



Some Best Practices for Biocontrol Success

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Biocontrol must be integrated into a Total IPM Program

- Monitoring/scouting
- Sanitation/weed management
- Insect exclusion
- Resistant cultivars/varieties
- Compatible pesticides

Mindset: Rely on beneficials for control, with pesticides as an occasional backup, if needed

Contrasting how biocontrol works vs. chemical control

- Biocontrol almost always must be used preventatively

Biocontrol agents (BCAs) rarely can control an already serious infestation

BCAs are used to keep a low level of pests from increasing

- BCAs are not “fast-acting”
- Must plan ahead!

Many BCAs, many companies, many products!



New shipment of beneficials.
Now what??



New shipment of beneficials.

Now what??

Check temp of box interior as soon as you open it
Ice packs still cold? Moldy smell?
IR Thermometer is handy

Release as soon as possible!

P. persimilis does not store well!

Storage of others depends on species & formulation

Nematodes store longest as long as package is not opened

If no *Encarsia* wasps have emerged from the cards, then no need to refrigerate unless you have to delay releasing them

Check user instructions for all beneficials



Photo: R. Valentin



New shipment of beneficials. Now what??

Do not store in hot room or in sunlight,
not even if they are still in shipping box

Do not store in air-conditioned office –
too dry!

Same with coolers or refrigerators

Keep in cool, not-too-dry space

- Storing in headhouse or greenhouse
may be better than airconditioned office



Photo: S. Wainwright-Evans

Predatory mite sachets stored under
bench in cool headhouse

New shipment of beneficials. Now what??



Always keep bottles horizontal, not vertical
(some companies changed label position)

If there seems to be a problem with the shipment, contact
your supplier immediately



NO

Note that bottles are shipped
on their sides

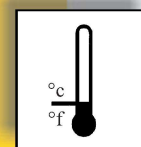


YES

Note the icons on label



ICON GUIDE



Temperatura indicada de almacenamiento.
Recommended storage temperature.
Indication de température recommandable.



Introducción sobre las plantas.
Introduce on the plant.
Introduire sur les plantes.



Introducir sobre el bloque de cultivo.
Introduce on the pot.
Introduire sur le pot.



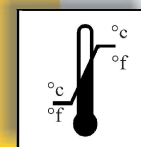
Agitar el embalaje antes de aplicar.
Shake the package before use.
Secouer l'emballage avant d'appliquer.



Extender el embalaje.
Do not place straight up.
Placer l'emballage à l'horizontal.



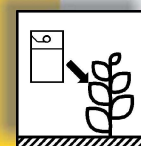
No exponer a la lluvia.
Do not place in the rain.
Ne pas placer sous la pluie.



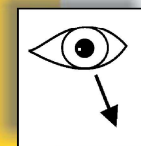
Indice de temperatura mínima y máxima.
Temperature indication with minimum and maximum value.
Indication de température avec minimum et maximum.



Abrir y colocar el embalaje entre medio de las plantas.
Open the package and place it between the plants.
Ouvrir et placer l'emballage entre les plantes.



Enganchar a la planta.
To hang in the plant.
Accrocher dans les plantes.



Producto para control y detección de plagas.
Product for the benefit of scouting.
Produit pour la signalisation des ravageurs.



Ver la lista de efectos secundarios.
Chk. list of secondary effects.
Voir la liste des effets secondaires.



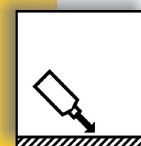
Colocar las colmenas sobre una superficie horizontal.
Place the bumblebee hive on a flat surface.
Placer la ruche de bourdons à l'horizontal.



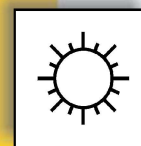
Dejar actuar el embalaje antes de aplicar.
Let the package activate before use.
Laisser l'emballage à température on bureau.



Introducir en Biobox.
Distribute in Biobox.
Épandre dans Biobox.



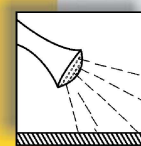
Aplicar al suelo.
Introduce on the ground.
Introduire sur le sol.



Se puede exponer a la luz solar.
Can be placed in sunlight.
Peut être laissé au soleil.



No exponer a la luz solar.
Do not place in sunlight.
Ne pas laisser au soleil.



Dissolver el producto en agua y aplicar al suelo.
Dissolve the product in water and spray them over the ground.
Arroser le sol avec le produit dilué dans l'eau.

