THE INTRODUCTION OF GORSE SPIDER MITE, *TETRANYCHUS LINTEARIUS*, FOR BIOLOGICAL CONTROL OF GORSE

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SUMMARY

Gorse spider mite, *Tetranychus lintearius*, was imported into New Zealand in 1988 for the biological control of gorse, *Ulex europaeus*. It has been released at 34 sites so far, and further widespread liberations are planned before the end of 1989. While in quarantine a fungal pathogen, *Verticillium lecanii*, was isolated from the mites. Initial attempts to eliminate the disease, using 2% sodium hypochlorite to surface sterilise eggs and 5% to sterilise substrate gorse, resulted in 100% male mites in the next generation. A less rigorous method using 0.5% sodium hypochlorite followed by a sodium citrate wash successfully eliminated the disease without altering the normal sex ratio.

INTRODUCTION

Gorse spider mite, *Tetranychus lintearius*, was imported into New Zealand from the UK in 1988 and has now been released. This followed approximately 5 years of debate over whether biological control of gorse in New Zealand was desirable. The issues involved have been summarised by Hill and Sandrey (1986).

An Environmental Impact Assessment (EIA) was prepared (Hill 1987) which contained all available information concerning the issues. This also contained detailed reports on the suitability of gorse spider mite as a control agent for gorse in New Zealand. These concluded that, if introduced, the mite would not damage plants other than gorse. The EIA was lodged in public libraries. Public submissions were sought and over 150 organisations were also asked to comment. Fifty-six submissions were received. These, along with the EIA, were examined by an independent, four person committee appointed by MAFQual New Zealand, which controls the importation of new organisms.

On 12 April 1988, 30 overwintering colonies, each numbering several hundred mites, were collected at Porthtowan, Cornwall, England. These were taken to the CAB International Institute of Biological Control laboratories at Silwood Park, Ascot, Berkshire, where laboratory cultures were maintained. Representatives from each culture were identified.

A permit to import and release gorse spider mites into New Zealand was granted by MAFQual in mid-July 1988, and the first of four shipments arrived at Christchurch on 22 July. In strict quarantine at DSIR, Lincoln, mites were reared for two generations. Following normal quarantine procedures, colonies were checked for pathogens by smearing surface-sterilised mites onto dextrose/agar plates. The fungus *Verticillium lecanii* was isolated. This species has only been recorded from tetranychids once before (van der Geest 1985). Strains of this fungus are known in New Zealand but have only been recorded attacking greenhouse whitefly (N. Martin pers. comm.).

Preliminary experiments showed that the disease was not present inside eggs, and that the disease cycle could be broken by surface-sterilisation of the eggs. This paper describes the methods adopted which enabled the mites to be released from quarantine disease-free, the subsequent rearing programme, and the progress of releases to date.

METHODS

There are no published accounts of methods for surface-sterilising mite eggs and so two modified insect egg sterilisation methods were used. Adult mites were transferred to

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a 10 cm tall gorse shoot standing in water, and were removed after 7 days. The shoot was placed in a 10 cm by 2 cm glass tube and the eggs were washed from the stem using 0.1% sodium hypochlorite which dissolved the web. In the first method, the solution was pipetted off and 2% sodium hypochlorite was added. After 5 minutes this was pipetted off, and the eggs were washed three times with sterile water. Eggs were washed onto filter paper. No *Verticillium lecanii* could be isolated from treated eggs. The filter papers were placed in sterile petri dishes and the mites removed from quarantine. Hatching larvae were individually transferred to gorse shoots. In case these shoots were the source of the fungus, each was soaked in 5% sodium hypochlorite for 20 minutes, washed carefully in tap water and left standing in water for several days before use. Mites completed full development on such shoots.

The second method used was less rigorous but still yielded disease-free eggs. In this, 0.5% instead of 2% sodium hypochlorite was used, and the second water wash was replaced with 0.1 M sodium citrate, which helped to neutralise chlorine activity. Hatching larvae were transferred to unsterilised gorse shoots.

One generation later, releases began. Fifty adult female mites were transferred to each of five cut gorse shoots standing in water. After 10-15 days at ambient temperature in the laboratory, each shoot, carrying approximately 700 mites, was tied closely onto a gorse bush using cotton thread. Five shoots were released at each of a number of sites.

RESULTS

Both egg-sterilisation methods yielded apparently healthy, mature mites in the normal sex ratio of at least five females per male. Mating was observed and many eggs were laid. The oviposition rate was not measured, but appeared normal. Development of these mites also appeared normal. There appeared to be no mortality amongst the eggs.

The progeny of mites which were treated as eggs using method one all developed into males. As a result, the second technique was used. Those treated using method two developed and produced both females and males in an apparently normal sex ratio.

The first mites were released near Christchurch on 22 February 1989. Mites successfully transferred from the shoots onto the gorse plants. A further 33 releases have been made since then. All release sites are shown in Fig. 1.

Fig. 1: Sites at which gorse spider mite, *T. lintearius*, has been released (as at 30 April 1989).

DISCUSSION

Several explanations might be furnished to explain minor changes in sex ratio from one generation of mites to the next, but the total absence of females from the progeny of mites treated using method one was very unusual. No such effects have been recorded when this method has been used to treat insect eggs. Tetranychid mites are haplo-diploid, i.e., fertilised eggs produce females while unfertilised eggs yield males. It seems likely that the parent males were rendered completely sterile, so that while apparently successful mating occurred, no eggs were fertilised.

Since mites retained in quarantine and in the original cultures in England maintained normal sex ratio, it is very likely that the techniques which were used to eliminate the *V. lecanii* infection caused this sterility. The cause of the sterility is likely to have been either the treatment applied to the eggs, exposure of developing mites to residual sodium hypochlorite on the gorse shoots, or some unknown chemosterilant generated on the shoots by sodium hypochlorite treatment. Experiments are underway to examine the effect of each of these factors on *T. lintearius* and to see if the same effect can be induced in two-spotted mite, *T. urticae*. If so, new control strategies might be developed in order to induce male sterility in two-spotted mite populations, with subsequent population collapse.

The second treatment successfully eliminated disease from the mite colony enabling releases of mites to be made.

Attempts to isolate *V. lecanii* from *T. urticae* populations collected near Lincoln failed. This strongly suggests that the fungus was imported from England along with its host, and was not introduced from the gorse shoots collected locally to feed the mites in quarantine. It may be that a mite-infesting strain of this fungus is not present in New Zealand. If so, the disease-free mites released in New Zealand may be more fecund, develop more quickly, and have higher survivorship than mites in Europe where the disease is endemic.

If *T. lintearius* establishes in New Zealand, the mites will complete four-six generations each year. Nevertheless, it is likely to be a number of years before populations capable of damaging gorse build up within the release sites and enable much natural dispersal to occur. Significant damage to a gorse bush will only occur once the colony numbers several thousand individuals. A colony of this size migrates *en masse* over the green foliage of a gorse plant, extracting mesophyll cell contents, and leaving behind browsed shoots which eventually die. The frequency with which such colonies will develop amongst gorse bushes (whether 10 or 10,000 per ha) remains to be seen.

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