

Hydroponics 101



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Topics :

- Production Systems
- Substrate
- Spacing
- Varietal Selection
- Germination
- Nutrients
- Temperature
- Light
- Winter Production
 - Heating
 - Supplemental Lighting



Hydroponic Production Systems

Flood and Drain Tables

Nutrient Film Technique

Deep Water Culture

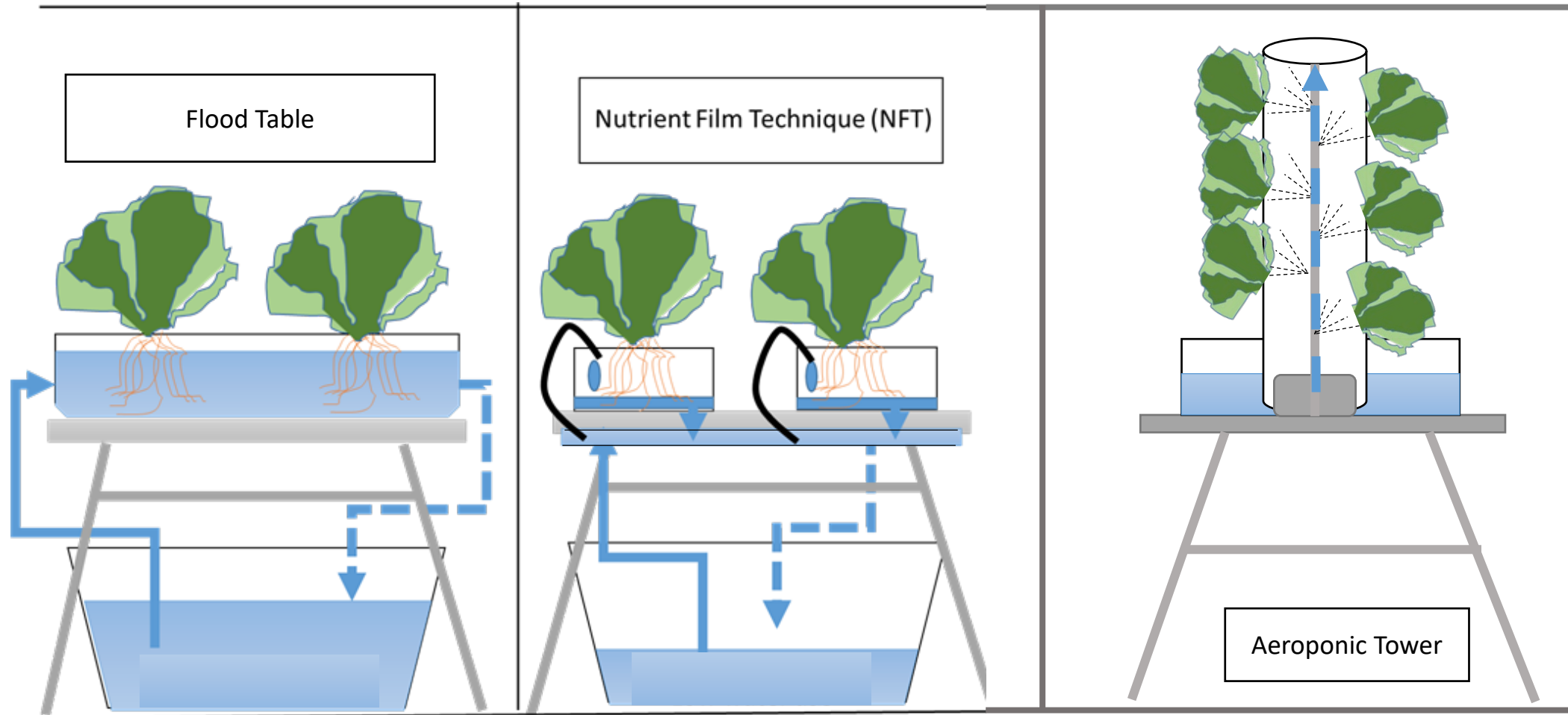


Aeroponic Production Systems

Aeroponic Towers

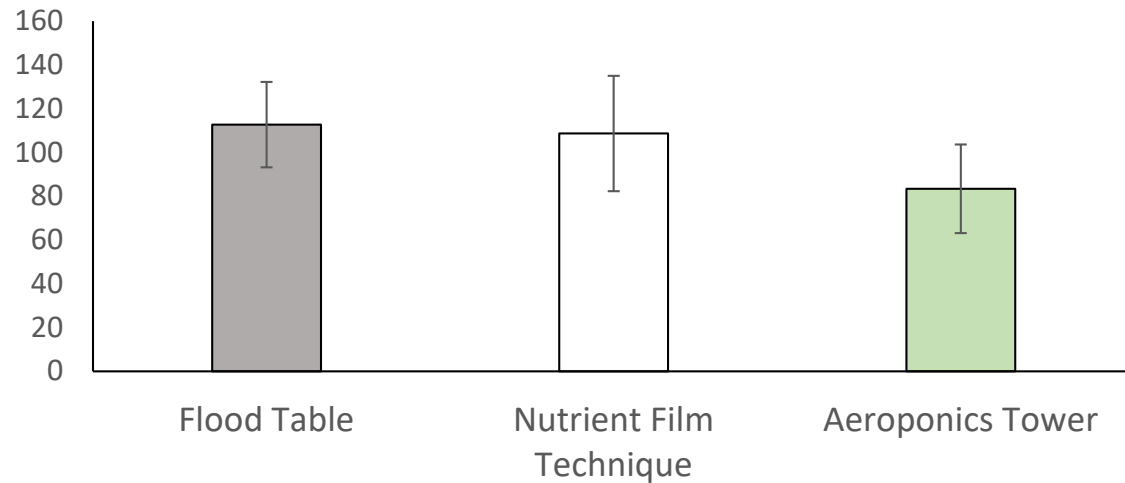


Production Systems

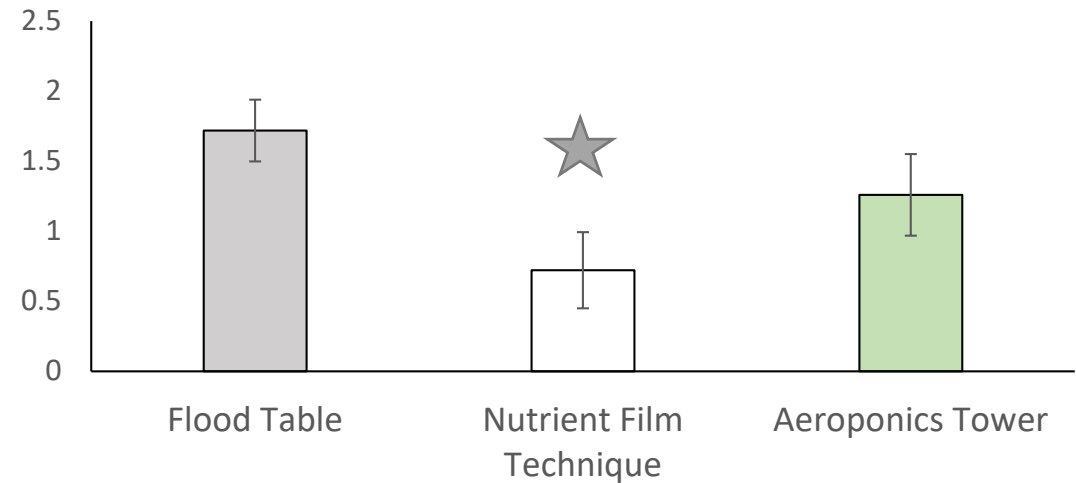


Production systems mostly differ in water use

Yield
(grams per square feet)



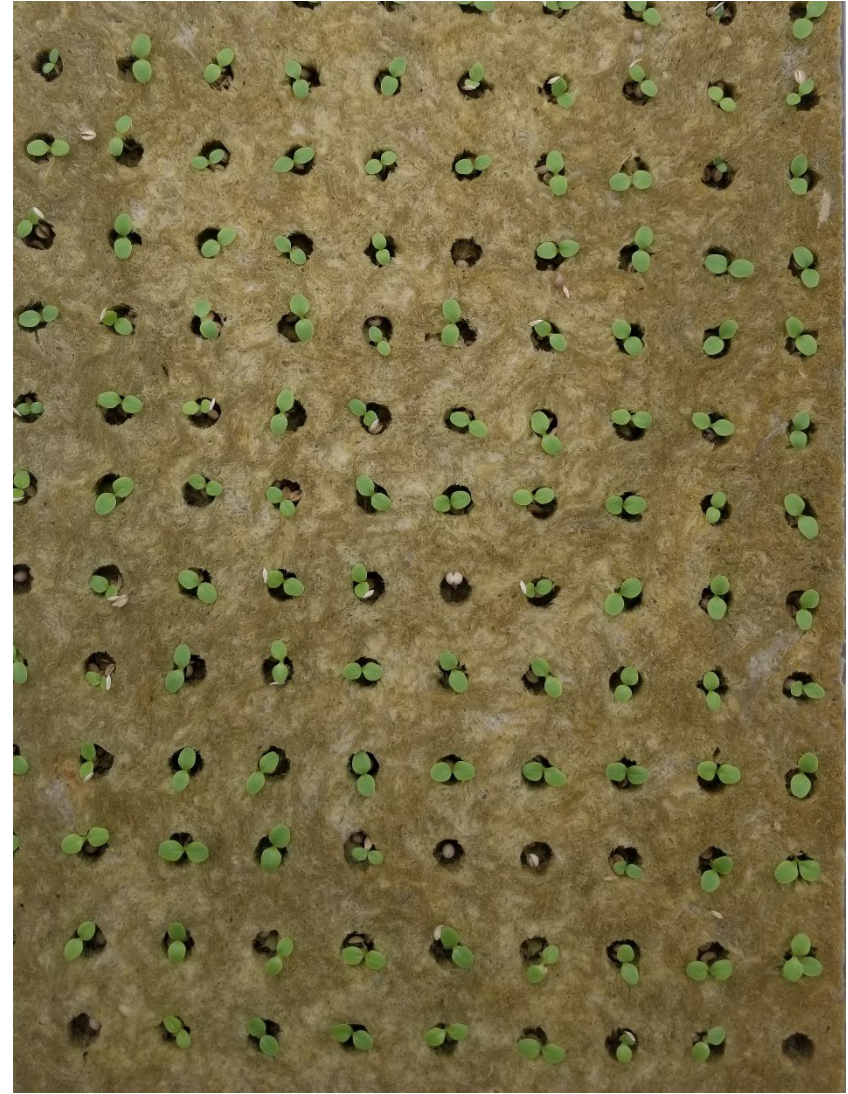
Water Use
(liters per week per square feet)



