Thrips vectors and resistance to 
*Tomato spotted wilt virus* (TSWV) in potato

by

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Preface

This study was formulated to examine the attributes of onion thrips (*Thrips tabaci* Lindeman) in relation to its vectoring role of *Tomato spotted wilt virus* (TSWV) in commercial and seed potato crops in Australia. Outbreaks of TSWV in potato have been sporadic, often not occurring for several years, but on occasion devastating, affecting up to one-third of some crops, and causing millions of dollars in industry losses. The accumulation of knowledge of TSWV disease epidemiology in potato has been limited due to its sporadic nature and low incidence outside Australia. Work conducted by Charles Jericho (2005) greatly increased this knowledge, but left many questions unanswered, not least of which is the ongoing confusion over the role of *T. tabaci* as a vector of TSWV in Australia.

This thesis consists of a general introduction followed by four research chapters and concludes with a thesis summary and general discussion. Each of the research chapters has been prepared as an independent, publishable manuscript, except that here, figures and tables have been numbered to fit with the thesis format. For this reason, on occasion, there is some repetition between chapters. The chapters are as follows:

Chapter 1 provides a general introduction and literature review

Chapter 2 examines three field trials undertaken in Tasmania and South Australia looking at differences in TSWV foliar and tuber infection levels, and *T. tabaci* numbers across a number of potato cultivars.

Chapter 3 examines the colour preferences of *T. tabaci*, *F. schultzei* and *F. occidentalis* for green, yellow, blue, red and white, as well as the preference of *T. tabaci* for different intensities of green. This chapter also contains a spectral analysis of potato cultivars.

Chapter 4 examines the host preferences of *T. tabaci*, *F. schultzei* and *F. occidentalis* for potato compared to a number of other plant hosts, and also the preferences of *T. tabaci* for potato at the cultivar level. This chapter also examines the oviposition preferences of *T. tabaci* for potato cultivars in choice and no-choice tests.

Chapter 5 examines the vector competence and transmission efficiency of several populations of *T. tabaci* in a number of acquisition-transmission host combinations, and relates this to the source hosts from which these populations were collected, and the relationship of these populations in a phylogenetic analysis.

Chapter 6 consists of a thesis summary and concluding remarks, with recommendations for further research and for industry.
Abstract

This study was formulated to examine the efficiency of *Tomato spotted wilt virus* (TSWV) transmission by onion thrips (*Thrips tabaci* Lindeman) and factors associated with host resistance in potato; in particular to investigate the suggestion that potato cv. Bismark has a high level of resistance to thrips, and to examine why onion thrips have failed to transmit TSWV in laboratory experiments in previous studies. Three field trials were conducted in Tasmania and South Australia to evaluate differences in potato cultivar resistance to thrips and TSWV (Chapter 2). TSWV-infection levels were moderate in two trials, with TSWV-incidence varying from 9-26 percent in Tasmania and 3-22 percent in South Australia, but only 0-6 percent in the second Tasmanian trial. Thrips counts showed the highest numbers of *T. tabaci* on Bismark and lowest thrips numbers were found on Shepody. There were no significant differences in TSWV foliar or tuber infections between cultivars, and no correlation between thrips numbers and TSWV incidence.

A population of *T. tabaci* was subjected to choice experiments to test for colour preference (Chapter 3), and host preference and oviposition choice (Chapter 4), using a number of commercial potato cultivars and coloured cards. Populations of western flower thrips (*Frankliniella occidentalis* Pergande) and tomato thrips (*Frankliniella schultzei* Trybom) were also tested for colour and host preference alongside onion thrips in separate experiments. Colour preference tests showed strong colour preferences amongst all three thrips species tested. Western flower thrips and tomato thrips strongly preferred green to red, blue and white; but preferred yellow to green. Onion thrips preferred green and yellow equally and over the other three colours. Onion thrips showed a strong preference for light-green over darker shades of green. Host preference tests showed differences in potato cultivar preference by onion thrips, with higher attraction to cultivars with lighter green foliage: Shepody and Russet Burbank. Oviposition choice tests showed almost the opposite, with higher numbers of hatched juvenile thrips on darker green potato cultivars: Atlantic, Bismark, Royal Blue and Tasman.

Several female-only, parthenogenetic populations of *T. tabaci* were collected from Tasmania, New South Wales and South Australia from potato, onion and *Chrysanthemum*. These populations were tested for their ability to transmit TSWV to potato and other hosts, and subjected to a phylogenetic analysis following DNA extraction and PCR amplification of mitochondrial gene cytochrome c oxidase subunit 1 (COI) (Chapter 5). Vector competence was associated with the host from which the populations were collected, with three populations collected from potato transmitting TSWV, but three populations collected from onion failing to transmit the virus. This ability to transmit TSWV was also associated with differentiation in COI, with vector competent and non-competent populations separating into subgroups within the ‘L2’ European clade of Brunner *et al.* (2004).

This is the first study to link genetic differentiation of *T. tabaci* to both source host and vector competence, and provides a credible explanation for why many studies have failed to achieve any transmission of TSWV by this species. Strong colour preferences and some host preferences were also demonstrated, however field experiments suggest that potato cultivar resistance to thrips is unlikely to provide a reliable method for reducing TSWV infection levels in commercial potato crops.