INTRODUCTION OF A WEEVIL FOR BIOLOGICAL CONTROL OF NODDING THISTLE

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Summary

Nodding thistle (*Carduus nutans*) is a noxious weed in many areas of New Zealand. An attempt at biological control of this weed is being made, using a receptacle-feeding weevil (*Rhinocyllus conicus*). Establishment has been achieved at five different sites. Preliminary tests on the value of this introduction show promise and further studies on survival, dispersal and overall effectiveness are continuing. When considering a candidate phytophagous insect for biological control of weeds, very strict guidelines must be followed to avoid the possibility of introducing undesirable organisms.

Nodding thistle (*Carduus nutans*) is now a major weed in many areas of New Zealand and 91 of the 109 county councils have declared it a noxious weed. Nodding thistle which was first recorded from Pomahaka in Otago by Kirk (1899) was accidentally introduced along with other thistles of the genus *Carduus* from Eurasia without any complement of natural enemies. It has established over a wide range of climates, at different altitudes and is a pest plant in many perennial and semi-perennial situations.

Normally three or four main stems are produced, but if the plant is damaged (as in mowing, trampling, etc.), many more stems and thus more flowers are produced. There appears to be no seed dormancy and seeds germinate as soon after shedding as there is sufficient moisture available. Bearing in mind that chemical control, especially in pasture, should be aimed at small rosettes, choice of timing for a weedicide spray programme is greatly compounded by this "time-variable" germination.

An attempt at biological control of nodding thistle is being made by Entomology Division, DSIR using a weevil *Rhinocyllus conicus*. Zwolfer (1967) reports that the genus *Rhinocyllus* contains only five known species, all associated with hosts from the plant family Compositae. He records *R. conicus* from Southern and Central Europe, parts of Northern Africa and Western Asia.

Harris introduced *R. conicus* into Canada from the Rhine Valley, Germany in 1968 (Harris and Zwolfer 1971) and was encouraged by the establishment rate. New Zealand consignments originated from Canada.

Females normally deposit their eggs externally on the bracts of the involucre, but, sometimes on stems and leaves. Each egg is individually deposited on a pad of frass, then well protected with a covering of more frass. The whole capsule is approximately 1.5 mm in diameter. Up to twenty, sometimes more, eggs may be laid on one inflorescence. Development periods are as follows: eggs five to eight days, larvae twenty to thirty days and pupae up to fourteen days. Final instar larvae construct, within their feeding tunnels, ovoid pupal cells with hard protective walls. There appears to be one generation per year in this country.

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Biological Control

Damage caused by the feeding of adult *R. conicus* is insignificant; usually they chew the peripheral tissues of the peduncle and leaves. The larval stage exerts greatest influence on nodding thistle plant populations. Larvae feed within the receptacle of the inflorescence effectively cutting off the food supply to the developing seeds; a very subtle way of interfering with seed production without initiating persistent regrowth of the plant.

Adults lay their eggs over an approximately eighteen week period (late spring, until early autumn). Newly hatched teneral adults remain in their pupal cells for several weeks before emerging and searching for suitable hibernating sites. Adult weevils can and do fly. They are very deliberate in searching for even the occasional nodding thistle plant. Efficiency of attack of *R. conicus* on nodding thistle depends on the size of the inflorescence and number of larvae feeding within. Tests have shown that six larvae feeding in an inflorescence with a receptacle diameter of 1.3 cm will reduce seed production by 84% of the potential. Under caged conditions at a Canterbury site, an adult to adult increase of 70 times occurred. It can be expected that field populations, in the absence of caging pressures, will increase by at least that amount, probably more.

R. conicus has now been released at (a) 88 Valley and Kokorua (Nelson), and Winchmore (Ashburton) in 1973; (b) Taneatua (Whakatane) and Hakataramea (South Canterbury) in 1974. Overwintering and successful establishment has taken place at three sites. Summer survival and successful reproduction indicate a similar level of establishment can be expected at Taneatua and Hakataramea. This insect, the first to be used for biological control of nodding thistle in New Zealand looks very promising. It is too early yet to predict the value of this release and work is continuing to measure natural dispersal and the effects on our nodding thistle population.

Guidelines for introducing phytophagous insects for biological control programmes are very rigid. A candidate insect should be host specific and its activities either destroy the target weed, prevent its reproduction or reduce the overall population to a level where normal agronomic practices, especially cultivation and competition, are sufficient to maintain that weed at minority status.

Weed plants like most of our insect pests are alien and in many cases are present here without their natural enemies. Our efforts are concentrated on correcting this imbalance. Choice of a target weed must, to a large extent be dictated by its relative economic importance. Another consideration is the practicability and economics of alternative control measures. Biological control must never be considered the complete answer, nor is it a "last resort" approach. It can be integrated with carefully calculated chemical applications and may lead to reductions in cost of weed control; a very important consideration in marginally economic farmland situations.

REFERENCES

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GENERAL INSECTS

CHAIRMAN'S SUMMARY

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The session represented something of a salad in that it contained three papers on caterpillars, two on weevils, two on nematodes and one on nysius. Esson described the biology and current knowledge on the distribution of three recently discovered weevils. Information of this kind is vital to any evaluation of the potential problem, to say nothing of control measures, and in a country as dependent as New Zealand on legumes, might have been expected to generate more discussion than it did.

East *et al.* described work aimed at control of white fringed weevil at the adult stage. Bearing in mind the difficulty experienced in attempting to control the larval stage with chemicals, the correlation between spraying of adults and the subsequent reduction in larval numbers is encouraging. The frequency of spraying needed will no doubt be a factor in the practicality of such an approach but the paper indicated the possible potential value of treating adult stem weevil as an approach to control.

A pest frequently associated with other weevils as a pest of emerging brassica crops was the subject of Trought's paper. In his quest for a substitute for parathion to control nysius the author screened more than 20 insecticides from which emerged four possibly successful compounds. In the course of his work Trought compared the technique of visual assessment of insect control with actual counts and found quite remarkable agreement. An important observation was that much crop damage occurs before remedial action is — or can be — taken.

Promising results from preliminary attempts to control root knot nematode on Chinese gooseberry were described by Griffin and Dixon. Difficulties in techniques associated with work on a perennial crop were partly overcome by the use of tomato as a susceptible indicator plant. Discussion however, centred more on the question of the economic significance of the nematode infestations and on the rather confusing nature of some tabulated data.

Logan *et al.* reported work with leptophos carried out between 1971 and 1974 on control of porina caterpillar. Substantial statistical data showed that leptophos, at rates above 0.6 kg/ha, particularly as the E.C. formulation, gave control equivalent to or better than fenitrothion at 1.0 kg/ha. In view of the climatic variations which afflict porina-infested areas, the success of applications followed by rainfall or frost was of interest.

The two papers presented by Ridler dealt with control of diamond back moth, cabbage white butterfly and corn ear worm. Common to both was the insecticide phenthoate in comparison with methamidophos in one trial and methomyl in the other.

The choice of rates of the standards was questioned as also was the acceptability of measurement data from unreplicated work. The relatively poor results from ULV application to cabbages were suggested in discussion as perhaps being a reflection of the nature of the equipment, a possibility in fact acknowledged in the paper itself.