

## **A Farming Systems Approach to Increased Use of Integrated Pest Management in the Australian Cotton Industry**

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### **Abstract**

Integrated Pest Management (IPM) is a response both to the biological necessity of dealing with increased resistance of insect pests to chemical controls, and of cotton industry and community concerns about the long term impact of chemicals on the environment and human health. The Australian Cotton Industry is a relatively new industry with a high reliance on private consultants to provide day-to-day extension and management advice. This paper reports on studies undertaken in 1995 and 1997 to better understand those factors affecting the effectiveness of the Research Development and Extension process in general, and the adoption of IPM approaches on cotton farms in particular. While much of the research and extension effort has been in providing technological and biological applications of IPM, cotton growers' emphasis on yield, their aversion to risk, and their requirement for local validation of recommended approaches were demonstrated to slow adoption. On the other hand, the high level of awareness of, and the need for, greater use of IPM alternatives within the cotton industry provides a positive climate for its development. Emphasis on grower, consultant and researcher involvement in localised on-farm trials, sharing of growers experiences in developing and integrating IPM approaches on their farms, and facilitating positive interaction between cotton growers and the broader community are strategies that are recommended to increase the rate of IPM usage.

### **Introduction**

This paper explores the relevance of Farming Systems Research approaches in increasing the use of effective Integrated Pest Management (IPM) on cotton farms in Australia. It reports on the results of two related studies carried out in 1995 and 1997 exploring the differing roles of researchers, extension officers, private consultants and growers in developing IPM approaches appropriate to localised farming systems, and the factors that influence their adoption.

Integrated Pest Management in the cotton industry is a concept being driven by the pragmatic needs of cotton growers to have an alternative to chemical control in the face of increasing pesticide resistance. It is also being driven by increasing community concern about the perceived negative impact of chemical residues on the environment and on human health. Despite these pressures, the adoption of IPM approaches is slow. This paper looks at the factors impacting on the development and adoption of IPM approaches in order to better define strategies for more effective management of change towards more sustainable and environmentally friendly farming practices.

## Widespread Concerns about Chemical Usage on-Farms

There is increasing concern about the negative impact of chemical use on farms with respect to the environment and human health (Fergusun et al 1996, Foster 1995). The International Organisation for Biological and Integrated Control (IOBC), for example, held its conference in 1991 with a theme of Biological Control and Integrated Crop Protection. It brought together a range of interests to...*progress harmoniously with common rules in order to achieve a healthy and sound agriculture, without harmful side effects* (Cavallo 1991, preface). This objective resulted from a...*perception of a general interest in IPM as problems with chemical use caused concern, particularly groundwater pollution and its effects as well as resistance problems faced by farmers.* ( Foster 1995 p.17) Other specific areas of concern that were highlighted included pollution of lakes by nitrate and phosphate, acidification of lakes and soil contamination (Foster 1995, Aitken et al 1995). An environmental audit of the Australian Cotton Industry listed environmental issues relating to the application of pesticides as: spray drift; community health; occupational health; effects on flora and fauna; quantity of pesticides used; insect resistance; pesticide issues; and noise (for example crop spraying aircraft) (Gibb Environmental Sciences 1991).

Foster (1995) reported that the Ecological Sustainable Working Group on Agriculture (Australia) stated that...future research and monitoring efforts relating to agricultural chemicals should concentrate on methods for implementing IPM systems and developing approaches for minimising chemical use in agriculture (Foster 1995 p.241). This is consistent with an international trend for governments to legislate (for example in Sweden, Denmark and the Netherlands) or to initiate pest reduction programs.

## IPM Definition

There is some confusion as to what constitutes Integrated Pest Management (Kimberely 1997) and how it should be defined. For the purposes of this paper, the following definition is used:

*Integrated Pest Management is the judicious use and integration of various pest control tactics in the context of the associated environment of the pest in ways that complement and facilitate the biological and other natural control of pests to meet economic, public health and environmental goals* (Cate & Hinkle 1994 in Aitken et al 1995 p.6).

Despite the political and community pressure to implement IPM approaches to crop management, and its logical benefits, broad adoption of IPM has been disappointingly slow. As Aitken (1995 p.5) put it...*if IPM is so advantageous, why has it not been universally implemented?*

## Constraints to the Wider Use of IPM

The literature raises a number of constraints to widespread adoption of IPM in cropping systems. A primary factor raised is the relatively cheap cost of chemical control, and its ease of use by farmers compared to the more labour intensive IPM alternatives (Allen & Rojottee 1990, Wearing 1998, Aitken et al 1995, Sorensen 1993).

