Integrated Pest Management (IPM)
in crops and pastures




Integrated Pest Management (IPM) means using a combination of biological, cultural and chemical control methods to manage pest problems. The term pest can be applied to invertebrates, vertebrates, weeds or diseases, but the emphasis here is on invertebrate pests and reduction in the use of pesticides. However IPM does not mean 'do nothing' or to simply stop using pesticides. It requires planning, regular monitoring and constant decision making to suit changing crop and pasture conditions.

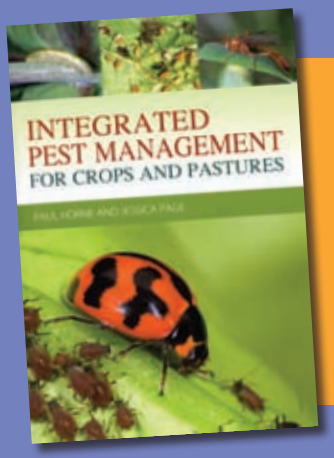
The aim of an IPM strategy is to use naturally occurring biological control agents (beneficials) where possible to help keep pests below damaging levels. In many cases, biological control and changes in farm practices (cultural changes) are sufficient to manage many pests.

It is critical to avoid killing beneficial species with broad-spectrum pesticides and one advantage of IPM is a decrease in chemical use. The toxicity of insecticides to a wide range of organisms makes reducing the use of pesticides an important first step in an integrated approach. A benefit of an IPM approach over a pesticide-based approach is that it aims to achieve sustainable control of a range of pests, avoiding problems such as chemical resistance and the creation of secondary pest problems.

An IPM approach deals with many pests. It is not a recipe and it needs to be adapted to suit individual situations. There are regional differences and modifications are often needed on individual farms.

IPM involves decision making based on the number and life stages of beneficial species, rather than the number and life stages of the pests. It also involves using farm management (cultural) practices that either favour the beneficials or discourage the pests. Obviously to do this, there needs to be regular crop and pasture monitoring and the person doing the monitoring needs to be able to identify these life stages and understand the impact of different cultural control options. Mis-identification of either pests or beneficials can lead to problems. For most people, the support from an IPM specialist is helpful in successfully developing the appropriate skills and confidence.

This brochure provides an introduction to an IPM programme and gives an example from Victoria. Producers who are keen to know more are encouraged to undertake a comprehensive training course being offered in each State.



Want to read more? Integrated Pest Management for Crops and Pastures provides details of what is required to successfully implement IPM in cropping and pasture operations. It is available through LandLinks, CSIRO publishing www.landlinks.com

Grain & Graze™ 2
Profit through knowledge

Which species help in pest control?

There are many naturally occurring predators for the major pests that occur in crops and pastures. If managed correctly these predators will usually provide sufficient control to minimise the economic damage caused by pest outbreaks.

Unfortunately some predators are difficult to see because of their size, they are transient (fly in and out) or they only hunt at night, such as spiders.

Even though there are many beneficial species that can contribute to pest control, there exists a few core beneficial species that are relatively easy to see and attack a wide range of pests. These species are the foundation of an IPM program.

The rate that beneficial species build up varies greatly. Some, like lacewings and ladybirds can be expected to build-up in number very quickly, within a single cropping season. Others, like some carabid beetles and spiders, have multi-year life-cycles and therefore are slower to respond to a changed management approach.

The core beneficial species are described.

Core beneficial species

Brown lacewing

Distinguishing features: Adults 8 to 10 mm long with delicate lacy brown wings, juveniles have no wings and long thin bodies

Transient

Lifecycle: Three weeks under warm condition

Where and how to look for them: Caught in sweep nets in early spring and autumn

Prey includes: Aphids, but many other pests if acceptable in size

Carabid beetle

Distinguishing features: Many different shapes and sizes but all have large jaws at the front

Resident

Lifecycle: One to two years

Prey includes: Slugs, caterpillars, European earwigs

Where and how to look for them: Under shelter traps

Damsel bugs

Distinguishing features: Slender, pencil shaped.

