Bringing science to the producers: Nitrogen and water-use in arable farming

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Abstract

Efficiency of use of inputs is becoming paramount in successful farming. During the growing season, nitrogen and water are key factors in increasing yield, and much research has been done on amounts and timing of both inputs. However, not all producers are familiar with current recommendations, and there is considerable debate on the best way to effect technology transfer. This paper reports on a workshop held on nitrogen and water-use in arable farming, addressing the issues of what questions remain to be answered and how best to take the answers to the producers. Many of the issues raised were concerned with technology transfer in general and were not specific to the particular technology discussed.

Additional key words: *technology transfer.*

Introduction

Arable growers are under increasing pressure to produce high quality products using environmentally-acceptable procedures (Pyke, 1996). To facilitate this, research must identify 'sustainable land management systems'. The requirements for sustainable production (Smyth and Dumanski, 1994) include:

- maintaining and enhancing productivity;
- decreasing risks to production;
- protecting the potential of natural resources and preventing the degradation of oil and water quality;
- being economically viable;
- being socially acceptable.

These requirements can be met only by increasing efficiency of production, which includes increasing efficiency of use of inputs. Some of these inputs, such as nitrogen and water, must be manipulated during the growing season because they are mobile within the soil-plant-atmosphere continuum; their very mobility causes concern within the framework of sustainability (Rowarth, 1997a). Research on efficiency of inputs is in vogue, as is increased grower participation in research funding (Rowarth, 1997a). The issue of 'technology transfer', and how best to achieve it, is of paramount interest to all parties (Rowarth, 1997b), particularly in this decade of emerging information technologies, down-sizing of research institutions, cutbacks in government research funding to land-based production, and demise of Government-funded agricultural consultants.

This paper reports on the workshop "Bringing science to the producers: nitrogen and water-use in arable farming" held at the national Agri-industry convention at Lincoln University in August 1997. Three papers were presented to set the scene of latest research results (Francis, 1995; Jamieson *et al.*, 1995; de Ruiter, 1996, 1997). The workshop participants, who included producers, industry personnel, consultants and scientists, then addressed the following questions within the topic of nitrogen and water management, although many of the issues raised were not-specific to the defined topics.

- What technology is required?
- What are the benefits the technology offers?
- What are the disincentives to the uptake of technology?
- Who wants the technology?
- How should the technology be transferred and who will it reach?
- How should information be packaged?
- Who should pay for technology transfer?
- What does technology transfer need to offer the producers?

Workshop Report

What technology is required?

Information on nitrogen and soil moisture, plus monitoring systems that will enable growers to manage inputs more efficiently with the aim of enhancing plant growth, yield and commodity quality.

What are the benefits the technology offers?

Technology must offer benefits to users if it is to be adopted. The benefits of improved information on nitrogen and soil moisture, plus improved monitoring systems were thought to include the following:

1. Yield and quality attributes will be improved, thereby increasing profits.
2. Environmental impacts will be reduced: improved use of nitrogen and irrigation will reduce the risk of nitrogen losses due to leaching. There will also be benefits in efficient use of non-renewable resources (e.g., electricity and diesel) and in reduced damage to soil structure.
3. Use of resources such as labour and equipment will be more efficient.
4. Producer satisfaction will improve (e.g., crops look good and risks in production are decreased).

What are the disincentives to the uptake of technology?

Disincentives to the uptake of technology include:

1. *Risk.* Cost-benefit analysis will be required.
   Knowledge gap. The technologies have not been proven by the producers, difficulties cannot be solved by discussions 'over the fence', and problems are likely to be producer-specific.
2. *Time.* Producers are concerned that the extra time spent in implementing a new technology is not available in the short term. In fact, time inputs required are not known in either the short or long term, which impacts upon the cost-benefit analysis.
3. *Ownership.* There are issues for both the provider and for the producer.
   For the scientist the issue is in who 'owns' the results. Levies are now directed towards particular research identified by the producers. As a consequence, the producers believe they 'own' the research results and scientists are not free to publish in the public arena without negotiation and a time delay. This has implications for information exchange, scientific progress and careers.
   For the producer to have a significant feeling of 'ownership', which is likely to increase desire for the new technology, involvement in research and technology transfer, not just in funding, is necessary.
4. *Trust.* The involvement of scientists in 'on-farm' trials builds confidence with the producers.
5. *Peer pressure.* This tends to stop growers from taking up new technology as they don't want to be seen to fail.

Who wants the technology?

The markets for new technology include:

1. *Producers.* The top producers want the latest information even before it becomes available.
   Uptake, however, will depend upon the return, risk and complexity of the new technology (Fig. 1). If the technology gives good returns and is relatively risk-free and simple, uptake will be rapid.

