

VG503

**Training program for growers on pests
and natural enemies in vegetable crops**

Sue Heisswolf, et al
QDPI



Know-how for Horticulture™

VG503

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**HORTICULTURAL
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**Partnership in
horticulture**

Training Program for growers on pests and natural enemies in vegetable crops

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Final report for HRDC project VG503

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Industry summary

Vegetable growers are under increasing pressure to reduce pesticide use in crops due to insecticide resistance problems, environmental concerns and marketing pressure. One option for minimising reliance on insecticides is to implement Integrated Pest Management (IPM) programs on farm.

The project goal was to place growers and industry in a better position to make sound pest management decisions within an IPM framework by building on their ability to identify pests and Beneficials in vegetable crops. A training program based on a workshop process and manual to deliver training in identification of pests and Beneficials in vegetable crops was developed for the project. This training program was tested with Lockyer Valley growers at three workshop series in April 1997.

The training program

The training program included an awareness meeting, a workshop series based on two field sessions and two laboratory sessions, and an evaluation meeting to conclude the training. Both the workshop manual and workshop series were based on the concept of classifying pests and Beneficials into broad groups to illustrate similarities in life cycles feeding habits, physical characteristics for these different groups and how this impacts on identification and management.

Training sessions for the workshop series were designed to be practical and involved the extensive use of specimens for identification and discussion in the laboratory. The field sessions were based on "learning by doing" and involved collecting pests and Beneficials in the field, identifying specimens and building on basic crop scouting skills. The laboratory sessions were also interactive and involved small group work, use of microscopes and identification of a wide range of pests, Beneficials and damaged plant specimens. Participants were also asked to complete an insect collection as part of the program.

Outcomes from the workshops

Over fifty growers and industry staff took part in the awareness meeting and workshop places were filled within 2 weeks of this meeting. Of the 46 participants that commenced workshop series, 43 took part in all four training sessions and over 50% of participants participated in the evaluation meeting. The strong demand for by growers for this type of training indicates that there is scope for expanding the training program into other crops or regions.

Evaluation of the workshop series showed that participants had increased their ability to identify pests and Beneficials by the end of the training sessions and that they had found both the laboratory and field sessions useful.

The colour workshop manual developed for the workshops was well received by participants and industry. The text, colour images and line drawings of the manual are stored in electronic format, providing flexibility in adapting the manual for use in other horticultural industries or regions. The stone fruit and apple industry has already made use of this resource by developing workshop manuals for training programs for their growers.

Technical summary

Vegetable growers are under increasing pressure to reduce pesticide use in crops due to insecticide resistance problems, environmental concerns and marketing pressure. One option for minimising reliance on insecticides is to implement Integrated Pest Management (IPM) programs on farm. A key component of IPM is the correct identification of pests and Beneficials within crops in order to improve pest management decisions.

The project goal was to place growers and industry in a better position to make sound pest management decisions within an IPM framework by building on their ability to identify pests and Beneficials in vegetable crops. A program based on a workshop process and manual to deliver training in identifying pests and Beneficials in vegetable crops was developed for the project. This training program was tested with Lockyer Valley growers at series of three workshops in April 1997.

Action learning and adult education

A feature of the program was to utilise a training delivery approach based on adult education and action learning principles. This involved the use of small group work, practical activities and a minimum of lecture style presentations to establish an interactive, supportive learning environment. Training sessions were designed to build on existing experience of participants, encouraged sharing of knowledge and learning with peers through discussion, and tended to be problem based rather than subject based.

Sessions were structured so that participants were encouraged to move through the four phases of the action learning cycle (act, reflect, decide and plan). This process facilitated assimilation of new information by allowing time for reflection, questioning and discussion, and provided scope for incorporating various training delivery methods to cater for differences in learning preferences and knowledge amongst participants.

The training program

The training program included an awareness meeting, a workshop series based on two field sessions and two laboratory sessions, and an evaluation meeting to conclude the training. In keeping with adult learning principles (involve adults in planning), session dates, times and sequence were decided with potential participants at the awareness meeting. While a basic structure for the training sessions existed, there was limited scope for rearrangement of content and training delivery in response to participants' requests.

Structure of the workshops and manual

Both the workshop manual and workshop series were based on the concept of classifying pests and Beneficials into broad groups (orders) to illustrate similarities in life cycles feeding habits, physical characteristics for these different groups and how this impacts on identification and management. Specific examples of pests and Beneficials in vegetable crops were then used to illustrate these differences in orders. This approach was used for several reasons:

- To illustrate a framework for classifying insects, mites and spiders similar to those used by entomologists rather than concentrating on identification of specific specimens to name in the first instance

- To assist participants in linking of different orders of pests and Beneficials to possible management options and strategies
- To build on existing experience of participants and so build confidence and facilitate learning. Most participants had prior knowledge of grouping insects, spiders and mites although they had not thought of these groups as orders in an entomological framework.

Training sessions were designed to be practical and interactive involving extensive use of specimens for identification. The field sessions were based on “learning by doing” and involved collection of pests and Beneficials, identification of specimens and practicing basic crop scouting skills. Laboratory sessions involved use of microscopes to group a range of pests and Beneficials and match pests with damaged plant material. Small group work was used in both the field and laboratory sessions to encourage discussion of topics covered and learning from peers. As part of the training program, participants were also asked to complete an insect collection.

The key objectives for each component of the training program were as follows:

The awareness meeting

This meeting was used to generate interest in the workshops and negotiate dates and times. It was held five weeks before the first training session and was of about 2 ½ hours duration

The workshop series

Each workshop series consisted of four training sessions of 2 to 2 ½ hours duration. The main components of each session are listed below:

Field session 1

- Introduction to finding and collecting pests and Beneficials in the field
- Collection of baseline information for workshop evaluation purposes

Laboratory session 1

- Building on participants existing knowledge in grouping pests and Beneficials
- Providing opportunities for practicing skills in identifying pests and Beneficials into groups, using microscopes and handlens, and preserving insects

Field session 2

- Introducing concepts of crop scouting and applying these principles in the field

Laboratory session 2

- Introducing the concepts of life cycles, mouthparts and other characteristics of different groups and how these relate to crop damage and pest management
- Applying these concepts to identify crop damage
- Reinforcing concepts and collecting evaluation data through a practical exam

The evaluation meeting

This meeting was held three weeks after completion of the last workshop series. It involved gathering of information from workshop participants using the focus group technique.

Outcomes from the workshops

The project resulted in a structured training program based on adult education and action learning principles and a colour workshop manual with an extensive collection of line drawings and colour images.

For this project, over fifty growers and industry staff took part in the awareness meeting and workshop places were filled within 2 weeks of this meeting. Of the 46 participants that commenced the workshop series, 43 took part in all four training sessions and over 50% of participants took part in the evaluation meeting.

Evaluation of the training program showed that participants had increased their ability to identify pests and Beneficials by the end of the training sessions and that they had found both the laboratory and field sessions useful.

The colour manual was well received by participants and industry. Seventy copies of the manual were initially produced for the project, but since then an additional 150 copies have been reprinted. The text, colour images and line drawings of the manual are stored in electronic format, providing flexibility in adapting the manual for use in other horticultural industries or regions.

The strong demand by growers for this type of training indicates that there is scope for expanding the training program into other crops or regions. At the request of industry, additional, crop specific workshops were held for a group of Lockyer Valley Brassica growers in spring 1997. The training program and workshop manual has also been adapted and used for delivering training in pest and Beneficials identification for stone fruit and apple growers on the Granite Belt.

The training program has also served as the basis for delivering extension training to Chinese extension officers as part of an ACIAR (Australian Centre for International Agricultural Research) project.

Recommendations

Design of training sessions

Our experience in developing the workshops showed that action learning and adult education concepts are useful tools for designing training programs. Use of these principles improved the rigour of the workshop design by ensuring that training sessions:

- built on participant's experience
- catered for different learning styles of participants
- included practical components
- allowed time for discussion and reflection
- encouraged learning from peers
- and were problem based rather than subject based.

Workshop evaluation results showed that material covered in training sessions needed to be seen as relevant by participants. Participants at the workshops varied age, level of farming experience, and educational level. A percentage of participants were also primarily involved in the seedling nursery industry and did not perceive the field training as directly relevant to their work.

