Decision support: Developing and delivering diagnostic information to strengthen Australia's biosecurity

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Abstract. Rapid identification of emergency plant pest and pathogen incursions is essential to reduce the cost of eradication and impacts through rapid response. Diagnostic technology and data underpin our capacity for early identification and monitoring. Previously there was no single information resource, web-based or otherwise, to provide diagnostic information for targeted emergency plant pests (EPPs). Fast access to diagnostic information at the time of a suspected incursion is vital to biosecurity responsiveness. This project has developed an easy-to-use, web- accessible national diagnostic database known as 'The Plant Biosecurity Toolbox' (PBT) that helps users to quickly assess a suspected incursion. The PBT has a wide audience, providing information at a variety of levels – from general biology and risk analysis to detailed molecular tests. The PBT contains a collection of diagnostic protocols for EPPs and provides users with images, taxonomic and biological information as well as identification instructions, diagnostic procedures and contact details for experts and accredited diagnostic laboratories. The PBT is accessible via the Pest and Diseases Image Library (PaDIL) website (www.padil.gov.au/pbt), and provides access to other linked biosecurity diagnostic tools, such as the Remote Microscope Diagnostic Network and the Biosecurity Bank. In the next phase of the project, we are looking to develop portable pest modules for specific industries, which will be available for PDAs or as podcasts. The PBT will increase Australia's capacity and skills for plant biosecurity.

Introduction

What was the biosecurity problem?

Most countries have identified plant pests that they want to prevent from entering their country. In Australia these are referred to as Emergency Plant Pests (EPPs). The species listed involves a wide range of taxa, covering insects, fungi, viruses and bacteria. Each pest is considered to pose a serious threat to Australia's agriculture. Before this project commenced, there was no single information resource, web-based or otherwise, to provide diagnostic information for Australia's targeted EPPs. This situation was limiting since having rapid access to diagnostic information at the time of a suspected incursion is vital to biosecurity responsiveness and effectiveness.

Globalisation has put added pressure on our borders and requires us to assure our trading partners of our current pest status. Growth in human and trade movement has increased the risk of incursion, and our borders need to be equipped to deal with this added pressure. Australia's plant health workers have never had a diagnostic manual for EPPs. If diagnostic information existed at all, it has been difficult to find. In contrast, animal health workers have well defined diagnostic information and networks for exotic animal pests. For plants, much of the diagnostic information for exotic pests is hidden in the literature, is locked up as personal experience or remains unpublished in filing cabinets. Until now, no attempt has been made to gather that information and make it easily accessible. The Plant Biosecurity Toolbox (PBT) is a collection of diagnostic information, put into a web-based form so that it can be easily accessed and searched. What makes it different from other such sites is that it is devoted to providing detailed diagnostic information that relates to Australia's EPPs. The PBT provides detailed, web-based diagnostic information to assist with the rapid identification of plant pests for the purposes of routine surveillance and in the event of an exotic pest incursion.

What were our goals?

The database needed to be easily navigable and make a vast amount of detailed information easily accessible. Due to the developing and variable potential end uses of this information, it needed to be easily repackaged to suit these changing needs. Other important considerations were that the website should have no limitation on pictorial or illustrative material and be quickly and easily accessed. This flexibility needed to be built in from the beginning.

How did we develop the solution?

The PBT project was developed by the Cooperative Research Centre for National Plant Biosecurity (CRCNPB). The project team collected diagnostic information for specific pests from many available sources. Over the past few years both the Australian Government Department of Agriculture, Forestry and Fisheries (DAFF) and Plant Health Australia (PHA) have commissioned diagnostic protocols for specific pests; however these have not been widely available and vary considerably in their quality and format. State departments of agriculture and similar agencies overseas have also been developing diagnostic information but again, the quality varied considerably and there was no standard format used. The information currently in the PBT has been extracted from these sources and many others, such as published texts and scientific papers.

