

International Macadamia Symposium 2023



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Macadamias South Africa (NPC)
(SAMAC)



**Towards biological
control of
macadamia felted
coccid**

Rosali Moffat

Macadamia felted coccid

Eriococcus (Acanthococcus) ironsidei (Hemiptera: Eriococcidae)

Native to Australia – pest status depend on farming practices

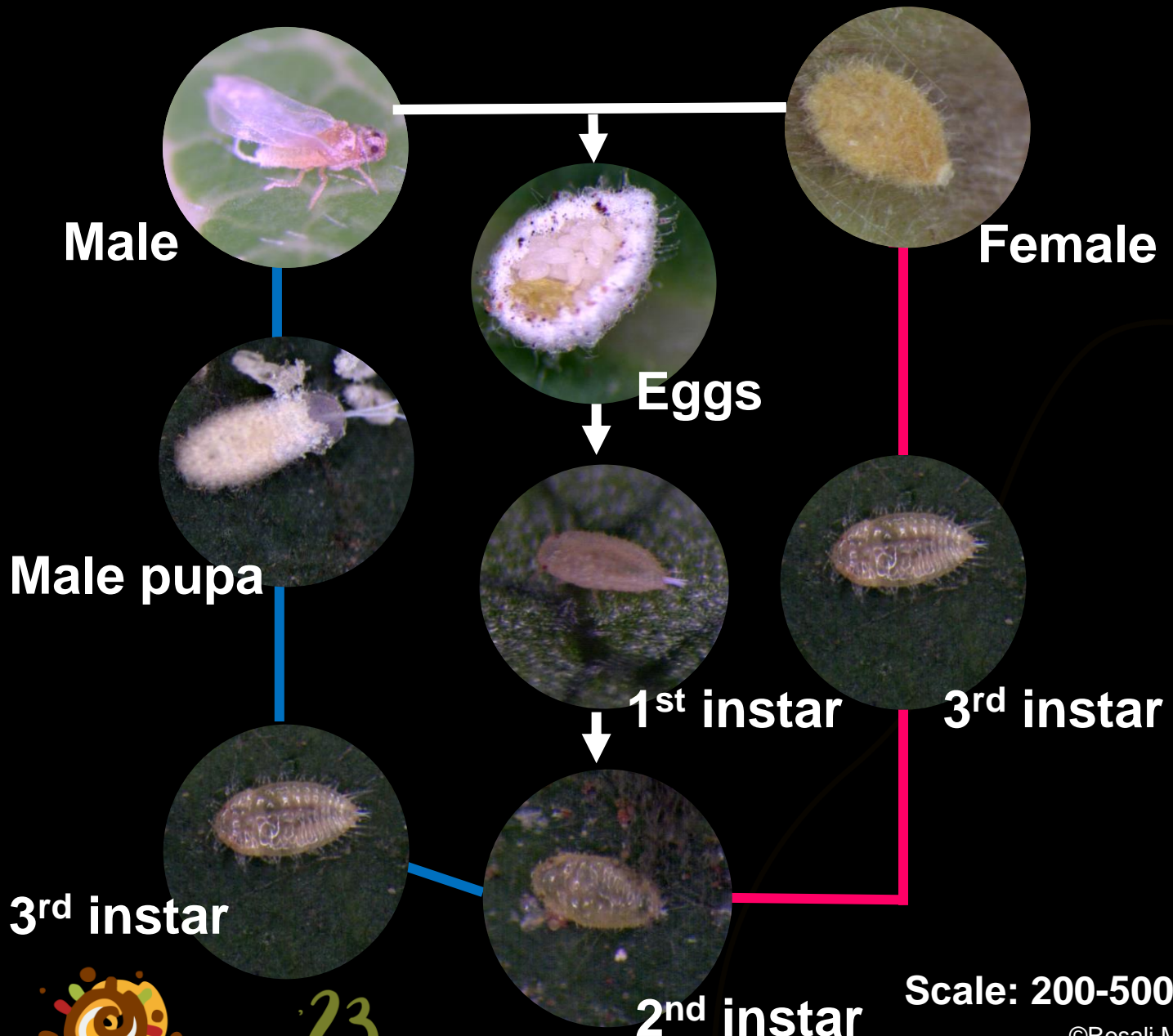
Latest pest of macadamia in South Africa - 2017

Serious pest in Hawaii

Sap-sucking insect – leaves, nuts, branches and stems



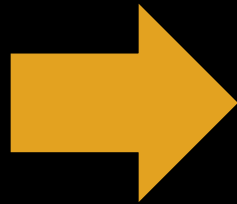
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Scale: 200-500µm

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Problem

- New pest of macadamia in SA
- Little known about biology and invasion potential
- Reduce pesticides



Solutions

- In-depth understanding of MFC biology
- Conservation biological control – increase suite of biological control agents



How

- Laboratory trials
- SDM and CLIMEX modelling
- Field surveys – potential biological control agents



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Understand biology

Development time?

