



ERMA NEW ZEALAND

# INFORMATION SHEET

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## Estimating the beneficial effects of biocontrol agents

### Biocontrol agents

In most circumstances biocontrol agents are introduced for the purpose of ameliorating the effects of an undesirable organism. This undesirable organism may be causing damage or unwanted effects to the natural environment, or the production environment. In some cases biocontrol releases may be very limited in scope (e.g. released into glass houses) or they may be (at least potentially) New Zealand wide.

Before any benefits can be realised, the biocontrol agent must establish, extend its range from the immediate release site, and interact with the undesirable organism. Thus estimating the likelihood of any beneficial effect requires estimating the likelihood of establishment, the likelihood of spread through the desired range, and the likelihood of the biocontrol agent adversely impacting the undesirable organism. Estimating the magnitude of the effect requires predicting the degree of control that is expected to be achieved by the biocontrol agent. There are three main categories of control –

- complete control where other control measures become redundant or are rarely required
- substantial control where a significant amount of control is achieved but other measures are also required
- partial control where the biocontrol agent interacts with a range of other measures (including other biocontrol agents)

An important aspect of assessing both the magnitude of the effect and the likelihood of the effect is the nature of the biocontrol itself, and its mode of operation.

## Issues relating to efficacy

Assessing the potential benefits of a biocontrol agent requires an understanding of the interaction between the biocontrol agent and its host (the undesirable organism). An important consideration with respect to the management of any pest incursion is the cyclic nature of infestation. Before the impact of a biocontrol agent can be fully understood, the nature of the infestation cycle must also be understood. Often there will be a latent period before the 'pest' exerts recognisable effect by increasing in numbers or range. Once active, typically introduced pests will increase exponentially, then either decline to an equilibrium level, or reduce to a fluctuation around a relative equilibrium. Biocontrol agents often behave in a similar manner. Therefore, in order to understand the effect of a biocontrol agent the two cycles and how they are expected to interact need to be understood.

Another relevant aspect in addition to the degree of control (as noted above) is the mode of operation of the biocontrol agent; will it reduce the pest to an equilibrium level, develop an outbreak/control cycle with the pest. Examples are in the predator and prey cycles among animals, e.g. lemmings and stoats, foxes, and birds of prey and rabbits and cats etc., or eradicate the pest (extremely rare).

The beneficial effects on the market economy resulting from the introduction of the biocontrol agent are in most circumstances based on the reduced cost of control of the pest or undesirable organism. What needs to be determined is how much cost reduction can be attributed to the biocontrol agent.

## Production benefits

### Biocontrol for new pest

Whenever a new production pest is recognised or discovered, farmers and the industry develop a range of responses. Typically there are two types of response:

- management innovation (change to farming practice), and
- technical response (development of tolerant plants, herbicides and pesticides etc).

The introduction of a biocontrol agent can be seen as part of a technical response.

Where a biocontrol agent is being introduced to control a new pest, there may not be a complete understanding of the biology of the pest and its activity in the New Zealand environment. In other words, the biocontrol agent may be being introduced before the pest has either developed a cycle of activity or reached a stable state with its host. Therefore there will be significant uncertainty around how both the pest and the biocontrol agent will behave in the New Zealand environment.

It is important to remember that all effects must be assessed as marginal effects, that is, ERMA New Zealand is interested in the difference between what would happen if the organism were introduced and what would happen if the organism were not introduced. Therefore when we assess the beneficial effects of the biocontrol agent it is important to separate out the expected effects of the biocontrol agent from the expected effects of all the other management and technical responses.

An additional complication, especially in the production sector is that changes in farming practice (such as changes in land management, or farm type) that are occurring for entirely different reasons may be having an convoluting effect.

It is difficult to –

- (a) separate out the cost of control of the pest from these other factors, and
- (b) determine how much of the saved cost of control is attributable to the biocontrol agent and how much is due to other control measures.

Resolving these factors requires forecasting both the effect of the biocontrol and other control measures. It may also be necessary to consider what will happen to the biocontrol agent if the other control measures limit the pest to a level below that which is required for the biocontrol to remain viable since the viability of a host specific biological control agent is likely to be related to the availability of the host.

### **Biocontrol for ‘old’ pest**

Where a biocontrol agent is introduced for an established pest, a common way of estimating the expected benefit may be a combination of reduced cost of control and increased productivity resulting from increased control (see below). Looking at the reduced cost of control may require comparisons of scenarios based on previous introductions of biological control agent(s) with new introductions and separately with measures other than the agent or agents. When both of these benefits are assessed it is important to make sure that the benefits are not counted twice.

Once again, in the production sector, farmers will be implementing a range of control measures, and the biocontrol agent must be seen as one of a suite of tools, or a means of providing the farmer with more choices.

