INTEGRATED PEST MANAGEMENT IN NEW ZEALAND: LIMITATIONS AND MODELS FOR CHANGE

MARK E. WHALON¹ and DAVID R. PENMAN

Department of Entomology, Lincoln University, Canterbury

SUMMARY

Issues that impact on integrated pest management (IPM) implementation were analysed through a relational data base. Growing consumer and environmental concerns are pushing agriculture into alternative production practices. IPM must be considered as a key element in moves to 'sustainable' or 'organic' farming systems and IPM must adapt to external forces such as political and consumer demands in overseas markets. IPM must also be developed for the local context and the particular phytosanitary and pesticide residue constraints New Zealand faces through export markets. Funding reductions and inadequate attention to negative externalities, such as public health, resistance and non-tariff trade barriers, are limiting the implementation of IPM. Change is necessary and regulatory, economic, and education and facilitation models for change are reviewed.

Keywords: integrated pest management, sustainable agriculture, pesticides, regulations, education

INTRODUCTION

Despite many efforts to diversify New Zealand's economy, agricultural exports are still viewed as the main basis for economic recovery. There has, however, been substantial diversification within agricultural exports such as new animal species, fruit crops and floriculture. In looking to maintain and expand exports we must be cognisant of rapidly changing views on agricultural production systems, particularly in our major markets in developed countries. Such markets are putting increasing emphasis on sustainability, environmental agriculture and 'organic' production. Our premise is that New Zealand will have to adjust production practices to retain or expand market access in those mature markets with a strong environmental or sustainability ethos.

Agricultural policy is being increasingly driven by urban socio/political forces where consumer and environmental interests are demanding more environmentally benign production practices (Hall *et al* 1989). In response to these pressures new farming systems are emerging with more sustainable methods and growing markets (McCrae *et al* 1989). To support such systems, we can expect enhancement of non-tariff barriers to imports, particularly those not produced with environmentally benign methods.

Pest control is a critical element in many of our production systems. Cancellation of pesticide registrations in our export markets has led to their removal from our systems illustrating that pest management practices can be driven by external and international issues. Short of a complete redesign of production systems (McCrae *et al* 1989), Integrated Pest Management (IPM) represents the best paradigm for a transition from a chemically based to a more sustainable approach to plant protection. This paper examines and evaluates some models for supporting IPM programmes.

¹Fulbright Fellow from Department of Entomology and Pesticide Research Center, Michigan State University, East Lansing, Michigan, USA.

Proc. 44th N.Z. Weed and Pest Control Conf. 1991: 150-155

METHODS

Our analysis was largely by developing and applying a relational data base to the issue. Over 500 articles detailing worldwide efforts to implement IPM and sustainable agriculture were available on a data base developed by M. Whalon and now held by Lincoln University. The information was accessed through Folio Views (Folio Corp, Provo, Utah, U.S.A.) and researchers wishing to access the system should contact the Department of Entomology, Lincoln University.

IPM IMPLEMENTATION

IPM is an approach to pest control that employs the best set of strategies, tactics and tools to maintain pest populations below economically damaging levels with minimum adverse environmental, economic and social consequences. IPM is often the first step towards a more sustainable agriculture which is a philosophy of production focusing on the agroecosystem as an integrated, evolutionary and interactive system.

IPM is also a subset of 'Low Input' Sustainable Agriculture (National Research Council 1989) where human labour, capital, information and non chemical inputs substitute for agrichemicals. 'Organics' refers to a particular set of production practices approved by an external organisation (e.g. IFOAM). In practice, organic systems may not be 'low input' and may make extensive use of approved pesticides, particularly in fruit and vegetable production.

