

# APPLYING PEST BIOLOGY INFORMATION IN THE FIELD

DR ELSJE JOUBERT

10 – 11 September 2024

SAMAC

*proudly presents*

Mac Day'24

*Together we move forward - fuelled by momentum*



# Outline

1. Pests
2. Biology
3. Field applications

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# Pests

Pests are defined as an organisms that has a negative influence on the desired outcome parameter.

E.g. Good crop + fungus = poor crop



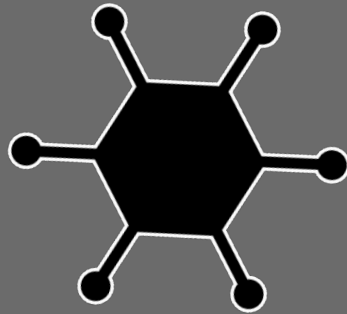
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# Pests

Pests are defined as an organisms that has a negative influence on the desired outcome parameter.

E.g. Good crop + fungus = poor crop



Presence, optimal climate conditions, host.



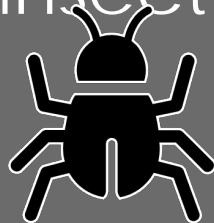
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# Pests

Pests are defined as an organisms that has a negative influence on the desired outcome parameter.

E.g. Good crop + insect = poor quality





# Integrated pest management: Prevent, Monitor & Control



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# Pest biology

Pests are defined as an organisms that has a negative influence on the desired outcome parameter.

