



**VERTICAL INDOOR CROP PRODUCTION: A
LEARNING PRODUCTION SYSTEM IN THE
COLLEGE OF AGRICULTURAL SCIENCES**

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Outline



01 Introduction

02 Objectives

03 Facilities description

04 Outcomes and conclusions

“Refers to the use of controlled environment systems to grow crops in structures without the use of solar light.”



INDOOR CROP PRODUCTION



CLIMATE SMART
AGRICULTURE



FARM
EFFICIENCY



INCREASEMENT OF
CROP YIELD PER FT²
OF SPACE



REDUCTION OF
WATER
CONSUMPTION



SHORTEN
PRODUCTION
CYCLES



INNOVATION



Aeroponic Greenhouse

translucent, climate controllable structure where plant roots are suspended in the air and misted with a nutrient solution



Aquaponic Greenhouse

translucent, climate controllable structure where plants are grown in water that has been used to cultivate aquatic organisms (typically, fish)



Container Farm

standardized, self-contained growing unit that employs vertical farming systems and artificial lighting.



Hydroponic Greenhouse

translucent, climate controllable structure where plants are grown in water as opposed to soil



Indoor Vertical Farm

fully enclosed and opaque room with a vertical hydroponic, aeroponic, and/or aquaponic system. Artificial lights are used.



Soil-based Greenhouse

translucent, climate controllable structure where plants are grown in soil



In Home Systems

small standardized growing unit for use by consumers in home settings.

Objectives



To establish an ICP facility in the UPRM Agricultural Experimental Station facilities at Lajas, PR



To develop specific recommendations for farmers, students, and investors



To educate, train, and promote agricultural production in such technology

Project Timeline

2017
RIIA/AGFEI
2018 \$

01



01

Identification
of empty
spaces across
campus

Technology
Innovation
and
equipment
search

03



04

Building
renovation:
food grade,
OSHA regulations

April 2019

05



Location



Renovate spaced of 17.8 m² (192 ft²) production area, and a showroom of 5.9 m² (64 ft²)