Within the action learning cycle there is scope to tailor the content of training sessions to the particular needs of prospective participants. In future workshops, more emphasis should be placed on involving participants in the planning phase of the action learning cycle to increase workshop relevance and flexibility. For example, during workshop registration, background information on interests, skills and knowledge level of participants could be collected to enable trainers to better tailor training to participants needs. This may be achieved by grading participants and assigning them to different workshops, making workshops more crop specific or offering additional, more difficult activities to more advanced participants.

Insect collections

Insect collections were seen as a useful component of the training program although only 15% of participants completed their collections to a high level. The insect collection should continue to be offered as an optional component at future workshops but could perhaps be made more attractive by involving participants in the choice of what to collect. For instance, examples of each insect order specific to a crop of interest or complete life cycles for pests and/or Beneficials of interest.

Field sessions

Two factors appeared to be important in delivery of the field sessions. Firstly, a wide range of pests and Beneficials active in the crop appeared critical to providing opportunities for new learning and maintaining interest. In our workshops, the unsprayed planting of brassicas were seen as particularly useful for supplying a range of material for identification, however monitoring of commercial crops was seen as less useful due to low pest activity. However, monitoring of on farm crops should remain a component of the training as it illustrates crop scouting under realistic conditions. Perhaps the reasons for checking crops with low pest activity need to be explained more clearly.

Secondly, directions to field sites and organisation of the field sessions need to be clearly outlined to participants, with attention given to the forging links between skills and concepts

learnt during the field sessions and the laboratory sessions. In future workshops, the organisational and linking components of the field sessions need to be strengthened.

The development of the workshop manual

The computer technology available through DPI Indooroopilly greatly assisted with development of the manual by providing flexibility, delivering a high quality colour workshop manual, providing an existing resource of colour images and line drawings and a vehicle for expanding this image library. Text, colour images and line drawings used in the manual are stored in electronic format and can be easily adapted for use in similar workshops in other regions or crops. It would be useful if future projects involving the generation of colour images utilised this DPI to further expand the range of images available for extension publications and activities.

Expertise required for delivering the training sessions

Different types of expertise are required for developing and delivering training based on adult education principles. These include entomological skills, extension process skills and practical skills in local pest management. Future workshops should utilise three types of trainers; an entomologist, an extension specialist and a local consultant to provide expertise in these different areas.

Evaluation of the training program

The evaluation process used during the program fulfilled two functions. Firstly, as a data gathering tool for evaluation purposes and, secondly, as a tool for the reflection and decision making phases of the action learning cycle. While overall, the process worked well, the collection of baseline data at the beginning of the first training session proved time consuming and was perhaps not the most effective method for starting the workshop series. In future workshops, it could be more effective to collect baseline data prior to the first training session, perhaps as part of the workshop registration process.

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Introduction and background

Vegetable growers are under increasing pressure to reduce pesticide use in crops due to insecticide resistance problems, environmental concerns and marketing pressures. Insecticide resistance in particular, is a major issue for the vegetable industry with pests such as heliothis, diamondback moth (cabbage moth), aphids and mites becoming increasingly difficult to manage successfully.

Apart from reducing insecticide resistance problems, other benefits of minimising insecticide use include:

- less risk to the environment and rural communities
- a safer working environment for farmers and their staff
- reduced risks of pesticide residues on produce
- improved access to export markets with residue restrictions

One approach for reducing reliance on insecticides is to implement an Integrated Pest Management (IPM) approach to manage pests. IPM involves using a range of pest management techniques in combination in order to keep pests below economic damage levels. In IPM, insecticides are used strategically for managing pest outbreaks.

Correct identification of pest and beneficial insects, spiders and mites is critical to managing pest outbreaks within an IPM framework. An understanding of which pests are likely to cause problems and which Beneficials may be useful for reducing pest levels helps to reduce reliance on pesticide sprays as the primary method of managing pests

The project goal was to place growers in a better position to make sound pest management decisions by building on their ability to identify pests and Beneficials in vegetable crops. This involved the following objectives:

- To develop a structured training program based on adult education principles
- To develop a colour workshop manual to complement the training program
- To test the training program and workshop manual by holding two workshops in the Lockyer Valley
- To evaluate the workshops and workshop manual

An earlier pilot project funded by QFVG and HRDC in 1994/95 served as the basis for the project. The workshop format used in this earlier project was reviewed leading to the development of a more flexible structure based on practical, interactive training sessions. The black and white workshop manual from the pilot project was further developed into a colour manual with an extensive collection of photos and line drawings.

Materials and Methods

The project team was comprised of three entomologists, two extension officers and one entomological technician from two different regions of the Department of Primary Industries Queensland. Staff was also contracted in Brisbane to develop the workshop manual and at Gatton College to assist with the preparation of laboratory materials. A diary of events is shown in Table 1.

Table 1 **Diary of events.**

Activity	Dates and locations	Objectives
Pilot workshops	March to April 1995 Granite Belt	To test the workshop concept
Training of extension staff	Autumn and Spring 1995 Rural Extension Centre, Gatton College	To develop skills in using current extension principles in the development, delivery and evaluation of training programs
Upgrade workshop manual	Monthly meetings of extension staff from October 96 to March 1997	To develop a high quality colour manual for use in workshops
Planning meeting with team members	22 January 1997 Gatton Research Station, Lockyer Valley	To develop action plan and distribute tasks amongst team members
Progress meeting with team members	21 March 1997 Applethorpe Research Station, Granite Belt	To report on progress, deal with problems and finalise timeframes for the workshops
Newspaper articles and leaflets	Late February to early March 1997	To publicise awareness meeting and workshops
Awareness meeting	27 February 1997 Gatton, Lockyer Valley	To create interest and register growers for the training program To discuss best options for holding the workshops with potential participants
Delivery of the training program	10 April to 2 May 1997 Gatton Research Station Entomology Laboratory, Gatton College Local farmers properties	To improve participants skills and knowledge of pests and Beneficials identification
Evaluation meeting	24 May 1997 Gatton	To evaluate the workshop series with participants and trainers

To help coordinate project activities, different tasks were allocated to team members at the planning meeting on the 22 February. These tasks were allocated depending on regional location and expertise:

- Extension staff were responsible for the development of the workshop manual and processes
- Entomological staff at Applethorpe produced the collection kits

- Entomological staff at Gatton were provided the majority of material used in the laboratory sessions with assistance from staff at Applethorpe
- The project leader was responsible for the coordination of planning meetings, publicity, organising venues including field sites, workshop registration and sponsorship

Progress in these different areas was reviewed at the meeting on 21 March. At the same meeting, decisions on which team members were responsible for delivering the various segments of the training sessions were also finalised.

Adult Education theories used to develop the workshops

Adult education principles outlined by Burns (1995), Knowles (1990) and Fell (1986) were used to develop and deliver the workshops. They include the following general concepts:

- Participation and self-direction by involving participants in planning the training sessions. One function of the awareness meeting was to determine the best time and place for the workshops, the best way of combining the laboratory and field modules and taking on board suggestions such as having the workshop dinner breaks sponsored by industry
- Building on experience for example, by using small group work to encourage sharing of information and learning from peers.
- Avoiding a classroom approach whenever possible by making sessions active through practical exercises and interactive by encouraging and making time for questions and discussion.
- Incorporating time for reflection and discussion to allow learners to think through new or more difficult information.
- Giving positive feedback to give a sense of progress to participants
- Making sessions problem based rather than subject based to encourage practical application of learning

The overall aim was to use adult education concepts to design training sessions that were interesting, active, social, varied in their presentation and encouraged participants to learn in a way most suitable for them.

The action learning cycle

The Kolb learning cycle as described by McGill and Beaty (1992) was the basis for developing each training session. Our interpretation of its components is shown in Figure 1.

The action learning cycle is a useful framework for incorporating adult education principles into training activities and by moving through different phases of the learning cycle, adults are encouraged to:

- reflect on learning activities
- decide how learning relates to their own situation
- plan how to incorporate learning to solve real problems
- and then apply this learning

This process helps adults assimilate learning by building on their own experience.