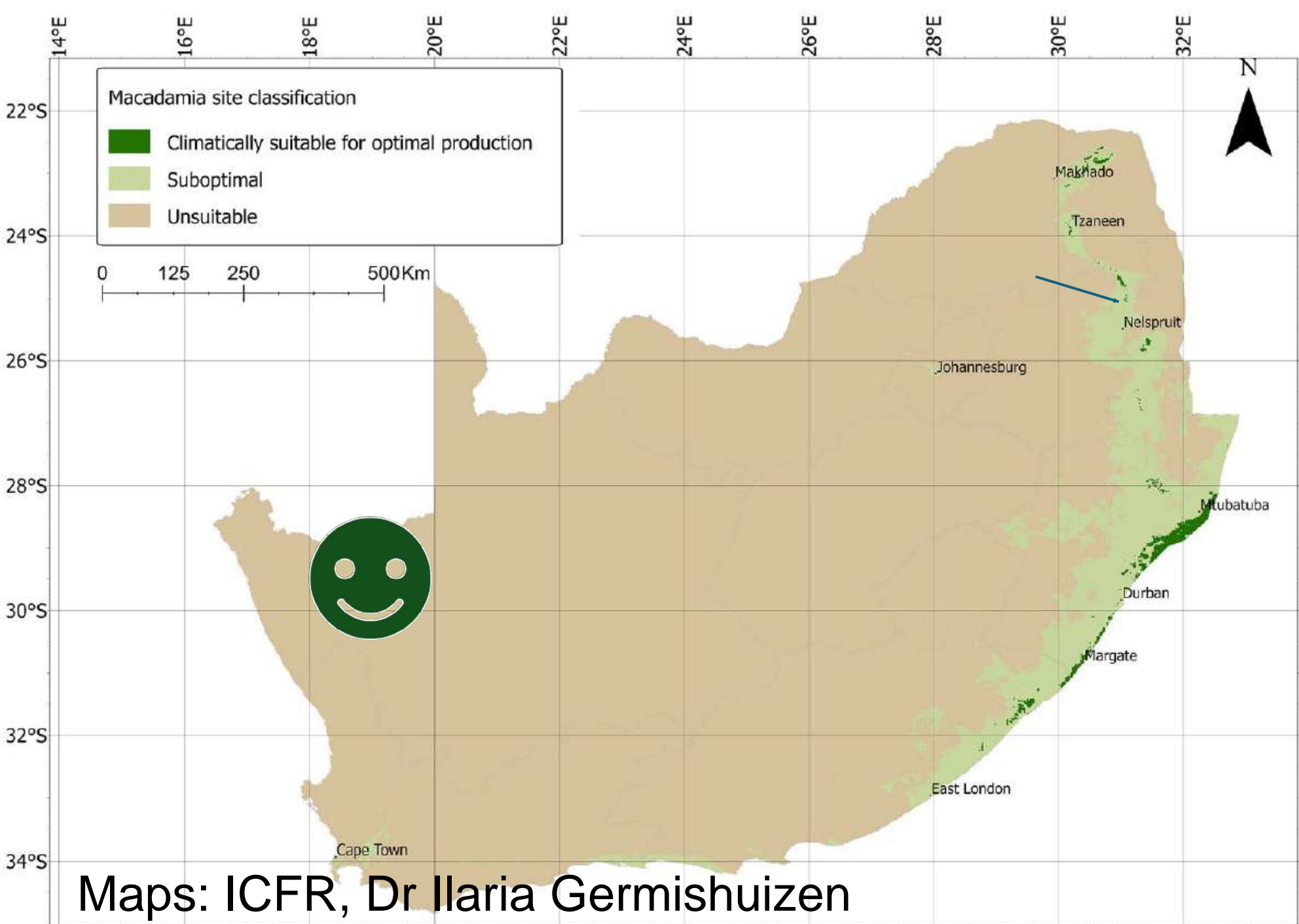
E.g. Good crop + insect = poor quality



Integrated pest management: Prevent, Monitor & Control

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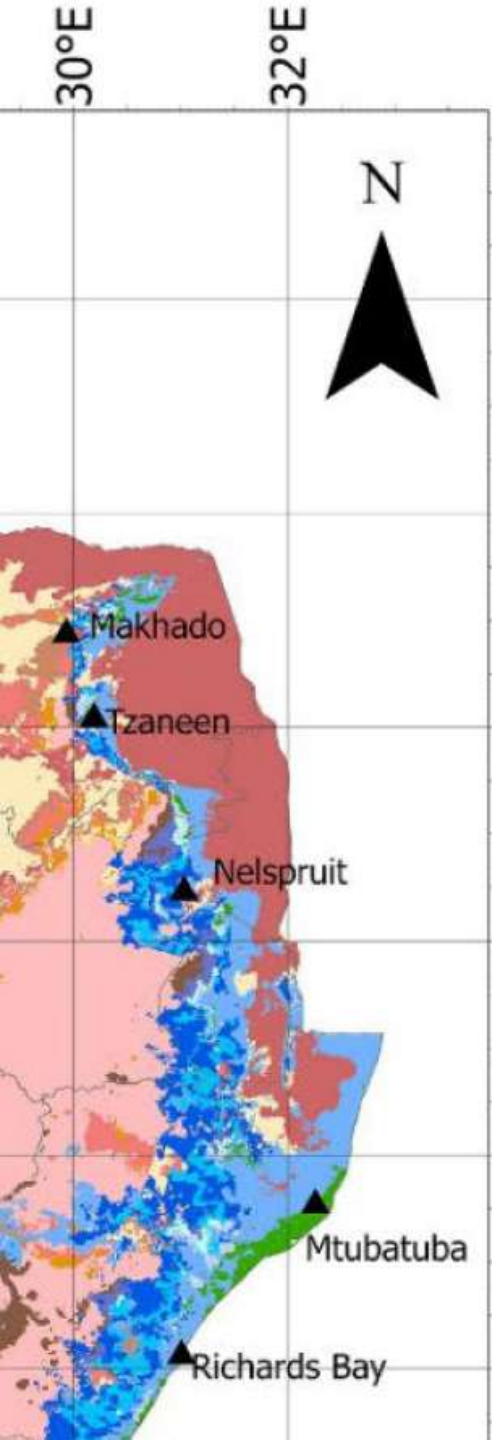
Macadamia orchard  
Climate suitability



Maps: ICFR, Dr Ilaria Germishuizen



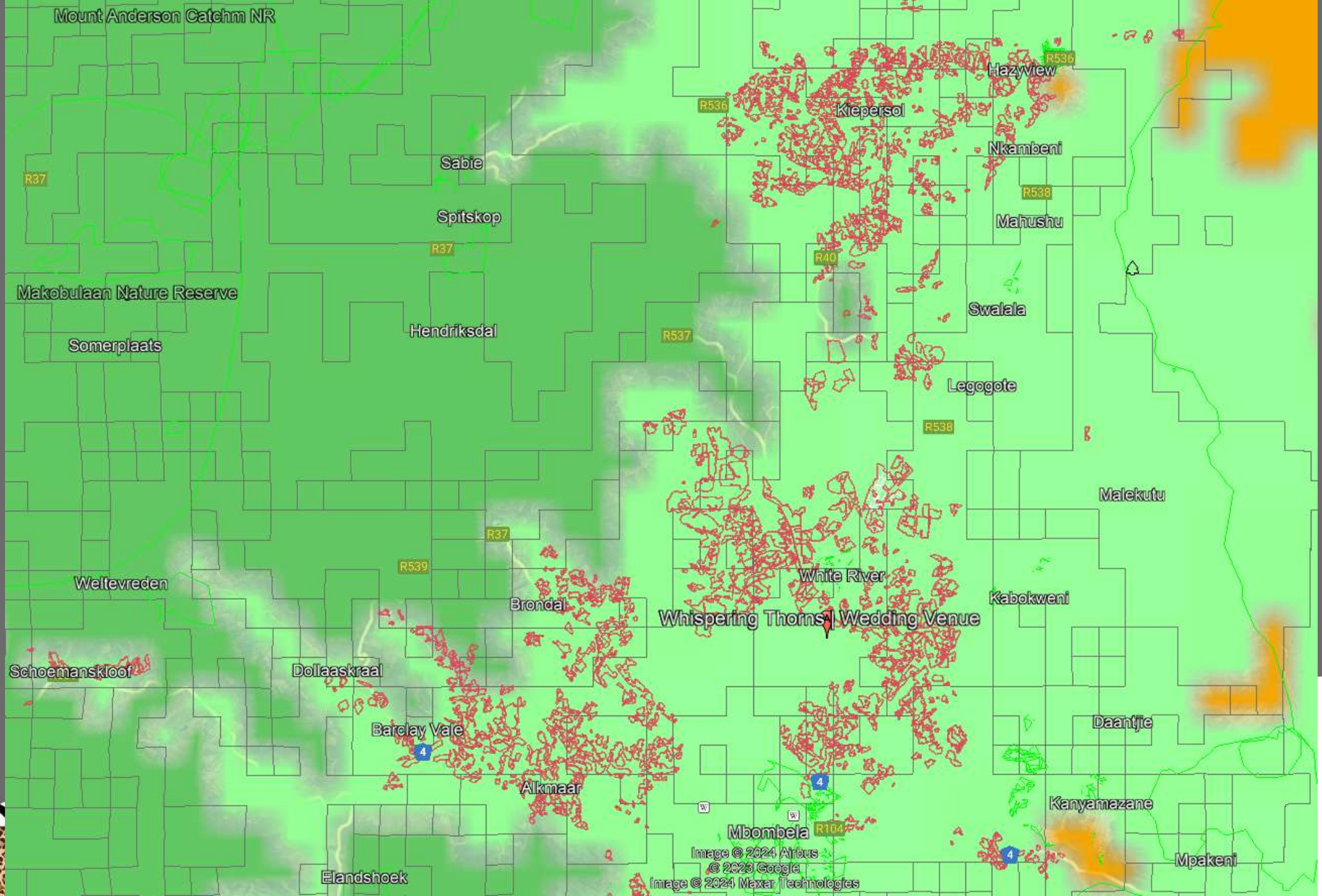




- Optimal climate
- Suboptimal HU
- Suboptimal rainfall
- Suboptimal rainfall; Moderate frost risk; Suboptimal HU
- Suboptimal rainfall; Suboptimal HU
- Suboptimal rainfall; Moderate frost risk
- Suboptimal: Moderate frost risk; Suboptimal HU
- Unsuitable: Dry
- Unsuitable: Dry; High frost risk; Suboptimal HU
- Unsuitable: Dry; Moderate frost risk
- Unsuitable: Dry; Moderate frost risk; Suboptimal HU
- Unsuitable: Dry; Suboptimal HU
- Unsuitable: Dry; High frost risk; Suboptimal HU
- Provincial boundaries

