BENEFITS OF A NATIONWIDE EXTENSION PROGRAMME TO BIOLOGICAL CONTROL OF WEEDS RESEARCH IN NEW ZEALAND

P. Syrett, L.M. Hayes, J.J. Sheat
Manaaki Whenua-Landcare Research, PO Box 69, Lincoln, Canterbury, New Zealand

Summary. The success of a 5-year nationwide biological control of weeds extension programme is evaluated in terms of agent establishment, level of community interest and support, and opportunities for enhancing research. Data from many sites have been collected. The support of collaborating organisations has allowed widespread establishment of control agents and geographical areas where agents are unsuccessful have been identified early. The programme has raised the profile of biological control of weeds projects in the community and increased client groups' knowledge and understanding of the technology. Release strategies are currently being tested in a way that integrates sound experimental design with client requirements; the results will provide data that may lead to improved success rates.

INTRODUCTION

In 1986 the Biological Control of Weeds Group of Entomology Division, DSIR (now Manaaki Whenua - Landcare Research) identified the need for an extension programme to build on existing links with the nationwide network of noxious plants officers who are appointed by local government to administer control of noxious plants. The idea arose firstly because research workers were unable to supply all the requests for biological control agents, and secondly because several weed control agents released and established in New Zealand many years previously were still of limited distribution. In some cases this was solely because insects dispersed only slowly from the original release points, which suggested that a programme of deliberate re-distribution would improve success of these agents. Even for species that spread well unaided, it is often desirable to achieve establishment in areas sooner than would occur by natural dispersal. Grindell (2) has described the cooperative extension programme currently operated by Landcare Research. This paper shows how extension work has been integrated with research projects and how the extension programme is increasing the effectiveness of biological control.

BENEFITS OF USER-PAYS

Under the cooperative extension programme, collaborating organisations (Regional Councils, the Department of Conservation, forestry companies, and Landcorp Farming Ltd) pay Landcare Research for a service that includes supplying insect biological control agents, managing release sites, collecting data and training field staff (2). Crown funding approved by the Foundation for Research, Science, and Technology (FRST) pays for research on exploration, selection and host testing of potential control agents, and impact assessment. In addition, 25% of the financial contribution from collaborating organisations supports research associated with their programme. This allows researchers to conduct work that interests or benefits collaborators but is unlikely to be funded by the Crown because it may not be of sufficiently high priority or relevance to FRST outputs. Examples of research funded in this way are studies which compare the efficiencies of different insect rearing methods, assessments of the impact of thistle crown weevil (*Trichosirocalus horridus* (Panzer)) on nodding thistle (*Carduus nutans* L.), and studies on the alligator weed beetle, *Agasicles hygrophila* Selman & Vogt.

An excellent relationship has developed between Landcare Research staff and collaborating organisations. In general collaborators greatly appreciate the programme's value and continue to give it their financial and logistical support. Close communication between research and user organisations allows Landcare Research to select projects important to users. One of their particular concerns has been the lack of data on the efficacy of biological control agents that are currently being released. Since collaborators need evidence to convince ratepayers, politicians, and management that the biological control technique is cost-effective and sound, impact information from previous projects is useful to them. Other organisations interested in a specific control project may prefer to fund research that will demonstrate the effectiveness of the control agent to be released, rather than joining the extension programme. Services received by collaborating organisations are negotiated annually and may be varied from time to time, by mutual agreement, as priorities of the organisations change. However, Landcare Research's flexibility has limitations. For example, it is not possible to provide control agents for a completely new target weed without obtaining additional funding or re-organising research priorities, but it may be possible to replace a previously agreed agent by another. By responding to the needs of the collaborators, the research effort is well focused, and users willingly provide both practical and political support to gain funding for the work.

EFFECTIVE ESTABLISHMENT OF BIOLOGICAL CONTROL AGENTS

The extension programme has enabled establishment of control agents to be achieved at many widely distributed release sites much more rapidly than would have been previously possible (Table 1). Noxious plants officers, with their extensive knowledge of local weed populations, have been invaluable in identifying suitable sites for releasing agents. Traditionally, releases of biological control agents were local and limited. Cinnabar moth (*Tyria jacobaeae* L.), first released in 1929, was still restricted to the southern part of the North Island in 1981 (7). Ragwort seedfly, *Botanophila jacobaeae* (Hardy), was released at fewer than 10 sites, and St John's wort beetle, *Chrysolina hyperici* (Förster), at close to 40. While ragwort seedfly is still confined to a limited area of the central North Island, St John's wort beetle rapidly became established on St John's wort (*Hypericum perforatum* L.) throughout New Zealand (3). This demonstrates that some species can establish widely from a small number of releases. After redistribution under the extension programme, cinnabar moth is now established at sites throughout New Zealand (8). Besides providing a large number of initial release sites, the extension programme also encourages and trains field staff to redistribute insects from these primary release sites once they are well established. This further increases the effectiveness of establishment.

