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Improving adoption of IPM in viticulture: from *Research to Practice*™

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Abstract

The change from routine use of chemicals to a more strategic or IPM (Integrated Pest Management) approach has had a huge impact on the need for grower training and education. Pest managers need a framework for developing an improved capacity for IPM strategic decisions. This includes not only the technological competence, but also developing a positive perspective with the confidence and commitment to implement the changes. They need a clear understanding of the options available and the dynamics of their agricultural system with up-to-date information, user-friendly identification and diagnostic tools. Scientific research has to be translated into information and methodology that works 'on the ground'.

The aim of the current project is to develop a model that bring these various aspects of IPM together, makes them accessible to growers and results in effective incorporation of research results into viticulture pest management practices in Australia. The model has been tested over two seasons with more than 600 participants including growers, scouts, researchers, chemical company representatives, extension workers and educators. Evaluation of results to date suggest that there have been a number of direct benefits from this program, including important changes in pest management practices and improved understanding of industry research priorities.

Introduction

As the wine grape industry strives to achieve *world best practice*, the focus of research in pest and disease management is shifting from improved chemical control to a more strategic and sustainable approach. Maximum Residue Limits (MRLs) in export markets are becoming more stringent and potential restrictions on chemical use more pressing (Sas and Daniel 1997). Vineyard managers are becoming more aware that chemical use needs to be carefully considered, as outbreaks of secondary pests such as mites and resistance problems become more common. Company demands for reduced chemical inputs are being met by the implementation of quality assurance (QA) systems with benchmarking, certification of vineyards, standardised processes and improved record keeping systems (Glenn 1998). Many retailers, especially in the United Kingdom, require certified analysis of agrochemical residue status and compliance in their purchase arrangements.

Improving yields and quality while reducing chemical inputs is not an easy task. It requires a change from traditional methods of pest and disease control to implementation of innovative integrated

management strategies. Many growers would like a more sustainable pest and disease program in their vineyards, but are faced not only with developing a new management perspective, but also the complicated task of interpreting research methods and outcomes from publications or seminars, and incorporating them into their routine vineyard management.

Effective implementation of IPM often requires an intermediate step. This involves not just research results and translating research findings into practical management options. It is important to understand how pest and disease management decisions fit in with available resource options, economic considerations, chemical availability, restrictions and/or desirability (Parigi 1995, Grinter 1997).Equally important is the need for development of practical methods and support materials (eg. identification materials, monitoring methods, calendar guides, improved application techniques, improved cultural methods), for technology adoption adapted to individual circumstances and skills and participative adult education programs for growers.

A project was initiated, in September 1996 to develop a model with techniques and support systems for technology transfer that would facilitate effective incorporation of IPM research results into adoption of improved pest management practices by growers. The aims were to reduce chemical use, improve risk assessment, reduce production costs and achieve higher quality wine grapes.

The *Research to Practice*™ model

Defining IPM

IPM is always difficult to define because it means different things to different people. In this paper, we define IPM as a knowledge-based scientific approach, based on *best available* pest and disease management practice adapted, to different regions, conditions and management requirements. IPM then becomes a series of management options dependent upon site-specific conditions.

Perceptions of IPM may range from a focus on organic practices to improving some aspect of a standard chemical program. Our use of the term *IPM* reflects a pest management approach from a *progressive grower* perspective. IPM is a dynamic process, incorporating the best information available, adapted to particular circumstances. It becomes a practical, knowledge-based, customer driven approach. We look at alternatives, softer options and phasing out older, broad-spectrum chemicals. We also explore the potential for achieving more durable and effective management systems by reducing chemical inputs, extending the life of chemicals at risk of resistance, and protecting ecosystems. Emphasis is given to implementing more strategic use - better timing, monitoring and effective spray application.