Transient

Lifecycle: Multiple generations per year, taking three to four weeks from eggs to adults under warm conditions. Adults live a few weeks

Where and how to look for them: In the canopy where caterpillars and aphids are feeding

Prey includes: Caterpillars, aphids

Ladybird beetles

Distinguishing features: Adults usually orange with black spots, juveniles look more like a grub and are soft bodied

Transient

Lifecycle: Multiple generations per year, taking three to four weeks from eggs to adults under warm conditions. Adults can live up to 12 months

Where and how to look for them: Caught in sweep nets from spring to autumn, direct search

Prey includes: Aphids

Native earwig

Distinguishing features: Orange triangular marking behind head

Resident

Lifecycle: One generation per year

Where and how to look for them: Under shelter traps, direct search

Prey includes: Caterpillars, redlegged earth mite, blue oat mite, lucerne flea.

Parasitic wasps (Aphidius spp and Netelia)

Distinguishing features: Aphidius are 2-3 mm long, black and look like tiny flies. Netelia are 10 mm long, with an orange body and black lace wings

Transient

Lifecycle: Follows the lifecycle of the pest, attack either the eggs or larvae. Typically wasps emerge after two to three week, with adults living a further few weeks

Where and how to look for them: Caught in sweep nets from spring to autumn

Prey includes: Caterpillars, aphids

Predatory mites

Distinguishing features: Bright red, fast moving

Resident

Lifecycle: Many generations per year

Where and how to look for them: In puddles of water after rain

Prey includes: Redlegged earth mite, blue oat mite, lucerne flea

Shield bug (stink bug)

Distinguishing features: Large spikes behind the head

Transient

Lifecycle: Several generations per year, taking three to four weeks from eggs to adults under warm conditions. Adults live for several months

Where and how to look for them: In the canopy where caterpillars and aphids are feeding

Prey includes: Larger caterpillars, aphids

Spiders (many species) – either ground dwelling or web spinning

Resident, *but can spread large distances by wind in the juvenile stage*

Lifecycle: Most spiders live more than one year, with annual breeding cycles

Where and how to look for them: Ground dwelling on the soil surface (often well camouflaged), canopy spiders in webs

Prey includes: Flies, crickets, lucerne flea, aphids, caterpillars and moths.

Other useful references:

GRDC publications, including Slugs in Crops, Crop Insects: The Ute Guide,

Cotton CRC website

The good bug book, Australian Biological Control Association

Farm management practices

There are many farm management practices that can be used in an IPM program. One group of practices aim to create an environment that is hostile to the pest and/or favourable to the beneficials we wish to encourge (table 1).

Table 1: Possible practices to encourage beneficial species and discourage pests

Practice	Desired effect	Possible limitations
Baits	Targets specific pests while minimising the exposure of beneficial species	Limited range of commercially available products
Border sprays	Controls pests invading crops from adjacent areas	Likely to reduce beneficial species in the sprayed area
Burning	Removes food and shelter for pests	Removes shelter for beneficial species such as predatory earwigs and carabid beetles
Crop rotations	Crop type hinders pest build up before next susceptible crop	Crop type hinders weed and disease management
Cultivation	Physically damages the pests, exposing them to predation, destroy food, shelter and breeding habitat	Can have detrimental effects on beneficial species
Grazing	Remove foliage on which pests are feeding and removes breeding sites.	Heavy grazing may reduce pasture growth
Retained organic matter	Increases shelter and food for beneficial species	May increase food and shelter for pests
Rolling	Crushes the pest (relies of the species being active on the surface surface when rolling is undertaken)	May kill some beneficial species
Weed control	Reduces feed source and disrupts breeding sites	Often needs to be undertaken the season before to have the desired effect. Herbicide selection is important to minimise detremental effects on beneficial species

The second group of actions aims to minimise the exposure of the crop or pasture to pest damage, especially at the vulnerable stage of germination and emergence (table 2).

Table 2: Possible practices to minimise exposure to pest damage at germination and establishment

Practice	Desired effect	Possible limitations
Crop agronomy eg large seed size and high soil fertility	Increases the rate of seedling emergence, reducing time crop is vulnerable	Added cost in seed screening and additional fertiliser at sowing
Pest resistant crop	Prevents pest from feeding on the plant so they starve or prevents their ability to reproduce	Limited range of varieties to chose from
Press wheels	Increases the rate of crop germination and compacted soil provides a physical barrier around the seed.	Requires machinery modification
Seed dressing	Provides protection to newly emerging plants at the vulnerable seedling stage.	Added cost and may interact negatively with other seed dressings eg fungicides and innoculants
Time of planting	Minimise time crop is exposed to pest attack	Seasonal conditions prevent ideal sowing time

Insecticides

Beneficial predators are affected (killed) by almost all of the commonly used insecticides and miticides in cropping and pasture programs as well as some herbicides.