Definitions must, however, be placed in the context of New Zealand's production and marketing systems. Pastoral agriculture is characterised by extensive management, low profitability and low pest control inputs. Economic necessity has driven producers to IPM practices (Pottinger *et al* 1987) with only 11 tonnes of insecticides being used in pastoral agriculture in 1987 (East and Holland 1991). In contrast, pipfruit growers are constrained by extreme phytosanitary standards in key export markets leading to the relatively high use of fungicides and insecticides. The IPM paradigm is constrained by these same external forces. In pipfruit, IPM implementation in New Zealand is probably not as advanced as, for example, in Michigan (Table 1). Harris and Whalon (1991) have identified at least five hierarchical levels that IPM adoption has taken. In New Zealand, pipfruit IPM has not advanced much beyond levels I and II, essentially pesticide management systems. While biological control of spider mites has reduced miticide use, and other natural enemy releases may reduce reservoirs of key pests, the phytosanitary imperative in export markets require the current emphasis on pesticide management.

TABLE 1: IPM implementation levels in Michigan fruit production (Harris and Whalon 1991).

Level	Percent adoption	IPM system practiced
Conventional	15	Agrichemical Intensive
I	22	Pesticide Selection and Reduced Rates
II	28	I and Pesticide Timing = Pest Monitoring
III	23	I and II and Economic Injury Levels
IV	11	I and II and III and Biological Control
V	<1	I and II and III and IV and Prevention Strategies = System Redesign

LIMITATIONS TO IMPLEMENTATION

The challenge to move IPM beyond pesticide management remains in many systems. A close link between IPM and the agrichemical industry has caused some environmental organisations to mistrust IPM and its proponents. IPM is at risk as an integrating philosophy as the new avant garde 'sustainable' philosophy takes hold in funding organisations. This would be unfortunate since IPM's full potential is unrealised and its underpinning philosophy is a key component of the more general sustainable view (McCrae *et al* 1989). Some of the major problems in IPM

implementation have recently been reviewed by Whalon (1989) and include major shortfalls in intellectual, operational and experimental resources.

New Zealand faces limitations to IPM adoption from lack of resources in research and extension. While accurate figures are difficult to obtain, it is clear that investments in IPM research and extension are declining in real terms. Recent economic reforms have demanded a greater commitment by industry groups to fund 'near market' or commercial research. The N.Z. Apple and Pear Marketing Board, has, for example, reacted by substantially increasing their budget for research into pest management, currently comprising about 40% of research funds, which relates directly to maintaining market access (J. Field-Dodgson, pers. comm.).

While industry contributions can assist in redressing reductions in government funding; a fundamental problem seems to be the failure to accept that research into IPM is a substantial 'public good'. Public goods can be viewed as having two features:

1. they are non rivalable, that is your use does not affect my use, and
2. they are non exclusive, that is anybody who wants it can have it.

Research into pesticides is more clearly a private good but many other IPM strategies cannot be captured by a single beneficiary, e.g., biological control. IPM research is likely to have many other public benefits such as reducing negative environmental and nontarget externalities from agriculture.

Conventional agriculture in New Zealand has many negative externalities (MacIntyre *et al* 1989), including various types of human and animal exposure to pesticides, biological consequences including pesticide resistance, susceptibility to pesticide residues as non-tariff trade barriers, and various environmental consequences. Conventional agriculture can be viewed as infringing on public goods, including clean air, water and food, while providing gain to a segment of the population. In contrast, any system that minimises negative effects of pesticide use (IPM), develops nonchemical means of producing food (sustainable agriculture), or produces a commodity free of conventional chemical use (organics) could be seen as a public good. In our view, if external and internal societal pressures demand a more sustainable, environmentally friendly agriculture, then society must share very significantly in the consequent costs.

Fig. 1: The sustainability — maximisation dilemma in agricultural systems.

Research requirements are often seen by policy makers as being one-time, short-term investments. Yet agroecosystems are dynamic, requiring continual maintenance research. Research into conventional agricultural production has been aimed at maximising productivity. This may lend itself to short-term interventions without the guarantee of sustainability. The challenge is to develop research paradigms to test the parameters for the alternative approach to agriculture, viz., productivity, sustainability, stability and equity (Lampkin 1991; McCrae *et al* 1989).

