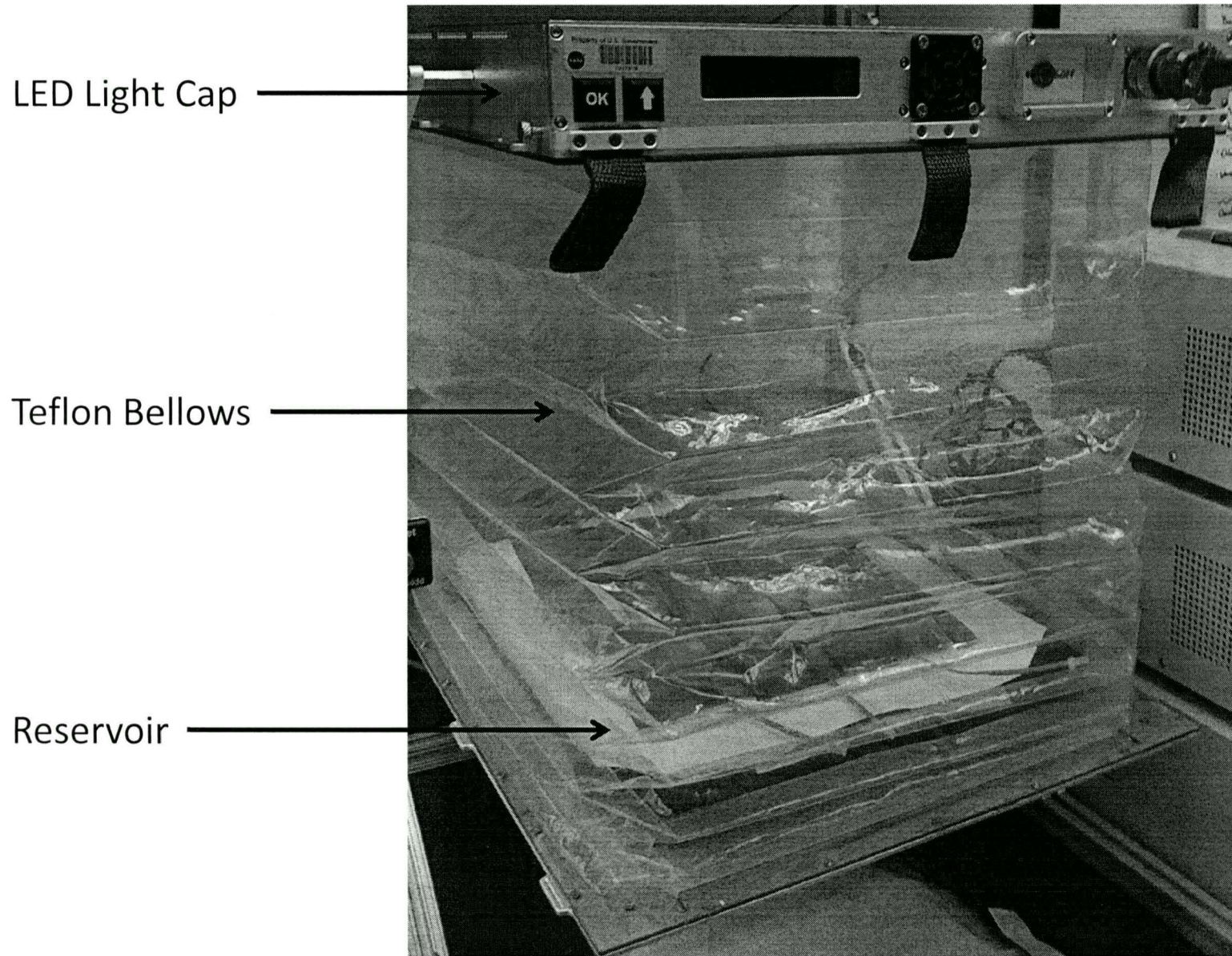


Species and Media Testing for the VEGGIE Plant Production System for Space

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2. Kennedy Space Center, ESC Team QNA
3. Orbital Technologies Corporation

VEGGIE Vegetable Production Unit



Designed and built by Orbital Technologies Corporation (ORBITEC)

Initial Planting Tests

Planting directly over reservoir:

- Stunted growth
- Decline by 21 DAP
- Stem girdling/collapse due to nutrient toxicity
- Salt damage in roots
- Water logging in roots

One Layer Nitex
with 1X Hoagland



Two Layer Nitex
with 1X Hoagland



Planting in blocks/plugs on reservoir:

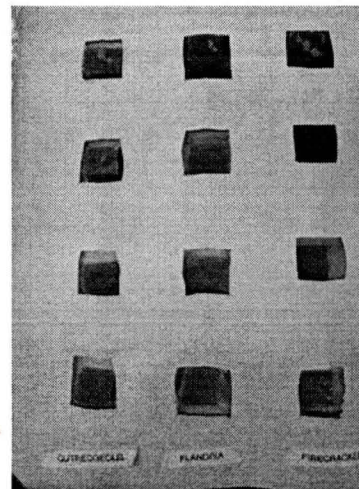
- in 1 X Hoagland solution:

- Poor germinations
- Salt build-up on plugs

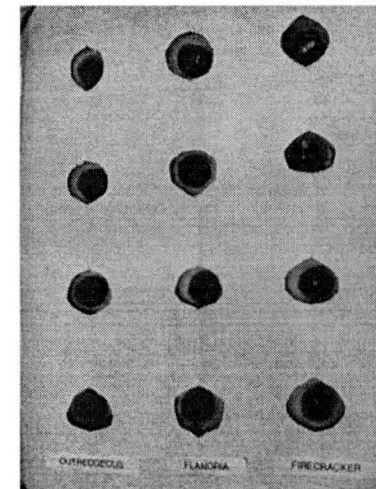
- In 1/2 X Hoagland solution:

- Slow growth
- Severe stunting
- Wilting
- Salt build-up

Rockwool blocks at 7 DAP with
1X Hoagland

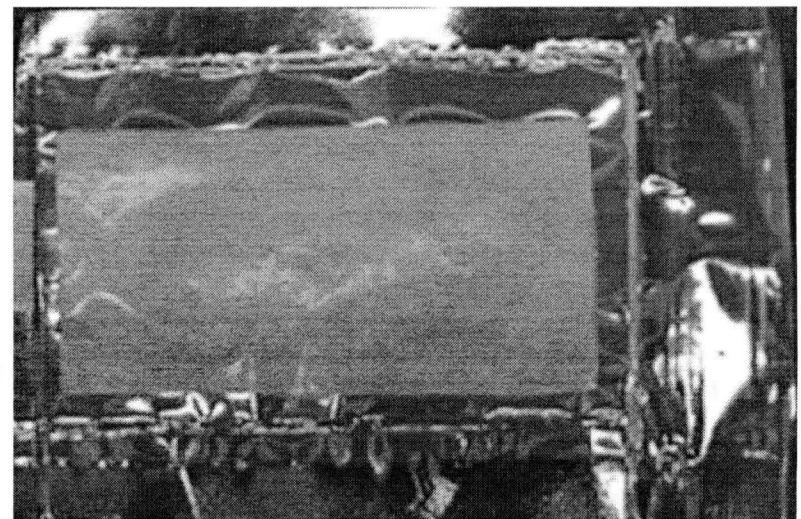


Oasis Plugs at 7 DAP with 1X
Hoagland



Pillow Concept

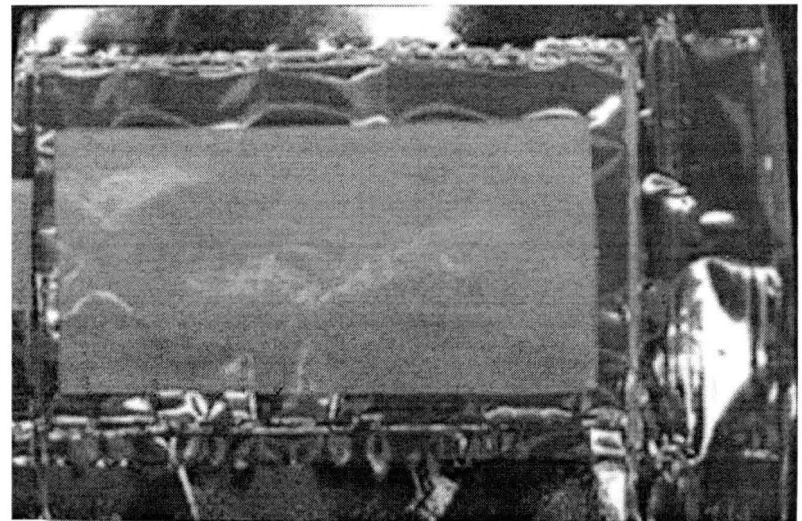
- Plant dry, in 1 g
 - Low launch mass
- Hydrate on orbit
- No energy requirement
- Minimal crew time
- Designed for single use
- Dispose after harvest
- Reduces sanitation requirements



Pillow Co

Pillow Concept (cont.)

- Small bag
 - Resealable
 - Electrostatic
- Wicking surface
 - Heat-welded Nitex membrane
 - Allows passive wicking from reservoir
- Media Contained
 - Testing underway
- Fertilizer Contained
 - Time release
 - Nutricote 18-6-8 selected

