MANAGING PESTS AND DISEASES
Integrated Pest Management

We have all suffered the disappointment of nurturing plants in our garden only to find pests arrive or disease strikes and we lose most, if not all, the crop. The following year we are determined to be more vigilant. We carefully watch for any sign of pests. Before they get out of control we reach for the nearest organic spray and destroy them, only to be surprised in a week or so when we notice the infestation is worse than ever. Again we spray, again the pests return with a vengeance. At this stage we seem doomed to continue using sprays, or we give up. If this is your experience then it is probably time to rethink your approach to managing pests and diseases in the garden and to carefully consider what it really means to gardening organically.

The NASAA Organic Standard (December 2004) defines organic agriculture as *"a holistic system built upon natural ecological processes"*. These ecological processes include the biological activities of all organisms living within the soil as well as those living above the soil surface. Of all such organisms, of which there are many tens of thousands of different types, only a relatively small number cause problems in our crops. In fact, most are beneficial and some are essential to the health of most plants. Consequently, we need to be mindful of the disturbance to the overall ecological balance of organisms living within our garden caused by the use of sprays or other methods to control pests and diseases. Afterall, it is the maintenance of that ecological balance which is the key to a productive organic garden.

Many of the control methods which are allowed under the organic standards, such as pyrethrum, derris dust, Bordeaux and Burgundy mixes etc, are fatal to many beneficial organisms and can easily destroy the ecological balance within a garden. Broad spectrum sprays (those which kill a large range of organisms), such as pyrethrum and derris dust, are particularly destructive of the ecological balance if used indiscriminately. Such sprays also destroy the natural predators and parasites of our pests. Some pests always survive any spray program and those survivors can then rapidly multiply, unchecked by their natural enemies. This forces us to spray again to try to control the new pest outbreak, and we become trapped into a vicious cycle of a regular spray program and each time causing more damage to the ecology of our garden.

Good organic gardeners have long been aware of these problems and many of the organic gardening techniques are designed to maintain the ecological balance of the garden so that pests and diseases are kept in check by their natural enemies. For example, crop rotation disrupts the build up of various soil borne diseases, companion planting can be used to "confuse" some insect pests and provide food and shelter for beneficial insects (the predators and parasites of pests), good nutrition facilitates the natural defence mechanisms of plants to pests and diseases etc. Broad spectrum sprays are only used as a very last resort and then very selectively. For example, they would not be used if predator or parasites of the pest are present. While these techniques are well known they are often applied in an ad hoc manner rather than as an integrated and systematic approach to pest and disease control.

The problem of creating ecological imbalance through the use of aggressive methods of controlling pests and diseases in crops is also becoming increasingly well recognised by conventional growers and a great deal of work has been undertaken to formulate better approaches to pest and disease control. One of the most promising is Integrated Pest Management (IPM). It largely comprises the range of techniques in common use by any good organic gardener but its advantage is that it applies those techniques in a systematic and integrated manner and it overtly aims to protect the ecology of the garden and surounding environment.

This article provides an overview of the main features of IPM, briefly summarises what the gardener needs to know and to do to successfully implement an IPM program and provides an example of IPM applied to the Green Vegetable Bug (GVB) on tomatoes. These procedures aim to maintain or enhance the ecological balance of living organisms within our soils and plants. Integral to the development of these IPM procedures and programs is the plant clinic which will be held at all COGS monthly meetings before the guest speaker starts at 8pm or after tea. Members are encouraged to bring along any pest or disease problems they have encountered so that the problem can be identified and their experience with it recorded. For members who cannot attend meetings details of pest and disease problems can be sent to gardens@cogs.asn.au and you will be contacted as soon as possible. These pest and disease problems will be the basis for developing IPM procedures for the range of common crops grown by gardeners in Canberra.

Integrated Pest Management

The main features of IPM are:

- it is a strategy for managing pest populations by taking advantage of all available control measures;
- it uses control measures which include physical, cultural, biological, varietal selection as well as chemical methods where organically acceptable, eg pyrethrum, derris dust etc;
- it aims to manage pest populations rather than eradicate them;
- it works with and protects the ecology of the garden and its environment;
- chemicals such as pyrethrum and derris dust are only used as a very last resort and are used very selectively to minimise ecological damage and the build up of chemical resistance in pests.

IPM Requirements

There are several requirements if an IPM program is to be successfully implemented. These are listed below.

- Gardeners need a good knowledge of the pests which affect our gardens and,
    - be able to identify the pest;
    - know its life cycle; and,
    - know how fast it can build up.

