Extension of weed research outcomes through the Australian cotton industry

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Summary  This paper describes a theoretical approach to extension strategies and the structure of weeds extension for the Australian cotton industry. The approach to be discussed is based on the concept of innovation design by Leeuwis and Van den Ban (2004), that all stakeholders interact to develop solutions to problems. While the cotton extension team currently uses aspects of this approach, this paper describes why a more coordinated approach to solving problems needs to be used.

Weeds are a significant problem in the Australian cotton industry as they result in loss of production efficiency. Technological and agronomic developments in the cotton industry have led to the emergence of other significant issues related to weeds. Weeds can be hosts for soil borne disease and insects. Another emerging issue is the management of glyphosate-tolerant cotton varieties when they become weeds in following crops.

The Australian cotton industry has invested a considerable amount of money to research weed problems and to develop integrated weed management strategies for the cotton production system. These research outcomes will only be effective if adopted by growers. The processes for successful adoption of this research present real challenges for all sectors of industry – not just for extension personnel.

The key to the management and adoption of these research outcomes is cooperation between cotton growers, and research and extension staff in the Australian Cotton Cooperative Research Centre (CRC). The CRC ethic is to have collaboration, communication and cooperation between all researchers, extension officers and industry stakeholders.

Extension staff in the Australian cotton industry use various methods of technology transfer and group facilitation to achieve the goals of sustainable cotton production. An improved understanding of extension techniques will provide improved effectiveness of personnel employed and resources available.

Keywords  Communication, Cotton CRC, extension, innovation, design.

INTRODUCTION

Rapidly changing problems and technologies in agriculture mean that problem solving is not a straightforward process. There are often conflicting issues that make solutions complex. Leeuwis and Van den Ban (2004) state that extension is no longer a process of disseminating knowledge, as quite often the knowledge, directions and policies are not pre-defined.

Complex problems  Changing technological opportunities and environmental values in the cotton industry have changed industry perceptions and priorities for weed management in the following areas.

1. The introduction of Bt cotton and highly selective insecticides in cotton has changed the insect pest complex resulting in an increased occurrence of what were previously secondary pests such as green mirids (Wilson 2002). An important aspect of management of secondary pests such as mirids is the control of alternative hosts (weeds) during winter (Mensah and Wilson 1999). However, weeds play a role in promoting natural insect predators of these pests so it can be beneficial to maintain winter weeds (Murray 2002). Weeds can also be alternative hosts of fusarium wilt (Fusarium oxysporum f.sp. vasinfectum), a fungal soil borne disease that has developed relatively recently in the Australian cotton industry (Kochman et al. 2002).

2. Residual herbicides have an important role in cotton production systems. There has been increasing concern over the effect of residual herbicides on soil health and in riverine systems (Taylor et al. 2002). However, if residual herbicides are removed from the production system an important tool in integrated weed management would be lost.

3. The introduction of glyphosate-tolerant cotton has been an important new management tool for many problem weeds and in high weed density fields. Using this tool correctly is important for preventing or controlling any unintended results including species shift, the development of glyphosate-resistant weeds and the development of volunteer cotton as a weed (Roberts 2002, Taylor et al. 2002).
It is in these problem areas where innovation is needed to develop solutions. While it is easy to recognise the problems through industry feedback and grower experience, the solutions are not so easily determined (Leeuwis and Van den Ban 2004). Extension activities are increasingly geared towards designing new innovations (solutions). When extension is needed to diffuse new innovations this cannot be done without an element of re-design of the innovation to suit individuals (Leeuwis and Van den Ban 2004). This is more commonly referred to as localising solutions, and is the basis of the placement of extension officers in most cotton growing valleys.

Solution development or the ‘innovation process’ is a two way process in which all parties can be expected to contribute, including growers, consultants, researchers, extension officers, policy makers and other members of the agricultural industry. The purpose of this paper is to describe ways in which the concept of innovation design could be used to improve problem solving in the cotton industry.

**INNOVATION DESIGN**

Innovation should not be primarily scientific research. Developing solutions should involve all stakeholders. Research is the analysis of these solutions, but doing research and gathering data should involve interactions between researchers and stakeholders that results in learning for both. Solutions are not likely to be successful if they are scientist owned or initiated (Leeuwis and Van den Ban 2004). The most successful innovations are where knowledge is generated in various places, for example when on-farm trials and research trials are integrated. In the innovation processes, scientists and farmers play an active role in the discussion. The resulting management solutions to the problems are then less likely to be artificial and imposed (Leeuwis and Van den Ban 2004).