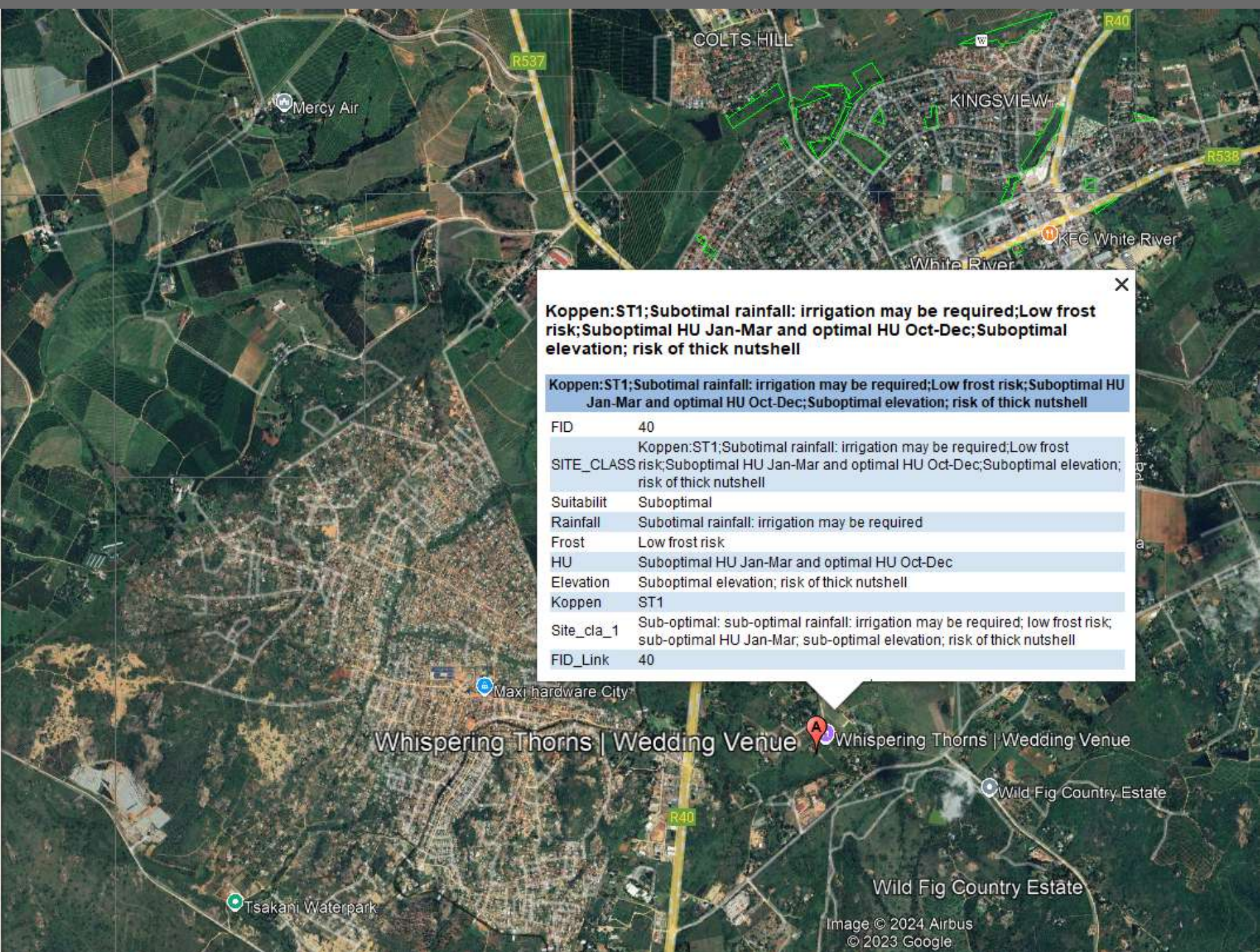
# Macadamia orchard Climate suitability





# A Whispering Thorns | Wedding Venue

High Road, White River, Mbombela, 1240  
- whisperingthorns.com



## Places

- Koppen:CT4;Suboptimal rainfall; irrigation may be required; risk of thick nutshell
- Koppen:CT4;Unsuitable: dry;High frost risk;Suboptimal HU Jan-Mar and optimal HU Oct-Dec;Suboptimal elevation; risk of thick nutshell
- Koppen:CT4;Unsuitable: dry;High frost risk;Suboptimal HU Jan-Mar and optimal HU Oct-Dec;Suboptimal elevation; risk of thick nutshell
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- Koppen:CT5;Suboptimal rainfall; irrigation may be required; risk of thick nutshell
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- Koppen:CT6;Optimal rainfall;High frost risk;Suboptimal HU Jan-Mar and optimal HU Oct-Dec;Suboptimal elevation; risk of thick nutshell
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- Koppen:CT7;Unsuitable: dry;High frost risk;Suboptimal HU Jan-Mar and optimal HU Oct-Dec;Suboptimal elevation; risk of thick nutshell
- Koppen:CT8;Suboptimal rainfall; irrigation may be required; risk of thick nutshell
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- Koppen:CT9;Optimal rainfall;High frost risk;Suboptimal HU Jan-Mar and optimal HU Oct-Dec;Suboptimal elevation; risk of thick nutshell
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**Koppen:ST1;Suboptimal rainfall; irrigation may be required;Low frost risk;Suboptimal HU Jan-Mar and optimal HU Oct-Dec;Suboptimal elevation; risk of thick nutshell**

<b>Koppen:ST1;Suboptimal rainfall; irrigation may be required;Low frost risk;Suboptimal HU Jan-Mar and optimal HU Oct-Dec;Suboptimal elevation; risk of thick nutshell</b>	
FID	40
SITE_CLASS	Koppen:ST1;Suboptimal rainfall; irrigation may be required;Low frost risk;Suboptimal HU Jan-Mar and optimal HU Oct-Dec;Suboptimal elevation; risk of thick nutshell
Suitabilit	Suboptimal
Rainfall	Suboptimal rainfall; irrigation may be required
Frost	Low frost risk
HU	Suboptimal HU Jan-Mar and optimal HU Oct-Dec
Elevation	Suboptimal elevation; risk of thick nutshell
Koppen	ST1
Site_cla_1	Sub-optimal: sub-optimal rainfall; irrigation may be required; low frost risk; sub-optimal HU Jan-Mar; sub-optimal elevation; risk of thick nutshell
FID_Link	40

# Insect Developmental Biology

Each developmental pathway allows insects to adapt to different ecological niches, contributing to their survival and reproduction.

