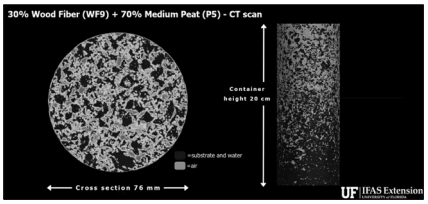
# Research & Outreach 2019
# Indoor growing & Root zone management




**Paul Fisher, pfisher@ufl.edu**
**Celina Gómez, cgomezv@ufl.edu**

UF IFAS UNIVERSITY of FLORIDA

# Thank you for your support!

**Growers**

- Dummen Orange
- Four Star (MI)
- Knox Horticulture (FL)
- Kube-Pak (NJ)
- Lucas (NJ)
- Mast Young Plants/Neal Mast (MI)
- Pleasant View Gardens (NH)
- Rockwell Farms (NC)
- Speedling (FL, CA)
- Spring Meadow (MI)
- Vivero Internacional (Mexico)
- Walters Gardens (MI)

**Allied**

- AMA Horticulture
- Blackmore Co.
- BlueLab
- Fine Americas
- Greencare Fertilizers
- Griffin Greenhouse Supplies
- Klasmann-Deilmann
- Pindstrup
- Premier Tech Horticulture
- Quality Analytical Laboratories
- Sun Gro Horticulture

USDA | American Floral Endowment | LONGWOOD GARDENS

George Grant | Dr. Erin Yafuso | Sofia Flores | Elisa Solis | Joaquin Saavedra | Fernanda Trientini | Alec Goff | Maria Paz | Dr. Celina Gómez | Dr. Rosanna Freyre



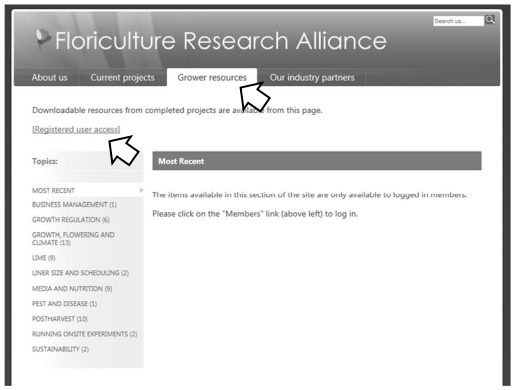
# Outline

1. Labor and Training
2. Plant factory propagation
3. Indoor growing
4. Root zone management



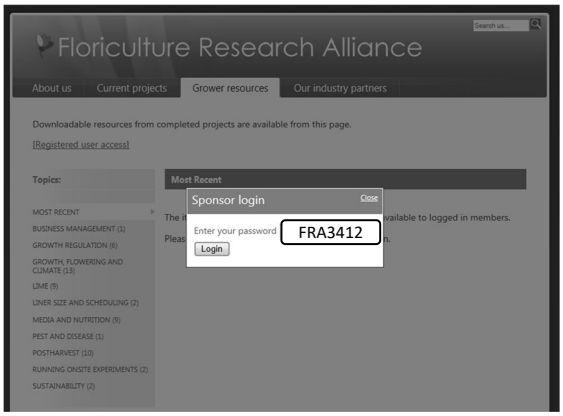
# How to access handouts & reports

- After conference, handouts will be uploaded to the floriculturealliance.org website for detailed reports






# Remember the secret code: FRA3412






# FRA account of Back Pocket Grower

- Go to backpocketgrower.org with your browser
- Looks best on a mobile device
- Sign in: new pw **FRA3412**

# Back Pocket Grower: New apps

- Currently in development

**Constant Light Level Calculator**
**Prototype by Paul Fisher, University of Florida, Oct 16 2019**

**Calculate the light intensity and photoperiod required to achieve a certain daily light integral, for an electric light source such as indoor LED (light-emitting diode) lighting.**

| | *Enter two of the values below then select "Calculate"* |
|---|---|
| Light intensity (micromoles/$m^2$/second) | 70 |
| Photoperiod (day length in hours/day) | 20.00 |
| Daily light integral (moles/$m^2$/day) | **5.04** |

Calculate



# Back Pocket Grower: New apps

## Vote for your priorities

- **Container substrates:**
  - Soil volume calculator to fill pots (beta version in development)
  - Make your own substrate blend amounts & cost
- **Chemical:**
  - Chemical spray and drench volume and cost
- **Fertilizer:**
  - Controlled release fertilizer amount, NPK per pot, & cost
- **Light:**
  - DLI from constant light source & photoperiod (beta version in development)
  - DLI quick estimator for sunlight (based on peak light, day length, & constant shade)
  - Light unit converter for different sources
- **OTHER???**