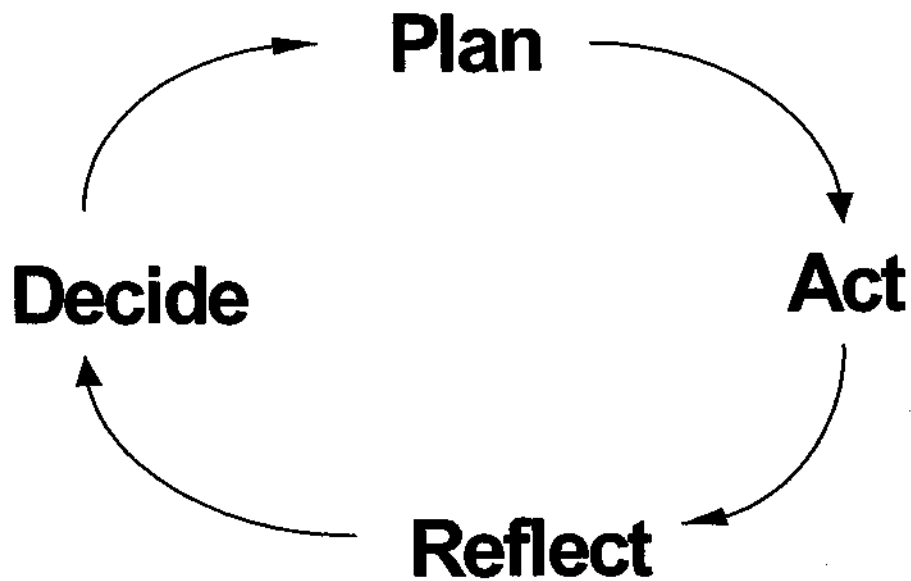


Figure 1: Components of the action learning cycle (adapted from McGill and Beaty, 1992)

Preferred learning styles

Mumford (1993) aligned four learning styles to different phases of the action learning cycle and this was another concept that was considered during training development and delivery. A brief description of the four learning styles (as summarised by Smith 1995) follows:

- Activists are open minded, uncomfortable with restrictions and become bored with long term considerations and tedium
- Reflectors need to think about experiences, analyse situations, delay making decisions and are cautious.
- Theorists are objective and rational, need to know why, dislike uncertainty and need to see patterns.
- Pragmatists like to try out ideas and techniques, are practical, realistic and dislike unresolved discussions.

A study by Smith (1995) with field crops farmers in South Burnett, Queensland, found that farmers tended to have a preference for reflector and pragmatist activities. This supports our experiences with vegetable farmers who enjoy activities that are practical and so illustrate how learning can be applied to their farming situation (the planning component of the action learning cycle). Farmers also gain much from discussing an activity or concept with their peers as this seems to assist with analysis of a concept or new practice and how this may impact on their current farming system (the reflective component of the action learning cycle).

Perceptual modalities

Wislock (1993) describes perceptual modalities as the means through which information is extracted from the environment. He suggests four different types of perceptual modalities:

- Visual – learning through reading, pictures, drawings
- Aural – learning through sound
- Interactive – learning with others
- Haptic – learning through hands on experience

As with preferred learning styles, the perceptual modalities concept deals with an individual's preference for learning. We used this concept to ensure that different methods of training delivery were utilised during training sessions.

Building on past experience

“Chunking” (or schemas) was a key concept used to structure the workshop manual and the basis on which the content of the workshop was delivered. According to Huber (1993) chunking or combining new bits of information with what is already known facilitates the storage of new information in long-term memory and also determines what importance and an individual places on new information. By linking new knowledge and skills with an individual's way of organising different aspects of the world, that is, by building on past experiences, learning and the introduction of new concepts is facilitated.

Workshop evaluation

An evaluation process was incorporated into the overall workshop design. A subject on evaluation of extension projects was being offered by the Rural Extension Centre, University of Queensland Gatton College (REC), in late 1995 and Ms Heisswolf took the opportunity to develop a participative evaluation process for this project as a case study for the REC course.

The seven-tiered hierarchy of evaluation criteria described by Bennet (1975) was a key tool used for structuring the evaluation process. This hierarchy and its relationship to the process used for evaluating the project are outlined in more detail in Table 2.

According to Bennett, data required to evaluate extension can be divided into seven levels, with levels one to three dealing with extension inputs, activities and people involvement while levels four to seven focus on the outcomes of these extension inputs and activities such as participants reactions, learnings, changes in practice and their results.

Bennett also suggests that these levels are interlinked with a lower level generally being an indicator for impact on the next level of evaluation criteria. For instance, if participant's reactions to an extension activity are unfavourable then they are less likely to learn new skills leading to a change in practice as a result of the activity. This concept of linkages between different levels of evaluation criteria can be applied in two ways:

- To help track the direct impact of a particular activity on higher levels of evaluation criteria ie. assist with screening out external impacts
- To help decide at which level data needs to be collected to evaluate the impact of a particular activity

Table 2 Bennett's hierarchy and the relationship with the evaluation process in the Pest and Beneficials Identification Training Program.

Level of evidence (Bennett 1975)	Evidence of impact of the training program	Data collection tools used
End result	Not evaluated – an example would be reduction in pesticide use	
Practice change	<i>Considered a low priority for evaluation</i> Majority of participants who complete the training employ a crop scout or systematically check crops prior to making a spray decision	Baseline data questionnaire Exploration of follow up data collection options during focus group interviews
Change in Knowledge Attitudes Skills Aspiration changes (KASA change)	<i>Considered a high priority for evaluation</i> Knowledge Participants able to classify pests and Beneficials into groups Skills Participants able to use a hand lens Attitudes Participants see Beneficials as important in managing pests Aspirations Participants intend to implement IPM	Baseline data questionnaire Practical exam questionnaire Focus group interviews
Reactions	Participants report favourably on the workshop 30% of participants complete the insect collection	Concluding comments in the practical exam questionnaire
People involvement	80% of participants complete the workshop series 50% of participants attend the evaluation meeting	Registration and attendance records
Activities	Eight hours of structured training plus awareness and evaluation meetings	
Inputs	Documented in the funding proposal	

These two ideas are useful for deciding between information that must be obtained, should be obtained or would be of interest to obtain (Woods, pers. comm.). Bennett (1975) argues that in general it becomes more difficult to obtain reliable evidence of extension impact as the hierarchy is ascended. Quantitative data is often more expensive to obtain, qualitative data which is collected may be more difficult to interpret confidently, and links between an activity and its impact becomes more difficult to attribute to that specific activity.

If the purpose of evaluation is seen as “the systematic collection of information to assist in decision making” (Wissemann, pers. comm.), then a compromise must be reached between the resources allocated for evaluation, the level of evidence required to make reliable decisions about the training program and the rigour of data that can be obtained within budget constraints.

After discussion with the project team, the following key questions were seen as important to the evaluation process:

- What level of skills and knowledge have participants gained during the workshop?
- Does taking part in the workshop change participants’ attitudes towards pests and Beneficials?
- Has there been a change in the way pests are managed on the farm?
- Are there any changes needed to the workshop process and manual to better achieve the project objectives?

Several data collection tools were used to collect information to answer these questions and these are outlined against Bennett’s hierarchy in Table 2. Baseline data was gathered through Questionnaire 1 (Appendix III) to provide information on the current level of skill and knowledge as well as general pest management practices. An exam style practical session at the end of Field day 2 was used to obtain information on changes in skills and knowledge. The completion of an insect collection was seen as an indicator for skill improvement.

Semi-structured interviews were used at the evaluation meeting:

- to explore changes in participants attitudes and aspirations with regard to managing pests as a result of the training
 - to obtain comments and suggestions for improving the workshop process and manual
- The sequence of questions used for these interviews is outlined in Appendix III). An attempt was also made to develop a process for following up changes in pest management practice on farm.

Once a decision on the evidence to be gathered for the evaluation is made, another aspect that should be considered is the benchmarks against which evidence is to be measured. This will contribute towards rigour of the evaluation process by setting a measurable goal, which if achieved, indicates that the training program has met particular performance criteria.

This concept is illustrated in Table 2 Column 2 – Evidence (Performance indicators). For example, for our training program, we set a benchmark of 80% completion rate for workshop series as indicating that the training program had been effective at the People Involvement level of Bennetts hierarchy.

Results and discussion

Summary

The workshops filled quickly and there was demand for further workshops. Two crop specific workshops based on the concepts developed in this project have already been held in the Lockyer Valley and similar workshops have been held in the stonefruit and apple industries on the Granite Belt. We have also been invited to develop and deliver a train the trainer program based on these workshops as part of an international project between Queensland and Australia funded by the Australian Centre for International Agricultural Research (ACIAR).

Forty-six people registered for the April 1997 workshops with all except three participants completing the four training sessions. Support from industry was also extensive and is illustrated by sponsors providing meals and drinks for the workshops as well as prizes for the best insect collections.

