

Developing best practice manuals for Weeds of National Significance

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Summary Best practice manuals have been and are being produced for a number of Weeds of National Significance (WoNS). This paper reviews the processes used to develop the best practice information associated with two WoNS, *Lantana camara* L. (lantana) and *Salvinia molesta* D.S.Mitch. (salvinia), with some reference to the information processes associated with other WoNS best practice manuals. This review highlights the difficulties of combining scientific and technical information with practical advice and opinions, substantiating information that is rarely trialled and incorporating the variables associated with each weed in order to offer practical management advice on a national scale.

Keywords Best practice manual, extension, Weeds of National Significance, WoNS.

INTRODUCTION

The role of best practice manuals The best practice manuals aim to provide comprehensive guides to the management and control of lantana (*Lantana camara* L.) and salvinia (*Salvinia molesta* D.S.Mitch.). Detailed information concerning management practices and control methods was gathered and reviewed to develop substantiated advice. This was then presented in the form of user-friendly manuals.

Although they are dubbed best practice manuals in the funding contracts, authors generally avoid using 'best practice' in the title if it is agreed that is it 'too early' to do so. It is usually assumed that best practice information is trialled and proven advice for the situation in which it is recommended. In most cases the manuals are considered to be comprehensive guides to management and control, and only part of the development of best practice information in the long term.

Format and style Most of the best practice manuals produced in association with the WoNS program (see Table 1) are professionally printed colour publications. Colour pictures and diagrams, plain English text and the use of headings have assisted with readability. Most of the manuals have been professionally edited and designed to assist with readability. Some criticism of the expense of producing glossy colour publications

has been received, but the majority of feedback is that the format and style of the manuals has assisted with readability and has appealed to users.

Funding and project coordination The manuals are developed through lead state agencies in conjunction with the Australian Government. Funding is applied for and delivered by contract within each lead agency (Queensland Department of Natural Resources, Mines and Water is the lead agency for lantana, and New South Wales Department of Primary Industries is the lead agency for salvinia). The lantana and salvinia manuals have had different resources and timeframes, but both had a full time project officer appointed as author.

METHODS

This paper draws on the authors' collective experience producing best practice manuals for lantana and salvinia, and for other management contexts (natural resource management in the Australian sub-tropical dairy industry). This is compared with the processes used to develop best practice manuals for the other WoNS weeds. Telephone interviews with authors and project coordinators of other WoNS best practice manuals supported this comparison.

THE PROCESS

The development of best practice information can be conceptualised as a continuum, with the process of refining information occurring through a series

Table 1. WoNS manuals available or in progress.

Manual	Number	WoNS weed
Completed manuals	7	lantana, parthenium, rubbervine, mesquite, prickly acacia, parkinsonia, salvinia
Manuals in progress	8	gorse, willows, pond apple, boneseed, hymenachne, alligator weed, Chilean needle grass, bridal creeper

of iterative cycles. This process is supported in the development of information systems (Checkland and Holwell 1998). The end result is a set of substantiated and effective recommendations for integrated control and management of the weed in question. As information is moved through each cycle it becomes more refined and substantiated. These cycles of information development include initial processes of information gathering (via literature reviews, surveys and networking), followed by processes of substantiation (through workshops, Delphi method, etc.) and the development of integrated management strategies. Finally, the information may be tested in field trials in order to provide integrated control strategies that are considered to be true best practice advice. Some of the issues associated with each cycle of information development are presented below.

Information gathering The initial step of preparing the manuals involved a review of scientific and management literature (journal articles, research reports, management strategies, pest status assessments, etc.). Published literature reviews exist for some weeds, but are not common. Published journal articles are usually available for background information such as weed biology and ecology.

Research trial data is usually available for chemical control (herbicide trials and comparisons) and biocontrol development. It is rare to find research trial data for physical or cultural control methods. One of the major gaps in the information is scientific trial data or adaptive management information looking at how control methods affect each other, or how they can be integrated.

Apart from the available literature, information was also gathered using postal and telephone surveys, interviews, questionnaires and field days.

Networking Networking allowed the author to meet and retrieve information from key people (experts, scientists, technical officers, land managers) associated with each weed and its available control methods. This included entomologists, herbicide researchers, researchers of the weed's ecology, land protection officers, regional weed management officers, local government weed control officers and private weed control contractors. Most of the WoNS authors have used networks to gain access to information, photos and case study material. Networks associated with specific weeds seem to snowball naturally and it is rare that vital contacts are overlooked. Networks also provided the basis for technical review and substantiation of the information.

Field visits Considerable time was spent talking to people involved with on ground management. Most authors visit field sites and case study sites and use site visits as opportunities to gather photographic images to use in the manuals. Finding out 'what people do in the field' is generally an informal but integral part of the process of developing the manuals, as many of the available control techniques are developed by innovative landholders facing specific issues.

