Commercial indoor growing installations

- Main crop is leafy greens
- Economics are challenging, new business models

Indoor propagation

- Greenhouse is not always the ideal environment for propagation, especially in the Florida summer

- Tissue culture laboratory stage (4 weeks)
- GH rooting stage (8-12 weeks)
  - $173 sales value/288 tray
Commercial indoor propagation

- Shenandoah Growers VA
- Battlefield Farms VA
- Frontier Lab South Africa

- Very approximate cost figures:
  - ≈ $0.70 to $0.90 per square foot per week
  - ≈ $5 to $7 per tray for 4 weeks

UF Trials on lighting

Indoor white-red-blue LEDs
Research and commercial Greenhouses

UF Trials: Tissue culture blueberries

- 4 Weeks After Initial Planting of Vaccinium corymbosum 'Emerald'
- Break even to pay for lights:
  - 17 more plants survive per 288 tray = 6%
- Observed 12% improvement

Grower Onsite “Light Cart” Trials

Gabriel Pelegrina and Joaquin Saavedra setting up at AgriStarts FL
Speedling FL
Spring Meadow MI
AgriStarts FL first trial
Indoor production – Next steps

- Research
  - Cost, scale, labor, & seasonality
  - Which crops are worthwhile? (high value, high shrinkage)
  - Technical: humidity, nutrition, lighting, pest & disease

- Extension
  - Gain experience, light cart trials, articles, conservative at this point

- Integrating Research and Extension
  - Grower/extension experience can drive research questions
  - Technical team (Environmental Hort, Hort Sci, AB Engineering, Plant Pathology, Entomology, Economics, multi-state)

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2. Small-scale hydroponics

Over 77% of U.S. households are involved in gardening activities (NGA, 2018)

30% of those activities take place indoors (NGA, 2018)

Indoor food gardening was recently ranked as one of the fastest-growing trends in horticulture (GMG, 2017)

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Commercial vs. Small-scale Plant Production

- Most research focused on:
  - Maximizing profit ($)
  - Reducing inputs
  - Increasing yield

- Lack of information:
  - Plant selection
  - Lighting requirements
  - Plant maintenance
  - Nutrient solution management

Consumer success could increase with low-maintenance, easy-to-use, and robust systems
Plug and play “resilient” transplants & growing systems

Resilient lighting for indoor home gardeners
• How little light can be provided for consumer success

Resilient nutrient management programs
• Simplifying nutrition for the home consumer market
• Controlled release fertilizer blends for one-time fertilizer application (tea-bag or value-added plug)

Small-scale hydronics/edible food – Next steps
• Research
  – Nutrition and lighting
  – Growing system
• Extension
  – Perfect link to target home grower
• Integrating Research and Extension
  – Growing resilient plants / Why do plants fail?
  – Mix of technical, social, and economic
3. Ginger (Zingiber officinale), galangal (Alpinia galanga), and turmeric (Curcuma spp.)

**Added-value products a.k.a. “Superfoods”**

In 2017, import values of spices reached $1,801 million (USDA, 2018)

Ginger ($117M in 2018) and turmeric ($87M in 2018) among top imported spices

**Product potential**

- Low value as commodity, global average $2.25 / kg
- High value as local fresh (baby ginger) or value-added product

**Conventional propagation – seed rhizomes**

Rhizomes are susceptible to soil-borne pathogens such as *Fusarium*, *Pythium*, *Ralstonia*, nematodes and other soil-borne diseases.
Tissue-culture transplants

Pathogen-free planting material

Lower yield during the first production cycle

Photoperiodic

Photoperiod Trials
- Natural days (<12 h)
- Long days (>12 h) + night interruption

Galangal & Ginger Yield

<table>
<thead>
<tr>
<th>Natural days</th>
<th>Long days</th>
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</thead>
<tbody>
<tr>
<td>Galangal tc</td>
<td>Ginger Bubba baba</td>
</tr>
<tr>
<td>Ginger tc</td>
<td>Galangal tc</td>
</tr>
<tr>
<td>Ginger rhizomes 2nd generation tc</td>
<td>Ginger rhizomes 2nd generation tc</td>
</tr>
</tbody>
</table>
Turmeric Yield

Natural days

Long days

Yellow tc
Yellow rhizomes
2nd generation tc
Yellow tc
Yellow rhizomes
2nd generation tc
White tc
White tc

Additional studies

- Field (shade vs full sun)
- Season extension
- Density
- Organic production
- Kaolin
- Postharvest
- Active ingredients

Ginger / Turmeric – Next steps

- Research
  - Young Plants – adequate supply, season extension
  - Economics & Marketing
  - Which are most profitable opportunities?

- Extension
  - Small farming potential

- Integrating Research and Extension
  - Specialty Crops Block Grant application in works
  - Multi-disciplinary