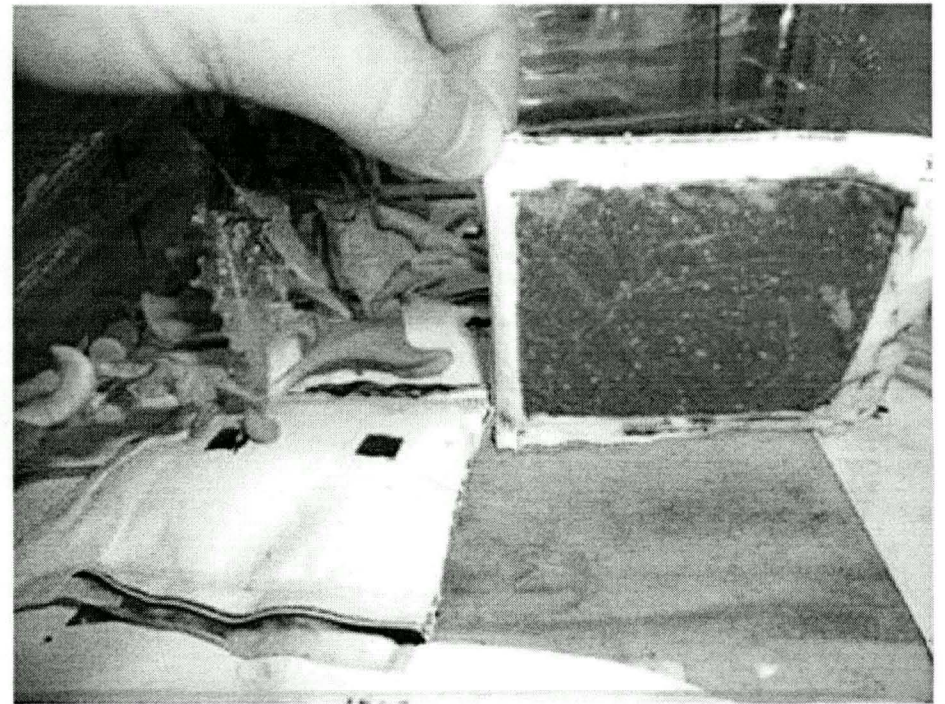


Small bag

– resealable

– Electrostatic

Early Media Studies

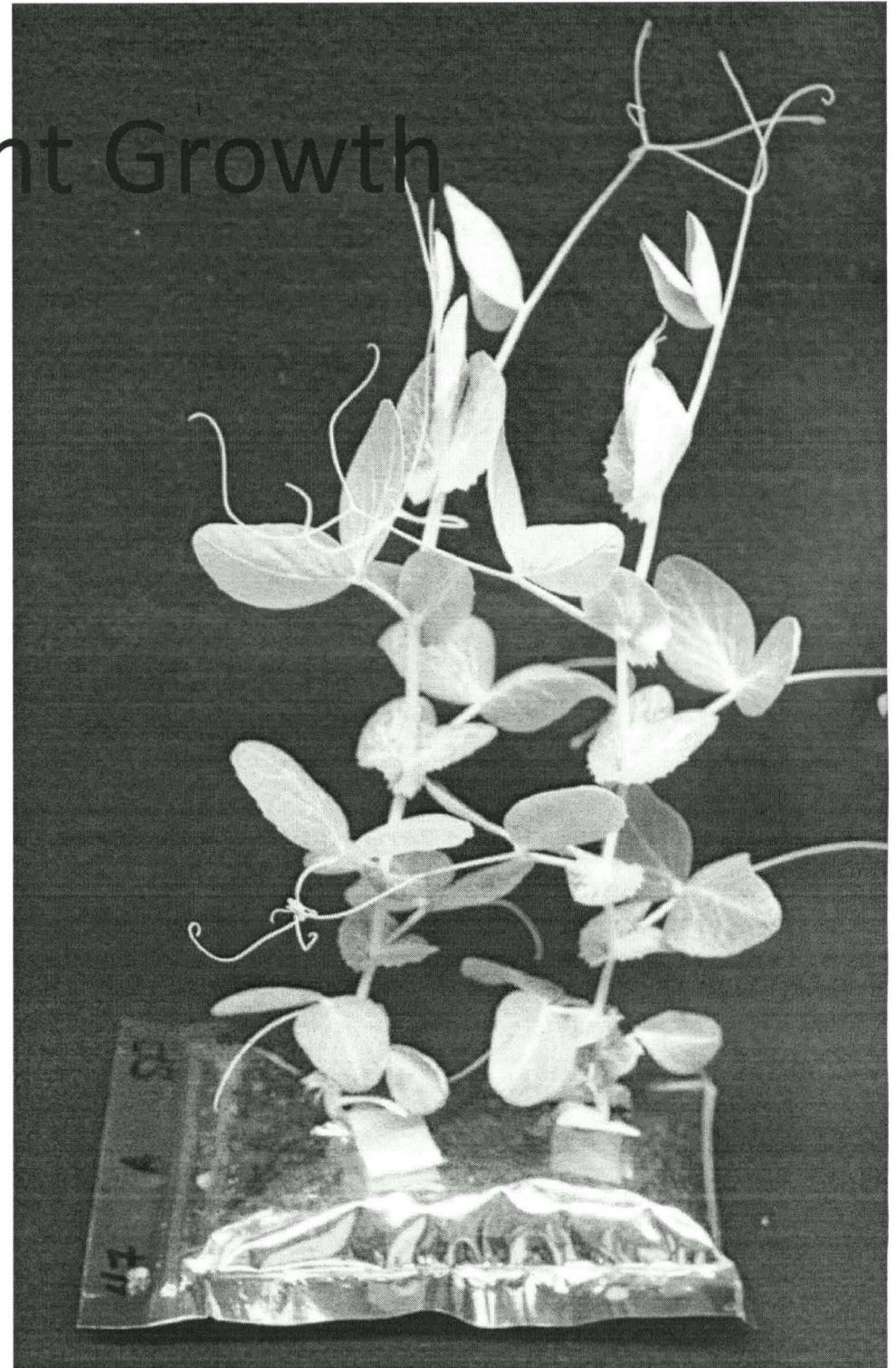


Relatively equal root growth and shoot yields in both peat-based and arcillite media

Pillow Testing in Reservoir Analog



Pillow Plant Growth



Media and Cultivar Testing

13 cultivars

- 'Outredgeous' lettuce
- 'Flandria' lettuce
- Mizuna
- 'Sierra' lettuce
- 'Oak leaf' lettuce
- 'Tender leaf' Vegetable Amaranth
- 'Bright lights' Swiss Chard
- 'Tokyo Bekana' Cabbage
- 'Sugar Pod II ' Snow Peas
- 'Spicy Globe' Basil
- 'Genovese' basil
- Common Chives
- Greek Oregano