Population buildup rate i.e., degree-days?

Temperature-dependent development

- Egg to adult development
- 15, 19, 22, 26, 29, 32 °C at 75% RH



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28.8 ± 0.9 days



7.0 ± 0.4



7.5 ± 1.5



9.9 ± 0.6



Scale: 200-500µm

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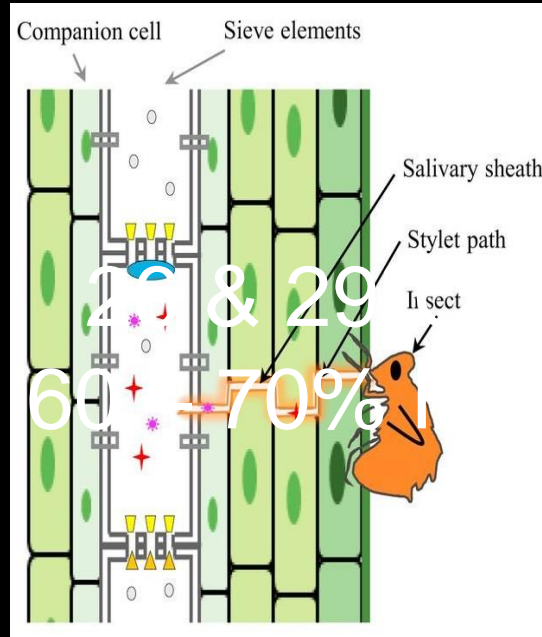
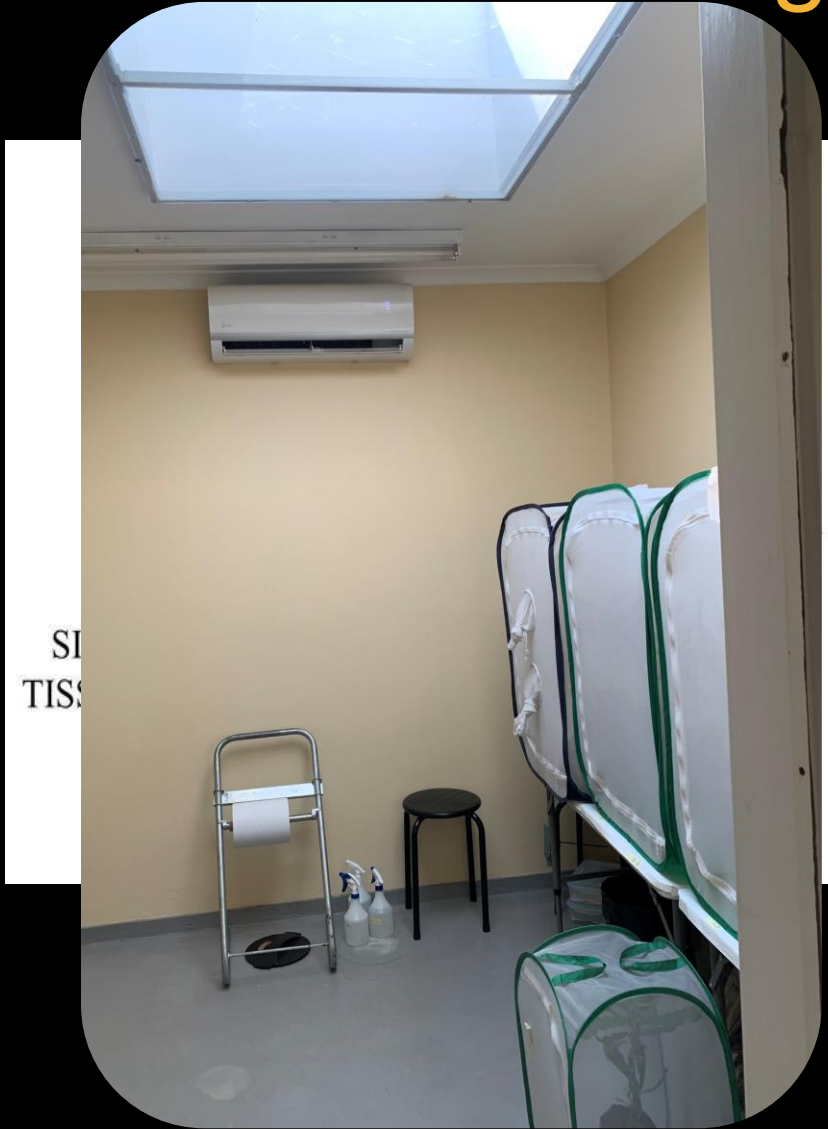


