NSW GOVERNMENT Department of Primary Industries

primefact

Citrus gall wasp in Southern Australia

September 2014 Primefact 1373 First edition

Dr Jianhua Mo (Entomologist, Yanco) and Steven Falivene (Citrus Development Officer Dareton)

Fast facts

- Citrus Gall Wasp (CGW) adults emerge around October and are present in the orchard for about 4 weeks
- CGW galls can reduce fruit size, tree vigour and yield
- Chemical insecticides targeting adult CGW are mostly ineffective and disrupt Integrated Pest Management (IPM)
- 0.5% oil sprays provide reasonable control (egg laying deterrent) and must be applied every 10-14 days with the first application when CGW adults are readily visible (monitoring is critical)
- Do not spray oil around flowering
- Parasitic wasps can help suppress numbers and they emerge about 2-3 weeks after CGW

Introduction

Citrus gall wasp (CGW) (Figure 1), *Bruchophagus fellis*, is an Australian native insect pest whose natural host is the Australian finger lime (*Citrus australasica*).

CGW has traditionally been a pest of citrus trees in Queensland and mid to north NSW. It has recently established in the southern citrus production regions of Sunraysia, Riverland, and Riverina, where Australian orange production is concentrated.

Figure 1: Adult citrus gall wasp

CGW infests young flush growth in spring causing woody galls to form around the developing larvae (Figure 2). A CGW gall houses many wasps each in a separate cell (Figure 3). All varieties can be attacked but lemons, grapefruit, and some rootstocks (e.g. Trifoliata) are most susceptible.

Figure 2: CGW galls on citrus shoots

Figure 3: Dissection before wasp emergence reveals the multi-cell structure of CGW galls

Life cycle

CGW life cycle consists of an egg stage, four larval stages, a pre-pupa stage, a pupa stage, and an adult stage (Figure 4). Except for the adults, all stages are completed inside the galls. The wasp has a single generation per year.

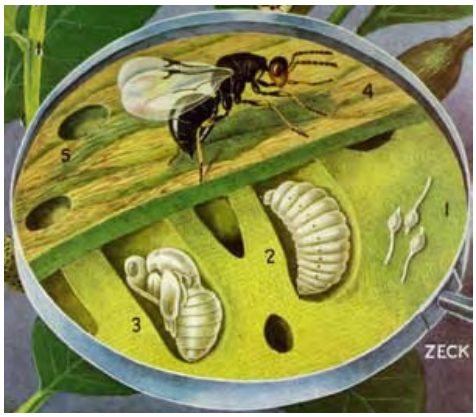

Figure 4: CGW life cycle. 1- egg, 2- larva, 3- pupa, 4- adult, 5- emergence hole (Adapted from E H Zeck)

Adult CGW emerge from galls in spring (Figure 4). Timing of emergence is influenced by temperature and closely associated with the appearance of the spring growth flush. In the southern regions, emergence commences from late September to mid-October and finishes by mid-December, with peak emergence occurring after an accumulation of 403 degree-days above 15°C from 1st April. Adult wasps are most abundant in southern region orchards from mid-October to mid-November.

Adult wasps normally do not move very far, but can be transported over long distances on prevailing winds. Egg-laying starts immediately after the wasps emerge from galls. Adult wasps live for 3–14 days depending on temperature. Each female can lay about 100 eggs. Most eggs are laid in the first two days after wasp emergence. Eggs are mostly laid under the bark of young spring shoots. Larvae hatch in 2–4 weeks.

Long-distance movement of CGW around Australia occurs mainly through the distribution of infected nursery trees. It is recommended that new trees should be thoroughly checked for the presence of galls, especially highly susceptible varieties such as lemons and grapefruit. If galls are found, contact the nursery and return the trees to avoid gall wasp establishing in your orchard or region.

Damage

Heavily galled trees lose vigour, which may result in reduced fruit size (Figure 5) and yield, and in extreme cases, branch dieback.