The colour manual has sparked a great deal of interest and all 75 copies produced for the workshops have been distributed to industry people with a further 100 copies printed for use in future workshops. There may be scope to print the manual through DPI publishing services as a commercial venture once further improvements have been made, especially since interest in the manual has been shown in other regions, interstate and overseas.

As documented in the evaluation results (Appendix IV) the interactive, practical approach to the training sessions was well received and in general, participants appeared to enjoy the workshop and found the training useful. There is some indication that the field sessions will need further improvement.

Structure of the training program

The training program was based on three components; an awareness meeting, a series of four training sessions and an evaluation meeting to conclude the training.

The awareness meeting

This meeting was used to stimulate interest in the workshops, obtain an idea of likely participant numbers, and involve potential participants in the setting of times and dates for the workshops. The meeting was advertised through the local newspaper and used a topical issue as a drawcard (copies of articles are attached in Appendix V). At the time, marketing of leafy vegetables into Victoria was creating some concern for local growers due to changes in quarantine regulations.

The meeting was 2 ½ hours in duration and commenced with a presentation and discussion on regulations for leafy vegetable marketing in Victoria. This session was followed by a pest identification activity to illustrate the interactive nature of the proposed workshop series. The meeting concluded with a discussion session to decide options for the workshops and possible dates and times. Growers were encouraged to register their interest at the meeting and

specific times and dates were advertised in the local paper over the following weeks, inviting growers to sign up for their preferred option. These options are outlined in Table 3 below.

Table 3 Workshop options available to Lockyer Valley vegetable growers for attending the Pest and Beneficials Identification Training Program.

Workshop No.	Sessions and dates	Times for the different sessions
Workshop 1 Thursdays Dates	Field session Dinner break Lab session 10 April 24 April	3.30 to 5.30 pm 7.00 to 9.00 pm (Field session 1 & Lab session 1) (Field session 2 & Lab session 2)
Workshop 2 Thursdays Dates	Field session Dinner break Lab session 17 April 1 May	3.30 to 5.30 pm 7.00 to 9.00 pm (Field session 1 & Lab session 1) (Field session 2 & Lab session 2)
Workshop 3 Fridays Dates	Field session Dinner break Lab session 10 April 24 April	1.00 to 3.00 pm 3.30 to 5.30 pm (Field session 1 & Lab session 1) (Field session 2 & Lab session 2)

The training sessions

The workshop was built on four modules; two laboratory sessions and two field sessions. In the previous pilot workshops on the Granite Belt in 1995, the laboratory sessions preceded the field session i.e. Laboratory session 1 was followed by Field session 1, followed by Laboratory session 2 and concluding with Field session 2. These sessions were held at weekly intervals.

In response to suggestions from potential participants at the awareness meeting, modules were reorganised, with Field session 1 preceding Laboratory session 1 on Day one of training

and Field session 2 preceding Laboratory session 2 on Day 2 of training a fortnight later. On each day, the field and laboratory sessions were separated by a meal break.

The outcome of participating in the training program was to develop:

- skills in identifying common pests and beneficials found in vegetable crops
- an increased understanding pests and beneficials lifecycles and their importance to monitoring and management of pests
- skills in collecting pests and beneficials for later identification
- a basic understanding of pest levels and pest control options and their effect on parasite and predator levels

To achieve this outcome, key objectives for the training sessions were as follows:

Field session 1

- Introduction to finding and collecting pests and Beneficials in the field
- Collection of baseline information for workshop evaluation purposes

Laboratory session 1

- Building on participants existing knowledge in grouping pests and Beneficials
- Providing opportunities for practicing skills in identifying pests and Beneficials into groups, using microscopes and handlens, and preserving insects

Field session 2

- Introducing concepts of crop scouting and applying these principles in the field

Laboratory session 2

- Introducing the concepts of life cycles, mouthparts and other characteristics of different groups and how these relate to crop damage and pest management
- Applying these concepts to identify crop damage
- Reinforcing concepts and collecting evaluation data through a practical exam

Participants had minimal input into the development of these objectives. In future workshops it would be useful to explore ways of increasing participant involvement in planning the workshop process and content. Comments from participants and results from the evaluation indicate that the general process for the workshop series worked well but that there is scope to adjust workshop content depending on participant's specific needs. For example:

- Allowing more time for linking pest and beneficial lifecycles to management
- Placing greater emphasis on choice of management strategies in relation to crop scouting results
- Greater use of crop or industry specific examples depending on areas of interest of participants
- Placing laboratory sessions before field sessions to improve linking of theory with practice

Details on the components of each training session, approximate times taken and processes used are outlined in Appendix 1.

Evaluation meeting

A meeting to evaluate the workshops was held three weeks after completion of the last training session. Over 50% of participants took part in this meeting. We recruited extension staff with experience in adult education and facilitation to assist with the evaluation process by facilitating discussion groups during the meeting. This was to improve the rigour of the process as well as allowing trainers to reflect on the workshops.

Focus group formats were used to lead the discussions and details of questions used are given in Appendix IV. Note that questions for the two groups of participants varied to those used by the trainers. For each of the three groups, one facilitator led the discussion, while another acted as group recorder. A tape recorder was also used to assist with later interpretation of the discussion.

Key comments from each group were reported back to the whole group for comment and discussion. The meeting concluded with the presentation of certificates and awards, and a BBQ and drinks.

Development of the workshop manual and insect collection kits

The process used to develop the manual in time for the April 1997 workshops revolved around regular meetings, generally on a monthly basis, of the three staff involved. These staff were based in Brisbane, Applethorpe and Gatton and the process of regular meetings assisted with the decision making process and ensured the manual was ready in time for the workshops. Seventy manuals were produced initially and since the workshops in April 1997 a further 100 copies have been used. These were easily reprinted, as the manual is stored in electronic format. Components of the manual have also been adapted for delivery of workshops in the stonefruit and apple industry.

The manual was developed using Pagemaker 5.0 but printed using Pagemaker 6.0. Photoshop 4.0 was used for editing and enhancing images before importing these into Pagemaker 5.0. Scanning was done on a Nikon LS-1000 slide scanner and these images were stored on JAZ disks in TIF format. Manuals were printed using a Canon colour Laser Copier. A copy of the workshop manual is attached.

The entomological team at Applethorpe was responsible for the collation of materials for the insect collection kits. Delegation of this task to a small group in a regional location worked well and the kits were completed well within time of the first workshop.

The kits included a x10 hand lens, collection net, killing jar, killing fluid, 2x small specimen tubes (glass), 2x larger specimen tubes (plastic), forceps, probe, instruction booklet, mounting board, entomological pins, paper strips.

Application of adult learning principles in delivery of the training sessions

The principles of adult learning and the action learning cycle were useful for designing training sessions that incorporated different styles of presentation in a logical manner. This ensured that each session contained an activity phase that was practical, a discussion stage to

encourage reflection, opportunities for linking learning with past experiences, and a planning stage to encourage ownership of the whole process.

In particular, application of the action learning cycle was useful for ensuring that adequate time was allocated for participants to reflect and decide on information presented or activity undertaken. These reflective sessions consisted of either a question and answer session or a group discussion. Table 4 illustrates application of the action learning cycle for delivering one of the workshop field sessions.

Using of the second field session shown in Table 4, two points are worth considering with regard to use of action learning to deliver training sessions.

- Is time used effectively? In this example, crop scouting is explained by a consultant, then practiced in the field in small groups, then reviewed in a large group discussion by considering pest management implications of crop scouting results. Similar information could perhaps be presented in a shorter time frame by giving a presentation of these different aspects of crop scouting but would this method be as effective? Or would there be a tendency for trainers to present too much information for participants to absorb and integrate with their existing knowledge base?
- Is trainer control over information generated reduced? Small group activities and discussions lend themselves to utilising and sharing of knowledge amongst participants. However, while trainers can influence the interpretation of this knowledge by guiding the discussion, the key concepts can be difficult to draw from the group. Is this a problem?

In future workshops, it would be useful:

- to critically review the processes used in the training sessions to ensure that time is used effectively when moving through the action learning cycle
- to ensure that facilitators are clear on the key objectives of each training session and how components within the session reinforce, link with and build on key concepts within the training program.