## Incomplete Metamorphosis (Hemimetabolism)

3 main stages

Egg

Nymph

Adult

## Complete Metamorphosis (Holometabolism)

4 main stages

Egg

Larvae

Pupae

Adult

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# Stink bug biology

Incomplete Metamorphosis  
(Hemimetabolism)

3 main stages



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# Macadamia nut borer biology

Complete Metamorphosis  
(Holometabolism)

4 main stages

Egg



Larvae



Pupae



Adult



# Insect Developmental Biology

Each developmental pathway allows insects to adapt to different ecological niches, contributing to their survival and reproduction.

Insects cannot regulate their body heat; their development time is based on ambient temperature.

Growing Degree Days (GDD) / heat units (HU) =  
Accumulation of heat units until the life stage changes.

$$^{\circ}\text{D} = T_{\text{AVERAGE}} - T_{\text{BASE}}$$

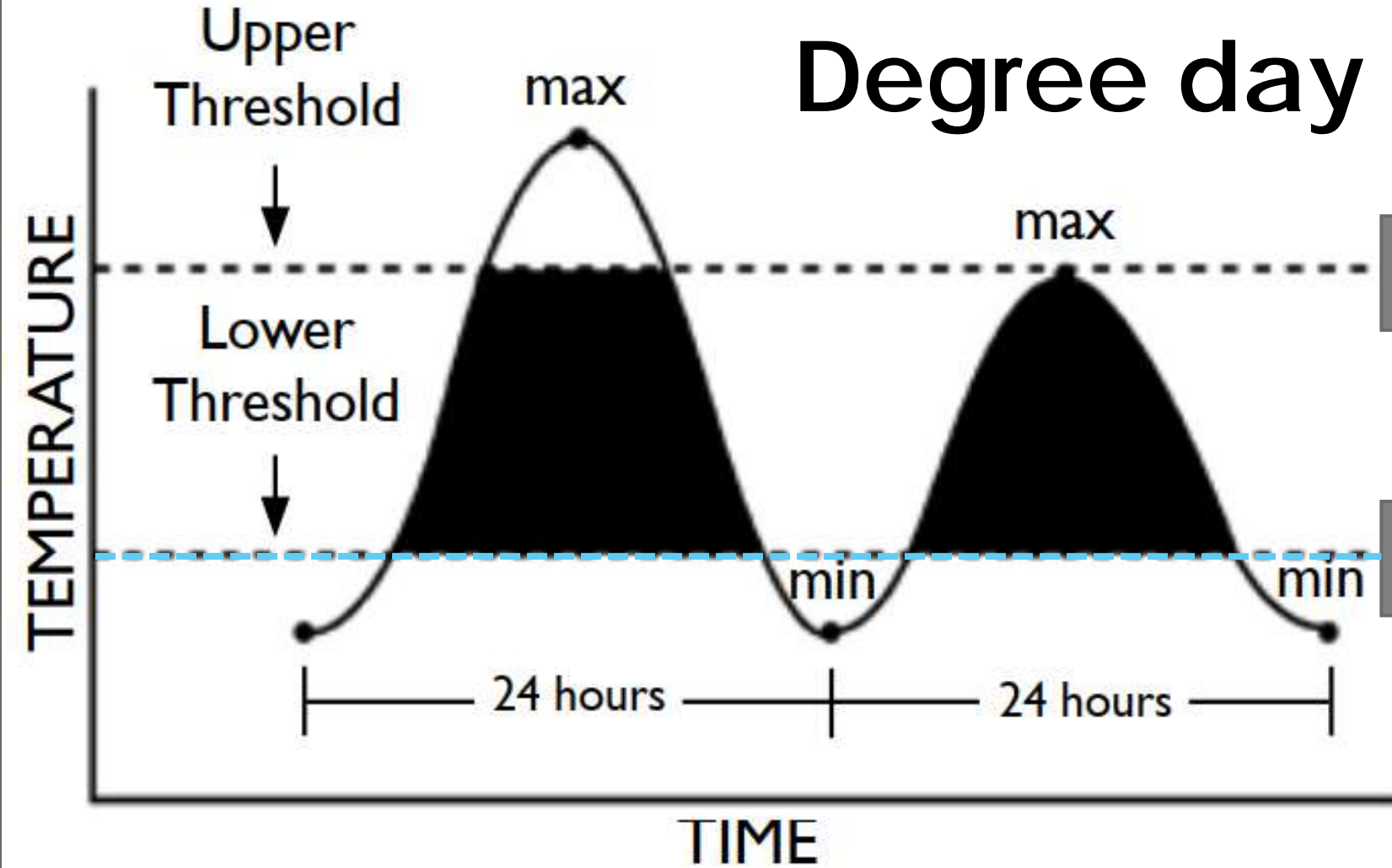
Lower developmental threshold



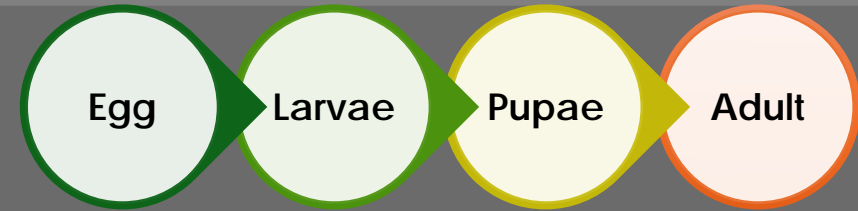
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# Degree day



Upper Developmental Threshold (UDT)



Lower Developmental Threshold (LDT)



