Aeroponics based seed potato systems

Peter VanderZaag and

Andre LaChance

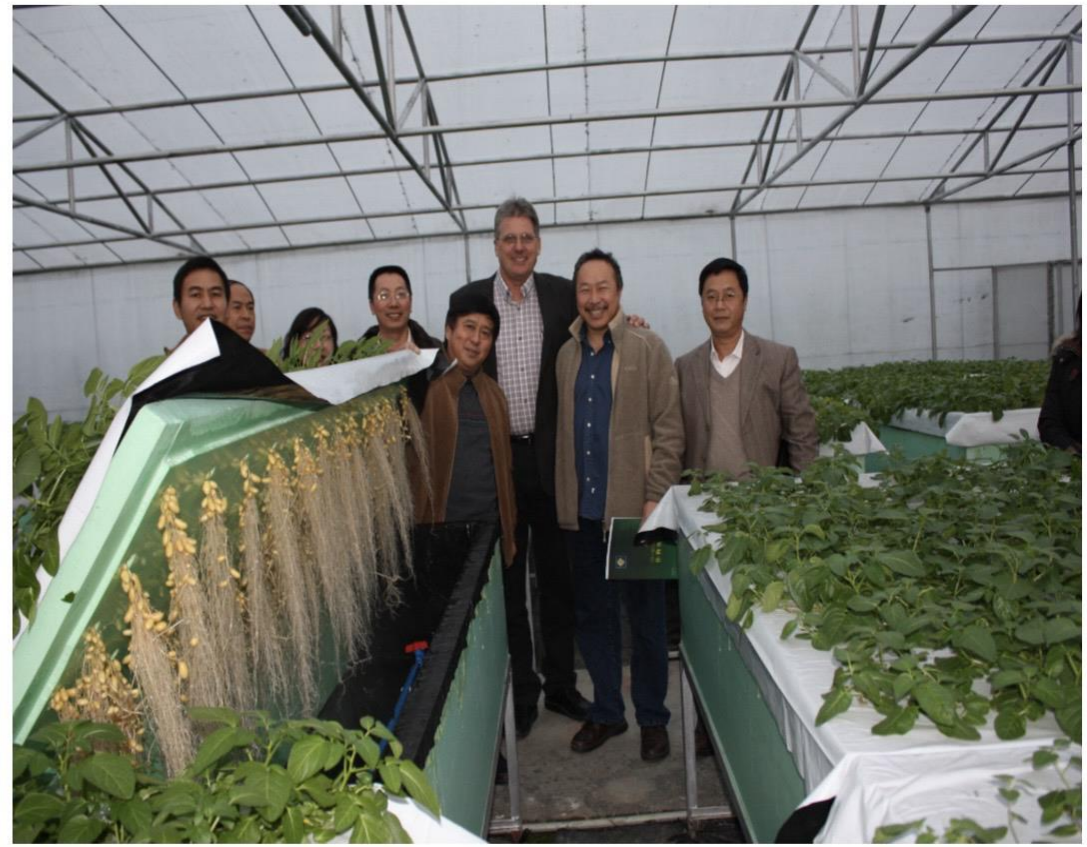
Devastating earthquake (8.0) strikes the mountain areas of Sichuan China in 2008

- 100K died
- 10M displaced
- 7K schools destroyed
- Potato crops badly damaged
- Seed potato shortage



World Bank through CIP financed a large effort to grow nuclear seed starting with Aeroponics (2008-10)

- Sichuan Academy of Agricultural Sciences implemented
- Dr HeWei and colleagues along with Dr Xie Kaiyun developed the plan and produced results
- The model was to be copied and improved



AEROPONICS / SEED POTATO PRODUCTION

Aeroponics-Based Seed Potato Production

Practical Experience, Challenges and Lessons Learned



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WHO WE ARE

A family-owned potato farming operation



COMMERCIAL PRODUCTION

Québec, Canada • Family-owned farm

2,000 ha cultivated | 1,000 ha potatoes

Potato chips & frozen French fries

Storage capacity supports 11 months of sales

SEED POTATO PRODUCTION

280 ha • 10 ha NUC G0 • 90 ha G1

180 ha in rotation

Operated in partnership with another company

OUR ORIGINAL STRATEGY

Why We Decided to Produce Our Own Seed

01

SUPPLY & COST CONTROL

Vertical integration to secure seed availability and manage costs.

