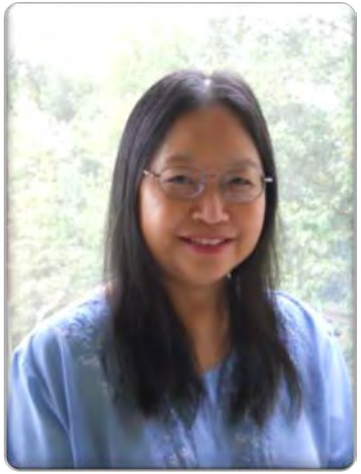
Dr Chin Gouk



Senior Plant Pathologist, Department of Primary Industries, Victoria

Dr Chin Gouk is a senior plant pathologist with the Department of Primary Industries, Victoria. DPI has a lead agency role for almond research, development and extension in the National Horticultural Research Network. Chin has a Bachelor of Horticultural Science (1st Class Honours) and a Ph.D in Plant Pathology (Lincoln University, New Zealand).

Chin has over 20 years R&D and consultancy experience working with agricultural industries in Australia and New Zealand. She has led national and international collaborative projects in microbial ecology and detection, disease epidemiology and prediction, and development of integrated disease management systems for temperate horticultural crops. Chin has held the role of Program Manager for research projects, and was Section Leader for DPI's crop health diagnostic service, managing quality assurance for ISO and AQIS accreditation. She has ten years research and consulting experience on almond plant health and production issues. She currently leads a Horticulture Australia Limited/ABA research project on almond food safety.

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Australian Almond Conference 2012

Abstract

Remote Profiling of Almond Stockpiles

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The almond industry has undergone rapid expansion in recent years. Production volume has increased and will continue to grow with more young trees coming into production. The increased production volume on some orchards has led to harvested nuts being stored for various periods prior to dehulling and shelling. Californian research and Australian industry experience has suggested that in-field storage may subject dried nuts to environmental conditions that lead to increased moisture content in nuts, an important factor for microbial growth and nut deterioration. However, no data is available on the environmental conditions in stockpiles in almond production regions in Australia.

A sophisticated system for monitoring stockpile temperatures and relative humidity was designed and tested in 2012. The system was evaluated against a set of criteria that included the capability for remote monitoring, the performance of sensors and data cables under various pressures and field conditions, and the capacity to monitor a wide area or long lengths of stockpiles. An array of sixteen smart sensors that relay data through interconnecting cables to a single datalogger, was installed at four depths at four different positions within a stockpile of nuts up to 100 m in length and 5 m in height. Weather and stockpile conditions were logged at five minute intervals between May–July 2012, during post-harvest storage. Data were successfully transmitted and downloaded from a distance of 1600 km.

The system was shown to meet the application requirements. The modular array of data cables and layout allowed flexibility for monitoring exterior and interior environmental conditions in stockpiles of various areas, heights, depths and lengths. The extensive capacity of the datalogger will enable monitoring of up to 200 sites in different stockpiles, and the total length of 2 km of data cables will enable monitoring of different stockpiles or orchards at distances apart.

The sensors and cables withstood pressure from a stockpile load of at least 5 m deep. Sensor performance was not affected when they were buried in a matrix of nuts, soil, grit, dust and debris, or by associated wetness. The system has enabled accurate measurement of environmental conditions in almond stockpiles, and demonstrated different fluctuations in temperature and humidity within stockpile of various depths. Further features, applications of the system and associated profiling of nuts within stockpiles are discussed.

Profiling Almond Stockpiles - Better Food Safety

Chin Gouk
Department of Primary Industries, Victoria

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Almond Food Safety

- A HAL project (AL11009) with co-investments from the Almond Board of Australia, Horticulture Australia Limited, DPI Victoria, and CSIRO

Overall objectives:

Improve understanding of biotic and non-biotic factors influencing almond quality and safety and develop strategies to minimise potential risks across the value and supply chain.