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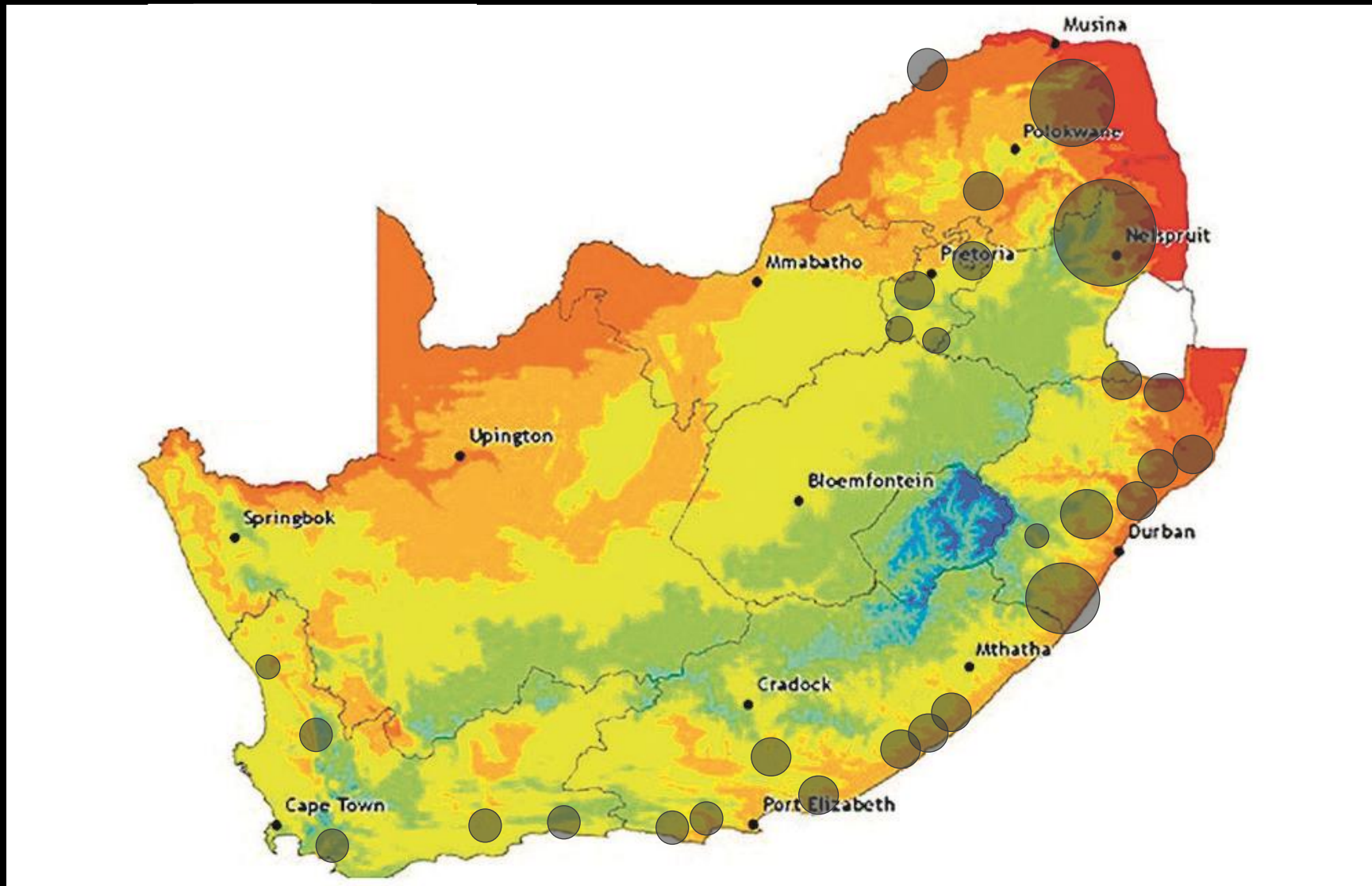
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Understand biology



