Vegetable Integrated Pest Management

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What is IPM?

Many insect pest and disease management problems arise from relying entirely on pesticides for control. Integrated pest management (IPM) is a strategy that draws on a range of management tools with the goal of using the least ecologically disruptive techniques to manage pests within economically acceptable levels. Pests can include insects, mites, diseases, nematodes, weeds and vertebrate pests.

IPM was first defined for managing insects and mites and in practice, most IPM growers begin with applying the strategy to insects and mites and later incorporating other pests such as diseases and nematodes. IPM covers a continuum of practices which ranges from ‘intelligent pesticide management’ to biointensive IPM strategies.

At the most basic IPM involves routine crop monitoring, to ensure that pesticides are only applied when needed, as well as to ensure appropriate timing of pesticide applications. The most developed biointensive IPM relies primarily on beneficial organisms to manage insect pests; when greater pest control is needed, interventions chosen are complementary to the survival of these beneficials. As other pests are incorporated more and more prevention strategies are adopted which reduces the need for direct control practices.

IPM is a model of continual improvement (see Figure 1). Growers adopting IPM typically focus initially on management strategies for a single key insect pest, usually after ‘conventional’ insecticides fail to control the pest adequately or are deregistered. As strategies are developed for the target pest, focus moves to other key or minor pests. IPM can become part of a fully integrated farm management system, and can potentially involve the whole market chain.

IPM considers the production system in a holistic manner, and looks at all aspects of the farming enterprise as potentially increasing or decreasing pest numbers and, where possible, enhancing the activities that reduce these pest populations.

Although this Factsheet uses insect pests as the main model, the same principles apply for diseases, weeds and vertebrate pests.

In natural systems, insect pest numbers are limited by food supply, climatic conditions and natural enemies, such as predatory and parasitic insects or insect diseases. IPM seeks to enhance, rather than disrupt, this ecological balance. Where direct control is needed, a management strategy is chosen that will reduce the pest population to within economically acceptable limits with minimal adverse impact on the environment.

IPM is knowledge-intensive. An IPM program is built on all compatible control tactics: cultural, biological, chemical, and mechanical; and aims over time to strengthen the preventative practices to reduce the need for control tactics.

IPM cycle

![Figure 1. IPM cycle](image-url)
Knowledge

It is important to develop an understanding of both key and minor (or occasional) pests that are found in crops in your area. Examples of common insect pests and diseases found in vegetable crops are listed in Table 1 and within resources found under Vegetable Resources at the end of the factsheet.

It is equally important to know and understand the management options that are available to you as a grower. As more 'tools' become available, it is important to know when and how they can be used, and what effect they will have on the management of your pests. The knowledge that is developed about both the pest and the management tools available is also largely dependent on the local area and the experience you gain on your own farm. What works on one part of your farm may, for some reason, not work on another, and what works for your neighbour may not be the most appropriate option for you.

The ideas behind IPM are based around knowing your 'enemy' and understanding the 'weapons' at your disposal.

Prevention

Where possible, it is preferable to prevent pest problems rather than manage them after they arrive – prevention is always better than cure. What measures you use will depend on your particular situation and what are your most serious pests. The following are some prevention strategies that can be important for vegetables:

1. From the available varieties, select ones that have resistance to or tolerance of important diseases or insect pests in your area.
2. Seeds and seedlings can be a source of pests (including: insects, diseases, weeds); use certified seed, know your nursery’s

management practices and inspect seedlings for pests. If you are using biological control agents, for example, this includes knowing and understanding the effects of chemical residues left from nursery pesticide applications on seedlings.

3. If possible, minimise susceptible crops in the ground during periods of high pest pressure.
4. Irrigating to minimise the period of leaf wetness will reduce foliar diseases.
5. When foliar diseases are present avoid working in the crops while foliage is wet to reduce spread.
6. Optimal nutrition – avoiding excess nitrogen will reduce crop susceptibility to some fungal diseases.
7. Remove weeds from within and around cropping areas particularly if western flower thrips (WFT) and tomato spotted wilt virus (TSWV), are a problem, or the weeds are known hosts of crop diseases or insect pests; e.g. sow thistles are hosts of lettuce necrotic yellows virus and brassica weeds are hosts of a range of brassica diseases and insect pests.
8. Chipping out and removing (roguing) diseased plants will reduce the source of host plants that assist in spreading infection to healthy plants. Once chipped, the plants need to be properly destroyed: buried, bagged or removed from site.
9. Cultivating paddocks immediately after harvest, or if crop is abandoned for some reason, will reduce the harbouring potential for pests, and thus reduce their potential to spread to other plantings on your farm.
10. Use crop records to identify factors or management practices that may be

