MEASURING THE COSTS AND BENEFITS OF PLANT PROTECTION

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Plant protection can encompass a number of activities. Weed control in cereals, competitor suppression for pine seedlings, weevil control in lucerne, control of fruit worm in tomatoes, black spot on apples, powdery mildew on peas, clematis vitalba and possums on native trees, rabbits on pasture, ultra violet light damage, salt toxicity and many others. The common element in all of these situations is a yield reduction effect, whether due to a predator, a competitor, or other other cause.

When faced with these situations, there are several possible responses which 'managers' can take including: do nothing; monitor and take action against 'yield reducers' at suitable occasions; follow calendar programmes of intervention against the 'yield reducers'; attempt long term suppression or mitigation , or even elimination of the 'yield reducer'.

Choice amongst these options is likely to be based upon several criteria including: profitability, efficiency, environmental acceptability, potential and actual effects on humans and other non-target species. For any chosen response, such as 'follow a calendar programme of intervention against the yield reducer', there are likely to a number of different techniques which will lead to the end sought. Again, choice amongst these techniques can be based on several criteria such as relative profitability, cost effectiveness, environmental acceptability, international trade implications, and many others.

1. Measurement of commercial costs and benefits

The six case study papers presented in this morning's session of the symposium focus primarily on the absolute profitability of the particular plant protection activities they have studied. This approach recognises that only some of the costs of protection, and some of the benefits of protection can be identified and readily quantified, but never-the -less attempt to determine whether plant protection is commercially attractive or not.

Given this approach what are the correct procedures to follow? The 'with and without principle' is widely suggested as an invaluable conceptual device in project appraisal and is a useful device here too (MAF, 1984). This approach leads an analyst to ask, What are the additional costs incurred if some plant protection action is taken including the costs of monitoring, planning, chemicals, application, losses due to wheel damage, etc. And, what are the additional benefits obtained if some protection action is taken including increased yields, better prices, reduced sorting costs, etc. Based on these vectors of additional costs and additional benefits, the analyst is in a position to determine whether a plant protection action results in

greater gross margin than occurs if there is no plant protection, or if it results in greater gross margin than occurs with alternative means of plant protection (Auld, et al 1987).

Application of this approach requires careful enumeration of all the relevant costs and benefits and equally careful reporting of the steps in the analysis and the data employed. Taking shortcuts in these processes is likely to lead to oversights, and errors in the conclusions reached about the absolute and relative profitability of various plant protection activities.

2. Imputing costs and benefits

Gross margins are one guide to the attractiveness of plant protection strategies, but there are many other aspects to consider if we are to go beyond simple statements such as 'Use of MCPA to control weeds on oat crops will provide a positive return.' Efficiency analysis aims to provide a comparison of all costs and benefits of plant protection. This should include more than monetary costs and returns for farmers. Planning, monitoring and the application of chemicals are likely to be real costs of plant protection strategies but may not have explicit costs if they are carried out by farmers themselves. Where this occurs estimates of these costs should be included to provide more accurate guide to the real merit of plant protection.

As well there may be effects of chemicals on operators, and consumers, and these should be considered, and costed if possible. Equally for non-chemical approaches to plant protection there may be benefits such as fewer health effects for operators, and consumers which should be included where possible in the analysis. Can these factors be measured or not? Economists have spent 30 years developing non-market valuation techniques such as the Contingent Valuation Method, which have been used in attempts to measure the benefits of plant protection activities in various instances (Greer and Sheppard 1990, Grundy 1989, Cullen and Kerr 1991). These techniques do require considerable technical expertise, but appear to be viable means of generating data where market transactions are absent. An alternative, simpler approach is that suggested by MAF (1984) whereby the direction of impacts is signalled by use of the symbols +, - , ?, to signify positive impact ,negative impact, and unknown impact . This information should be included alongside the quantitative data to give as complete as possible guide to the merits of the plant protection activity.

3. Scale and time of adoption

The gains achievable from adoption of a plant protection activity may be influenced by the scale, and the time of adoption of the technology. Data on costs and benefits of plant protection can be obtained from several sources including trial plots, field size trials, enterprise trials, cross-sectional data from regions or nations, and time series data. These sources will provide differing reports on the merits of a plant protection activity. Small scale trial are likely to produce quite different results to enterprise level results. At the enterprise level alternative strategies can be employed to combat weeds or pest such as crop rotations, and various grazing strategies, and the use of chemicals for example may look much less attractive.

Widespread adoption of a plant protection activity within a region or a nation may result in very different results to those calculated at the enterprise level when the plant protection activity was first introduced. If everyone adopts a plant protection strategy, this may result in total yield increasing, price decreasing, and total revenue increasing, remaining constant, or decreasing. The effect of price falls in these cases is to transfer the benefits from the plant protection activity from producers to consumers. These price changes effects should be included in the assessment of gains from plant protection at the macro level (Auld et al, 1987).

4. Risk and Uncertainty

Plant protection activities will only be warranted in some circumstances. A clearer understanding of the benefits of a plant protection activity will be obtained if some information is available on the probabilities that plant protection will provide net returns to producers or to society. G. Bourdot (1993) paper provides a good example of how information on the distribution of threats to a crop helps determine whether plant protection action is merited. Inevitably attitudes towards risk will influence decisions about the worth of plant protection. Many plant protection actions appear to be taken because decision makers are risk averse and certain outcomes are valued more highly than are risky outcomes. Plant protection activities may result in lower average net returns, but reduce the variability of net returns.

Modern appraisal techniques attempt to weigh risky outcomes to indicate their relative attractiveness compared to certain outcomes (MAF, 1984). Where there is uncertainty about the possible incidence and impact of predators, alternative analytic approaches to gross margin analysis or cost benefit analysis may be helpful. Game theory provides a rich framework to help analyse situations involving uncertainty, including 'games against nature' (Auld et al, 1987).

5. Statics to Dynamics

Long term control plant protection may require different approaches to one-off or annual protection. Continued use of chemicals to protect plants may be judged environmentally unacceptable. Several authors at this symposium discuss biological control alternatives to chemical control. There are some obvious attractions in going in that direction including reduced use of chemicals, and their financial and environmental costs. I observe there is a tendency to overlook or to underestimate, the costs associated with biological control techniques. They tend to be described as costless, instantly effective once introduced. The scientific effort to identify, trial, release and continue, biological controls should be recorded. There is a need here also for careful listing and estimation of all the costs and benefits of plant protection by these means. When assessing the costs and benefits of long term plant protection activities such as biological control, discounting of costs and benefits from differing years is required to make them comparable (Auld et al, 1987).

Alternative modeling techniques can be employed to determine dynamic optimal plant protection rules. Researchers who have employed dynamic programming models in conjunction with bioeconomic simulation models have determined that significant gains can be achieved by considering future-period effects as well as current-period effects (Pandey et al, 1991). Results from these studies provide a clearer understanding of the role of risk in determining plant protection strategies, and the rules to follow to maximize long term benefits of plant protection (Feder, 1979).

6. Concluding points

Assessment of the costs and benefits of plant protection activities can be a quite complex task. While the assessment of gross margin changes can be straightforward, to go beyond that point requires recognition of several factors including imputed values for some costs and benefits, the effect of possible price changes, enterprise adjustment effects, attitudes to risk and uncertainty, and discounting of long term costs and benefits. Dealing with these issues requires more than ability to operate a calculator. Modern science is very much about teamwork and assessment of the costs and benefits of plant protection requires teamwork between biological scientists, statisticians, systems modellers, and economists to ensure that appropriate methodologies are employed, and accurate information generated.

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