Integrated Pest Management Strategies at Southern Woods Nursery©

Ema Hewson
Southern Woods Nursery, P O Box 16148, Christchurch 8441
Email: production@southernwoods.co.nz

INTRODUCTION

For the past 3 years Southern Woods Nursery has been looking at different ways of controlling pests and diseases in the nursery. As a result we have now moved away from the calendar-based spray programme to a more preventative spraying system with an integrated pest management (IPM) approach.

There were several reasons for moving away from the calendar-based spraying approach, these being:

- To minimise environmental impact
- To be safer for the health of people in the nursery
- To reduce the costs of chemicals being used

HISTORY

The basic concepts of IPM have been practiced since the start of human civilisation. However, what really set the ball rolling was a book by Rachel Carson in 1962, "Silent Spring." She addressed a number of issues related to pesticide use in both agricultural settings and home landscapes. Prior to the publication of her book, the application of pesticides was often the only method used to manage insects, mites, and plant diseases. However, continued reliance on pesticides gave rise to resistant pest populations and undesirable environmental effects (Cloyd et al., 2004). The acceptance of IPM as a philosophy and a technology can be traced back to 1970, to the first symposium of agricultural scientists where the concepts, strategies, and tactics of integrated pest management were synthesized and expressed as a philosophy and a set of technologies. The objectives are to manage pests using methods that are economically rewarding, culturally suitable, and environmentally acceptable (National Science Foundation Center for Integrated Pest Management, 2006).

In the United States of America, IPM was formulated into national policy in February 1972 when President Nixon directed federal agencies to take steps to advance the concept and application of IPM in all the relevant sectors. In 1979 President Carter established an interagency IPM Coordinating Committee to ensure development and implementation practices (Biocontrol Reference Centre, 2006).

WHAT IS INTEGRATED PEST MANAGEMENT?

Integrated pest management aims to manage pest populations at an acceptable level while at the same time significantly reducing or eliminating the use of pesticides. Often eradication of a pest is not only impossible but also costly and can have a detrimental effect on the environment. Instead of relying primarily on chemicals, IPM uses a wide range of strategies. These strategies can be identified in the following four-step approach.

1) **Set Action Thresholds.** The point at which economic damage is likely to occur is often called the action threshold, which can be triggered by environmental conditions or pest populations. The presence of one or two pests does not mean that control is needed; but when they become an economic threat to the crop actions need to be taken. Some controls like pesticides can be used very close to the action threshold, while others such as biological controls must be introduced well before a pest reaches the action threshold. It is important to know these thresholds for all pests.
2) **Monitor and Identify Pests.** Regular monitoring of the crop and environment can assist in determining when a pest is nearing the action threshold. Monitoring generally involves a combination of visual crop inspection, the use of insect traps or crop sampling, and record keeping.

   It is essential to accurately identify all the pest organisms found on a crop. This is especially important when biological control agents are to be used, because biological control agents are often quite specific to the pest(s) they attack. Incorrect identification could result in incorrect actions.

   The order in which control methods are used, their timing in relation to the pest's life cycle, and the pest's lifestyle are all important in effectively controlling a pest.
3) **Prevention.** As a first line of control, IPM programmes work to minimise the pest becoming a threat. Most pests are opportunists. However, by making conditions unfavourable the chance of pest invasion is reduced. Examples of unfavourable conditions include the selection of pest-resistant cultivars, maintenance of suitable environmental conditions, and sound crop practices. In order to successfully adopt these strategies it is important to understand the pest's biology. These control methods can be very effective and cost-efficient and present little to no risk to people or the environment (Biocontrol Reference Centre, 2006).
4) **Control.** Once it has been identified that a pest population is above the set action threshold, and preventative methods are no longer effective, control is required. There are three different types of control available — mechanical, biological, and chemical. Mechanical and biological control are usually employed, with chemical control only used as a last resort.
   a) **Mechanical Control.** This type of control involves directly killing the pests or making the environment unsuitable for them to live in. Using sticky traps or steam sterilising mixes are two good examples.
   b) **Biological Controls.** These can be broadly defined as an activity of one species that reduces the harmful effect of another species. Biological controls agents (BCAs) are usually low cost and can be very effective. Compared to chemical control they have minimal impact on the environment and are relatively safe for human health. Biological controls agents include

pathogens, predators, parasites, antagonists, and competitors. A wide range of BCAs is available in New Zealand.

c) **Chemical Control.** Even though the aim of an IPM programme is to reduce or eliminate chemicals, chemicals can still be an important tool. Some pests can only be controlled by chemicals, whereas with other pests, chemicals need to be used in combination with other management strategies for successful control. In any cases, chemicals are only used when other management strategies are unable to keep the pest below a certain threshold.