- A monitoring strategy is needed which includes,
    - a timetable for monitoring at critical times;
    - a sampling method eg inspection of plants, sticky traps, light traps etc.
- Gardeners need to be aware of all the possible control methods including,
    - Biological controls, such as
        - natural enemies;
        - introduced enemies eg Bt (*Bacillus thuringiensis*),
    - Cultural controls, such as
        - irrigation/mulch;
        - fertilising/compost;
        - weed control;
        - companion planting;
        - habitat for biological controls,
    - Physical controls, such as
        - squashing;
        - chooks, blue tongue lizards etc;
        - destruction of overwintering habitat for pests,
    - Varietal selection of
        - pest resistant plants;
        - pest resistant root stocks (eg woolly aphid resistant apple root stock, grape phylloxera resistant root stock),
    - Chemical controls (only to be used as a very last resort), including
        - whether they are they allowed under the National Standard;
        - whether they are registered with APVMA;
        - the frequency of application required;
        - their mode of action to avoid problems with pest and disease resistance;
        - their effects on other (non-target organisms)
- Gardeners must also set thresholds to determine when control strategies should be implemented. This will depend on how much damage can be tolerated.

Evaluating the IPM Procedures

An IPM procedure is not fixed in concrete. It is an iterative process which uses experience from the previous season to identify where adjustments are needed for the next season. Consequently, records should be kept throughout the year to allow the following points to be considered when evaluating the procedure and making any necessary adjustments.

- Planning
    - What do you want to achieve? Have your requirements changed?
    - Can you identify pests and diseases and their control options or is more training required?
    - Was record-keeping adequate?
- Do changes, or expected changes, in climate, soil, light, water require changes in the procedure?

- Pest and disease identification.
    - Do the IPM procedures cover the list the pests and diseases which occurred?
    - Do records of pest life cycle, conditions favouring, control options, beneficials suggest the need to modify IPM procedures?
    - Is there any new information from research which requires modification of IPM procedures?
- Were monitoring procedures sufficiently quick, accurate, reliable and frequent
- Were the rating systems, sampling patterns and traps adequate for monitoring pest numbers?
- Were thresholds for the level of the pest population at which treatment is applied adequate?
- Were the decision making processes adequate for dealing with pest outbreaks?

An IPM procedure for Green Vegetable Bug on Tomatoes

This example outlines an IPM procedure for green vegetable bugs on tomatoes. Normally an IPM program for a particular crop would address all the pests and diseases to which that crop is susceptible in a particular area as well as a monitoring and control calendar for each pest and disease. However, the example given below is for illustrative purposes only and considers just the green vegetable bug in tomatoes.

Pest Details

Green Vegetable Bug (*Nezara viridula*)

Problems/Symptoms

- Causes mottled white, hard and corky spots, where the bug has been sucking on the fruit making the fruit less attractive to eat.
- Bugs can also be present on the stems and leaves but with no obvious signs.

Pest Identification

- The adults are green, shield-shaped bugs, approximately 15mm long by 8mm wide, with three small spots in a line between the wing insertions. They feed by inserting their sharp, tubular mouthparts into soft plant tissues and sucking the sap.
- They prefer sunny positions. If mildly disturbed they will hide, but if the disturbance persists they will drop to the ground or fly away.
- In common with many other bugs, when provoked they can exude a brownish, foul-smelling fluid which will stain fingers or clothes and leave a persistent odour. Because of this defence mechanism they are not favoured as food by most predators.

Pest Cycle

- Mating takes place on vegetation during spring and summer.
- Approximately 60-80 eggs are laid in a raft shaped formation. Each egg is 0.75mm in diameter and is yellow when first laid. As the embryo develops a reddish-orange Y-shaped mark becomes noticeable.

- Incubation time varies with temperature – 5 days in summer to 2 to 3 weeks in early spring.
- Egg rafts may contain eggs of varying colour: yellow or orange eggs are normal; black eggs have been parasitised, and will produce a small parasitic insect; and there may be whitish empty eggs from which either a nymph or a parasite has emerged.
- The nymphs are orange when they emerge, but soon change to a shining black.
- In later instars the hind wings gradually develop and the green colour becomes more dominant.
- At the final moult the colour changes completely to green, or rarely, to orange.
- Life cycle is approximately 65-70 days, up to four generations a year.
- Over winters as an adult in tree bark, litter or anywhere it can obtain protection.