# Greenhouse Issues: Labor and Training

- Greenhouse Grower 2019 State of the Industry survey

**Which topics you are most concerned about with regard to your business? (check all that apply)**

| | |
|---|---|
| Labor | 66% |
| Production costs (energy, equipment, etc.) | 56% |
| Weather/ changing weather patterns | 48% |
| The economy | 42% |
| Government regulation (immigration, labor, health care, etc.) | 38% |
| Transportation (cost, availability, regulation, etc.) | 31% |
| Insect and disease pressure | 31% |
| Succession planning | 17% |
| Mechanization | 16% |
| Water | 16% |
| Environmental sustainability | 12% |
| Access to credit/financing | 7% |
| Other | 5% |



# Manual & Automatic Transplanting of Plant Cuttings



# Priorities from 2018 FRA conference

- More ROI analysis on automated sticking
  - See Cultivate 2019 notes in floriculturealliance.org from Pleasant View Gardens, Spring Meadow Nursery, Four Star Greenhouses, Dickman Farms, and UF



# Priorities from 2018 FRA conference

- Best method for manually sticking cuttings
- Training materials
  - Introducing (drum roll please)…

**StickOlympics!**

## Training: StickOlympics

- Onsite transplanting competition to
  - Identify the quickest methods to transplant cuttings
  - Provide a fun pre-season tune-up to motivate and train
  - Reward excellence and professionalism
  - $600 in prize money for each of 10 operations sponsored by Blackmore Co. (Thank you!)



## Training: Online courses

- Best ROI is to train existing staff
- Greenhouse Training Online (hort.ifas.ufl.edu/training/)

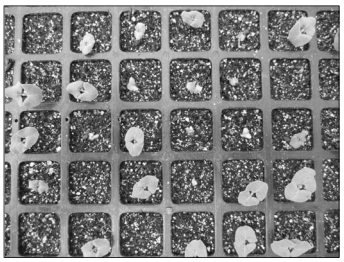
| Course Title | Dates (Enrollment) | Level | Fee |
|---|---|---|---|
| Greenhouse 101 | June 27 (152) | • | $US199 |
| Nutrient Management 1 (Intro) | July 1 (165) | •• | $US199 |
| Nutrient Management 2 (Advanced) | Aug-5 (120) | ••• | $US199 |
| Costing and Profitability | Sept 2 (37) | ••• | $US499 |
| Disease Management | Sep-19 (115) | •• | $US199 |
| Weed Management | Nov-19 | •• | $US199 |
| Water Quality & Treatment | Nov-19 | ••• | $US199 |

- 2019 American Floral Endowment grant
- Talk with me about discounts, commissions & scholarships for your company and your customers
- Course development in substrates & hydroponics



## 2. Plant factory propagation

- Greenhouse is not always the ideal environment
- We know this very well for seed germination

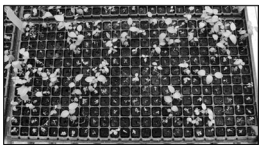




## Plant factory propagation

- Greenhouse is not always the ideal environment
- Also true for propagating high-valued cuttings

Tissue culture laboratory stage (4 weeks)

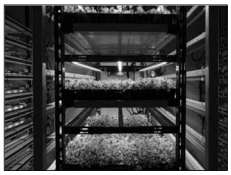


GH rooting stage (8-12 weeks)



## Commercial plant factory installations

Shenandoah Growers



Battlefield Farms

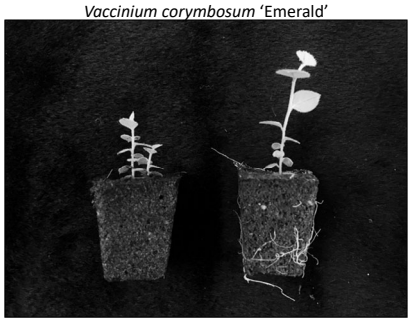
Frontier Lab

"Enhanced Rooting Chambers"