Beneficial species are often more vulnerable than the target pests because the predators will often consume dead and dying pest insects and be killed by secondary poisoning and not just by direct chemical contact. They are also usually killed by lower doses of insecticide than the target pests.

However insecticides can still be used to great effect in an IPM program, but more consideration is given to the way insecticides are delivered to the target pest (such as through baiting, seed dressings or border sprays) and to the degree of selectivity and residual nature of the chemical used.

Selection of insecticides to use

Broad spectrum insecticides are not favoured in an IPM program as they kill a wide range of beneficial species. Many products in this group of insecticides, such as synthetic pyrethroids and organophosphates have long periods of residual action. The use of such insecticides is particularly damaging to insects such as predatory carabid beetles that have long breeding cycles, as the population will take many years to recover. Killing a range of beneficial species can also cause the creation of secondary pests. This occurs when the use of an insecticides targeting one pest can kill the beneficials that would otherwise control another pest.

There are very few selective or 'soft' insecticides currently registered for use in broad acre crops and pastures. The products that are available, such as Pirimicarb and BT (Bacillus thuringiensis) are usually more expensive per hectare than the broad spectrum insecticides, but are cost effective when considering overall pest control and sustainability. Information on effects of pesticides on beneficial species is more difficult to obtain and it is recommended to consult an IPM specialist for the latest information.

Case Study

Rowan Peel, Inverleigh, Victoria

Rowan and brother Colin run a cropping and grazing property near Inverleigh in South West Victoria. The main farm is 1,350 ha and there is an additional 400 ha run as a share farm. Crops are a rotation of wheat, barley, canola and lucerne.

Before using IPM Rowan had a fairly standard, calendar-based pesticide strategy (using broad spectrum insecticides). That consisted of applying insecticide with the herbicides before planting and just after sowing, then spraying for aphids at pre-determined times and possibly for grubs such as Heliothis late in the season. Baiting for slugs was also standard for Rowan in canola crops.

Rowan's approach to pests and pesticide use has now changed dramatically. He now only uses insecticides if absolutely necessary and when he has to, tries to use selective products. For pests such as lucerne flea in lucerne, Rowan now treats only problem spots rather than the whole paddock.

Rowan began by trialling IPM on three paddocks in 2003, but quickly decided that this was the way to go and the next year decided to apply IPM on the whole farm.

Rowan sees several advantages in using IPM. He says the main advantages are being financially better off, not having to handle as much pesticide, it is better for the environment and also that he know exactly what pests he is dealing with and therefore gets better control.

(Edited extract from Integrated Pest Management for Crops and Pastures by Paul Horne and Jessica Page, Landlinks Press 2008)

Monitoring and action

The most important aspect of an IPM strategy is the correct identification of pest and beneficial species and the ability to distinguish these from the thousands of other "benign" species that are neither pest nor beneficial in the farming system. Many apparent control failures may be due to inappropriate treatment because of mis-identification of the pests.

Monitoring needs to take into account:

- the range of pests and beneficial species eg slugs, earwigs, aphids, mites etc
- the fact that different species of pests can cause identical symptoms of crop damage
- the life-stages and life-cycle of each species.

In addition, the monitoring needs to look at trends rather than just absolute numbers of pests. That is, are the numbers of pests increasing or decreasing in relation to the appropriate beneficial species?

While detailed monitoring is a specialist skill, farmers can make the first step by undertaking some simple monitoring on their own farms.

On farm monitoring

IPM specialists use a range of different monitoring techniques to build an accurate picture of the beneficial and pest populations over time. For most farmers this level of detail would be un-necessary unless you are able to distinguish between pests, beneficials and other species present and their life stages. However farmer monitoring can be used to identify the high and low risk paddocks for particular pests.