This approach to pest management requires growers to develop decision-making skills that enable them to develop the competence, confidence and commitment to make changes (Fig. 1). It is a long-term approach to change incorporating the development of knowledge and understanding over time. We stress the importance of monitoring and keeping effective records which can be used to gain a historic perspective of the property, and help to implement, refine and adapt responses to different circumstances and seasons. Fig. 2 shows lightbrown apple moth (LBAM) monitoring data. When recorded over a number of years, pest monitoring data can help growers better understand and predict pest cycles.

Target audience

The technology transfer model described in this paper has been designed to address the needs of pest managers and staff involved in developing and carrying out pest management strategies. The target audience spans a wide range of viticulture skills, including second or third generation growers working their own blocks, vineyard workers, university educated corporate vineyard managers and investors on smaller properties.

Training workshops are limited to a maximum of 30 participants in each regional workshop. It is expected that those who benefit from the course will promote its value to others, making it less daunting and more accessible, and amplifying the effects and uptake of new practices in the region over time. Regional delivery not only improves grower access to information and training, it also provides a regional perspective, and promotes on-going exchanges between those who have participated in the course. It has been shown that growers commonly follow the successes of neighbours (Kirkpatrick 1997), although this will vary between regions and will be dependent on the attitudes and abilities of individual participants.

Workshop structure/ information delivery

The two-day workshops were set up with a format that allows presentation of information as well as interaction between participants and presenters. This interactive approach helped with the understanding of regional pest and disease problems, and adaptation of information to suit particular circumstances. A pre-course survey was used to gather information on current practices and pest perceptions. The workshop program included information presentation, group discussion, problem solving exercises and 'hands-on' sessions. Where possible, demonstrations were used to make information directly relevant to participants' pest management experience. Support materials, such as identification guides (Broadley *et al*. 1995; Malipatil *et al*. 1997), reference materials, hand lenses and microscopes were introduced and made available for purchase.

Participants were encouraged to try new IPM methods in their own vineyards. They were encouraged to make a written *promise of intent* at the end of the 2-day workshop, and to report back on their experiences in a "Third Day" post-harvest meeting. These Third Day meetings were held in each region for workshop participants to discuss the success of their pest management programs, including their 'promise to try something new', and to explore other aspects of IPM in their vineyards and issues they have considered since the workshop.

The interactive setting provided the opportunity for growers within a region to collaborate with researchers and each other to consider regional IPM strategies. Over the 2 seasons, there have been more than 40 presenters who have contributed to the workshops. Regional expertise has been encouraged and new presenters recruited. Workshop evaluation sheets, written 'promises' as well as written and oral reports provide feedback on the incorporation of new techniques into vineyards.

The information package

A major part of the task of preparation for the workshops was sorting, translating and synthesising the volumes of detailed, complex scientific information into a package that did not include extraneous information and provided an 'appropriate' knowledge base in a format that was accessible to participants. Research results were drawn together from available resources, incorporating published data, and data from work-in-progress, and built into a series of 'how-to' options for pest and disease

management in IPM in Australian viticulture. Key areas include pest and disease recognition, vineyard monitoring methods, strategic decision-making, and how available chemicals are best used.

The compiled material was developed from textbooks, published papers and reference books such as Diseases and Pests (Nicholas *et al*., 1994). It was reviewed by researchers, chemical companies, consultants and viticulturists in their specific areas of expertise. The information was presented in a comprehensive and clear fashion, using minimal jargon. None-the-less, it was considered important that a certain level of scientific terminology was both necessary and desirable given the complexity of some of the information presented. Adult learning principles were applied, and some education, knowledge or experience in viticulture for participants was assumed.

Standardised presentations, a comprehensive manual (Glenn and Aitken 1997) and support materials were developed and tested in pilot workshops and then expanded for use in regional workshops. Scientists and others working in viticulture pest management helped to develop and present the workshop training package.

Two facilitators ran each workshop, one assuring that all participants and presenters were adequately provided for, that the time was well managed and that adult learning principles were applied. The other facilitator ensured that priority science and management options were adequately exposed and that practical sessions and delivery were clear and focused.

