

Avocado propagation from lab to orchard

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Maluma symposium
South Africa
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The Team

Prof. Neena Mitter, Dr. Alice Hayward, Mr. Chris O'brien,
Prof. Christine Beveridge, Mrs. Amitoj Walia, Dr. Madeleine
Gleeson, Mr. Calrence Mok, Mr. Kyle Lamont



Trend of avocado industry

❖ Global production increasing with cultivation expansion

Area harvested increased from 2016 -2017 was over 15,000 ha

❖ Intensive orchard practices

Conventional planting 400 plants/ha to high density planting 800 plants/ha to ultra high density >1200 plants/ha



1.25 m X 1.25 m in Chile

The current industry challenge

Sourcing avocado plants for orchard expansion and new orchard establishment

2-3 year wait-lists for new plants
Cost and time intensive propagation
Diseases and biosecurity

Rootstock Propagation

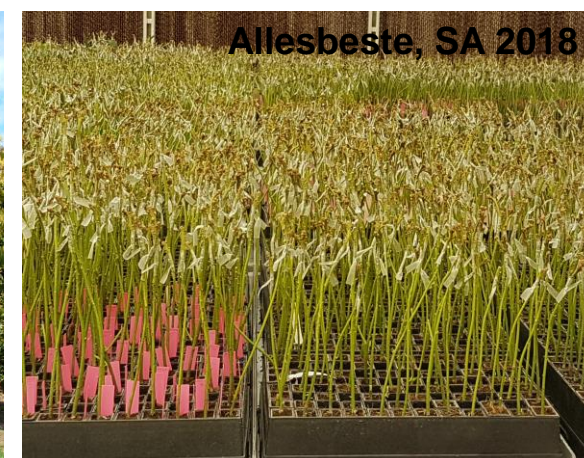
Seedling rootstocks

- Availability of seeds
- Seasonal
- Large orchard maintenance to obtain rootstock seeds
- Resource intensive
- Pest and disease risks
- > A\$22



Clonal Rootstock

- Depend on seed & budwood; seasonal
- Large orchard maintenance to obtain rootstock seeds
- Depend on grafting success
- Resource intensive
- Pest and disease risks
- >A\$42



- Waste of nutritious food (tonnes of fruit/year/nursery)



Tissue culture

“Totipotency of cells”

- Allows mass propagation of true-to-type plants
- Not seasonal
- Disease free
- No stress from outside environment
- Suitable as an industrial application
- Easy to export

Overall Objective

***Develop a tissue culture based
propagation system for avocado***

Key considerations

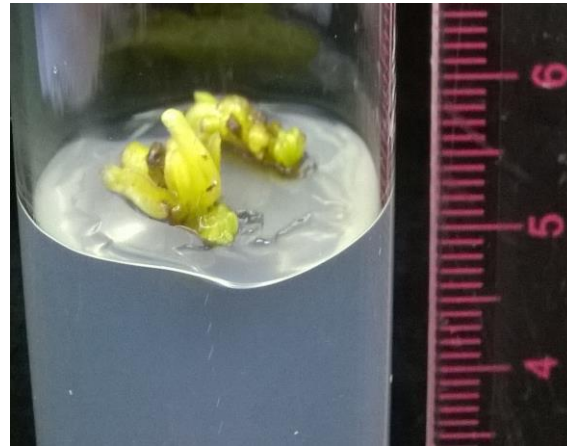
- Propagation of mature cuttings
- High multiplication rate
- Produce high quality plants (pest & disease free)
- Practical procedure applicable at industrial scale

Avocado tissue culture techniques

Nodal culture
(Direct organogenesis)



Meristem /Shoot tip culture
(Direct organogenesis)



Regeneration through callus
culture
(Indirect organogenesis)



(Hiti-Bandaralage et al., 2017)

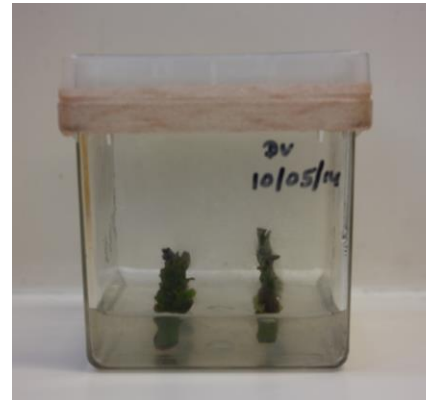
Avocado tissue culture

45 – 50 years of research in global sphere

Highly recalcitrant woody plant species, specially when mature

Problems

- Very low multiplication
- Loss of vigour in culture
- Failures for long term culture
- Poor plant quality
- Very difficult to root *in vitro*
- Low acclimatisation success
- Problems in practicality for large scale production