The main techniques used in monitoring are:

- Shelter traps when invertebrates are active and need some shelter during the day eg wood tiles, ceramic tiles, hessian sacks
- Direct searching such as looking under the leaves of broadleaf plants, in puddles after rain, under rocks and through stubble
- Yellow sticky traps that collect small flying insects
- Sweep nets
- Pheremone traps for some key species such as Heliothis


Shelter traps


Direct search


Yellow sticky traps

As a rule monitoring is best undertaken when the invertebrates are active. For most pests, this is from the autumn break to before the onset of summer. The suggested monitoring times and methods for a range of crop and pasture pests (table 3) and beneficial species (table 4) is listed.

Table 3: Suggested monitoring methods and timing for some common pest invertebrates.

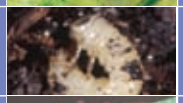
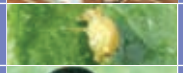
Pest		Type	Monitoring methods	When to look
Aphids		Transient	Yellow sticky traps in the crop. This should be done weekly during flight times. Direct search on plants.	Autumn (if an early break) and in early spring.
Black headed cockchafers		Resident	Emergence tunnels in the paddock	After the autumn break
Blue oat mite		Resident	Check on broadleaf plants. In puddles of water	Mid winter until mid spring
Diamondback moth		Transient	Sweep net. Pheromone traps	Spring to autumn
European earwig		Resident	Shelter traps	October
Heliothis caterpillars		Transient	Pheromone traps	September to May
Lucerne flea		Resident	Inspection of crop or pasture	Mid winter until mid spring
Redlegged earth mite		Resident	Check on broadleaf plants. In puddles of water	Mid winter until mid spring
Rutherglen bugs		Transient	Direct search	Late spring until early summer
Slugs (black keel slug, grey field slug)		Resident	Shelter traps	September to October
Wireworm False wireworm		Resident	Shelter traps	In the previous season (once or twice a year would be sufficient).

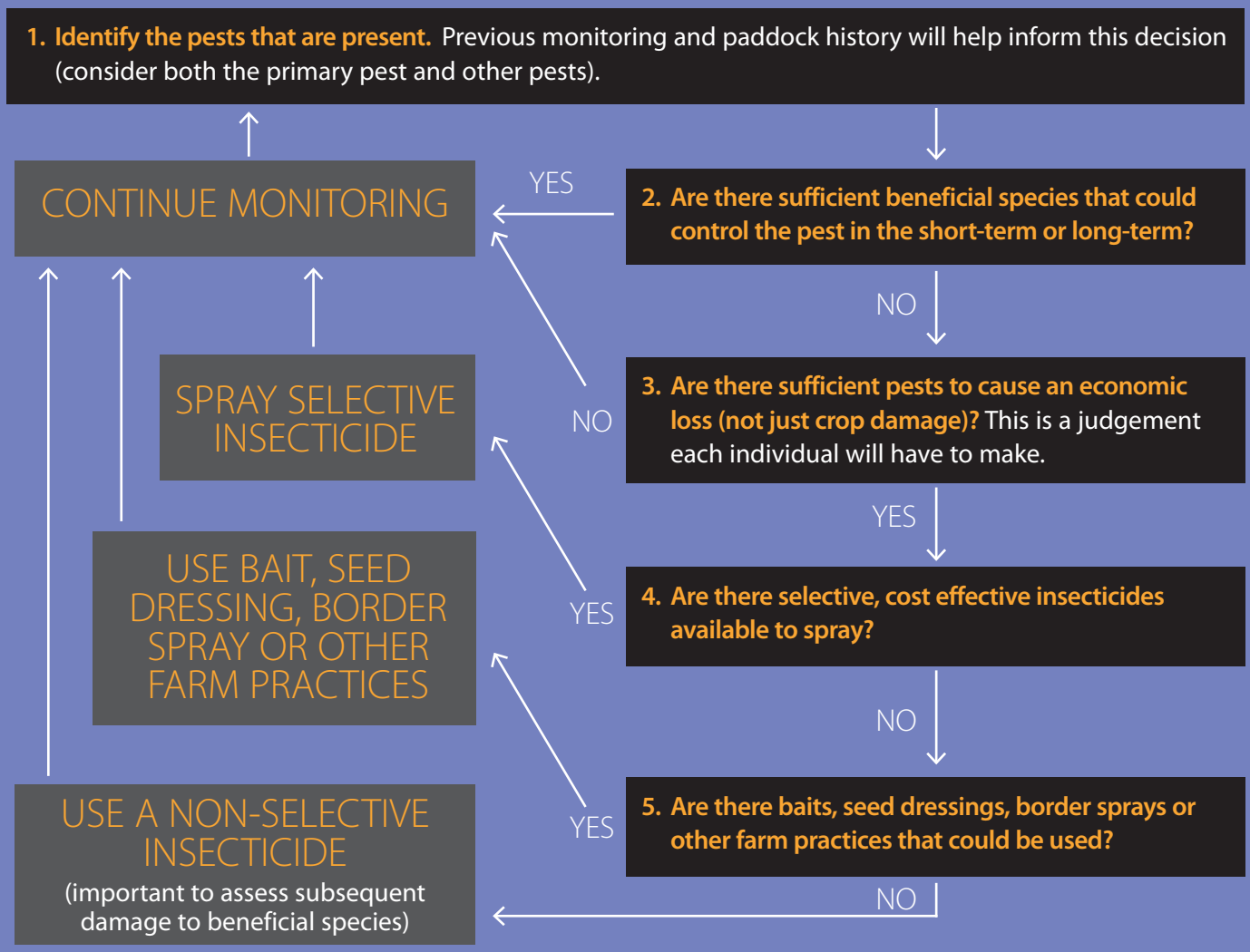
Table 4: Suggested monitoring methods and timing for some common beneficial invertebrates.