Perhaps an even greater problem was the previous lack of resources to assess establishment at large numbers of widely dispersed sites which meant that many release sites were not subsequently monitored (6). The extension programme has greatly increased the quality of monitoring. Data are collected on standard recovery sheets, which have been designed so that a range of observers can provide reliable information. Field staff employed by collaborating organisations are taught the skills required to complete these assessment forms.

In general, by removing the costs of rearing and establishing control agents from the research programme, the extension programme allows research to focus on the problem of identifying factors that influence success or failure. Information gathered from ragwort flea beetle (*Longitarsus jacobaeae* (Waterhouse)) and cinnabar moth release sites showed that establishment was achieved at 75% and 35% of 106 sites respectively (8). Rates of spread, as well as

establishment, were greater for ragwort flea beetle. There was also a strong indication that ragwort (*Senecio jacobaea* L.) populations were declining at most sites where ragwort flea beetles, alone or together with cinnabar moth, were established. Establishment data for gorse spider mite (*Tetranychus lintearius* Dufour) releases showed that after 2 years of widespread release, mites had failed to establish in several discrete areas. Identifying the establishment pattern enabled new strains of spider mite to be sought from areas of Europe better matched climatically with those areas where the original strain failed to establish (4). Without the comprehensive and simultaneous establishment data provided through the extension programme it would have taken significantly longer for the pattern to become apparent.

Information from the extension programme benefits research projects on the biology and impact of control agents because it aids selection of optimal sites for more detailed experimental work. Field staff from collaborating organisations sometimes help to collect data for these studies. A current example involves a large-scale experiment to test release strategies. A post-doctoral fellow from the Centre for Population Biology, Silwood Park, UK, is collaborating with Landcare Research to determine how numbers of agents per release and numbers of releases per site affect establishment success. This work will be conducted in conjunction with the extension programme, so that recovery information can be collected in the normal way, but more releases will be made to fulfil the needs of the scientific objectives as well as those of the collaborating organisations. The cost of extra releases is more than compensated for by the savings to the research programme.

Table 1. Number of insect releases made under the cooperative extension programme up to 1993

Species	1986-7	1987-8	1988-9	1989-90	1990-1	1991-2	1992-3	Total
Alligator weed (*Alternanthera philoxeroides*)								
*Agasicles hygrophila**							3	3
Vogtia malloi		10	3		1	1	1	16
St John's wort (*Hypericum perforatum*)								
Chrysolina quadrigemina					4			4
Californian thistle (*Cirsium arvense*)								
Lema cyanella					3	4	6	13
Altica carduorum					2		1	3
Nodding thistle (*Carduus nutans*)								
Trichosirocalus horridus		2	26	16	22	21	11	98
Urophora solstitialis				1	6	6	1	14
Ragwort (*Senecio jacobaea*)								
Tyria jacobaeae		43	12	27	36	22		140
Longitarsus jacobaeae	10	33	25	5	6	9	4	92
Gorse (*Ulex europaeus*)								
Tetranychus lintearius				139	88	9	15	251
Sericothrips staphylinus					16	85	96	197
Agonopterix ulicetella					6		13	19
Cydia succedana							6	6
Broom (*Cytisus scoparius*)								
Bruchidius villosus						3		3
Total number species reared	1	4	4	5	11	9	11	14

* Original releases of *Agasicles hygrophila* were made at 34 sites under an earlier scheme.

BENEFITS FROM COMMUNICATION AND PUBLIC RELATIONS

About 90 noxious plants officers are employed by Regional Councils to implement weed control policies. Noxious plants officers are trained in biological control of weeds during their formal training programme. Like other field staff from all collaborating organisations they participate in workshops and field days held by Landcare Research. High-quality information supplied by Landcare Research through regular newsletters and personal contact is greatly appreciated by collaborating organisations. Their field staff now form an integral part of the biological control of weeds programme. They help to raise the profile of biological control in the community by organising local publicity and by communicating with local councillors and the public. In several areas noxious plants officers have successfully encouraged local schools to rear biological control agents for release. This develops an interest among children, their parents and their teachers in the principles and practicalities of biological control of weeds. In addition these groups identify with biological control activities being undertaken in their local areas.

