Broadening the range of pest management tools – Integrated Pest Management in the apple and pear industry

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Introduction

For many years when faced with a pest problem, orchardists have reached for a container of chemical and applied a calendar based protective spray program. In recent times orchardists have been more likely to reach for the latest report from their pest scout in order to decide whether a chemical spray is appropriate.

While chemicals are still a crucial part of pest management, orchardists are drawing from an ever increasing bag of management tools to solve their pest problems.

This paper will describe the range of pest management techniques that orchardists are using. It will focus on techniques currently used by the apple and pear industry, but will also draw on examples of research work occurring in other fruit industries which indicate the trend of things to come in a range of fruit producing industries.

Catalysts for change – the role of IPM

Due to a range of considerations including market pressure for "clean" produce, resistance in pest populations, cost and availability of chemicals and operator and environmental safety, orchardists are faced with the need to reduce their overall chemical use.

A pest management style or strategy that addresses many current concerns is Integrated Pest Management (IPM) or as it was recently called, Information Based Pest Management (Kirsch 1993).

IPM involves the use of chemical, biological, physical and cultural controls to complement one another. Pest management planning is based on information gained from field monitoring of pest and predator populations and weather.

In the apple and pear industry, IPM has involved the strategic use of carefully selected chemicals thus allowing beneficial insects and mites to reduce pest numbers. Weather monitoring has also allowed orchardists to predict the behaviour of pests and diseases and to time chemicals sprays accordingly. Cultural controls that disrupt the life cycle of pests, such as good orchard hygiene are also important facets of IPM programs.

Managing the pome fruit pest complex with IPM techniques

Four species of pest are economically important to apple and pear growers in Victoria: codling moth *Cydia pomonella* (Linnaeus), lightbrown apple moth *Epiphyas postvittana* (Walker), longtailed mealybug *Pseudococcus longispinus* (Targioni-Tozetti) and twospotted mite, *Tetranychus urticae* (Koch). Management of each of these pests has a biological control component with the exception of codling moth.

Chemical use techniques in IPM orchards

While broad spectrum chemicals are still commonly used, the type of chemical products used by orchardists have greatly diversified during the last decade. Orchardists can now select chemicals that will kill only specific pests. Some chemical labels also quote lower IPM rates which are useful in situations where predators are present and the pest population only needs to be moderately reduced so that predators can regroup and regain control of the pest population.

Codling moth has remained the key pest in apple and pear orchards as it has no viable biological control. Use of day degree models to predict phenological development of pests, and the use of pheromone traps has given orchardists the information to time applications so that they will contact the vulnerable life stages of codling moth i.e., the eggs and adults. The development of mating confusion and insect growth regulators offers some new management options for orchardists that have medium to low codling moth pressure.

The use of petroleum spray oils that have a physical rather than a chemical action are commonly used for control of San José scale *Comstockaspis perniciosus* (Comstock).

In one orchard situation where IPM techniques had been implemented in pears over a two year period, there was a decrease in overall chemical cost of 48% (Barrass and Brown 1992). Even though the use of IPM techniques will not necessarily reduce chemical use in every season, over a number of seasons the economic saving can be considerable. Orchardists perceive that cost savings made on reduced use of chemical product and application more than pay for the cost of field monitoring (Bates 1991).

Biological control

Successful use of IPM techniques is based on the colonization of the orchard by beneficial insects and mites. In order that this occur, a minimized spray program must be adopted. With the exception of the predator mites *Typhlodromus occidentalis* (Nesbitt) and *Typhlodromus pyri* (Scheuten) beneficial insects can only function in orchards where the use of chemicals is minimal.

The surface feeding behaviour of lightbrown apple moth larvae has allowed the bacteria *Bacillus thuringiensis* to be used for control of lightbrown apple moth. This method has been commonly used by orchardists for a number of years and its success relies heavily on the orchardists ability to time sprays to coincide with the early larval stages of the moth.

Where the use of chemicals is minimized a native parasitoid wasp *Tetracnemous sydneyensis* (Timberlake) can reduce mealybug numbers to low levels (Barrass and Brown 1992).

The twospotted mite predators *T. occidentalis* and *T. pyri* are resistant to many of the organophosphate insecticides used in orchards, making chemical choice easier for growers. The native beetles *Stethorus* spp. are also useful predators of twospotted mite, but will only contribute to twospotted mite control where minimal chemical programs are used.

Cultural techniques

Many practices are carried out by orchardists that are aimed at breaking the pests life cycle, principally by depriving them of either an alternate host or an overwintering site.

Controlling bracken fern as an alternative host for lightbrown apple moth has been cited as a useful management practice in Tasmanian apple orchards (Price 1993). Van Steenwyk and Fouche (1993) recently reported that the removal of post harvest crop remnants in pear orchards substantially reduced the number of overwintering codling moth larvae. Pruning to remove old and rough wood, replacement of old trees, cleaning of fruit bins, and removal of old tree props and dead trees deprives pests of overwintering sites and so decreases their chances of survival.

The effect of many of these cultural practices have not been documented to a great extent in the scientific literature, however the value of these practices may well be substantial.