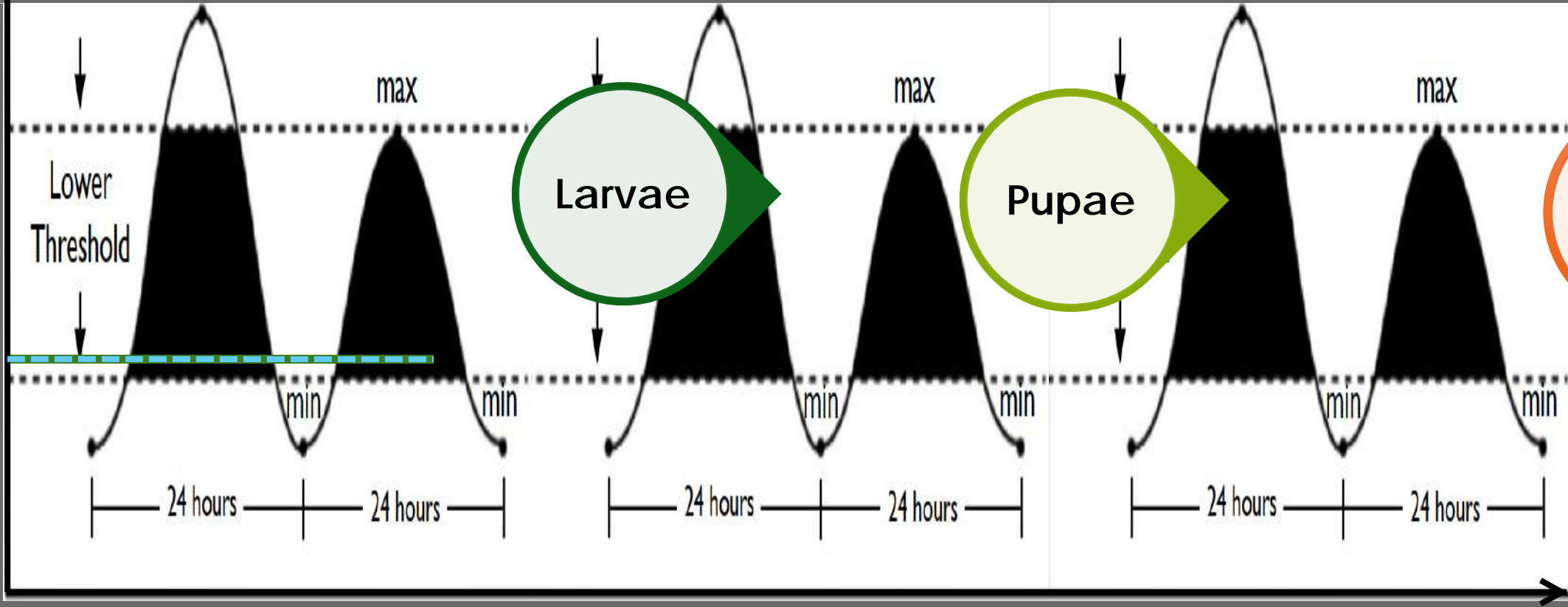
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# Accumulated day degrees

TEMPERATURE (°C)



TIME



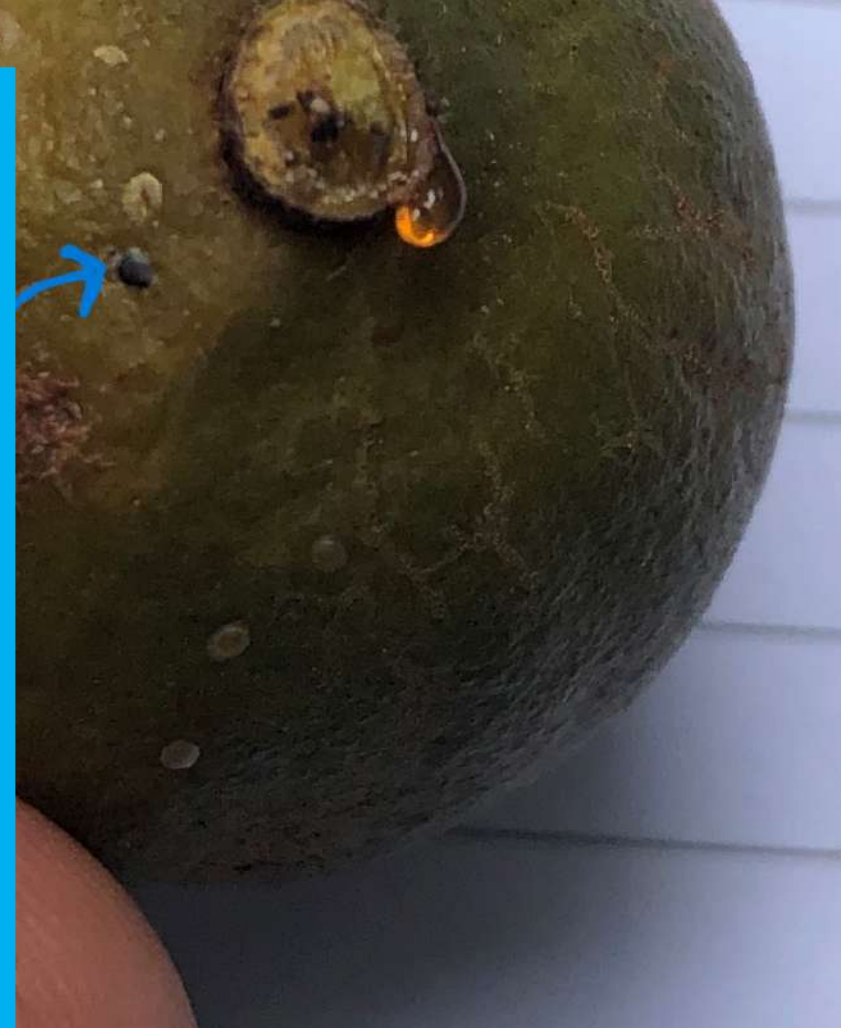
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Photo: Dr Schalk Schoeman

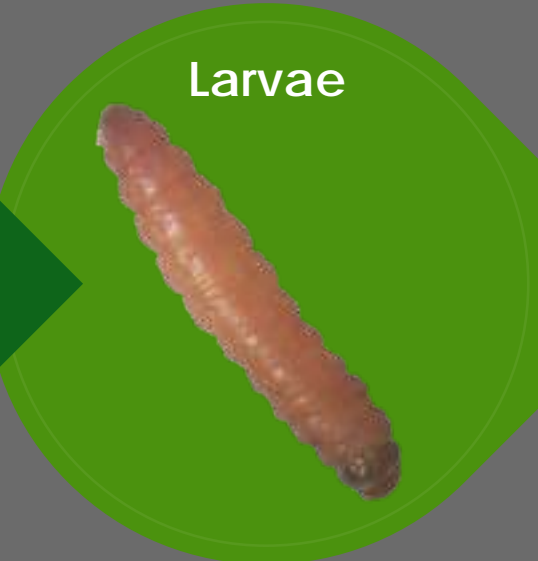


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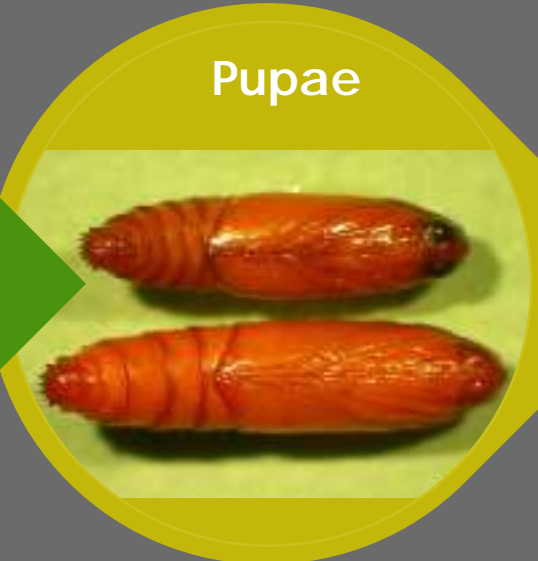




