Packing the punch to weeds: WEEDpak – a weed identification and management guide for the Australian cotton industry

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Summary  WEEDpak is a comprehensive weed identification and management guide for the Australian cotton industry. It was one of the first complete integrated weed management (IWM) guides for a single cropping industry in Australia and in the world. WEEDpak was developed to address the need for readily accessible weed information within the cotton industry and synthesises more than a decade of research in a single updateable ‘user-friendly’ A4 folder. To provide for a whole system IWM approach, both weed specific and farming systems issues have been addressed with the information linked to other Australian cotton industry publications such as ENTOpak, SPRAYpak and the Integrated Disease Management guidelines.

Although the principal focus of WEEDpak is the importance of and practices involved in IWM, a range of other information is included. One key aspect is a weed identification and information guide that includes a number of key growth stage images and basic biological information. Another aspect is the range of management information included in specific sections on problem weeds, and in particular a best bet management guide. This guide was compiled using a series of grower, agronomist and consultant interviews. Other management information includes sections on the management of weeds in Roundup Ready® cotton systems and in rotation crops, control of volunteer cotton and the use of farm hygiene.

Printed copies of WEEDpak have already been widely distributed to cotton growers and other support personnel through the Australian Cotton Cooperative Research Centre (CRC) Technology Resource Centre. WEEDpak is also available in other formats such as being downloadable from the internet (www.cottoncrc.com.au) and has recently been distributed on the COTTONpak compact disk (CD).

Keywords Integrated weed management, identification, biology, ecology, best bet management, interviews, focus group.

INTRODUCTION
Weeds pose an increasing challenge to the Australian cotton industry. The cost of weed management was recently estimated to be in excess of $400 ha⁻¹ when both management and crop yield reductions were included (Taylor and Walker 2002). This resulted in a $150 million impost in the 2001/2002 season alone. Taylor and Charles (2002) outlined various means of improving the economic and environmental sustainability of these farming systems, the most important being the adoption and implementation of integrated weed management (IWM).

The adoption of IWM is reliant on management tools being available to control weeds and information on how and when to best use these management tools. The production of WEEDpak, a comprehensive and integrated weed identification and management package, will help facilitate this. For successful weed management, accurate identification followed by implementation of effective management practices is needed. WEEDpak combines both existing and new identification and management information in an easily accessible and readily updateable format. Previously, while a number of weed identification publications were available (Cunningham et al. 1981, Auld and Medd 1987, Wilson et al. 1995), none of these covered the specific and often diverse weed flora encountered throughout the cotton industry. While there is substantial information on the management of specific problem weeds (e.g. Charles 1995, Osten 1996, Charles 1997, Johnson 2000), generally there is a paucity of information on the management and control of many others. Much of the information that is available is anecdotal and is not supported by research data. WEEDpak is a compilation of all available sources of information.

In this paper three key areas involved with the production of WEEDpak are examined, these being the content, compilation and future expansion of the publication. An examination of the content of the publication will help identify how more economic and environmental IWM outcomes in cotton farming systems can be achieved. Secondly, a review of the processes involved in compiling the information, in particular the production of the best bet management guide, is covered. The processes undertaken here are of particular interest to industries where weed management information is largely anecdotal and needs to
be formalised for industry-wide application. Finally, the paper covers how WEEDpak will continue to be updated and expanded in the future.

CONTENT OF WEEDPAK

Integrated weed management  Integrated weed management is the central theme of WEEDpak. IWM systems are important to achieve economic and environmentally sustainable weed management in the long-term. The overall results of the use of IWM in Australian cotton farming systems will be a reduction in the current reliance on herbicides in cotton farming systems, less chance of herbicide resistance and weed species shifts, and a reduction in the impact of herbicides on the environment.

Weed identification and information guide  The correct identification of a weed combined with knowledge of the lifecycle of the weed are important first steps in management. Correct identification is important to match a weed species to appropriate management strategies, while a sound knowledge of the lifecycle of the weed will help in targeting management before seed set and further spread occur.