Sub-projects

1. Microbial infection risks –

   What? When? Where? How?
2. Role of diseases and mummies in microbial and insect infestation
3. Phenology and incidence of carob moth

4. Factors affecting nut quality & safety
5. Stockpile management strategies
6. Identify critical control points and develop strategies to enhance nut quality and safety

Outcomes

- Improved understanding of key factors
- Smart sensor technology transfer
- Moth monitoring technology transfer
- Enhanced nut quality & safety
- Improved storage management
- Minimised contamination risks
- Reduced pre and post harvest losses

Aspergillus & Aflatoxins

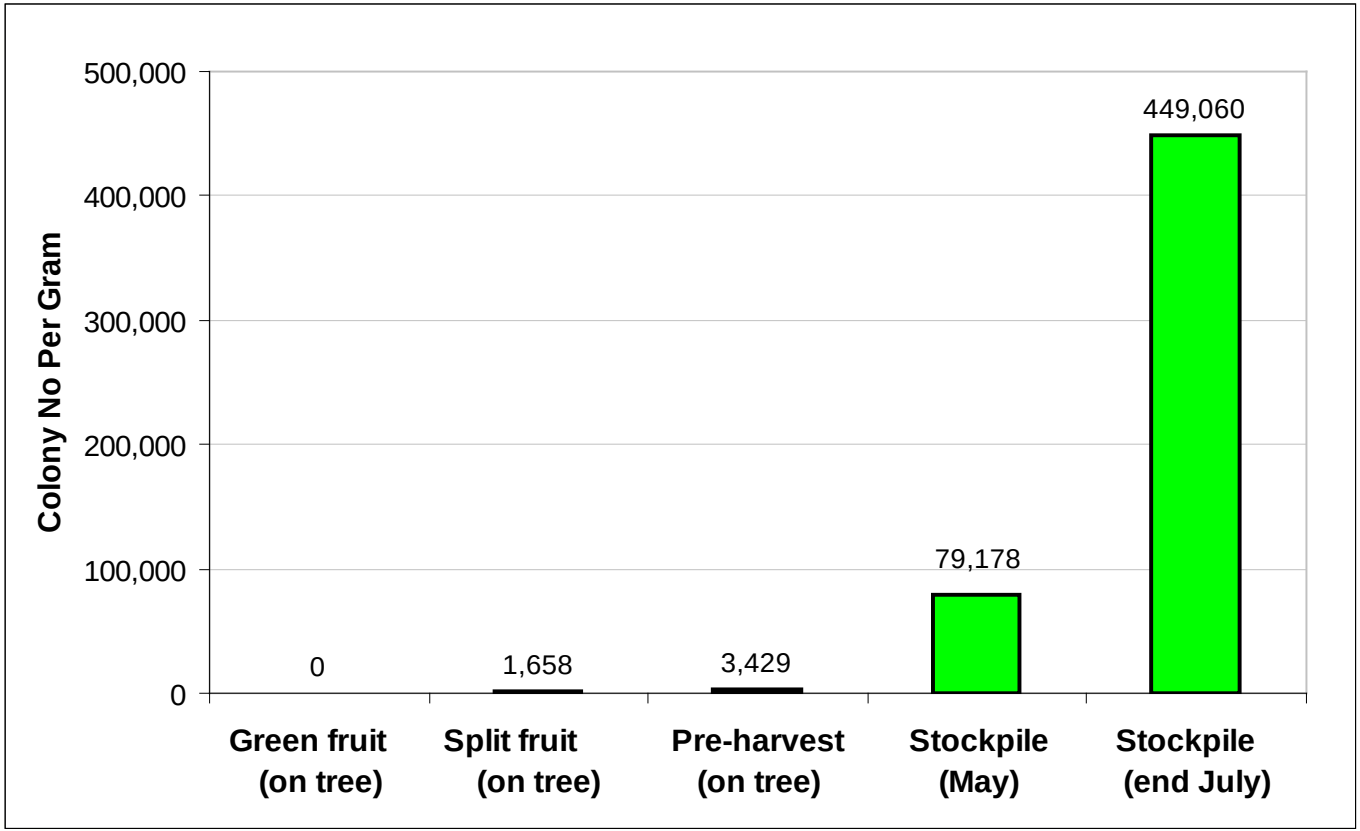
- Ubiquitous fungi
- Large spore numbers
- Survives well
- Wide temperature range:

  12–48°C

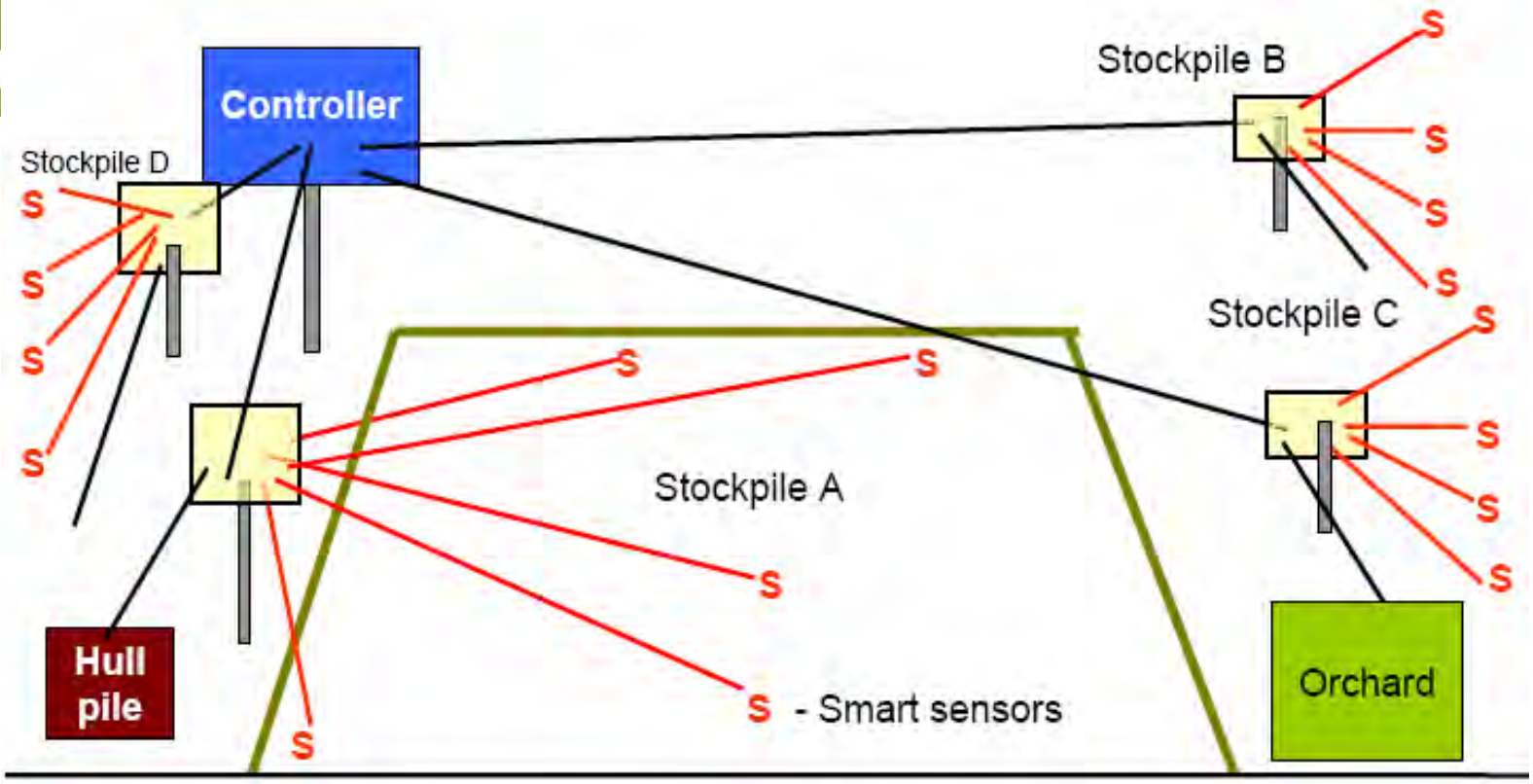
Aflatoxins

- Toxic at low levels, heat stable,
- No smell, no taste

Estimated *Aspergillus* Numbers: Dec - July