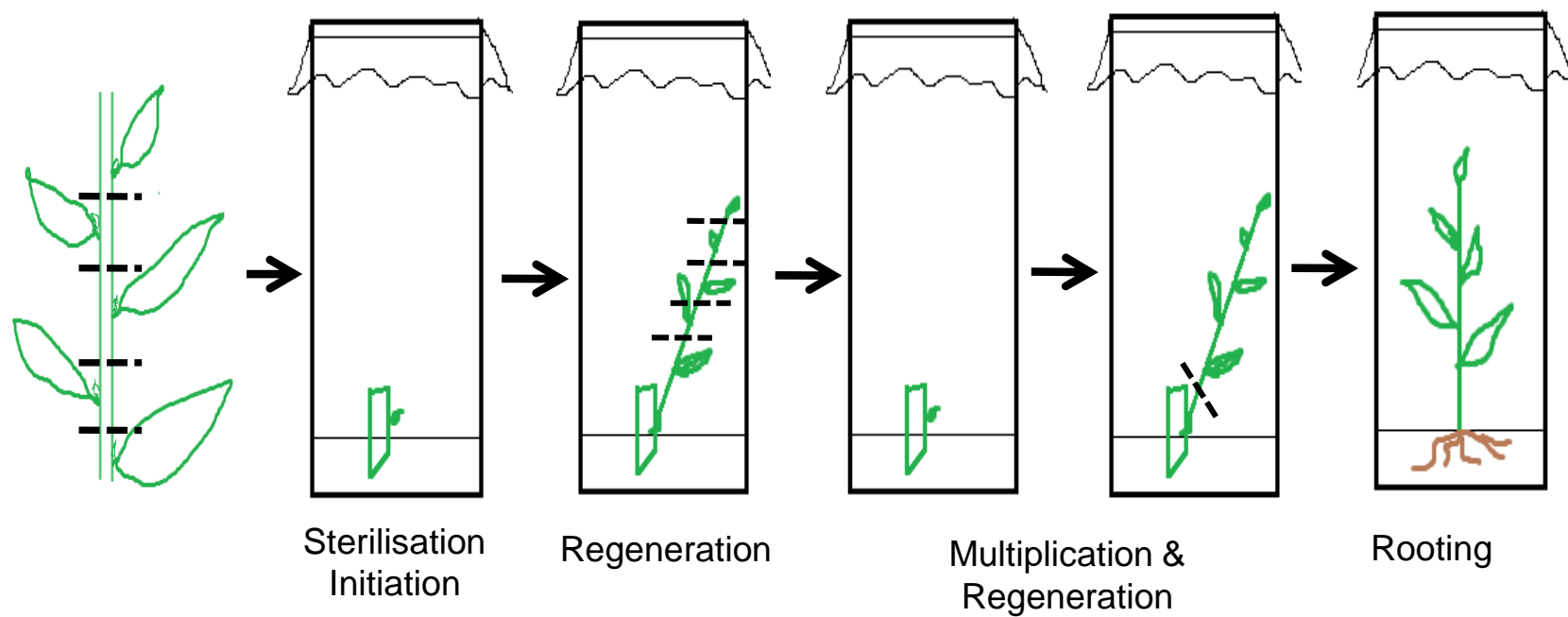
Hiti-Bandaralage et al. 2017

The Challenge

Numerous optimisations for every stage in tissue culture

- Sterilisation of explants
- Basal nutrient media
- Hormone levels/combinations/mode of application/exposure
- Additives – promote growth + reduce dieback/necrosis
- Type of vessel
- Incubation conditions (light, temp, CO₂)

Nodal culture



Nodal culture

Multiplication is limited

Cultivar	Total multiplication (culture period)
'Velvick'	10.68 (12 months)
'Reed'	3.48 (6 months)
'Kidd'	21.78 (12months)



Reed (80% - 8 wks)



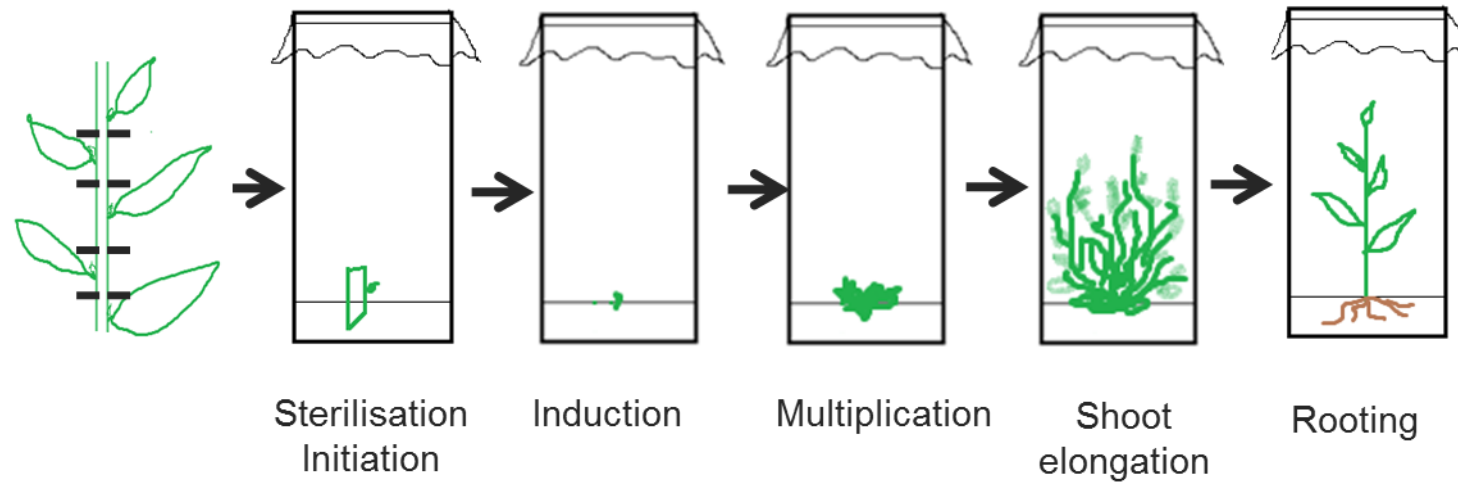
Velvick (50% - 12 wks)



Kidd (90% - 4 wks)

