

Integrated pest and disease management

An integrated pest and disease management (IPDM) strategy aims to manage pests and diseases using a combination of biological, cultural and chemical control options to produce high-quality fruit while minimising harmful effects on the environment (Figure 1).

Biological control options in citrus include using natural enemies – parasitoids, predators, and pathogens that attack pests. Natural enemies are often referred to as ‘beneficials’. Beneficials occur naturally in citrus orchards, and for some pests, the release of beneficials works very well.

Cultural control options are orchard management practices that support pest and disease control. For example, managing weeds and tree skirting for Fuller’s rose weevil. Practising good orchard hygiene and annual pruning to improve spray penetration and air flow are cultural controls to reduce disease incidence and improve pest control from chemical applications.

Pest and disease management decisions are based on economic thresholds, and multiple pest management tools are often used.

Some components of an IPDM program include:

- knowledge of pests, beneficials and diseases
- regular crop monitoring
- keeping records
- decision-making with consideration for natural enemies
- take action to manage pests
- post-harvest assessments for pest damage.

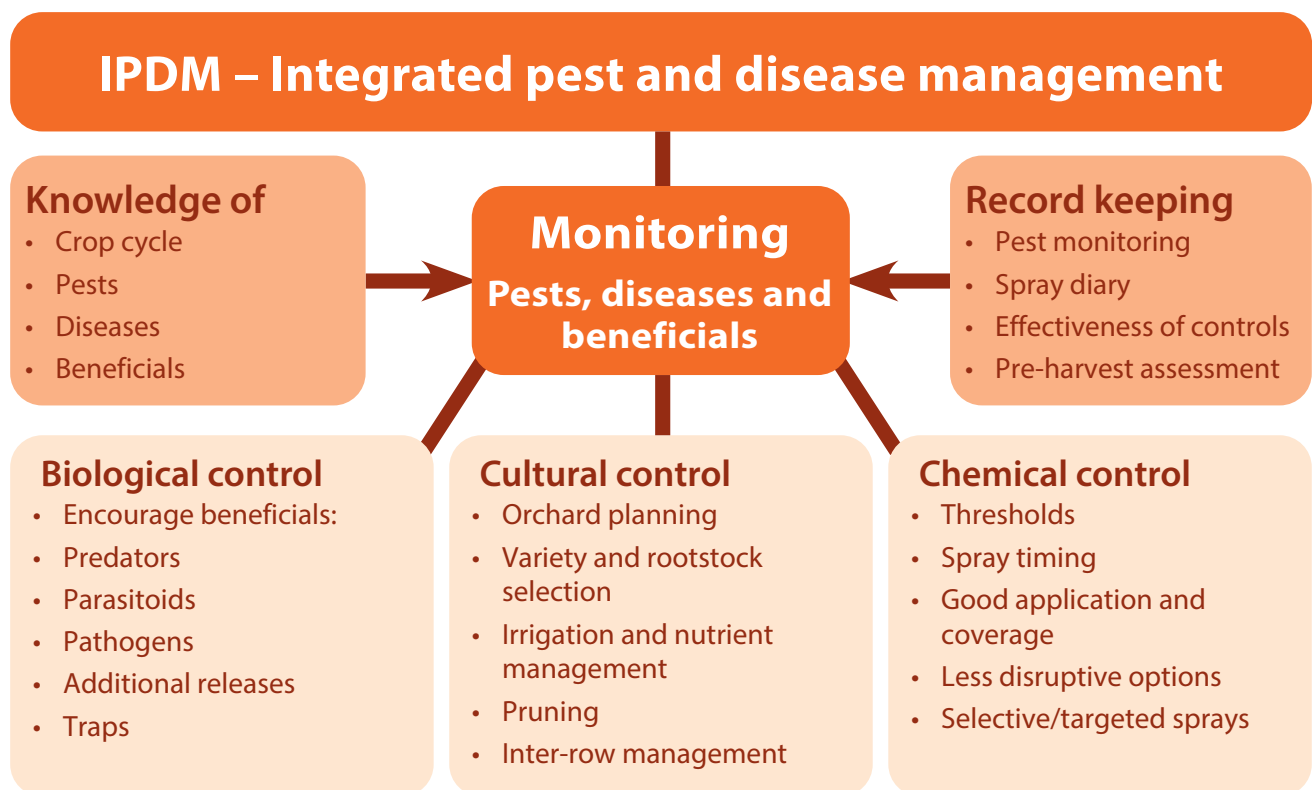


Figure 1. Factors to consider when using an integrated pest and disease management (IPDM) strategy.

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Effective IPDM requires familiarity with pest life cycles and crop thresholds to enable action before pest numbers cause economic damage.

Thresholds, monitoring, and management will vary between orchards, blocks, varieties and target markets for the product.

IPDM focuses on monitoring pests and beneficials and then implementing biological and cultural control options, with chemical controls playing a supportive rather than disruptive role. Using IPDM does not exclude chemicals, but a preference for using the least disruptive pesticides to natural enemies in the citrus orchard.

Identifying pests and diseases

An integral part of an IPDM program is learning to recognise pests and beneficials and understand their lifecycles.

When starting an IPDM program, collect specimens for identification by an experienced entomologist or crop scout. A 10x hand lens is an essential tool for identifying pests during monitoring.