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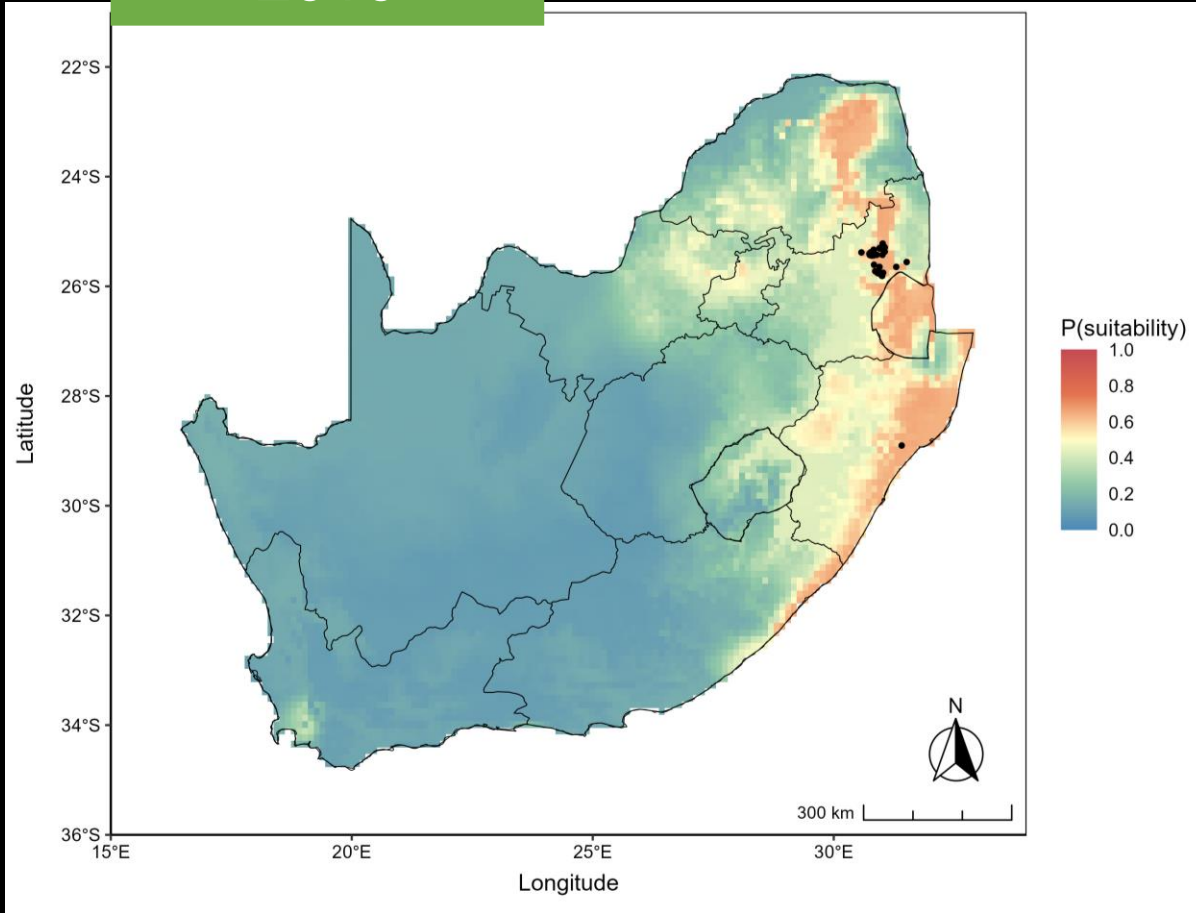