5 types of media

- Fafard # 2 (commercial peat-based media)
- Arcillite (1-2mm)
- 1:1 Fafard # 2 : Arcillite
- 7:3 Fafard # 2 : Arcillite
- 1:1 Perlite : Vermiculite

- Reservoir analogs
- Walk-in CEC
- Analog Temp. and RH (28°C, 70%)
- 16 h photoperiod
- Elevated CO₂ – 1200 ppm
- Grown for 36 Days

Multiple Species and Cultivars



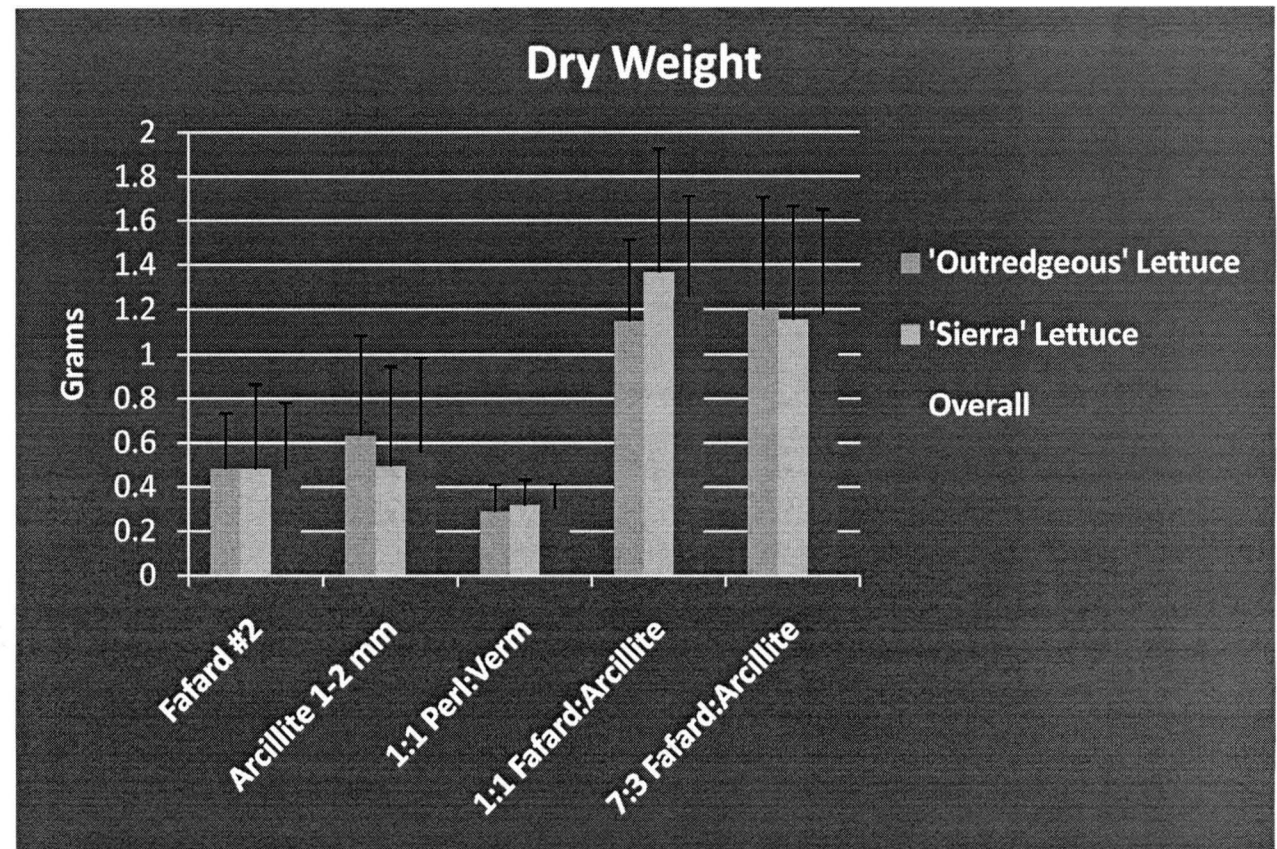
General Results – Cultivars and Media

Species/Cultivar Testing

