Australian Hazelnut Program of Research

Theme 1: Promote efficient and sustainable production systems.

Project 1: Crop load management for Hazelnut industry - A digital tool (app) for growers

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Introduction

Crop load Management

Yield (per plant) = #Nut * <weight$_{nut}$>

#Nut = f(water, NPK, pruning, GDD, Soil)

<weight$_{nut}$> = f(water, NPK, pruning, GDD, Soil)

The objective: Develop digital tool that helps identifying practices that improve yield

- Research & Development of management practices
- Managing crops in hazelnut orchard according to variability

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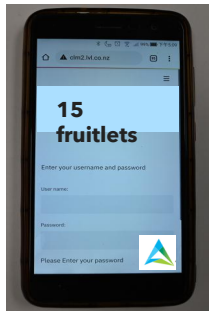
Background – Previously developed tool

Apple/Grape Crop Load Estimation

Data uploaded automatically

User:
- collects *photos*
- some ground truth



App:
Sends back *estimates* to the user's phone

AI:
Data processed on the 'cloud'

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Digital tool for Hazelnut Growers

Outputs at the end of the project:

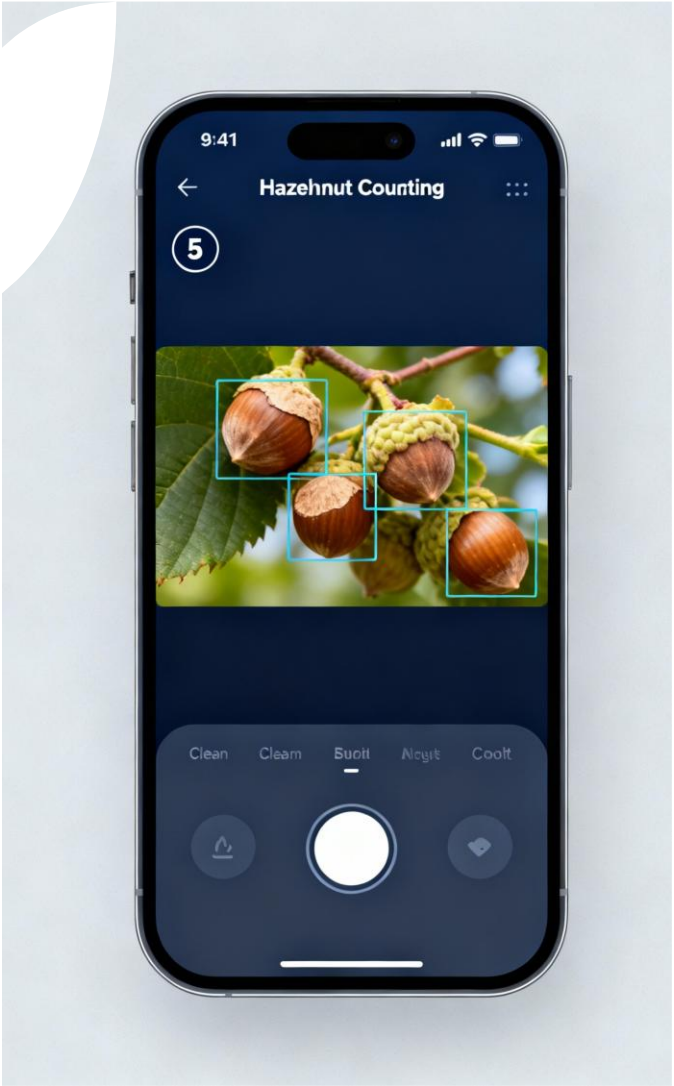
- A phone app that provide counts of flower / nut from images.

Progress of our work:

- Data collection.
- SOP, workflow

Future opportunities co-design use cases:

- Monitor growth and support growers with various orchard management decision making.
- Yield Estimation.



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Hazelnut flowers and Nuts estimations













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Current Progress

What is required

Digital Tool

- AI model for flower and hazelnuts detection in images
- A mobile app

Workflow

- SOP (Standard Operating Procedure)
- Grower use cases

What we will do

- Data Collection
- Grower Feedback
  - Focus on female flowers on new growth longer than 150mm.
- Co design of the SOP