Beneficial	Type	Monitoring method	When to look
Carabid beetles	Resident	Shelter traps	All year
Predatory mites	Resident	Puddle of water	All year
Native earwigs	Resident	Direct search, shelter traps	All year
Brown lacewings	Transient	Sweep net	Early spring
Ladybird beetles	Transient	Sweep net, Direct search	Spring to summer
Parasitic wasps	Transient	Sweep net	Spring to autumn

Deciding which IPM tactics to use

Many tactics can be used in an IPM program, but it is critical to appreciate the sequence in which these actions need to be taken (figure 1). Monitoring is the first step and is repeated many times during the life of a crop or pasture.

Figure 1: Flowchart to assist IPM decision making.



Forward planning is essential to maximize the pest control options available. If control of the pest problem is only addressed in the year of sowing, the options and ability to minimise the effect on beneficial species through different treatment options is greatly reduced. For example if a seed dressing is not used, then pest control options are further reduced to just in-crop spraying.

Deciding if IPM is right for you

Information is available to begin implementing a successful IPM programme and new insights are enabling IPM to be constantly refined. However it must be acknowledged the transition from using a familiar pesticide-based approach to using IPM is likely to make most farmers anxious, as often the best action will be to not use an insecticide.

While IPM has many potential benefits it may not suit everyone. The main consideration is being prepared to spend more time monitoring crops and pastures for pest and beneficial species. The resulting action may be just to wait and continue monitoring rather than spraying, even though a pest may be present. This can be stressful. Having access to an IPM specialist may reduce this stress, but the expertise may have to be paid for.

Above all else, IPM requires a shift in thinking about pest control. New skills in identification, monitoring and tactics are required.

A fully developed IPM strategy is probably not achievable for many farmers in the first year over the whole farm. Due to circumstances posed by the existing pest problem along with the perceived risk and stress, the potential economic damage may be too great and a broad spectrum insecticide will have to be used. This simply means the benefits of an IPM approach are delayed.

Simple tips to start an Integrated Pest Management program

- Do not apply unnecessary insecticides, they will only create problems.
- Begin monitoring to correctly identify pests and beneficial species and their changes over time.
- Using the information from the monitoring, assess the risk of damage on each paddock and type of crop.
- If taking action, consider changes to farm practices as part of the integrated approach.
- If using insecticides, consider more targeted application, eg baits, seed dressing and border sprays and more selective products.
- If using broad-spectrum pesticides on one paddock, flush the tank before moving to the next paddock.

This brochure was compiled by Cam Nicholson with assistance from Dr Paul Horne and Jessica Page of IPM Technologies Pty Ltd. The information summarises the knowledge and experiences of many farmers and specialist in South west Victoria. Thanks are extended to the staff at Southern Farming Systems and Agvise Services. Most photos courtesy of Denis Crawford.