Controlling Carpophilus Beetle

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Kevin Farnier, Mofakhar Hossain, Blair Grossman,
Lea Rako, Cathy Taylor, David Madge
The Carpophilus problem

Since 2014, the almond industry has been suffering from unacceptably high levels of kernel damage as a result of Carpophilus beetle attack.

Project: 2015-2018

Project Leader: Mofakhar Hossain
1. The *Carpophilus* species attacking almonds is not the same species that attacks stone fruit. Temporarily named *C. near* dimidiatus

Genetic differences:
- *C. davidsoni*
- *C. dimidiatus*
- *C. nr. dimidiatus*
- *C. hemipterus*

Morphological differences:
- Pitting on prosternum
- Hind tibia

*[Blacket & Semeraro]*
The *Carpophilus* problem

2. The current Attract & Kill trap is not sufficiently effective against *C. nr* *dimidiatus*

3. The ecology of this species is very different from the stone fruit attacking species

Mean numbers of *Carpophilus* species in A & K traps, Riverland 2016/17

[Hossain 2018]
Almond IPM Project 2018-2022

IPM Project Aim:

To develop a toolkit of complementary tools and practices that form the backbone of an IPM strategy for almond pest management.

1. Improved orchard hygiene
2. New technologies in insect Attract & Kill
3. Improved mating disruption
4. IPM compatible pesticides
5. Biocontrol options
6. Post harvest disinfestation
7. Engagement & extension

Carpophilus
Carob moth
A multipronged attack: all life stages, all angles

1. Improved orchard hygiene
2. New technologies in insect Attract & Kill
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4. IPM compatible pesticides
5. Biocontrol options
6. Post harvest disinfestation
7. Engagement & extension

Reduce feeding & breeding sites (mummy management)
Effectively trap adult beetles as they disperse (A&K)
Assist industry with new pesticide options
Explore ways to utilize natural predators and diseases

Work closely with growers and industry
Reduce infestation of stored product
1. Improved orchard hygiene
Spatial distribution of insects

Infestation of ground vs tree mummies
20 ha block, 133 trees sampled

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Findings:

- CB is mainly infesting fallen mummies
- Infestation is lower down in the tree canopy
- Destroying fallen mummies is key to control

[Madge, Grossman, Taylor]
Mummy nut destruction: Prelim work

Flail mulching

Reduced intact mummies by 70-90%
BUT… left 16,000 intact mummies / ha

Beetles in kernels one month after mulching

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- Producers need to monitor the efficiency of nut destruction
- Mummies probably need to be pulverised to eliminate infestations / reinfestation

[Madge, Grossman, Taylor]
2. New technologies in insect Attract & Kill
Developing an effective Attract & Kill trap

1. Improved orchard hygiene
2. New technologies in insect Attract & Kill

Co-attractant (host odours) + Beetle aggregation pheromone = “Tri-species lure”

- Fermenting fruits
- C. davidsoni
- C. hemipterus
- C. mutilatis

Stone fruit attractant
Developing an effective Attract & Kill trap

1. Improved orchard hygiene

2. New technologies in insect Attract & Kill

- Redesign the co-attractant
- Analyse / redesign the pheromone

Almond attractant

Beetle aggregation pheromone?

Co-attractant (host odours)

Almond odours

C. nr dimidiatus pheromone?
A new co-attractant: 2018 Plans & Progress

1. Improved orchard hygiene
2. New technologies in insect Attract & Kill

1. Reformulating the current co-attractant
2. Selecting and screening new volatiles
3. Improving the dispenser (odour release)
1. Reformulating the current co-attractant

- *C. nr dimidiatus* does not respond well to the current co-attractant

Beetle responses to co-attractant in wind tunnel [Hossain 2017]
1. Reformulating the current co-attractant

Bioassays on current 6-volatile co-attractant

RESULTS:

- Volatiles 2 & 5 are main attractants (removal decrease attraction)
- Volatile 6 is a deterrent (also maybe 3) (removal increases attraction)
- Some but not all of the volatiles attract C. nr dimidiatus

[Farnier]
A new co-attractant: 2018 Plans & Progress

1. Improved orchard hygiene
2. New technologies in insect Attract & Kill

2. Selecting and screening new volatiles
2. Selecting and screening new volatiles

Odours are complex blends of volatile compounds

Gas chromatogram (GC-MS)

- Each peak represents a volatile
- The area beneath the peak (height) = relative proportion in the blend

1. Improved orchard hygiene

2. New technologies in insect Attract & Kill

Only some of these will be detected by the insect

How do we decide which ones to select?
2. Selecting and screening new volatiles

Using electro-antennography to select attractants

1. Improved orchard hygiene

2. New technologies in insect Attract & Kill

First time for *Carpophilus*!

[Farnier & Baig]
Screening hull split volatiles

Volatile sampling

1. Improved orchard hygiene
2. New technologies in insect Attract & Kill

* = detection by antennae

Post-hull Split

Pre-hull Split

Retention time (min.)

[Figure showing GC chromatograms with marked peaks and antennal responses]

[Farnier]
A new co-attractant: 2018 Plans & Progress

1. Improved orchard hygiene

2. New technologies in insect Attract & Kill

3. Improving the dispenser (odour release)
### 3. Improving the dispenser

#### 1. Improved orchard hygiene

- **RESULTS:** Sachets emit the same proportions of components, but last FAR longer (weeks to months)
1. Dispenser efficacy and longevity
2. Efficacy of current tri-species lure (pheromone)
3. Modified versions of the co-attractant (in solution and sachet form)
4. First prototype hull split synthetic blends
5. Yeast volatiles blends
5. Biocontrol Options
Exploring biocontrol options

1. Field Surveys
   - Molecular barcoding
   - Morphology

2. Desktop review
   - Biopesticides (*Beauveria*)
   - Auto-dissemination?

---

[1. Rako, Semeraro, Blacket]

[2. Lubanga]
Almond IPM project

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Acknowledgements

Project Team

David Madge (lead Mildura / field)
Kevin Farnier (lead lure development)
Mofakhar Hossain (lead field trapping)

Blair Grossman (Mildura)
Cathy Taylor (Mildura)
Daniel Lai (culturing)
Farrukh Baig (yeast analysis)
Junji Miyazaki (wind tunnel)
Linda Semeraro (diagnostics)
Mark Blacket (diagnostics)
Lea Rako (diagnostics)

Joanne Hollaway (NSW DPI)
Greg Baker (SARDI)

Almond producers in S.A., VIC. & N.S.W.