

Coordinated weeds RD&E in Australia: despair or opportunity?

John Virtue¹, Andy Sheppard², John Tracey³, Cameron Allan⁴, Ken Young⁵ and Jim Thompson⁶

¹ Primary Industries & Regions South Australia, GPO Box 1671, Adelaide, SA 5001, Australia

² CSIRO, Black Mountain Laboratories, GPO Box 1700, Canberra, ACT 2601, Australia

³ NSW Department of Primary Industries, 1447 Forest Rd, Orange, NSW 2800, Australia

⁴ Meat and Livestock Australia Ltd., Locked Bag 991, North Sydney, NSW 2059, Australia

⁵ Grains Research and Development Corporation, PO Box 5367, Kingston, ACT 2604, Australia

⁶ Department of Agriculture, Fisheries and Forestry, GPO Box 46, Brisbane, Qld 4001, Australia

(John.Virtue@sa.gov.au)

Summary There is currently no nationally coordinated weeds research, development and extension (RD&E) program, despite past demonstrated benefits from such investment. There continues to be industry focused weeds RD&E through bodies such as Grains Research and Development Corporation (GRDC) and Meat and Livestock Australia (MLA) but for environmental weeds and many noxious weeds there are few current investment options. Governments in all jurisdictions are under significant, long-term budget pressures. Policy drivers in biosecurity include beneficiary pays (with governments' focus on market failure) and achieving high benefit:cost from investments. There is ongoing end user demand for better weed control. How do we shift back to a pro-active approach to weeds RD&E?

The Australian Weeds Committee (AWC) has been considering weeds RD&E priorities, current capacity and investment frameworks. The National Environmental and Community Biosecurity RD&E Strategy has also been drafted. In times of austerity the necessity is to tightly focus on few, achievable activities that cost-effectively meet shared national needs. Four areas are suggested as the basis for pursuing future collaborative investment in weeds RD&E: biocontrol for landscape-scale reduction in impacts of established weeds, sustainable herbicide usage patterns, new technologies for early detections and successful eradications, and socioeconomic drivers to achieve landholder-led coordinated weed control programs.

Keywords Research, weeds RD&E, priorities.

INTRODUCTION

The collective term RD&E is prominent on the national policy agenda with the development of the National Primary Industries RD&E Framework (www.npirdef.org). The framework's intent is to increase coordination and collaboration between governments, rural research and development corporations (RDCs), CSIRO and universities, such that national research capability

is better focused and used efficiently and effectively to achieve the best outcome and uptake by primary industries. At the same time the Intergovernmental Agreement on Biosecurity includes a National Biosecurity RD&E Framework. These two frameworks have culminated in three national biosecurity RD&E strategies for animal industries, plant industries, and environment and community, but only the latter two include weeds in their scope.

Weed research in Australia in the last two decades has fluctuated, influenced predominantly by the existence or not of a nationally coordinated program. The peak in national activity and outputs were from the two successive weed Cooperative Research Centres (hereafter Weeds CRC) from 1995 to 2008, distinguished by close collaboration and partnerships between many state/territory agencies, universities, CSIRO and industry research and development corporations.

Near the end of the Weeds CRC the Australian government established the Defeating the Weed Menace (DWM) Program, with Land and Water Australia managing a research program from 2006 to 2008. This was competitive project calls and some commissioned work, guided by a draft R&D strategy (CRC for Australian Weed Management 2005). The National Weeds and Productivity Research Program (NWPRP) had a targeted grants program in 2009 and then competitive and commissioned eighteen month projects managed by Rural Industries Research and Development Corporation (RIRDC) in 2011 to 2012 under an accompanying Five Year R&D plan (RIRDC 2010). These funding initiatives enabled activity in weed RD&E, yet a coherent, collective focused effort to support weed RD&E was not developed. Indeed, the funding mechanisms often drove fragmentation between the organisations involved in research and delivery.

Australia currently has no nationally coordinated weeds RD&E program. This is not to say that there is no nationally beneficial weed RD&E occurring. The GRDC has remained a strong investor throughout the

last decade, with a particular focus on integrated weed management to manage herbicide resistance. Some states and industries still invest substantially in weed research, such as biological control research where there are infrastructure investments.

What is Australia foregoing in not having a nationally coordinated weed RD&E program? This paper briefly reviews current capacity, suggests priority areas for investment and considers options for implementation.

