DO FARMERS ADOPT NEW MANAGEMENT STRATEGIES DEVELOPED BY RESEARCHERS? DO RESEARCHERS COMMUNICATE THEIR RESULTS EFFECTIVELY?

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Abstract Recent research in relation to herbicide resistance has focused on the science of herbicide resistance. From the knowledge gained, management strategies for herbicide resistance have been developed. Currently, in relation to herbicide management strategies, there is little documented knowledge of the rate and process by which farmers adopt such strategies. Few studies relate outcomes to a particular learning or communication process and the capacity of technical information to meet individual farmers' needs for fine tuning and system management is not known. Understanding what is necessary for successful adoption is important for achieving on-farm management to contain or avoid herbicide resistance problems. This paper reviews existing knowledge on farmers' processes when adopting new management strategies. This sets the scene for identifying future research priorities

INTRODUCTION

Herbicide resistance and management strategies Herbicide resistance is a global phenomenon resulting from widespread chemical weed control since the 1940s. In Australia, broad acre cropping systems using reduced tillage have become the norm, proving beneficial to soil structure, fertility, disease control and the ability of farmers to sustain profitable crop production (Bishop *et al.*, 1996). However, these systems rely heavily on the use of chemicals, with consequent appearance of herbicide resistant weeds. Although resistance results from basic evolutionary processes that occur among all classes of pests, its development has been accelerated by excessive dependence upon single weed control tactics (Smale, B.C., 1991).

Research on herbicide resistance has focused largely on the biological mechanisms by which it occurs. From this, researchers have developed herbicide resistance management strategies integrating a range of weed control options including crop rotation, herbicide group rotation, cultivation and manipulation of agronomic practices such as sowing time and rate, and varietal selection. While these strategies are scientifically credible, the perception is that the adoption rate by the end-users (especially farmers) is less than anticipated, and must improve if widespread herbicide resistance is to be avoided.

There is little available knowledge linking the process of developing management strategies with the rate and process of on-farm adoption of herbicide management strategies. Few studies relate outcomes to a particular learning or communication process, or provide insights to improve links between an information exchange process and learning or decision making by the end user. In addition the capacity of technical information to meet individual farmers' needs for fine tuning and system management is not known. In this paper we argue that understanding these processes will be important for achieving management to contain or avoid herbicide resistance.

PROBLEM

Achieving on-farm management practices The challenge in herbicide resistance is not to produce information but to have management practices adopted which contain or avoid resistance problems. Often non-adoption by farmers is for very pragmatic reasons where the technology promoted is simply not suited to the environmental or social context. Assisting farmers to avoid herbicide resistance involves the special challenge of supporting decisions to prevent potential problems - inherently more difficult than management decisions to alleviate an existing, visible problem. Unless farmers perceive a potential problem with herbicide resistance, they are unlikely to adopt resistance management strategies. The problem includes linking farmers' perception of the problem at hand with the often different perceptions of scientists, in the context of a complex farming system where changes cannot be made in isolation.

INSIGHTS FROM THE LITERATURE

Theories of adoption and extension Many theories and models have been developed to explain adoption and extension practices. The diffusion model (Rogers, 1983) was derived from observations that innovations diffuse throughout the wider community. Research and extension services until recently based their operations on linear transfer of technology from this model. However, evidence of its poor effectiveness in relation to systems of management includes slow uptake of stubble retention and ley systems (Blacket, 1996).

More recent models recognise 'barriers to adoption'. Adoption is unlikely if management strategies are not in the best interests of individual farmers, even if their wide adoption would be socially acceptable. Some key considerations affecting adoption of new technologies are:

- complexity - more complex innovations encounter greater resistance to adoption;
- divisibility - a strategy which can be partially adopted is more likely to be accepted;
- congruence - innovations which are compatible with other farm and personal objectives are more likely to be adopted;
- loss of flexibility - farmers are likely to resist innovations that restrict flexibility;
- economics - the more likely an economic benefit, the greater the adoption rate;
- implementation cost – innovations may be limited by the capital outlay required;
- intellectual cost - new farming strategies may require greater knowledge about the cropping system than the farmer can access;
- risk and uncertainty – the more risky the strategy the less likely it will be adopted;
- conflicting information – farmers receiving conflicting information from various sources are less likely to adopt new innovations;
- environmental perception – non-adoption sometimes results if media images of the problem conflict with the farmers' experience and knowledge;
- social infrastructure – if specific management strategies are not part of the farmers' subculture, adoption in that group is unlikely.

(Rogers, 1983; Frank and Chamala, 1992; Vanclay, 1992).

Approaches to agricultural research and extension practice which recognise the perspectives of key affected groups include 'farmer-first' (Chambers *et al*., 1989) and Agricultural Knowledge and Information Systems (Röling, 1990). In these approaches farmers are responsible for setting the agenda; therefore barriers to adoption do not logically exist, since there is no longer a normative reason why adoption ought to occur (Vanclay and Lawrence, 1995). These approaches are well suited to an existing acknowledged problem but may be less useful in adoption of strategies such as management of herbicide resistance where the opportunity is to utilise expert knowledge to anticipate and avoid future problems.

Between these two positions lies an alternative model which acknowledges the rationality and diversity of farmers and the social context in which adoption occurs (Vanclay and Lawrence, 1995). This model is participatory and views the activities of research, development and extension as complementary to on-farm management. The approach develops in a cyclical manner involving the activities of key stakeholders and learning throughout the process. Active participation in group processes is encouraged and the extension task is not one of delivering a product, but of facilitating cooperative action in relation to a negotiated and shared agenda (Vanclay and Lawrence, 1995). This participatory approach underpins Landcare and Catchment Management programs, which like efforts to contain or avoid herbicide resistance, seek to prevent potential problems as well as addressing existing problems.

