

# Potato storage technology

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# Background

NEPG: Annual EU potato production averaged 51.8M tonnes in the period 2017-2021. This excludes the United Kingdom, where production averaged a further 5.4M tonnes over this time.

Storage represents a significant proportion of this tonnage, especially in NW Europe. For example, in the UK, the potato industry stores around 55% of its production to provide a year-round supply for seed, fresh and processed markets.



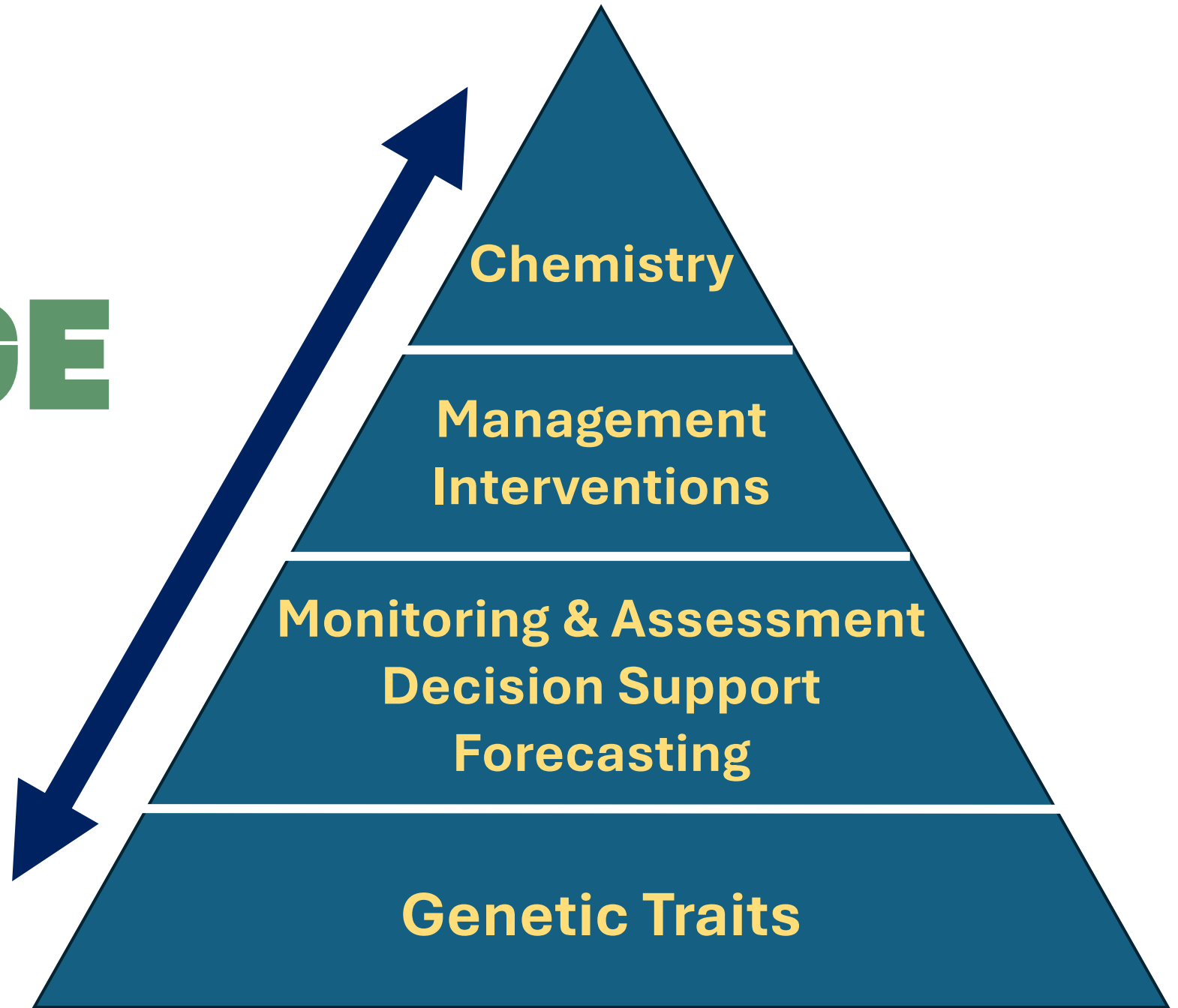
# Storage

Remember! We are dealing with a living crop!