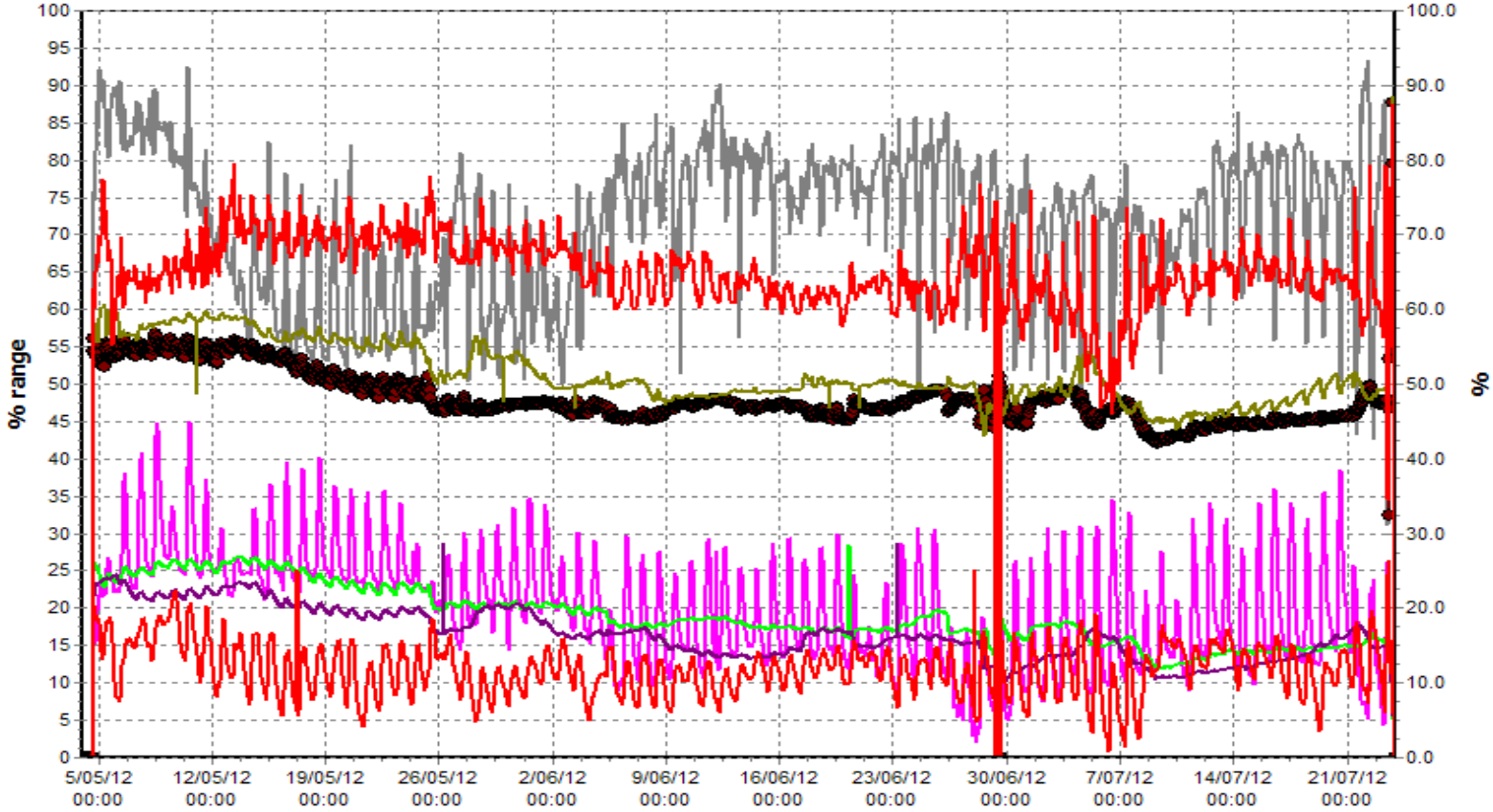
Modular Smart Sensor System



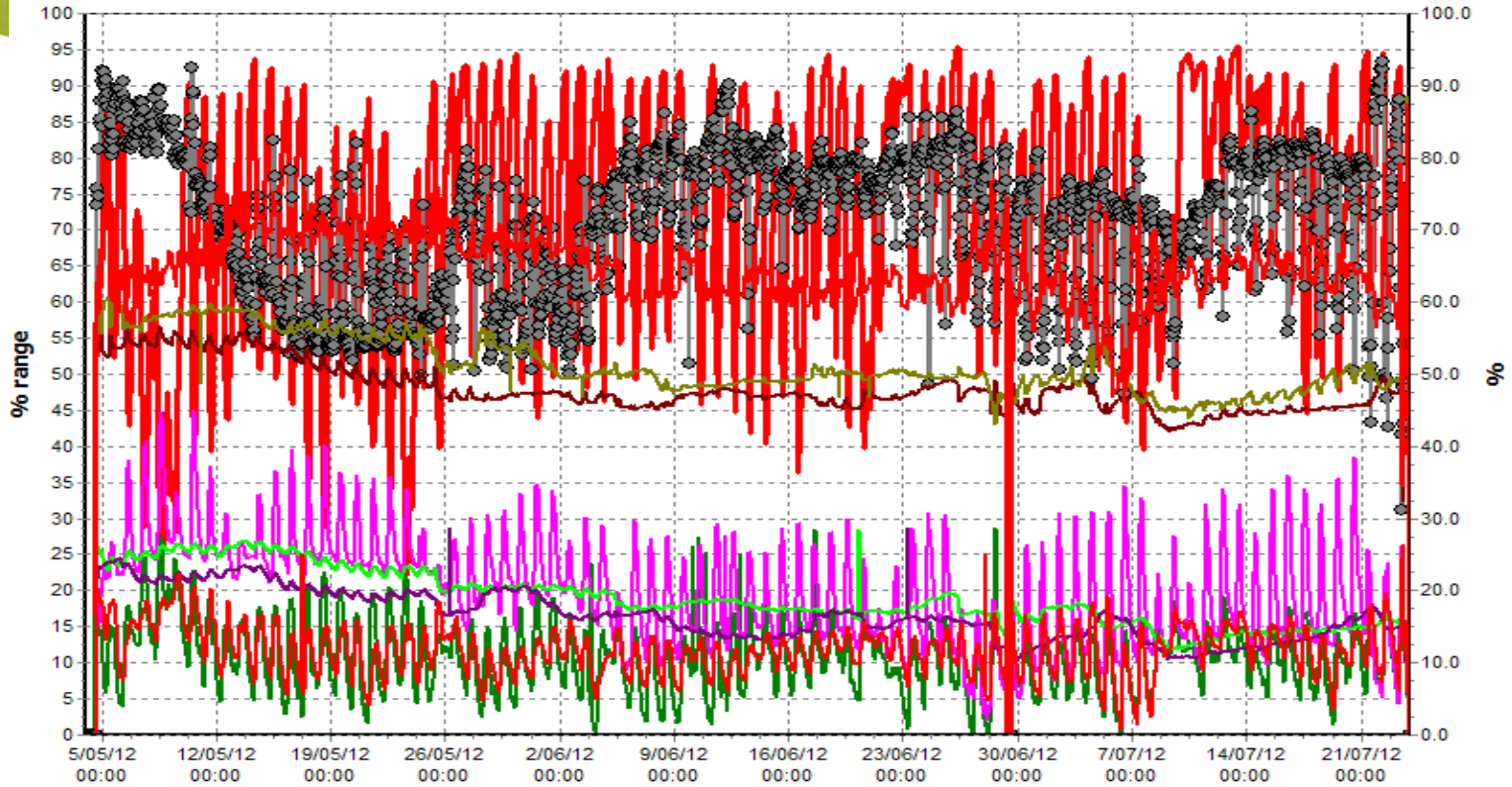
Smart Sensors: Applications

- Stockpile profiling
- Storage conditions
- Nut moisture monitoring
- Targeted drying
- Weather monitoring
- Orchard & soil monitoring
- Insect heat unit accumulation

