The Australian Hazelnut Program of Research: a $4 million program to accelerate industry growth.

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Abstract

The Australian Hazelnut Program of Research (AUSHAZ) is a five-year-long, multi-agency consortium program. The aim of this program of research is to grow Australia's emerging hazelnut industry in a sustainable manner so that current growers are incentivised to expand production area and benefit from greater yields, product quality and profitability. Correspondingly, new entrants to the industry will be encouraged. This is being achieved by carefully targeted research effort to address key technical and knowledge gaps that have previously constrained industry growth. Guided by the Australian Hazelnut 2030 Strategic Blueprint, the AUSHAZ will deliver research across multiple disciplinary fields. This paper will provide an overview of the program's three themes. ***Theme 1*** *addresses key knowledge gaps in production to improve overall production outcomes. Major projects focus on irrigation and fertiliser optimization, AI technology to understand and manage flower phenology and crop load, and the impacts of diseases.* ***Theme 2*** *is establishing a benchmarking framework that will include mapping the location and extent of all commercial hazelnut orchards across Australia. Linked with relevant grower, processor and marketer metrics, this foundation will underpin quality standards, sustainability frameworks, production forecasting, and resilience to biosecurity threats and natural disasters.* ***Theme 3*** *is evaluating and delivering new knowledge to growers, including the dissemination of information on innovative technologies for biosecurity and on-farm nut drying and highlighting opportunities arising from the advancements in the production and benchmarking themes. The AUSHAZ program represents a total research investment of AUD4.2 million, with a cash commitment of $2.0m by AgriFutures Australia. It began in 2024 and draws industry members (Hazelnut Growers of Australia Inc, Fourjay Farms), private research providers (Lincoln Agritech, ERM Australia Consultants), and leading university researchers at Charles Sturt, Melbourne, New England, New South Wales, and Central Queensland.*

Keywords: Hazelnuts, flower phenology, crop load, nutrition, fertiliser, diseases, pests, sustainability framework, benchmarking, irrigation, Artificial Intelligence (AI), biosecurity, drying, mapping, quality, value-adding, food science.

INTRODUCTION:

Although hazelnuts were introduced into Australia in the 1880s (Law, Somner and Co, 1886) they have not become developed to match the scale of other nut industries such as almonds and macadamias. Several orchards were established in the 1920s in the Ovens Valley, Victoria (Prescott, 1937), but, over time, these were removed in favour of tobacco growing. During the 1970s, several growers and government institutions imported varieties from Europe and Oregon, USA. In the 1990s, the Commonwealth government, through the Rual Industries Research and Development Corporation (RIRDC), provided funds for an evaluation of hazelnut varieties in southeastern Australia. Field experiments were established in New South Wales, Victoria and Tasmania. Data was obtained on tree growth, floral phenology, nut yields and kernel quality (Baldwin, 2015).

Hazelnuts are generally considered to be a cool climate crop. However, climate modelling by NSW Agriculture (Simpson, 2016) indicated they could be grown in warmer areas with irrigation, such as in the Murray and Murrumbidgee irrigation districts. Despite this, field work in that environment showed that pollination was unreliable (Simpson et al. 2022) and Australia's largest hazelnut plantation, that had been established at Narrandera in the Murrumbidgee district, proved to be economically unviable and was removed (Doak, 2023).

Notwithstanding that event, there has been a steady development in the hazelnut industry over the last 20 to 30 years, with an increase in the size of orchards, improved yields and greater mechanisation. In 2022, the Hazelnut Growers of Australia (HGA) released the 'Australian Hazelnut 2030 Strategic Blueprint' for industry development and sought funding from AgriFutures Australia to implement this plan.

AgriFutures Australia has partnered with the Hazelnut Growers of Australia Inc to fund The Australian Hazelnut Program of Research (AUSHAZ). The program being led by Charles Sturt University, consists of 11 projects addressing key themes identified within the Australian Hazelnut 2030 Strategic Blueprint. This paper outlines the key objectives of the projects being undertaken and reports selected early finding.

Theme 1: Promote efficient and sustainable production systems.

Theme 1 lead: Dr Jason Smith, Charles Sturt university.

Theme 1 delivers research focused on efficient and sustainable growing practices. Integrating desktop studies and agronomic research to address knowledge gaps in production and deliver practical advice to enhance production both on and off farm.

Project 1.1. Crop load management.

Project lead: Dr. Armin Werner & Dr. Jeffery Hsiao, Lincoln Agritech

The development of methods for the analysis of parameters that influence the phenological conversion of flowers to nuts in hazelnuts is critical for the enhancement of the understanding of crop load. Automated counting of flowers and the identification of those that develop into nuts provides a significant opportunity in production management. The development a tool that helps hazelnut growers understand the conversion rate from flowers to nuts, enabling them to make informed decisions for various relevant orchard management practices to optimise yield and improve orchard efficiency is the ultimate objective. The project output will be smartphone-based tool for estimating the number of flowers and nuts in a hazelnut orchard.