**Our objective:** To retain a supply of potatoes, with the crop's integrity and qualities maintained, with a minimum level of loss and to do so without unnecessary (and costly) intervention.



# POTATO STORAGE



# Genetic traits

- The potato is ‘designed’ for storage. We are starting from a good place!
- Must better select cultivars for storage; this is key to reducing waste
- Especially for attributes that help us store with reduced risk
  - **Disease resistance** is a primary requirement
  - **Dormancy** is also a key factor but often not prioritised
  - **Processing: sugar stability** is an important need
  - **Ethylene sensitivity?**
  - **Nutritional profile...**



# Seed storage

- Good quality seed is crucial to successful potato production
- Must focus on storing seed well to minimise disease
- **Seed stores need good, drying ventilation and temperature control** ▶
- Models focusing on better storage of seed to improve quality (e.g. Kenya work of Derek Roulston and Ian Barker) has worked well



Univ of Idaho seed potato research, USA (PNT)



Seed in storage (Potatopro.com)



# Monitoring, Assessment, Decision Support, Forecasting

- **Unexploited but huge potential** remains to refine potato store management...
- Sensor 'revolution' could be aiding monitoring and assessment...
- Data acquisition improves our understanding/forecasting accuracy
- Better prospects for successful long-term storage. Less risk!
- Lots of attributes we can measure in storage: temperature, humidity, carbon dioxide, crop weight loss, moisture levels, energy use/ ventilation hours – all can offer the store operator guidance



# Decision support

- Shortage of expertise globally
- Accurate, relevant information and data enables managers to make better decisions ►
- Need to provide help which is contextual and relevant to the potato store and crop
- Good user-interface is key!





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SOURCE: OMNICURO / ACT-20 /  
ACT-40 (Omnivent NL)

## AT THE END OF THE DAY

Set the program to **'Manual'**

### Outdoor conditions suitable

Temperature around product temperature

Dew point difference < 0.5 °C



Start with **external ventilation** (inlet 50%)  
for 5 hours, use Time Blocks.