This unique guide contains a range of growth stage photographs for each weed species along with associated text descriptions so that positive identification can be made at any stage during the lifecycle of the weed. Because well over 200 native and introduced species have been identified as weeds in Australian cotton farming systems, this guide will continue to be expanded in the future.

Herbicide resistance  Although herbicide resistance is an increasing problem in many farming systems, no herbicide resistant weeds have yet been recorded in the cotton cropping phase of these farming systems. Over-reliance on herbicides and other control methods may also induce weed spectrum shifts. Information in this section outlines how the use of IWM can overcome both weed species shifts and reduce the likelihood of herbicide resistance developing in cotton farming systems.

Herbicides  Herbicides are important tools in IWM in cotton farming systems. Once the weed species present have been ascertained, the selection of the most appropriate herbicide, and the correct application of that herbicide are crucial steps to achieve successful weed management. This section outlines what options are available along with general guidelines for effective application techniques. More specific information on the many aspects of correct pesticide application has been covered in SPRAYpak, another Australian Cotton Cooperative Research Centre (CRC) publication.

Roundup Ready® cotton  The introduction of transgenic glyphosate-tolerant cotton has provided another important IWM tool for Australian cotton growers. The use of this technology offers a number of advantages including reductions in the use of residual herbicides, with improved economic and environmental outcomes as well as more flexible and improved management of many other weeds (Taylor and Charles 2002).

This new technology is also limited with the potential for spray drift, for herbicide contact with the lower parts of the plant with directed applications, and with application timing. The information contained seeks to help users avoid these problems.

Farm hygiene  Good farm hygiene, although often overlooked, is an important aspect of IWM systems. Information covered in this section includes the importance of managing weeds that grow in cotton crops, in fallows, along roads, channels and waterways, and in other waste areas on the farm. In particular the management of volunteer cotton is outlined as it is one of the more prevalent weeds in many cotton farming systems. Because IWM will also impact on integrated insect and disease management, references to other Australian Cotton CRC publications are included, for example ENTOpak and the Integrated Disease Management guidelines.

Best bet management guide  Successful IWM strategies are driven by practical and effective weed management practices. These may result from in-depth research, or from much broader anecdotal observations that have been gained via trial and error weed management practices. This section covers the best bet management options for a range of difficult-to-control weed species in Australian cotton farming systems. The information was derived from a series of weed management interviews with the intention of passing on the experience of these industry leaders to a wider audience. The compilation of this information has been covered in more detail in a later section of this paper.

Managing problem weeds  Most weeds are adequately managed by the implementation of good IWM practices on Australian cotton farms. There are however problem weeds that are not well controlled by these practices and continue to spread year after year despite a land manager’s best efforts. These problem weeds require a specific set of management practices distilled from various research programs. WEEDpak
Currently has information on how to best manage three weeds, namely nutgrass (**Cyperus rotundus** L.), cowvine (**Ipomoea lonchophylla** J.M. Black) and polymeria take-all (**Polymeria longifolia** Lindl.). The information will be expanded as more research is completed.

**Rotation crops**  Rotation crops and fallows are important components of IWM systems. They allow alternative weed management methods to be implemented, as well as helping with other disease, pest and soil management issues. One particular issue that requires attention is the management of weeds within these crops, and in particular the use of residual herbicides with plant-back restrictions for future crops. Information in this section will continue to be expanded as research into weed management issues in rotation crops continues.

**Appendices**  A number of appendices give valuable support to WEEDpak. These include regional lists of weeds compiled from a variety of sources and a comprehensive list of over 200 plant species that have been recorded as weeds on Australian cotton farms. Both lists will help raise the awareness of land managers of the weeds present in their areas. WEEDpak also contains a list of references that contain further reading on aspects of weed identification, biology and general management.