Managing herbicide resistance also has similar elements to Integrated Pest Management (IPM). IPM experience suggests there is little justification in viewing pesticide resistance as solely a technical problem. For even a single crop, to design, implement and monitor a new management strategy is a major endeavor. Agriculture is a complex social process, not simply a complex, diverse and risky technical activity (Scoones and Thompson, 1994). In effective agricultural systems, farmers are very active in developing and adapting information and in asking for the kinds of information which they find useful (Röling and Jiggins,1994). In participatory research, researchers and scientists can learn from farmers and develop new processes of thinking, whilst contributing to participatory action (King, 1998). Agricultural research and extension practice forms part of a dynamic social process of coming to terms with conflicting interests, changing alliances and competing worldviews (Scoones and Thompson, 1994).

Theories of adult learning Learning theorists (Lave and Wenger, 1990 cited in Cohen and Sproull, 1996) have rejected information transfer models which isolate knowledge from practice and developed a view of learning as social construction, putting knowledge back into the contexts in which it has meaning. From this perspective, learners construct their understanding out of a wide range of materials that include ambient social and physical circumstances and the histories and social relations of the people involved (Cohen and Sproull, 1996). Where issues are complex, learning based approaches are more likely to result in a shared understanding of the problem. Lack of shared understanding between stakeholders of what the problem is, rather than a lack of awareness of scientists' solutions, is a significant cause of inaction on complex issues (Blacket, 1996). If farmers do not perceive the long term implications of herbicide resistance and scientists do not perceive the complex farming systems within which strategies must fit, then joint learning to manage the problem cannot begin.

Decision making in complex situations Reductionist research focuses on exploring and analysing separate parts of the system. A systems approach takes on a holistic view of the world and allows for interaction to be discovered (Röling and Jiggins, 1998). Wilson (1988) claims that once we know how to go about learning and understanding a complex situation we have laid the foundations for the decision making process which can lead to its improvement. Systems approaches to agricultural research have been successfully used in the Viable Farming Systems Group project and the Sustainable Beef Production Systems project (King *et al.*, 1998).

PRACTICAL IMPLICATIONS

Implications for farmers Many of the characteristics associated with non-adoption – such as complexity, divisibility, congruence, loss of flexibility, economics, intellectual cost – are likely to be relevant to managing herbicide resistance. This is particularly the case for farmers who do not currently have herbicide resistance problems. These farmers may have difficulty perceiving the need to adopt strategies to prevent resistance occurring when there is no apparent economic advantage. Gill (1996) found that the lack of adoption of pasture topping in ryegrass for controlling resistance to herbicides was not due to ignorance but more likely due to unattractive gross margins.

The factors previously indicated explain why farmer non-adoption of management strategies for herbicide resistance is understandable and rational. Scientists operate within their own social power relations (Vanclay and Lawrence, 1995) which may lead to their promoting solutions to problems in ways which support their own interests as much as farmers' interests. It might be entirely appropriate for farmers to reject advice which is in the interest of some other group rather than their own.

Implications for Reasearch and Extension The trend towards scientists co-learning with farmers rather than teaching or telling, recognises farmers' ownership of the problem and of the development of herbicide resistance solutions. Scientists need to be aware of the potential to become trapped in top-down thinking where they determine priorities, generate strategies for management and then attempt to transfer them to farmers. An active interface needs to be created between scientists and farmers which ensures scientists are fully cognizant of current farmer practices. While the merits of joint decision making are acknowledged at the research funding level, the mechanisms at the on-farm level are less developed for problems which are systemic and anticipated rather than experienced.

Farmers need to be proactive in solving their own problems, both current and potential, and have ownership in developing new management strategies. An example of this approach is the Do Your Own Research Scheme (DOOR) advocated by Hunter *et al.* (1996). A range of efficient systems of constructive interaction between scientists and farmers are needed to effectively and efficiently co-learn with farmers. The aim is sharing understanding of the problem or issues at the values and perceptions level and developing understanding of the mechanics of management process, to assist in linking expert knowledge with ongoing farmer decisions and actions.

Priorities for future research The suitability of researchers' technical information, as currently presented, to meet farmers' needs must be investigated. Farmers' current behaviour may provide clues to their learning approaches and existing farming strategy preferences. Researchers and farmers may need to develop new mechanisms of co-learning to address the management of herbicide resistance, raising the question of the capacity (human and other resources) of researchers and research systems to make these adjustments.

Co-research is required to determine what the farmers' decision points are, what decisions are being made, who is taking responsibility for the decisions and which sources of information are being used. It should also investigate if this decision process is focused in terms of one commodity only or in a whole farm sense. For example, when concepts are developed in relation to one enterprise do farmers subsequently apply them to other enterprises or issues within their businesses? Proposed research by the authors will investigate how technical information can be provided to support holistic farm requirements and when the focus on weed management is better based on understanding of one particular cropping situation.

Increasing demands for environmental management assurance systems associated with quality characteristics of marketed products (see, for example, Hess and Bryant, 1999) suggest that the level of complexity in herbicide resistance management may rise further, from an issue concerned with environmental and production management to also involving marketing and regulatory standards. This confirms the priority of better understanding the links between farmers' management strategies and the processes of research and extension in relation to managing herbicide resistance.

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