# Management interventions



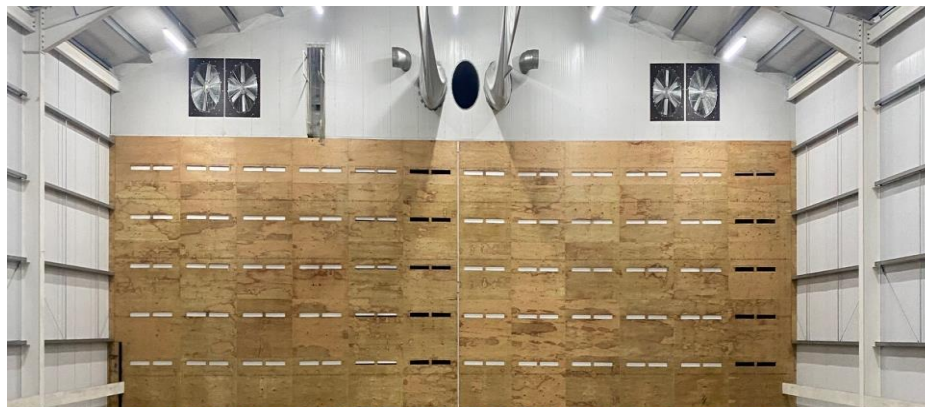
French Klim'top system in Ireland



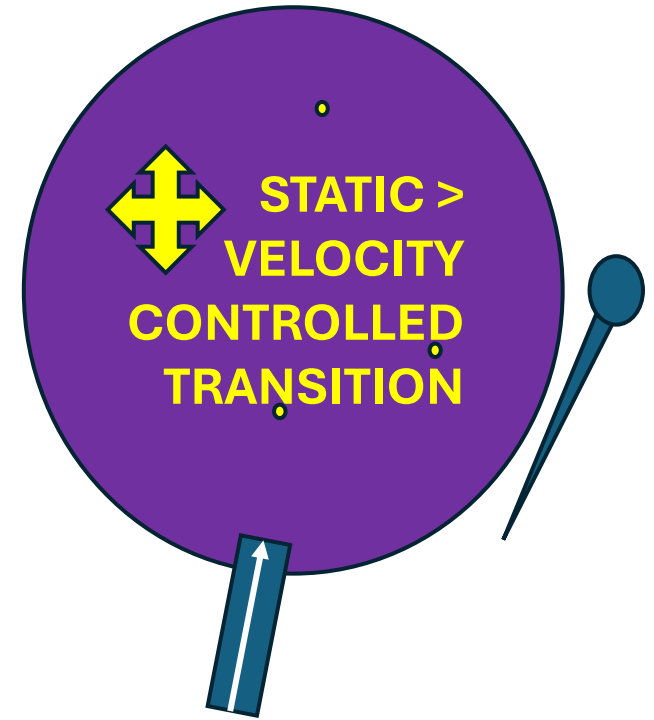
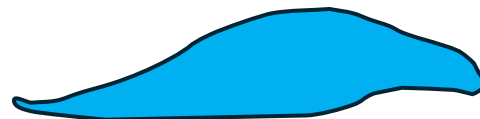
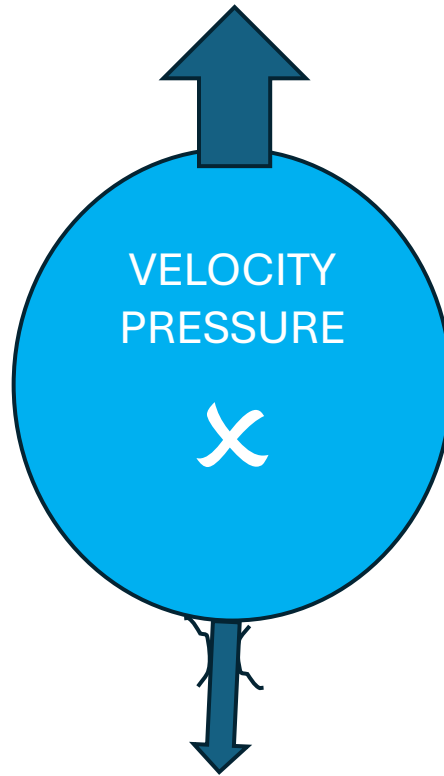
- Drying, using ambient air, is the key management intervention to keep potatoes in good condition.
- Traditionally cooling with ambient air has also been the simplest way to stabilise potatoes in store in temperate climates.
- In many countries, mechanical refrigeration is also being widely adopted.
- **Most potato stores generate heat** and, to keep conditions cool and uniform enough to prevent problems like condensation, we must use ventilation (or refrigeration).
- This ventilation must be evenly distributed - even in the smallest store.

# Air distribution

- When you go into a potato store look for where the store ventilation system can build up **static pressure** to deliver air to the crop **evenly**
- This might be a bulk duct system, the perforated bases of some boxes or a simple plenum chamber
- Without somewhere for this to happen, air distribution will generally be poor. If air can short-circuit, it will...