Table 4 Outline of the second field session of the Pest Identification workshop illustrating the application of the action learning cycle

Session component	Format of delivery	Component of the action learning cycle?
Explain crop scouting and its purpose - how to monitor a crop for insects	Informal presentation by a local consultant	PLAN
Monitor crops and discuss possible management options (using Questionnaire 3 Appendix II)	Small group activity	ACT REFLECT
Discuss monitoring results and decide best management options	Large group discussion	REFLECT DECIDE

Preferred learning styles and perceptual modalities

As a result of structuring sessions using the action learning cycle and adult education principles, the training program tended to cater for individual preferences for learning.

Each session filled the requirements of the four preferred learning styles outlined by Mumford (1993):

- Activist – by encouraging interaction and questioning eg. small group work, practical activities
- Reflector – by including processes which encouraged reflection on new learning eg. discussions, questionnaires, workshop manual
- Theorist – by providing principles and structures eg. classification into groups, structure of workshop manual
- and Pragmatist – by incorporating practical sessions during field and laboratory sessions eg. practical activities and examples that assisted with application of concepts

The action learning process also provided opportunities for incorporating a range of tools and methods for training delivery into the workshop. This ensured that variations in individual preferred perceptual modalities (Wislock 1993) were taken into account during training. Examples used during the training sessions are outlined in Table 5.

Table 5 Training program components used in the workshops to cater for different perceptual modalities as described by Wislock (1993)

Example of learning tool or technique	Perceptual modalities involved
Using the colour workshop manual	Visual (print and pictures)
Videos	Visual and aural (pictures and sound)
Discussions	Interactive
Use of microscopes	Haptic (hands on experience)
Monitoring for pests in crops	visual, interactive, haptic
Small group work	Interactive, haptic
Presentations	Visual, aural

“Chunking” to build on past experience

We used “chunking” to introduce the concept of insect orders as used by entomologists at the first training session by asking participants to sort through coloured cards of insects, spiders and mites. In small groups, we asked participants to order like with like and then collated the reasons for why they had decided on the different groupings on a whiteboard. This then led to the introduction of orders as a way of grouping pests and Beneficials.

The idea of orders to group pests and Beneficials was used throughout the workshop manual. This is illustrated by the brief descriptions of the three main sections of the manual:

- An introductory section which introduces the idea of insect orders, lifecycles, damage symptoms, general identification features
- A section on identifying the different insect orders with more detailed descriptions of what separates different orders from each other
- A colour section organised according to insect orders and consisting of a collection of photos of major pests and Beneficials found in vegetable crops with accompanying description

This concept was reinforced during training sessions by linking groups of pests and Beneficials to discuss general traits of different orders eg. how many wings, what type of life cycle, what type of mouthpart and the type of damage different orders were likely to cause.

Workshop evaluation results

Thinking through and developing an evaluation process which attempts to move beyond the reaction level of a training activity was a valuable learning experience as it raises questions such as:

- How do we know if the extension activity has been effective?
- How do we measure this effectiveness?
- How much and what type of data do we need? And who will analyse this data?
- What's the cost/benefit?

Outcomes from the evaluation has been chiefly positive. Using the performance indicators outlined previously in Table 2 against Bennett's (1975) hierarchy of evaluation, the following conclusions can be drawn.

Level 2 – Activities

The aim was to complete a series of training sessions for two workshops of about 15 people per workshop. This performance indicator has been exceeded as due to demand for the workshops, three not two workshops were held with a total of 46 growers and industry staff starting the workshop series.

An awareness meeting and an evaluation meeting were held as well as three lots of 9 hrs of structured training sessions.

Level 3 – People involvement

Of the 46 participants who started the workshop series, 94 % completed the workshop series, with those who were unable to attend all sessions placing an apology with the trainers and quoting other more pressing commitments as the reason for not attending. Over 50% of participants took part in the evaluation meeting. About 30% of people that attended the workshop were from the nursery industry and this contingent made up the majority of participants that attended the evaluation meeting.

Level 4 - Reactions

Two specific questions and a request for comment were included in Questionnaire 2 (Appendix III). Information from this questionnaire has been summarised in Table 6.

Table 6 Reactions of workshop participants to the training sessions based on information gathered in Questionnaire 2 (Appendix III)

	Useful	Quite useful	Not sure	Sometimes useful	Not useful		
The field sessions were:	65%	29%	-	6%	-		
The laboratory sessions were:	52%	45%	-	3%	-		
Comments on the field sessions:							
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> Enjoyed how to identify insects Good to see demonstration of techniques Identified insects that I didn't really know Entomologist present to identify what was found (in the field) </td> <td style="width: 50%; vertical-align: top;"> Unsprayed broccoli crop was an eyeopener Enjoyed the field session Not enough insects infield (sprayed crop) Where to look for things </td> </tr> </table>						Enjoyed how to identify insects Good to see demonstration of techniques Identified insects that I didn't really know Entomologist present to identify what was found (in the field)	Unsprayed broccoli crop was an eyeopener Enjoyed the field session Not enough insects infield (sprayed crop) Where to look for things
Enjoyed how to identify insects Good to see demonstration of techniques Identified insects that I didn't really know Entomologist present to identify what was found (in the field)	Unsprayed broccoli crop was an eyeopener Enjoyed the field session Not enough insects infield (sprayed crop) Where to look for things						
Comments on the laboratory sessions:							
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> Laboratory sessions were quite interesting Use of microscopes to identify small insects Use of microscopes to look at insects in detail Microscope use to watch cannibalism in action </td> <td style="width: 50%; vertical-align: top;"> Use of microscopes to see insects clearly Good insect collections at lab sessions Good material in lab Good range of insects that were quite different </td> </tr> </table>						Laboratory sessions were quite interesting Use of microscopes to identify small insects Use of microscopes to look at insects in detail Microscope use to watch cannibalism in action	Use of microscopes to see insects clearly Good insect collections at lab sessions Good material in lab Good range of insects that were quite different
Laboratory sessions were quite interesting Use of microscopes to identify small insects Use of microscopes to look at insects in detail Microscope use to watch cannibalism in action	Use of microscopes to see insects clearly Good insect collections at lab sessions Good material in lab Good range of insects that were quite different						
General comments on the training program							
<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; vertical-align: top;"> Saw things not seen before First week a bit basic Learning without feeling stupid ID of insects and knowing if they are good or bad </td> <td style="width: 50%; vertical-align: top;"> Very good printed material Enjoyed insect ID and their function Looking at damage (was good) Instructors were helpful </td> </tr> </table>						Saw things not seen before First week a bit basic Learning without feeling stupid ID of insects and knowing if they are good or bad	Very good printed material Enjoyed insect ID and their function Looking at damage (was good) Instructors were helpful
Saw things not seen before First week a bit basic Learning without feeling stupid ID of insects and knowing if they are good or bad	Very good printed material Enjoyed insect ID and their function Looking at damage (was good) Instructors were helpful						

Results indicate that participants saw the training program as enjoyable and useful although results gathered during the focus group interviews (Appendix IV) highlight specific areas of the training that could be improved.

About 15% of participants completed their insect collections to a high standard, so while this particular indicator was not met (our target was 30%) the high percentage of participants who graded the training as either useful or quite useful suggests that at the reaction level the training program was a success.

Level 5 – Changes in Knowledge, Attitudes, Skills and Aspirations

The questionnaires/exams were useful tools for reflection but were not detailed enough to measure changes in skills and knowledge to any depth. Lengthier questionnaires however would have interfered with the workshop process and been seen as too tedious by participants.

A comparison of baseline data collected at the start of the workshop (Questionnaire 1 – Appendix III) and at the end of the second field session (Questionnaire 2 – Appendix III) is given in Table 7. These results show that participants had improved their skills and knowledge by the end of the workshop.

Table 7 Degree of change in skills and knowledge of participants. Results are summarised from data gathered with Questionnaire 1 & 2 (Appendix III).

Workshop number	No. of Questionnaires returned	Knowledge of insects, mites and spiders grouping		Skills in identifying pests and Beneficials into groups		Knowledge about life cycles	
		Baseline Q2	Practical Exam Q1	Baseline Q3	Practical Exam Q3	Baseline Q4	Practical Exam Q2
1	15	73%	77%	43%	78%	80%	62%
2	7	82%	83%	53%	64%	64%	86%
3	11	80%	89%	48%	81%	36%	70%
Questionnaires returned	72%	77%	85%	47%	77%	44%	70%
Increase in skills and knowledge		8%		30%		26%	

The focus group interviews at the evaluation meeting were an excellent method for obtaining ideas on how to improve the training sessions and workshop manual and but less useful for gathering impressions on changes in attitude and aspirations.