Most pests can be controlled by a combination of chemical and nonchemical control methods. For integrated pest management, these control methods must be compatible, i.e., they must not disrupt each other when they are used together. In the long term the combined effect of two or more control measures is often greater than that of a single method. As biological control agents are susceptible to many pesticides, it is essential to determine which chemicals are integrated into an IPM programme.

IPM AT SOUTHERN WOODS NURSERY

Over the past 3 years IPM has slowly been integrated into the pest and disease programmes.

Our spray technician, Stephen Lockett, was in a position to "get the ball rolling" in the nursery as he had seen the vast amount of unnecessary chemicals being applied around the nursery before he had taken the job. Through the following four-step approach we set about making change and implementing IPM strategies. The following is an example of whereby IPM can be integrated into a nursery with significant result.

1) **Set Action Thresholds.** This varies greatly around the nursery and is determined on a case-by-case basis.
2) **Monitor and Identify Pests.** Monitoring is carried out on a weekly basis, and with the nursery increasing in size it was essential to get the staff on board. The staff are a vital part of the monitoring process, reporting back anything of concerns with regard to pests or diseases (PODs).

   Every week Southern Woods staff document the PODs that have been identified and the plants they are affecting. These records have allowed preventative systems to be put in place for more effective control.

   For example, two-spotted spider mites have been a significant problem in a few of our deciduous tree lines and from our records we know which trees are hosts to these mites. Therefore using this information we have put a system in place whereby in late winter/early spring we spray oils over the trees to kill any overwintering mites. This has dramatically reduced the mite populations in the deciduous trees and therefore reduced amounts of chemicals needed during the season when they are active.
3) **Prevention.** When focusing on IPM strategies, cultural controls can often seem less important compared to reducing chemicals and using biological controls. Around Southern Woods I am always looking at ways to change the conditions to favour the plants rather than the pests.

Although we have not eliminated powdery mildew in our *Quercus*, we have modified the cultural conditions to reduce the susceptibility of the trees to disease. In the past, the trees have been spaced very closely together, where they were watered by overhead irrigation. The lack of air flow caused high humidity amongst the crop, creating perfect conditions for powdery mildew. However, now all of our *Quercus* that are susceptible to powdery mildew are held on wires and spaced further apart to allow greater air flow throughout the crop. They are also watered in the morning to give the plants a chance to dry out.

This helps to reduce fungal conditions such as botrytis in the smaller grade plants.

4) **Control.**

Biological Controls. There first became an opportunity to trial the use of biological controls when fungus gnat populations exploded in our tunnel houses. Since then, we have been looking into and trialling other biological controls for aphids and two-spotted spider mites. Next year we plan to investigate biological controls for thrips that cause damage in our *Pinus* spp.

Case Study: Fungus Gnats or Sciarid Flies (*Bradysia* spp.). Fungus gnats have a large economic impact in plant nurseries. The adults have been implicated in the passive transmission of fungal spores from one plant to another, and thus may assist the spread of some plant diseases. Damage caused by fungus gnat larvae feeding on roots can cause direct loss of seedlings, and is likely to promote the development of soil-borne fungal diseases and loss of seedlings and cuttings.

A range of insecticides are claimed to be effective against fungus gnats although few have specific registration claims for use on greenhouse crops. At Southern Woods Nursery, chemicals were applied regularly and were very costly.

A number of natural enemies (predators, parasites, and diseases) have been researched to assist with the management of fungus gnats. The predatory mite *Hypoaspis aculeifer* has been found to have the most effective control.

It is a small pale brown mite with a distinct V-shaped dorsal shield. Adults are 0.5–1.0 mm long and are commonly found in the top few centimetres of potting mix. Females lay their eggs near the soil surface, and these hatch into six-legged larvae. There are two further nymph stages and a life cycle can be completed in 10 days at 25 °C, but can vary from 7 to 30 days depending on temperature. Below 12 °C, the mite becomes inactive, and development stops when temperatures fall below 8 °C. The species does not hibernate and is able to survive for 6 to 8 weeks without prey by feeding on decaying organic matter.

Southern Woods buys the mites in for our tunnel houses and for the areas with our smaller-grade plants. Since using the predatory mite at the nursery the use of chemicals to control the fungus gnats has reduced dramatically.

Chemical Control. The use of chemicals to control pests and diseases has decreased over the past 3 years. Insecticides and fungicides are very costly, not only in down time (re-entry/withholding periods) but also because better quality protective clothing is required. Instead of using general insecticides that only have one use, we started to look at other products. What we found were two products, De-Pact® wetting agent/insecticide and JMS Stylet-Oil®. JMS Stylet-Oil is an organic product which contains 97.1% white mineral oil. It is distributed by Elliott Technologies Ltd. in New Zealand and is a registered trademark of JMS Flower Farms Inc., U.S.A. De-Pact® wetting agent/insecticide contains 10 $g \cdot L^{-1}$ eucalyptus oil and 2.5 $g \cdot L^{-1}$ tea tree oil combined with organic wetting agents. De-Pact is a registered trademark of Barmac Industries Pty Ltd, Queensland, Australia. These products are both used in vineyards around New Zealand for powdery mildew and foliage pests, and the JMS Stylet-Oil label also claims botrytis suppression plus mite and mealy bug control. JMS Stylet-Oil works by smothering the disease and modifying the plant surface, making it inhospitable and unsuitable for disease establishment. It also destroys powdery mildew cell walls in seconds and interferes with attachment to plant surfaces.