Topic areas considered in the workshops were tailored to encompass the needs of all regions, and currently include: Botrytis, *Phomopsis*, powdery mildew, downy mildew, phylloxera, *Eutypa*, nematodes, lightbrown apple moth, bud and rust mite, weevils and beetles, biological and cultural control methods, chemical activity in pest management, quality management systems, property management and planning, record keeping and spray application. Some modules are only presented in regions where the pest is a problem, such as fig longicorn beetle, which is a pest in New South Wales or African black beetle in Western Australia.

Evaluation

There are two aspects of evaluation that have been incorporated into this model: assessing the success of the program in fulfilling grower expectations, and measuring whether growers incorporate or improve their IPM practices as a result.

We have developed a number of methods to evaluate the success of workshops in meeting grower expectations. These include questionnaires on current practices used by growers, their perceptions of pests and diseases in their region, written 'promises' following the two-day workshop and workshop evaluation sheets completed by participants for the two-day workshop and the Third Day meeting. During the two-day workshop there were also reports from group discussions concerning the management of major pests in the region (eg. *What do we do now?* and *What do we want to change?).* In the Third Day meetings following harvest, participants reported on their experiences of implementing new practices in their vineyard. Written reports were also presented by those seeking formal accreditation under the Australian National Training Association (ANTA) scheme.

Results

Defining IPM

The positive response by participants to the information presented implies industry acceptance of the basic IPM concept, ie. that *best practice pest management* within current constraints depends on a high level of knowledge of the target pest and on-going monitoring. Acknowledgment of regional variation in the occurrence of specific pests (Fig. 1) has helped illustrate the importance of monitoring and managing pests based on the circumstances in the region and the vineyard rather than general industry-wide recommendations.

There has been some indication that more traditional growers in the Sunraysia region of Victoria and in Queensland are not interested in attending IPM workshops. They believe they would be asked to eliminate the use of chemicals without viable alternatives. In contrast, some workshop participants commented that they expected more emphasis on cutting out the use of chemicals altogether.

The complexity of a dynamic IPM approach, based on a better understanding of the vineyard ecosystem, has stimulated participants to think and discuss together new ways to manage pests and diseases in their vineyards. Variability across regions and between seasons means that the IPM approach provides tools to develop customised pest management programs. Participants recognise that IPM is a long-term approach to better pest management, and that historic information, preparation and planning are important.

Target audience

Since October 1997, 30 two-day training workshops with more than 600 participants and nine post-harvest Third Day meetings have been held in grape growing regions in New South Wales, Victoria, South Australia, Western Australia and Tasmania.

As indicated in Fig. 3, 75 percent of workshop participants were grape growers. Chemical representatives and resellers, consultants and educators have also recognised the importance of improving the knowledge base to address IPM and have participated in each regional workshop.

The workshops attracted participants with a diverse range of experience and knowledge. By presenting information using various approaches including interactive sessions and demonstrations, participants were able to draw out the information relevant to them at different levels. For example, inexperienced participants asked questions that ensured the basic information was clearly explained, while others were able to put new approaches into context and contribute valuable local experience to the discussions.

A majority of the grower group came from privately owned vineyards, although support from corporate vineyards has also been very positive. Managers and monitoring staff from the same vineyard have often attended workshops together. This has resulted in improved communication and understanding of the tasks required and provided a basis for a 'team approach' to pest management with positive results. Some companies have requested workshops specifically for their employees while others prefer to attend with growers from other companies. We have found that participants from different vineyards have worked extremely well together to address pest and disease issues in the region, with very few signs of hesitation to maintain a perceived competitive advantage.

Educating local chemical resellers and consultants has also provided an effective method of getting information and services out to growers. Several chemical resellers and other workshop participants have begun offering pest monitoring services. This has helped overcome a major obstacle for the adoption of IPM as many growers now have access to monitoring information through scouts and consultants. The contact with pest consultants also helps them gain confidence in effectively identifying and monitoring various pests and diseases, and subsequently adopting a more strategic approach to pest management.