Control

- Threshold – no more than one Green Vegetable Bug (GVB) per plant.
- Monitoring
    - weekly inspection of every third plant for bug and eggs under leaves until first fruit picked.
    - weekly inspection of every plant for bug and eggs under leaves during fruit picking.
- Cultural Methods
    - Stressed plants seem more likely to be attacked – ensure optimum plant nutrition.
    - Smaller fruit varieties and yellow varieties seem less susceptible but will still be damaged.
- Physical/Mechanical
    - Physically squash any bugs found.
    - Physically squash any eggs found if fewer than 1/3 are parasitised.
    - Remove weeds which may harbour bugs and eggs in vegetable plot. Weeds known to host GVB include castor oil plant, caltrop, privet, amaranthus, silver leaf nightshade.
    - Separate soybeans and sunflowers (both known to host GVB) as much as possible from tomato crop to avoid cross-contamination with GVB.
- Biological/Beneficial Organisms (all available and selected)
    - There are no biological controls available commercially.
    - CSIRO has successfully established a South American parasitoid *Trichopoda Giacomelli* in northern NSW and southern QLD which attacks GVB but it has not been established in ACT or southern NSW.
    - Other species of *Trichopoda* occur naturally and also parasitise GVB eggs.
    - A naturally occurring parasitoid wasp *Trissolcus spp* parasitises GVB eggs but it is not known how effective it is in reducing crop GVB populations.
    - Ants are also known to be predators of GVB.
- Chemical Controls

- The only registered insecticide acceptable under the National Standard for Organic and Biodynamic Produce is PyGanic (pyrethrum) but it is not registered for GVB in tomatoes by the APVMA making it illegal to use for this purpose. In any case NSW Agriculture reports that the pyrethrum does not give satisfactory control of GVB. Consequently, chemical controls are not suitable for the GVB on tomatoes and non-chemical methods must be used instead.

Tomato IPM Monitoring and Control Calendar

The successful application of an IPM program requires constant vigilence by the gardener. It requires regular monitoring of the crop for pests and diseases. The following monitoring and control calendar is suggested as suitable for GVB on tomatoes.

Month	**November to May**	**June to October**
Pest: Green Vegetable Bug	Weekly: During picking check each plant for GVB and eggs If more than one bug per plant found, squash any GVB and egg rafts where fewer than one third the eggs are parasitised. Remove any weeds from the crop and nearby which may host GVB	Monthly: Check for overwintering adult GVB on any perennial host plants and on any sheltered surface where they may seek protection. Squash any GVB found.

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    - Do records of pest life cycle, conditions favouring, control options, beneficials suggest the need to modify IPM procedures?
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- Were thresholds for the level of the pest population at which treatment is applied adequate?
- Were the decision making processes adequate for dealing with pest outbreaks?

Further Work

Because different crops are susceptible to different pests and diseases, separate IPM procedures for each of the common crops will be developed over time. These will be placed on the COGS web site as they are developed.

Further Reading

R.A. Cloyd, P.L. Nixon, N.R.Pataky,
IPM for Gardeners; A Guide to Integrated Pest Management, 2004, Timber Press

PC Hely, G Pasfield, JG Gellatley,
Insect Pests of Fruit and Vegetables in NSW, 1982, Inkata Press

Integrated Pest Management Pty Ltd,
The Good Bug Book, 2nd Ed, 2002, Australian Biological Control Inc

Ruth M. Kerruish,
Plant Protection 3 – Selected Ornamentals Fruit and Vegetables, 1997, Rootrot Press

Judy McMaugh,
What Garden Pest or Disease is That, 2000, New Holland

National Association for Sustainable Agriculture Australia Limited,
NASAA Organic Standard, December 2004

Organic Industry Export Consultative Committee,
National Standard For Organic And Bio-Dynamic Produce, Ed 3.2, October 2005

A Selection of Internet Resources (not necessarily organic)

www.apvma.gov.au for the list of registered chemicals in Australia.
www.goodbugs.org.au for biological control agents available commercially in Australia.
www.agric.nsw.gov.au for advice on IPM and various crops, pests and diseases.
www.ento.csiro.au/biocontrol for biocontrol work being undertaken at CSIRO
plantnet.rbgsyd.nsw.gov.au Sydney Royal Botanic Gardens site for Flora of NSW including some weeds
www.weeds.asn.au Tasmanian site dealing with weeds and control methods.
www.agric.nsw.gov.au/reader/vegetable-ipm for copies of the *NSW Vegetable IPM Newsletter*
www.weeds.org.au site of the Australian Weeds Committee and the National Weeds Strategy

creatures.ifas.ufl edu. A useful University of Florida site with management programs for various pests in crops
www.hortnet.co.nz A site which contains information to manage pests and diseases in various crops.

