

HORTGRO CA ENGINEERS WEBINAR • 3 JUNE 2026

Smaller Tools, Bigger Questions.

Rethinking CA research for industry use.



Josh Kreft

Gas At Site (Pty) Ltd

Your Partner in Fruit Storage



THE ROOM WE LIVE IN

~R16B in pome fruit exports; 52.2M apple + 22.3M pear cartons; ride on decisions made at this scale.

1,200

m³

Typical CA room volume

400

tonnes

Fruit loaded per room

16

Billion ZAR

Pome fruit exports

Every commercial decision happens at this scale. The science behind it doesn't.

THE TWO-WAY SCALING PROBLEM

Research and industry sit at opposite ends of the same question.



SCALE DOWN

Commercial → research

1,200 m³ → 167 L

Can we shrink a commercial question into a vessel small enough to run dozens of treatments in parallel, without losing the answer?



SCALE UP

Research → industry

6 L → 1,200 m³

Does the result from a 6 L desiccator hold up when we're filling a 400-tonne room, concentration, uniformity, safety and all?

Both directions break in different places. That's where the engineering lives.

THE SCALING LADDER

From a packhouse room to a lug of fruit. The tools we use at every rung.

1,200 m³

Commercial CA room

400 t fruit · packhouse scale

24 m³

PHYLA research rooms

Real CA dynamics · research-friendly

610 L

Janny Bin

32 units · cultivar treatments in parallel

167 L

TinyCARR

One lug · CA, DCA-CF, RR, RQ, ethylene

≈6 L

Desiccator

First-pass screening · EF dose-response

Each rung gives up some realism for some control. The trick is knowing which rung answers which question.

PHYLA: THE MIDDLE STEP

Hortgro's Phytosanitary Research Facility · 24 m³ CA rooms.

24

m³ research CA rooms

*Big enough to behave like commercial.
Small enough to experiment meaningfully.*



Real CA dynamics

Pull-down behaviour, CO₂ build-up, CA control mirror a commercial room.



Multiple treatments in parallel

Several rooms = several gas recipes side-by-side, same cultivar, same harvest.



Phytosanitary by design

Built for pest/pathogen work, with isolation, dosing and safety procedures



Closer to commercial, still controlled

Large enough to test distribution and room dynamics for commercial validation.

TINYCARR: ONE LUG, MANY CHALLENGES

167 L gastight container for one lug of fruit (≈15 kg).

WHAT BREAKS AT 167 L

Gas-tightness

A leak rate that's invisible in a 1,200 m³ room overwhelms a 167 L vessel.

Humidity & temperature

Replicating commercial RH and pulp-temp dynamics in a small box is genuinely hard.

Signal-to-noise at low O₂

Tiny gas deltas + sensor accuracy + any leakage = unreliable RQ even if every variable is controlled.

CA

O₂ & CO₂ control

DCA-CF

Chlorophyll
fluorescence

RH

Relative Humidity

RQ

Respiration quotient

C₂H₄

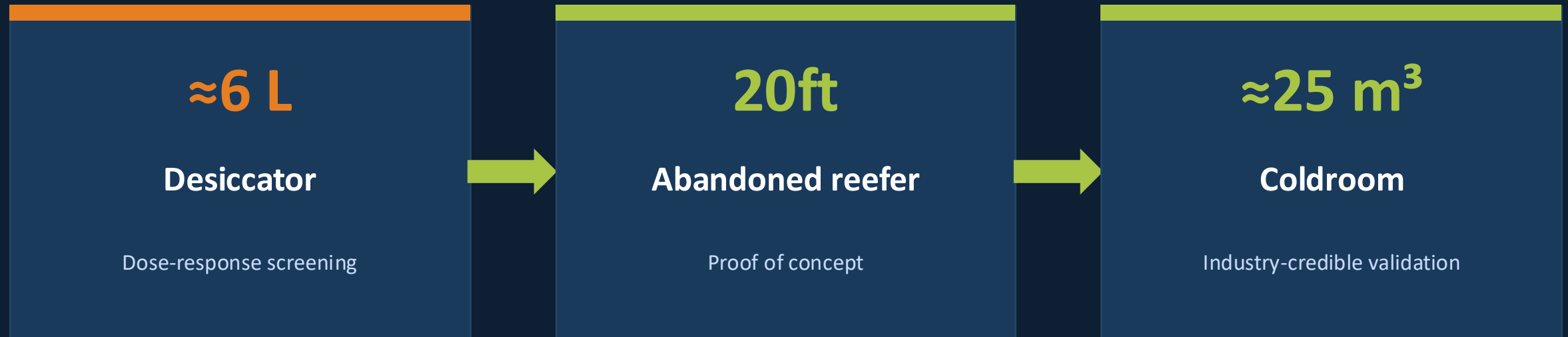
Ethylene production

RR & CO₂

Production rate

FROM DESICCATOR TO COLDROOM

From desiccator to abandoned reefer to coldroom. The engineering arc.



WHAT WE HAD TO SOLVE AT EACH JUMP

Vapourisation & dosing

Dosing EF practically has different challenges as volume grows.

Theoretical modelling

We couldn't trial-and-error our way, for safety reasons. Theoretical dosing had to and still does inform dosage, which is then confirmed with handheld and GC.

Safety envelope

EF is flammable. Human exposure, ventilation, and post-treatment recovery procedures had to be re-engineered at every scale.

EF reference: 50 g/m³ × 1 h achieves 100% grain chinch bug mortality on pome fruit (no phytotoxicity 50–150 g/m³).

EACH SCALE CHALLENGES DIFFERENTLY

The failure modes at each end are different. The bridge in the middle is engineering.

AT SMALL SCALE

Leaks & noise dominate

- Tiny gas-tightness defects destroy measurement and control.
- At small volumes, sensor accuracy becomes the limiting factor.
- RH and pulp-temp profiles are hard to mimic.

IN THE MIDDLE

Modelling earns its keep

- PHYLA / Janny Bin behave like commercial.
- Same instrumentation across scales = comparable results.

AT FULL SCALE

Uniformity & dosing rule

- Distribution becomes the engineering problem.
- Safety envelopes must be re-validated at scale.
- Operator-facing controls have to be boringly reliable.

No single rung answers the whole question. The work is to keep results comparable across them.

THE WORK ISN'T DONE.

It needs all three of us.



Engineers

Choose the right rung. Build the rig, model the gas, instrument the trial, de-risk the scale-up.



Researchers

Define the endpoint: ACP, RQ, dose-response, mortality, quality, residue, storage outcome or failure mode.



Industry

Bring the fruit, the cultivar, the commercial constraint, and the decision at stake. We'll triage.

Smaller tools only ask bigger questions when we point them together.

Bring the questions,
we'll build the solutions.

Josh Kreft

Gas At Site (Pty) Ltd

Your Partner in Fruit Storage

joshk@gasatsite.com

083 3109 134