Information substantiation The next cycle of best practice development tried to substantiate the information that had been gathered. This was done mostly through workshops and Delphi-based processes (Linstone and Turoff 1975, Buckley 1995). Delphi-based processes involved emailing sections of draft text to key reviewers to provide comment (up to 50 individuals). The author's role was then to consider all the expert reviews and ask for further review until consensus was reached, or differences of opinion identified and issues discussed separately.

Workshops were used to bring key people together to discuss and review the current knowledge or issues regarding control. Key individuals with different backgrounds were given the opportunity to respond to various problems and situations associated with the weed in question.

In all cases, the amount of technical review of the information, particularly face to face interaction between reviewers or experts at working sessions or workshops, enhanced the development of the information.

DISCUSSION

The logic that a best practice manual is produced at the end of a number of iterative cycles does not always match the reality. Project funding timelines and the different levels of available information have meant that best practice manuals have been developed at different stages along the continuum. In the case of lantana and salvinia, the manuals have been produced after only two iterations of information development. In the case of mesquite, the manual was developed at the end of the process where the information was tried and tested and considered to be best practice.

The scope of the information that develops in relation to a best practice manual increases as its development proceeds through each cycle, as do the problems faced by the author or compiler. Of these problems, the development of prescriptive integrated control strategies provides the greatest challenge.

Prescribing integrated control strategies It is widely agreed that integrated control is best practice

in weed management. The traditional weed fact sheets produced by government departments always advise readers to integrate controls for more effective results, but very few fact sheets provide integrated control strategies. It could be expected therefore, that a best practice manual should present integrated management strategies where the best combinations of control methods are prescribed in terms of techniques, timing, order, season, costs and efficacy of results. This is difficult early in the cycles of information development.

In their first cycle of information development, most of the manuals can deal with control methods in detail, presenting information about the techniques and their applications. Case studies have been used as a way of incorporating integrated control strategies, where the subset of variables can be defined upfront. The few manuals that have provided prescriptive integrated management strategies have had integrated research trials and fewer variables to incorporate (i.e. mesquite).

Prescribing integrated control strategies is further complicated by the number of variables associated with each weed. In the second cycle of information development, workshops have been used to bring experts together to develop integrated control strategies, considering all the relevant variables and opinions. One workshop was held for salvinia, with the proceedings recorded verbatim, and strategies white-boarded. The author hoped to draw integrated control strategies from the workshop, but found that after analysing the information, at least two more cycles of information development (two more two-day workshops) would be required before integrated control strategies could be refined and substantiated from the range of different expert and practical opinions.

If integrated control strategies can be identified, field trials often provide an ideal third cycle. Only after the lantana manual had been produced (two cycles completed), could time be spent devising what integrated control strategies should form the basis of field trials. A total of eight trials were designed incorporating the major variables associated with lantana. These are beginning to develop further and the results from these field trials will provide information that will help land managers assess their best course of action with an approximate understanding of the costs involved. The trial results will be presented within adaptive management frameworks (introducing adaptive management as an approach) and this will provide some decision support for land managers. The use of decision support systems to develop integrated approaches across a number of variables has been identified as an area in need of further investigation for best practice development (Bosch *et al.* 1996).

Where to from here – decision support systems? Decision support systems (DSS) have been developed in other fields to assist the decision making capability of managers in situations where large numbers of variables affect actions (Mallach 1994). The range of variables associated with the management of an individual WoNS weed includes:

- Geographic distribution (variation of soil types, climate, temperatures and rainfall), which affects growth patterns and seasonal/timing opportunities;
- Extent of the infestation at the beginning of the management effort (coverage, density, physical size, height etc.);
- Topography and vegetation (this can affect access and permissible actions);
- Species variability (including growth habits, flower types, hybrid varieties);
- Existing land use (e.g. conservation, agriculture, private land, forestry, etc). This affects the value of the land, the motivation for controlling a weed, and appropriateness of control methods; and
- Regulatory issues. Different states and regions have variation in terms of declarations, vegetation management requirements, herbicide registrations, and other permissions to carry out control methods.

To date it has been the author's task to put information together in conjunction with the others involved in the iterative process of information development (experts, scientists, practitioners etc). A DSS would lend itself to the next stage of processing the information according to the associated variables and could generate integrated control strategies (as flowcharts) for a specific set of variables (Cox 1996). These could then be adapted to cover some of the more situation specific variables such as available resources, costs, audience or end user and desired outcomes or objectives for management. Of course, the usefulness of a DSS is dependent on the quality of the information that is fed into it (Liou 1992) and this would still need to move through as many cycles of development and substantiation as are required (McCowan 2002).

CONCLUSION

The greatest contribution of a best practice manual that has to be produced early in the process of information development may be to provide a focal point for the next cycle. Whether that be further refinement of strategies by experts and DSSs or the designing and running of field trials. The ability to generate useful, practical, substantiated, integrated information and advice is dependent on the information development processes used. Generally, the number of iterations

of development that the information passes through increases its status towards best practice. The refinement of this process in the context of weed management will help to develop even better best practice manuals in the future.

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