Egg



Larvae



Pupae



Adult

$T_{BASE} = 11.7\text{ }^{\circ}\text{C}$

$11.7\text{ }^{\circ}\text{C}$

$11.7\text{ }^{\circ}\text{C}$

GDD =  $71.0\text{ }^{\circ}\text{D}$

$155.0\text{ }^{\circ}\text{D}$

$175.0\text{ }^{\circ}\text{D}$

$401.0\text{ }^{\circ}\text{D}$

4 days

12 days

14 days

15 days  
Up to 800  
eggs/female

Optimal



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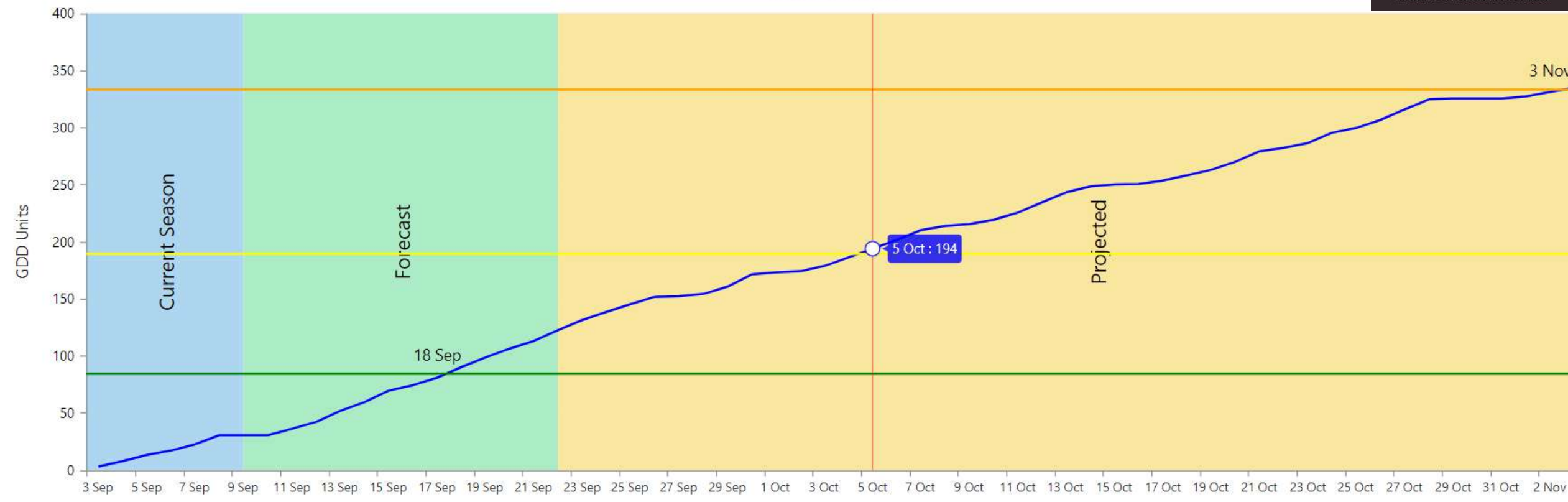
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Macadamias South Africa NPC

# Thrips development



Thrips : Curlews



■ Spray (egg hatch)   
 ■ Next adult (1st peak)   
 ■ Next adult (2nd peak)



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Video courtesy: Werner Muller



Egg



Nymph



Adult

$T_{BASE} = 13.9\text{ }^{\circ}\text{C}$

$14.4\text{ }^{\circ}\text{C}$

GDD =  $62.9\text{ }^{\circ}\text{D}$

$719.8\text{ }^{\circ}\text{D}$

Egg  
**7 days**

**42 days**

Nymph

Adult  
**33 days**  
**246 eggs/female**

# Two-spotted stink bug development



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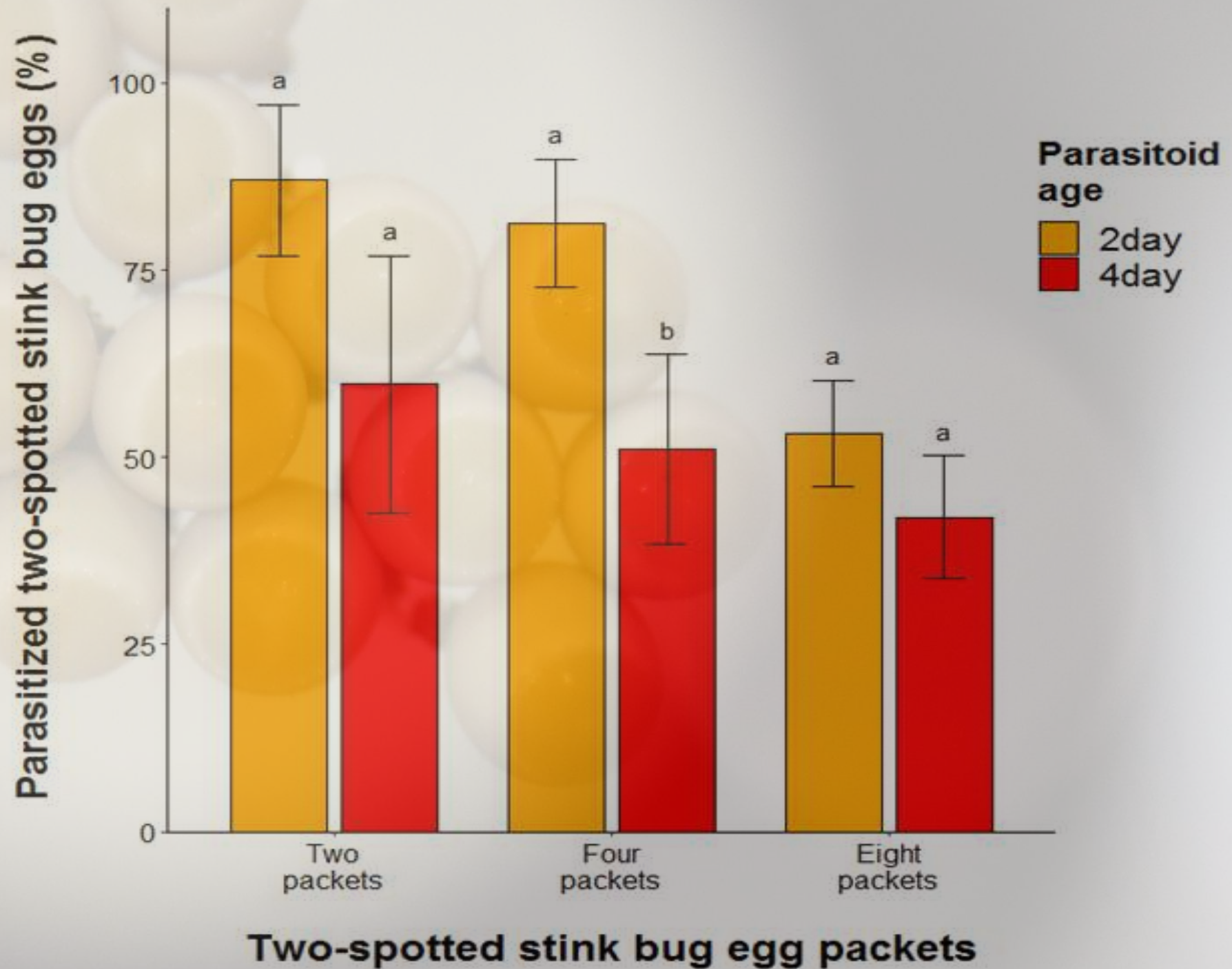
**Not parasitised  
Stink bugs hatched**