Meristem culture

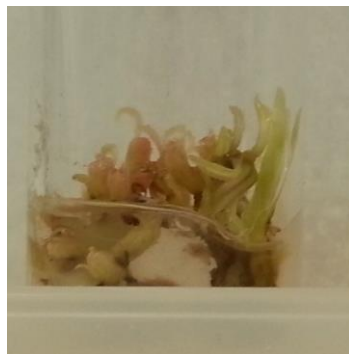
Culturing of extreme apical tissues (ideally <0.1 mm) with no visible leaf primordia (*Lane., 1978*)



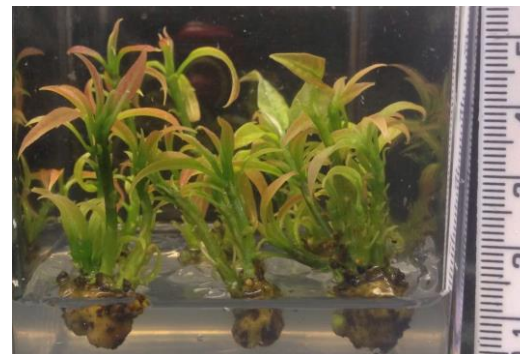
Reed



Meristem induction



Multiplication



Shoot elongation



Single shoots



**Rooting (90%
success at 4 weeks)**



**Acclimatised 6 wks
(>95% success)**

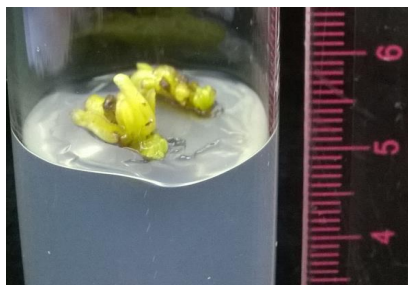


<1 year old

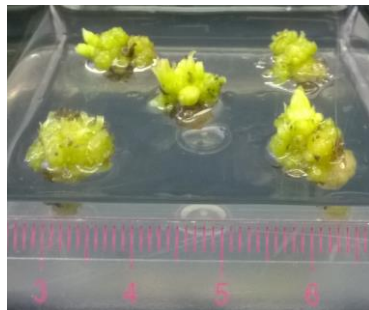


Nursery maintained plants

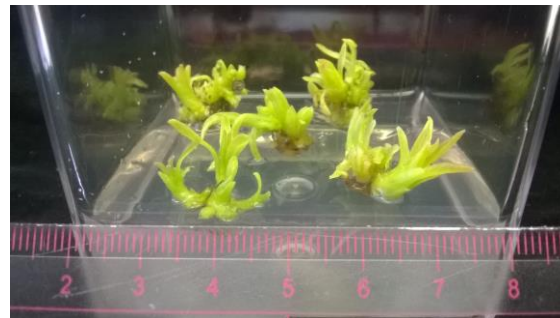
Velvick



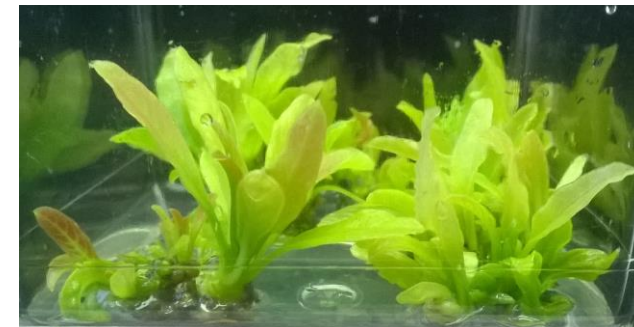
Meristem induction



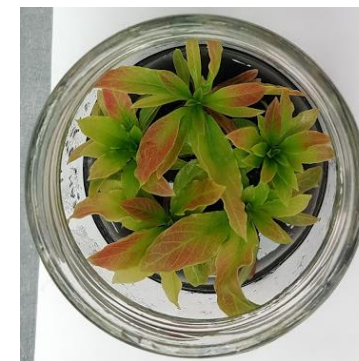
Multiplication



Shoot elongation



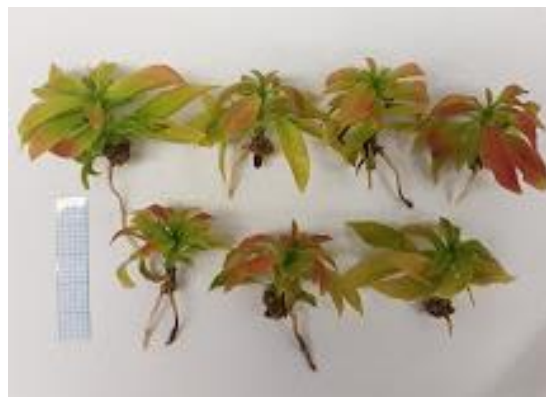
Shoot elongation



***In vitro* hardening**



Rooting

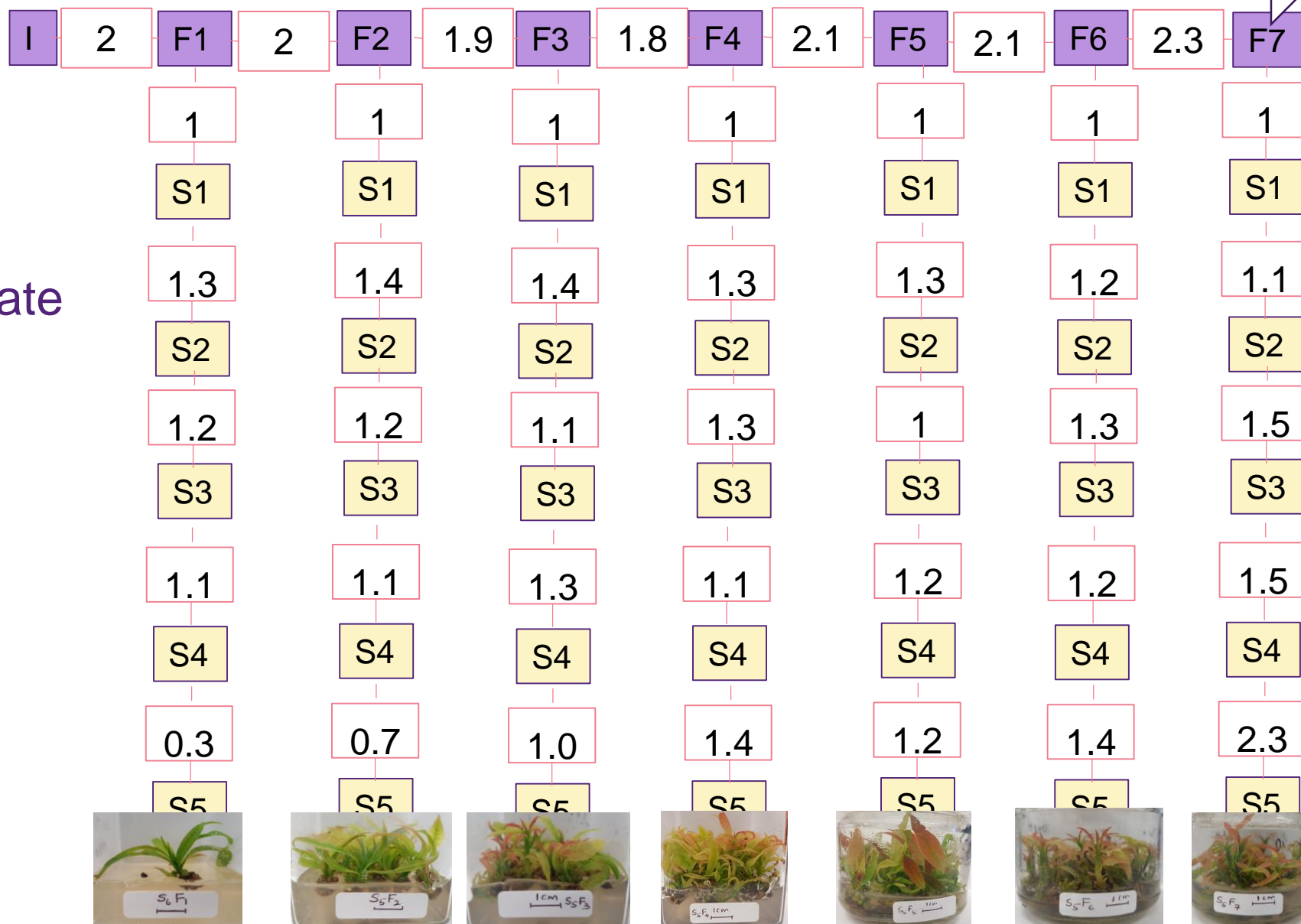