Innovation design is not a straight-forward process; rather it is a process of network building, social learning and negotiation that takes place in an evolutionary context. The ‘design’ or solution may originally have been a rather abstract idea that gradually forms into a coherent practice (Leeuwis and Van den Ban 2004). The tradition of ‘adoption’ of a solution or practice is difficult to extend when the solution is yet to be designed.

In order to arrive at coherent practices, all stakeholders need to somehow develop a shared understanding of the problem as the basis for effective coordinated action (Leeuwis and Van den Ban 2004). Once the awareness of this problem has developed there needs to be mobilisation of interest in a network of stakeholders action (Leeuwis and Van den Ban 2004).

In the case of the Australian cotton industry this means bringing together a group of researchers, extension officers, farmers, agronomists, consultants and the funding organisations. Once the various stakeholders are involved there is a process of experimentation, research, trial and error and careful adaptation including a negotiation period where various ideas are formulated and reformulated. In the learning and negotiation process, knowledge can be generated in the field or on the research station by researchers or growers. The process can take many years. For innovation to become mature there needs to be space and time for experimentation and the development of the design. For example this can be done through small scale trials which over time gradually move through to larger field scale trials and offer a learning period for all involved. After this period there is a gradual expansion of the experimental design and implementation. This design is then either evolved to fit various systems, or in the case of failure, redesigned (Leeuwis and Van den Ban 2004).

**CONFLICTING SOLUTIONS**

Whenever different stakeholder groups are involved in the process of meaningful change, conflicts are likely to emerge since such changes may have consequences that affect the values and interests of many stakeholders (Leeuwis and Van den Ban 2004). For example, controlling winter weeds in cotton fields is recommended to prevent the over-wintering and early build up of pests such as aphids and mirids, especially if it is suspected that there could be resistant individuals present. However, weeds are also a host for beneficial insects and can act as a nursery for the build up of beneficial insects (Murray 2002). To follow IWM principles it is important to prevent weed seed set, but to maintain biodiversity for beneficial insects it is important that weeds remain. The action taken by the grower will depend on their understanding of the problem and their individual preferences.

The effectiveness of a reduction or the removal of residual herbicides in the cotton production system is dependent on the weed pressure in each individual cotton field. However, determining the weed pressure in individual fields and thresholds for the reduction of residual herbicides needs to be a negotiated process between growers, agronomists and researchers. Individual growers have different attitudes towards risk and labour management that will necessitate a redesign of thresholds for each individual farmer.

**THE ROLE OF EXTENSION**

The role of the extension team is to guide the innovation process and to ensure effective interaction of all
stakeholders. Although extension officers do not need to be directly involved in all the innovation process, that is they do not need to be present for every grower-researcher discussion, they are in a position to monitor the process and to facilitate critical feedback.

The existing focus team is the focal point for weeds and disease extension. The focus team currently collects information about problem areas to provide feedback for continued research and as a key role in determining knowledge gaps that weaken the extension process. This includes putting together weeds information for distribution and communicating the progress of on going innovation development.

Traditional extension and research practices do not cope well with the complexity of these multiple paths of sustainability. The role of extension needs to be in connecting relevant stakeholders and guiding the interactive process. The process of innovation design is not designed to be extra work but to incorporate many processes to make solving problems (and extending them) more efficient.

CONCLUSIONS
Dissemination of solutions developed by research implies that there is only one development path, which sooner or later all farmers will have to walk if they wish to survive (Leeuwis 1999). These solutions are difficult to extend as they tend not to suit all growers and situations. In reality there is a great deal of diversity of sustainable practices (Leeuwis 1999). Solutions to the complex problems mentioned above require coordinated and interactive action of all stakeholders.

Communication and coordination are roles that the national cotton extension team attempts to carry out. However all stakeholders, growers, research and other industry members are equally important in this process and need to operate together in developing solutions rather than separately. The approach needs to be gradual and not forceful as in practice there will be a maximum degree of change and learning that farmers and research can accommodate at a particular point in time (Leeuwis 1999). However this process allows growers, consultants and researchers to gain more confidence in developing solutions and thinking about better practices (Leeuwis and Van der Ban 2004).

Various parts of this method are currently in practice in many parts of the cotton industry. For extension to be more effective coordinated processes need to be designed. There should not be a specific design but rather one that suits all the stakeholders involved in the processes. This implementation of such processes will require a change not only for extension staff but research and growers too.

ACKNOWLEDGMENTS
Much of the theory for this paper comes from Cees Leeuwis and A. Van den Ban’s book, ‘Communication for Rural Innovation’. The main author of this paper wishes to thank the Communication and Innovation Studies Department at Wageningen University for allowing her to view a draft copy.

The authors are currently funded by Cotton Research and Development Corporation and the Australian Cotton CRC.

REFERENCES