The focus group questions used for participants and trainers as well as a summary of responses are supplied in Appendix IV. Results to specific questions relating to assessing changes in attitude and aspirations are as follows:

Do you feel more confident about identifying pests and Beneficials in your crop?
Responses ranged from not feeling confident to being confident

At this stage do you intend to change the way you manage pests on your farm as a result of the workshop?

Nursery staff did not see a great deal of relevance of crop scouting to their situation although they did mention that they had become more aware

Response from others varied and but was no real indication that participants were going to change their pest management practices

External indicators of attitude, aspiration and practice change

Indicators external to the formal evaluation process show that the workshops have contributed to changes in attitudes and aspirations with regard to pest management:

- One business is planning to buy a microscope to encourage staff to continue developing their identification skills
- Positive comments from industry people other than participants about the workshops
- A waiting list of vegetable growers for the next series of workshops
- There have been a number of requests for extra copies of the workshop manual and there may be scope to publish the manual as a commercial venture

It is difficult to attribute changes in practice to any particular extension activity. Two other changes which relate to IPM have occurred in the Lockyer Valley since the April 1997 Pest and Beneficials ID workshops. Firstly, at a field day held at a grower property to discuss pest management, the concept of IPM was well supported and the discussion revolved around how to implement rather than if to implement IPM. This was a change from previous field days where the usefulness and practicality of IPM was questioned.

Secondly, a small group of local growers initiated the formation of a Brassica Improvement Group in the Lockyer Valley in February 1998. The objective of this group is to improve production by improving the knowledge and skills base of group members. This is achieved by inviting experts to address specific issues at group meetings. For instance, two brassica specific workshops modelled on the concepts and techniques of this project were held for local growers in spring 1998.

Key growers and industry staff involved in the field day and formation of the Brassica Improvement Group also took part in our Pest and Beneficials Training Program. As these people have also been involved in other IPM projects conducted over the past few years it is difficult to specify what contribution the Pest and Beneficials ID workshops made in helping to change grower perceptions, aspirations and practice with regard to IPM.

Perhaps the important point to make is that a by promoting the use of IPM over several years through a variety of methods, grower attitudes and aspirations shifted over time to create practice change. One key to creating practice change within a complex environment may therefore be the consistency of messages produced from a range of projects and activities to all parts of an industry over several years.

Conclusions and recommendations

The overall response to the workshops has been very positive. Over fifty growers and industry staff took part in the awareness meeting and workshop places were filled within 2 weeks of this meeting. Of the 46 participants that commenced the workshop series, 43 took part in all four training sessions and over 50% of participants took part in the evaluation meeting.

The project has resulted a structured training program based on adult education and action learning principles and a colour workshop manual with an extensive collection of line drawings and colour images.

While the evaluation provided mixed results on the impact of the workshops particularly at the level of attitude, aspiration and practice change, indications are that the project has had an impact on grower practice. Evaluation of the training program showed that participants had increased their ability to identify pests and Beneficials by the end of the training sessions and that they had found both the laboratory and field sessions useful. A trend in increased use of crop scouting as a pest management tool and grower initiated opportunities for further training in Pest Identification workshops should result in increased adoption of IPM techniques and concepts, resulting in decreased dependence on insecticides for pest control.

Design of training sessions

Our experience in developing the training program showed that action learning and adult education concepts are useful tools for designing training sessions. Use of these principles improved the rigour of the workshop design by ensuring that training sessions:

- built on participant's experience
- catered for different learning styles of participants
- included practical components
- allowed time for discussion and reflection
- encouraged learning from peers
- and were problem based rather than subject based.

The workshop evaluation results showed that material covered in training sessions needed to be seen as relevant by participants. Participants at the training sessions varied age, depth of farming experience and educational level. A percentage of participants were also primarily involved in the seedling nursery industry and did not perceive the field training as directly relevant to their work.

Within the action learning cycle there is scope to tailor the content of training sessions to the particular needs of prospective participants. In future workshops, more emphasis should be placed on involving participants in the planning phase of the action learning cycle to increase workshop relevance and flexibility. For example, during workshop registration, background information on interests, skills and knowledge level of participants could be collected to enable trainers to better tailor training to participants needs. This may be achieved by grading participants and assigning them to different workshops, making workshops more crop specific or offering additional, more difficult activities to more advanced participants.

Insect collections

Insect collections were seen as a useful component of the training program although only 15% of participants completed their collections to a high level. The insect collection should continue to be offered as an optional component at future workshops but could perhaps be made more attractive by involving participants in the choice of what to collect. For instance, examples of each insect order specific to a crop of interest or complete life cycles for pests and/or beneficials of interest.

Field sessions

Two factors appeared to be important in delivery of the field sessions. Firstly, a wide range of pests and Beneficials active in the crop appeared critical to providing opportunities for new learning and maintaining interest. In our workshops, the unsprayed planting of brassicas were seen as particularly useful for supplying a range of material for identification, however monitoring of commercial crops was seen as less useful due to low pest activity. However, monitoring of on farm crops should remain a component of the training as it illustrates crop scouting under realistic conditions. Perhaps the reasons for checking crops with low pest activity need to be explained more clearly.

Secondly, directions to field sites and organisation of the field sessions need to be clearly outlined to participants, with attention given to the forging links between skills and concepts learnt during the field sessions and the laboratory sessions. In future workshops, the organisational and linking components of the field sessions need to be strengthened. To aid this linking of concepts, we recommend that the laboratory sessions precede the field sessions.

The development of the workshop manual

The colour manual was well received by participants and industry. Seventy copies of the manual were initially produced for the project, but since then an additional 150 copies have been reprinted. The computer technology available through DPI Indooroopilly greatly assisted with development of the manual by providing flexibility, delivering a high quality colour workshop manual, providing an existing resource of colour images and line drawings and a vehicle for expanding this image library.

The text, colour images and line drawings of the workshop manual are stored in electronic format, providing flexibility in adapting the manual for use in other horticultural industries or regions. It would be useful if future projects involving the generation of colour images utilised this DPI resource to help further expand the range of images available for extension publications and activities.

Expertise required for delivering the training sessions

Different types of expertise are required for developing and delivering training based on adult education principles. For the Pest and Beneficials ID training program, these include entomological skills, extension process skills and practical skills in local pest management. Future workshops should utilise three types of trainers; an entomologist, an extension specialist and a local consultant to provide expertise in these different areas.

Evaluation of the training program

The evaluation process used during the program fulfilled two functions. Firstly, as a data gathering tool for evaluation purposes and, secondly, as a tool for the reflection and decision making phases of the action learning cycle. While overall, the process worked well, the collection of baseline data at the beginning of the first training session proved time consuming and was perhaps not the most effective method for starting the workshop series. In future workshops, it could be more effective to collect baseline data prior to the first training session, perhaps as part of the workshop registration process.

Transferability of the workshop process

The strong demand by growers for this type of training indicates that there is scope for expanding the training program into other crops or regions. At the request of industry, additional, crop specific workshops were held for a group of Lockyer Valley Brassica growers in spring 1997.

The program and workshop manual has also been adapted and used for delivering training in Pest and Beneficials ID for stone fruit and apple growers on the Granite Belt. The training program has also served as the basis for illustrating Australian extension techniques and concepts to Chinese extension officers. This training was part of an ACIAR (Australian Centre for International Agricultural Research) funded project.

The workshop format developed as part of this project could be used to design workshops to provide training in dealing with other production issues in vegetable crops. For example, the processes developed could be used to design similar training programs for disease, weed and disorder identification.