Program structure/information delivery

Surveys of participant responses showed that they were very satisfied with the content and the structure of the 2-day workshops. They indicated that demonstrations in the vineyards and the potential for immediate application of information was very useful. For example, many who previously thought that lightbrown apple moth egg monitoring was too difficult, found that vineyard demonstrations and subsequent success in their own vineyards gave them much more confidence in managing this pest. Although it is often difficult for growers to take two days off during busy periods, they have clearly indicated that they prefer workshops during the season rather than over the winter.

The compilation of information into accessible and improved management practices was a key component of the program. There has been substantial comment on the value of the manual for gaining practical, accessible information. Many have reported that they consult their manual when they are unsure about identification or when making treatment decisions. Participants often lend their manual to other employees, friends or neighbours.

There was variable response to participant group sessions. In reporting back to the whole group, participants provided feedback to presenters on their understanding of the information presented, and gave the opportunity for immediate recognition by the group of potential changes they could make in relation to the specific pests and diseases covered. Personality issues and expertise of group members had an influence on the outcome of some sessions. Some participants found them extremely useful, while others preferred more interaction with presenters than with other growers.

Many participants made positive comments on the quality of the speakers. Poor presentation skills were ameliorated by the structure of the workshop, repeat performances and training workshops for presenters. Standardised presentations saved preparation time for presenters and were very helpful for less accomplished presenters. The presenters' expertise and depth of understanding of the subject were most appreciated by participants. The scientific facilitator and workshop facilitator were both able to support those who lacked confidence or polish. Participants were rarely critical of presentation style if information presented was useful and presentation materials were clear.

By the Third Day post-harvest meeting, workshop participants had thought about the information, tried new methods, and were keen to discuss them. A typical comment from a grower was, "I saw my neighbour out there spraying, and since attending the IPM workshop, I knew he was wasting his time and money." Most came prepared to present the issues which they were considering, comfortable with their questions or level of understanding. Even the most shy were willing to report on their 'promises' and discuss relevant issues. Participants felt they benefited from hearing the experiences of others in the Third Day meeting and discussed their approaches to similar problems.

Researchers found the reports and discussions with growers during the Third Day meetings were very useful. It gave them a better understanding of the way growers perceive the information and its relevance to their management practices. Researchers received feed-back on their work, gained insights into problems encountered under commercial practice and identified needs and priorities in research directions.

The growers' responses during the Third Day meetings showed that they had gained confidence in monitoring and were more confident in their treatment decisions. They recognised the value of being more able to identify pests and diseases and recognised the importance of field demonstrations and diagnostic tools such as moist incubation for diseases and information cards which include size of instars and development time of larvae (Fig. 4).

The Information Package

Feedback from over 600 participants has indicated that they place a high value on the information presented as well as the opportunity to discuss ideas with presenters and other growers. They have shown particular interest in tools that will help them to measure and evaluate IPM management techniques.

Response to the information presented in the workshop has been extremely favourable. While some participants recognised that they had read many articles with similar information, it was difficult for them to put it all together. Putting national and international research results into a local context gave growers confidence that they were up with the latest information and in a better position to question and evaluate its relevance. Educators who participated were more able to understand the information needed for training pest consultants, managers and vineyard workers .

The involvement of recognised experts as presenters and the use of standardised presentations was most effective. Presentations were developed using visual images and words on PowerPoint© and high quality photographic slides on an adjacent screen. When presenters did not follow the prescribed format, participants indicated that the information was more confusing and that they did not get as much out of the presentation.

Fortunately, researchers have been very cooperative, both in contributing to the development of the information and to the presentation and interaction with growers. Participants have indicated that they prefer local researchers to be included when they are available. The shared knowledge has provided a sound basis for more effective communication between researchers and growers.

By speaking to growers and service providers in each region and sending out surveys prior to each workshop to identify regional differences, we have been able to focus each workshop on the key pest and disease issues. Fig. 5 gives an indication of the variability between regions. The level of group concern has an effect on determining which topics are presented. Gaps in information have been highlighted and in some instances more research was required before we could provide participants with answers about the best options. We found it essential to have practical management options backed with science to present topics satisfactorily.