# Where's the balloon?!!



# Global stores



pictures courtesy Nora Olsen

# Management interventions

- Many of these stores don't have any controlled pressure transition
- Lack of a uniform airflow leads to temperature variability and condensation.
- Free moisture on the crop can quickly cause soft-rotting and this commonly results in catastrophic losses

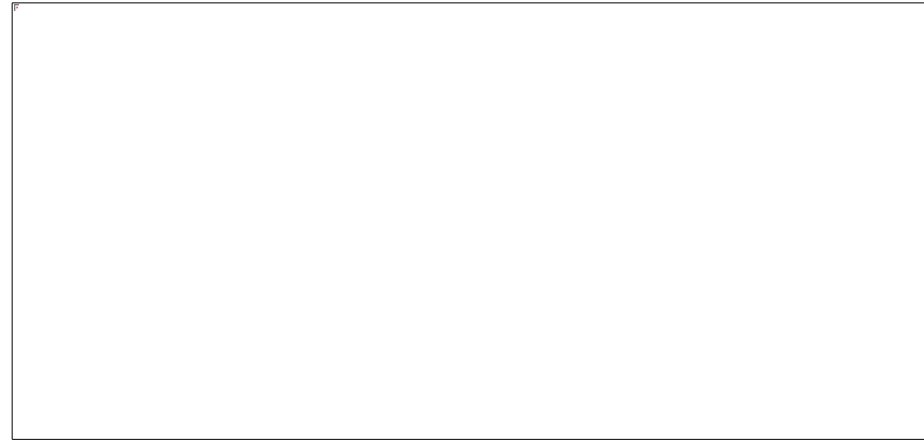


Source: WA Government,  
Australia

# Alternative control



## SOLAR



- Controllers such as the Crop Systems *SmartSola*™ from the UK prioritises store cooling when the sun is shining and providing free energy
- If closely controlled, this then uses the potatoes' capability to act as a cold sink to utilise that cooling later to counteract a temperature rise
- Battery technology may make this easier?

# Alternative control



- Carbon dioxide (CO<sub>2</sub>) has become a control parameter in many processing stores driving costly flushing regimes
- But research has shown there is little **direct** impact of CO<sub>2</sub> on fry colour
- A threshold of 5000-6000 ppm is adequate in most situations – **unless** there is **ETHYLENE** being used in (or contaminating) the store.
- If ethylene is present, the CO<sub>2</sub>/ethylene interaction will darken fry colour. Ethylene blockers like 1-MCP currently being trialled.