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### Table 1. Common insect pests and diseases of vegetables (will vary between crops and regions)

<table>
<thead>
<tr>
<th>Insect Pests</th>
<th>Diseases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Major</strong></td>
<td><strong>Minor</strong></td>
</tr>
<tr>
<td>Heliothis</td>
<td>Rutherglen bugs</td>
</tr>
<tr>
<td>Diamondback moth (brassicas only)</td>
<td>Cutworm, loopers, cluster caterpillars</td>
</tr>
<tr>
<td>Silverleaf whitefly</td>
<td>Wireworm &amp; false wireworm</td>
</tr>
<tr>
<td>Western flower thrips (WFT) (when virus present)</td>
<td>Leafhoppers</td>
</tr>
<tr>
<td>Tomato or onion thrips (when virus levels high)</td>
<td>Thrips (when virus absent)</td>
</tr>
<tr>
<td>Aphids (when virus levels high)</td>
<td>Aphids (when virus levels low)</td>
</tr>
</tbody>
</table>

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encouraging or discouraging pests. Because IPM is knowledge-based and relies on local experience, this information will improve your ability to use IPM effectively in subsequent seasons, by allowing you to see what did and didn’t work.

**Crop monitoring**

Routine crop monitoring is the first and most fundamental step in adopting IPM. It is important to keep check on the number of insects (both pest and beneficial) in your crop and to assess crop health. Most beginning IPM growers find it very helpful to contract a professional crop consultant to monitor your crops on a regular basis. If you are monitoring yourself ensure that you can identify the key insect pests, diseases and beneficials that may be present, and send specimens away for identification when there is doubt. All state departments of agriculture offer this service.

Follow a systematic protocol for monitoring, so that direct comparisons can be made of numbers found between monitoring dates and plantings, and keep accurate crop monitoring records so that you can develop a deep understanding of your crop system. Some crops, such as brassicas, lettuce, tomatoes and sweet corn, have suggested monitoring strategies.

A basic strategy involves visual monitoring the same number of plants on a regular basis (e.g. 40 seedlings or 20 mature plants). It is recommended that monitoring sites are widely dispersed throughout the planting, including near crop boundaries. Monitoring should be carried out on at least a weekly basis – at critical points in crop development or pest outbreak situations, crops should be monitored more frequently.

**Intervention**

Crop monitoring information, past crop records and any pest ‘economic threshold’ (the point at which the cost of control is equal to yield loss if no control measure is taken) will help with deciding whether the pest numbers warrant active intervention. An ‘action threshold’ is the point at which you decide to ‘act’, such as by putting on a pesticide.

In vegetables, economic thresholds are very hard to identify, given the large fluctuations in crop price and quality. Some basic thresholds have been developed for a few pests in a few crops, but these are developed largely from experience, keeping records and evaluating the success of particular decisions.

The factors that will influence your action threshold are the crop stage (e.g. heliothis are more difficult to control once sweet corn cobs have formed, or head lettuce has hearted), crop destination (i.e. export, domestic fresh, or processing), numbers of beneficials known to predate on the target pest, current and expected weather conditions, regional resistance management strategies, previous treatments used and effectiveness of control options.

The factors most likely to affect disease control decisions are varietal susceptibility, diseases...
present in the crop, whether the climatic conditions favour spread or development, crop vigour/health/nutritional status, irrigation methods, crop destination, the effectiveness of control options and, if the disease is transmitted by an insect, the population size and source of that insect.

The actual control option selected should be the option least likely to disrupt beneficial organisms, but also one that will control the pest within certain constraints. Constraints can include product registration, withholding periods, market requirements, cost, resistance management strategies and current conditions. If a pesticide is selected, it needs to be applied using best practice spray application techniques.

**Evaluation**

All insect sprays should be evaluated after application. Synthetic pyrethroids, organophosphate and carbamates insecticides should show immediate effects; however, some of the newer chemistries, such as Success®, Avatar®, Chess®, and biological pesticides such as NPV (a viral pathogen insecticide for Heliothis) and Bts (a bacterial pathogen against caterpillars) can be expected to take many days to kill. Feeding usually ceases shortly after application.