Rooted plants



Acclimatised plants (6wks)

Single tip multiplied 141.47 times



Elongation multiplication times 6.19

X875

Multiplication rate

E.g. Reed

Lab to Nursery



Nursery to Field

- Three small trials
- Started in 2017
- Ungrafted/grafted TC rootstocks (Reed, Velvick)
- Rootstock comparison
 - TC
 - Seeding
 - Conventional clonal



Reed TC



Reed TC
2 years



Ready for planting



Velvick TC



Velvick TC
5 months

Small field trials – Duranbah, NSW

- Three small trials
- Started in 2017
- Ungrafted/grafted TC rootstocks (Reed, Velvick)
- Rootstock comparison
 - TC
 - Seeding
 - Conventional clonal



TC Velvick 2nd year



Hass/TC Velvick second year



Harvest day, 2019 April, 2 years from planting

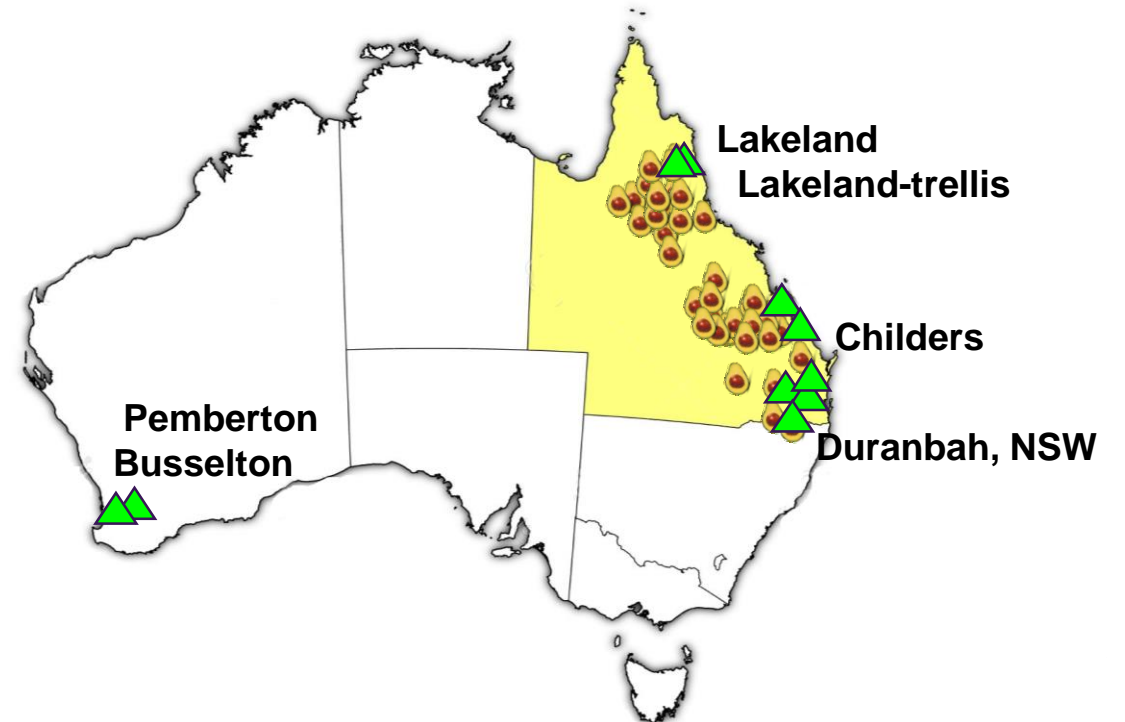
Large field trials – commercially managed orchards



