphid

Cotton aphid

# Melon aphid - *Aphis gossypii*



# Foxglove aphid - *Aulacorthum solani*



Potato aphid - *Macrosiphum  
euphorbiae*



Green peach aphid -  
*Myzus persicae*

## Aphid controls supplied by Biological Services:

- ❖ *Aphidius colemani* – Controls a wide range of aphids including green peach aphid and melon aphids
- ❖ *Aphidius ervi* – Controls potato aphid and greenhouse potato aphid
- ❖ *Aphelinus abdominalis* - Controls green peach aphid, potato aphid and greenhouse potato aphid
- ❖ Aphid parasite mix – a combination of the 3 parasites listed above to control a range of aphid species.

# Aphid parasites



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*Aphelinus abdominalis*



*Aphidius colemani*





Aphid mummies found in AP mix

# Thrips



- ❖ **Only a few thrips species cause serious problems**
  - ❖ Western flower thrips (WFT)
    - ❖ Attacks over 200 different plant species
    - ❖ Damage can be direct via feeding
    - ❖ Feed on pollen
    - ❖ Indirect – vectors of Impatiens Necrotic Spot Virus (INSV) and Tomato Spotted Wilt Virus (TSWV)

# Western flower thrips (WFT)



- ❖ Greenhouse thrips – *Heliothrips haemorrhoidalis*
  - ❖ Large black thrips – less attractive to predatory mites due to size and defence mechanism
  - ❖ Wide host range including Vireyas, citrus, avocado and rhododendron
  - ❖ Causes silvering on leaves
  - ❖ Black faecal spots on underside of leaves and/or on flowers
  - ❖ Monitor with yellow or blue sticky traps



## Greenhouse thrips



- ❖ Thrips controls supplied by Biological Services:
  - ❖ Hypo-A - *Hypoaspis aculiefer*. Applied to media at seeding/planting
  - ❖ Cucumeris - *Neoseiulus cucumeris*. Applied to media or over plants
  - ❖ Orius - *Orius tantillus*. Must be used in conjunction with banker plants



Hypo-A



Cucumeris



Orius



Basil bankers for Orius

# Whitefly

- ❖ Attack a wide range of plants
- ❖ Deposit honey dew on upper surfaces of lower leaves
- ❖ Black sooty moulds grow on the honey dew
- ❖ Some species can transmit plant viruses
- ❖ Most life stages are not affected by non systemic chemicals due to a protective covering , ie. eggs, larvae, pupae

- ❖ 2 main species
  - ❖ Greenhouse whitefly – *Trialeurodes vaporariorum*
    - ❖ Females lay up to 400 eggs in a lifetime on preferred hosts
    - ❖ Wings held “tent like” over the body
      - ❖ Abdomen not clearly visible between wings
    - ❖ Adults more concentrated in the heads of plants
  - ❖ Silverleaf whitefly – *Bemisia tabaci*
    - ❖ Adults slightly smaller than greenhouse whitefly
    - ❖ Wings held slightly parallel to each other
    - ❖ Adults well distributed over the plant
    - ❖ Highly resistant to chemicals



Silverleaf whitefly



Greenhouse  
whitefly

- ❖ Whitefly controls supplied by Biological Services:
  - ❖ *Encarsia formosa* – parasitic wasp
    - ❖ Supplied as pupae stuck to cardboard tags (100 pupae/tag)
    - ❖ Need temps over 18°C to fly
    - ❖ Must be introduced when whitefly levels are very low
    - ❖ Most effective against greenhouse whitefly
  - ❖ *Eretmocerus hayati* – parasitic wasp
    - ❖ Supplied as pupae in vials of 1000
    - ❖ More effective against silverleaf whitefly than *Encarsia*
  - ❖ *Nesiocoris tenuis* – predatory bug
    - ❖ Supplied as juveniles and adults on contract only per square metre
    - ❖ Only suitable for tomatoes and eggplants
    - ❖ Can cause some damage if numbers build too high (can be controlled with natural Pyrethrum)



Eretmocerus adult and  
whitefly scale



Encarsia adult



Greenhouse  
whitefly -  
unparasitized and  
parasitized pupae



Nesidiocoris nymph,  
and adults



## Nesidiocoris damage symptoms



Feeding rings

## ❖ Fungus Gnats (Sciarid flies)

- ❖ Direct damage if larvae numbers are high – chew on root tips, or young leaves touching soil/media
- ❖ Indirect damage by providing entry points for plant fungal pathogens



## ❖ Shore flies

- ❖ Live in the soil/growing media
- ❖ Feed on dead and decaying material
- ❖ Pupae are easily found on flooring plastic around puddles of standing water



