Developing a training and information package for IPM implementation in *Brassica* vegetable crops

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Abstract

The ability to correctly identify a pest or disease problem or to determine disorders within *Brassica* vegetable crops is critical to making a sound decision on corrective actions and the most appropriate strategy for a particular situation. Most research into problems of *Brassica* crops has been discipline based, focusing on identification and “best practice” recommendations for managing specific pathogens, insects, nutrient deficiencies or other disorders. A project to develop an electronic knowledge management system, based on Integrated Crop Management principles, aims to bring together insect, weed, disease and disorder information in a comprehensive and integrated multi-media product.

The information and training needs of farmers, advisers, students and scientists will determine the structure of this decision support tool. It will incorporate Lucid™ keys for diagnosing problems in *Brassica* vegetable crops, linked to “best practice” management strategies that can be delivered via CD and/or the Internet. The CD uses software (WebGIST), developed by the Centre for Pest Information Technology and Transfer at The University of Queensland, that enables the user to view, search and print the information in a format similar to current web browsers. The information is created in HTML so that it can easily be transferred and linked to the Internet. An English prototype CD has already been developed. A proposal has been submitted to the Australian Centre for International Agricultural Research to develop a final product, which will be bilingual (English and Mandarin), with the intention to develop a generic English version that can subsequently be customised for other languages and regions.

Keywords
decision support tool, Integrated Crop Management, problem diagnosis, Lucid™, best practice management

Background

A farmer’s or adviser’s ability to determine what is wrong with a particular *Brassica* vegetable crop, or to correctly identify a pest or disease problem, is critical to making a sound decision on the most appropriate strategy to take in a particular situation. By contrast, research to solve problems in *Brassica* vegetable crops has largely been discipline based, focusing on identification and “best practice” recommendations for managing specific pathogens, insects, weeds, nutrient disorders or environmental effects. So while information or knowledge for solving a particular problem may exist, it may be in a form that is not easily accessible and immediately applicable for specific on-farm situations.

Pest management in tropical and sub-tropical *Brassica* vegetable crops has been particularly problematical for many years. The complex of insect pests, the quality issues regarding the level of control required, problems with insecticide resistance and the health risks to operators and consumers associated with excessive insecticide use all contribute to the intractability of the problem. Implementation of Integrated Pest Management (IPM) systems in vegetable crops is also difficult as it usually involves more complex decision-making processes when compared with calendar treatment with insecticides. For instance, in China, the greater use of biopesticides has increased the need for improved management skills as these products are often most effective when deployed as part of an overall IPM approach.

On the other hand, significant advances have been made in the development of IPM systems in Australia, China and some regions of south-east Asia. In particular, since 1995 two consecutive China/Australia projects funded by the Australian Centre for International Agricultural Research (ACIAR) have focused on
managing the insect pest complex affecting *Brassica* vegetables using an IPM systems approach. Activities were targeted at addressing priority research and development issues, but also incorporated a strong implementation component in work programs (Heisswolf & Bilston 2004, Liu *et al.* 2004, Heisswolf *et al.* 1997).

Combined with government initiatives, these efforts have had a considerable impact on the implementation of IPM in the project areas, and in Zhejiang Province and south-east Queensland as a whole. For example, an independent evaluation of project impact in Hangzhou, Zhejiang Province, in 2000 indicated that the proportion of growers keen on non-chemical measures for insect pest control reached 36% in a project area, compared to 20-23% in non-project areas in the same region (Liu & Qui 2001). In Queensland, Lockyer Valley, *Brassica* farmers have gradually implemented various IPM practices over the past ten years, with an estimated 60% of farmers using a crop scout to aid in decision-making and 70% of farmers using IPM to some degree (Heisswolf & Bilston 2004). The long-term impact and sustainability of these extension efforts could be considerably enhanced through the use of more efficient tools and systems for training and for integrating and delivering information to end users.