Donovan Farms, Bundaberg, AUS



Dr. Maddy Gleeson



Commercially managed field trials – productivity evaluation

Site	Planted date	Cultivar tested	Comparison	No of plants	Special growth condition
Childers	April 2018	Hass/TC reed	Hass/A10 Hass/Seedling Reed	N=43	-
Lakeland, NQLD 1	September 2018	Maluma /TC reed	Maluma/Seedling Reed	N=50	Trellis, Shade netting
Busselton, WA	October 2018	Hass/TC Reed	Hass/Seedling Reed Hass/clonal Reed	N=50 N=5	-
Lakeland	November 2018	Maluma /TC Reed	Maluma/Seedling Reed	N=50	-
Pemberton ,WA	November 2018	Hass/TC Reed	Hass/Seedling Reed Hass/clonal Reed	N=50 N=5	-



Childers, QLD



Lakeland 1, NQLD
1



Lakeland 2, NQLD



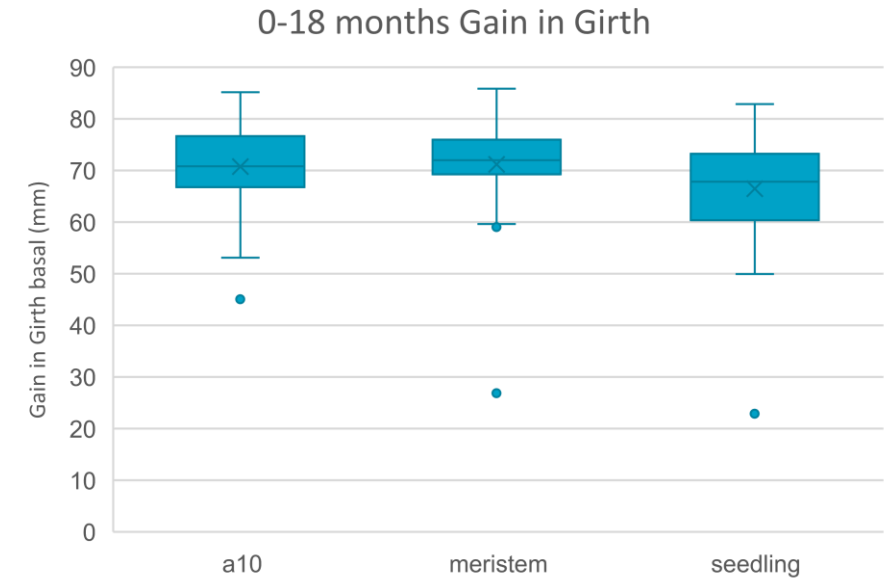
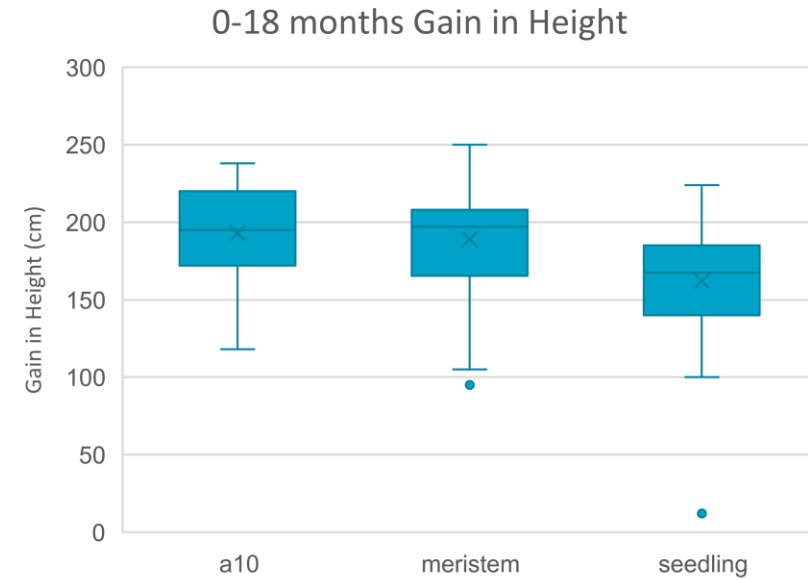
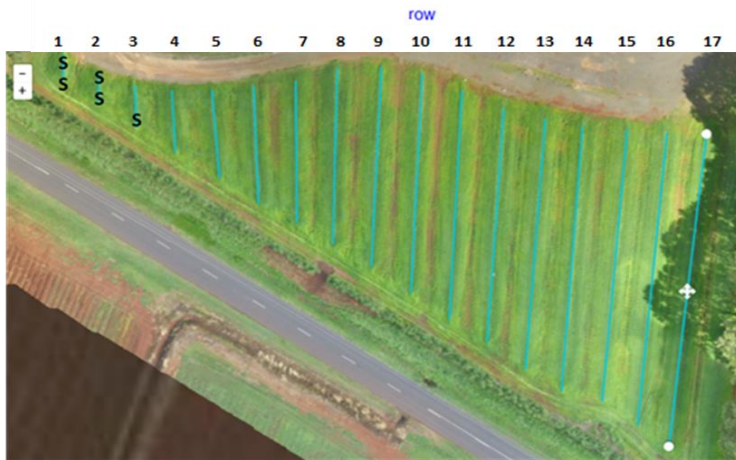
Busselton, WA