**COMPILATION OF WEEDPAK**

There were three processes that were integral in the compilation of WEEDpak. The first involved the collation of many separately published cotton weed research articles. Secondly, research of information that was not specific to cotton farming systems was drawn together. And thirdly, and most uniquely, a series of grower, agronomist and consultant interviews was conducted that enabled the compilation of the best bet management guide.

**Specific cotton weed research**  The Australian cotton industry has commissioned research into a variety of weed management issues, particularly over the last 25 years, and most notably through the Cotton Research and Development Corporation (CRDC). The outcomes of that research formed the major part of the material that was compiled and published in WEEDpak.

**Weed research that was not cotton specific**  One problem encountered in collating the information for the weed identification and information guide was that the basic biology of a large number of weeds that occur in cotton farming systems was poorly understood. For this reason, information was sourced from research into these weeds from other agricultural or environmental management systems. Where this information was not available, the information was then sourced from plant identification and general weed control books, and from internet-based material.

**Industry interviews to determine best bet management**  Successful on-farm weed management is being achieved despite the lack of management information for a number of weed species. These interviews were undertaken to collate this anecdotal information and to make it available industry wide.

Approximately 50 leading growers, agronomists and consultants were interviewed on an individual and focus group basis. These people were drawn from areas covering the entire Australian cotton industry. A basic questionnaire was set up with the questions pre-trialed on a select group of growers and agronomists to elucidate any difficulties. During the interviews or focus groups, participants were asked specific questions, particularly on how they managed a range of problematic weed species. Participants were then asked to elaborate if further information was required. All responses were recorded for later transcription and compilation.

Three factors aided the interview and focus group process. Firstly, area contacts were facilitated through the local cotton extension officers employed by the Australian Cotton CRC. Secondly, a comprehensive view of weed management for a range of different species was gained by talking with this number of participants because actual grower numbers were also small (around 1500). Thirdly, a very broad area of the cotton industry was surveyed. This was possible because private consultants who dealt with many small growers were interviewed in addition to large farm agronomists.

The information derived from these interviews was compiled on a species-specific basis before being summarised. Sufficient information was derived for 38 of the most problematic weed species. Knowing that many more species are weeds on Australian cotton farms, further work is needed to complete this section, in particular via postal surveys and further focus groups.

**FUTURE EXPANSION OF WEEDPAK**

WEEDpak was first published in August 2002 and well over 500 paper copies have been distributed to cotton growers, on-farm and sales agronomists, private consultants and other personnel throughout the cotton industry to date. This distribution has been facilitated through the Australian Cotton CRC’s Technology Resource Centre together with the National Cotton Extension Network. The information in WEEDpak...
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has been a focus of the CRC extension network for on-farm demonstrations.

With the high degree of computer access among cotton producers and improving on-line facilities in many areas WEEDpak has also been provided in two electronic formats. The first is on the Australian Cotton CRC web site at: http://www.cotton.crc.org.au/Publicat/Weeds/index.htm where the information is available in .pdf format and available to the general public. The second is the inclusion of WEEDpak with other Australian Cotton CRC information packages like ENTOpak, SOILpak, NUTRIpak, SPRAYpak, MACHINEpak and the Integrated Disease Management guidelines on the COTTONpak CD. This CD will allow users to access the information quickly from their own computers and help in cross-referencing between different publications.

Aside from these delivery modes, we ultimately aim to provide the information in WEEDpak in a number of other formats. For example, there is considerable potential to publish a separate weeds identification and information guide small enough to be carried around in farm vehicles. This cotton-specific guide is necessary as existing guides lack a range of seedling and adult plant photographs. The information in WEEDpak also needs to be adapted for other IWM and industry publications in the future. The information may also be published with other decision support software like CottonLOGIC, now available on small hand-held computers like the Palm Pilot®. This means of distribution is under investigation.

Sections in WEEDpak will continue to be reviewed and updated in the future, with changes available instantly on the Australian Cotton CRC website and sent to registered users of the printed version. To facilitate this, sectioned page numbering and the easy removal of pages in the original ring folder have been included as features of the product.

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REFERENCES