Shipment survival/quality check

Basic guide to assessing the shipment survival and quality of nearly all commercial beneficial arthropods:

<https://www.appliedbio-nomics.com/wp-content/uploads/170-quality.pdf>

Thorough and detailed guide:

<https://www.vinelandresearch.com/wp-content/uploads/2020/02/Grower-Guide.pdf>

Western Flower Thrips



Release Methods
for
cucumeris/swirskii
predatory mites



Two Basic Formulations

Broadcast Formulation



Slow-release sachets



Minimum check for survival/quality of predaceous mites



Look for fast-running mites with
handlens or scope



Use for:

- **N. cucumeris*
- **A. swirskii*
- **Phytoseilulus persimilis*
- **N. californicus*
- *etc.

Broadcast Formulation





Preparing to broadcast swirskii
onto poinsettias

“Mini-sachets”



Stick or Stake

Hanger



Photo: BioBest

Tips on using sachets

Keep sachets shaded:

- hangers – inside canopy

- stakes – beneath canopy

If shade is not possible, consider broadcast or sprinkle releases.

Place one sachet per pot and at least one per tray:

- Dispersal among different plants will increase once canopies are touching.

- To reduce cost, limit sachets to crops/cultivars that are most susceptible to thrips rather than all pots in the greenhouse.

Making it cost-effective

Make sure these crops have sachets

Ageranthemum

Bidens

Dahlia

Dracaena

Geraniums, Balcon

Geraniums, ivy

Ipomoea

Rudbeckia

Thunbergia

Verbena

Mixed containers (esp. if contain calibrachoa, ipomoea, and/or verbena)

Important Background Info: Predatory Mite Hunting

- Predatory mites are tiny
crawling 1 inch is like a football field
- No image-forming eyes
do not use vision for hunting or walking
use smell and touch, over mm distances
- Most species randomly search to run into prey

Sachet
placement is
critical for
success





Why might this be a ineffective use of sachets?

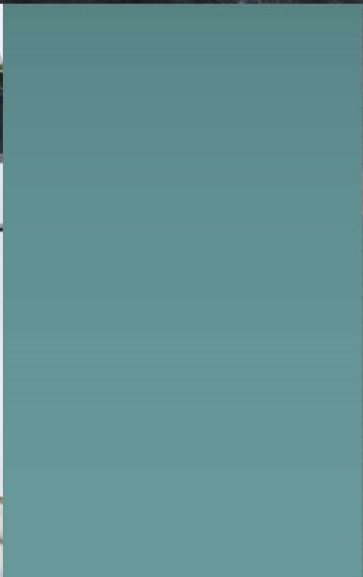
Much better



How many
predators never
reached a
plant?



A concern?



Using predatory mites during propagation

Broadcast weekly until canopy fills in

Then use sachets when plants are transplanted





Water-soaked sachets

Keep the bottoms of the sachets just above the soil surface



Aphids



“Colemani”

(Aphidius colemani)



Controls:

Small aphids such as green peach aphid, melon aphid

Type:

Wasp (parasitoid)

Characteristics:

- about the size of a fungus gnat
 - shiny black with clear wings
 - parasitizes aphids
- (“mummies”) straw-colored and round (may have a round exit hole at the end of the mummy)



“Ervi”

(*Aphidius ervi*)



Controls:

Large aphids such as foxglove aphid and potato aphid

Type:

Wasp (parasitoid)

Characteristics:

- about twice the size of *A. colemani*
- shiny black with clear wings
- parasitizes aphids (“mummies”) straw-colored and round (may have a round exit hole at the end of the mummy)

Aphidius wasps for aphids



Blister packs



Mummies in buckwheat hulls



Mostly mummies

Aphidius wasps for aphids

Minimum check for survival/quality:

Set aside a small sample that includes some mummies in transparent escape-proof container