CURRENT STATE OF WEED RESEARCH

In May 2014 there were approximately 85 full time equivalent weed researchers and technicians in government agencies (internally or externally funded; compiled data from AWC members). Smaller jurisdictions have very few weed research staff. Queensland and New South Wales have the highest staff levels, much of this being crop weed focused which is mainly undertaken by universities in other jurisdictions. A dramatic decrease in capacity is weed biocontrol research, from a peak of thirty scientists working world wide for Australia's weed problems in the 1980s to approximately five in 2014 (Palmer *et al.* 2014). This implies a long-term decrease in benefits to Australia, given the long timeframes from discovery to release of agents and the need to maintain quarantine facilities.

Within universities, most staff are funded by industry and governments on contracts that rely on periodic external funding success. Nationally, the largest and most coordinated weed research focus is for cropping systems, particularly the University of Western Australia, University of Adelaide and Charles Sturt University. However, many universities have specialist expertise in invasive plant ecology and are an important resource for the training of undergraduate and post-graduate students, as well as their own research programs.

NATIONAL RD&E PRIORITIES

The current absence of a nationally coordinated weeds RD&E program does not mean that such research is not seen as important by stakeholders. The most recent weed specific plan is the NWPRP Five Year R&D Plan 2010 to 2015 (RIRDC 2010), which took a comprehensive approach to investment needs. Weeds are included in the national plant, and environment and community biosecurity RD&E strategies. Weeds of National Significance Strategic Plans list RD&E needs (www.weeds.org.sa/WoNS). Meat and Live-stock Australia has identified priority weed research activities including biocontrol targets (Grice *et al.* 2014, Morin *et al.* 2013), many of which cross-over to environmental weeds.

AWC held a national workshop in October 2013 on weeds RD&E investment models, subsequently establishing a working group with government and industry membership. The following were identified as important factors for effective national weeds RD&E:

- Sustained national economic, environmental and/or social outcomes arising from widespread adoption of best practice.
- Efficiency and maximising value from investment (i.e. high benefit:cost).
- Beneficiary pays, such that governments primarily invest where there is market failure.
- Long-term investment to maintain key capabilities and infrastructures.
- Balancing national, jurisdictional and industry interests in investment models.
- End-user driven through involvement along the RD&E continuum, to target research to broad needs and foster effective adoption.
- Flexibility to change research directions in response to roadblocks or new opportunities.
- Collaboration between RD&E provider organisations rather than competition and duplication with limited resources.
- Recognising and fostering national specialist capacity to deliver on specific RD&E needs.
- Collaboration and shared learning between environmental and agricultural sectors.
- Capacity to leverage traditional funders' investments by attracting new investors.
- A large focus on extension of past and new research findings, as often these do not sufficiently reach end users.

The greatest driver in Weeds RD&E is adequate funding. The business model of research organisations is changing, requiring partial external funding of tenured staff, while technical support and funding for PhDs and post doctorates is also required to ensure ongoing capacity. Thus the cost of weed research has risen dramatically over the past 20 years and combined with reduced funding has constrained the breadth of work that can be completed. Low funding levels necessitate a narrow focus on high impact, high feasibility, and nationally important areas of research. Through AWC four priority areas have been identified:

Biocontrol Few RD&E investments could match the 23:1 average benefit:cost ratio of weed biological control (Page and Lacey 2006), yet there has been a substantial decline in the number of weeds and agents under current research. It is constrained by an often long lead time to delivery and the need for specialist skills and facilities. However, there is already a strong international network for collaboration on particular

weeds and efficiencies to be gained in working on groups of related weeds concurrently. There are currently three main quarantine facilities for weed biocontrol, in Brisbane, Canberra and Melbourne. Ideally, there would be at least ten weeds being subject to biocontrol research in Australia at any one time, servicing high impact weed species of grazing, cropping, natural and aquatic systems. A decision support tool for policy makers has been developed to aid prioritisation of weed targets for biocontrol research (Hennecke *et al.* 2013). A detailed prioritisation framework was subsequently developed and applied to weeds of livestock industries (Morin *et al.* 2013), with many of the priority weeds also being WoNS and/or environmental weeds. Extension through state-based redistribution networks brings in community ownership and is fundamental to hasten establishment, spread and impacts of effective biocontrol agents.

Sustainability of herbicide use Herbicides are a fundamental tool for weed management, yet their effective, long-term use is at risk due to issues of widespread herbicide resistance, application cost, market failure for new minor uses, off-label usage and off-target risks. Integrated weed management (IWM) remains a priority, not just in cropping systems, but also in extensive grazing, nature conservation and amenity land uses. What opportunities and lessons can be shared by greater scientific and practitioner interactions across these systems to build new approaches to IWM? In cropping, key RD&E areas include extending utility and access to herbicide modes of action, improved pre-emergent strategies in minimum tillage farming systems, increasing herbicide tolerant and competitive crop and pasture options, and accelerating new herbicides from overseas.