Hydroponic Substrates



Peat

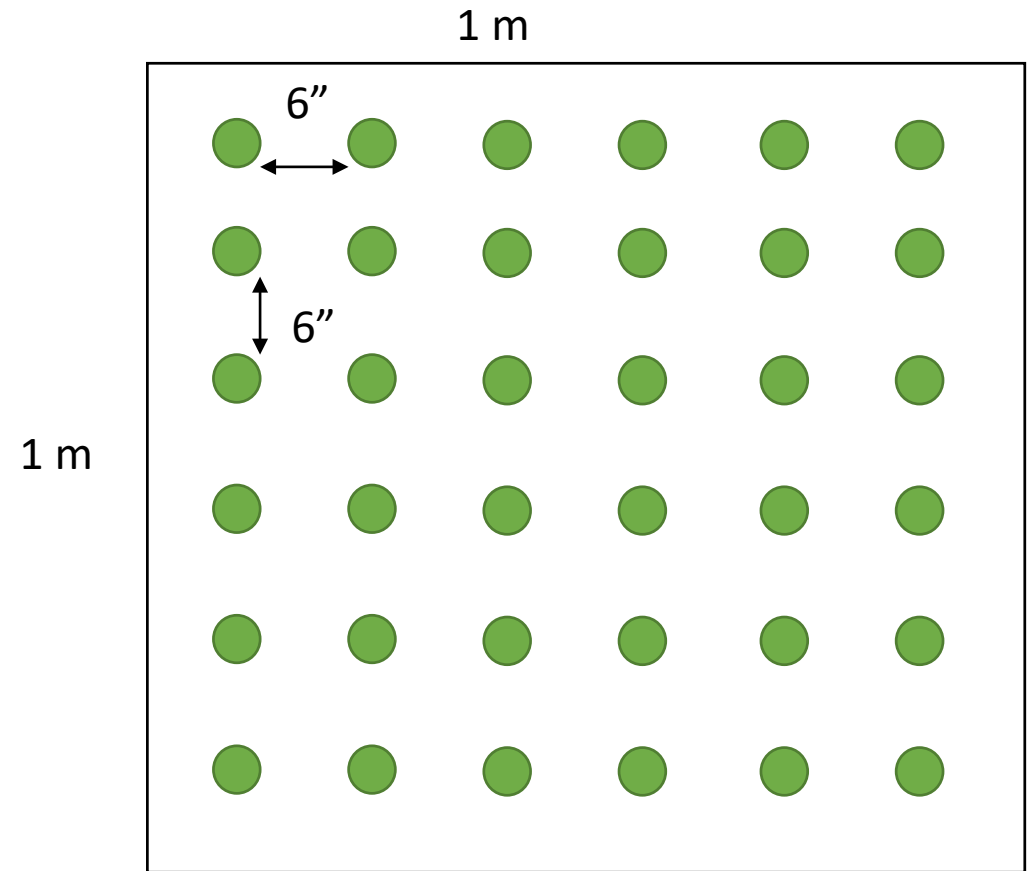


Rockwool

Peat substrates resulted in faster growth

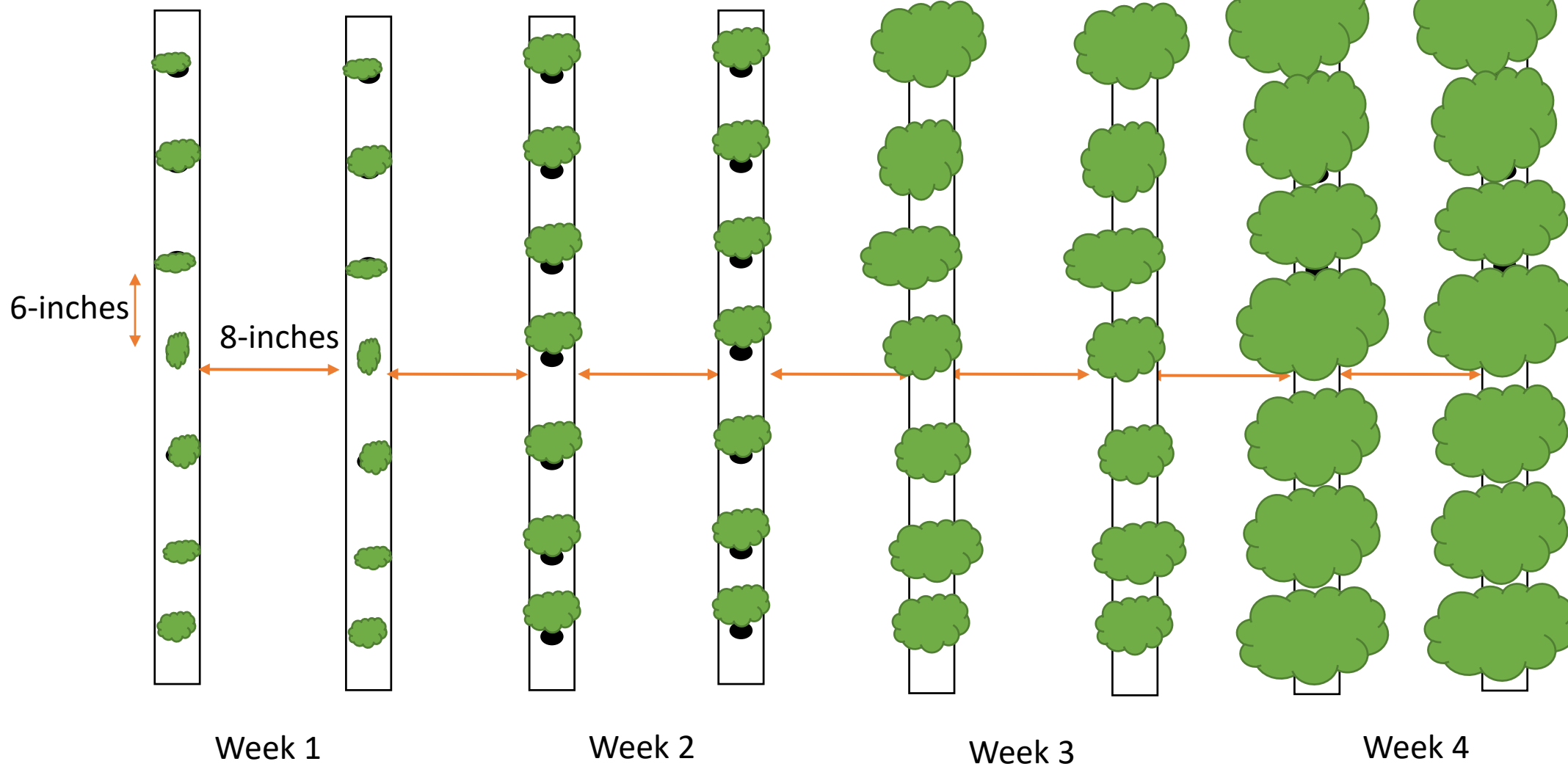


Spacing (36 plants/m²)