Hold in shade at room temperature

Wasps should be visible, moving in container, after 1-5 days



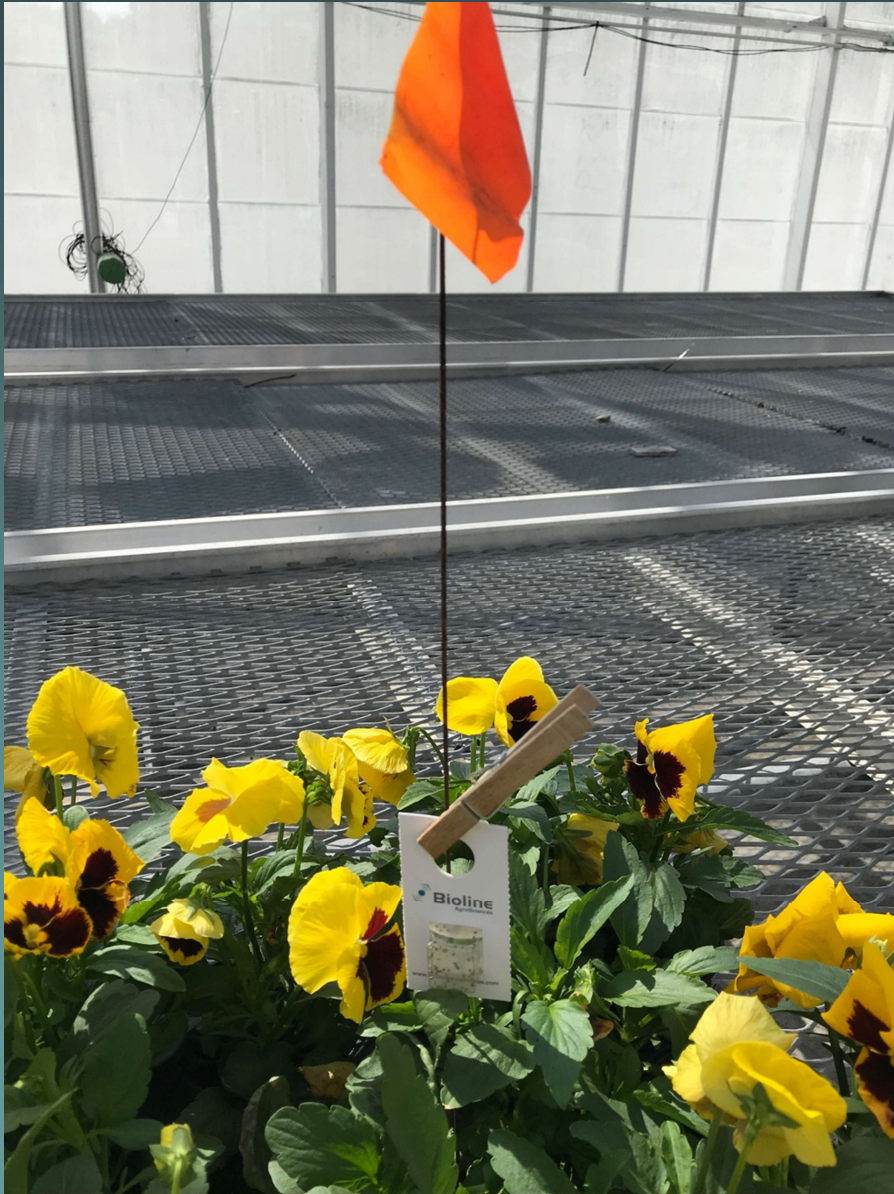
Most companies sell a mixture of *A. colemani* plus *A. ervi*



Some companies sell a mixture of *A. colemani* plus *A. ervi* plus *Aphelinus abdominalis*



Aphidius wasps in blister packs



Important things to remember about blister packs

Keep them shaded – blister can act like mini-greenhouse and cook beneficials inside

Remember to open the back flap!

But leave it angled to prevent water from entering





Photo: Betsy Lamb

Aphidius colemani wasps emerging from
a shipment bottle

- Bottles of pure mummies with no carrier often arrive with emerged wasps
- Can place bottles in plant canopy at slightly inclined angle to let wasps emerge

Release Cups/boxes



Release Cups/boxes



- Release boxes are little containers which can easily be hung in the crop
- Predatory bugs, mummies and pupae of parasitic wasps can be put in these containers
- Avoids having to scatter these BCAs directly onto the crop where they could fall off the foliage

Release Cups/boxes



Photos: S. Wainwright-Evans

D-I-Y

Release cups can be used to release many kinds of beneficials.