Physical pest control

Techniques such as flame weeding may become useful in certain orchard situations (Morgan 1991). The use of sticky bands, and selective weed control, are commonly used in the citrus industry (Edwards *et al.* 1992) and may become

useful techniques for apple and pear growers in view of the greater weevil activity in orchards using IPM practices. The use of bird netting has been common practice in the cherry industry, however is only likely to be used in high dollar return situations.

Monitoring techniques

Monitoring involves a weekly, and in some parts of the season, daily inspection of the orchard. Shoots, fruit and leaves are inspected for pests and predators using standardized procedures and the information is recorded in a standardized format. Standardization allows information to be compared within the season as well as between orchards and between seasons. Pheromone traps are available to monitor codling moth and lightbrown apple moth numbers. Pheromone traps are an extremely useful technique because untrained people can use them. This is because there is no need to identify the insect in the trap as the attractive power of the pheromones are specific to individual moth species (Kirsch 1993).

Average daily temperatures are also monitored in order to predict life-cycle events of moth pests.

Advantages and disadvantages of IPM

The benefits of IPM include reduced pesticide use in most seasons, reduced environmental impact from chemical use, improved pest control, safety for operator and consumer and greater potential for management of resistance if it occurs.

Resistance to a commonly used codling moth insecticide, azinphos methyl, has occurred widely in America and to a lesser extent in the eastern states of Australia (Thwaite *et al.* 1992). It appears that there is also cross resistance to a number of commonly used organophosphate, carbamate and pyrethroid insecticides as well as insect growth regulators (Welter 1992). Precise techniques will be required to manage this resistance situation.

There are, however, some disadvantages in using IPM techniques, which can be difficult for orchardists to manage. IPM is based on the need for a thorough monitoring program, which requires commitment and training in insect identification and standardized monitoring techniques. Most IPM friendly chemical and biological tools are not always as effective as conventional chemicals and require a higher degree of management to allow their integration with other techniques. Where the use of broad spectrum chemical is greatly reduced low level pests such as lightbrown apple moth, fruit tree root weevil *Leptopius squalidus* (Boheman), and possibly Queensland fruit fly *Dacus tryoni* (Frogatt) may become economically important pests.

Challenges for extension agents

Orchardists tend to compare new technologies with conventional pesticides. This can lead to problems as often newer technologies are not as effective and may be designed for use only under certain levels of pest pressure. Orchardists will need technical backup to choose techniques appropriate to the levels of pest pressure on their properties. The complexity of selecting IPM compatible chemicals can be a stumbling block for orchardists and pest management scouts alike (Wearing 1988). Often orchardists have to use conventional pesticides in tandem with pheromone technology which can require a high level of management skill. Orchardists are concerned about the incidence of secondary pests. A vigilant monitoring program will have to be undertaken so that any new or increasing pest species in the orchard will be promptly noticed and identified.

Challenges for the future

In order to increase the level of implementation of IPM it will be necessary to develop simple monitoring techniques as well as action thresholds for individual pests.

In the Goulburn Valley property sizes vary from 8 hectares to 245 hectares. It can be difficult for small growers to implement new pest management technology as they often don't have access to technical support. If the cost of monitoring were lower many smaller orchardists would be more likely to use IPM techniques. Particularly with the use of techniques such as mating confusion where large treated areas are necessary, orchardists may have to work together with their neighbours in order to succeed (Sexton 1993). Co-ordination between neighbouring orchardists may also make the cost of pest monitoring more accessible to smaller orchardists. A greater focus on the need for regional pest management will have to be fostered.

In order to make IPM work there has to be concerted effort and commitment from the grower, from resellers, chemical company personnel, pest management scouts and the industry in general.

Chemical companies can assist with addition of IPM rates to labels where appropriate, and predator toxicity information on the labels of products.

Possible future developments in IPM

While mating confusion products are soon to be registered for codling moth control in apples and pears, work is well underway on mating confusion for lightbrown apple moth.

Pheromones have great potential to further develop the use of IPM. Not only in terms of mating confusion, but also their use for cheaper and easier monitoring of orchards (Kirsch 1993). Pheromones may theoretically be used to attract predators into an orchard to control pests, or to draw predators out of the orchard when spraying has to be carried out (James *et al.* 1991). Further research into various insect pheromones may provide practical tools to "herd" predators. The further development of biological control agents for insect management shows great promise, particularly in regard to the use of fungi and nematodes to control weevil pests (Edwards *et al.* 1992).

Biological control of weeds using mycoherbicides may also assist in orchard management (Auld 1991). Plant breeding and genetic engineering techniques may also supply orchardists with varieties resistant to certain pests.

Summary

IPM is diverse and flexible, calling on a wide range of techniques to manage continually changing types and amounts of pests. To succeed in such a situation good management skills are necessary. However it is through the skill and commitment of orchardists that many of the IPM techniques mentioned in this paper have developed from theory to practical implementation. It is up to the chemical companies, pest management consultants, and researchers to give orchardists as much support as possible in developing these techniques.

Where do these developing practices leave chemical companies? They may suffer loss in chemical sales, but in the long term the products will have a longer shelf life. Orchardists using IPM techniques are better informed and better able to make management decisions. This can only be an advantage for the apple and pear industry.

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