## UF Trials: Tissue culture blueberries

4 Weeks After Initial Planting of *Vaccinium corymbosum* 'Emerald'



Greenhouse Plant Factory

George Grant

# UF Trial on light level

4 light levels (35 to 140 micromol/m$^2$/s) from white-red-blue LEDs

Research and commercial Greenhouses

Megh Poudel

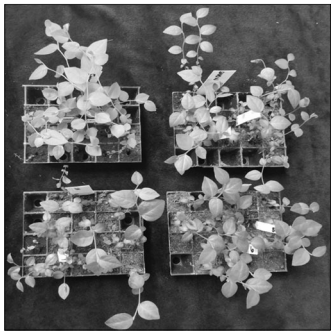


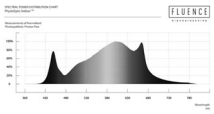
# UF Trial on light level

- 4 light levels (in micromol/m$^2$/s of PAR light) under LEDs

35

70

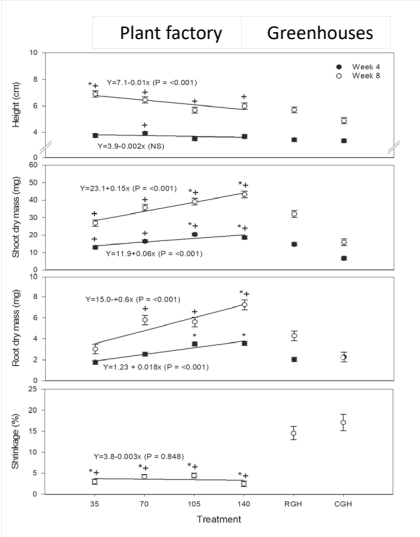





105

140






At week 4, Plant factory resulted in similar rooting to week 8 in greenhouse

Week 8 shrinkage
4% Plant factory
15% Research greenhouse
17% Commercial greenhouse



# Current UF trial: varying light quality & quantity

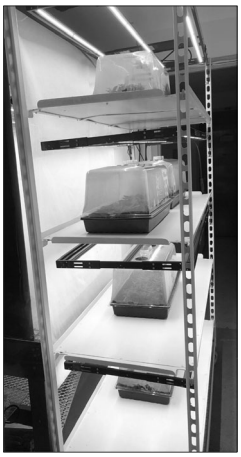
Joaquin Saavedra



# Current UF trial: Indoor Fog & Mist Environment



# Current UF trial: Light Cart & Dome Environment



## Current UF trial: Unrooted cuttings

Alec Goff

Indoor Fog and Mist

Light Cart & Dome

Greenhouse



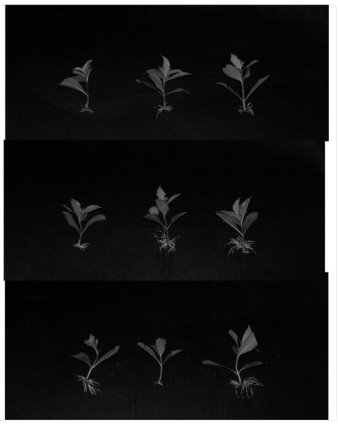
## Current UF trial: Woody flowering shrub URCs

*Weigela* Week 2

Indoor Fog and Mist

Light Cart & Dome

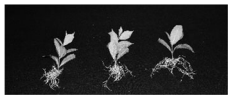
Greenhouse





## Current UF trial: Woody flowering shrub URCs

*Weigela*

| | Last 2 weeks Indoor LEDs | Last 2 weeks Greenhouse |
|---|---|---|
| First 2 weeks Indoor Fog and Mist |  |  |
| Light Cart & Dome |  |  |
| Greenhouse | |  |



## Plant factory propagation

- Will it pay?
- Very approximate cost figures:
  - ≈ $0.70 to $0.90 per square foot per week
  - ≈ $1.20 to $1.60 per tray per week
  - ≈ $5 to $7 per tray for 4 weeks



## Plant factory – Return on investment

– Reduced shrinkage

Break even number of extra cuttings surviving per tray in PF

$$17 = \frac{\text{Extra production cost in PF compared with greenhouse}}{\text{Value of each rooted cutting}} \quad \frac{\$10}{\$0.60}$$

17/288 = 6% (blueberries observed 11 to 13% less shrinkage)

– Shorter crop time:

| | Only in GH | PF then GH |
|---|---|---|
| Weeks in PF | | 4 |
| Weeks in GH | 10 | 4 |
| Extra cost in PF | | $8 |
| Sales price/cutting | $0.60 | $0.60 |
| Tray count | 288 | 288 |
| Revenue/tray | $173 | $165 |
| Revenue per tray per week in GH | $17 | $41 |



## Plant factory propagation – key questions

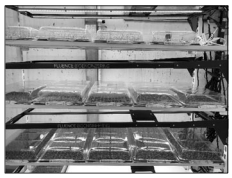
- It looks nice on paper… What is the reality?
  - Cost, scale, labor, & seasonality
  - High-valued crops
  - High shrinkage (PF v. better greenhouse & cutting quality?)
  - Technical: humidity, nutrition, lighting, pest management
- We can optimize the environment & learn physiology that can spin off into the greenhouse in the process