Box 1.

Work in project 1.1. is generating a better understanding of the phenology of nut production, commencing with female flowers in the depths of winter. A standard operating procedure has been developed for capture of images using a standard smartphone camera. Images are being captured from locations such as Orange, NSW (a significant hazelnut production area) and will be used to 'train an artificial intelligence (AI) tool that will be able to identify and count female flowers automatically. This will allow the development of a smartphone app that will allow a grower to accurately forecast later nut yield. Orchard management practices, such as pruning to manage wood density offer scope to maximise nut yields. (Photograph credit: Geoff Gurr)

Project 1.2. Nutrition and irrigation

Project lead: Dr. Jason Smith, Charles Sturt University.

Optimising seasonal nutrient and water requirements in hazelnut production systems is important for maximising yield and sustaining the long-term cropping capacity of orchards. This in turn requires tools to monitor nutrient and water availability, and the knowledge to refine fertilizer and irrigation practices based in this information. From a combination of research and demonstration sites in NSW this project will collect baseline data on tree nutritional status and soil water dynamics to the depth of the root-zone. Fertilizer treatments will then be applied to test the capacity to increase tree growth and yield based on results of plant tissue analysis, and water supplied varied to characterize the link between soil-based water measurements and tree responses. The outcome will be recommendations that enhance yield and provide growers with improved capacity to manage orchards through variable seasons and climate extremes.

Project 1.3. Reproductive development.

Project lead: Dr. Jason Smith, Charles Sturt University.

This project will review the current information on the tree and environmental factors that may interfere with the reproductive outcomes of hazelnuts. Through analysis of existing literature, key influences on hazelnut reproduction and in particular climatic variability, will be identified. Available information in the literature will be combined into one piece for easy consultation by growers and other industry stakeholders.

Project 1.4. Creating a sustainable hazelnut industry: understanding the impact of disease on varieties and propagation material.

Project lead: Prof. Sandra Savocchia of Charles Sturt University.

This project aims to understand and document diseases that threaten the hazelnut industry as it grows. It will review existing information to identify risks, management strategies, and future research needed for a sustainable industry. The goal is to provide hazelnut producers and nurseries with information on managing diseases to reduce crop loss. Key outcomes include fact sheets and publications for growers, and a better understanding of diseases affecting common hazelnut varieties.

Box 2.

Australia is free from several diseases that damage hazelnut orchards overseas, such as Eastern Filbert Blight caused by *Anisogramma anomala* in north America, Bacterial canker and dieback caused by *Pseudomonas amygdali* pv. *corylicola* (*Pac*) and *P. syringe* pv. *avellanae* (*Psa*) in Europe, and the aggressive powdery mildew associated with *Erysiphe corylacearum* in Europe. These pathogens have been identified as biosecurity risks to the Australian hazelnut industry, along with a few others such as *Pucciniastrum coryli*, *Phytophthora ramorum* and *Cryptosporiopsis tarraconensis* (Plant Health Australia, 2024).

Theme 2: Developing a Benchmarking Framework for the Hazelnut Industry.

Theme 2 lead: Dr. Pangzhen Zhang, University of Melbourne

Theme 2 seeks to develop a benchmarking framework that defines standards for comparing and evaluating industry performance, based on a robust statistical foundation. An industry specific sustainability framework supports growers, processors and marketers to strengthen the promotion of their industry.

Project 2.1. Development of an Australian Hazelnut Sustainability Framework.

***Project lead: Alan Dayeh, ERM Australia*.**

Drawing from insights gained across the Australian Hazelnut Program of Research and building on the principles of the sustainability frameworks for Australian Agriculture and Horticulture, this project will facilitate the design a sustainability framework specifically for the Australian hazelnut industry and its growth aspirations. By reviewing environmental and social topics, outcomes of other projects in the program, documenting industry practices, and engaging with stakeholders, the project team will develop an Australian Hazelnut Sustainability Framework roadmap and industry specific indicators to guide the industry towards sustainable practices over time.

Project 2.2. Spatially enabling the Australian Hazelnut industry.

Project lead: Craig Shephard and Prof. Andrew Robson, University of New England.

Mapping the location and area of all commercial hazelnut orchards in Australia (>1 hectare) will provide important baseline data for understanding current industry extent as well as subsequent annual changes in production area. When coupled with benchmarking data from growers and processors, this comprehensive industry data set will support decision making around market access, traceability, biosecurity, and yield forecasting as well as build industry resilience to climate variability. In addition, this will align the hazelnut industry with other Australian horticultural tree crops by integrating with the Australian Tree Crop Dashboard –

https://experience.arcgis.com/experience/6cde8c0467e542398fb0afd1dde48a73/

Project 2.3. Understanding the current status of Australian hazelnut production and development of a real-time management platform of industry data.

Project lead: Dr. Pangzhen Zhang, University of Melbourne.

A comparative analysis of hazelnut orchards for various factors, such as farm income, costs, and yields, will help identify best practice and provide an action plan for improvements in orchard management. This will be supported by the development of online software allowing growers to regularly monitor and update their benchmarking and practice data.

