The efficacy of biological control agents of gorse, *Ulex europaeus* L., in Tasmania

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DECLARATION

This thesis contains no material that has been accepted for a degree or diploma by the University of Tasmania or any other institution, except by way of background information, which has been duly acknowledged within the thesis. To the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where reference is made in the text.

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Abstract

The primary aim of this study was to assess the individual impact of the gorse seed weevil (*Exapion ulicis*), gorse spider mite (*Tetranychus lintearius*) and gorse thrips (*Sericothrips staphylinus*) on the growth and development of gorse. Factors such as natural enemy attack and herbicide use may affect biological control agent populations and their resulting impact on the target weed. For this reason, the study was extended to assess the potential impact of natural enemies on the gorse spider mite and the gorse thrips and assess the toxicity of herbicides and adjuvants commonly used for gorse control on the gorse thrips.

The gorse spider mite caused a reduction in dry matter production of approximately 36% in a field experiment that compared mite-attacked plants to sprayed controls over two and a half years. A threat to the effectiveness of this agent is predation by the Chilean predatory mite, *Phytoseiulus persimilis*. An experiment showed this species will develop at a similar rate on a diet of gorse spider mite as it would on the two-spotted mite, therefore confirming the ability of this species to have a negative impact on gorse spider mite populations.

In a glasshouse experiment, gorse thrips, ryegrass competition and simulated grazing individually reduced the growth of gorse seedlings. When treatments were combined, survival of gorse seedlings was also reduced. These results suggest that this species has the potential to be a useful biological control agent of gorse. However, as population build up in the field has been slow, further studies on the biology and ecology of this species are required. A field study was conducted to identify potential natural enemies of the gorse thrips within the arthropod fauna inhabiting gorse. A

range of species, including generalist predators, were identified. Of these, the Phlaeothripid *Haplothrips victoriensis* and mites in the family Phytoseiidae were the most abundant predatory arthropods present on gorse throughout the study and are also reported to be natural enemies of other members of the family Thripidae. Further studies are required to test the predatory efficacy of these arthropods on gorse thrips.

The gorse seed weevil was found to reduce seed production of gorse at two sites in Tasmania. Due to pod production being continual at Lymington and only over spring and summer at Stonehenge, the percentage of mature seed damaged in black pods for the whole 20 months of sampling was 2.7 times higher at Stonehenge (45.5%) than at Lymington (16.7%). On an annual basis, damage to mature seed at Stonehenge was 34.4% (2001/2002) and 55.4% (2002/2003) and at Lymington was 18.1% (2001/2002) and 12.4% (2002/2003). Based on the results of this study and population models produced elsewhere, it was concluded that additional seed feeding biological control agents would be required to reduce seed production of gorse to below replacement levels.

A bioassay was conducted to determine the toxicity of herbicides and adjuvants commonly used to control gorse on adult and juvenile gorse thrips. The herbicide triclopyr/picloram was found to be consistently the most toxic chemical to both juvenile and adult gorse thrips. Some toxicity was measured for the herbicide glyphosate, the adjuvant modified polydimethylsiloxane and the adjuvant soyal phospholipids/propionic acid. Metsulfuron methyl was not significantly toxic to either adult or juvenile gorse thrips. Both adjuvants seemed to increase the toxicity of all the herbicides on both juvenile and adult gorse thrips. The integration of chemical and biological control using the gorse thrips is discussed.

Although each individual agent did have a measurable impact on certain aspects of gorse performance, each had its limitations. Predation of the gorse spider mite by the specialist predator, *Phytoseiulus persimilis*, is likely to limit its impact on gorse. The gorse thrips did have an impact on gorse in a glasshouse environment but populations have been slow to establish in the field and no evidence of an impact of this species has been recorded five years after release. The gorse seed weevil does have an impact on the production of gorse seed, however, the levels recorded in this study were not enough to have an impact on gorse populations. The combined impact of these agents on gorse populations was beyond the scope of this study, however, due to limitations of each agent, it seems apparent that additional agents will be required if biological control is to be considered an important long-term component of an integrated management strategy for gorse.

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