Monitoring

Monitoring of pests and natural enemies is a key component of IPDM. It is a structured system for quantifying the likelihood of a pest becoming an issue in the orchard. To be effective, it must be done regularly and systematically.

Monitoring should be quick and efficient. Checking for the presence or absence of pests will be quicker than doing precise counts.

How to start a monitoring plan

1. Make a map of your orchard.
2. Include details such as the number of trees, rootstock, and planting dates.
3. Decide how many trees to sample per block. This will vary with block size and time available to sample (Table 1).

Table 1. The number of trees to sample for monitoring based on block size and approximate time required.

Trees per block	Area (hectares)	Trees to sample	Time (minutes)
0–500	<2	10	20–30
501–750	2–3	12	25–35
751–1,000	3–4	15	30–45
1,000–2,000	4–8	20	40–60
2,000–4,000	8–16	25	50–75
>4,000	>16	30	60–90

How often to monitor

Monitoring frequency depends on the time of year and the level of pest activity. Pest activity is seasonal; insects are more active from spring to autumn.

Morning is the best time to monitor for insects as this is when they are least active and most likely to be seen. Some insects, such as scale, do not move and can be found in the same spot throughout the day.

How to sample

Sampling must be random. Do not use the same tree every time. The only exception is if a particular area in the block has a history of being attacked by a certain pest. Even then, choose other trees to sample as well.

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The easiest way to randomly sample is to walk through the block on a diagonal or a zigzag (Figure 2). Start at a new point each time that you monitor. Avoid sampling small or unhealthy trees as these will give you a biased sample.

Sampling units

The parts of the tree that are sampled are called 'units'. Units can be fruit (young or maturing), shoots, flowers, leaves, twigs, or branches. The unit will depend on which pests are likely to be found at the time of year.

For example, red scales are found on fruit as it matures, but at other times of the year, they are found on the leaves or branches.

Sample from four quadrants of the tree—north, south, east, and west. Take the fifth sample from the middle of the tree where pests often shelter.

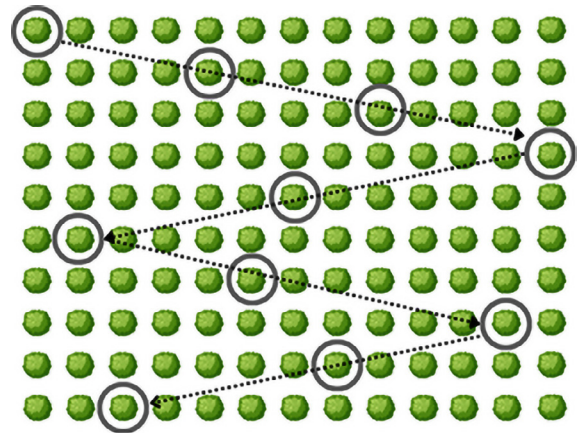


Figure 2. Zigzag through the block and select random trees to monitor.