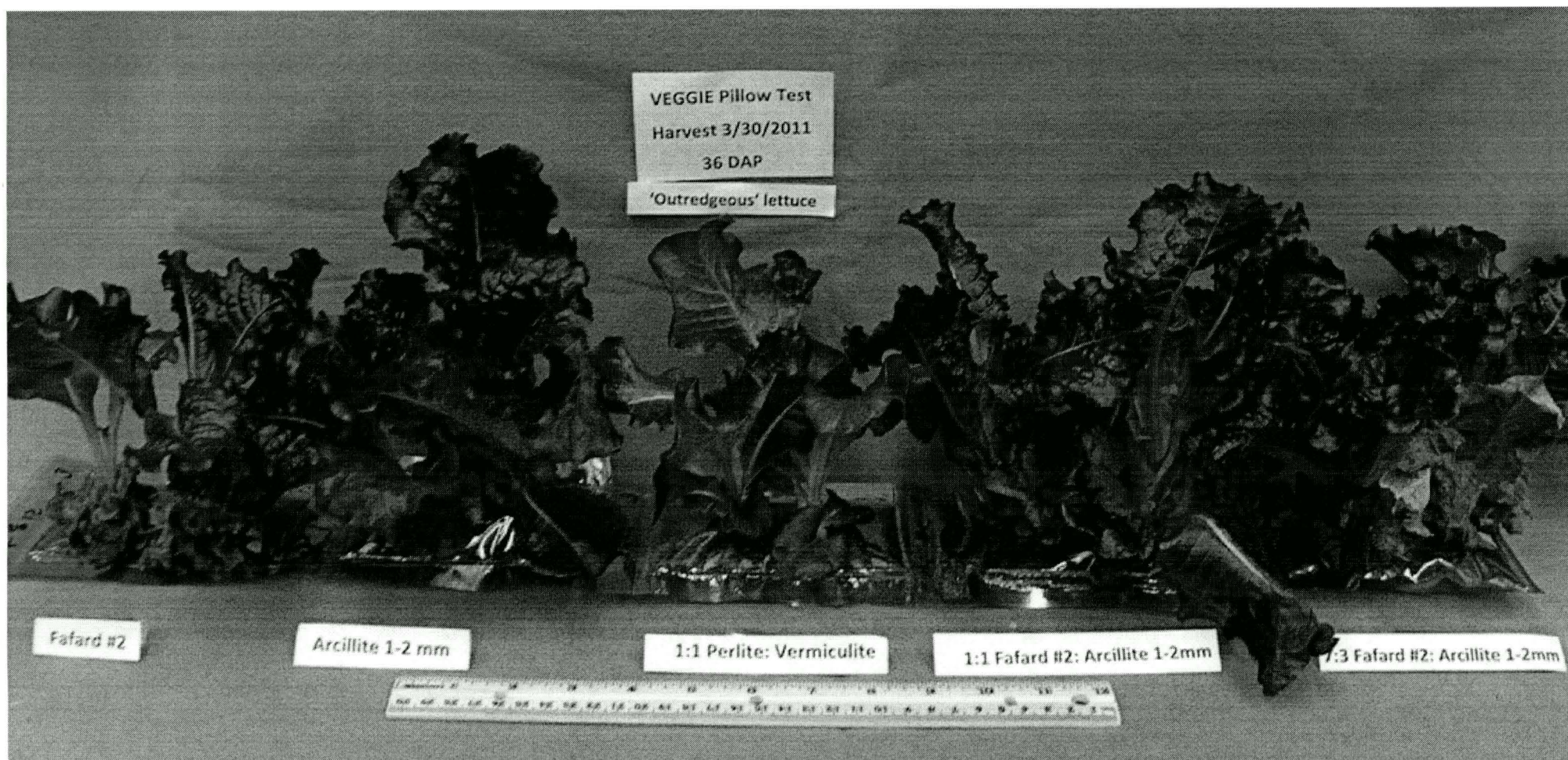
- Best performance in pillows seen from cultivars of:
 - Radish
 - Snow Pea
 - Lettuce
 - Chinese Cabbage
 - Mizuna
 - Swiss Chard
 - Basil

Media Testing

- 1:1 and 7:3 mixes support best growth



Different Media Types



Root Response Varies with Species and Media



Second Test

Cultivars

- 'Sugar Pod II' Snowpea
- 'Tokyo Bekana' Chinese Cabbage
- 'Bright Lights' Swiss Chard
- 'Outredgeous' Lettuce

