Development of phenology models and a timing guide for the management of red scale in Australian citrus

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Introduction

Red scale is a key citrus pest in Australian. It downgrade fruit quality and is a declared quarantine pest for citrus export to Korea. A red scale lifecycle consists of several stages. Only the crawlers and adult males are mobile (Figure 1).

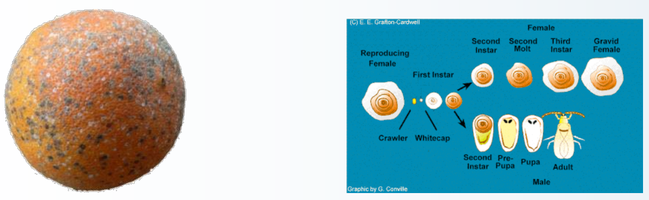

Figure 1. Red scales on a citrus fruit (left) and life cycle (right).

A number of natural enemies attack red scale including several parasitic wasps and ladybirds (Figure 2). A key red scale control strategy is to protect the natural enemies by not using broad-spectrum insecticides and to release of Aphytis wasps. Another popular control strategy is petroleum spray oil (PSO).

Figure 2. Some natural enemies of red scale. a: Aphytis wasp, b: Comperiella wasp, c: Encarcia wasp, d: Rhyzobius, e: orange-spotted ladybird, f: steelblue ladybird, g: Chilocorus ladybird.

Timing is critical in red scale control as PSO sprays and other contact chemicals are most effective against the crawlers and newly settled 1st instar (whitecap) and Aphytis wasps only parasitise large 2nd instar male and females and 3rd instar virgin females. This project aims to develop timing guide for red scale control.

Male flights

Different stages of red scale development are not easy to tell apart. Timing of peak males flight serves as a convenient starting point for the prediction of peak timing of follow-up stages. We monitored red scale males flight in the Riverina using pheromone traps during 2013-2014 and 2015-2016.

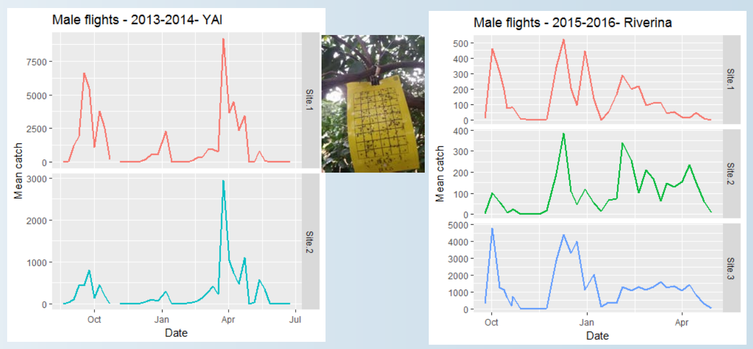

Figure 3. Seasonal patterns of males flights in the Riverina monitored with pheromone traps (middle).

Multiple peaks were detected over the season and timing of peaks at different sites within the same season appeared synchronised, that is, they occurred on similar dates. The 1st major peak was visible at all sites in both seasons (Figures 3), occurring in mid September in 2013-14 and in early October in 2015-2016.

Crawler peaks

Crawler numbers were monitored with double scotch tapes at the same sites as male flights over the two seasons. In both seasons, crawler number started to rise sharply at all sites in late October (Figure 4). Crawler number stayed relatively high until mid December in 2013-2014 but only until mid November in 2015-2016. Other crawler peaks were also visible but they were not common to both seasons or present at all sites.

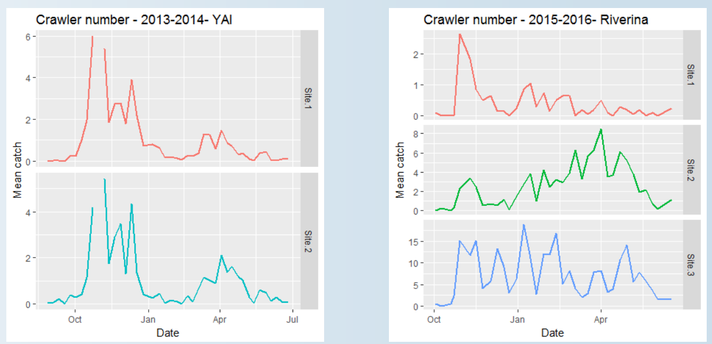

Figure 4. Seasonal patterns of crawler numbers in the Riverina

Degree-days

To be able to predict the timing of crawler peaks from that of male flight peaks, we calculated the number of degree-days above 11.7^{o}C (DD) accumulated between the two peaks. It varied between 224 and 299 DD. In the 2015-2016, the amount of DD was the same at 268 DD.

Timing trial

A timing trial was conducted in the Riverina during 2015-2016 to investigate possible timing effects in red scale control. Four spray timings were assessed with Chlorpyrifos (50ml/100L) plus Biopest oil (0.5%) in a red scale infested Valencia block. The first two timings were during the later part of the 1st crawler peak at the trial site.

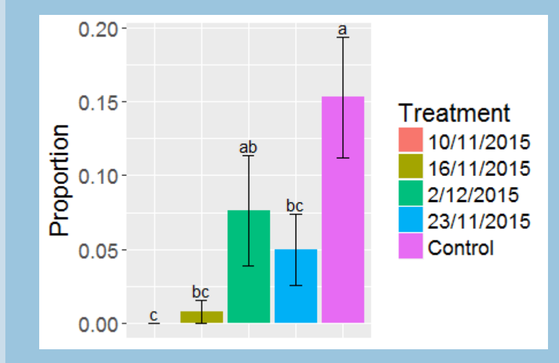

Figure 5. Proportions of young fruit infested with >10 red scales in trees sprayed on different dates.

Six months after the last spray, the proportions of young fruit infested with 10 or more red scales were reduced by >90% in trees sprayed on 10 Nov and 16 Nov 2015 compared with untreated trees (Figure 5), wheras trees sprayed on 2 Dec 2015 did not reduce red scale infestation.

Summary

There were multiple peaks of red scale male flight and crawler numbers. The first post-winter peak of male flight peak was and the first post-winter crawler peak were present at all sites in both 2013-2014 and 2015-2016. There was a time lag of 224-299 DD or 27-41 days between the two peaks. More data will be collected to finalise the time lag.

A timing trial conducted in the Riverina during 2015-2016 confirmed the benefits of timing red scale sprays when crawlers were abundant.

Acknowledgements

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