Release Cups/boxes

- Keep dry and shaded
- Add only a thin layer of BCA product so the BCAs do not get buried

Use “sentinel plants” for monitoring aphid biocontrol

Look for

- mummified aphids
- BCAs themselves
- dead (eaten) aphids



Aphidoletes aphidimyza

- Unlike parasitic wasps, not specific to certain aphid species
- Larvae are the predators
- Good searching capacity
- Kill more than they consume



Aphidoletes eggs

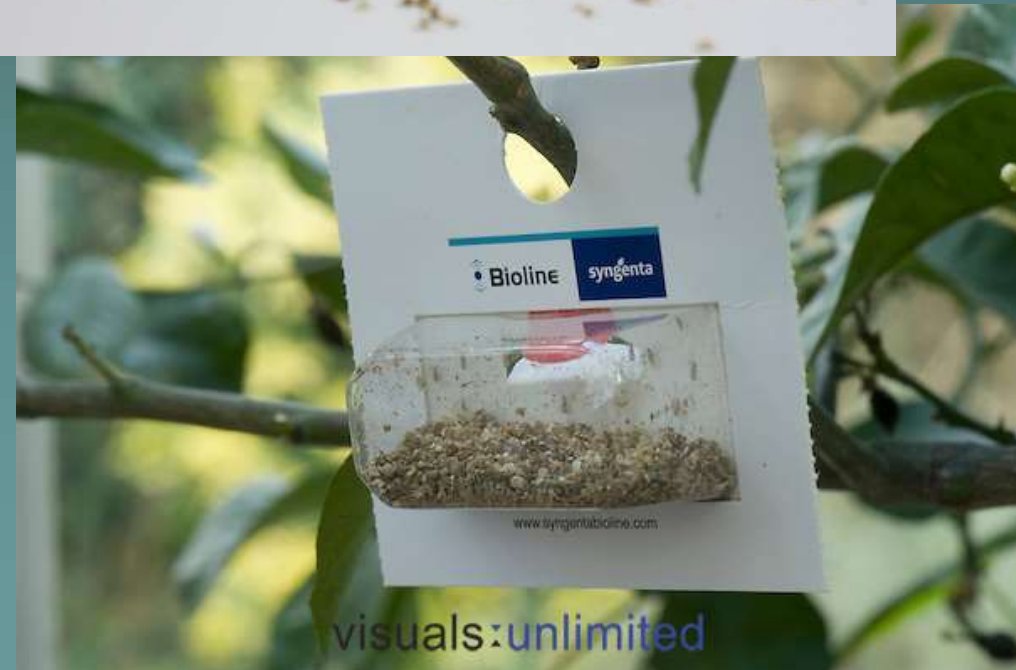


UC Statewide IPM Project
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Pupae mixed in vermiculite
in trays, blister packs, bottles



visuals:unlimited

Use “sentinel plants” for monitoring aphid biocontrol

Look for aphids killed by *Aphidoletes*,
orange eggs, and/or orange larvae



Please answer the poll now

Whitefly Parasitoids

Encarsia formosa



For greenhouse whitefly

For sweetpotato/silverleaf whitefly,
Also attacks greenhouse whitefly



Eretmocerus eremicus



Parasitized (black) and unparasitized (white) whitefly pupae
(by *Encarsia formosa*)



Whitefly pupae parasitized by *Encarsia formosa*
on cards

Eretmocerus may be glued onto cards.
Not all wasps will emerge, and some are
males, so cards are over-filled



Blister packs
for
Eretmocerus
due to how
they emerge
from pupae



Eretmocer can also ship as loose parasitized whitefly pupae in sawdust



Sprinkle loose *Eretmocerus* into release boxes



Minimum check for survival/quality



Transparent sealed container

11-14-07 ②

Yellow sticky trap

BCA sample

© Syngenta Biofine

Encarsia formosa plus *Eretmocerus eremicus* for both greenhouse whitefly and sweetpotato/silverleaf whitefly



Encarsia formosa plus *Eretmocerus eremicus* for both greenhouse whitefly and sweetpotato/silverleaf whitefly





Flag to mark
release sites

Another release option



Won't need to remove
cards at sale



Make sure that cards are within the
canopy, not above

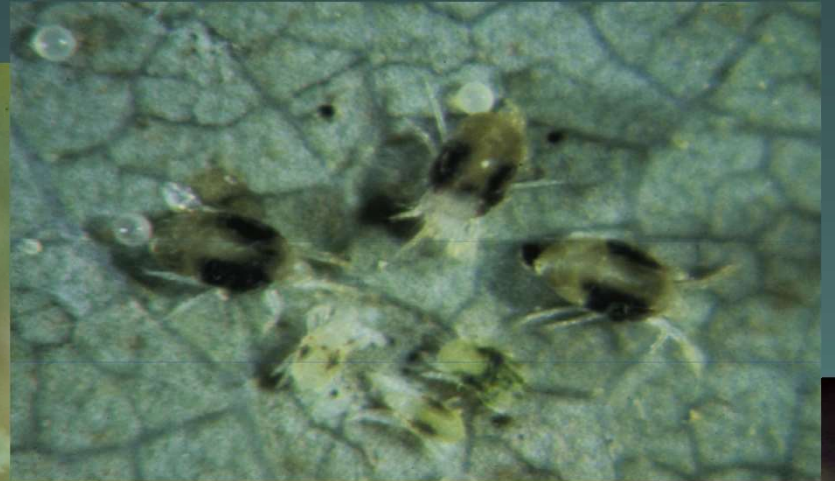
Can you spot the problem here?