The identification of gaps in knowledge and barriers to the adoption of specific practices has also resulted in development of new research directions. For example, while spray application is a key

component of effective pest management, growers do not have the assessment tools necessary for evaluating their performance in this area. As a result, a new research project is aimed at developing a field kit that would enable growers to evaluate the dose of chemical reaching a spray target.

Evaluation

We have used feedback from workshop evaluation surveys, and participants' and presenters' comments to modify the workshop format and presentations, and to improve presentation skills. Comparison of information between workshops has given insights into regional variations and perceptions. The survey of current used by participants prior to the workshop will be compared with information from repeat surveys after 2 or 3 years.

Discussion

IPM is a relatively new approach to pest management in vineyards. As growers become more experienced and confident using IPM processes, we expect improved economic returns in the short term and a better understanding of IPM's potential for meeting the demands of a changing marketplace, for resistance management and environmentally sustainable viticulture practices. In most cases, growers are keen to improve their pest management as they face more restrictions on chemical use.

IPM itself is a dynamic process, involving growers, researchers, chemical companies, and others in the industry. It continues to change and grow in the light of new observations, evidence and experiences. We have become more aware that IPM requires an extensive support system including targeted research, monitoring, diagnostic and information services as well as trained consultants. The reduction in government provision of extension services has hampered the implementation of IPM in recent years, but has resulted in more commercial services being developed.

It has become more apparent that a *best practice* IPM program in viticulture is very complex. A clear and comprehensive understanding of all the pests, diseases and management options available is an immense task. For the vineyard manager, this is coupled with the need to consider other aspects of integrated crop management (ICM) which includes vine nutrition and soil and water management.

An important aspect of this project has been the contributions of participating researchers, consultants and growers who helped in the translation of new methods, tools and decision-making guidelines into a *user-friendly* integrated approach. As teaching modules and guidelines for competency training were put into use, scientists participated in teaching situations and workshops.

The adoption of new techniques takes time. Growers would like to reduce sprays and still sleep at night. To gain the confidence necessary to initiate IPM methods, they need up-to-date information and understanding of pest and disease activity in their vineyards. This means there must be identification and diagnostic tools and methods available, and effective demonstration and training (Pascoe and Glenn 1997).

Although it is difficult to estimate the number of participants who have adopted IPM practices, the most common comment about the effects of the workshop is that it has changed the way they look at

their vines. Identification skills and knowledge about management options and variation due to regional factors have modified participants' perception of pest management and resulted in the first stage of IPM implementation. Many growers have realised that the broad knowledge base of IPM makes it easier to get planning and management decisions 'right', and to avoid unanticipated problems and often costly *ad hoc* solutions. Several growers reported that they had begun regular monitoring of lightbrown apple moth. They would have normally applied sprays, but after finding no sign of lightbrown apple moth, they did not spray. This has resulted in many thousands of dollars in savings for growers, as many regions had low population pressure of lightbrown apple moth in the 1997-98 season.

Closer involvement of growers and crop consultants in research, training and technology transfer gives IPM the greatest chance of adoption. The implementation of IPM systems will be tested and validated over the next few years by the growers. Those methods that meet their requirements will stand the test of time. The breadth of the IPM knowledge network means solutions to difficult pest management problems may be more easily found in the future. Trained crop consultants, providing commercial services in IPM, and trained growers act as seeds to spread information. There is broad support from the viticulture industry and researchers for the continuation of the program. A model for self-funded workshops will be finalised within the next few months. Viticulture consultants and large wineries have expressed interest in organising future workshops, with the on-going participation of trained facilitators and presenters and a central coordinator to update information and organise workshop materials.

This *Research to Practice*™ model has been adapted to workshops on soil and water management in viticulture and to IPM in processing tomatoes. The same format has been used for the Water Management for Grape Production: *Research to Practice*™ with little need for modifications. It has been altered significantly for IPM in tomatoes, to accommodate the different groups of participants and their needs, and to service only 70 growers as compared to over 5000 in grapes.

