This *case study resource* was developed by TIA for education & extension purposes across Tasmanian schools & industry

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Supporting Insect Diversity for Pest Management

Exploring Sustainable Approaches in Horticulture

*Resource developed by B. Deans^, M. Buntain# & J. Finch** (2024)

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Background

Tasmania produces high-quality, high-value horticultural produce that is consumed locally, Australia-wide, & exported globally.

Horticultural crops including raspberries & blackberries are susceptible to a range of **pests.** These pests can negatively impact crops by damaging plants & reducing fruit yields.

Pests can include a variety of insects, as well as arachnids such as mites.

Strategies to manage pests

Traditionally, growers have relied upon **chemical pesticides** to manage pests.
However, some pesticides pose a risk to human & environmental health. **Some pesticides are not selective** & cause harm to beneficial insect species such as bees, predators & parasitoids. Further, overuse of pesticides can result in **pesticide resistance**, where pests are no longer effectively controlled by pesticides. Pesticide resistance is now a major problem in agriculture.

Case Study Sections

Integrated Pest Management (IPM)

Agricultural industry can manage pests in a more sustainable way using an approach called 'integrated pest management' (IPM).

This method uses the **best combination of complementary pest management strategies** that minimise chemical use.

This approach can include **cultural & biological controls,** as well as **selected chemicals** with low impact on the environment.

For example, selecting pesticides that break down quickly & do not persist in the environment can reduce their broader impacts.

The following sections will describe cultural, biological & chemical controls.

Cultural Controls

Cultural controls are the first step in developing an IPM program. Cultural controls are non-chemical or biological strategies that **discourage pests from establishing** in, or around, the crop.
There are a range of cultural controls, including:

Removing weeds that are known to harbour pests.

Maintain crop hygiene by removing fallen fruit that can harbour pests.

Crop variety selection: Select varieties that aren't susceptible to pests & diseases.

Crop rotation: grow a series of different types of crops in the same area across a sequence of growing seasons.

Inter-cropping: select complementary crops & grow multiple varieties simultaneously in the same field. This can increase resource utilisation, raise the productivity of crops & nutrient-use efficiency.

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Biological Controls

These include introducing **predators or parasitoids** into a crop to manage pests. These can help manage the population size (abundance)of pests.

Further, biological controls can influence the relationships between different species & their roles in the ecosystem – especially if they are **competing for resources** such as food or shelter.

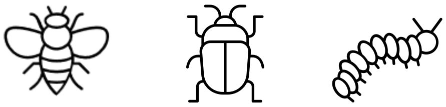
Examples of **biological controls** include:

- **Environmental species**: Naturally-occurring beneficial species within the ecosystem (e.g., ladybirds that are predators of some pests).
- **Commercial predators:** Species that are bred commercially & introduced to a location to prey on a target pest species.
- **Parasitoid** insect species that are released into a location to target a species *(see below)*

Parasitoids – what are they?

An organism that has young that develops **on or inside** another organism (the **host**), eventually killing it. This typically happens at a slower rate than a predator would kill its prey.

Examples: specific types of wasps, flies & beetles.



Chemical Controls

Chemical controls can be used to **complement** biological & cultural control when they are selected to have low impacts on beneficial species & the environment.

Example methods of chemical controls include:

- **Highly selective** chemicals that only impact a specific pest species;
- Use of chemicals when pests reach a **threshold** that will have an economic impact.
- **Pheromones** (chemical communication to insects) that can change the behaviour & location of an insect in an environment.

Above: *Horticultural crops such as a berries face constant threats from pests, with innovative methods required to overcome these challenges in a sustainable & responsible manner.*

Challenges Facing Our Fruit Growers

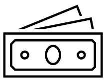
Different growing methods present their own benefits & challenges across a range of environments. The problems for growers in implementing good integrated pest management include:

Biodiversity Balancing Act

Horticultural crops including raspberries & blackberries are most often grown as a monoculture in pots within protected cropping structures (e.g., polytunnels) to protect them from rain& wind.

These **protected environments** are warmer & typically contain lower plant biodiversity for insects. This can promote pest establishment when compared to traditional **field production** that often also contain a variety of other plant species in & around the crops (e.g., grasses, or surrounded by hedges, wind-breaks & fields of diverse plant species).

Problem: The more intensive growing conditions of the polytunnel systems have seen the emergence of new pests & increased pest pressure.

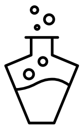


Costs of Pest Management

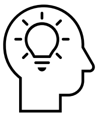
Financial issues: Commercially bred & raised beneficial insect species (predators, parasites & parasitoids) are expensive & often must be released multiple times into the crop to control pests.

Problem: This can be costly for producers if the lifespan of the pest management is short.

Chemical Impacts



Potential Problems: Chemical applications, such as for disease management or difficult pest outbreaks, can kill or adversely affect beneficial species, disrupting the integrated pest management (IPM) practices targeting other pests & diseases.