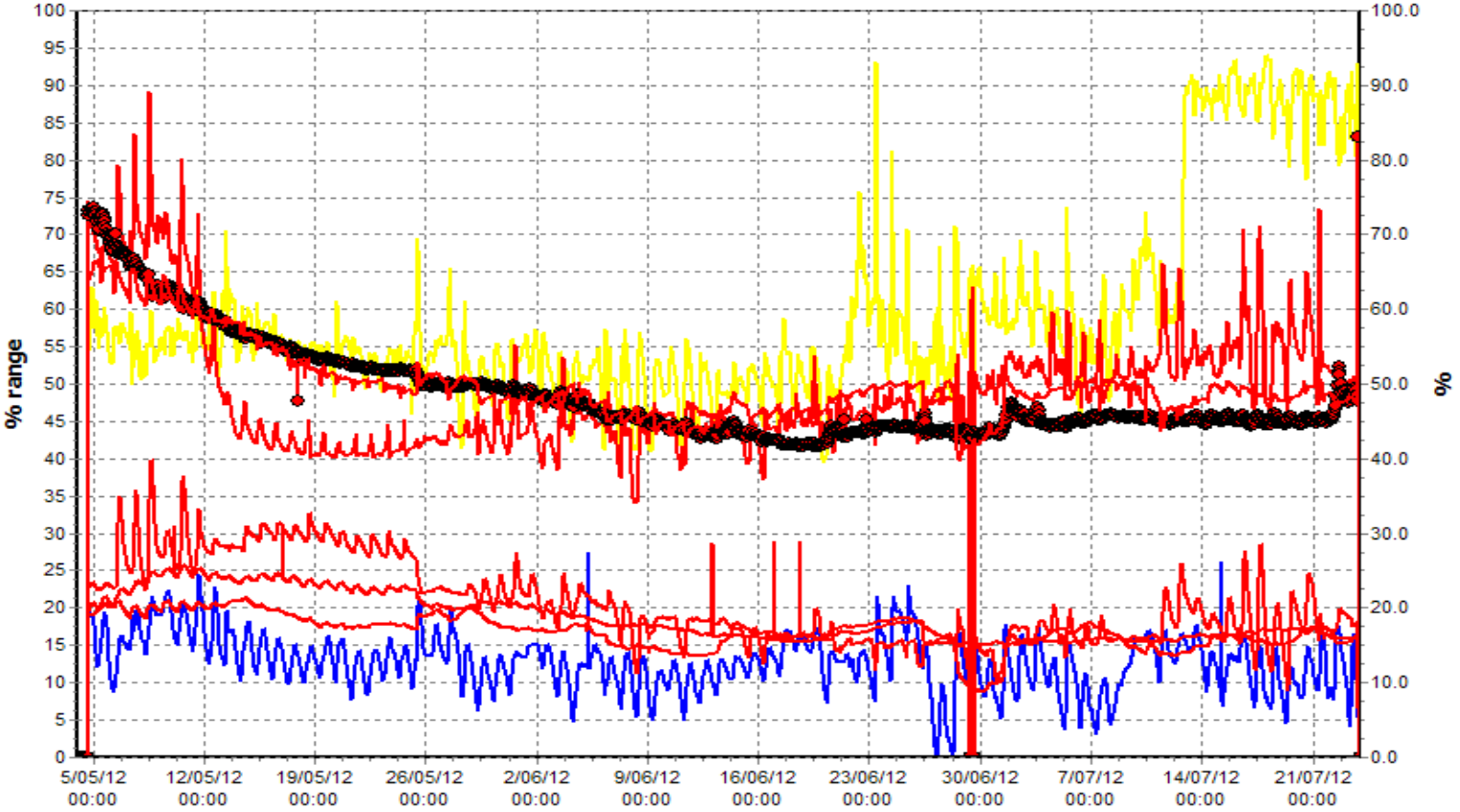
Temperature and RH Profile



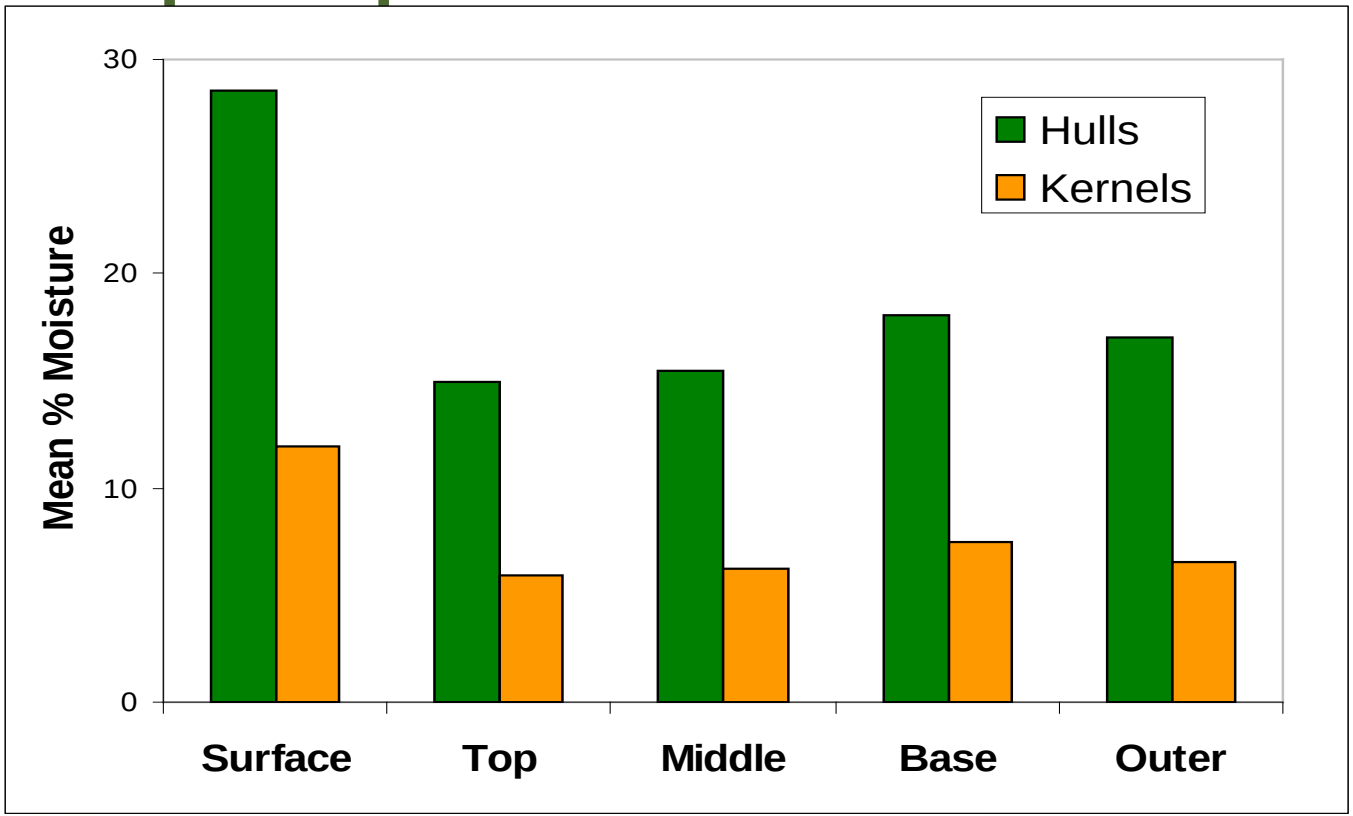
Weather Fluctuations



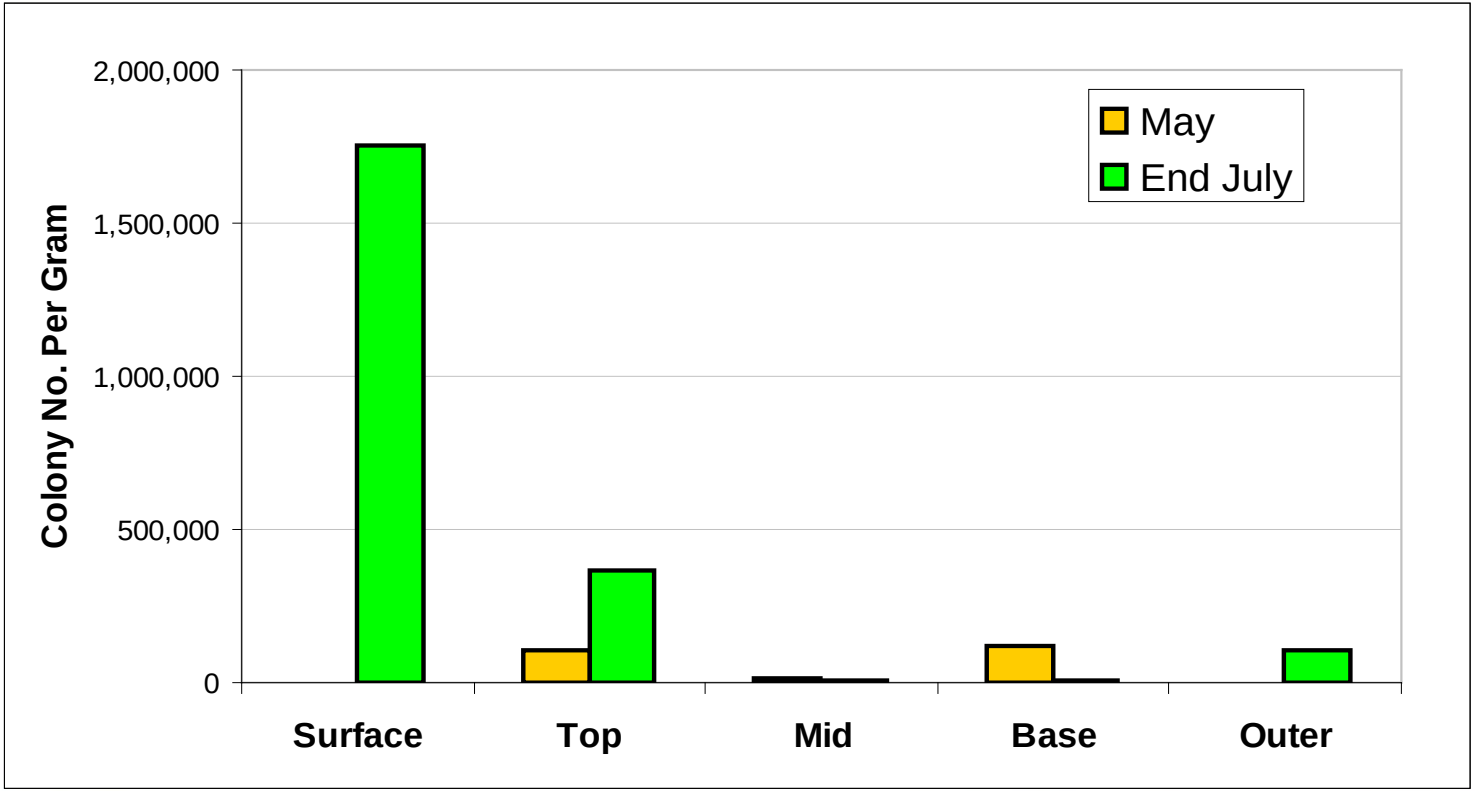
Temperature and RH Profile



Nut Moisture Contents at Different Stockpile Depths



Estimated *Aspergillus* Numbers at Different Stockpile Depths



Key Findings

- Moisture favours microbial growth
- Harvest and post harvest conditions are critical
- Wet conditions pre-harvest conducive to hull rot
- Hulls, shells and kernels need to be kept dry
- Dried hulls absorb moisture when wetted
- Split hulls and cracked shells allow infection
- Any damage to kernels provides pathway for infection

Key Findings

- Smart sensor technology profiles fluctuations in stockpile conditions
- Longer stockpiling duration, longer exposure
- Need to prevent moisture and high humidity

Additional Challenges

- Large numbers, multiplier effect
- Re-distribution of spores by processes
- Common in the environment
- Survive well
- Symptomless appearance