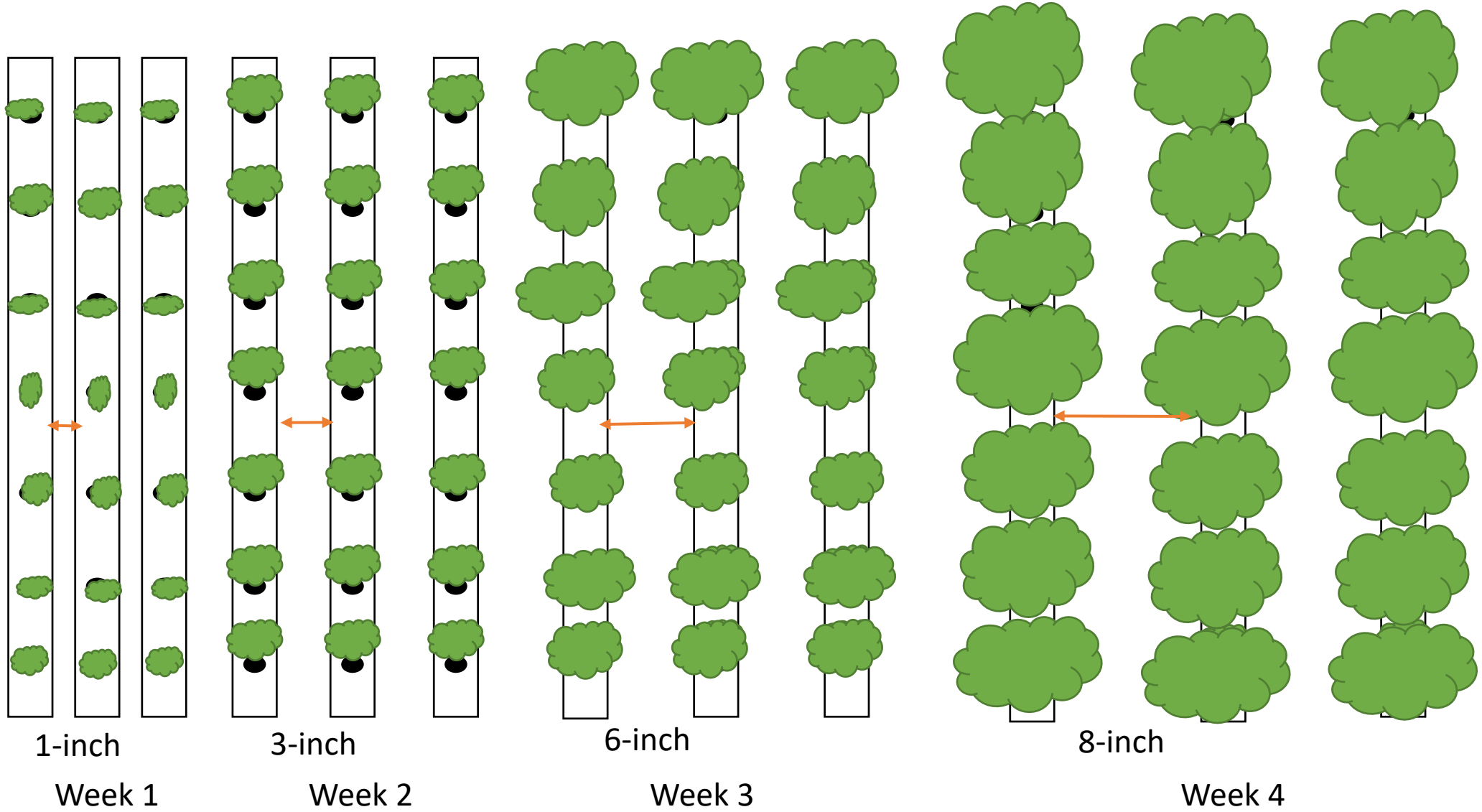


Spacing: Fixed NFT Benches



3 plants/ft² or 32 plants/m²





Spacing: Sliding NFT Benches

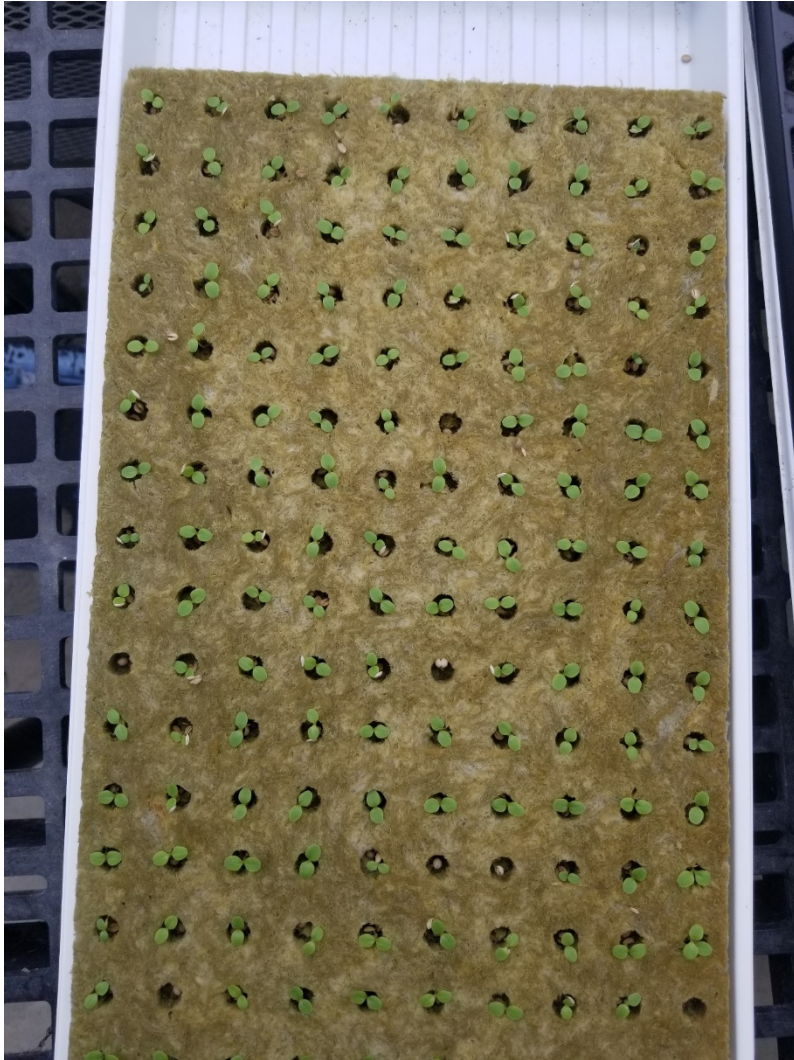


Lettuce Varietal Trial

| Group | Rank | Variety | Color | Plant dry weight (g/plant) |
|---|------|-----------------------|-------|----------------------------|
| Leaf  | 1 | Red Sails | Red | 16.2 |
| | 2 | Walkmann's Dark Green | Green | 14.0 |
| | 3 | Cherokee | Red | 11.6 |
| | 4 | Black Seeded Simpson | Green | 11.3 |
| | 5 | New Red Fire | Red | 10.5 |
| | 6 | Nevada | Green | 7.5 |
| Romaine  | 1 | Salvius | Green | 18.6 |
| | 2 | Dragoon | Green | 14.1 |
| | 3 | Breen | Red | 9.2 |
| | 4 | Truchas | Red | 8.2 |
| | 5 | Amadeus | Green | 7.1 |
| | 6 | Intred | Red | 6.1 |