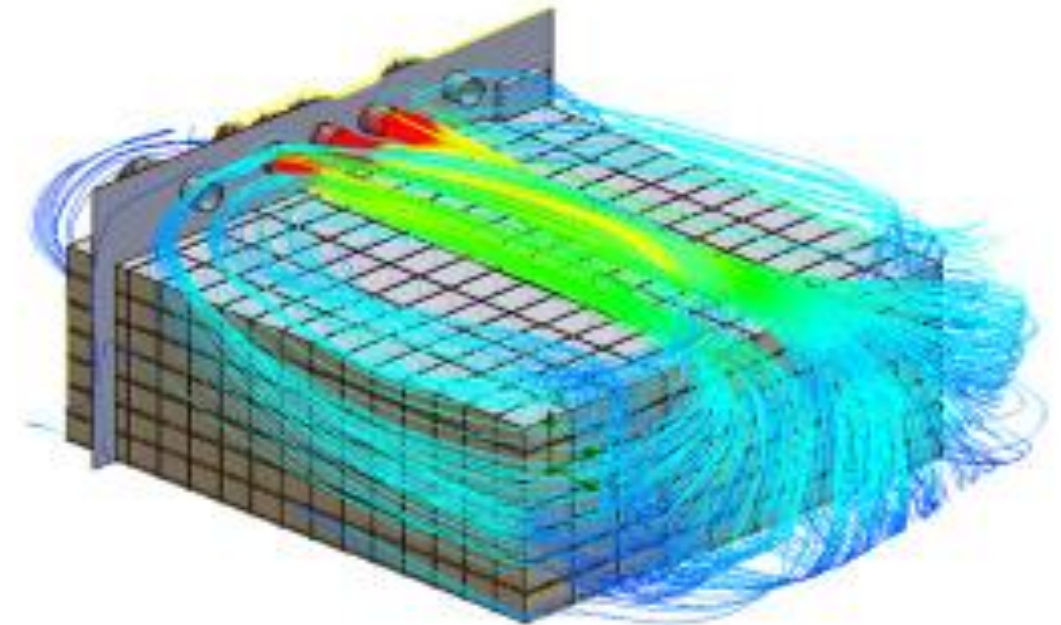
# Storage efficiency

- Fans cost money to run and ventilating potatoes causes them to dehydrate, so weight is lost too
- Efficient stores apply high volumes of air in a targeted way for short periods of time to change the crop condition
- Positive ventilation is crucial; all other systems are comparatively inefficient. But there's a lot we can do to improve space ventilation...
- Metering of energy use should be on an *individual* store basis: every store is different. Allows comparisons and benchmarking! Good systems available for this: energy management tools, IoT



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# Chemistry

- Historical reliance on chemical use in storage: especially for processing
- Fewer fungicides used in stores now?
- Sprout suppressants remain a major input: changing landscape
- Move away from more persistent chemicals by regulators
- No CIPC in Europe and parts of Asia – regulated management of residues
- Stewardship and best practice schemes



## Life after CIPC

**Michelle Knott** considers how the potato stores have coped since the loss of chlorpropham (CIPC), which was widely used to suppress sprouting in stored potatoes. Several alternatives have been gaining popularity in the wake of the ban

**B**EFORE 2020, the majority of potato storage facilities across the EU and UK relied on in-store treatment with chlorpropham (CIPC) to prevent potatoes from sprouting. Several alternatives have since been approved for use, but none of them are quite as 'bullet proof' as CIPC, leading many store operators to upgrade their facilities and/or change the way they work.

"The loss of authorisation for CIPC did have a significant impact upon the potato sector, and in some countries more than others," says Andrew Curtis, director general at the Potato Processors Association. "With limited time to familiarise themselves with the new actives, in the first year there were some major losses in store and the quality of

back on the transition, growers have actually adapted quite well, and they continue to learn year on year. There remain significant costs associated with the various new technologies and CIPC residues remain a real issue that the sector cannot afford to lose sight of."

"One of the things about CIPC was that it was remarkably brutal and remarkably effective, almost regardless of what storekeepers did, and very persistent in the fabric of stores and boxes," explains Nick Tapp, director of Juno (Plant Protection), whose BloxM treatment is based on mint oil. "You could get nearly everything wrong, and it would still work. It made the industry – and I admit I'm being a bit unkind here – a bit lazy in relation to sprout suppression."

across a lot of different scenarios. Now we're having to be a lot more specific in the way we use these other products because they all have their own characteristics that have to be taken into account," agrees Adrian Cunnington, managing director of Potato Storage Insight and chair of the UK CIPC Residues Management Group.

The other issue following the ban is that CIPC is very persistent within the fabric of the stores, leaving potatoes in subsequent years contaminated with residues. This required the EU and UK authorities to set temporary maximum residue levels (tMRLs) for CIPC, so these crops could continue to be placed on the market.

"Obviously, to use CIPC after the ban was out of the question but despite

# Sprout suppression

- Post-CIPC ban in Europe, industry has moved to multiple solutions
- Maleic hydrazide used more, as residual control remains key to success
- In-store applications more challenging ▶
- Ethylene: market-specific solution for some varieties – but more R&D reqd!
- Selection for longer dormancy should still be a goal; progress is slow...



Veugen Synofog applying *Biox M™* mint oil in UK

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- Ethylene: market-specific solution for some varieties – but more R&D required on use with 1-MCP and respiration rate interactions ▶
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# My take aways

- Uniform control of the store environment is essential to reduce condensation and disease risk
- Energy efficiency is key to improving margins: big isn't always better for the potato. Smaller, easily controllable stores are often perform best
- Climate change: more mechanical refrigeration in hot climates
- Raise ventilation rates where cool air is scarce to control rots
- Create more off-grid storage solutions – especially for seed
- Train more personnel and do more storage R&D: lack of capability globally. Potatoes are key for food security so why wouldn't you?



# Acknowledgements

## WPC organisers

**Prof. Nora Olsen, University of Idaho**  
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