Pemberton, WA

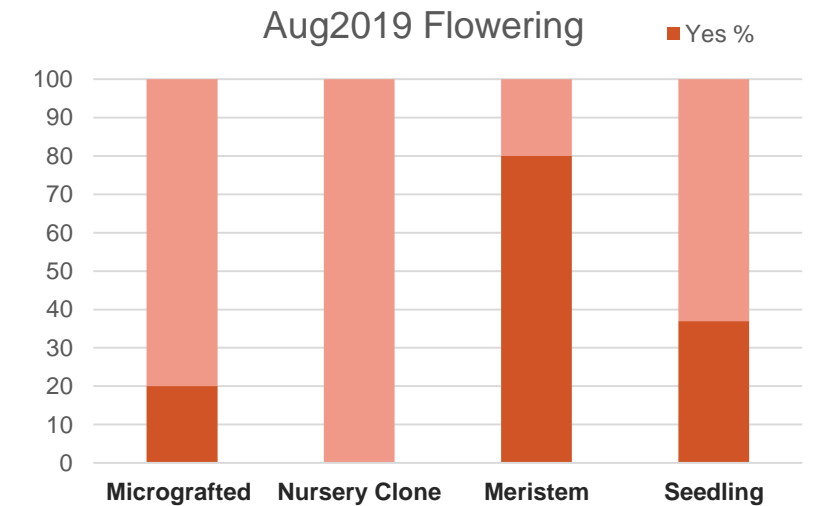
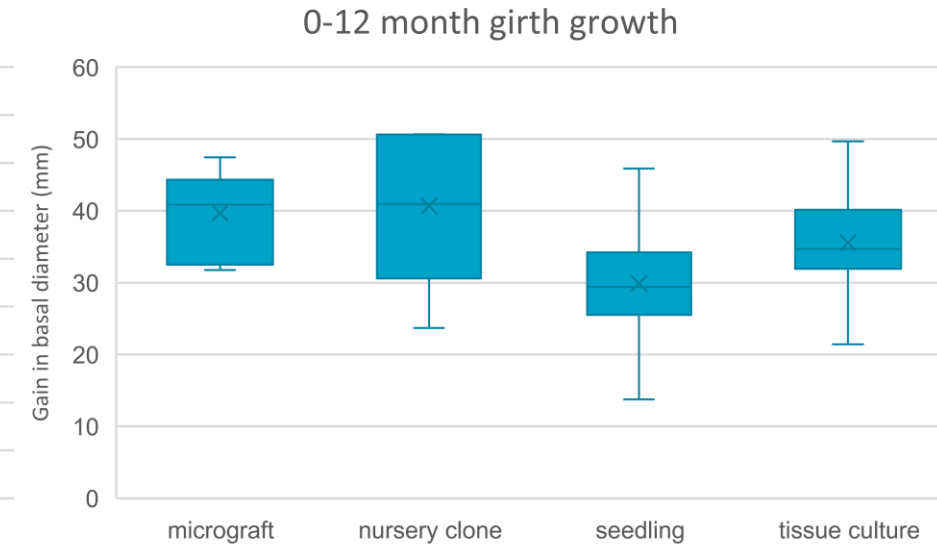
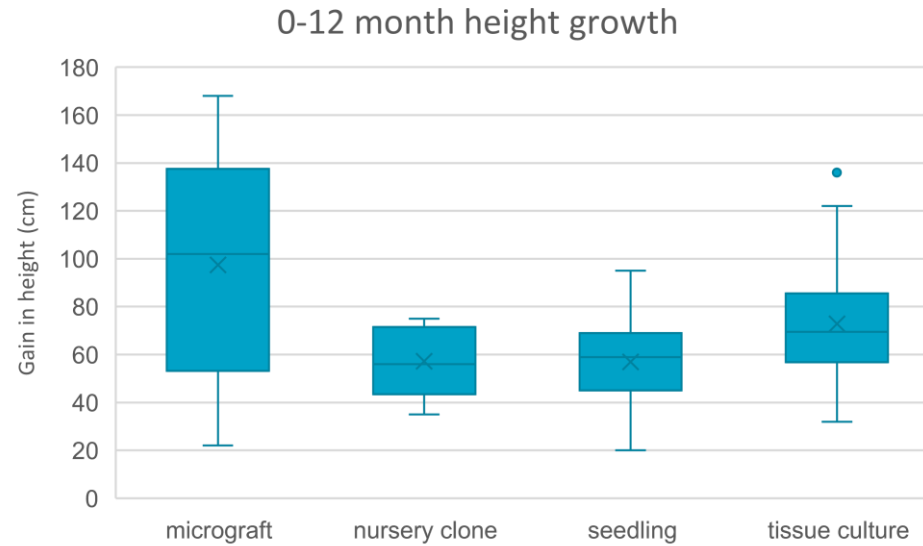
Childers QLD

