NURSERY PAPERS

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BIOLOGICAL CONTROL IN PRODUCTION NURSERIES

SUMMARY

- There are a growing number of production nursery businesses that are using predators and parasitoids as their main strategy to manage nursery pests.
- Most major pest groups including aphids, caterpillars, selected scale insects, spider mites, fungus gnats, thrips, whitefly and others, can be managed using biological control.
- Successful use of biological control requires some dedication and relies on regular crop monitoring and cultural management strategies to passively reduce pest populations.
- Use of pesticides can be very detrimental to predator populations and must be managed carefully, replacing broad spectrum and highly residual products with low-risk products and spot spraying low-level pest populations.
- Unfortunately, biological control cannot be used in every situation including when pest populations are very high or during extremely hot or cold temperatures.
- This nursery paper describes how to preserve and encourage populations of beneficials to manage pests in production nurseries and produce healthy crops.

The predatory mite Persimilis eating a spider mite. Adult Persimilis are a deeper red colour than this nymphal individual.

BACKGROUND

Managing insect and mite pests are critical for producing healthy nursery crops. There are many ways that production managers can achieve this goal including cultural practices to prevent pest populations. Pesticides are also a valuable and commonly used tool. Biological control has been used less often by production nurseries but is now being used more.

Some of the reasons for this is that more pests can be managed with commercially available predators, i.e. there are more products being offered by biocontrol agent producers. The cost of predators has also decreased as producers of these species have adopted more efficient methods to rear and delivery their products. This can make biological control more attractive and competitive compared to use of pesticides.

Other benefits associated with the approach include:

- Reduced health risks associated with applying pesticides
- Reduced dependence on pesticides, which are increasingly expensive
- Increased environmental stewardship; reduced environmental contamination
- Improved plant health, quality and production
- Reduced development of pesticide resistance (products are preserved for when they are really needed)

Using predators and parasitoids requires a significant amount of knowledge to manage pests successfully. Therefore, this nursery paper describes some aspects of their biology, methods to attract predators that are naturally in the environment, how to preserve their populations in the nursery, and actions that lead to successful and unsuccessful use of biocontrol agents.

Greenlife Industry Australia

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Working with beneficials

Biology of Beneficials

Many experts refer to 'beneficials' to include insect and mite predators, parasitoids (a specific type of insect parasite) and pollinators. Successful use of beneficial organisms requires some knowledge of their biology.

Each species is slightly different, but all have certain environmental requirements to survive and kill pests, mainly temperature and humidity. Low or high temperatures can cause beneficial organisms to become inactive; more extreme temperatures will cause them to die.

For many beneficial species, optimal conditions are between about 15–30°C. While air temperature is used as a proxy, most organisms will move to cooler areas when it is very hot and may survive in deeply shaded areas of a plant, particularly if they are well hydrated. Some beneficials are susceptible to low humidity environments (i.e. less than about 50%RH), though nurseries that use overhead irrigation may not be limited by this factor.

All beneficials require food and water. If there are no prey organisms on which to feed, some will feed on pollen or nectar to survive. Some species will become inactive and wait until prey become available, e.g. the predatory mite, Occidentalis. Other species will move in search of prey, sometimes covering a relatively large distance when the supply in the current area runs out, e.g. Persimilis.

It is important to understand how the beneficial organisms in your crop move. Some species only move short distances, e.g. most soil mites. Others can move a substantial distance, but only when foliage is touching the neighbouring plant, e.g. most foliar predatory mites.

Most beneficial insects have stages that fly and can potentially move between cropping areas in search of their prey or suitable habitat. However, keep in mind that many small flying insects (most parasitoid wasps), will not fly when wind speeds are significant. In many instances, biological control is enhanced in protected cropping environments where the beneficials are somewhat contained within the structure.

Each species is different. Specific information for each commercially available beneficial species can be found on the product guide of the biological control agent producers' website. For other species that may not be commercially available, information can often be found online.

WHAT PESTS CAN BE MANAGED WITH BIOLOGICAL CONTROLS?