02

SEED HEALTH & RISK

Earlier generations to limit pathogen build-up and protect genetic potential.

03

SPEED & NEW VARIETIES

Faster multiplication to respond to processing market needs.

04

UNIFORMITY IN THE FIELD

More consistent emergence, field operations and processing quality.

Our goal was to build a more reliable and efficient seed supply system.

OUR JOURNEY / 1992–2009

A long-term commitment to seed quality

The goal came first. The technology evolved over time.

1992–1998

Conventional production

In vitro plants · aphid-proof greenhouse

Inert substrate · drip irrigation

1999–2008

NFT (Nutrient Film Technique)

Successive minituber harvests

Improving early-generation multiplication

2009

First aeroponic observations

Small-scale, preliminary system

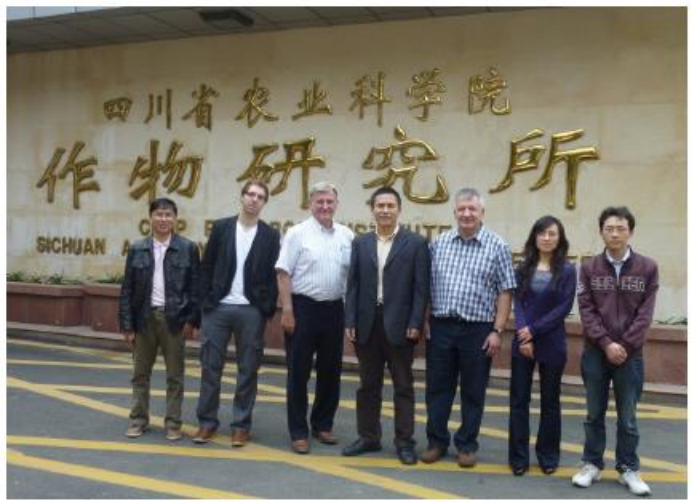
~50% higher output than NFT (preliminary observation)

Our aim since 1992: a reliable supply of healthy, high-quality seed.

COLLABORATION / RESEARCH / 2014

A turning point: learning together

China → Québec research → commercial greenhouse



2009 · Chengdu

Knowledge generously shared



First aeroponic trials

Simple observation system



Université Laval

48 experimental units

2014 | From experimental research to a commercial greenhouse

FROM RESEARCH TO PRODUCTION

Our Commercial Aeroponic Greenhouse

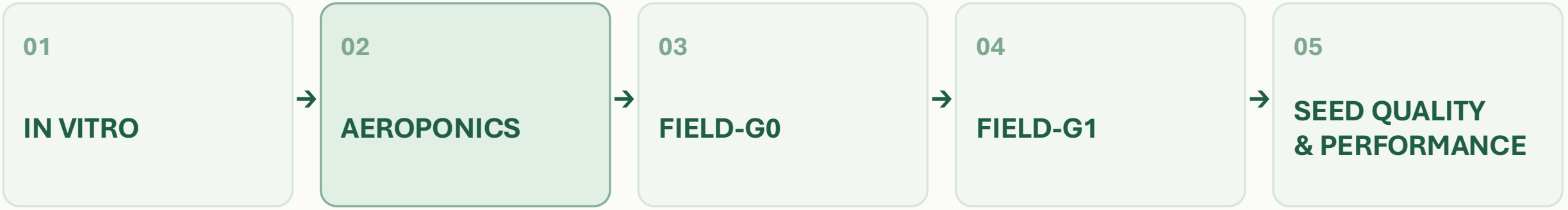
2014 — A new chapter

Moving from replicated research trials to commercial-scale seed production.

The challenge: apply what we learned under real production conditions.

THE FULL SEED MULTIPLICATION CHAIN

Aeroponics Is One Step, Not the Final Goal



Greenhouse output is only one part of the result.

The real test is healthy, vigorous, uniform seed in the following field generations.