As well as working as an insecticide and a fungicide, the spraying oils are better for the environment and safer for the health of people working within Southern Woods nursery, as there is little to no withholding/re-entry period. Compare this to a general insecticide which can be up to 24-h re-entry and 7 days withholding period. De-Pact and JMS Stylet-Oil are also very cost effective. Karate® costs $255 per liter and has one function — to kill insects (Karate contains 250 $g \cdot L^{-1}$ lambdacyhalothrin in the form of a capsule suspension. Karate is a Registered Trademark of a Syngenta Group Company and is distributed by Syngenta Crop Protection). JMS Stylet-Oil, on the other hand, costs $6.30 per liter, approximately one-fortieth the cost of Karate, and not only kills insects but is also a very good fungicide.

Insecticides are still an important part of our spray programme, but we have reduced the use of them and only use them where essential. For example, we have found that woolly aphid on hornbeam (*Carpinus betulus*) in our nursery can only be controlled by a systemic insecticide, due to the aphids living and feeding on the underside of the leaves. In this case it is almost impossible to control them using an oil.

CONCLUSION

Since using IPM strategies at Southern Woods Nursery, not only are we using fewer chemicals but we also have better control of the whole system. This is due to having more knowledge in all areas of the process and therefore we are able to make better decisions.

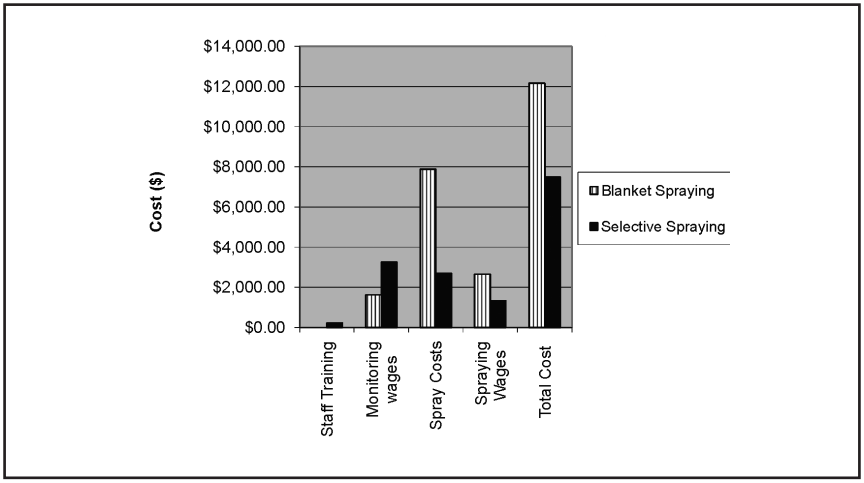

Figure 1. Comparison of costs associated with blanket spraying compared to selective spraying and the total cost of each programme.

The costs associated with staff training and monitoring have increased as a result of introducing IPM strategies. However the cost of sprays and the spraying wages have decreased, and overall we have reduced our total costs by 33% per year (Fig. 1).

The investment in time taken to change our system has been well worth it, and has resulted in a healthier, more environmentally aware workplace, not to mention the money we are saving.

LITERATURE CITED

Biocontrol Reference Centre. 2006. The history of integrated pest management. Acessed 6 February 2010. <http://www.biconet.com/reference/IPMhistory.html>.

Biocontrol Reference Centre. 2006. The history of integrated pest management (IPM). <http://www.biconet.com/reference/IPMhistory.html>.

Bioforce. Hypo-Mite (n.d.). Retrieved 25 January 2010 from <http://www.bioforce.net.nz/products/hypoaspis_aculeifer.html>.

Carson, R. 1962. Silent spring. Houghton Mifflin, United States.

Cloyd, R.A., P.L. Nixon, and **N.R. Pataky.** 2004. IPM for gardeners. A guide to integrated pest management. Timber Press, Portland, Oregon.

Elliott Technologies Ltd. JMS Stylet Oil Organic (n.d.). Retrieved 25 January 2010 from <http://www.elliott-technologies.co.nz/products/31.html>.

National Science Foundation Center for Integrated Pest Management. 2006. <http://www.cipm.ncsu.edu/history.cfm>.

FURTHER READING

Flint, M., and **P. Gouveia.** 2001. IPM in practice: principles and methods of integrated pest management. California, USA. Regents of the University of California.