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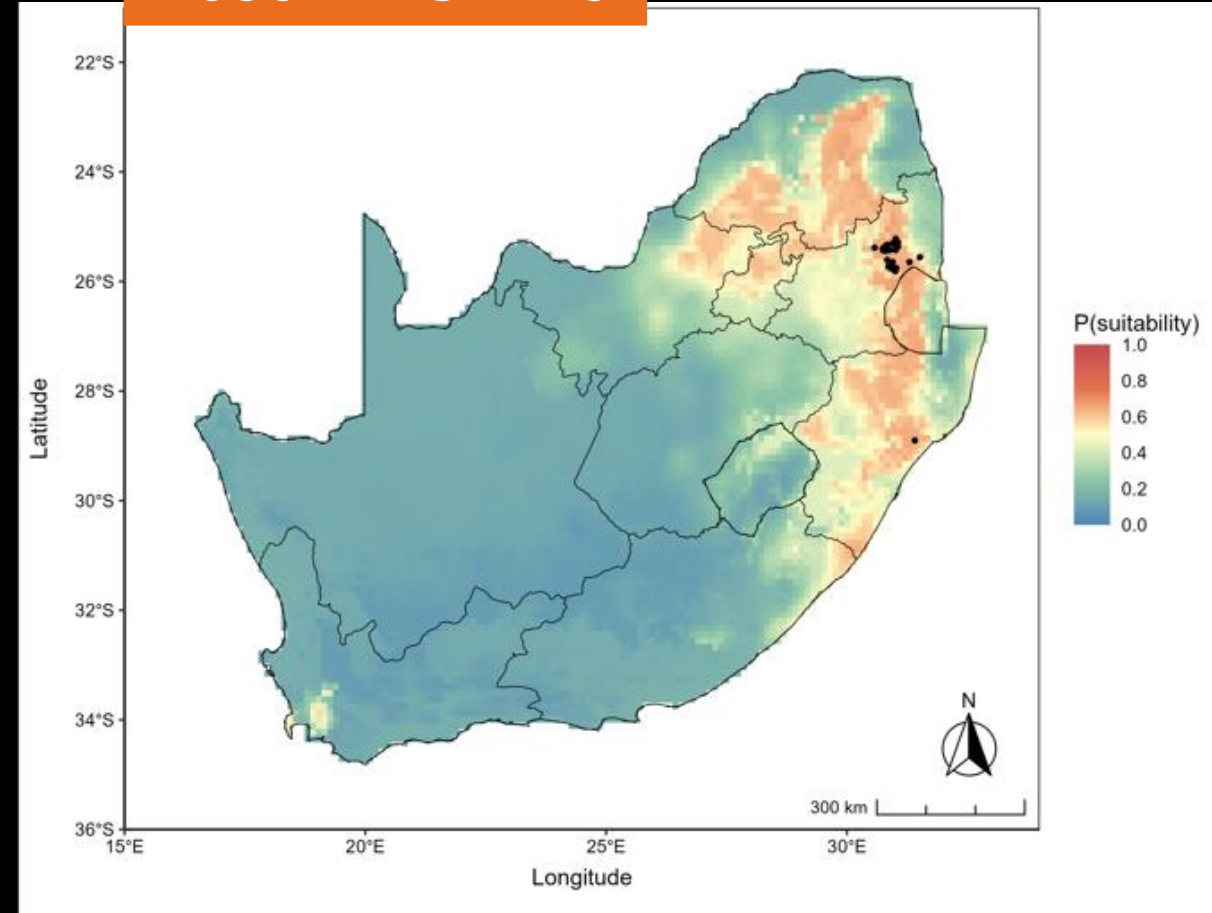
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Ecological niche modelling

2010



2050 – RCP 4.5



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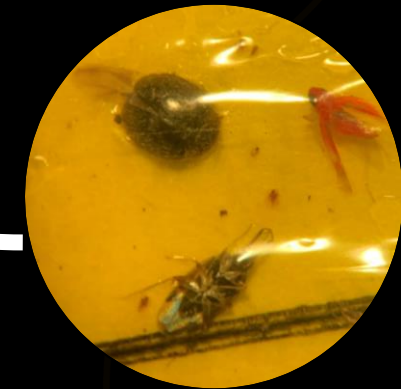
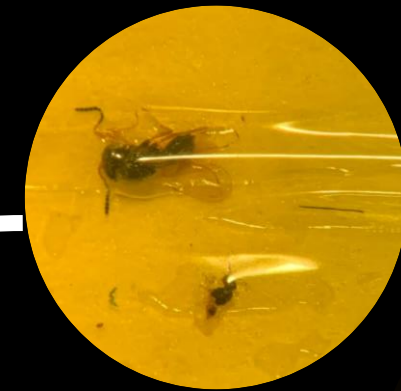
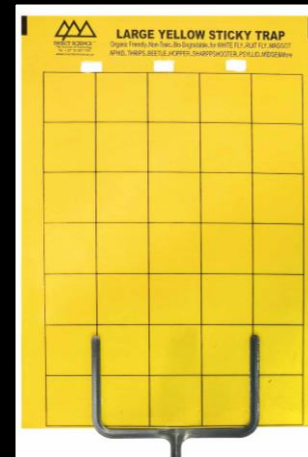
Conservation biological control

Survey macadamia orchards

Identify and investigate predators/parasitoids

Survey: starting point

- yellow sticky traps
- monthly (3 months)



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Conservation biological control