These and broader social and economic constraints described in literature are captured in the following quote:

*Constraints identified are generally tied to: reliance on pesticide control and government policy that supports continuance of that pest problems solution; research related issues such as funding levels and a concentration on insect problems alone, with economic, agronomic and social constraints often overlooked; institutional issues such as the independent operation and conflicting goals and interest of research, extension and technical services; and communication problems arising from science driven development of IPM such as lack of communication with farmers, lack of understanding of their level of resources and needs and lack of knowledge of farming contexts and practices (Aitken et al 1995. p36).*

Fergusun et al (1996) also reported on restraints to IPM approaches from the perspective of consultants. These included a perceived lack of viable non-chemical alternatives, lower yields, poorer quality and higher production costs with IPM, the need for higher management skills and a general lack of quality information. Growers' unwillingness to assume risk was another factor proposed by pest control advisors.

### **Farming Systems Perspective**

Despite an emphasis on the use of IPM over a number of years, widespread adoption of comprehensive IPM programs has not taken place. One reason, according to Norton (1994), the Director of the Cooperative Research Centre for Tropical Pest Management (Brisbane Australia), is that there is... *a major flaw in the conventional approach to IPM [with] its excessive emphasis on a science driven approach, based on the traditional technology transfer model...[where it is assumed that] basic research leads to the development of novel control methods and practices that are then relayed to extension services resulting in farmer adoption.* Norton advocated a different model incorporating an interdisciplinary approach and involving the participation of farmers and other stakeholders.

Other authors have concurred with Norton on the need for new Research and Extension models to improve the use and effectiveness of IPM approaches on farm. Røling and Fliert (1994) assert that...*sustainable agriculture is not an 'innovation' that farmers 'adopt', but rather*

*...changing to more sustainable practices is more like a paradigm shift, involving a learning path leading to new perspectives on risk avoidance, new professionalism, and a greater reliance on one's own experiences and observation, the use of new indicators and new instruments to make things visible, and usually a greater dependence on collective decision making in cooperation with other stakeholders in the same ecosystem (Røling and Fliert 1994 p.1).*

The need for IPM approaches to fit into the complexity of existing farming systems, within the resource base of farmers, and in line with farming families needs and goals have been raised as important in increasing the use of IPM approaches (Aitken et al 1995, Fenmore and Norton 1985, McNamara et al 1991). Kimbereley (1997) also pointed to the critical role played by the personal interaction between the farmer and his/her consultant in the level of IPM usage.

## The Australian Cotton Industry

The Australian Cotton industry is a relatively new industry mainly situated in Eastern Australia, inland between Northern New South Wales (Narrabri) to Emerald in Central Queensland. It is a rapidly growing industry with the total area of cotton grown largely dependant on seasonal rainfall. It has a high reliance on private consultants to provide day-to-day extension and management advice. The Cotton Research and Development Corporation and the Cooperative Research Centre for Sustainable Cotton Production are involved in funding and carrying out research and public sector extension across the industry. There are approximately 1100 growers, serviced by 120 private consultants, and supported by 10 public and industry funded extension officers (1995 figures in Coutts et al 1995).

The 1995 study noted that key issues for the cotton industry were the relationship between extension and the large number of consultants (in comparison to most other agricultural industries), and insect pest management - including chemical resistance strategies and other IPM approaches. (Coutts et al 1995). The 1997 study was embedded in...*concerns about the dwindling choice of chemicals for insect pest control, environmental pollution and community concerns towards the cotton industry*. It referred to a perceived...*unexplained slowness in adopting recommended IPM strategies across the industry...*and sought to increase the understanding of issues impacting on the adoption of IPM (Coutts et al 1997).

## Methodology

Two studies were undertaken across the major cotton growing districts in Australia. Both studies used group approaches for data collection from each major stakeholder group - cotton growers, private consultants, extension officers and researchers.

The 1995 study used a group interview approach, where a panel of the same four interviewers posed a series of open survey questions to homogenous groups (that is, the group comprised only of growers or researchers etc) in each region. In some cases the extension officer in the region was interviewed separately. The questions were focused on the interviewee's experiences as well as on issues relating to extension in the cotton industry. A total of 24 group and individual interviews took place in 7 regional centres. The four interviewees took notes and compared the key themes emerging from the data. A matrix was used to cross reference knowledge processes undertaken by different groups, agencies and information sources. Results of the analysis were presented to representatives across the stakeholder groups as an audit prior to completing the final report.