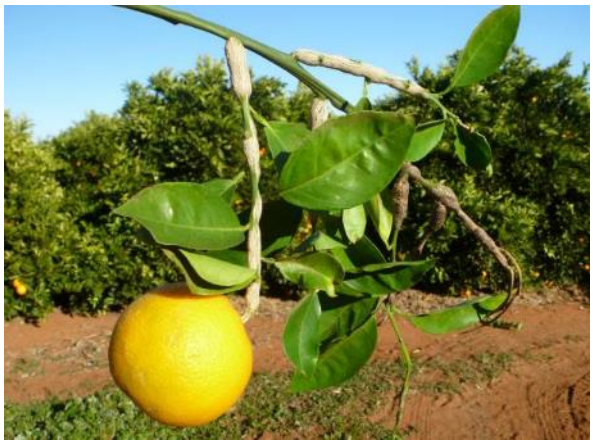

Figure 5: CGW galls can reduce shoot vigour and fruit size

Natural enemies

Two parasitic wasps, *Megastigmus brevivalvus* and *M. trisulcus*, are important natural enemies of CGW (Figure 6). They are similar sized to CGW but are honey-coloured and can be easily distinguished from the black coloured CGW adults. Parasitic wasps insert their eggs directly into CGW eggs. After hatching, the larvae feed and develop inside CGW larvae, eventually killing the CGW. Where populations of the parasitic wasps are high, up to 90% of gall wasp larvae can be parasitised. Both wasp species have now established in the southern citrus regions with *M. brevivalvus* the more abundant species.

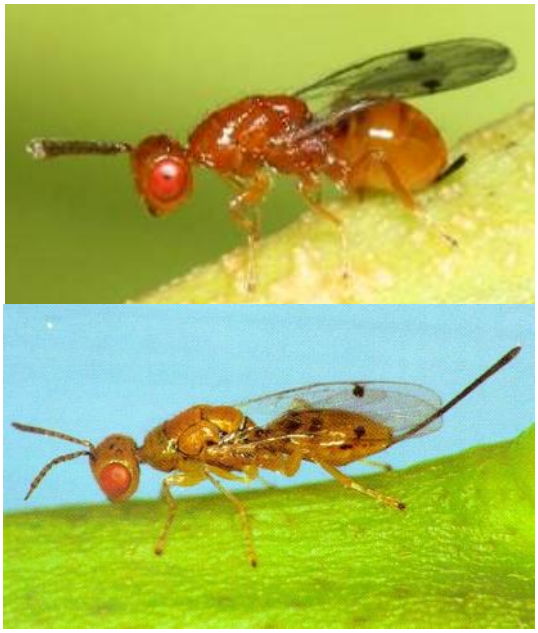

Figure 6: Two parasitic wasps of CGW: *Megastigmus brevivalvus* (top) and *M. trisulcus* (bottom, courtesy of Smith et al. 1996)

Monitoring

Monitoring of CGW is best conducted between June and September when galls are at their largest and most visible.

Low level infestations are very difficult to detect since galls are small (Figure 7) and only a few are present on a tree.

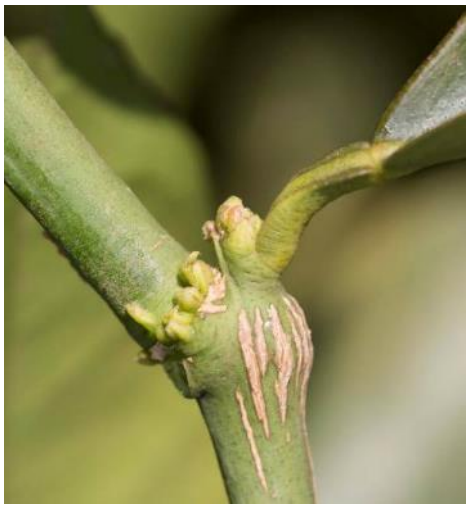

Figure 7: A small CGW gall at the base of a leaf

Galls tend to be more abundant in the lower canopy close to the skirt line. A good monitoring technique is to check underneath the canopy and look for shoots growing at a right angle from the main branch (Figure 8). Rootstocks are preferred by CGW and can be targeted for monitoring.