Distribution and seasonal abundance

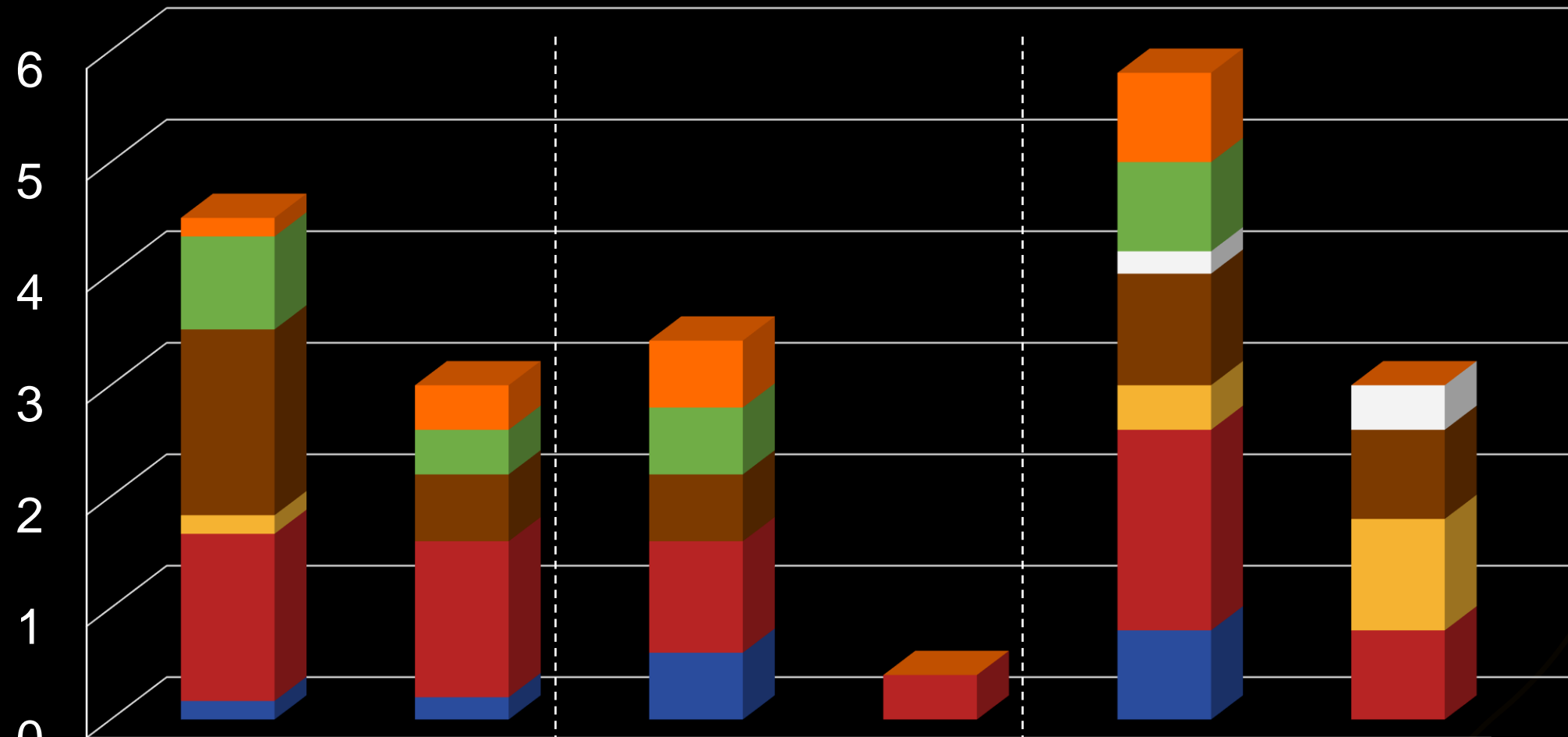
Collect specimens for identification



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Mean number of species



- Coleoptera
- Diptera
- Hemiptera
- Hymenoptera
- Lepidoptera
- Psocoptera
- Thysanoptera