Applying of IPM in Your Business

Knowledge & confidence: knowing how to use IPM is harder than knowing how to operate a chemical sprayer. Pesticides are comparatively cheaper & work quickly. IPM can appear expensive to growers & positive impacts may take several years to become apparent.

Problem: There is limited financial & technical support for growers to introduce or switch to IPM. This can impact the confidence of growers to explore & adopt IPM in their businesses.

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Working Together to Solve Challenges

Who's involved? Research & industry are collaborating to solve these problems.

Key roles in problem-solving pest challenges include:

Horticultural Scientists

Specialists in the growing, breeding & harvesting of horticultural crops. This combines expertise in plant science, genetics, nutrition, soil science, ecology & microbiology.

Insect Scientists (Entomologists)

Specialists in insect ecology & behaviour. This combines expertise in zoology (animal biology), ecology (interactions of organisms & non-living elements of environments), animal behaviour, genetics, chemistry.

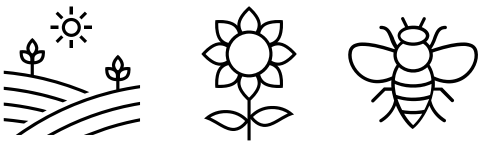
Agricultural Industry Growers who manage, monitor & maintain agricultural ecosystems. Their expertise can include growing specific crops, land management, resource management, observation & monitoring methods, crop health, pest management & agribusiness.

How?

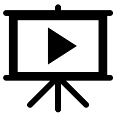
Agricultural researchers & industry are designing systems that includes **growing diverse flowering plants** near fruit crops to provide safe refuges as habitats to support both beneficial **predators & parasitoids.**

Key Aims

- **Reduce pest impacts** in crops
- **Increase the number & diversity** of beneficial insects & mites.
- **Welcome & Supported:** support a *longer persistence* of beneficial insects across the year in & around the crop.



Above: *Effective pest management in horticulture crops combines knowledge & experience across many fields, including plant biology, animal behaviour, ecology, plant health & disease.*



TIA Case Study Video – Raspberries (2 Minutes)

Link: *Conservation Biocontrol for Rubus crops*

A brief introduction to TIA's industry projects focussed on berry pest management.

Benefits of Biodiversity Plantings for Fruit Crops

Positives of supporting beneficial insects with biodiversity plantings (conservation biocontrol) include:

- **Spraying less pesticides** on crops - better for the environment, industry workers & the consumer;
- **Reduced impact of pests**, means increased fruit quality & quantity for sale (greater profits)
- **More predators in the crops** that can help control pests;
- **Greater biodiversity** to support **better pollination** – resulting in an increased fruit yields & higher quality fruit.

Pollination for Fruit Production

See TIA's ***How Many Pollen Grains*** *learning* resource: This explores the importance of pollinators, plus explains **how many pollen grains are needed to successfully fertilise flowers** of a variety of fruit crops, including berries, apples & avocado.

- Access TIA's free online resource **here.**

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Insectaries:
What & How

Insectaries (also called **flower strips**) are areas of farms that are planted with plant species to encourage beneficial insects.

There are **four critical components** to creating insectaries. They can be remembered with the acronym **SNAP:**

"SNAP" – key factors for designing insectaries & biodiversity plantings

- **S – Shelter** (habitat)
- **N – Nectar** (energy source)
- **A – Alternative prey** sources
- **P – Pollen** (protein source)

Above: *Protected cropping areas such as polytunnels can support year-round berry production. Researchers & industry are exploring ways that planting strips of flowering plants nearby crops to support IPM strategies, including attracting pollinators & predators of pests.*

S – Shelter for beneficial species to feed & reproduce

Why? Different shelters can be created from diverse plants: different plant heights (ground-cover, shrubs, tall canopies), shapes, textures (leaves, bark), smells (natural chemicals).

N - Nectar for insects

Why? The sugary nectar is a key energy source for insects.

A – Alternative prey to eat

Why? This provides multiple feeding options in the food web. This is important as conditions & species change across the seasons.

P – Pollen sources for food

Why? Pollen is a key protein source for that is important for insect growth & development.

Designing an Insectary: Selecting Plants for Blackberries & Raspberry Crops in this Case Study

Plant varieties for the neighbouring insectaries were selected with the following features:

Plants that:

- Do not attract serious pests of the fruit crop;
- Flower over an extended time period;
- Are a range of heights & structures;
- Do not interfere with pickers accessing the crop (straggly plants could impair the picking of fruit);
- Low maintenance plants (e.g., no pruning).

What Will Agricultural Scientists Measure?

Researchers will monitor pests & beneficial species in the crop and in the 'conservation biocontrol strip/ insectaries' to see if they promote beneficial insects. Insect species in berry farms without the insectaries (conservation biocontrol strips) will also be monitored using various equipment – e.g., sticky traps & sweep nets (essentially large nets with a long handle).

The hypothesis of this research is that there will be greater numbers of beneficial insects **(abundance)** & greater numbers of species **(diversity)** present in the protected cropping polytunnels that have insectaries planted, compared to that polytunnel crops without the insectary strips.

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