Pest group	Beneficials commercially available
Aphids including green peach aphid, cotton aphid, potato aphid, foxglove aphid and others	*Aphelinus*, *Aphidius colemani*[1,2] including banker plants, *A. ervi*, *Harmonia conformis*, *Coccinella transversalis* and *Hippodamia variegata*
Caterpillars	Beneficial nematodes for cutworms and armyworms, Diadegma for cabbage moth, Ladybirds, green lacewing[2,4]
Selected scale insects including red scale	*Aphytis melinus*, *A. lignanensis*, *Lindorus*, *Chilocorus*
Mealybugs and some soft scales	*Cryptolaemus*, *Lindorus*
Scarab beetle larvae and selected other beetles	Beneficial nematodes
Spider mites	*Californicus*[1,2], *Occidentalis*, *Persimilis*[1,2,3]
Broad mite	*Californicus*[1,2], *Cucumeris*[1,2,3], *Doreenae*
Fungus gnats	*Dalotia*, *Hypoaspis*[1,2,3], *H. aculeifer*, *Gnatnem*
Thrips pupae (in growing media)	*Dalotia*, *Hypoaspis*[1,2,3], *H. aculeifer*
Thrips larvae and adults (on foliage)	*Cucumeris*[1,2,3], *Montdorensis*[1,2], *Orius*[1,2] and banker plants, *Javae*, *Lailae*
Whitefly	*Encarsia*, *Eretmocerus hayati*[1,2], *E. warrae*, *Orius*[1,2] and banker plants, *Montdorensis*, *Lailae*
Generalist predators feeding on a range of pests often including aphids, whiteflies, mealybugs, scales, thrips, mites, moth eggs, small caterpillars, other small larvae, etc	Ladybirds, green lacewing[2,4]

Where multiple biological control agent producers supply the same species they are indicated by a superscript number that links you to the relevant supplier of that product:

[1] Biological Services
[2] Bugs for Bugs
[3] Bio Works

There is a large and growing number of pests that can be managed using commercially available biological control agents (see table). Australian biological control agent producers continue to increase the number of predators available to manage major pests, e.g. the predatory mites Doreenae for broad mites and rust mites and Javae for greenhouse thrips that are only recently available.

It is important to understand that many predators and parasitoids are specific to certain pests. Therefore you may need to seek advice on the identification of the pest species to select the correct biocontrol agent.

A series of pest management plans for specific pests are available via the levy-funded Australian Plant Production Standard website. Check them out here: https://nurseryproductionfms.com.au/pests-diseases-weeds/pest-and-disease-management-plans/

Preserving beneficials

Beneficials have certain requirements to survive and flourish. These include a food supply, correct environmental conditions and places to hide and rest. When there are sufficient pests in the crop, beneficials can thrive and grow to large numbers. However, when pests decrease in number it can be valuable to have alternative food sources nearby. Flowering plants present in growing areas and in non-growing areas can provide places to rest and sources of pollen and nectar. These factors will assist beneficials that are released or that naturally move into the growing area from the landscape around the nursery.

The prevalence of weeds in and around your business will also influence populations of beneficials. Though they increase the presence of beneficials, they also tend to harbour many pests as well as diseases. Therefore, it is always recommended to manage weeds proactively as they cause more harm than good in a production nursery setting.

Alternative food types

The plant species used as alternative food sources can be important and will need to be altered depending on the location of your business, the main pests present and the plant lines that you produce.

Plants with small flowers, that are present for most of the year make ideal food sources, e.g. buckwheat, alyssum, and many species from the family Asteraceae. Flowers, with compact heads are excellent places for small beneficials to rest, hide and consume nectar and pollen if required. When using alternative food plants in non-cropping areas grower should:

- Evaluate the use of different plant species that are suited to your climatic region and season that produce pollen or nectar; monitor the species of insects and mites present over time.
- Grow plants in containers or raised beds that can be easily removed if they become infested with pests or diseases. Do not grow large shrubs or trees as permanent plants in garden beds for this purpose.
- Plan according to seasons.
- Monitor the plants on a regular basis as part of normal scouting through the nursery. Some plants may be effecstive sentinel plants for initial pest populations and increase beneficial populations throughout the nursery.
- Replace alternative food plants periodically, especially if it is a plant that is also grown as a crop line. This will help avoid diseases creeping into the nursery.

Banker plants

Banker plants can be used to rear specific pest species to support beneficial insect populations. As a result beneficial species increase, crop pests decrease and the pests provided in the banker plants do not effect crop plants. The host and pest species is carefully chosen.