Information obtained by Landcare Research from contact with field staff includes useful anecdotal observations. Information on damage to weeds by pathogens or insects observed by, or reported to, field staff may result in the identification of organisms new to New Zealand. For example, many records of the spread of blackberry rust (*Phragmidium violaceum* (Schulz)) in New Zealand have been obtained from noxious plants officers. When information on weed status or insect establishment is required, Landcare Research achieves a high level of returns from field staff because of the excellent relationship developed with them. For example, a student supported by Landcare Research surveyed noxious plants officers in the northern part of the North Island for information on alligator weed, *Alternanthera philoxeroides* (C. Martius), and alligator weed beetle and achieved a 96% return from her questionnaire.

DISADVANTAGES AND PROBLEMS

Although the requirements of research and extension are often the same - both sides want to select the best site to achieve establishment and long-term survival of control agents - inevitably some conflicts arise between the scientific requirements of the biological control project and the needs of collaborating organisations, particularly when the supply of agents is limited. Releasing insects on a pragmatic basis is rarely compatible with achieving a properly replicated experimental design.

The extension programme was first negotiated in 1986 to achieve the release of 17 species of control agent over a 5-year period. Perhaps inevitably, the proposed programme was ambitious and it has been a struggle to fulfil the original commitments. The availability of new control agents is difficult to predict in advance. It depends both on the ease with which Importation Impact Assessments can be completed for agents that successfully meet increasingly stringent safety criteria and on the technical difficulties of rearing large numbers for distribution. When local government was re-organised in 1990 the programme was re-negotiated and some of the original objectives were modified.

Information on recovery sheets has been transferred to a PC-based database, which is invaluable in providing a comprehensive record of the status of control agents at release sites. Such a large database can easily become unwieldy, so it has been important to ensure that every piece of information collected is essential and is in a readily usable form. It is costly to store information that is unnecessary.

The number of species being reared in any one year tends to increase (Table 1). It is difficult to cease rearing any species once widespread release is complete because requests for additional releases continue to be made as new organisations join the programme and priorities of organisations change.

CONCLUSIONS: THE FUTURE

The biological control of weeds extension programme has been extremely worthwhile. The level of support for the work in the community has increased, and widespread establishment of control agents has been achieved more rapidly than would have occurred otherwise. Useful information on establishment has been obtained, and new funding has been made available for research. However, only limited conclusions can be drawn about factors influencing establishment and impact of agents because scientifically designed and replicated release strategies were not used.

In the future, increasingly stringent requirements for the scrutiny of new introductions will probably reduce the number of control agents available for the programme and there will be an increasing focus on developing strategies for managing control agents. Programmes will be more closely tailored to the requirements of individual organisations and regions. Already distinct differences are appearing in programmes being run in different parts of the country in response to differing needs. Attempts will be made to implement release strategies that allow statistical comparisons of releases while still maintaining compatibility with the needs of collaborating organisations.

ACKOWLEDGEMENTS

We would like to thank all the organisations and individuals who have contributed to the success of this programme.

REFERENCES

1. Dymock, J.J. 1987. NZ J. Zool. 14, 337-342.
2. Grindell, J.M. in press. Proc VIII Int. Symp. Biol. Ctl. Wds. 2-7 Feb 1992, Lincoln, New Zealand.
3. Hancox, N.G., Syrett, P. and Scott, R.R. 1986. Plant Prot. Qty. 1, 152-155.
4. Hill, R.L., Gourlay, A.H. and Winks, C.J. in press. Proc. 6th Aust. Conf. Grassland Invertebrate Ecology, 17-19 Feb. 1993, Hamilton, New Zealand.
5. Miller, D. 1947. NZ J. Agric. 75, 341-344.
6. Miller, D. 1970. NZ DSIR Information Series No. 74, pp 104.
7. Syrett, P., Scheele, S.M. and Philip, B.A. 1984. Proc. 37th NZ Weed and Pest Control Conf. pp 37-41.
8. Syrett, P., Grindell, J.M., Hayes, L.M. and Winks, C.J. 1991. Proc. 44th NZ Weed and Pest Control Conf. pp 292-295.