| Group | Rank | Variety | Color | Plant dry weight (g/plant) |
|---|------|-------------------------|-------|----------------------------|
| Butter-head  | 1 | Alkindus | Red | 10.2 |
| | 2 | Butter Crunch | Green | 9.4 |
| | 3 | Adriana | Green | 8.8 |
| | 4 | Natalia | Green | 7.9 |
| | 5 | Rex | Green | 7.9 |
| | 6 | Skyphos | Red | 5.0 |
| | 7 | Salanova Red Butterhead | Red | 2.6 |
| Oakleaf  | 1 | Salanova Green Oakleaf | Green | 10.4 |
| | 2 | Navara | Red | 9.1 |
| | 3 | Cedar | Green | 8.5 |
| | 4 | Red Salad Bowl | Red | 6.4 |
| | 5 | Salanova Red Oakleaf | Red | 6.4 |

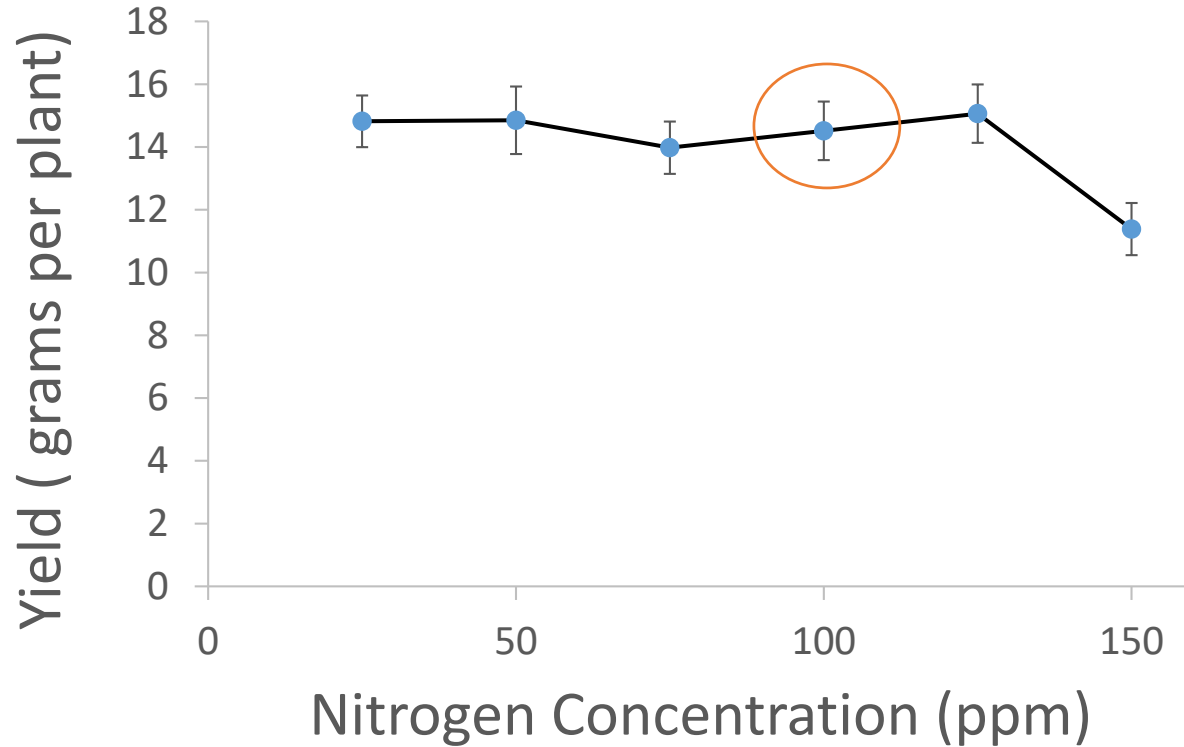
Germination



- Keep humidity high and plugs moist during germination
- Use a dilute fertilizer solution (EC of 0.5 to 0.75 dS/m)
- Light intensity can be low (100 to 150 $\mu\text{mol}/\text{m}^2/\text{s}$) during the initial week
- Preferred germination temp \sim 70 F or 21 C
- Seedlings may need to be thinned, earlier preferred
- Transplant seedlings prior to leaf overlap

Nutrient requirement

(combined data from 8 lettuce varieties and 2 production systems)