STAGE 1 / ACCLIMATIZATION

Build a strong, uniform root system before transfer to aeroponics



Plantlet placement



Raft acclimatization



Root development

STARTING MATERIAL	METHOD	DURATION	AIR · DAY / NIGHT	SOLUTION TEMP.
In vitro plantlets	**Floating rafts**	**2–3 weeks**	**24 °C**	**24 °C**

NUTRIENT SOLUTION **N 150–200 ppm • P 45 ppm • K 220–270 ppm**

MANAGEMENT BASED ON POTATO PHYSIOLOGY

Four distinct growth stages — management adapted to the plant's needs

01	02	03	04
ACCLIMATIZATION	**VEGETATIVE**	**TUBER INITIATION**	**HARVESTING**
Rooting	Canopy development	& BULKING	Repeated harvests

A practical framework for crop management

Vegetative growth

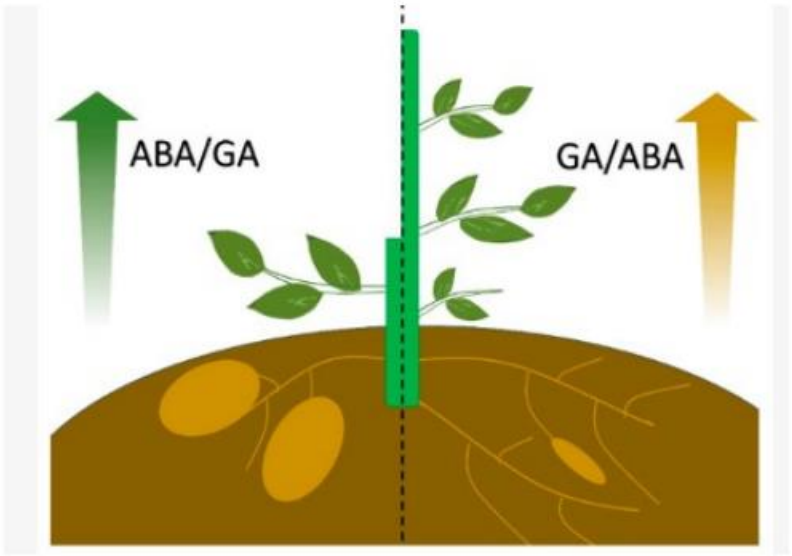
Favor gibberellin activity

Higher GA / ABA

Tuber initiation & bulking

Favor conditions associated with tuberization

Lower GA / ABA



ALL MANAGEMENT DECISIONS ARE BASED ON POTATO PHYSIOLOGY

STAGE 2 | VEGETATIVE GROWTH

From transplanting to a vigorous canopy and stolon system



Transplanting



Early establishment



Canopy development

CROP OBJECTIVE

Foliage + stolon growth

PHYSIOLOGICAL APPROACH

Favor higher GA / ABA balance

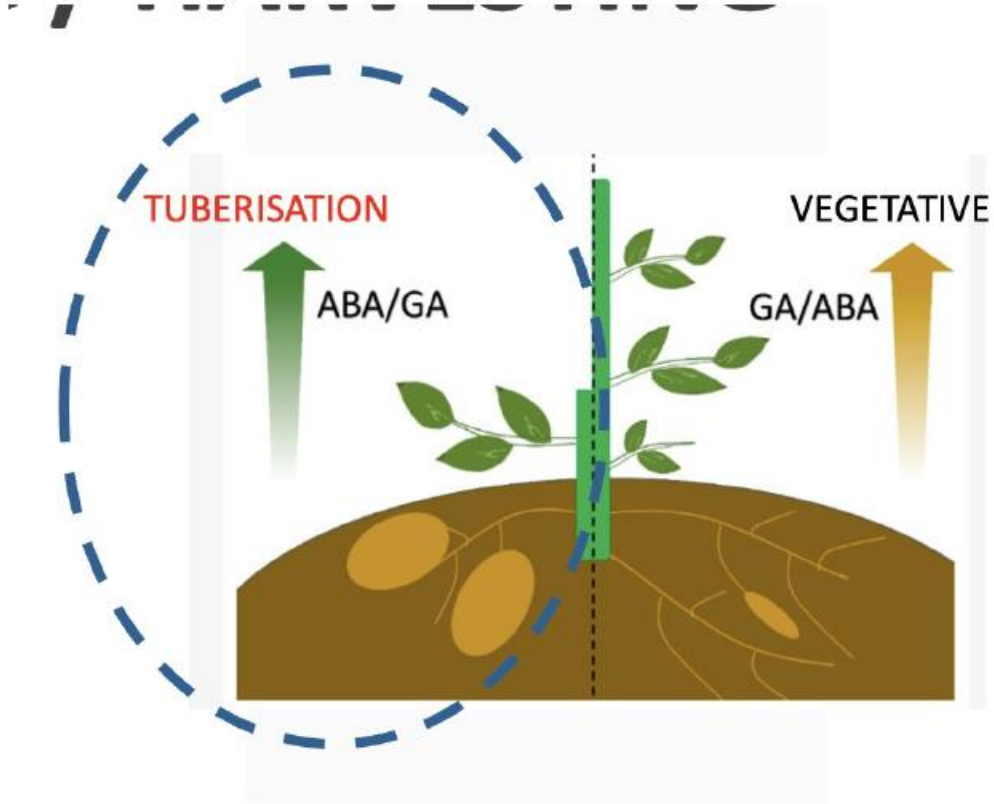
GROWING CONDITIONS