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Flowers – New growth

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Flower – Square area

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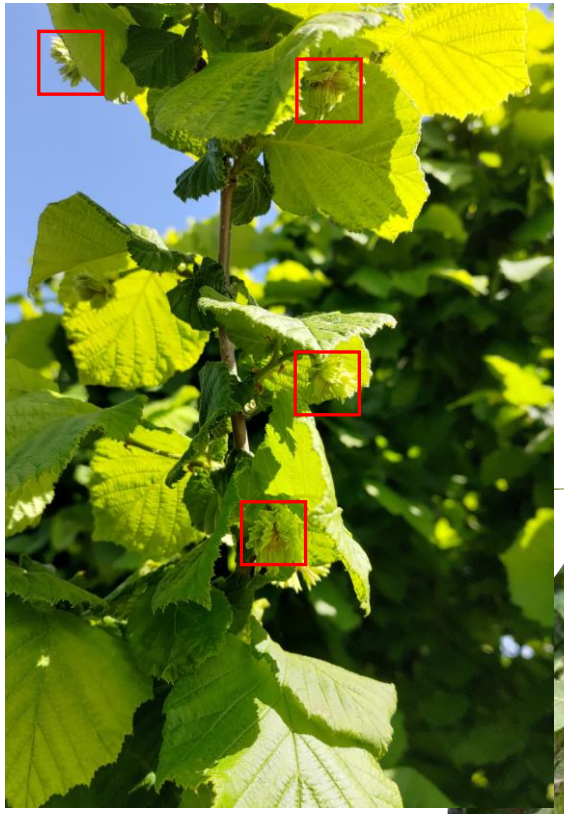
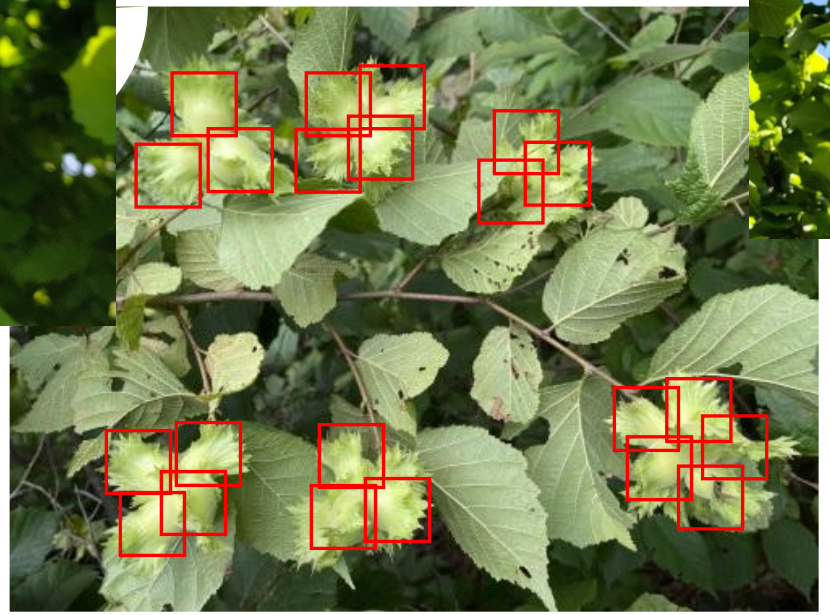
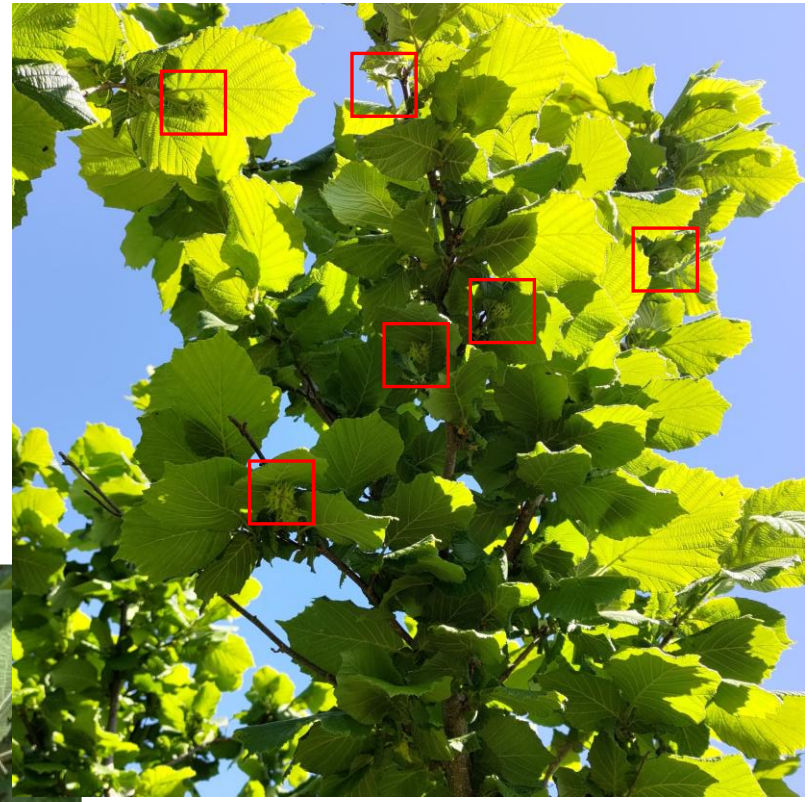
Green Nut