Weight (In Ounces) Of Product Needed To Mix One U.S. Gallon Of Concentrate

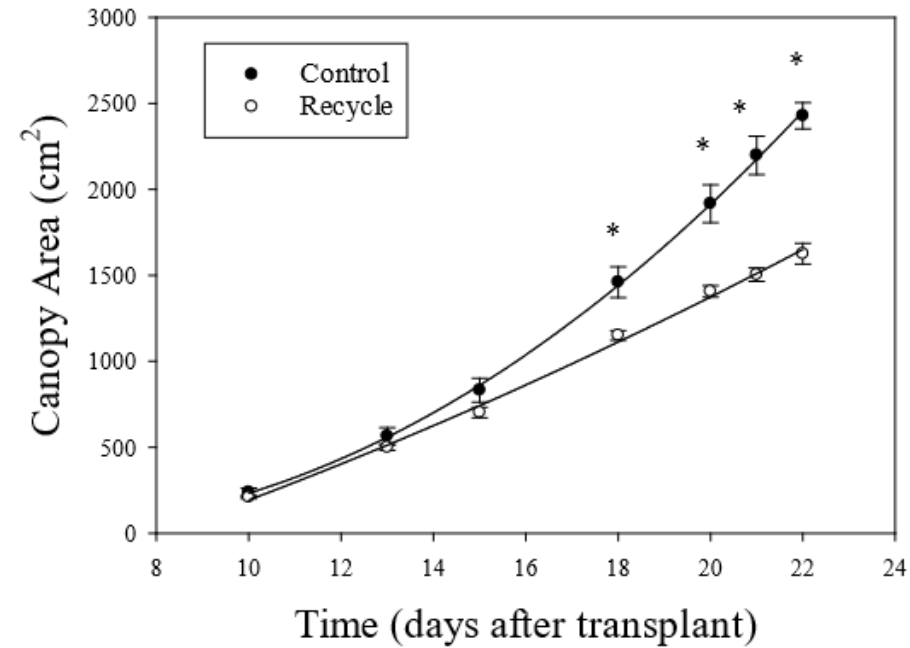
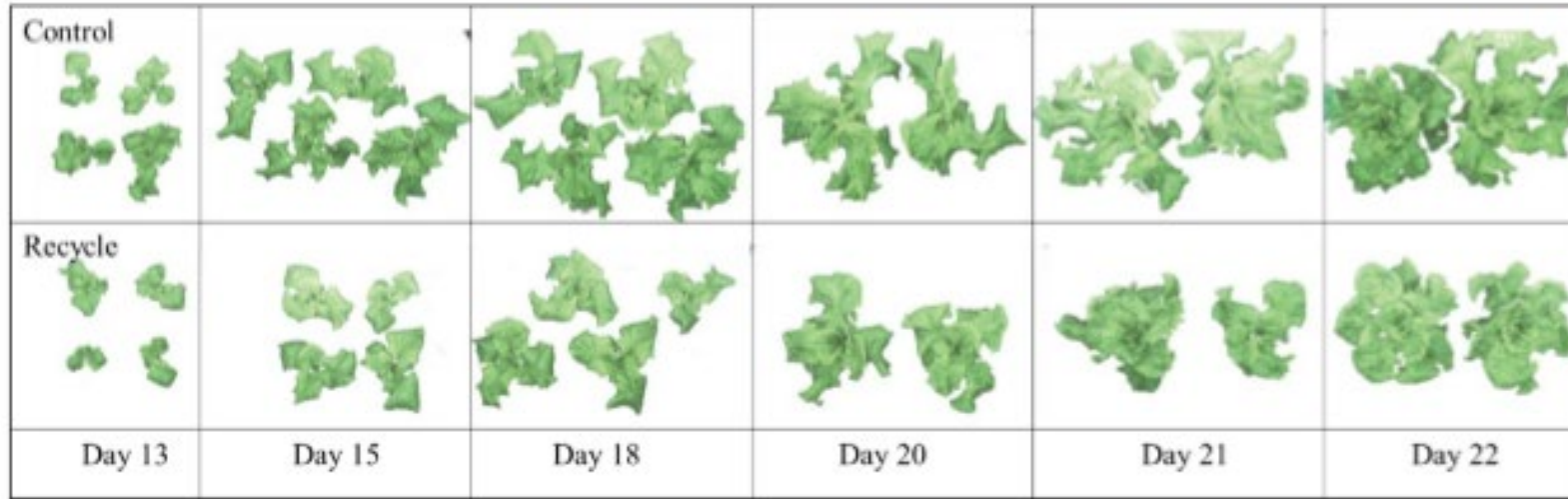
| Target Fertilizer Concentration (ppm N) After Dilution | Injector Ratios | | | EC mmhos/cm of Target Feed Rate After Dilution |
|--|-----------------|-------|-------|--|
| | 1:15 | 1:100 | 1:200 | |
| 50 | 0.5 | 3.4 | 6.8 | 0.31 |
| 100 | 1.0 | 6.8 | 13.5 | 0.62 |
| 200 | 2.0 | 13.5 | 27.0 | 1.24 |
| 300 | 3.0 | 20.3 | 40.5 | 1.86 |

Managing recycled fertilizer solution

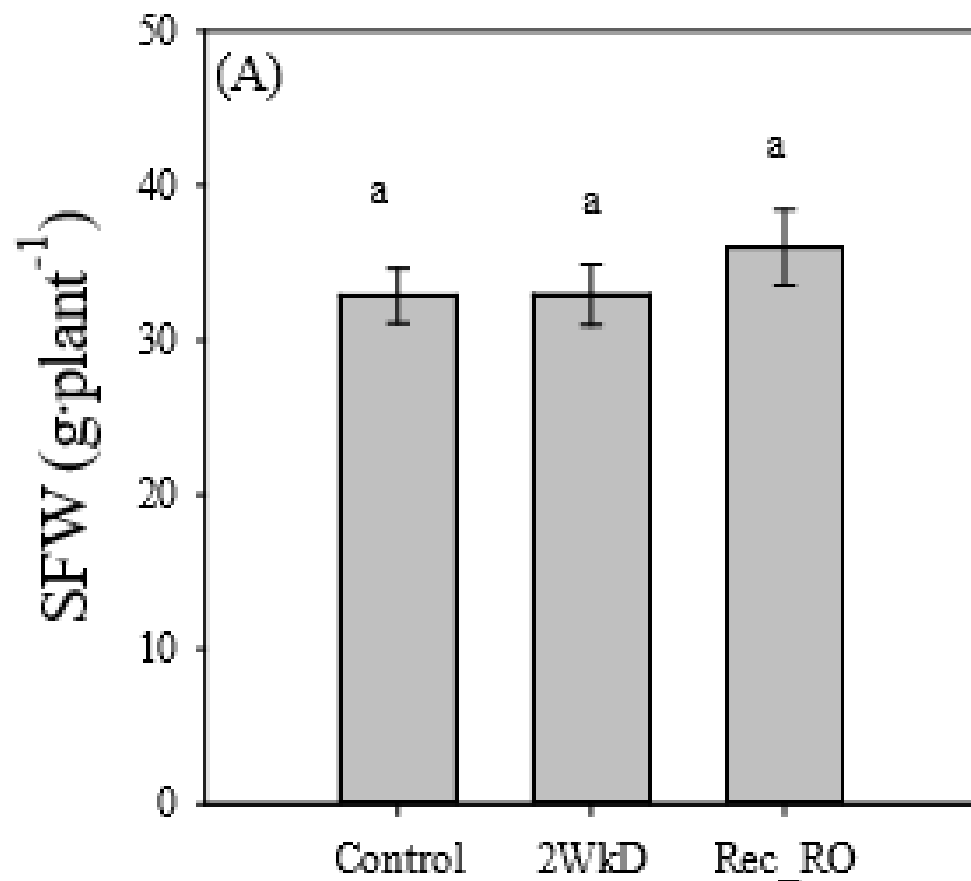
| Treatment | SFW g·plant ⁻¹ |
|-----------|------------------------------|
| Control | 31.0 (4.35) a |
| Recycle | 20.9 (3.61) b |