An improved capacity for IPM strategic decisions needs a support framework of knowledge and expertise. This depends not only on developing the confidence to change, but also achieving the technological competence and the commitment to implement the changes. The *Research to Practice*™ model has contributed to a sense of regional understanding, confidence and security which creates a positive attitude toward change. Discussions with other growers, commitments to try new approaches and the opportunity to discuss these changes with technical experts as well as other growers in the region has supported implementation of new IPM approaches. The *Research to Practice*™ model, tested over two seasons, is likely to substantially change future pest management practices within the viticulture industry. Although it is difficult to measure the direct impact of this program on adoption of new practices, participant surveys have suggested that there has been an increase in vineyard monitoring, and a more informed and strategic approach to spray programs. The effect of the *Research to Practice*™ program on adoption of improved IPM practices will be more fully evaluated within the current year of the project.

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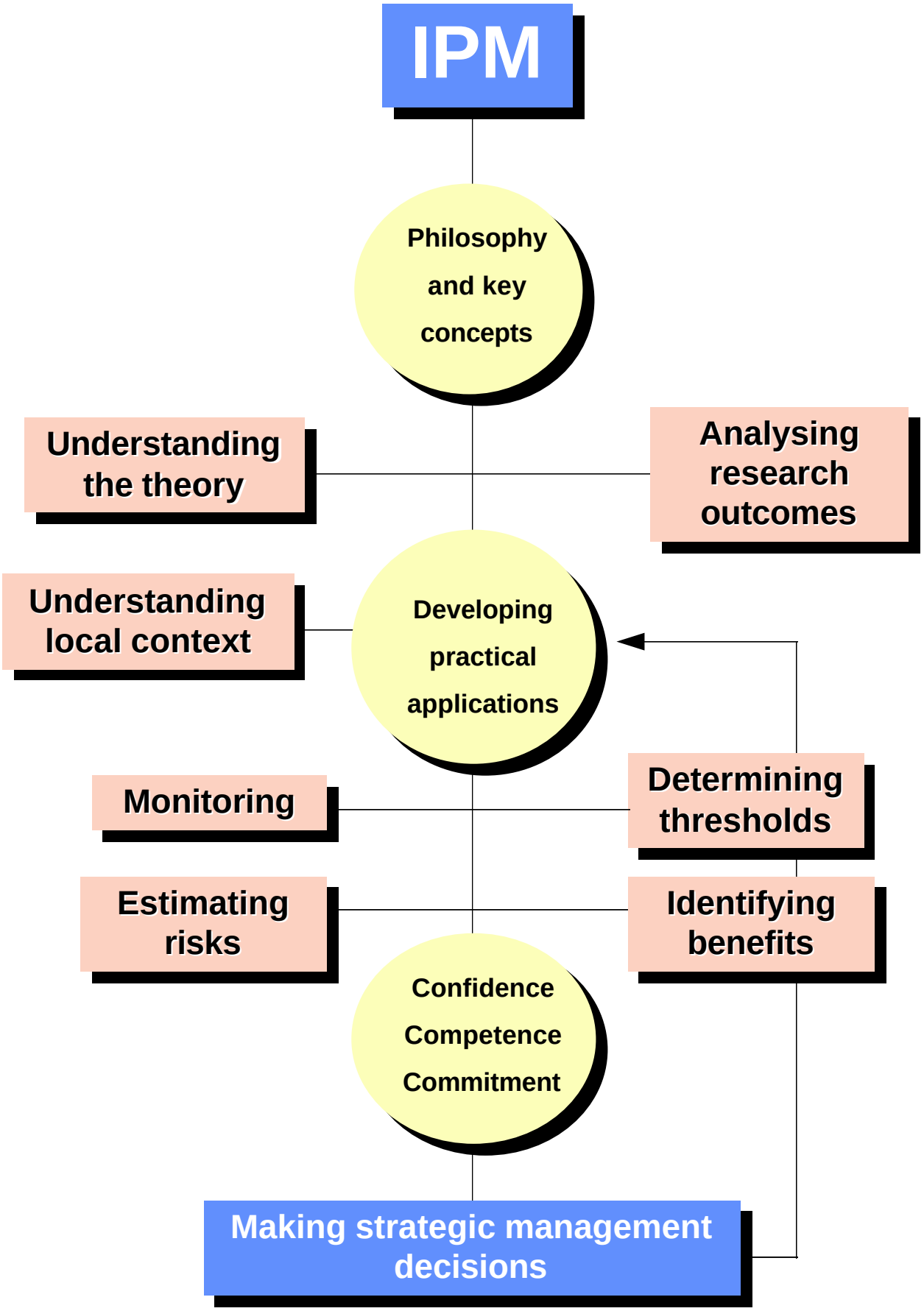