### **Parameters required**

The type of parameters required to estimate benefits from biological control for production pests will be cost of control (current and anticipated – see ‘establishing scenarios’ below), and expected benefits in terms of production data (current and anticipated stocking rates, value of pest damaged and high quality fruit etc).

### **Conservation benefits**

Applications for biocontrol agents to control undesirable organisms in the natural (non-production) environment need to be considered in a very similar way. Once again, the biocontrol will in most circumstances be one of a range of control measures, which may include other biocontrol agents that impact on different parts of the plant or lifecycle of the undesired organism. The benefit due to the biocontrol must therefore similarly be differentiated from benefits accruing from other activities.

Conservation benefits are often more directly linked to social benefit and environmental benefit than to benefits to the market economy. However, there may be indirect conservation benefits to the market economy, for example through enhanced tourism experiences. A specific example might be a biocontrol agent for an invasive weed that is inhibiting access to coastal tracks.

Because it is more difficult to obtain information about conservation benefits, creative methods such as shadow pricing may be used. Shadow pricing consists of measuring or pricing the benefits by estimating an equivalent cost of achieving the same outcome by alternative means (such as herbicide use, manual removal). Shadow pricing may use an averaging approach or a marginal approach (more complex). The averaging approach will tend to overstate the benefit which will reduce as the pest declines. A simpler approach is to use reduced cost of control (described below). However, this may underestimate the benefits.

### **Establishing scenarios**

The first step in estimating the benefits of a biocontrol is to decide on a reasonable time frame to work with. This is usually related to the time expected to take for the biocontrol to establish, spread and

start affecting the pest. If possible the time frame should go out far enough for equilibrium to be expected. Alternatively, the time to reach a steady state of reduction may be used.

Two scenarios should then be developed. The first scenario is what would be expected to happen if the biocontrol were not introduced. This will include estimates of control costs by current existing methods, taking account of any factors that might affect existing control methods; for example, if a current herbicide was known to be losing efficacy or simply getting too expensive, if new products were coming available, if the pest was spreading rapidly. The second scenario will be what is expected to happen if the biocontrol is introduced. In most cases this will be a combination of conventional plus biocontrol.

## Estimating reduced cost of control

Once the scenarios have been identified and described, the next step will be to estimate the costs associated with the two scenarios, ideally as a time series on an annual basis.

For the second ‘with biocontrol’ scenario, the conventional costs will in most case either remain static (if the biocontrol is expected to supplement conventional control, or if the biocontrol is expected to allow reallocation of resources to different areas), or reduce (if the biocontrol is expected to replace conventional methods). Thus in the initial stages, the cost for the ‘with biocontrol’ scenario may well be higher than the ‘without’ scenario for conventional control alone.

The reduced cost of control is the difference between the values for the two scenarios. This can be presented as a time series, as a total sum or a discounted sum.

## Estimating increased productivity

It is also important to look at the effect that the biocontrol is expected to have on the pest. For example, it may reduce the density of the pest in particular areas, it may reduce the area infested (measured in hectares) or it may have another form of action. The increased productivity can then be estimated using parameters relevant to the area of effect.

It is important to be careful about calculating both reduced cost of control and increased productivity as there is the possibility of double counting.

## Cost-benefit analysis and discounting

Cost-benefit analysis can be a useful way of summarising the beneficial effects of a biocontrol agent over time where there is good information about the expected effects of the biocontrol agent. Where cost-benefit analysis is used, the expected benefits will commonly be discounted over time, so that short-term benefits are given greater weight than long-term benefits. The discount rate will have a significant effect on the present value of future benefits of biocontrol agents because in most cases there will be a long lead time before benefits are fully realised, and it may also be a long time before any effect will be observed.

## Sensitivity analysis

There will always be uncertainty with respect to the action of the biocontrol agent, therefore where possible sensitivity analysis should be used to illustrate a range of possible futures in terms of expected control. This is really an expansion of the ‘with biocontrol’ scenario.

The most useful approach in most cases will be for the applicant to use a 'best/educated estimate' or expected scenario and then looking at a range of efficacy levels around this mode. For example, if the expected efficacy is that pest will be reduced to 30% of the current level within a 10 year time frame, then also look at reduction to 50% and 20%, and perhaps look at what might happen if it took 15 years to reduce to these levels. In some circumstances where there is good data available, it may be possible to bound the analysis by using best-case and worst-case scenarios, however in other cases the range between them may be so great that they are not useful.

Sensitivity analysis should also be applied to any cost-benefit analysis. A range of discount rates may be used, and the selection of the discount rate should be justified in both economic and ecological terms.

## **Further information or feedback**

For further information on Estimating the beneficial effects of biocontrol agents, or to provide any feedback or comment on the new initiatives described above, just contact us at ERMA New Zealand, or visit the website at **[www.ermanz.govt.nz](http://www.ermanz.govt.nz)**.

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