A template for re-organising the information was developed using the reference standards developed by the Sub-committee for Plant Health Diagnostic Standards (SPHDS) for diagnostic protocols. These standards are based on those recommended by the International Plant Protection Convention (IPPC). This format will be accepted as that required by SPHDS for a national diagnostic standard. Therefore, if a standard doesn't already exist, information within the PBT will provide the basis for a new standard to be developed.

This template formed the basis for how information is displayed on the website. Similar information is located together. For example, all biological and ecologically related information can be found under the 'Biology' menu. Some more detailed sections were broken into subsections, for example, all identification related information is collated under the 'Identification' menu but split into subsections for morphological, molecular, biological and biochemical methodologies. This reconfiguration broke the potentially quite lengthy documents into manageable and logical sections. The web-based template was programmed using cascading style sheet (CSS) technologies to allow flexibility in the look and feel of the resulting web page. All collated information was uploaded into the web based template for display within the webpage. Each pest species page was reviewed by the original author of the document, and is reflective of information contained in National Diagnostic Protocols where they are available.

The result is that the diagnostic information is packaged under discrete, searchable categories which collectively comprise a manual of diverse diagnostic information for specified pests. A PDF on the fly option is available so that a PBT diagnostic manual can be printed for each pest in its entirety or particular section as requested by the user.

The comprehensive resources of the PBT include:

- Information on biology and taxonomy of the pest
- Diagnostic morphological, biochemical and molecular tests
- Images of the pest, host symptoms and damage.
- Pest threat and risk information where available
- Expert contacts
- Reference sources