Lampkin (1991) and McCrae *et al* (1989) also argue that institutions fail to truly integrate research across disciplinary boundaries, particularly during periods of declining resources. This occurs at a time when research and educational institutions should be challenging the dilemma posed by sustainability versus maximisation. This dilemma is illustrated in Figure 1. Agricultural institutions tend to study and develop maximisation biology, while natural science institutions study and protect natural resources. The challenge is to link the two biologies to support a long-term sustainable and productive agriculture. Stewardship of our land as a key natural resources is an overriding requirement.

Society can choose a number of technological pathways for agriculture (Figure 2). A combination of scientific, political and economic reasons suggest that current practices in Western agriculture may not be sustainable. Developing an alternative of sustainable, highly productive agriculture will not come without substantially greater investment in research, development and education and our contention is that these developments will not occur without substantial public support in research and implementation of these alternative forms of agriculture.

Fig. 2: Technological pathways for future agricultural development.

MODELS FOR CHANGE

We contend that substantial changes in methods of agricultural production are almost inevitable. It behooves us to analyse possible models for implementing change.

1. Regulatory

Regulatory authorities can focus on particular negative externalities from the use of pesticides and regulate respective industries. Agencies such as the U.S. Environmental Protection Agency (EPA), the Netherlands Ministry for the Environment and the German Federal Environmental Agency hold regulatory

authority. Administrative costs can be high and their environmental protection mandate in agriculture sometimes fails because of the non-point nature of agriculture-environmental impacts and the discrete rather than continuous policy options available to the agencies.

The current process of cancellation of agrichemical registration in the USA by the EPA is an example of discrete control rather than a continuous voluntary incentive through education and facilitation to reduce pesticide use. Enforcement is discrete yet negative externalities may be continuous so that regulatory agencies can be an inefficient means of changing agricultural practices. Regulatory authorities can, however, be an important catalyst for change such as through the EPA's support of the Huffaker (Bottrell 1979) and Adkisson projects developing multi-institution and interdisciplinary foundations for IPM implementation (Frisbie and Adkisson 1985). The basis for change was not because of regulatory action, but rather for its stimulation of research and education.

2. Economic Instruments

The use of economic instruments to modify human behaviour is currently in vogue. Economic instruments are based on the premise that fees, taxes, tradable permits, input taxes, subsidies and torts may recoup losses or foster change. Some of the negative externalities of, for example, pesticide use may be redressed by the use of such instruments.

The use of a 'hazards' tax based on the principle of 'the polluter pays' was suggested by MacIntyre *et al* (1989). This may give some incentive for producers to change behaviours but such taxes may not be the optimum way to influence change in society. They often incur large monitoring, administrative and political costs so they are only useful for substances generating large amounts of revenue. Any change in production practices may also harm farmers while the greatest beneficiary, the general public through reduced negative externalities, do not contribute to abating those negative factors.

Subsidies are viewed by many Western governments as a mechanism to promote change (Hall *et al* 1989). Payments for products produced in particular ways can be seen as helping farmers with only indirect harm to chemical companies. Thus, the US 1990 Farm Bill aims to foster change to a more sustainable agriculture through modified subsidies. Similar processes are occurring in the European Community. Unfortunately, subsidies harm free trade, distort markets and can be a form of nontariff trade barrier (Hillman 1991) which have disproportionate impacts on countries like New Zealand. Nevertheless, we foresee that subsidies may become the principal agricultural policy process in many developed countries through the next era.

3. Education and Facilitation

Education and enhanced technology transfer are often touted as the most effective means of promoting permanent change. Yet current policies have seen a reduction in extension services despite increasing technological change. The emphasis on a 'user pays' extension service has seen consultancy based on private gain at the expense of public good. IPM can lose in this process as the benefits of many of its strategies cannot be wholly captured by a private individual.