* Control treatment received freshly prepared solution twice a week

Negative effects of recycling appears after two weeks



Negative effects can be reduced by discarding recycle solution after two weeks or using RO water



Optimum greenhouse temperature



Light requirement



20 mol/m²/day



10 mol/m²/day

Greenhouse production during winter

- Heating and supplemental lighting are required
- Energy costs for heating and supplemental lighting affect profits
- Productivity and energy efficiency should be increased for profits



GC III
Air Temp. 60°F
Water Temps
60°F 64°F 66.5°F 70.7°F
↙ ↓ ↓ ↘

Greenhouse was maintained at cooler temperature to reduce heating costs
Solution temperature was increased from 60 to 71°F



Maximize heating efficiency using root zone heating



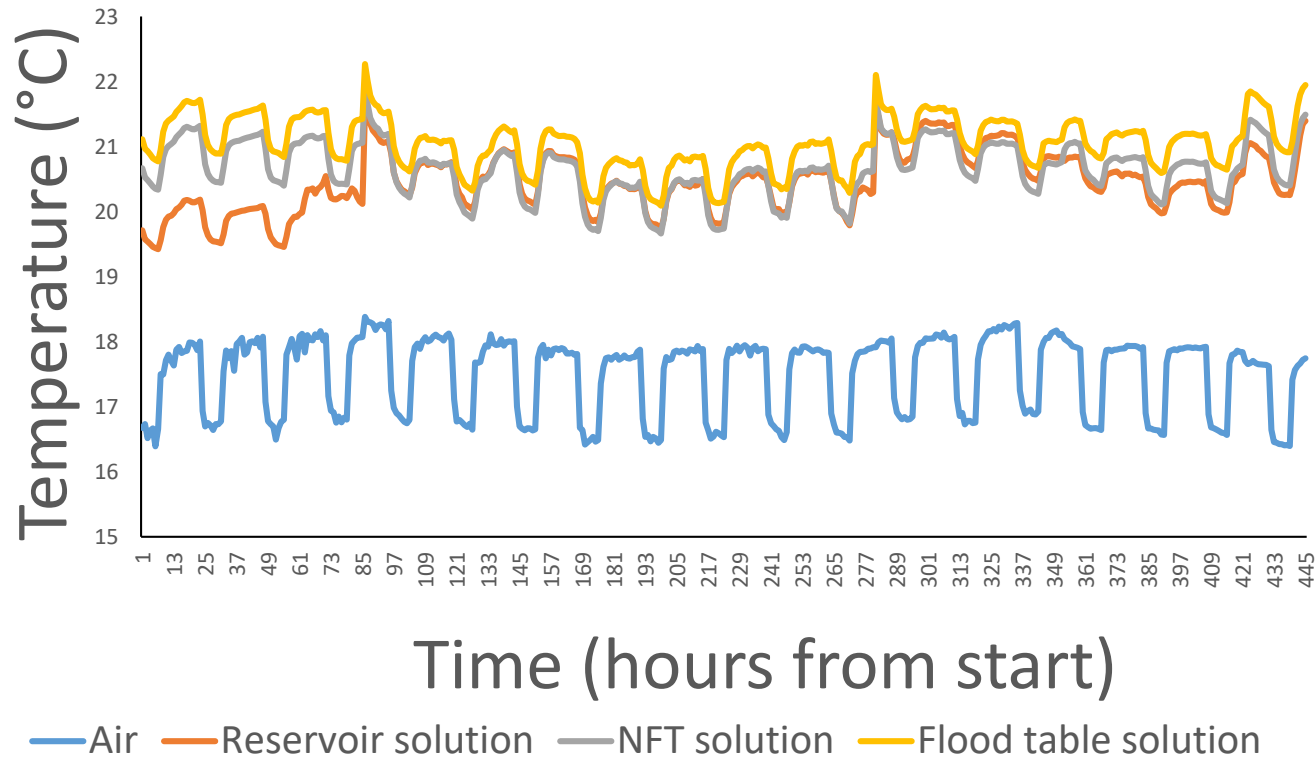
Greenhouse 60/50 F

Heated Solution (70 F)