- 'Cherry Bomb II' Radish

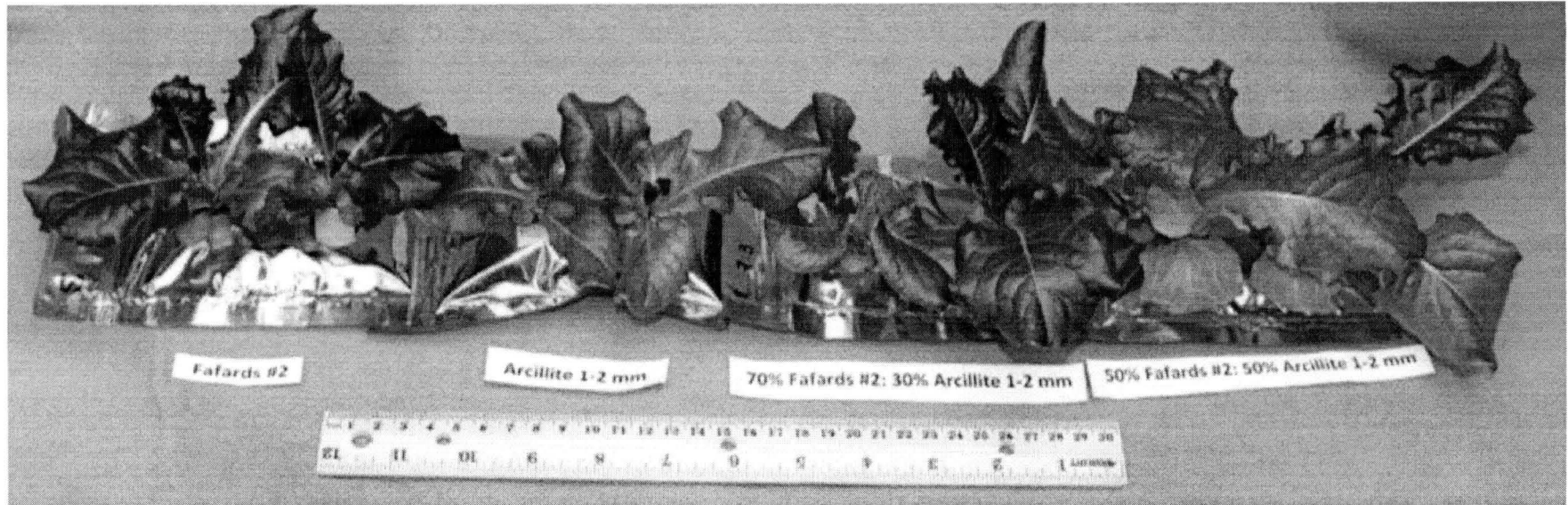
Media

- Fafard # 2 (commercial peat-based media)
- Arcillite (1-2mm)
- 1:1 Fafard # 2 : Arcillite
- 7:3 Fafard # 2 : Arcillite

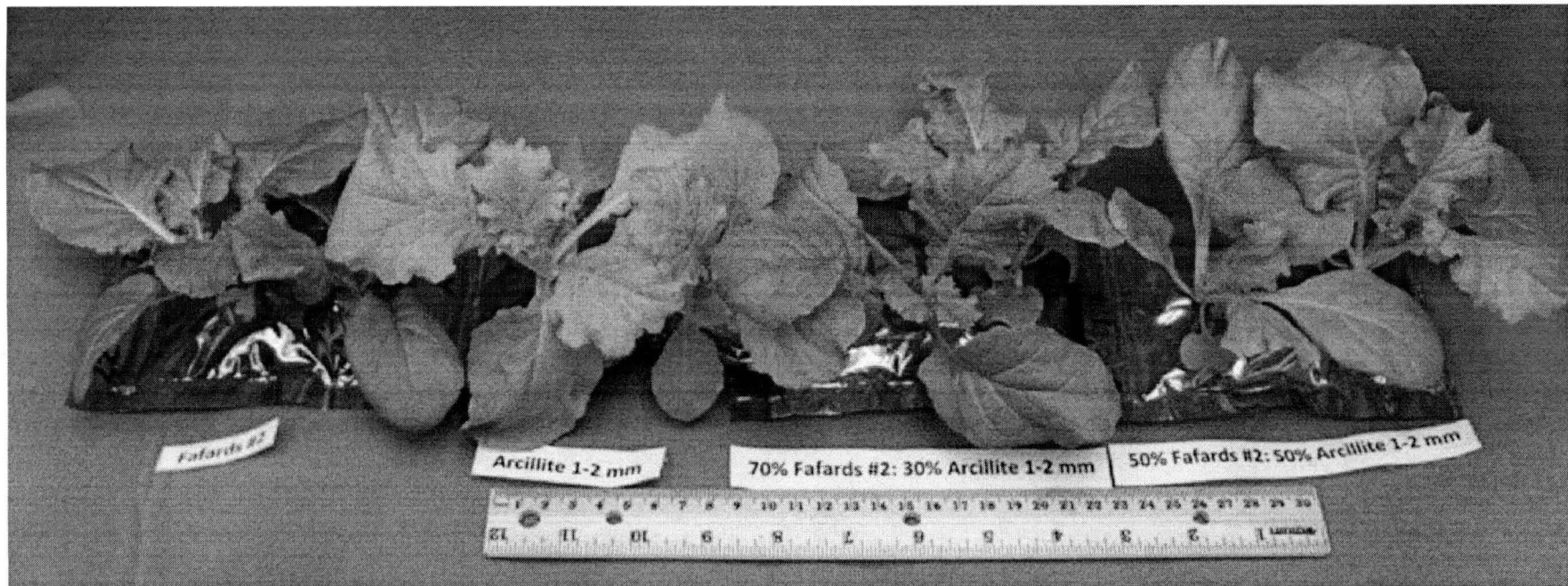
- Same environmental conditions
- All cultivars tested with all media
- Larger sample sizes
- Grown for 28 Days