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Appendix 1 Session plans

(a) Awareness meeting

Activity	Time allowed	Objective	Process/Materials used
Introduction	10 min	Get the meeting started	
Presentation on quarantine requirements to Victoria	50 min	To act as a drawcard as this was a topical issue at the time	OHT presentation for 20 min then general question and answer session
Coffee break	15 min	Allow everybody to mingle and walk around	
Pest ID exercise	15 min	Create interest in workshops	Small group work with facilitator
Discuss workshop options	15 min	Encourage potential participants to get involved in structure of workshops	Small group work with a facilitator
Finalise workshop options	15 min	Get some consensus on best timing	Discussion as a large group with facilitator

(b) First field session

Activity	Time allowed	Objective	Process/Materials used
Sign up and filling out of questionnaire 1 baseline data	As participants arrive	To collect baseline information on skills and knowledge	Individuals complete questionnaire
Expectations session followed by a brief outline of sessions	20 min	To encourage participants to contribute and link expectations to workshop contents	Round robin session
Introduction to and handing out of insect collection kits	20 min	To familiarise participants with contents of collection kit and explain role of kit in workshops	Presentation with trainers demonstrating use of equipment
Using kit contents in the field	60 min	To develop skills in insect collecting	Small group work in different crops
Discussion on what was found in different crops	20 min	To expand knowledge on variety of pests and Beneficials identified	Large group discussion Show and tell format leading into possible management strategies

(c) First laboratory session

Activity	Time allowed	Objective	Process/Materials used
Flash cards session	30 min	To link what participants already know with the concept of insect orders	Small group work followed by facilitated whiteboard session and introduction to the workshop manual
Use of microscopes and handlens	20 min	To develop skills in using identification tools	Trainer leads participants through the use of these tools
Identification of specimens and discussion on results (See list of specimens in Appendix)	50 min	To develop skills in grouping pests and Beneficials into different orders	Pest and Beneficials identification work in pairs Discussion in large group
Preserving insects	20 min	Re introduce the insect collection kit Start developing skills in preserving pests and Beneficials	Show "Kill and pin" video Demonstration on how to preserve a butterfly Individuals pin butterflies

(d) Second field session

Activity	Time allowed	Objective	Process/Materials used
Introduction to crop scouting and its purpose by a consultant	15 min	To put crop monitoring in context as a crop management tool and decision making aid	Presentation by consultant Action threshold guidelines for different crops supplied
Crop scouting exercise	45 min	To develop skills in crop scouting	Participants monitor crop in pair or groups of three using monitoring sheets
Discussion of crop scouting results and possible actions	45 min	To develop skills in interpreting crop scouting results; linking orders to life cycles and damage potential and making management decisions	Discussion in large group
Monitoring test	15 min	To reinforce monitoring skills, consolidate learning To collect data for evaluation purposes	Individual exercise

(e) Second laboratory session

Activity	Time allowed	Objective	Process/Materials used
Introduction to life cycles, mouthparts	15 min	To relate orders and their life cycles, mouthparts etc to damage caused in the field	Presentation with visual aids
Practical exercise in identification of symptoms and possible causal agents	50 min		Work in pairs or groups or three to identify specimens (Important to include a range from easy to difficult) Group discussion on results
Share individual insect collections	30 min	To encourage group learning To introduce a wider range of specimens	Small group work
Practical exam using a range of specimens	15 min	To reinforce learning To collect data for evaluation purposes	Individual exercise
Workshop closure and planning for the evaluation meeting	10 min	To involve participants in planning for the evaluation meeting	Short presentation followed by large group discussion

(f) Evaluation meeting

Activity	Time allowed	Objective	Process/Materials used
General introduction	10 min	Get the meeting started	Presentation
Evaluation sessions - concurrent 1. Focus group interviews with participants 2. Evaluation of workshops by trainers	90 min	Obtain information on: <ul style="list-style-type: none"> • changes in attitudes and aspirations • reactions to the workshop process and manual • Consolidate learning for participants and trainers 	Focus group interviews Two groups of participants and one group of trainers using external facilitators
Explore follow up evaluation process with participants	20 min	Attempt to devise a post workshop evaluation strategy	Large group discussion
Conclude formal part of the meeting	30 min plus	Encourage socialising Presentation of certificates and prizes for collections	BBQ and drinks

Appendix II

List of specimens for Laboratory Session One

Insect/arachnid group	First preference	Second preference	Third preference
Moths and butterflies	Heliothis adult	Cabbage moth adult	Spodoptera adult
Flies	Hover fly adult	Fruit fly adult	Bean fly adult
Lacewings OR dragon fly	Green lacewing adult	Brown lacewing adult	Dragon fly
Wasps, bees, ants	Orange caterpillar parasite adult	Aphid parasite adult	Bee adult
Beetles	Two spotted ladybird adult	Transverse ladybird adult	Stripped ladybird adult
Thrips	Onion thrips	Bean blossom thrips	Plague thrips
Bugs	Aphid - winged and not winged forms	Vegetable jassid adult	Green Vegetable bug adult
Bugs	Assassin bug adult	Damsel bug adult	Predatory shield bug
Mites	Two spotted mite	Predatory mite	Tomato russet mite
Spiders	Flower spider	Wolf spider	Lynx spider

Appendix III - Questionnaires

Questionnaire 1

Collecting baseline information

To determine if the training sessions are useful, we need to have some idea on how much you know about identifying pests before the workshop starts. We (you and the trainers) can use this information at the end of the workshop to see if the training has been useful.

Without using your manual, please answer the following questions

Question 1 This question is from the awareness meeting in February (at the Gatton Bowls Club). Some of you have already answered the question and your answer sheet *may* be in your collection kit. To answer this question, collect a black and white answer sheet from one of the trainers as well as one of the colour photo sheets. Return the colour sheet to the trainers when you have finished the question.

Question 2 Entomologists classify insects into a different group from spiders and mites. What makes the two groups different?

Spiders and mites have.....legs andantennae

Insects have.....legs andantennae

Question 3 Insects are further classified into groups called "Orders" depending on their physical characteristics. Circle your answer to the following questions.

A fly has.... 2 4 6wings and.... 4 6 8legs

Beetles have.... 2 4 6wings and.... *chewing* .. *sucking* .. *rasping* ...mouthparts

Bugs have.... 2 4 6wings and.... *chewing* .. *sucking* .. *rasping* ... mouthparts

Ants are in the same order as.... *bees* *lacewings* *earwigs* *aphids* *termites*

Question 4 Most insects, mites and spiders change as they mature into adults.

- The change can be gradual with immature stages resembling adults. This is called *Incomplete Metamorphosis*. Can you give an example of an insect which undergoes incomplete metamorphosis?

.....

- The change can be more dramatic with immature stages being very different from the adults. This is called *Complete Metamorphosis*. Can you give an example of an insect which undergoes complete metamorphosis?

.....

Why is this knowledge important in pest management?

.....
.....

Question 5 Choose a vegetable crop that you have grown over the last year or two and intend to grow in the future.

The crop is

Think about how you manage pests in this crop in a normal season.

What are three methods that you use?

.....
.....
.....

What is the most damaging pest in the crop?

.....

What are three other pests that can cause problems in the crop?

1 2 3

Is it easy for you to find and identify these pests in the field?

.....

Question 5 continued *What were the most common insecticides you used last season to control pests in this crop?*

Insecticide:

How many sprays/crop?

.....
.....
.....

Do you tank mix insecticides?

What's a common mixture for the crop?.....

Why do you use this mixture?.....

Do you check the crop before spraying? Please circle your answer.

Always	Usually	Sometimes	Never
--------	---------	-----------	-------

Do you employ a crop scout?

Do you keep spray records for the season?

Question 6 *What do you understand by the term Integrated Pest Management?*

.....

.....

.....

Question 7 *What do you hope to learn at the workshop?*

.....

.....

.....

Questionnaire 2

Insects, Spiders and Mites in vegetable crops Review of the workshop sessions

To determine if the training sessions have been useful, could you complete this short questionnaire? This isn't meant to be an exam!! We hope that by completing this exercise, you will consolidate the last 8 hours of workshop training, and also give us some indication of how useful the training has been for you.

Without using your manual, please answer the following questions

Question 1 Write your answer in the blank space

An insect has legs and antennae

A spider has legs and antennae

A mite has legs and antennae

Question 2 The following pictures are of an adult insect and one of the younger stages in its life cycle. Which type of metamorphosis does each example represent? Circle your answer.

For Questions 3 and 4, we collected some live specimens. There are five examples set up in the room. Using your manual, please answer the following questions.

Question 3 Which group (order) do the following examples belong to? List two features which helped you decide. If you know the name of the pest or beneficial, please give its name.

Example 1

This is a

Features that helped me decide were

(a)

(b).....

Example 2

This is a

Features that helped me decide were

(a)

(b).....

Example 3

This is a

Features that helped me decide were

(a)

(b).....

Example 4

The damage has been caused by

Features that helped me decide were

(a)

(b).....