Project 2.4. Developing quality standards for hazelnut primary and by-products. ***Project lead: Dr. Pangzhen Zhang, University of Melbourne.***

This project aims to set consistent standards for measuring the quality of raw and processed hazelnuts and their by-products. By analysing the appearance and composition of hazelnuts grown under different conditions, and processed using various methods, the establishment of industry standards will enable the consistent categorisation of hazelnuts sited to different market segments, leading to enhanced trust in the supply chain.

Theme 3: Driving industry growth through innovation and integrated communication and engagement.

Theme 3 lead: Dr Ben Stodart, Charles Sturt University

Theme 3 addresses several challenges identified by the industry. Focusing on innovations in nut drying and biosecurity, the aim is to deliver information on innovative technologies to the industry. Integrated within this theme are the communication and engagement strategies that, alongside HGA Inc., will deliver new knowledge to growers, and highlight opportunities arising from the AUSHAZ program.

Project 3.1. Hazelnut drying and optimise for sustainable processing. ***Project lead: Dr. Yong Wang, University of New South Wales.***

Dr. Wang's team will undertake research and development activities to identify suitable drying techniques for hazelnut varieties grown under Australian conditions. Their goal is to find drying methods that improve product quality, save energy, and can be scaled up for larger operations, thus delivering validated protocols to aid the industry consistently achieve high-quality post-harvest processing.

Project 3.2. Implementing an integrated communication and engagement strategy for industry growth, innovation and sustainability.

Project lead: Dr. Ben Stodart, Charles Sturt University.

This will provide the conduit between research providers and the research end users, a two-way communication stream with the ability to respond to growers wants while providing the pathway to the delivery of outcomes stemming directly from AUSHAZ. Providing collaborative access to enhance the existing knowledge networks, harnessing innovative solutions with a productivity focus, the communications and extension project provides the avenue to highlighting sustainable production practices, value added products, and a grower network linked to research providers, essential elements for industry expansion.

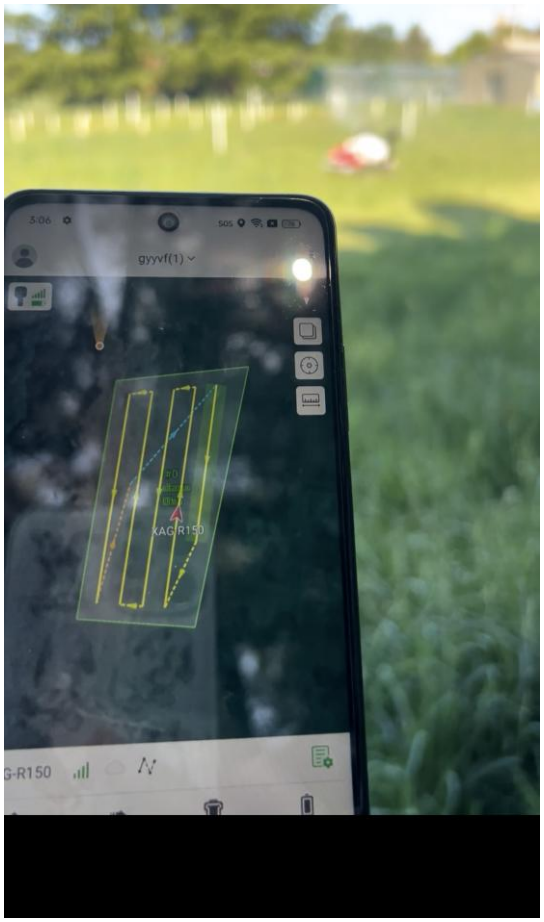
Project 3.3: Recent advances in technologies for optimised biosecurity in hazelnut orchards

Project lead: Dr. Jian Liu, Charles Sturt University.

This project involves an assessment of the latest technology and tools for the detection of diseases and arthropod pests and will determine their potential for adaptation to benefit the hazelnut industry The key outcome will be the complete understanding of the performance of biothreat detection tools and their effectiveness in detecting and combating those considered important for hazelnut production systems.

Box 3.

Rapid technological advances in fields such as robotics and AI are making a new generation of tools available to detect, monitor and even manage biosecurity threats. Project 3.3 is evaluation a range of commercially available technologies for use in hazelnut orchards, The activity of an autonomous ground vehicle (background) is tracked here using a smartphone interface (foreground).



CONCLUSION:

The Australian Hazelnut Program of Research is now entering its second year of activity and most projects have commenced activities in the field, in laboratories, and in undertaking data capture from growers and the public domain literature. Work is being reviewed by an Industry Advisory Panel that includes national and international stakeholders from production- and processing-related industry members, government agencies and researchers. The author team welcomes contact from the international hazelnut community to share ideas and results and explore opportunities for collaboration.

ACKNOWLEDGEMENTS:

This project is supported by funding from AgriFutures Australia as part of the AgriFutures Emerging Industries Program.

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