How many wasps will make it to the whiteflies on the poinsettias?



Twospotted Spider Mite



“Persimilis” (*Phytoseiulus persimilis*)



Controls:

Webspinning spider mites

Type:

Predaceous mite

Characteristics:

- tiny
- bright orange
- very fast running
- sensitive to low RH



Persimilis only eats spider mites

Usually formulated with sawdust or vermiculite as a carrier and sprinkled or blown onto the foliage

How to release them so that they end up on the foliage and don't fall through the canopy?

P. persimilis in vermiculite



Solution

Place newspapers on top of canopy across crop

Shake small amount onto each paper

Remove the papers the following day

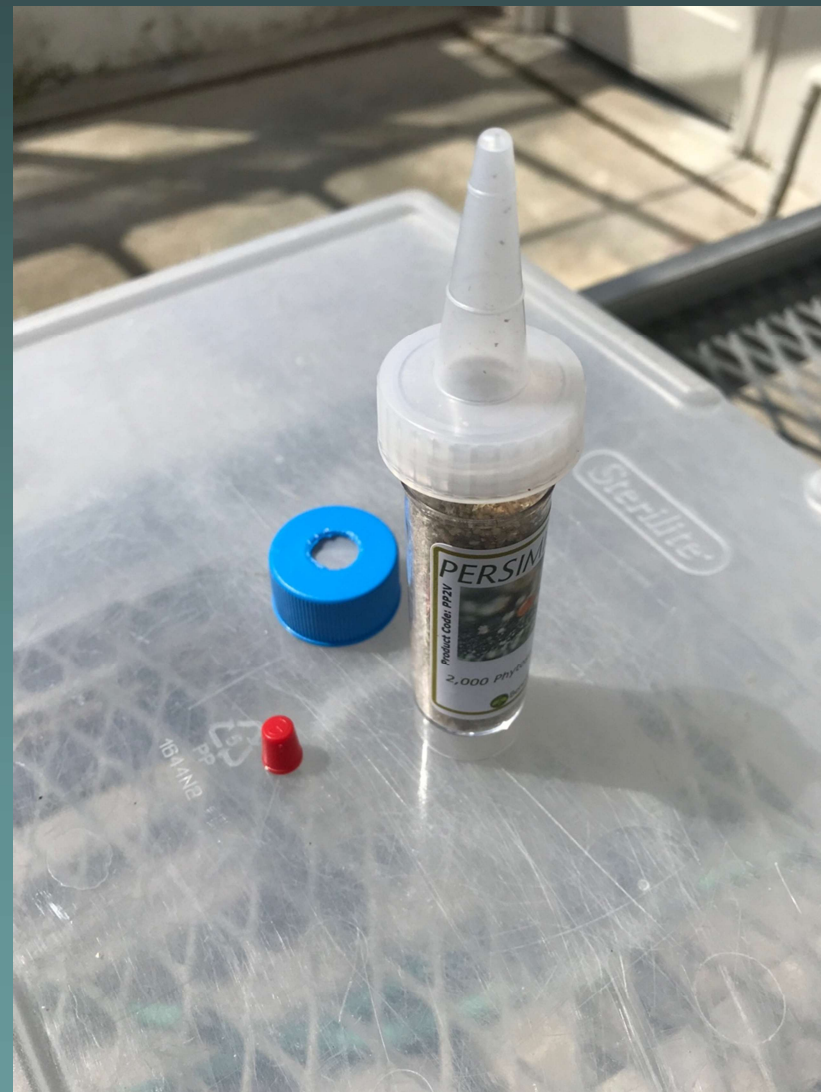


Ronald Valentin (BioWorks)



2,000 mites
in each bottle

“Hot spot” applicator



“Hot spot” applicator

Useful for cannabis – no carrier residue