## Current: Grower Onsite “Light Cart” Trials

Gabriel Pelegrina and Joaquin Saavedra setting up at AgriStarts FL

Speedling FL

Spring Meadow MI

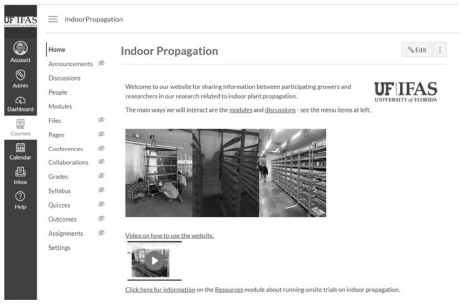


AgriStarts first trial



## Current: Grower Onsite “Light Cart” Trials

- Goals:
  a. Refine growing protocols
  b. Compare growth
  c. Evaluate ROI & logistics
  d. Share information & experience






# 3. Indoor Gardening

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)

## Commercial vs. Small-scale Plant Production

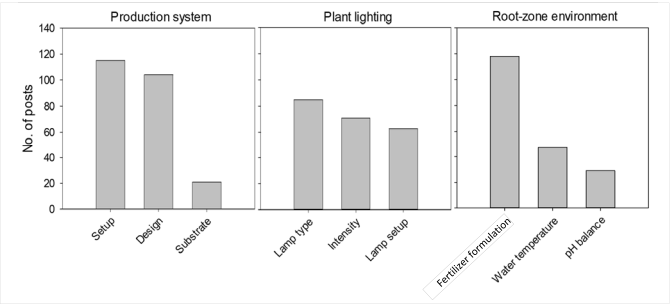
•Most research focused on:
- Maximizing profit ($)
- Reducing inputs
- Increasing yield

•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*

## Data Mining on Reddit: Common consumer questions

Elisa Solis




r/hydro
25.1k Members
24 Online

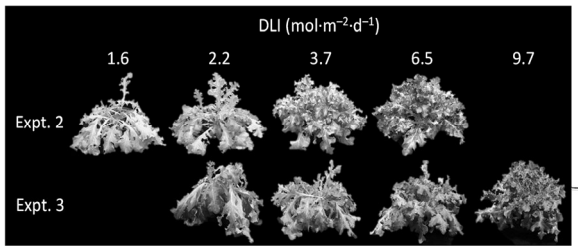
r/Hydroponics
18.4k Members
41 Online

## Plug and play “resilient” transplants & growing systems

## Resilient lighting for indoor home gardeners

Maria "Pili" Paz

- How little light can be provided for consumer success



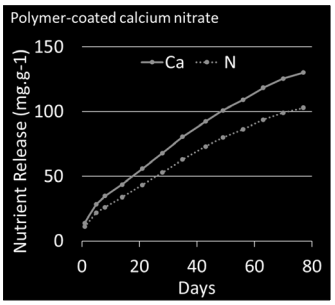

- Red Leaf lettuce after 4 weeks exposure to daily light integral (DLI) treatments from 4000-K white LED lamps (Expt. 2) or Philips GreenPower LED production modules (Expt. 3).

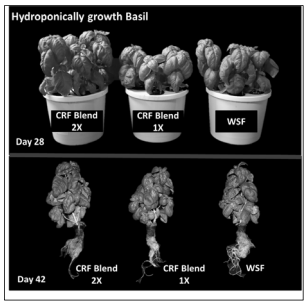


## Resilient nutrient management programs

Fernanda Trientini

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



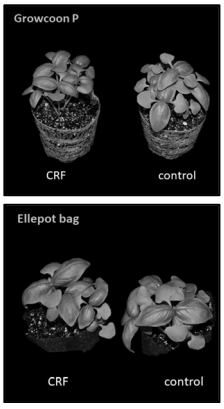






## Value-added plug

Fernanda Trientini

- Growcoons (Klasmann-Deilmann) & Growbags (Ellepot USA)




## 4. Root zone management

Maria "Pili" Paz

- Physical properties testing for communication: use by our partners, and substrate training



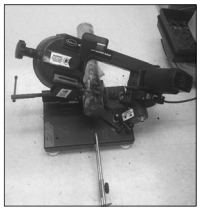
## Porosity testing

Example: Pindstrup Forest Gold & Peat

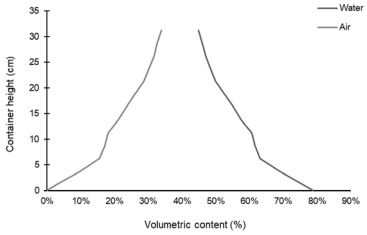
| | Air-filled porosity (%) | Water holding capacity (%) |
|---|---|---|
| Fine peat | 7% | 75% |
| Medium peat | 9% | 70% |
| Wood fiber | 32% | 52% |
| 30% WF + 70% Fine peat | 10% | 70% |
| 30% WF + 70% Medium peat | 14% | 64% |