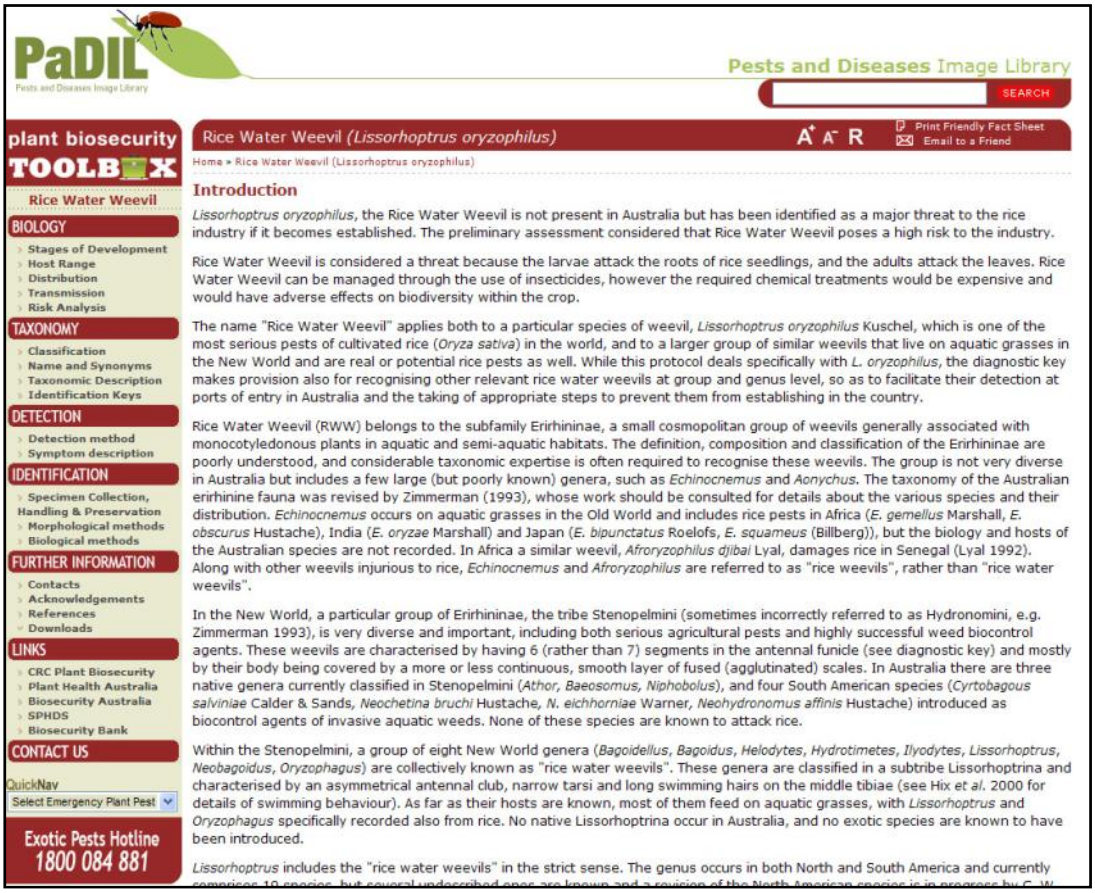
Behind the scenes

The template through which project team members upload the information for each species is available on the web through a password protected portal. Team members can work on species and keep it viewable to content editors only, until such time as the information has undergone expert review. The template is very similar to Microsoft Word and similar programs with familiar functions of text alignment, cut, paste, bold, italics and underline (see Figure 2). Tables, figures and images are all inserted at the click of a button.

Each section of the template can be switched on or off as required for data entry. Checking the box at the top left of each section will determine whether that particular section is displayed. This feature eliminates the menu bar displaying options which have no information or where information is incomplete or currently being edited.

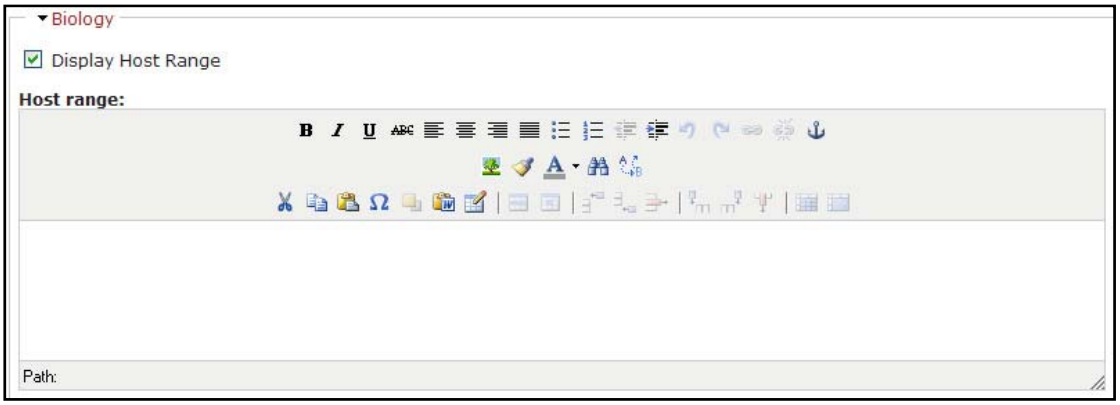
To prevent duplication of images within the database, images from the Pest and Diseases Image Library PaDIL are easily linked from the PBT database, retrieving the required image as needed.

Figure 1. A screen capture of rice water weevil, in the PBT, demonstrating the comprehensive resources contained within the website.



Source: Amy Carmichael, 2009

Figure 2. The PBT editor template.



Source: Amy Carmichael, 2009

Where is the PBT?

The PBT is located on the PaDIL website at http://www.padil.gov.au/pbt and can be accessed directly or via a link from the main PaDIL homepage. Direct links to species pages are also available from listed results pages within the PaDIL website.