Fig. 1. Flow chart of *Research to Practice*™ Model.

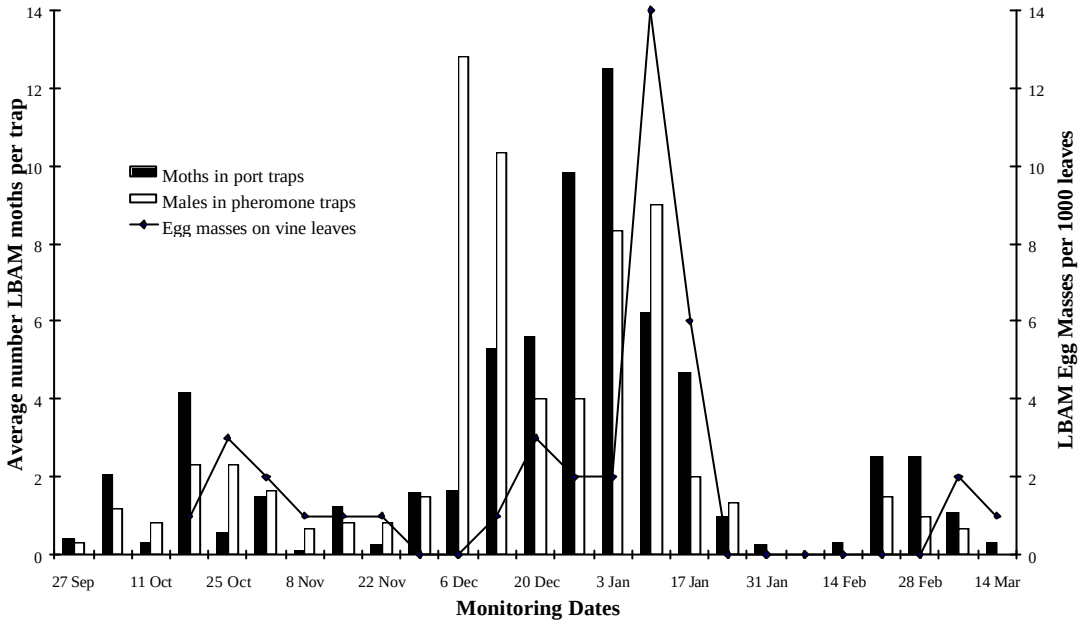


Fig. 2. LBAM monitoring data collected over one season, including number of egg masses found per 1000 vine leaves, and average number of moths in pheromone traps and lure pots (graph modified from Glenn and Hoffmann 1997).