Farm 1

Farm 2

Farm 1

Farm 2

Farm 1

Farm 2

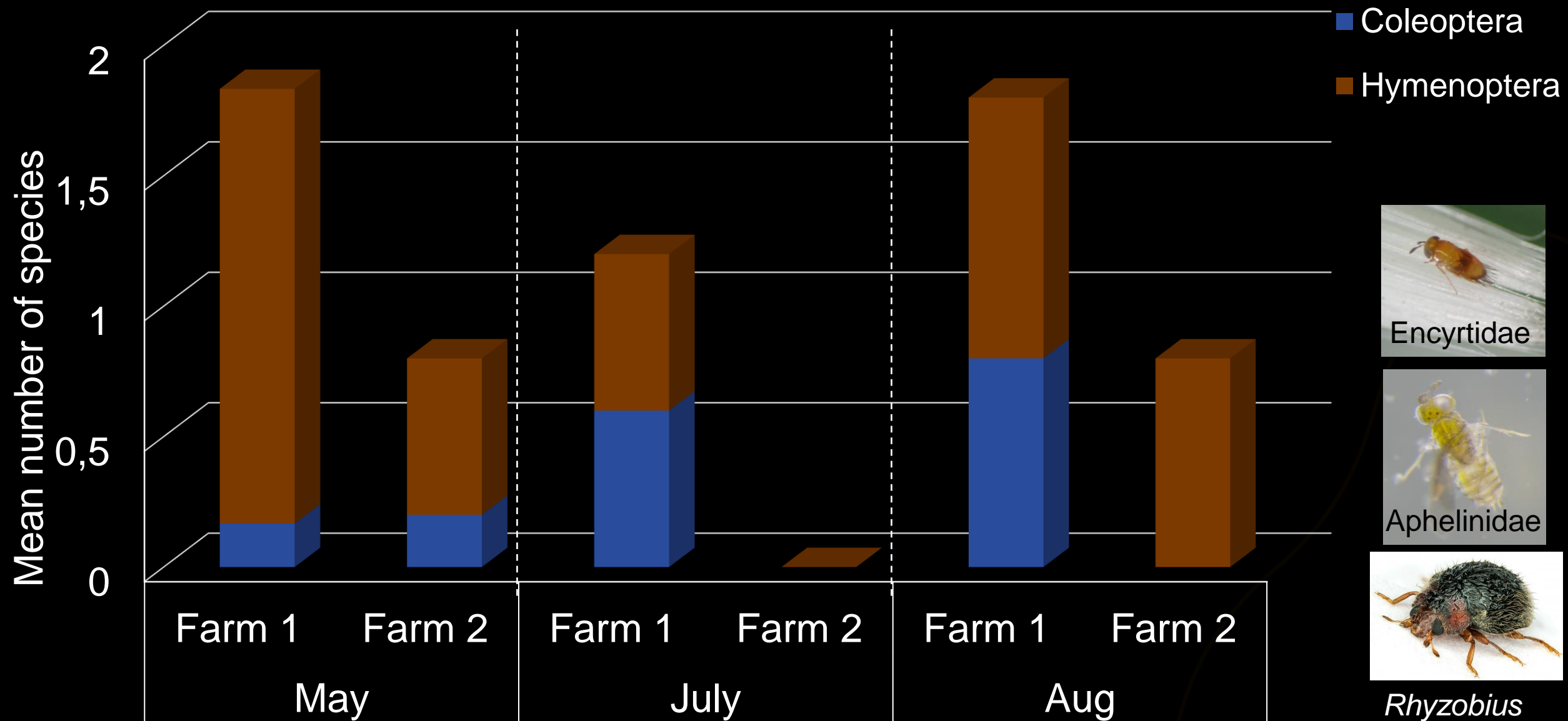
May

July

Aug



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Conservation biological control – pilot study



Rhyzobius lophanthae

59.4%

5 crawlers



Cryptolaemus montrouzieri

73%

6 crawlers



71.9%

6 crawlers



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Summary



- MFC is present – invasion process
- reduce impact and spread



- understanding MFC biological traits
- utilizing available natural enemies



- IPM programme



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Acknowledgements



Dr. Gerda Fourie



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Anthony King



Dr. Clarke
van Steenderen



Dr. Gerhard Prinsloo





Biological control with specialist natural enemies

Anthony King





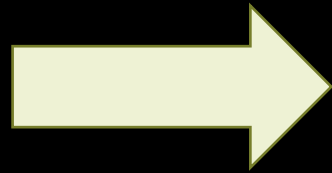
MFC in its native range



- MFC problematic in nurseries, young in-field plantings and newly infested areas
- Generally considered a minor and sporadic pest that is seldomly actively managed
- Suppression from a suite of indigenous natural enemies which maintain adequate control under most circumstances
- Classical biological control utilising specialist parasitoids could offer a long-term, sustainable solution to MFC in invaded areas

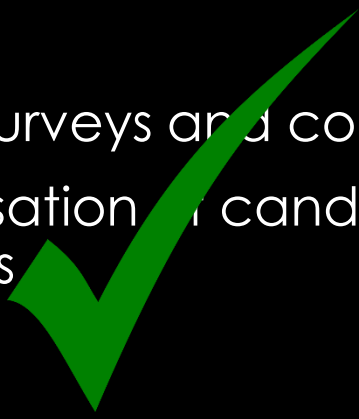
Classical biological control

Native range



Introduced range

- Field surveys and collection
- Prioritisation of candidate agents
- Export



- Establishment in quarantine
- Host-specificity testing
- Application for release