In grazing systems greater effort is needed to develop and promote decision tools that inform the on-farm profitability of IWM. A similar need remains for natural ecosystems, where managers are faced with multi-weed invasions and very limited operating budgets. Here, new and existing, broad-scale weed and native vegetation management techniques need to be cost-effectively combined. A key to this area is dealing with ‘causes’ and not just ‘symptoms’. For all systems, direct involvement of land managers in research and at demonstration sites is fundamental to reality check and foster broader adoption of new IWM approaches.

New approaches to detection and eradication Infestation delimitation is the major challenge to successful weed eradications and the detection prior to reproduction of all individuals within these areas.

Seed bank longevity adds a further temporal dimension of many years required for regular searching. Eradications are highly labour intensive and hence multi-million dollar programs. Technologies such as remote sensing, unmanned aerial vehicles and environmental DNA detection may provide alternative or complementary options to human searchers, but cost effectiveness, accessibility and accuracy remain challenges. Chemical, physical and/or biological means to enable rapid declines in soil seed banks with limited long-term detrimental effects would be highly desirable for many weed control programs.

Socioeconomic drivers of adopting best practice

Weed management is primarily driven by people’s knowledge, behaviours and actions. Government policy and regulation intervention through compliance and incentive programs seeks to motivate land holders when weeds are not perceived to threaten their self-interest, such as a new invader or a weed that impacts more in other land uses. However, government investment in weed management through one-on-one officer interaction with individual land holders is in serious decline as budgets shrink. Alternative, community and industry-led models of cooperative action need to evolve as the social norm. How can local peer pressure and community standards harness positive behavioural change to foster individual actions to prevent the establishment and spread of new and existing weeds?

Socioeconomic factors that foster widespread land manager adoption of existing and new R&D need to be factored into all research programs, rather than just the traditional extension reliance on the factsheet, website and field day model. Likewise, presenting weeds information in the context of a production system is important – a decision on managing weeds is in direct competition with other on-farm resourcing needs. A ‘communities of practice’ approach, bringing together land holders across multiple land uses, weed scientists, weed authorities, socioeconomic researchers, and advisers (e.g. financial, agronomic) may yield longer-term outcomes around an agreed weed problem of mutual concern. But the coordination effort would need to be balanced with an appropriate compliance approach, for example through district weeds officers. The cost effectiveness of these approaches need to be considered.

STEPS FOR IMPLEMENTATION

Australian Weeds Committee has considered a range of investment frameworks. The CRC model fosters collaboration of many government and industry organisations across primary industries, environmental and amenity sectors, can be both public good and

commercial in its outputs and includes student training. Government CRC investments are on the decline, but a similar approach could be pursued through other funding sources, for example, cross RDC programs, Australian Research Council linkage grants or direct Commonwealth and state investment. A stand alone, not for profit entity may offer greater flexibility than a CRC in work planning and investment options, but still needs a clear research program with specific outcomes and timeframes to allow partners to invest, as well as rigid financial and legal governance. A funding program through a government national research program (i.e. an RDC) utilises existing expertise and governance structures but competitive funding risks poor collaboration, inefficient duplication between research providers and poor long-term adoption. Direct government funding grants may arise in relatively short timeframes and focus on specific needs. But these risk being political rather than strategic priorities and are still short-term and potentially non-collaborative.

The 2013 AWC weeds RD&E workshop preferred a centralised structure and coordinated process that allows participants to commit their cash, people and/or infrastructure to their priorities, without requiring compromises on outcomes. The concept of establishing specialist hubs (e.g. biocontrol, herbicide sustainability) is being explored with the future possibility of linking these under a broad umbrella organisation. This model would not exclude more specific collaborative opportunities being pursued by organisations, but rather provide a way to guide, encourage and promote these activities.

CONCLUSION

Governments and industry are moving beyond despair at the state of national weeds RD&E and are actively exploring future opportunities. The challenge is that simply relying on high benefit:cost and strategic needs will not get us over the line. A political driver is also needed. Government investment is strongly influenced by community and industry attitudes and advocacy. In this regard the demand for weeds RD&E needs to come from the broader community, such that there is both short-term political capital and long-term economic, environmental and social benefits.

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