Question 4

Example 5

You have found an unusual insect in your crop and wonder if it could become a problem. Using the materials provided, package up the insect so you can have it identified later. What else could you do to find out more about the insect?

.....
.....

Question 5 We would like to know what you thought of the workshops. Please circle the answer that best describes your feelings on the workshop. Feel free to make comments as well.

(a) The field sessions were

- | | | | | |
|--------|--------------|----------|------------------|------------|
| Useful | Quite useful | Not sure | Sometimes useful | Not useful |
|--------|--------------|----------|------------------|------------|

Comments.....
.....

(b) The laboratory sessions were

- | | | | | |
|--------|--------------|----------|------------------|------------|
| Useful | Quite useful | Not sure | Sometimes useful | Not useful |
|--------|--------------|----------|------------------|------------|

Comments.....
.....

(c) What did you enjoy most about the workshop?

.....

(c) What did you least enjoy about the workshop?

.....

Thank you for your participation. We hope that we will see you at the Workshop Evaluation BBQ in mid May. We will contact you about the place and time later.

Questionnaire 3

Monitoring a crop and making a recommendation

In front of you is a planting of You have been asked to monitor the crop for pests and make a recommendation. The monitoring sheet from Monday looks like this:

Check the crop using your monitoring booklet. What is your recommendation? What are some of the factors you took into consideration before deciding on this recommendation?

.....
.....
.....

If you took no action, what would you expect to see in the crop in a week's time?

.....
.....
.....

Appendix IV

(a) Focus Group Questions for participants at the evaluation meeting

Q1 If your neighbour asked you what you have been doing for the past weeks on a Thursday / Friday, what would you say?

To learn about pests and predators, better identification skills

To learn about damage pests do

To learn about and improve control of pests

For work purposes, because company asked us to go (seedling nursery staff)

As a refresher on what I already know about pest identification and to pick up anything new

Q2 Do you think the workshop has helped with pest monitoring on your farm?

If yes, how?

If no, is there something that could have happened or been included?

Do you feel more confident about identifying pests and Beneficials in your crop?

Why do you say that?

How much more confident are you?

How much of this can be attributed to the workshop?

What happened during the workshop that gave you more confidence?

Various responses:

Not confident to go into the field and identify as there were too few examples, too simplistic and not enough reinforcement

Didn't get a lot of confidence from workshops

Had a good idea about identification before the workshops which the training confirmed

Knew most but learnt to identify a few more pests and Beneficials

Not confident but learnt something

Good to have expert (entomologist) present as support until familiar with what to look for

Good to know which are pests and which are Beneficials

Learnt a lot but wants to learn more

Felt that the number of insects shown was ok and is confident that I could identify in field

Comments for improvement:

Had more than enough time to do everything

Could put more into the Laboratory sessions

Didn't show how much damage insects could do

Focus more on life cycles particularly identifying egg stages

Sketch different stages of pests and Beneficials

Q4 I'm going to ask you about three aspects of the workshop.

The manual

How useful has the workshop manual been at home since the workshop finished?

How useful was the manual during the workshop?

How useful was the manual for the insect collections?

Useful but doesn't substitute practical sessions
Bring egg stages to attention in the manual
Found it very useful since the workshop with good pictures, useful in the field
Colour pictures great – don't get anything from black and white and is worth paying extra for colour
Manual is worth \$30 on its own
Need a good book for the seedling nursery (but needs to be waterproof?), keep as reference
Make manual more robust so it can be used outside
Would be good to do disease identification as well
Use as a reference manual and for collection

The workshops

Think about the workshop sessions, both in the classroom and the field.
 Were you happy with the amount of time spend in the classroom and field (with regard to meeting your objectives)?
 How could we change it to make the sessions more useful?
 Prompts: Content, timing, order and process

Good to do both field and lab sessions, not just told were to look but actually look
Could bring samples back from the field and vise versa
Want hands on practical experience (More?)
Do lab first then go out into the field or could have lab session either end of workshops and field sessions in between
The experimental block (unsprayed broccoli planting) could do a full day on this when bugs are active
The field sessions were good but should include nursery examples (for nursery staff)
Need to know more about what grubs to expect before going out in the field
Good to decide the timings for the meetings democratically (at the awareness meeting)
Meal breaks perhaps a bit long but good to talk with others in between sessions
Use first questionnaire to split participants into different groups depending on crops, field or nursery or skills
The questionnaire made no difference to course, we did a set subject anyway
Could have taken in a lot more in eighth hours
Wanted more structure and sometimes not well organised (field sessions)
Need to cater to different levels of knowledge
Maybe use more consultants
Need follow up on management and how to spray and what to spray

The insect collections

How useful was the collection in terms of improving your insect identification skills?
 How did you feel about doing the collection?

No time and not interested, or done collections in the past (a number of participants)
No time at work and busy at home
Would rather collect during field sessions and then identify in lab (over and done with then)
Only useful if entomologist or as a personal reference collection, handy as a nursery reference collection

*Not enough help with the preservation
 Make collection optional
 Interesting and helps to reinforce learning
 Liked doing the collection and was quite enthusiastic grabbing bugs at work*

Q5 At this stage, do you intend to change the way you manage pests on your farm as a result of the workshop?

If yes, how?

If no, why not?

Two themes:

Nursery staff saw the field work as not relevant to the nursery situation as they see pest management to be preventative quoting a much narrower margin of error for both damage and time to react to pest outbreaks but some commented that it had sparked interest and will help to keep track of pest problems

Workshops were more on identification than management but now more aware

Maybe could manage between prevention and monitoring

Reinforce what I am already doing and manual will be useful to take to farmers

Won't do the monitoring myself but I'll get someone else to do it

(b) Questions for reflection on the workshops for the trainers

Were the objectives of each training session met?

We did seem to achieve objectives and awareness meeting in particular achieved objective of creating interest in the workshops but:

Did not spend enough time on lifecycles

Should spend more time on ordering pests and Beneficials in the lab

Lab sessions did not really follow through to the field

How important is the collection kit to the learning?

Some time wasted because there were too many trainers

Too much travel involved, use local people

General consensus on the flash cards session being very useful to introduce grouping of pests and Beneficials

Were the methods and materials used suitable?

Maybe we could use growers/nursery crops and also have more examples

Use a video as a promotional tool for the workshops

The microscope on TV was fantastic

Buy made up collection nets and killing jars but the collection kit was good in general

Need more than one person to look for suitable crops for the field sessions – the unsprayed broccoli and other crops at the research station were good – perhaps plant unsprayed crops specifically for the workshop

Improvements:

For delivery of the workshops

Have lab sessions in the morning and field sessions in the afternoon

Theory before field might be more successful

Video certain sessions to save time and add more variety (as we did for the kill and pin session) – life cycles would be a good candidate

Some sessions could be longer eg. 3 hrs rather than 2 to 2 ½ although sessions can't be extended too much

Expand life cycle component - use more material for life cycles eg. Crop/life cycle examples

No strong links with killing and preserving insects maybe participants only need to know more about it - Maybe use evaluation method for linking sessions

Need to create a stronger link between identification and control recommendations in the field eg. better structured discussion session after looking in the field to make sure of link between pests and Beneficials and pros and cons of different control options

Monitoring specific crops could be a follow on option – may need unsprayed plantings to show as wide a range of pests and Beneficials as possible

Entomologists are important for identifying less common specimens and answering specialist questions – improves credibility of workshops

Good to use lay person approach rather than entomologist exactness

Concepts can be taken to disease and weed identification and other crops

Building on participants current knowledge, no one made to look stupid and people respected for their current level of expertise and to share this expertise

Suitable for all levels of expertise ie. Some participants had tertiary training, some left school at grade 5, some were farmers with many years experience others were new farmers – all could learn and teach others

Good team approach between trainers and good humour and fun

For the workshop manual

*State the purpose for which the manual is designed for clearly at the front of the manual
Manual is a reference for the course and that's its priority – it is not designed for making control recommendations*

It is preliminary background information

It needs a key page for systematic looking up of information

Separate different sections of the manual with colour pages

For the collection kits

Comment on how to improve the resources in the collection kit eg. Better, larger containers, more pins

Needed the connection between the manual and collection kit emphasised perhaps by putting specific instructions on the lid of the collection kit

Collection was seen as important for getting participants to actively look for pests and Beneficials but the time problem was acknowledged – make the kit optional – how can the kits be made more attractive?

Some good jobs on the collection kit (about 6)