The 1997 study used a focus group methodology - a rigorous qualitative marketing and evaluation technique (Kruger 1988). Extension officers participating in the data collection were trained in the theory and application of the methodology including data analysis, and pairs were allocated one of the 10 focus groups undertaken in the study. These were carried out in all cotton districts, and also in homogenous groupings of growers, extension officers, private consultants or researchers. As with accepted focus group methodology, the questioning route went from general to specific questions, increasingly focusing on the issue of Integrated Pest Management and its application. The ten independent reports were provided to participants for accuracy checking and were further analysed for common themes. The combined analysis was audited by those cotton extension officers who participated in the original data collection.

## Key Findings

This section brings together the results of both studies in terms of the insights gained into the use of IPM approaches on cotton farms and the related issues of the roles of research, extension and private consultants. These findings are reported below in terms of emergent themes and the perspectives obtained from participants around these themes.

**There was a general acceptance across all stakeholder groups of the need for, and inevitability of, greater use of IPM approaches in the medium to long term.**

This acceptance emerged through the focus groups as being driven largely by the perception of the long term inadequacy of chemicals in pest control...*as they (insect pests) mutate and adapt they are going to beat us in the end* (cotton grower informant). Negative community attitudes of the cotton industry with respect to the highly visible level of chemical usage (for example, the use of aircraft to spray fields), was another factor emerging from the data as influencing this general level of acceptance of the inevitability of increased use of IPM. A high level of awareness of environmental issues and concerns about family and community health was evident in the data.

**There was a high level of awareness of IPM approaches amongst growers, however there was a low rate of adoption of comprehensive IPM programs on farm.**

All producers involved in the focus groups were aware of the term 'Integrated Pest Management'. Generally, producers viewed IPM as being primarily about ...*controlling insect pests with minimal chemical usage*. There was also a high level of awareness about a range of different components of IPM approaches.

All stakeholders in the focus groups reported that different components of IPM were being used throughout the industry, however this was piecemeal and there was not evidence of widespread adoption of comprehensive IPM programs. This situation is highlighted by a cotton grower who stated that...*no one is using every available option of IPM, but everyone is using it in some form*. Traditional chemicals, however, emerged clearly from the research as remaining the primary insect control mechanism in the industry.

**There was some lack of acceptance by cotton growers of research results that originated on research farms or in other farming districts.**

A strong theme emerging in both studies was the suspicion or lack of acceptance by cotton growers of research carried out at remote locations on research stations or in other cotton growing districts. This was particularly in the case of IPM strategies. Both consultants and growers expressed the need for flexibility in IPM approaches, and the concern that differing climatic, soil and catchment situations precluded direct adoption of recommendations based on research undertaken elsewhere. This was the case even for growers in the same district as the major research station, but was more evident the greater the distance the cotton district is from the research station.

As a result, there was strong support for localised trials and demonstrations. Private consultants, in particular, supported this approach as a way of exposing their clients to IPM

approaches, and giving them the confidence to permit consultants to trial alternative approaches on their farms.

**Private consultants faced difficulties in encouraging IPM approaches with their grower clients.**

A strong theme which came out of both studies was the difficulties faced by consultants in recommending 'softer', or more comprehensive IPM approaches to their grower clients. The problem facing consultants is captured in the following quote from the 1997 focus groups: *...it's pretty tough to take what limited IPM tools we do have to a grower who still wants 4 bales of cotton, who has a lifestyle and overheads that dictates.* There was a reluctance by many growers to give their consultants scope to experiment with IPM where there was a risk to income. Likewise, consultants were reluctant to put their credibility on the line, where a 'bad' decision might diminish their reputation amongst grower clients. This trust issue and preparedness of growers to give consultants latitude and 'permission to fail' came through as a critical factor in encouraging IPM approaches on smaller farms.

Another issue was the extra consultant time needed to monitor crops with a 'softer' chemical regime to ensure pest numbers did not build up to damaging levels. Consultants appeared to be already overstretched in meeting time demands through the critical stages in the season, and growers were reluctant to pay consultants for extra time in the field.

**There was a clear distinction between the roles of private consultants, extension officers and researchers with respect to pest management and IPM.**

The 1995 study focused on the different roles played by researchers, public extension officers and private consultants. The study found that there was strong evidence that the roles of extension officers and consultants were synergistic and complementary. The study brought together the knowledge processes evident in addressing pest management/IPM issues on farm, and the different roles being played by the key groups. An adaptation of the resulting Matrix is shown in **Figure 1**.