Record keeping

Data should be recorded each time you monitor. Use a monitoring sheet or notebook in the field and transfer it to a spreadsheet to keep track of changes and patterns. Any control actions taken should also be recorded.

Action levels

The level of infestation or damage at which some action must be taken to prevent an economic loss is referred to as the action level. These are usually based on research and experience.

Control methods

When action levels are reached, you will need to decide on the most appropriate control strategy, whether it is biological (e.g. release of parasites) or chemical (e.g. selective pesticide, horticultural oil).

Biological control

Biological control includes the use of natural enemies or beneficials. Three types of beneficials occur naturally:

- parasites (adults lay eggs and develop in or on the host)
- predators (larvae and adults eat the host) e.g. green lacewings (Figure 3)
- pathogens (nematodes, viruses and bacteria infect the host, killing it).



Figure 3. Green lacewing eggs (left), larvae (middle) and adult (right). Green lacewings are an effective natural enemy in citrus orchards. The larvae predate on a variety of citrus pests.

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Beneficial releases can assist in managing some pests, such as parasitic *Aphytis* spp. wasps for red scale. Naturally occurring populations can also be encouraged in the orchard by careful pesticide choices and cultural practices.

Mass trapping devices (pheromone traps) can be used as population suppression tools for some pests.

Mating disruption is an effective biological control for managing light brown apple moth (LBAM) in citrus. Pheromone ties are used to reduce the success rate of LBAM males finding females, resulting in lower numbers of eggs. Refer to the light brown apple moth [LBAM fact sheet](https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/1477365/Light-brown-apple-moth.pdf) for more information (https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0006/1477365/Light-brown-apple-moth.pdf).

Chemical control

The use of most broad-spectrum pesticides can severely disrupt an IPDM program. When possible, use a pesticide that is least disruptive to natural enemies. Chemical groups should be rotated—avoid using the same chemical more than twice in the same season. Toxicity rating tables for insecticides, fungicides and miticides on natural enemies can be found in the [Natural enemies in Australian citrus fact sheet](https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/1567520/Natural-enemies-in-Australian-citrus.pdf) (https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0008/1567520/Natural-enemies-in-Australian-citrus.pdf).

To preserve natural enemies in the orchard, avoid using synthetic pyrethroids, organophosphate and carbamate insecticides. If they must be used, selectively spray problem areas (avoid spraying entire blocks if possible) and wait at least 4 weeks before releasing parasites.

Check your spray coverage

Effective spray coverage is essential for managing pests and diseases. Achieving proper coverage can be difficult and involves a balance of varying droplet size, amount of spray, and ground speed. Sprayers should be calibrated and checked regularly to ensure good coverage.

Cultural control

Cultural practices can encourage natural enemies in the orchard. Practices include weed management, tree skirting and orchard hygiene. Maintaining inter-row vegetation and alternate inter-row slashing provides habitat and a pollen food source for beneficial insects and mites.

Practicing good orchard hygiene and annual pruning to improve spray penetration and airflow will help reduce disease incidence and improve pest control from chemical applications.

Review of the season

At the end of the growing season, packout quality should be assessed to provide feedback on the success of the pest management program. Record the main causes of fruit downgrades for each block to allow comparison between monitoring and quality. This will help refine your action levels.

More information

Individual IPDM pest fact sheets are on the [Citrus IPDM extension program webpage](https://www.dpi.nsw.gov.au/agriculture/horticulture/citrus/content/ipdm-extension-program) (<https://www.dpi.nsw.gov.au/agriculture/horticulture/citrus/content/ipdm-extension-program>).

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