Sector groups will have to address this issue in partnership with government and educational institutions. Grower and farmer groups will need to become proactive in developing imaginative solutions to make information a primary input and agrichemicals a secondary input into farming systems. The investment may be substantial as a recent study in Michigan (Harris and Whalon 1991) suggests a 6:1 extension to research investment is necessary for optimum uptake of new IPM technology in non-crisis times.

Of immediate benefit would be a requirement for certification and licensing of all users of pesticides. This 'user pays' system is required in many US states, Canada and Europe. The certification programmes are ongoing and require regular updating by users. New approaches can be promoted to all users of pesticides so the basis for change becomes a legal requirement to exhibit competency in the use of potentially harmful management tools and to exhibit stewardship of our natural resources.

CONCLUSIONS

Change in agricultural production practices is inevitable and external factors may force change at a rate exceeding that for which we are prepared. Sustainable agriculture and organic production are but two of the challenges facing New Zealand's future. Our targeting of markets in the developed world means that we must be responsive to consumer demands, be they for 'residue free' products, or adherence to 'environmentally friendly' production practices.

The key issue is how to meet these challenges given the decline of public funding for agricultural research and extension. The 'new' agriculture is, to a large degree, a 'public good' requiring a substantial investment through general taxation.

Agriculture production change cannot be supported only by regulation. The discrete policy options are limited in their effects because of the continuous and distributed nature of the problems. Taxes or fees on agrichemicals may also be clumsy and inefficient instruments for change with disproportionate effects on some members of the community. Targeted subsidies, while not featuring in New Zealand's public policy agenda, are likely to proliferate to protect new markets for sustainable and organic agriculture in our primary market countries.

Education and facilitation models have the greatest potential for fostering change yet they are not without social, political or economic challenges. A certification system of pesticide users would ensure educational access to most producers for implementing change. However, no amount of education will succeed if the research system to provide the basic information is ineffective. A coordinated approach to research, extension and education is needed if we are to take advantage of future new opportunities in agriculture and maintain our current markets.

REFERENCES

- Bottrell, D.R., 1979. Integrated Pest Management. Council on Environmental Quality. USA Library of Congress. 120 pp.
- East, R. and Holland, P.T., 1991. Pests, pesticides and market access. In: Scott, R.R. (Ed.), New Zealand Applied Entomology: Future Challenges. *Bull. Ent. Soc. N.Z.* 10: 25-36.
- Frisbie, R.A. and Adkisson, P.L., 1985. Consortium of Integrated Pest Management Success Stories. Texas A & M University Publications No. 262. 265 pp.
- Hall, D.C., Baker, B.P., Franco, J. and Jolly, D.A., 1989. Organic food and sustainable agriculture. *Western Economic Assoc. International* 7: 47-72.
- Harris, K.C. and Whalon, M.E., 1991. Integrated Pest Management — A harbinger of non-silent spring. Society and Natural Resources (In Press).
- Hillman, J.S., 1991. Technical Barriers to Agricultural Trade. Westview Press, Boulder, CO. 199p.
- Lampkin, N., 1991. Organic Farming. Farming Press, U.K., 701 p.
- McCrae, R.J., Hill, S.B., Henning, J. and Mehuys, G.R., 1989. Agricultural science and sustainable agriculture: a review of the existing scientific barriers to sustainable food production and potential solutions. *Biol. Agric. and Hort.* 6: 173-219.
- MacIntyre, A.A., Allison, N. and Penman, D.R., 1989. Pesticides: Issues and Options for New Zealand. Ministry for the Environment, Wellington, N.Z. 208p.
- National Research Council, 1989. Alternative Agriculture. National Academy Press, Washington DC. 448p.
- Pottinger, R.P., Lane, P.M.S. and East, R., 1987. Pasture Renovation. MAF Technology, Hamilton, New Zealand.
- Whalon, M.E., 1989. Operationalizing sustainable farming systems: A pest management perspective. Michigan State University, Pesticide Alternatives Laboratory Series 108. 20 pp. East Lansing, U.S.A.