Harvest assessments are recommended for the purpose of comparing crops and seasons. Spending some time each year looking at crop records to see why some plantings were more successful than others can be insightful. Records will reveal pest population trends following control measures. This will help you to learn more about the indirect effects of particular chemical applications; for example, the use of a broad-spectrum insecticide may wipe out the target insect pest as well as the beneficial insects present in the crop, which may result in a minor insect pest becoming a serious problem.

Talking to others about current conditions, crop quality and pack-outs can provide information on how you are performing relative to others, and give you ideas for ways to improve your management. Looking over records over a number of seasons may show patterns or paddock variations that you hadn’t noticed previously, which will allow you to address the problem and improve your overall performance.

IPM continues to evolve as new pests arrive, new management options become available and new techniques are adopted. Over time, an IPM strategy will tend to shift effort from intervention strategies to prevention strategies.

**Sending samples for identification**

Management strategies are most effective when accurate identification of a pest is made.

Insects can be identified either from specimens collected into a vial or container, or from sticky traps. If possible collect at least 10 specimens to send. If it is likely to be some time before you can deliver or send the sample then and the insect is soft bodied (e.g. aphid, caterpillar or thrips) then, if possible, collect specimens into a small quantity of rubbing alcohol (available at the chemist). Sticky traps can be covered in plastic cling wrap before removing from the field or greenhouse. Try to avoid squashing sticky traps as accurate identification is difficult if specimens are damaged.

For diseased plants collect a number of plants showing the range of symptoms. Wrap plant material in damp but not wet paper, place in a plastic bag, keep cool and send or deliver as quickly as possible.

Samples can be left at any NSW DPI office or sent to:

**Insect specimens** - Delivery or Postal

Attention: Sample Submissions
NSW DPI
OAI, Forest Road, Orange NSW  2800
Ph: (02) 6391 3980

**Plant specimens** - Delivery

Attention: Sample Submissions
Elizabeth Macarthur Agricultural Institute
Woodbridge Rd  MENANGLE NSW 2568

Or Postal

Attention: Sample Submissions
NSW DPI  Elizabeth Macarthur Agricultural Institute
PMB 8  CAMDEN NSW 2570
Ph: (02) 4640 6327

[fees are charged for diagnostic services]

NSW DPI Pest & disease diagnostic laboratories information and submission forms:

Vegetable Resources

Information manuals/guides

**Keep It Clean** (2009) NSW I&I Badgery Parker *et al.*
Comprehensive guide for greenhouse growers that lists and describes more than 70 management practices that can significantly reduce the costs and losses that can result from pests and diseases.

A series of summary fact sheets and example record sheets are also available to download. Manual can be downloaded or hard copy ordered.


**Commercial Greenhouse Cucumber Production** (2010) NSW I & J James and Badgery Parker. This 216 page growing guide for greenhouse cucumber growers includes sections on managing crop pests. This manual can be purchased.

**Integrated pest management in lettuce**: information guide (2002) NSW Agriculture McDougall *et al.* 150pp


**Integrated pest management in greenhouse vegetables**: information guide (2002) NSW Agriculture Goodwin & Steiner 216pp


Both information guides provide information about IPM, what it is, recognizing and monitoring of pests, beneficials, diseases and weeds (lettuce only), spray application and record sheets.

Companion field identification guides are also available:

**Pests, beneficials, diseases and disorders in lettuce** (2003) NSW Agriculture McDougall & Creek


**Pests, diseases, disorders and beneficials in greenhouse vegetables** (2002) NSW DPI Goodwin


**Pests, Beneficials, Diseases and Disorders in Cucurbits** (2009) NSW DPI Napier & Draper


**Chemical use**

**Western flower thrips (WFT) insecticide resistance management plan** (2010), NSW DPI, G. Herron *et al.* This series of web pages gives basic information on WFT resistance management and pages of the permitted insecticides for crops.


**Spray Sense** – information for users of chemicals. This booklet is available from the NSW DPI bookshop or as pdf leaflets from the NSW DPI website. Spray Sense covers all aspects of chemical application from reading chemical labels, calibrating sprayers, using different spray applicators to cleaning out tanks.

Further information

Visit the Vegetable diseases, pests & disorders section of NSW DPI website for more factsheets


or the Pests, diseases & disorders in greenhouses section of NSW DPI website


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