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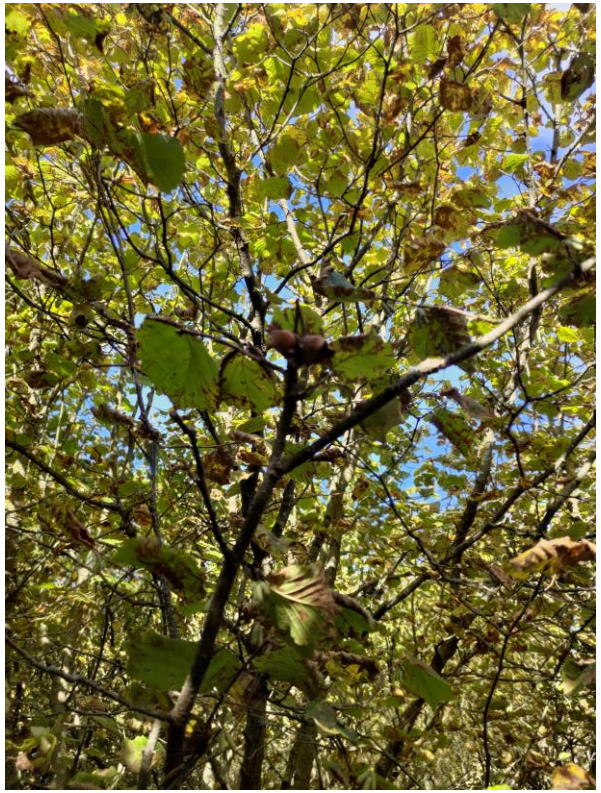
Matured Nuts



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Year 1

Design of tree variability for data collection

- 3 Varieties, Lewis, Barcelona, and TBC, 6 trees each
- Each tree is divided into 4 regions with the tree trunk being the centre
- 2 branches (new growth) is tagged in each region (8 in total)
- 18 trees tagged, with total of 144 branches (new growth) being tagged.

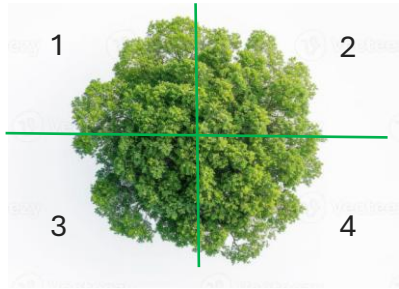

Image Collection

- *Image Set 1*: Take close-up, focused images of each new growth branch
- *Image Set 2*: For each of the four regions per tree, take two images with a field of view covering approximately a 1x1 meter square area.

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Findings

Challenges in identifying

Flowers

- Small and sparse
- 3-Dimensional tree canopy
- Flowering period is long (6 weeks), and bud burst are not at the same time

Hazelnuts

- Heavy Leaf occlusion

Solutions:

- Sampling with calibration. Focus on new growth shoots
- Monitoring over the flowering period
  - Statistical calibration
  - Tracking flower buds
- Train the model to detect flower buds in various lighting conditions, including shadows and slightly blurred images

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Next Steps

On Going Data collection –

- Green Nuts Dec 2025
- Matured Nuts Feb/March 2026

Data processing and AI model training

- Flowers and nuts

Re-design with growers if necessary

- Develop use cases with growers and design mobile app interface
- Trial improvement for next season

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Summary

Tools for counting objects in flower-to-nut conversion

Outcomes: ***Optimising*** *Hazelnut Production: From Flowers to Nuts*

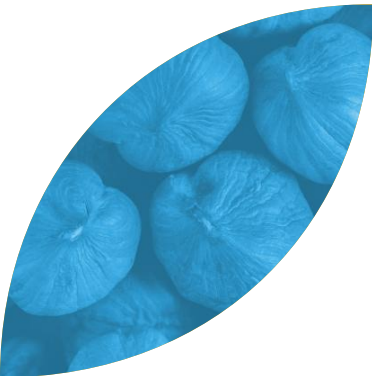
- Counting tools are used by industry (towards yield and quality).
- Collecting data advances our understanding of nut growth
- Optimising nutrient, water supply and/or other orchard practices.

Approach: ***Workflow and tools* for** Flower and Nuts Counts

- From canopy images
- Low-cost hardware (Smart phone)
- Image collection protocol
- AI based flower and nut detection

Outputs for the AUS Hazelnut Industry:

- Flower & nut counting App for Smartphones
- Protocol and video how to use the app
- Workshops to discuss (i) development and (ii) how to use of the App



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Thank you