There is an opportunity to build on existing knowledge by integrating information on the identification and management of insect pests, diseases, disorders and weeds within one flexible information management system using an Integrated Crop Management approach. Our proposal is to develop an IT package that contains tools to correctly diagnose and evaluate problems in *Brassica* vegetable crops, backed up by “Best Practice” information, so creating a new information resource designed to get existing knowledge and technology into the field. This system will have a number of advantages over traditional paper-based materials:

- it will provide much greater flexibility and capacity than paper-based systems, allowing for a more stream-lined integration of knowledge from different disciplines within a problem-centred approach
- it can be used directly as an interactive training and decision support tool
- it will be easier to update and offers more potential for web site linkages
- it will be a resource for problem diagnosis and identification of “Best Management” options, with users having the option of printing off advisory leaflets and other products as needed

To ensure that the final IT product meets client needs, end users will be involved in the design and testing of prototypes.

In the past, extension material associated with crop protection problems has largely been in the form of booklets or pamphlets on specific problems or a class of problems. In China, a survey of literature of insects associated with *Brassica* vegetable crops in 1996 showed that although an extensive literature existed on individual species of pests, there had been little literature on *Brassica* IPM at the cropping systems' level (Liu & Yan 1998, Liu *et al.* 1996). There have been many manuals on insect pests and diseases in vegetable crops, however most of these manuals only give information on the morphology, biology and control of individual species, and only a few of them, such as the manual by Liu *et al.* (1995), offer limited coverage on the management of insects and diseases at the crop level.

In Australia, the availability of decision support tools that are aimed at the cropping systems level for *Brassica* vegetable crops is limited. Publications and Facts Sheets provided by state government departments are usually also discipline or species based, or provide agronomic information with limited detail for problem diagnosis and their solution. The exceptions are a field guide for identifying pests, natural enemies, diseases and disorders in *Brassica* vegetables (Donald *et al.* 2000) and a pest monitoring guide for these crops (Heisswolf & Brown 1997).

A non-computer based approach to dealing with knowledge management issues in horticulture is the approach adopted for the Agrilink Information kits produced by the Queensland Department of Primary Industries (DPI) (Anonymous 2001). These information kits were developed in response to an increasing need for “stand alone” information packages targeted at advisers, consultants, students and farmers. A key feature of these kits is the reorganisation of written and visual information in a form that reflects how decision-makers actually search for information.

The Agrilink kits encompass the principles of adult education, taking a problem-centred approach to presenting information, catering for different levels of user skills and preferred methods of searching for answers to problems. Each Agrilink kit is divided into sections which target various information needs, providing different entry points to a specific problem, which are then also cross referenced to other relevant
information within the package. The Problem Solver section of the kits represents a paper-based diagnostic key. It allows the user to work through a collection of images arranged according to symptoms seen in the field or nursery – the problem – rather than presenting images arranged along discipline lines – as a disease, pest or disorder.

The Queensland DPI is currently integrating information derived from the two China/Australia ACIAR projects within a Brassica Agrilink information package. Information on IPM and all other aspects of Brassica crop management is being brought together by tapping into expertise of departmental and industry staff in Queensland and linking with existing projects in other Australian states on diamondback moth (DBM), Plutella xylostella (L.) (Lepidoptera: Plutellidae); Clubroot disease; and IPM implementation. The Brassica Agrilink publication will contain a large collection of images and drawings on which our proposed IT product can build.

The IT product will use software tools - WebGIST and Lucid™ - developed by the Centre for Pest Information Technology and Transfer. WebGIST is a software package that allows a CD product to have all the familiar functions of a web browser such as navigating the information screens and fact sheets, and printing and searching the content. Lucid™ software is a tool for building interactive multi-media identification keys (See www.lucidcentral.com). Lucid™ keys differ from traditional paper-based dichotomous or pathway keys by allowing the user the flexibility to begin an identification or diagnosis anywhere in the key, using whichever character is easiest to use. They are also not restricted by unanswerable couplets and can use various functions to progress through the key quickly to get an answer.

For more information on Lucid™ identification keys and diagnostic keys, see www.lucidcentral.com and www.cpitt.uq.edu.au.

All the fact sheets on the CD product will be produced in Hyper Text Mark-up Language (HTML) that allows the user to navigate more easily through the CD content and also allows for future publication on the Internet. These fact sheets can incorporate text, images, sounds and video so that all information on a topic can be accessed from a single screen.