For example, one of the more common systems involves the use of barley or wheat to grow the aphid pest, *Rhopalosiphum padi*, a pest of grain crops and some grass species. This species is a good host for the parasitoid wasp, *Aphidius colemani*, which also controls the very common and highly polyphagous pests, green peach aphid and cotton aphid. As a result, growers can produce large numbers of aphid parasitoids at an economical rate on an ongoing basis. This system can be purchased through Biological Services.

How pesticides affect beneficials

Many pesticides are highly toxic to most beneficial species. Sometimes even slight residues can cause high death rates on beneficial populations weeks (or even months) after application. In addition, some products can cause non-lethal side effects to beneficials, i.e. the beneficial remains alive but is impacted in other ways.

This may include one or more of the following:

- It may not live as long.
- It may not lay as many eggs.
- It may not kill as many prey.
- It may not be as energetic or move around as often perhaps influencing its ability to survive harsh environmental conditions, escape predation etc.

Each beneficial has slightly different tolerances and susceptibilities to different pesticides. Even 'IPM compatible' products may cause non-lethal negative effects in certain cases. These impacts will be greater with more frequent pesticide applications and with higher concentrations applied. Fungicides and other products applied to foliage can also negatively impact beneficial populations.

How to mitigate pesticide side effects

The following recommendations will minimise the amount of damage imposed by pesticides on beneficial populations:

- Use cultural management to prevent pest populations where possible

- Monitor your crops regularly (at least weekly) for pests, diseases and beneficial insects
- Only apply pesticides when pests are present and in numbers that will cause damage
- Spot spray pesticides in hot spot areas
- Avoid application of broad spectrum and highly residual products. In particular, older compounds tend to have greater negative effects including many compounds from the following groups (note that there are exceptions, e.g. the active pirimicarb is a relatively safe aphidicide even though it is a carbamate compound):
  - Carbamates (1A)
  - Organophosphates (1B)
  - Fiproles (2B)
  - Pyrethroids (3A)
  - Neonicotinoids (4A)
- Avoid using broad spectrum products in protected cropping areas
- When product labels give a range of application rates against certain pests, e.g. 2–4mL/L, use the minimum rate to achieve a successful application. Higher rates of application produce greater negative side-effects. Therefore, use your experience or small trials to determine the lowest application rate possible to successfully kill pests that are present

Getting started with biological control

Applying beneficial species to manage pests can be very successful. However, there is a lot more information required to do it well compared to reliance on pesticides to manage pests.

If you are considering using this approach, develop a strong relationship with your biocontrol agent supplier/s or a consultant experienced with using biocontrol in a production nursery setting.

It can be tempting to start using biocontrol in a small area of your nursery before rolling it out everywhere. However, this can cause problems with pesticide residues and contaminated irrigation water reducing the efficacy of beneficials in that small area.

Low risk pesticides are recommended during periods where biocontrol is not suited to manage the problem. Then, when conditions are more suitable, biocontrol agents can become established more easily.

To use biological control successfully, the following three areas are of critical importance:

1. Crop monitoring must become the foundation on which pest management actions are built. It must be scheduled into your daily/weekly plan. If crop monitoring does not occur, pests will increase and you are likely to end up with an outbreak situation that causes crop loss.
2. Improve cultural strategies to prevent pests and diseases from entering the nursery. Employ as many cultural practices as possible and always be thinking about ways to increase hygiene practices. Complete small-scale trials to test your ideas and make continual improvements.

Hover fly adults and larvae are common aphid predators that occur naturally in the environment and will colonise pests in production nurseries.

3. It is very important to have no pesticide residues present. Where water is recycled irrigation water can become contaminated and may negatively impact beneficials when reapplied to crops.

FURTHER INFORMATION

A network of Plant Protection Officers (PPOs) provides extension services to industry across Australia, funded through the levy-funded *National Biosecurity and Sustainable Plant Production Program* (NY20001). For on-site assistance and guidance on implementing biological control and other best management practices at your nursery, please email ***info@greenlifeindustry.com.au*** with your state or territory to be connected with your local PPO.

Pest and Disease Fact Sheet – Managing Predator and Parasite Populations in Production Nurseries: ***https://nurseryproductionfms.com.au/download/pest-and-disease-fact-sheet-managing-predator-and-parasite-populations-in-production-nurseries/***

Pest and disease management plans: ***https://nurseryproductionfms.com.au/pests-diseases-weeds/pest-and-disease-management-plans/***

Videos and webinars are available here: ***https://www.youtube.com/user/ausngi***

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