- Hass/Reed, Hass/a10
- 2 years old in April 2020
- First fruit picked April 2019



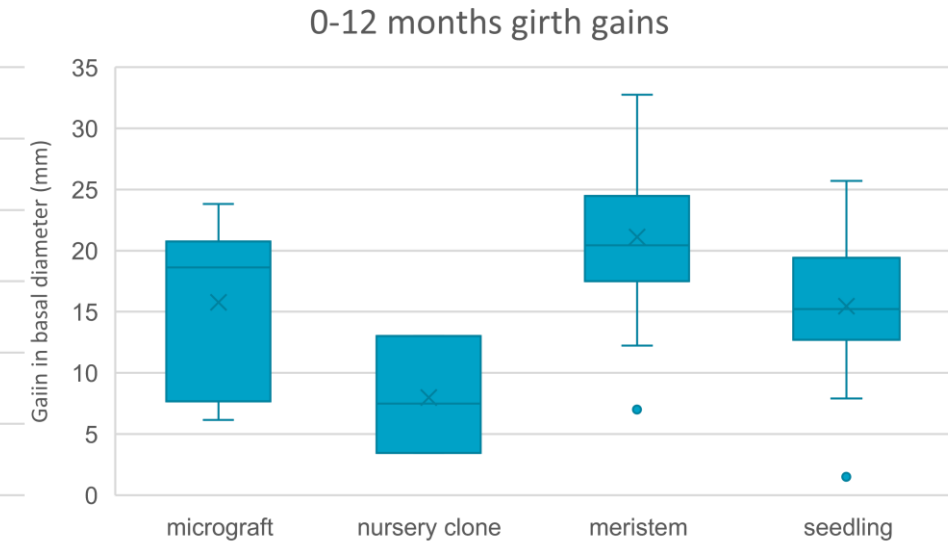
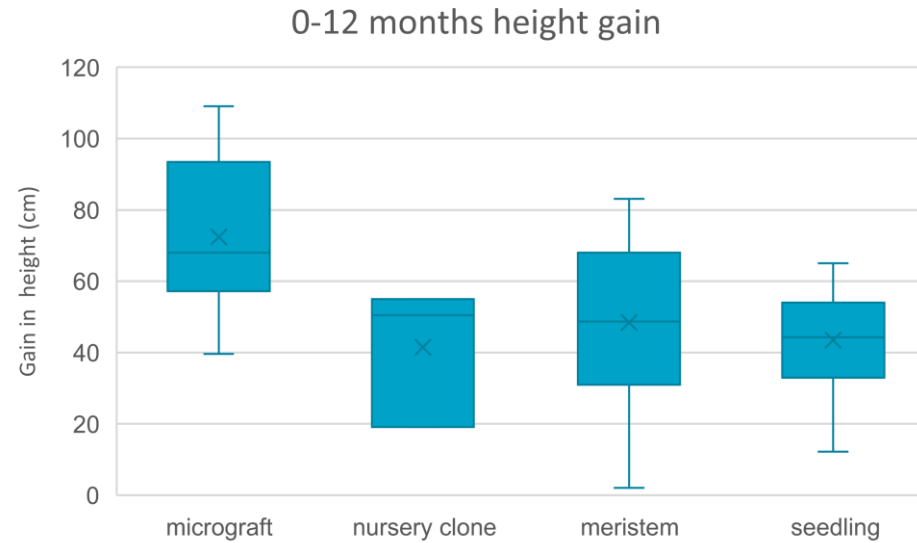
Busselton WA