- Sensitive analytical detection

Critical Control Points

In Field

Minimise risks: Pre-stockpiling

- Sanitation before shaking
- Sweep up before re-starting irrigation
- Check leaky irrigation pipes, damp ground, low lying areas
- Leave/segregate wet nuts
- Minimise insect infestation
- Remove mummies – hull rot
- Ensure nuts are dry sufficiently before stockpiling

Hot (Damp) Spots

Minimise risks: Stockpile Management

- Store damp nuts separate from dry nuts
- Process damp nut piles first
- Fill troughs & depressions when building stockpile
- Fumigation – how soon, how effective?
- Minimise condensation run-off points

Minimise risks: Stockpile Management

- Inspect stockpile – hot (damp) spots
- Monitor stockpile/storage conditions
- Ventilate stockpiles
- Avoid large temperature fluctuations
- Which cover type? – Least condensation
- Remove mouldy nuts during long storage

Minimise Risks: Pre-processing

- Segregate quality nuts from spoilt nuts
- Additional sanitation steps
- Inspect stockpile hot spots - ridge, contact points, troughs, ground level
- Discard mouldy nuts – white, green, blue, pink, yellowish, black, soggy or damp patches
- Reduce spore re-distributing in the processing plant & environment

Minimise risks: Capability & Feasibility?

- Dehull and shell asap
- Shorten storage time as much as possible
- Store nuts without hulls ?(Less bulky, less risk of hulls re-absorbing moisture)
- Minimise contamination on the ground
- Additional drying
- Silo, shed, other types of covers – efficacy?
- Pasteurisation – efficacy vs local situation?
- Other kill steps / technologies

Project Collaborators

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- **A. Hocking, J. Pitt** (Mycologist consultants)

  Animal, Food and Health, CSIRO, North Ryde, NSW.

- **B. Brown** (Industry co-ordinator)

  Almond Board of Australia

- **Almond growers and processors**

Acknowledgements

Almond Board Australia

- Almond growers
- Processors

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