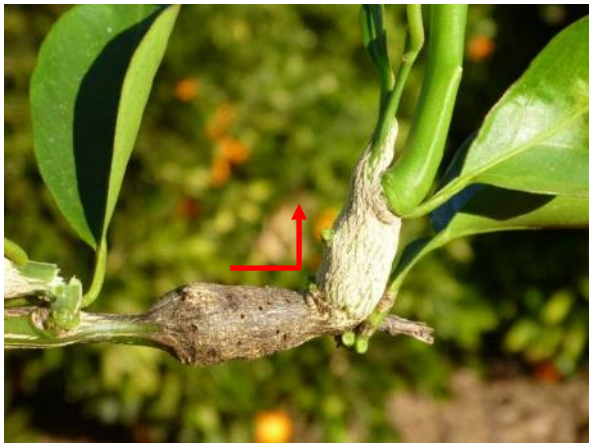

Figure 8: A current season's gall (mottled beige) forming at the end of a previous season's gall (dark brown). Notice the right angle between the two galls.

In orchards where CGW is well established, randomly select 20 trees from each block for monitoring. In each tree, insert a 50 x 50 x 50 cm frame randomly into the lower canopy (Figure 9). Count the number of galls in branches inside the frame that are above a certain size (e.g. more than 1 cm long).

Figure 9: Using a counting frame to measure CGW infestation level

Timing of peak CGW emergence can be monitored with yellow sticky insect traps (minimum 10 traps per ha). The traps should be hung in the lower canopy, where galls are more prevalent. Replace the traps weekly and count the number of wasps caught each week.

Management

Cultural practices

Adult gall wasps are only present in the orchard in spring and early summer and only attack spring flush. It is important not to encourage excessive spring flush by over-fertilising (particularly heavy nitrogen applications) in early spring. Summer flush will miss CGW emergence and can flower in the following spring.

In orchards where CGW is restricted to isolated trees, gall-bearing branches should be cut off. In heavily infested orchards trees can be pruned (i.e. heavy hedging) at least one month prior to expected CGW emergence. Pruning will encourage regrowth that can be attacked by CGW. Removing as many galls as possible and protecting new foliage (e.g. oil sprays) will help to reduce reinfestation. CGW can emerge from cut galls if pruned too close to the normal emergence period. It is recommended to slash all prunings to accelerate the drying/decomposition process.

Galls appear to be more abundant in the lower parts of the tree canopy, which may be a result of shading and a more humid micro-climate. CGW also favour under-tree sprinklers as compared to the dryer conditions of drip irrigation. Skirting trees high will reduce favoured infection sites.

Galls are also more abundant on rootstock (i.e. trifoliata). Desuckering trees after CGW emergence will allow the rootstock to act as a decoy attractant and help to deter laying on productive foliage.

Spraying border rows will hinder the introduction of CGW into new blocks. A good strategy is to

involve neighbouring or local region orchards in control measures (area wide management).

Biological control

Parasitic wasps play an important role in regulating CGW populations. In new CGW incursion areas or where the parasitic wasp number is low, consider introducing parasitic wasps.

Figure 10: Male (top) and female (bottom) parasitic wasps (*M. brevivalvus)*. Do not confuse the black male parasitic wasps with CGW

Parasitic wasps can be introduced by collecting galls from orchards close to the beginning of their emergence (the end of CGW emergence) and relocating them to the target area. To avoid desiccation, collected galls should have all leaves removed, waxed at both ends and placed in a moist enclosed environment during relocation.

Figure 11: If present, brown female parasitic wasps will be obvious in late Nov to mid Dec

It is best to source galls with parasitic wasps from the same region. Parasitic wasps are most effective when released just after CGW peak emergence so CGW eggs are available to parasitise.

Figure 12: Gall with developing and emerging parasitic wasps

Repeated releases for 3-5 years may be needed to establish parasitic wasps. Establishment and levels of parasitism can be checked with sleeve cages (Figure 13). Randomly select a few branches with galls at the release site and place sleeve cages over the galls shortly after gall wasp emergence has peaked. Check the sleeve cages after a minimum of four weeks to count the number of parasitic wasps and CGW emerged. After checking, release the parasitic wasps back into the orchard.

