

**Biological and molecular analysis of important
agricultural pest species in southern Australia:
Penthaleus species and *Halotydeus destructor***

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SUMMARY

Blue oat mite species, *Penthaleus* spp. (Acari: Penthaleidae), and the redlegged earth mite, *Halotydeus destructor* (Tucker) (Acari: Penthaleidae), are some of the most serious and widespread agricultural pests in southern Australia. Management of these mites has been complicated by the recent discovery of three cryptic species of *Penthaleus*, whereas prior research had assumed a single species. The species differ markedly in their distribution, plant preferences and response to pesticides. This thesis looks at various aspects of the biology, ecology and molecular analyses of earth mites with particular emphasis on agricultural control.

I tested the initiation of diapause egg production in mites using field and shade-house experiments. *Halotydeus destructor* has a very different diapause response from *Penthaleus* species. Thus, carefully timed spring sprays are unlikely to be effective against *Penthaleus* spp., highlighting the importance of correctly distinguishing earth mite species before implementing control strategies. There is also variation in diapause induction among the three *Penthaleus* spp. that could contribute to their relative distributions and pest status.

I examined the effects of different plant hosts on the persistence and reproduction of earth mites. The results are consistent with field observations that mite species differ in their host plants. For all species, pasture is a suitable host and lentils are generally a poor host plant. Canola, ox-tongue, and a mixture of wheat and oats differ in their suitability as long-term hosts for each mite species. This information is important for

developing more sustainable management practices, such as weed management and crop rotations.

Competitive interactions between earth mites were also investigated in the field and the laboratory over a number of seasons. In order to make valid conclusions with an applied implication, competition was examined on four different plant treatments: pasture, canola, wheat/oats and ox-tongue. I showed that close competition exists between mite species and that competitive interactions differ temporally and on different plant types.

Finally, I undertook biochemical analysis of *Penthaleus* spp. for the development of a rapid and simple field test that could be used by agronomists and farmers to distinguish the different mite species on individual properties. This would allow appropriate control strategies to be devised, as well as reduce the ineffectual application of pesticides. Using mostly immunological techniques, I revealed important information about the complex nature of the *Penthaleus* group, the similarity between the three species, as well as develop methods for isolating and characterising species-specific proteins. Directions this work may take in future studies are also discussed.

STATEMENT OF AUTHORSHIP

Except where reference is made in the text of the thesis, this thesis contains no material published elsewhere or extracted in whole or in part from a thesis by which I have qualified for or been awarded another degree or diploma.

No other person's work has been used without due acknowledgement in the main text of the thesis.

This thesis has not been submitted for the award of any degree or diploma in any other tertiary institution.

Paul Umina

13th January 2004

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DEDICATION

This thesis is entirely dedicated to my nonna,

Rina Barri.

**I love you. I miss you and will always remember the special way you made me
feel.**

PREFACE

The experimental results are divided into four self-contained chapters, some of which have also been prepared for publication in peer-reviewed journals. Chapter 2 is a paper with minor revisions and appeared in *Experimental and Applied Acarology* (2003) 31: 209-223. Chapter 3 has been accepted for publication in *Experimental and Applied Acarology* and Chapter 4 has been accepted for publication in *Journal of Economic Entomology*. A revised version of Chapter 1 has been submitted to *Experimental and Applied Acarology*.