**Parasitised &  
Parasitoids hatched**

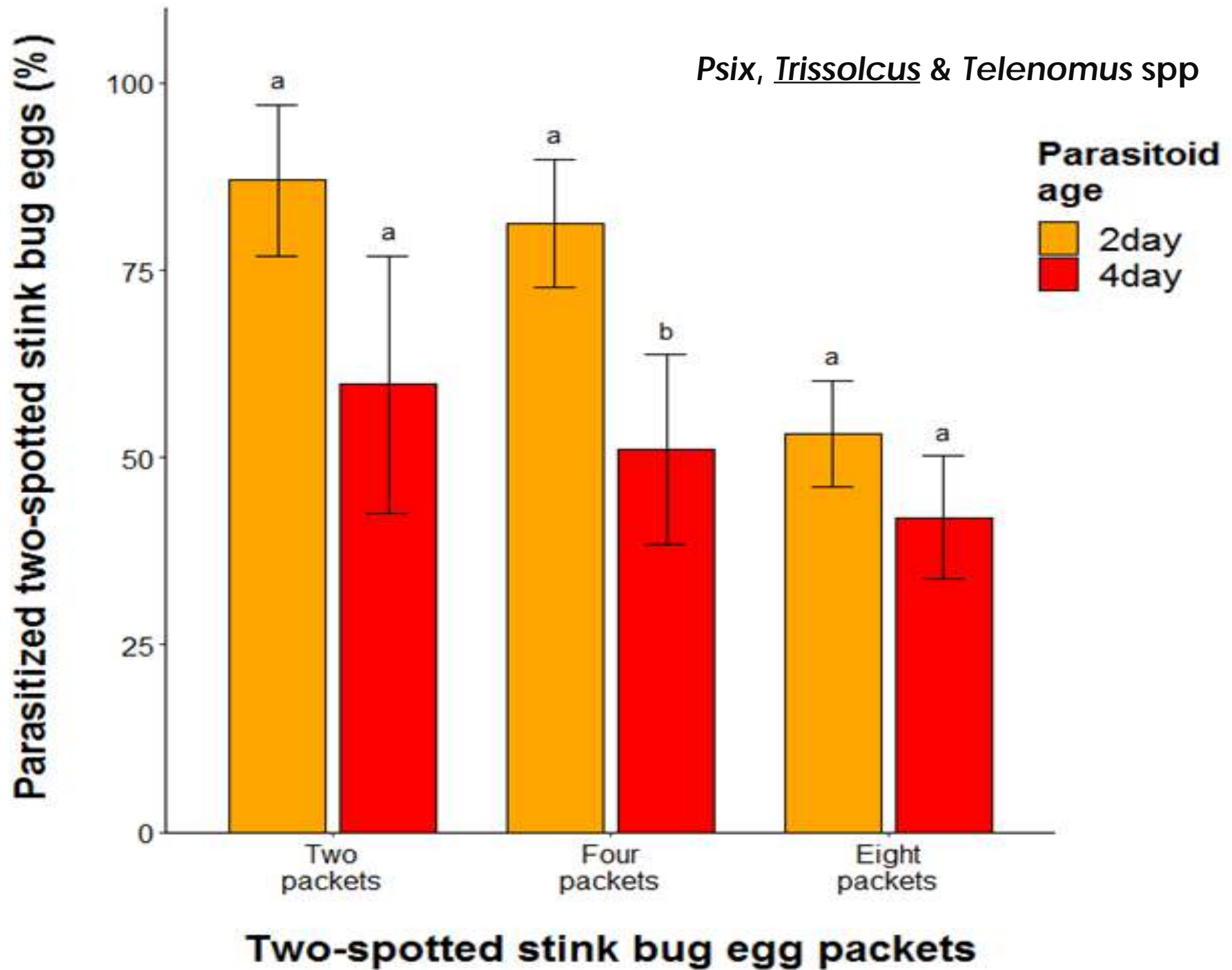




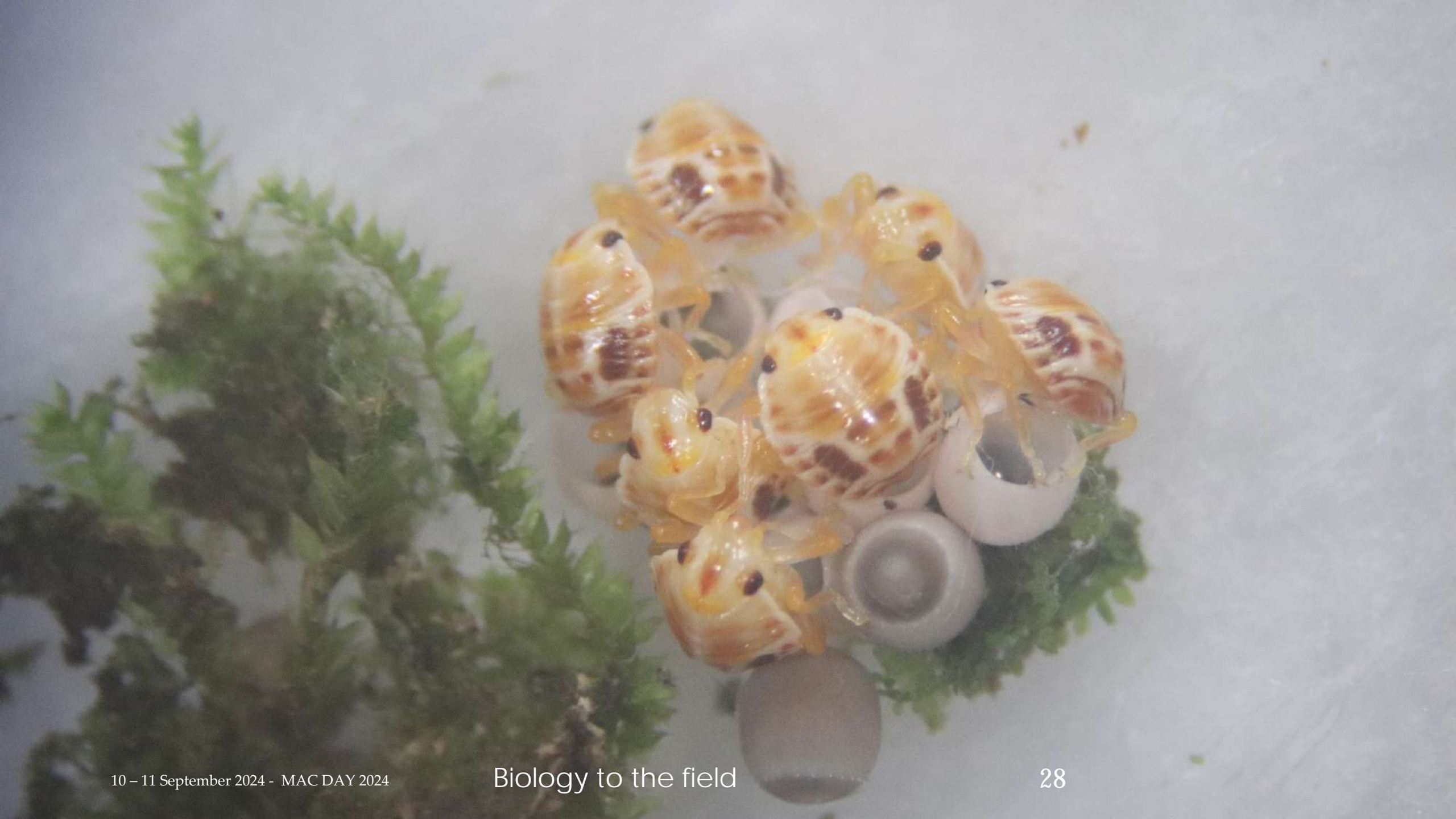




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# Macadamia felted coccid (MFC)

*Eriococcus ironsidei*



$T_{BASE} = 9.2\text{ }^{\circ}\text{C}$   
 $GDD = 448.7\text{ }^{\circ}\text{C days}$   
 1-Jul  
 16-Sep  
 20-Oct  
 28-Nov  
 31-Dec  
 5-Feb  
 14-Mar  
 30-Apr  
 5-Jul  
 eggs/female

**28.8 ± 0.9 days**

**7.5 ± 1.5**

**7.0 ± 0.4**

**9.9 ± 0.6**



Male

8 generations / season



Female



Eggs



Male pupa



1<sup>st</sup> instar



3<sup>rd</sup> instar



3<sup>rd</sup> instar

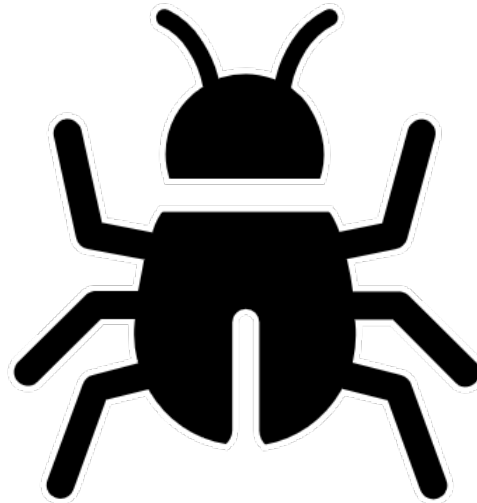
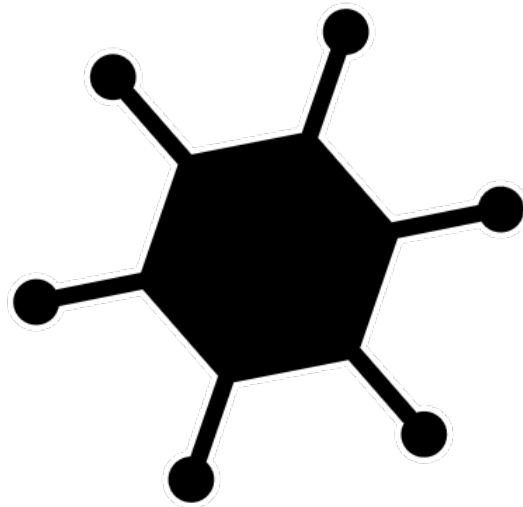


2<sup>nd</sup> instar

Photos: FABI (Rosali Moffat)

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Biology to the field



# Take-home message:

A thorough understanding of the plant & pest biology is fundamental to effective prevention, monitoring and control.

Plant, fungi and insect development is temperature-dependent, and the biological thresholds can be applied to the local climate to determine important intervention timesteps in macadamia orchards.

*Together we move forward - fuelled by momentum*



# References & Acknowledgements

1. FABI
2. ipm.ucanr.edu
3. Schoeman P.S. & Millar M. 2018 African Entomology 26:247-249.
4. Site classification for macadamia orchards in South Africa. ICFR.
5. USDA APHIS PPQ 12/2/2019

## Questions

Thank you