## Water – Air distribution: frozen columns

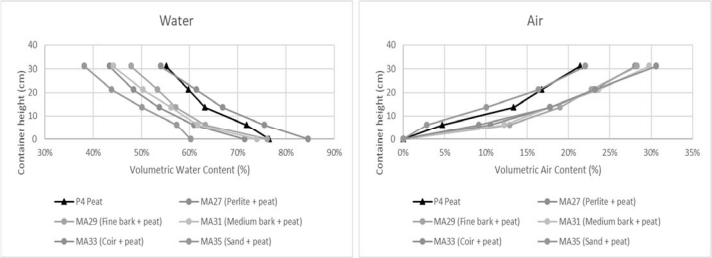


| % Water | % Air |
|---|---|
| 45% | 34% |
| 46% | 33% |
| 47% | 32% |
| 48% | 30% |
| 50% | 29% |
| 53% | 26% |
| 55% | 23% |
| 58% | 21% |
| 61% | 18% |
| 62% | 17% |
| 63% | 16% |
| 69% | 10% |
| 76% | 3% |
| 79% | 0% |




Example: Premier Tech Peat-Coir-Perlite cutting propagation substrate

## Water – Air distribution: frozen columns



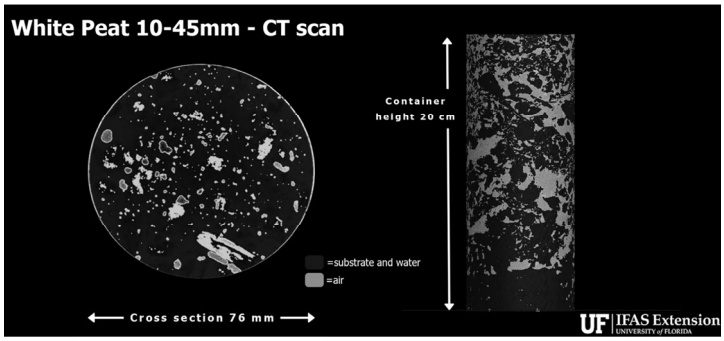

Example: Sun Gro components and blends



## Water – Air distribution: CT Scans

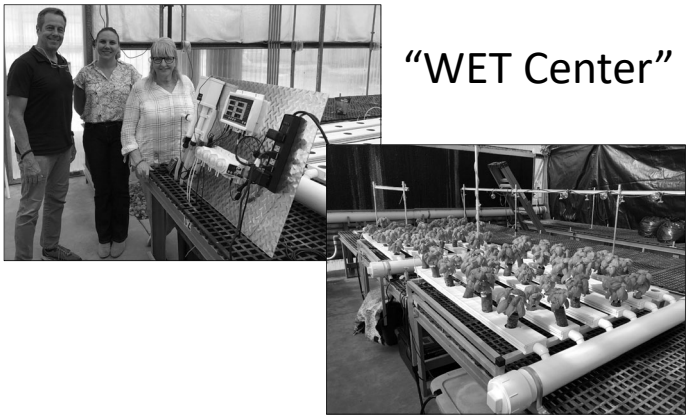
Maria "Pili" Paz

Unlisted YouTube videos. Can be embedded on substrate partner websites or we can provide to download






## Training: Hydroponics, Water treatment

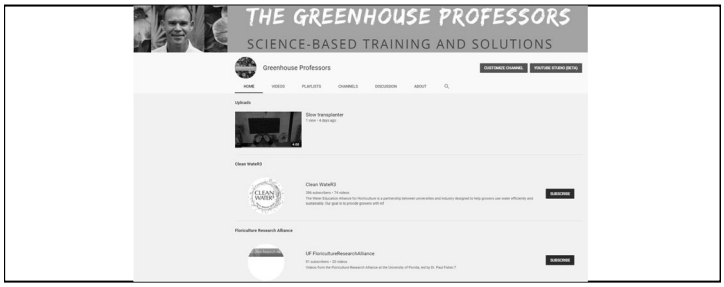


"WET Center"



## Training: Bite-sized videos

- New YouTube channel launching Jan 2020




- Brand: Reliable, quality, science-based, collaborative
- Aim for weekly posts
- Recognize funding sources



## Thank you!

1. Labor and Training
2. Plant factory propagation
3. Indoor growing
4. Root zone management