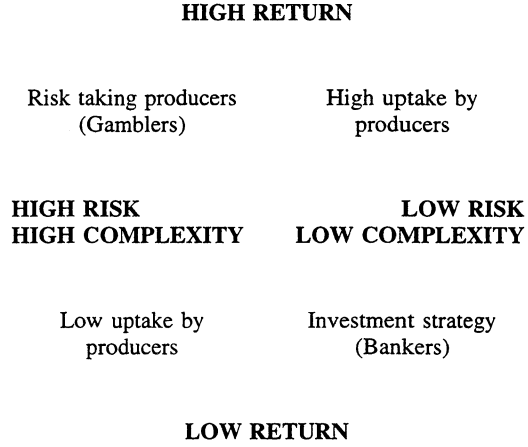

Figure 1. The relationship between uptake of a new technology and return on, risk in, and complexity of the technology

2. *Consultants* - generally acquire new technologies only if they add value to the existing packages of information. They will sometimes be involved in technology packages if they improve relations with either the scientist or producers.
3. *Agri-industry* - requires new technologies if they add value to the support service network and if they provide the link between the scientist and the producer.

4. *End-users* - require new technologies to ensure that the product meets quality standards.
5. *Regulatory authorities* - require new technologies to ensure adherence to effective environmental management and quality assurance.

How should information be transferred and who will it reach?

Different methods of communication have different audiences. Participants in the workshop associated the following methods with the indicated audiences:

1. *Scientific papers* - top 5 % of growers and consultants.
2. *Consultant seminars* - top 20 % of consultants.
3. *Demonstration/monitor farms* - top to mid range producers.
4. *Discussion groups* - top to mid range producers.
5. *Field days/seminars* - top to mid range producers.
6. *Technical publications* - all producers; interpreted by top to mid range producers.
7. *Press articles* - all producers.

How should information be packaged?

Information packaging was thought to have a large effect on its uptake.

1. *Scientific models* - not effective.
2. *Producer models* - can be successful; direction and terminology must be appropriate.
3. *Best management packages* - can be successful if presented as scenarios (rather than recipes); can be linked to models.
4. *Technical information sheets* - successful, particularly if the possible outcomes are identified.
5. *Computer information base* - currently being evaluated.
6. *Seminar/field days* - very successful, particularly if on a specific topic and planning outcomes are identified.

Who should pay for technology transfer?

This depends upon how the information is packaged.

1. *On-farm/producer research and development* - Foundation for Research, Science and Technology - Technology for Business Growth programmes, AGMARDT, grower organisations.
2. *Best management packages* - users of package.
3. *Technical information* - producer levies.

What does the technology package need to offer the producers?

1. Time to get into the detail of the research results and what it means for the producers in their particular situation.
2. Realistic cost-benefit of implementation.
3. A 'best management package giving answers or scenarios for a particular situation.
4. Two-way exchanges at field days, seminars and discussion groups.
5. One-to-one contact and advice.
6. Assurance that the technology will work and has been demonstrated to work in the particular situation of the producer.

Conclusions

Research funding is still in an extremely unsettled state in New Zealand. In striving to encourage useful research, the Foundation for Research, Science and Technology emphasise relevance, industry support and information transfer in their bids. In striving to encourage progressive farming, AGMARDT allow bids for research funding from farmers, as does the Foundation for Research, Science and Technology - Technology for Business Growth programme. Scientists spend considerable time and effort in achieving research funds and then disseminating the information gathered. Private consultants gather this information, and then sell it to their clients in a management package which may or may not fit the original intention of the scientist. Thus the boundaries between who should be doing what, particularly when it comes to technology transfer, are unclear. Furthermore, as research funding in the land-based sectors reduces, there will be increased competition for fewer dollars, and more consultants vying for clients.

What the producers want is individual advice - they want to know what research results mean for them on their soil types within their management systems (Rowarth, 1997b). Although one-to-one technology transfer schemes can be extremely effective not only in increasing yields but also in identifying areas for future research, they are extremely expensive (Rowarth *et al.*, 1993), and are increasingly unlikely to occur unless through private consultants. However, the diminishing dollar means that the scientist is increasingly unlikely to 'give' information to the private consultant who will then 'sell' it to the client; the scientist could do the 'selling', but this will, of course, reduce research output.

A further consideration is that, in an attempt to meet the individual requirements of the producers, scientists are producing decision-support models based on an amalgamation of data. Averaging of data removes the reliability of a result for an individual situation (Cornforth, 1998).

New Zealand is one of the few countries in the world which still has a 'clean, green image' (even though it

simply reflects a small population and strong westerly winds) and can produce sufficient food for its population. We must produce this food in a sustainable manner, which means using inputs efficiently. The major issues of how to use nitrogen and water efficiently are being addressed by scientists. It is paramount that reliable information be given to the producers as soon as it becomes available. Bodies such as the Foundation for Arable Research, providing a nexus between scientists, producers, consultants and agri-industry personnel, are assisting the flow of information. It is to be hoped that Government funding to land-based production will not continue to be reduced, and that some stability in the sector and boundary definition can be achieved in the near future.

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