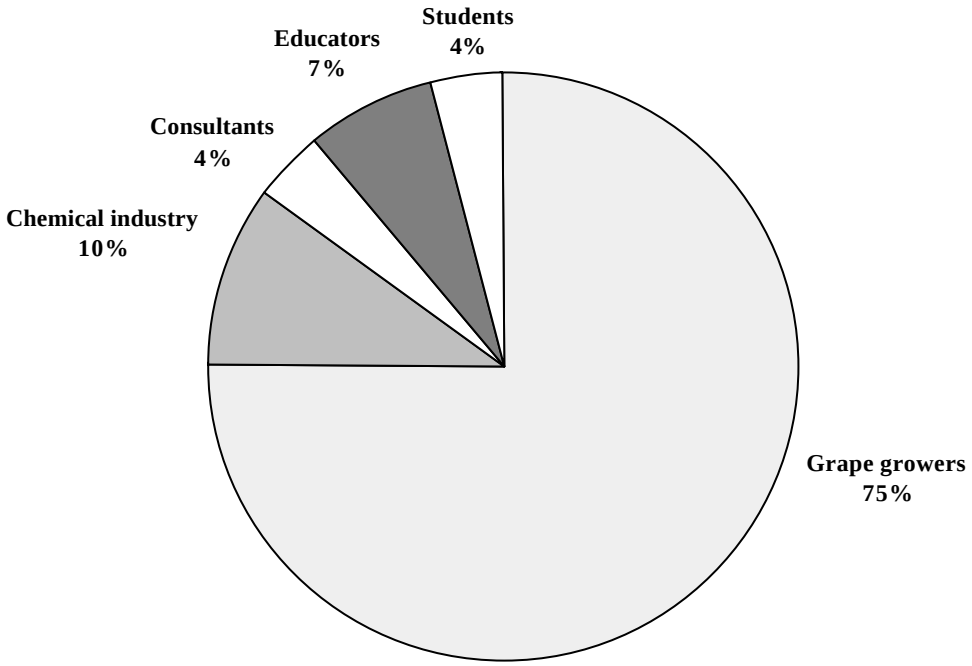


Fig. 3. Breakdown of workshop participants by occupation.

LBAM	Approx. Growth Rate (days)		Head width	Body length	**Size Range** Each Square = 5 mm
Instar	**spring**	**summer**	mm	mm	
egg	19	8			
1	16	4	0.2	2	
2	7	4	0.3	4	
3	7	3	0.4-0.5	5-6	
4	14	6	0.6-0.8	7-9	
5	11	8	0.8-1.0	10-12	
6	22	7	1.1-1.4	15-20	

Fig. 4. Size and development chart from monitoring card for lightbrown apple moth.

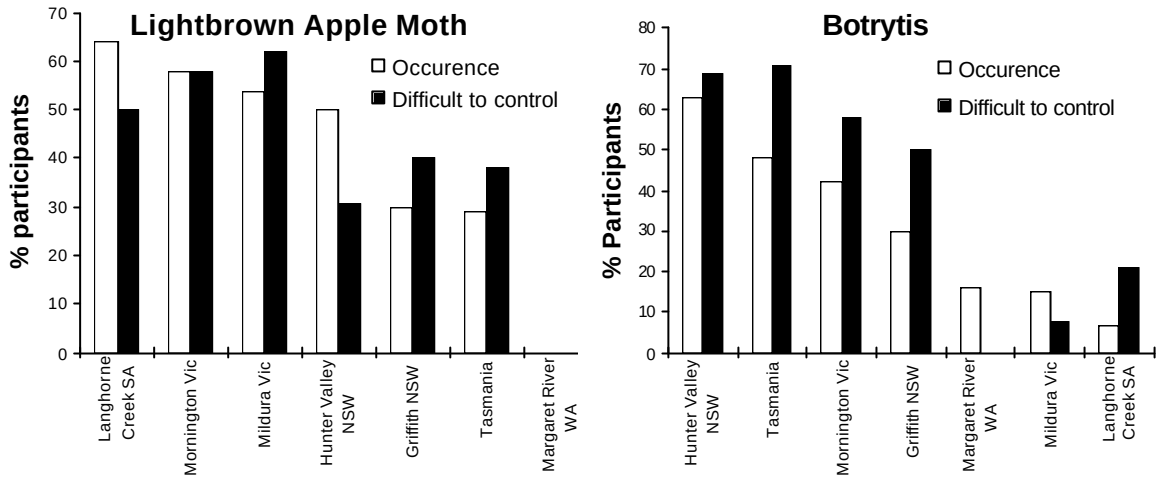


Fig. 5. Summary of response to surveys of regional workshop participants concerning occurrence and difficulty controlling lightbrown apple moth and Botrytis.