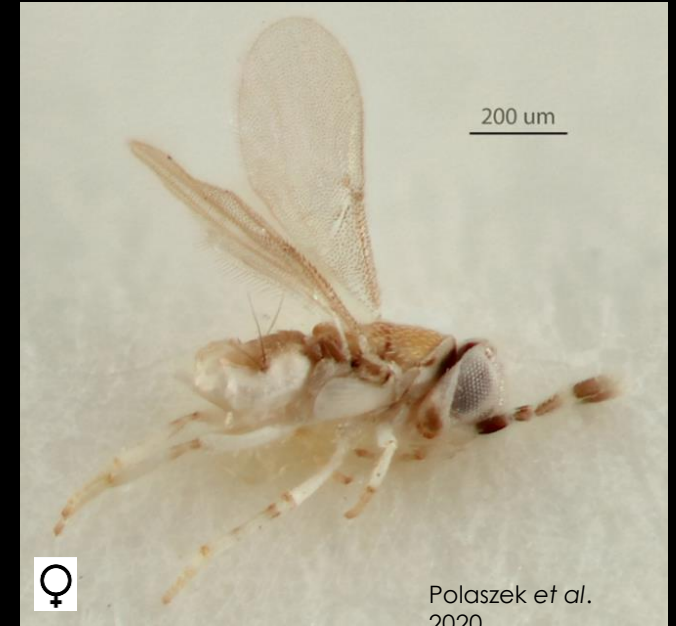
Metaphycus macadamiae

Surveys conducted
in Australia in 2013



- A new species, *M. macadamiae*, dominant natural enemy in Australia
- Female wasps feed on MFC nymphs and utilise adults for oviposition
- *Metaphycus* wasps widely used for biological control of pests of other economically important crops

(Yalemar et al. 2023)



Host-range evaluation



- Host-specificity testing completed by HDOA-PPC in Hawaii showing a high degree of specialisation
- 12 non-target insect hosts tested
- 9 Hemiptera (including 5 neococcid genera) and 3 Lepidoptera
- *M. macadamiae* did not emerge from or feed on any test species



(Yalemar et al. 2023)

Host-range evaluation



- Host-specificity testing completed by HDOA-PPC in Hawaii showing a high degree of specialisation
- 12 non-target insect hosts tested
- 9 Hemiptera (including 5 neococcid genera) and 3 Lepidoptera
- *M. macadamiae* did not emerge from or feed on any test species
- Indigenous scale insects more numerous in South Africa
- Prioritisation of test species based on phylogenetic distance from MFC
- Phylogeny of Eriococcidae not well resolved
- Non-target hosts to be selected from 36 species in 8 neococcid families
- Only 1 indigenous Eriococcid species recorded in South Africa

(Yalemar et al. 2023)

Research aims

- Three-year project funded by SAMAC
- Import a culture of *M. macadamiae*
- Establish the wasp in quarantine at both ARC-PHP and FABI
- Undertake host-range assessment using indigenous and economically important scale insects
- Prepare risk assessment report requesting release of *M. macadamiae* in South Africa



Anticipated outcomes

- Obtaining cultures of *M. macadamiae* represents a substantial short cut for initiating a biological control program against MFC in South Africa
- A successful biological control programme will reduce the current over-reliance on insecticides for the control of MFC
- This will lessen non-target impacts on extant natural enemies and pollinators present in orchards
- The wasp is anticipated to make a valuable contribution to sustainable pest management in South African orchards



Acknowledgements



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References cited:

Yalemar, J.A.; Tateno-Bisel, A.P.; Chun, S.G.; Ramadan, M.M. Prospects for Biological Control of Macadamia Felted Coccid in Hawaii with *Metaphycus macadamiae* Polaszek & Noyes, a New Encyrtid Wasp Native to NSW Australia. Preprints 2023, 2023082189. <https://doi.org/10.20944/preprints202308.2189.v1>

Polaszek A, Noyes JS, Russell S, Ramadan MM (2020) *Metaphycus macadamiae* (Hymenoptera: Encyrtidae) – a biological control agent of macadamia felted coccid *Acanthococcus ironsidei* (Hemiptera: Eriococcidae) in Hawaii. PLoS ONE 15(4): e0230944. <https://doi.org/10.1371/journal.pone.0230944>





QUESTIONS ?