Figure 13: A sleeve cage around current-year galls used to check for establishment of parasitic wasps and parasitism level

Chemical control

Foliar insecticides are disruptive to IPM and do not always achieve effective CGW control due to the short residual periods of most foliar insecticides.

Horticultural mineral oil deters CGW egg-laying. In the southern citrus regions, three sprays of an oil product 10-14 days apart at 0.5% during CGW emergence provided good control. Oil sprays will not eliminate CGW but can reduce galls in the following season. Good spray coverage is critical as any unprotected foliage will be susceptible to egg-laying (e.g. high volume oscillating boom).

Oil is a preventative treatment and must be applied prior to peak emergence. Good monitoring is required to determine the timing of the first oil spray. It is important to monitor at least twice weekly from late September (Figure 14).

The first oil spray should be applied when CGW adults are first readily visible (about 5% emergence). Some sporadic CGW may emerge

up to 20 days prior to that point and these populations are too low for economic control (Figure 15). Sunraysia data indicated that 5% to peak emergence only took 10-15 days. Oil sprays applied during flowering can reduce fruit set and should be delayed till the end of petal fall.

Figure 14: Peeling back galls with a pocket knife can provide an indication of the development stage and emergence (% of vacated sites) of CGW

Figure 15: The first emerged CGW leaving behind an exit hole (right side of the gall)

Systemic insecticides offer another potential option to kill CGW larvae, however, no systemic insecticides are currently registered for CGW control in Australia.

References

Hardy S, and Creek A. 2009. Final Report - Citrus Gall Wasp Technical Forum 5th May 2009, NSW Department of Primary Industries, Orange.

Mo J, Creek A, Munro S, and Stevens MM. 2014a. Managing Citrus Gall Wasp in Southern Citrus Regions. Final Report, HAL CT10021, Horticulture, Australia Ltd, Sydney.

Mo J, and Stevens MM. 2014b. Emergence patterns of adult citrus gall wasp, *Bruchophagus fellis* (Hymenoptera: Eurytomidae), and its key parasitoids in southern Australia. *Journal of Asia-Pacific Entomology* 17: 311-317.

Noble, NS. 1936. The Citrus Gall Wasp. Science Bulletin No.53, Department of Agriculture NSW, Sydney.

Smith, D, Beattie, GAC & Broadley R (eds) 1997, Citrus pests and their natural enemies – integrated pest management in Australia, Queensland Department of Primary Industries, Brisbane.

Acknowledgements

This Primefact is a revision of a previous version by Sandra Hardy and Andrew Creek (formerly NSW DPI) with new information from a HAL-funded project (CT10021). Dan Papacek (Bugs for Bugs) and Dr Andrew Beattie (University of Western Sydney) are acknowledged for their input. Richard and Judy Bertalli (Sunraysia citrus grower) are acknowledged for their participation and knowledge shared during NSW DPI and MVCB trials conducted in 2010 and their ongoing collaboration. Mary Cannard is acknowledged for her facilitation of the MVCB gall wasp trials. Shane Smythe (Sunraysia citrus grower) is acknowledged for his collaboration.

For updates go to
www.dpi.nsw.gov.au/factsheets

Warning

© State of New South Wales through the Department of Trade and Investment, Regional Infrastructure and Services 2014. You may copy, distribute and otherwise freely deal with this publication for any purpose, provided that you attribute the NSW Department of Primary Industries as the owner.

Disclaimer: The information contained in this publication is based on knowledge and understanding at the time of writing (September 2014). However, because of advances in knowledge, users are reminded of the need to ensure that information upon which they rely is up to date and to check currency of the information with the appropriate officer of the Department of Primary Industries or the user's independent adviser. Users of agricultural (or veterinary) chemical products must always read the label and any Permit before using the product, and strictly comply with the directions on the label and the conditions of any Permit. Users are not absolved from compliance with the directions on the label or the conditions of the Permit by reason of any statement made or not made in this publication.

ISSN 1832-6668

Published by the NSW Department of Primary Industries.

INT14/80533

Jobtrack 13196