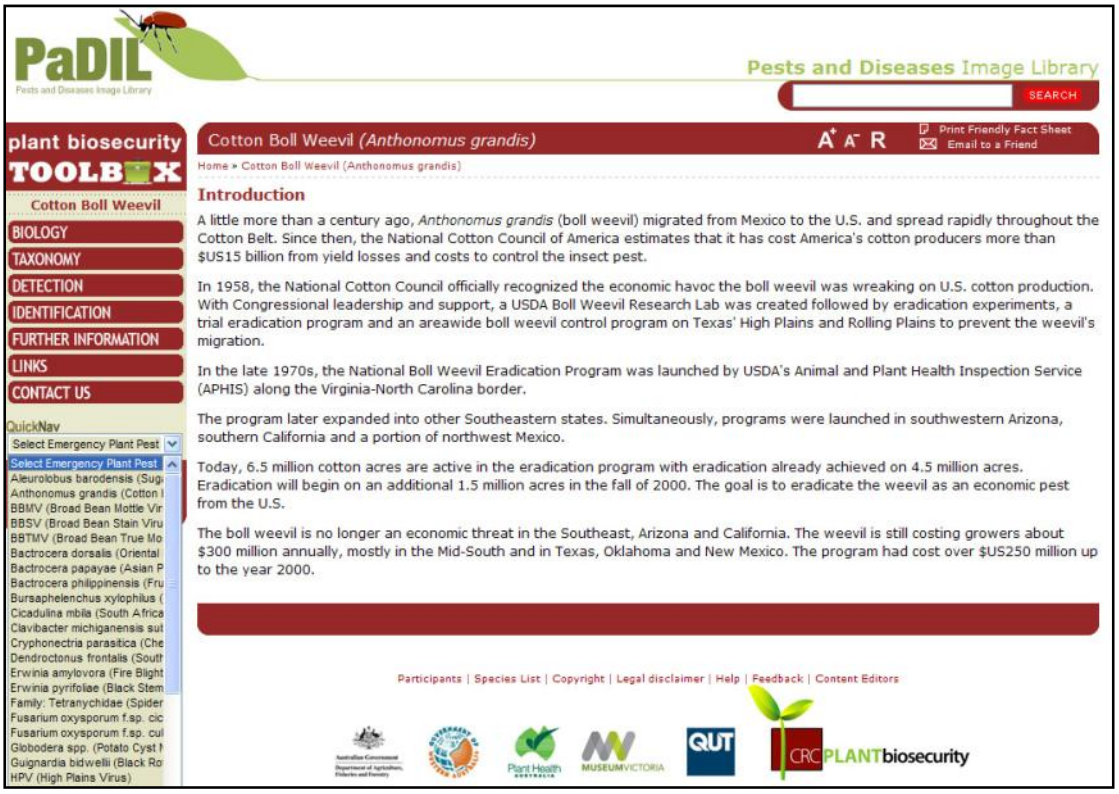
Who are the people who use this tool?

The users of the PBT range from inspectors in our ports and at our borders to field-based crop protection officers to taxonomists and experts in labs. They can be farmers, consultants, policy makers and regulators or just simply members of the public. So the PBT has a wide audience, providing information at a number of levels – from general biology and risk analyses to detailed molecular tests. In the 90 days to the 14th of July, 2009, the PBT received 21817 user visits.

A brief tour of the website

One of the most important features of the PBT is the functionality and navigability of the site. Users of the site can easily conduct searches via keyword in the search box, or select a species from the QuickNav drop down box (Figure 3). This quickly opens the species at the Introduction page, with all menus displayed on the left hand navigation bar.

Figure 3. The layout of the PBT web pages.



Source: Amy Carmichael, 2009

Once clicked, the menu items open to display submenus of information. The font size is adjustable by clicking the A+ or A- buttons on the top toolbar. Printable fact sheets are available for individual sections or as an entire manual for each species.

Where to next?

The functionality offered by the initial database design has ensured a wide scope of potential uses and repackage options. Personal Digital Assistant (PDA) modules are currently being developed and refined for specific industries e.g. Grain EPP's or banana pests. Podcasts of individual species pages or particular technical procedures (including video) are also being developed.

The big picture

The PBT is one project fitting into a boarder suite of projects. PaDIL, the Pest and Diseases Image Library, is home to a variety of biosecurity related projects currently being developed. The Remote Microscope Diagnostic Network is a network of microscopes and experts communicating via the internet, enabling real-time collaboration between non-experts and experts to rapidly identify potentially threatening species instantly. After the identification is confirmed, management and control decisions relying on solid information about the particular pest need to be made; the toolbox fills this need. Morphological or molecular testing may need to be conduct to verify the identification. The Biosecurity Bank is a further site under construction which houses confirmed DNA data samples able to be loaned for cross checking and verification. These databases are complementary and will together provide Australia with useful and functional tools to improve our capacity and skills for biosecurity.

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