11–22 plants/m² • Air: 23°C day / 21°C night • Solution: ~21°C • N: 225 ppm • K: 300 ppm

Management adapted to plant physiology — not a fixed recipe.

Stage 3 — Tuber Initiation, Bulking & Harvesting

Shift from vegetative growth toward tuber development



Physiological direction: lower GA activity relative to ABA

HORMONAL BALANCE

Favor a lower GA / ABA balance

AIR TEMPERATURE · DAY / NIGHT

21 °C / 16 °C

NUTRIENT SOLUTION TEMPERATURE

Approximately 16 °C

NUTRIENT SOLUTION

N 50 ppm • K 100 ppm

Management is guided by potato physiology — not by a fixed recipe.

Managing Tuber Initiation — Our Observations

Metconazole: a growth-regulating response observed in our system



2 days after application



7 days after application



14 days after application

Observed: reduced vegetative growth and increased tuber formation

Supporting Bulking Without Restarting Vegetative Growth

A second management lesson: where nitrogen is applied can matter

NITROGEN IN THE NUTRIENT SOLUTION

May encourage renewed vegetative growth during tuber production

FOLIAR NITROGEN

Used in our system to support tuber bulking while maintaining the tuber-production phase

Practical caution • Foliar phytotoxicity depends on product, concentration and conditions.