18 DAP

'Outredgeous' Lettuce



'Tokyo Bekana' Chinese Cabbage

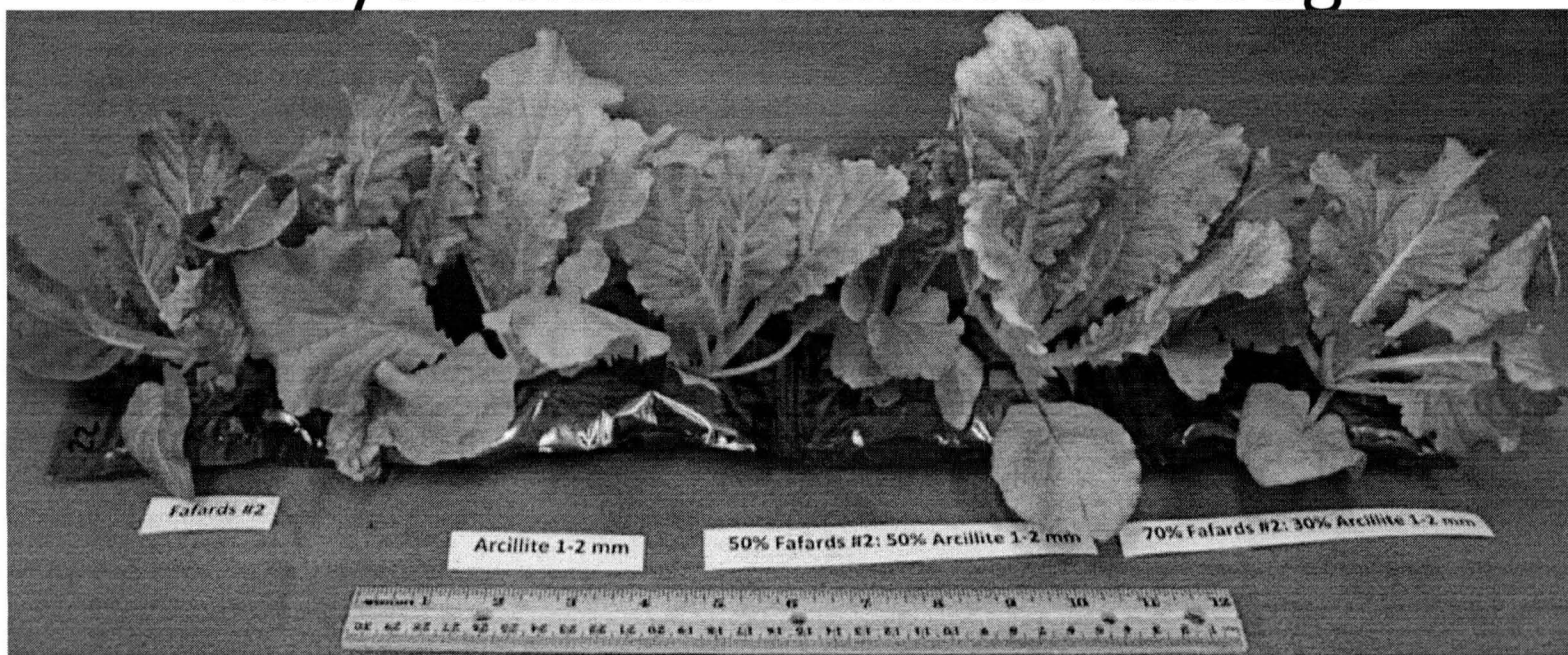


28 DAP

'Outredgeous' Lettuce



'Tokyo Bekana' Chinese Cabbage

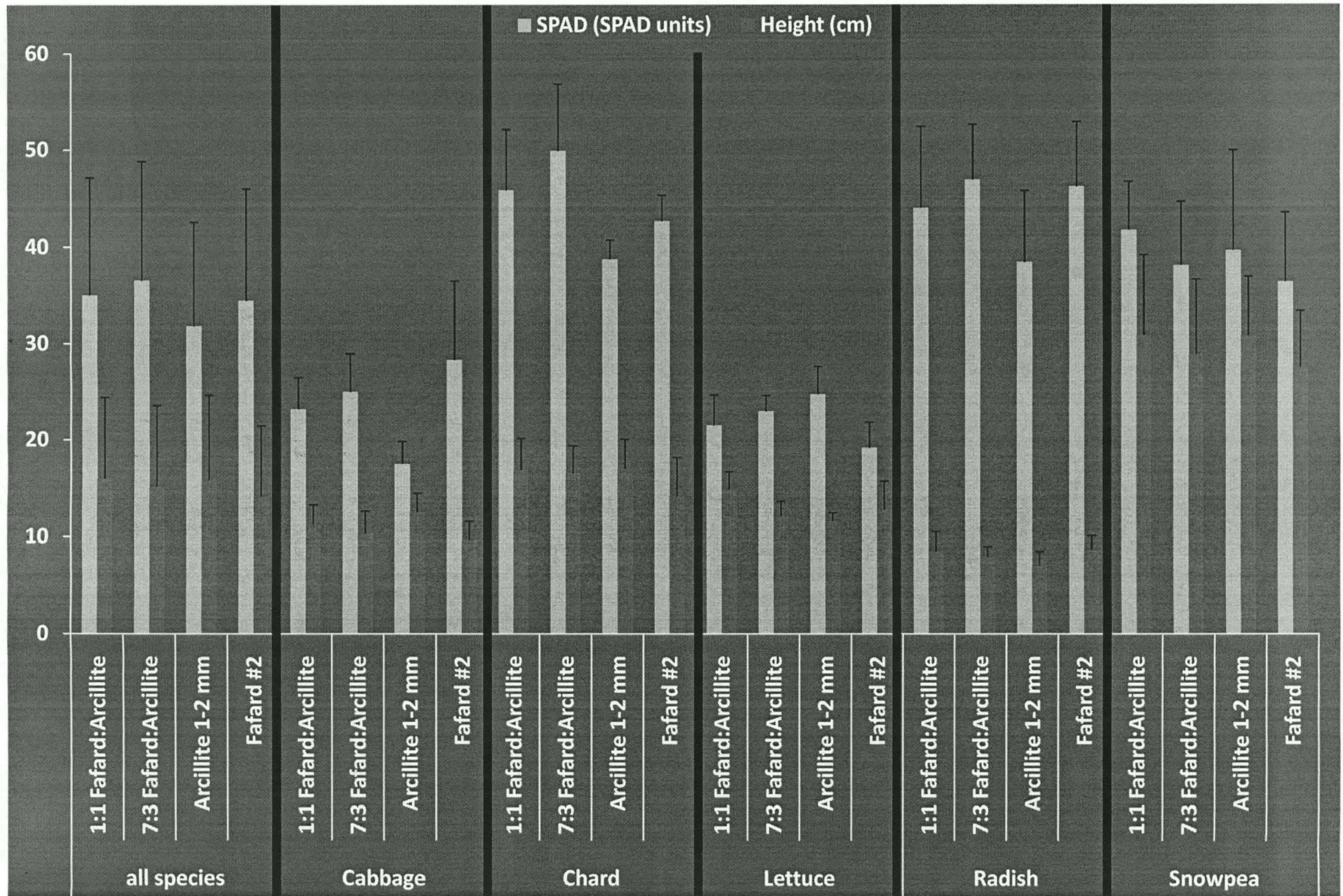


Space Competition

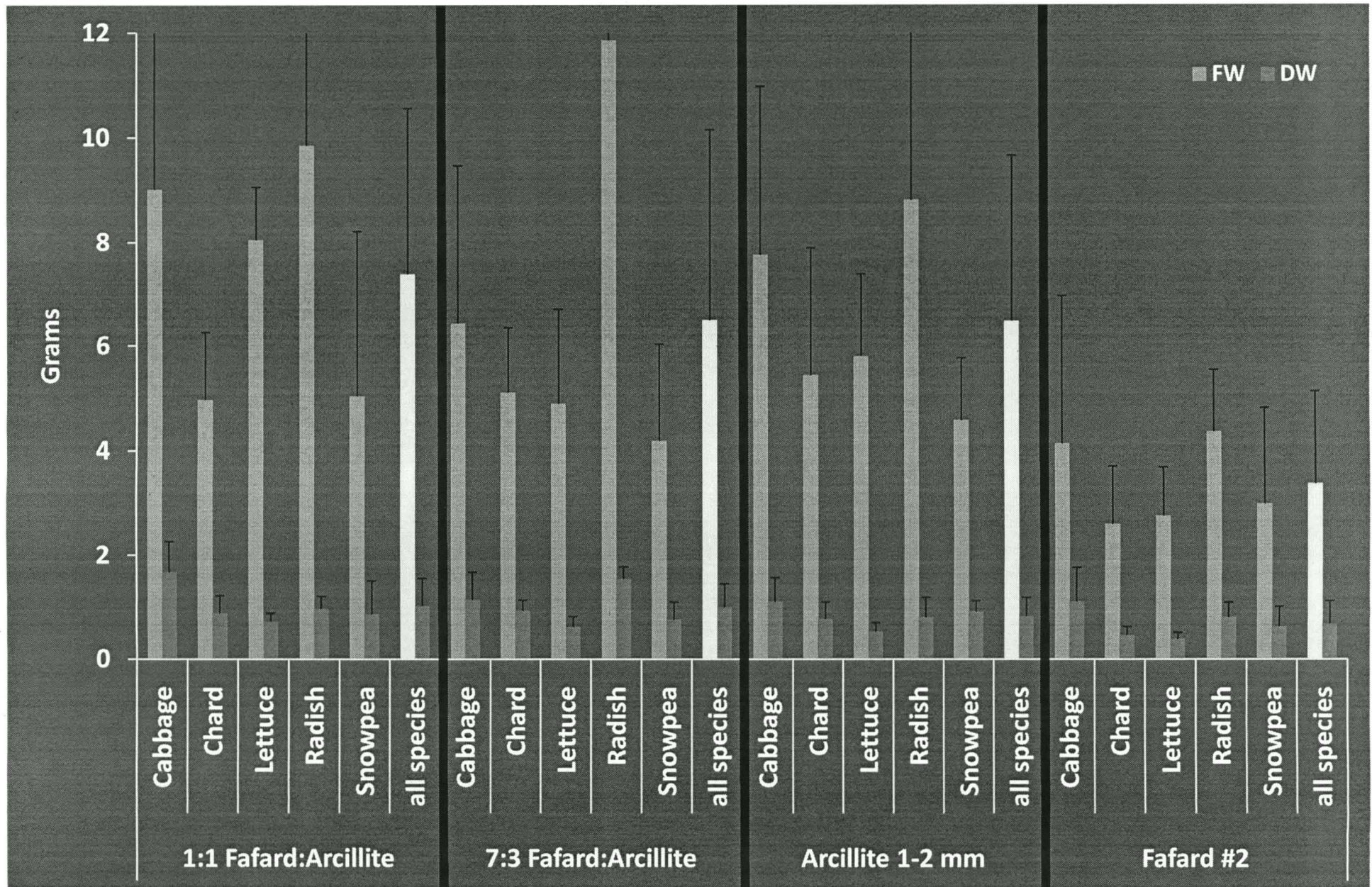
(28 DAP)



SPAD and Height are cultivar-specific



FW has strong media influence



Next Steps

- Harvest strategies and microbial load
- Other media combinations
- Consideration of other factors:
 - Launch mass
 - Ease of rewetting
 - Uniformity
 - Storage
- Planting for microgravity

Acknowledgements

- Larry Koss
- Oscar Monje
- Mary Hummerick
- Anthony Nguyen
- NASA Postdoctoral Program administered by Oak Ridge Associated Universities
- NASA Innovative Partnership Program
- ISS Research
- Exploration Systems Mission Directorate (ESMD)