Fungus gnat



Shore fly

## ❖ Fungus gnat and shore fly controls available from Biological Services:

### ❖ Hypo M – *Hypoaspis miles* and Hypo A – *Hypoaspis aculeifer*

- ❖ Controls fungus gnat larvae
- ❖ Soil dwelling mites
- ❖ Sprinkled over new potting material when seeding/propagating plant material
- ❖ Generalist feeder
- ❖ Compatible with predatory nematodes

### ❖ Dalotia – *Dalotia coriaria*

- ❖ Also known as rove beetles or devil's coachmen
- ❖ Soil dwelling beetle
- ❖ Controls shore flies
- ❖ Generalist feeder
- ❖ Likes moist conditions – good for areas around standing water



Hypo M



Dalotia juvenile



Hypo A



Dalotia adult

# Mites



- ❖ Piercing/sucking pests
- ❖ Attack a wide range of plants
- ❖ Overwinter in wooden structures/shelter belts
- ❖ Like hot dry conditions
- ❖ Short lifecycle so hard to kill with sprays
- ❖ Easily spread by humans, wind and animals

- ❖ Main pest species:
  - ❖ Two spotted mite – *Tetranychus urticae*
  - ❖ Broad mite/cyclamen mite – *Polyphagotarsonemus latus*
  - ❖ Russet mite – various
    - ❖ Scarring on fruit/leaves
  - ❖ Bulb mite – *Rhyzoglyphus echinops*

- ❖ Mite controls available from Biological Services
  - ❖ Persimilis – *Phytoseiulus persimilis*
    - ❖ Predatory mite
    - ❖ Short lifecycle
    - ❖ Prefers warm humid conditions
    - ❖ Works well inside and outside
    - ❖ Sprinkled over plants
  - ❖ Californicus – *Neoseiulus californicus*
    - ❖ Predatory mite
    - ❖ Resistant to many chemicals
    - ❖ Works well in hot dry conditions
    - ❖ Sprinkled over plants
  - ❖ Occidentalis – *Typhlodromus occidentalis* (on leaf)
    - ❖ Predatory mite
    - ❖ Likes hot dry conditions
    - ❖ Supplied on leaf material – high numbers of all stages of predators



Persimilis



Occidentalis



Californicus

# Red Scale



- ❖ Sucking insect
- ❖ Mainly attacks citrus, but also found on passionfruit, olives, walnuts, roses and ivy
- ❖ Will attack all plant parts, but more prevalent on fruit
- ❖ Heavy infestations may cause discolouration, leaf drop and shoot distortion, which can lead to bark splitting, twig dieback and even tree death
- ❖ Adults produce 150 + eggs
- ❖ When first hatched, crawlers have 6 legs and will move to find a suitable place to settle
- ❖ Once settled, waxy filaments are produced to protect the developing scale, and the juvenile starts feeding



Adult red scale

Male and female  
red scale



## Red scale controls supplied by Biological Services

### ❖ *Aphytis melinus*

- ❖ Tiny yellow wasp
- ❖ Prefers healthy well –foliated trees which can provide shelter from extremes of heat and low humidity
- ❖ Dust is harmful, so less likely to be effective in dusty areas such as along roadways. Irrigation can be used to help minimise dust and increase humidity
- ❖ Citrus up to 5 years of age are usually poor candidates for biological control as they offer little natural shelter
- ❖ Supplied in paper cups containing 10,000 wasps distributed over 9 pieces of shredded paper

- ❖ Difficult to assess level of parasitism due to size
- ❖ Windbreaks and overhead irrigation are effective means of helping Aphytis to establish
- ❖ Cover crops between rows help to increase humidity within the orchard and supply supplemental nectar for the parasites
- ❖ Ants can interfere with parasites and reduce their performance



Adult *Aphytis melinus*

# Caterpillars



- ❖ Chewing pests

- ❖ Diamondback moth

- ❖ Attacks most brassicas including:

- ❖ Cabbage

- ❖ Broccoli

- ❖ Kale

- ❖ Radish

- ❖ Canola

- ❖ More prevalent in dryer seasons

- ❖ May completely defoliate plants



DBM grubs feeding



DBM adult



Defoliated Chinese cabbage

# DBM controls supplied by Biological Supplies Ltd

## ❖ Diadegma - *Diadegma semiclausum*

- ❖ Parasitic wasp
- ❖ Deposits eggs into 1<sup>st</sup> instar grubs (first signs of mining on leaves)
- ❖ Wasps capable of covering a large search area
- ❖ Supplied as pupae attached to paper squares
- ❖ Need to be released prior to main moth infestations - just after planting
- ❖ Can be released into surrounding areas prior to planting



Diadegma female



Diadegma pupae on  
cards



Diadegma release  
point

## ❖ Further information:

- ❖ [www.biologicalservices.com.au](http://www.biologicalservices.com.au)
- ❖ [www.goodbugs.org.au](http://www.goodbugs.org.au)