- Hass/Reed
- 1.5 years old in April 2020



Pemberton WA

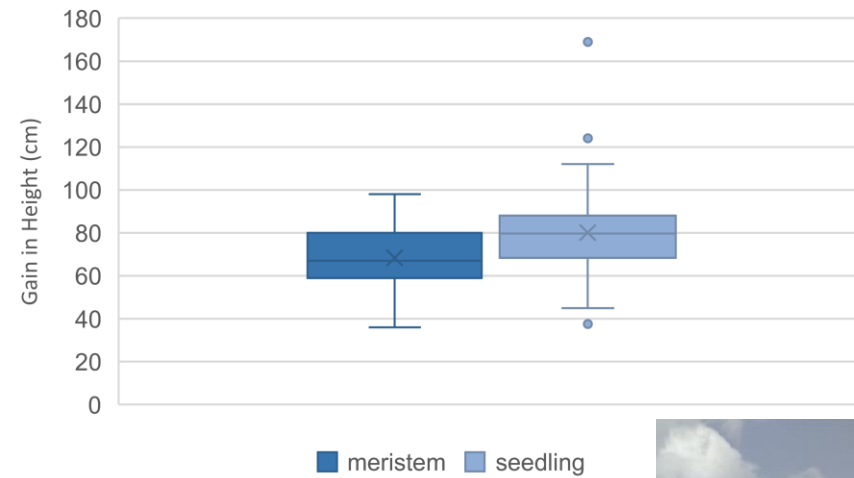
- Hass/Reed
- 1.5 years old in May 2020



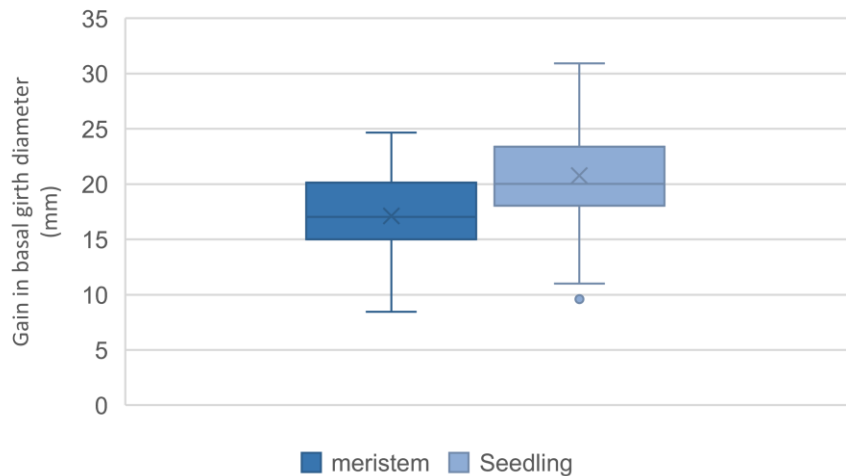
Lakeland FN QLD

- Maluma/Reed
- Trellis, shade netting
- 1.5 years old in April 2020

0-12 month height growth

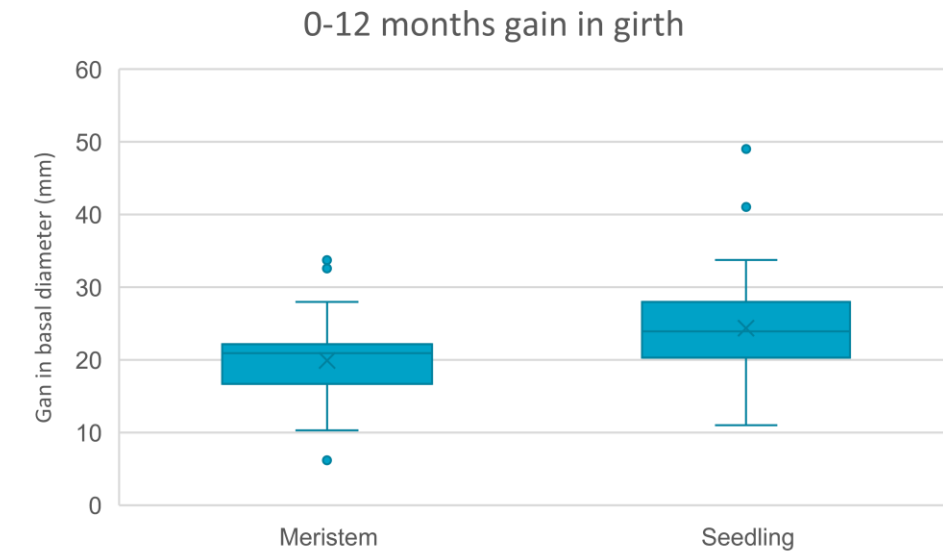
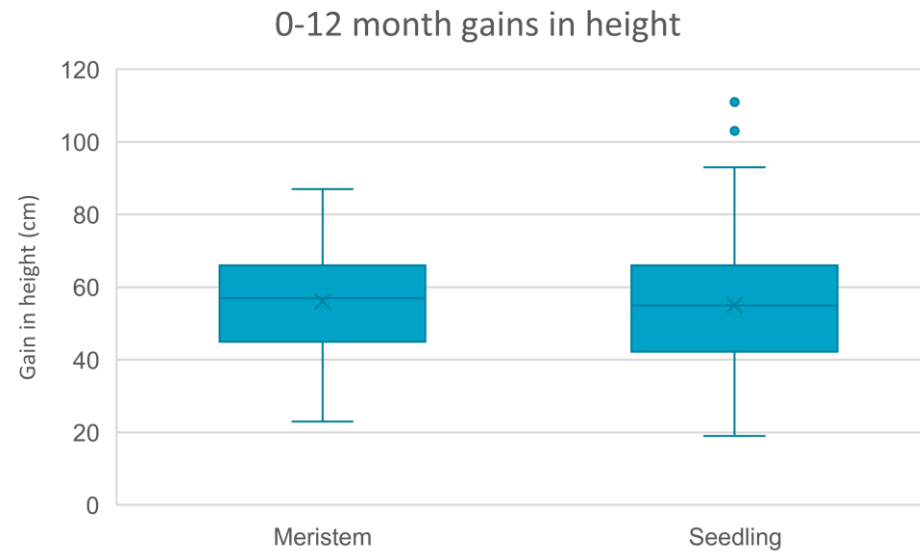


0-12 month girth gain



Lakeland FN QLD

- Maluma/Reed
- Conventional
- 1.5 years old in May 2020



At QAAFI Mitter lab tissue culture..

WORLD'S FIRST avocado tissue culture technology – 500 plants from one shoot tip in 8-12 months

Commercial licence negotiated

Production capacity - 500,000 plants in 500 sq meters

**Disease-free
new breeds**



Land-free



Year-round



Elite



Avocado Tissue Culture; Industry Stakeholder's Day 25th March 2020, Childers, Queensland, Australia



<https://www.eventbrite.com.au/e/avocado-tissue-culture-industry-stakeholders-day-tickets-91284156369>

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Thank you