HARVESTING | Repeated Minituber Harvests

Stage 3 — Tuber Initiation / Bulking / Harvesting



HARVEST PROGRAM

2× / week

Repeated harvests for ~15 weeks

TARGET MINITUBER SIZE

1.8–2.2 cm

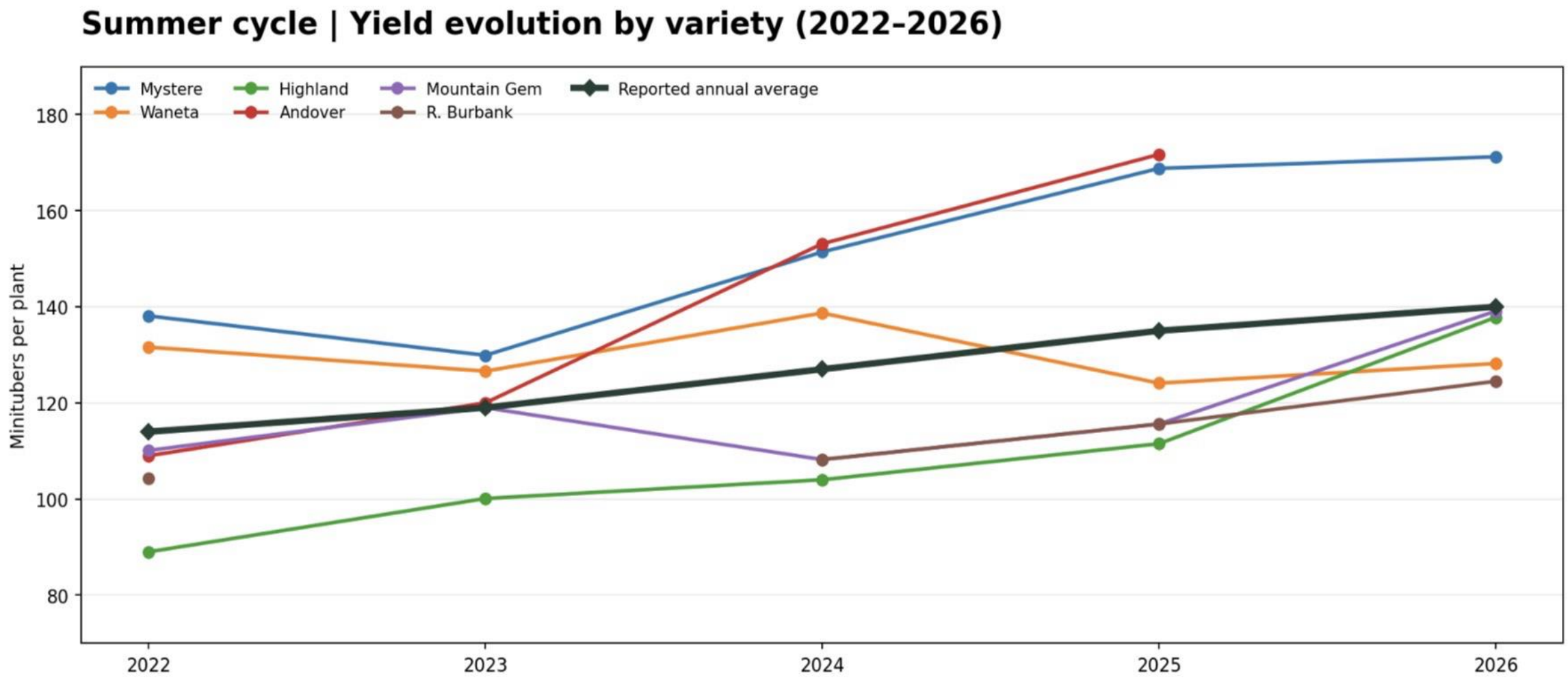
SUPPORTING CROP MANAGEMENT

Weekly metconazole and foliar N (Last-N)
Metalaxyl / propamocarb alternation for Pythium management

Harvesting is repeated — but seed quality remains the goal.

SUMMER CYCLE — YIELD EVOLUTION

Six main varieties | 2022–2026 | Minitubers per plant



Source: Maxi-Plant production records. Missing variety-years are not interpolated. Annual averages are reported values.

Summer-cycle production results; not a measure of final seed-system performance.

Three Additional Keys to Success

01	**MINITUBER CURING**	Controlled suberization after successive harvests helps limit dehydration.
02	**WINTER CO_2 MANAGEMENT**	Limited ventilation can make CO_2 limiting; enrichment supports photosynthesis.
03	**NUTRIENT SOLUTION SANITATION**	UV disinfection reduces microbial load and pathogen pressure.

Successful aeroponics requires control beyond the growing chamber.

From Harvest to Field Planting

Year-round production requires active dormancy management

Harvest
Repeated harvests

Curing
Skin development

Cold storage
4 °C

Dormancy management
When needed

Seed farm
Transfer

Pre-sprouting
Chitting

Planting
May

Inspection
Certification

Storage
Next generation

Late-winter minitubers may have only ~2 months in cold storage before planting.

Seed farm → PRE-SPROUTING (CHITTING) → Planting

From Minitubers to Field Performance

The next generation is where greenhouse success must be confirmed



Careful minituber handling and planting



Field multiplication at the seed farm

Our real measure of success: healthy, uniform seed that performs in the field.

TAKE-HOME MESSAGES

What We Learned — and What We Still Have to Learn

NO UNIVERSAL RECIPE	What works for us may not work everywhere.
UNDERSTAND THE PLANT	Physiology guides decisions — not miracle products.
THINK BEYOND AEROPONICS	Seed health, uniformity and field performance matter.
KEEP LEARNING TOGETHER	Observation, discussion and collaboration drive progress.

Alone we go faster. Together we go further.

Aeroponics Thematic workshop held at WPC2026

Speakers

- Wang Kexiu, China
- Emeritus Kasee, Kenya
- Meksy Dianawati, Indonesia
- Dawie Ras, South Africa
- Ximena Henzi, Chile

Topics

- Lab Acclimation
- Vegetative
- Tuberization
- Pathogen control
- Environmental/ Nutrition
- Storage and field performance

The Aeroponics workshop of 2015, WPC webinars and now Aeroponics Thematic working group will lead to successes by working together to overcome the issues we all may face.