A prototype IT package for Brassica vegetable crops

A prototype CD utilising text and images from the draft Brassica Agrilink kit has already been developed for demonstration purposes as part of the current ACIAR project. The home page for this prototype is shown in Figure 1. The prototype contains rudimentary problem diagnosis and insect and weed identification keys. While the specific design of diagnostic and identification keys, and entry points and linkages to “Best Practice” information, will depend on the outcomes from participative planning processes with end users, three major keys are likely to be incorporated into the package:

- a problem specification key based on symptoms seen in the field e.g. diseases, disorders, pest damage etc. – this gallery type key is illustrated in Figure 2
- an insect identification key for both pests and natural enemies – this key may combine dichotomous and gallery keys (Figure 3) with a Lucid™ key
- a weed identification key based specifically on Lucid™. Figure 4 illustrates the layout of this matrix key

Figure 1. The home page of the prototype Brassica IPM CD illustrating the broad framework of the package
The management of diamondback moth and other crucifer pests

Figure 2. The problem diagnosis and identification key, illustrating the gallery key for spots and marks on leaves. Each image can be linked to a Fact Sheet or other relevant parts of the package.

Figure 3. The entry point for the insect identification key, illustrating the gallery of drawings for major insect orders.

We estimate that between 100–120 “Best Practice” Fact Sheets on insect pests, natural enemies, diseases, weeds and disorders will be required to support the problem specification and identification keys. These information sheets will contain text and images, the likely format including an introduction, details on monitoring, the lifecycle of the pest or disease, damage and control – covering production breaks, crop hygiene, biological control options and pesticides. The prototype also contains a section outlining the principles and practices of IPM (Figure 5), a glossary and reference section and scope for integrating links to other sites.
The management of diamondback moth and other crucifer pests

Proceedings of the 4th International Workshop, Nov. 2001, Melbourne, Australia

407

Figure 4. The Lucid™ matrix key for identifying weeds.

Figure 5. The section on the principles and practices of IPM in Brassica vegetable crops with major topics at the top and left hand side of the screen.

Plans for the future

A project proposal to develop the prototype CD into a field-tested, multi-media IT product ready for final production and distribution has been submitted to ACIAR. By providing an integrated resource base of information on the diagnosis and corrective treatment of crop problems in Brassica vegetable crops, the aim of the project is to contribute towards improved crop management by building the skills and capacity of decision-makers through several avenues:

- the use of the diagnostic and identification keys in training courses and by individual research and extension officers will lead to improved diagnostic skills and improved extension advice
- wider availability of “Best Practice” information, linked to crop diagnostic keys, will encourage improved decision-making and crop management skills on the part of research and extension staff, consultants and farmers
- images, keys and the interactive nature of the IT package will improve student and farmer training activities and, in the case of the latter, lead more directly to improved crop management

The main project activities will include design specification, integrating relevant text, images and other material to assist with identification, developing “best practice” fact sheets, building keys and testing the evolving training and decision support tool with researchers, extension officers, consultants, other advisers, students and farmers. An action research approach that involves end users in the design and testing of the IT
package will be incorporated as an integral part of the project. Based on adult education and action learning principles, this approach will ensure that the knowledge brought together from the different disciplines is placed within a cohesive framework that can be easily accessed and implemented by potential end users.

It is anticipated that the project will start in January 2003 and be completed by the end of June 2004. The Queensland DPI and Zhejiang University will coordinate the project and end-user participation in package design and testing, and provide technical expertise on Integrated Crop Management and “Best Practice” information on pests, diseases, disorders and weeds in this international collaboration. The Centre for Pest Information Technology and Transfer will facilitate the development of the multi-media diagnostic keys and provide software support and services. The Zhejiang Department of Agriculture will support development and testing of the package with end users in China through training workshops.

The chief output from the proposed project will be two field-tested, multi-media information management systems based on Integrated Crop Management principles. In the Chinese version, diagnostic keys and “best practice” management strategies will initially be developed for conditions in the east region of China, but there is potential for adapting the package to other regions in China. This IT product will be ready for final production and distribution in China with the aim of having it widely used as a training tool for students, researchers and extension officers; and to serve as a decision support tool for extension staff and farmers.

A second output from the proposed project will be a field-tested generic IT package in English ready for customisation for other regions and languages, such as Indonesia and Vietnam. The Australian Brassica industry is interested in the concept of this multi-media package and our intention is to develop a process for customising the generic English version for Australian conditions, in collaboration with industry stakeholders.

References
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