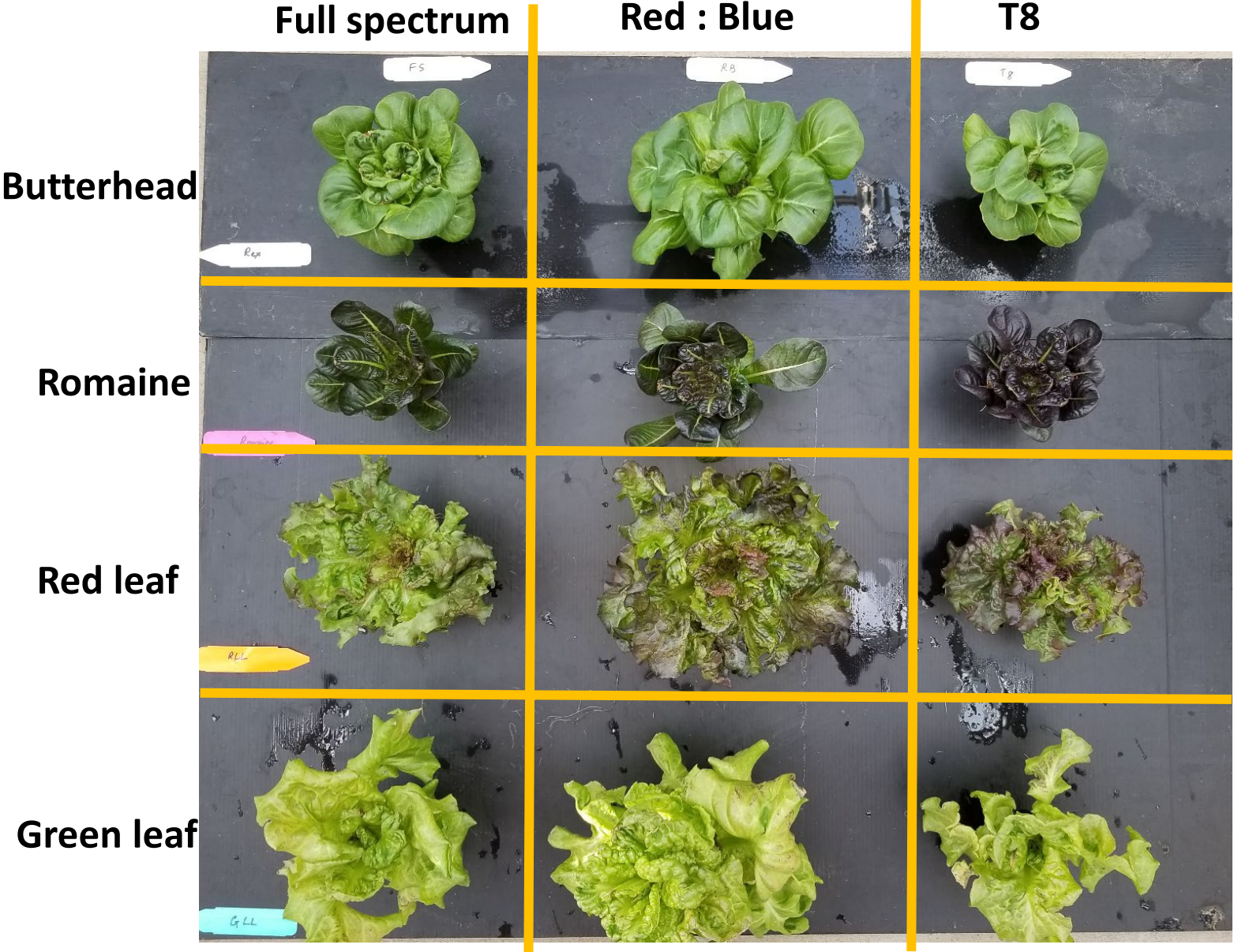
Unheated Solution (60/50 F)

Production system effects on root zone heating

Plant growth was better under flood tables than NFT when warm solution was supplied to roots



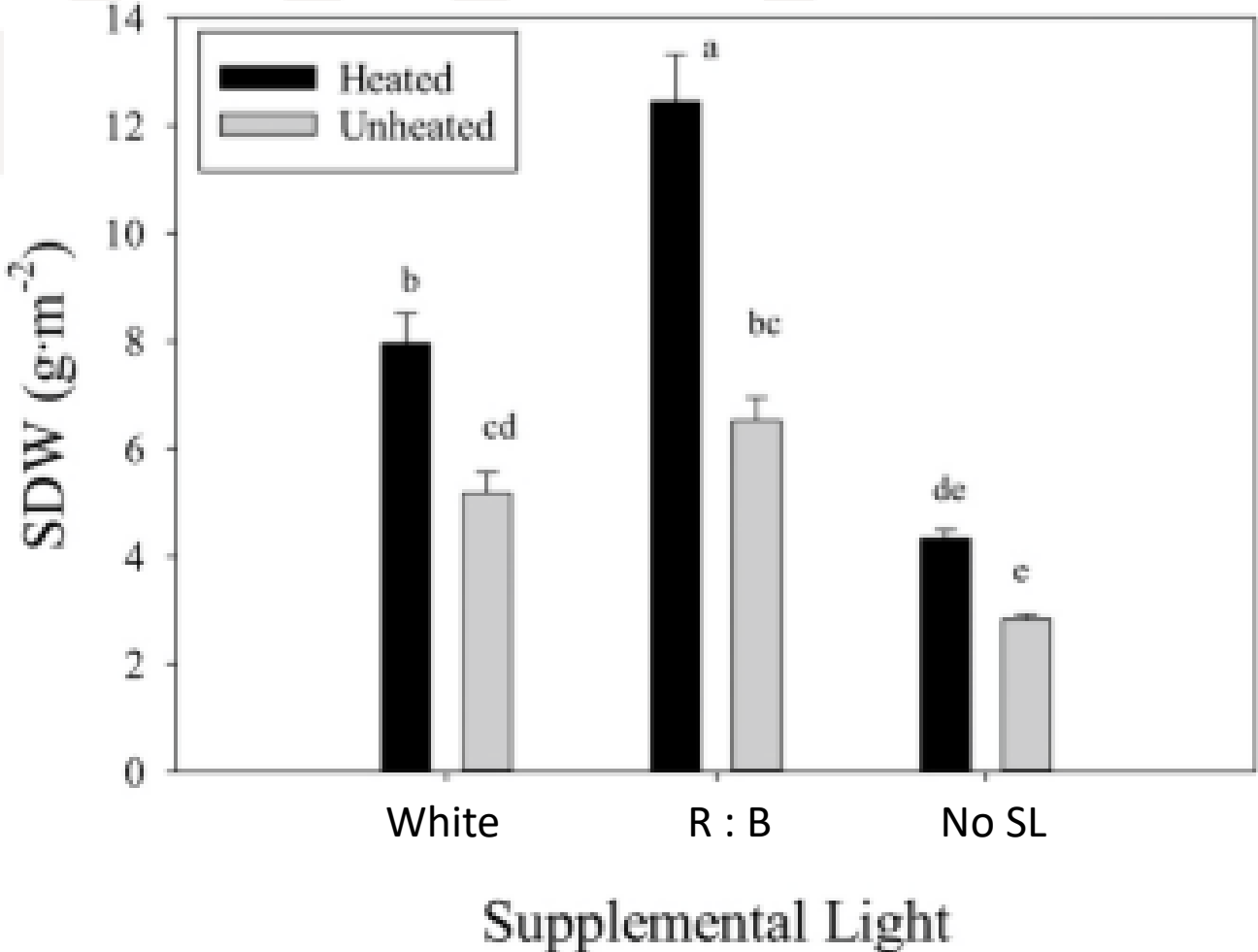
Lettuce growth is highly influenced by light spectrum



Supplemental lighting at nighttime



Increased productivity under Red (90%) : Blue (10%)



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