The Matrix highlights the importance of each player in developing IPM strategies applicable to different farming systems needs. Consultants have a close operational relationship with growers, with enormous potential for impact on IPM development and adoption.....*if I don't do what he (the consultant) says, why pay him?* (grower informant 1997). The consultants were the greatest champions for increasing extension resources (with also strong support from growers) - primarily to facilitate/undertake local trials/demonstrations in conjunction with local grower groups. Consultants viewed such activities as essential in allowing growers to experience and evaluate strategies with direct relevance to their farming situation, and hence provide greater scope for experimenting with alternative approaches on individual farms.

**Decision-making by growers was influenced by their attitude to risk management, accepted criteria for success, industry image and personal goals.**

Cotton growers are influenced by their attitudes to risk and personal needs and goals with their respect to adoption of IPM approaches. A general view expressed by growers in the focus groups is represented by the quote...*we are not just here to make cotton, but also here*

*to make money.* The relatively low cost of chemicals in relation to their assured impact on yield came out as a major disincentive to use softer approaches with their perceived higher costs and risks. Economics alone was not the only factor in play - status was also an issue: *...low yielding farmers have never been industry leaders* (cotton grower informant 1997). There was an expressed need for a greater link made between IPM strategies and short and longer term costs/benefits.

There was also a suggestion that benefits should be expressed in terms of community attitude, environment and public health. Negative community attitudes to the cotton industry came across as a significant concern to growers. Despite the awareness of, and some sympathy for, community concerns about chemical usage, there was some indication that growers felt that community perceptions also resulted from misunderstandings. There was a strong call for the cotton industry to become more involved in school and community education programs.

Figure 1. Roles of stakeholder groups in knowledge processes for IPM

Knowledge process	Consultant	Extension	Research	Growers and grower organisation
Day-to-day operations - insect monitoring, chemical decisions	XXXXX	X	X	X
Raising awareness of emergent industry issues - IPM, resistance	XXX	XXX	XX	XXXX
Developing new strategies for IPM	X	XX	XXXXX	X
Raising awareness of new strategies	XX	XXX	XX	XX
Planning of local RD&E trials and activities	XX	XXXX	XO	XXXX
Undertaking local trials and validation of new strategies	X	XXXXX	XX	O
Coordinating local trials and data collation across districts	X	XXXXX		
Demonstrations, workshops, field days and seminars on issues	X	XXXX	XXX	X
Bringing in specialists and information from outside regions	XX	XXXX		
Feedback to researchers	X	XX	XX	XX

Where the number of 'Xs' indicate the degree to which the stakeholder group was involved in the knowledge process. 'O' indicated that a potential for increased involvement was recognised. Adapted from Coutts et al (1995).

## Discussion and Conclusions

From these studies, the development of IPM in the Australian Cotton Industry has been shown to be a good example of the tension between the immediate economic needs of

farmers engaged in production focused agriculture, their own long term need for biological sustainability, and community demands for environmental protection. Despite the broad acceptance by all groups of IPM as a desirable concept and the inevitability of its more intense application, the surrounding biological, economic and social complexities inhibit rapid adoption. New strategies are needed to assist the development, acceptance and faster adoption of IPM approaches. The results of this research provides some leads in the development of these strategies.

The factors that emerged from this study which *potentially discouraged or prevented*, and those which *potentially encouraged or enabled* the rapid development, acceptance and adoption of IPM approaches are listed below:

**Discouraged or prevented IPM:** lack of economic links to IPM recommendations/approaches; conservative attitude to risk; lack of confidence in results obtained from research outside of local area; emphasis on yields rather than net returns; and, lack of scope for consultants to take risks with their client's crops.

**Encouraged or enabled IPM:** a high level of awareness and acceptance of the concept of IPM amongst growers; increasing concern about the growing pesticide resistance; a desire for a positive image of the industry in the wider community; a recognition of non-economic benefits; the close relationship between consultants and growers at an operational level; evidence of local trials/demonstrations and value of local grower experience; and synergistic roles of consultants, extension officers, researchers and growers.

Based on these factors then, a number of strategies are suggested below to *reduce* the impact of the discouraging factors and *increase* the benefit of the encouraging factors:

1. Introducing economists as key members of the IPM development team. Economists should work closely with researchers and growers experimenting with IPM to research, extrapolate and document short, medium and long term impacts of IPM. Inclusion of the value of 'intangibles' (for example, positive community attitude) should also occur;
2. Encouraging extension officers to facilitate groups of growers who, in conjunction with researchers, are prepared to trial, document and share their experiences of IPM with other growers in their district;
3. Recognising consultants as key clients of extension education and extension programs and including them in the planning of local trials;
4. Holding high profile crop competitions based on IPM indicators rather than the traditional yield indicators; and
5. Providing opportunities for increased interaction and dialogue between cotton growers and other members of the community - including farm walks, seminars, educational activities and discussion groups.

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