UPRM Lajas Research Substation
Bo. Palmarejo
Carr. 101 Km 8.5
Lajas, PR







UPRM Indoor Crop Lab Facilities





Figura 1

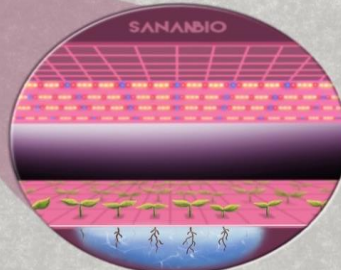


Figura 1a

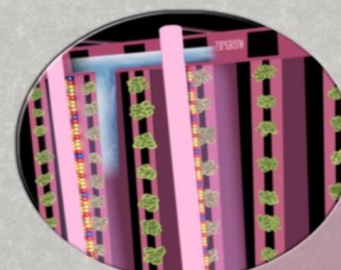


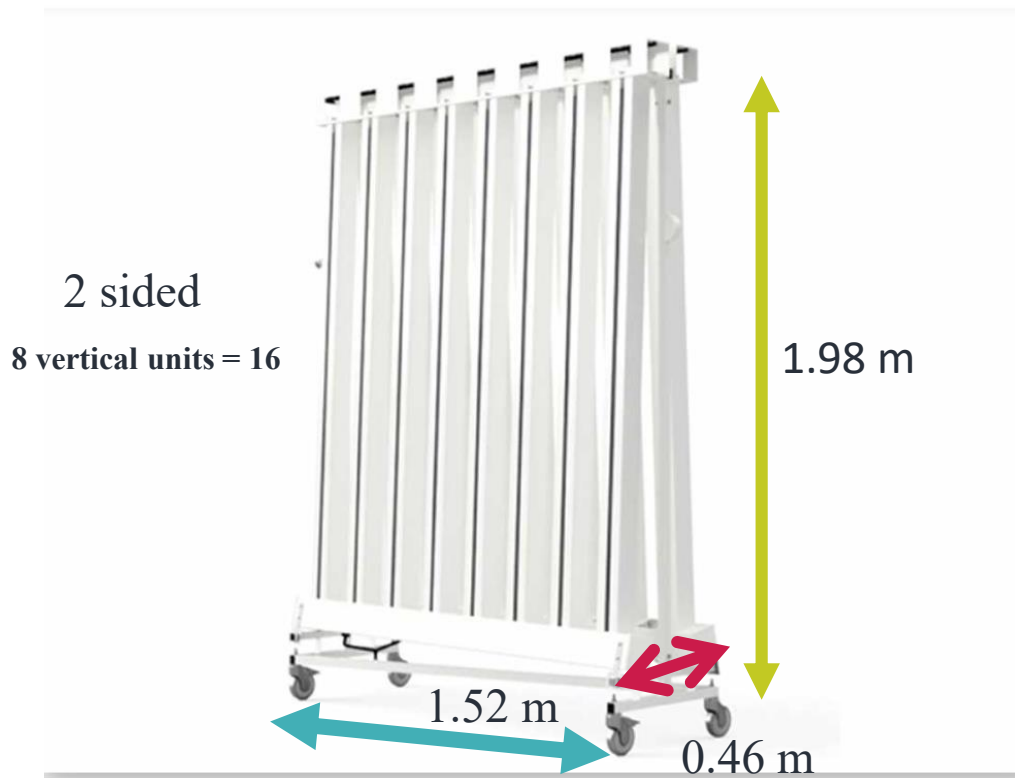
Figura 2a



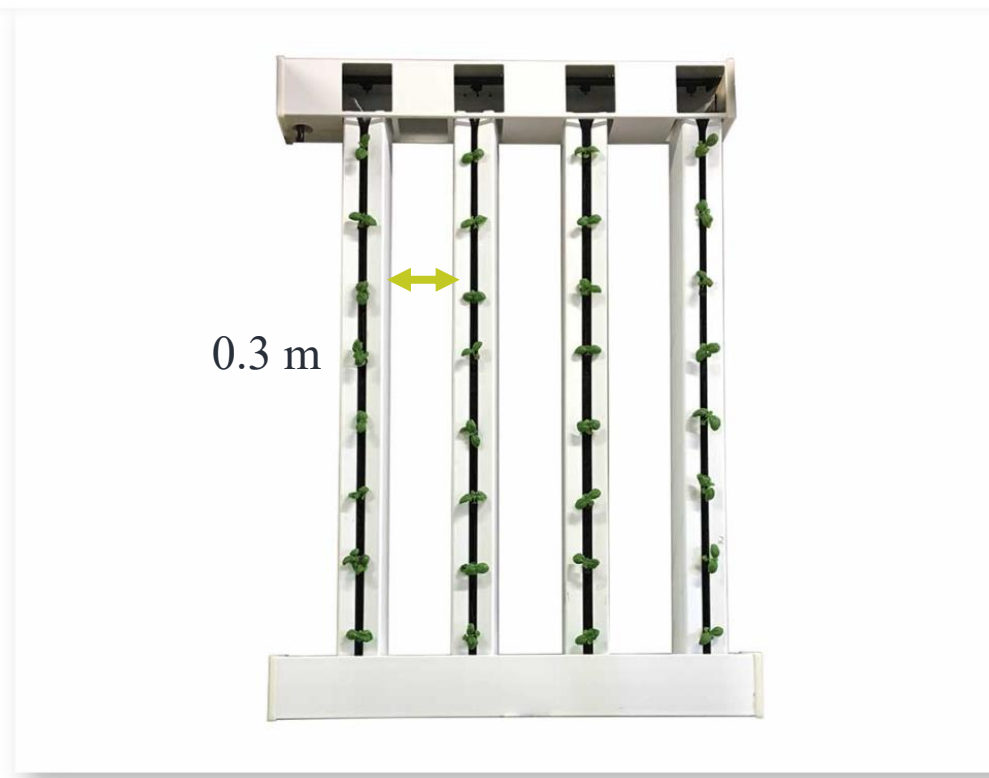
Figura 2

May
2019

Zipgrow[®] Towers



Education and market testing unit



Area total= 1.35 m³

Capacity:

128 plants 8x8

256 plants 4x4



Sananbio[®] Radix



Radix

Up to 8 layers

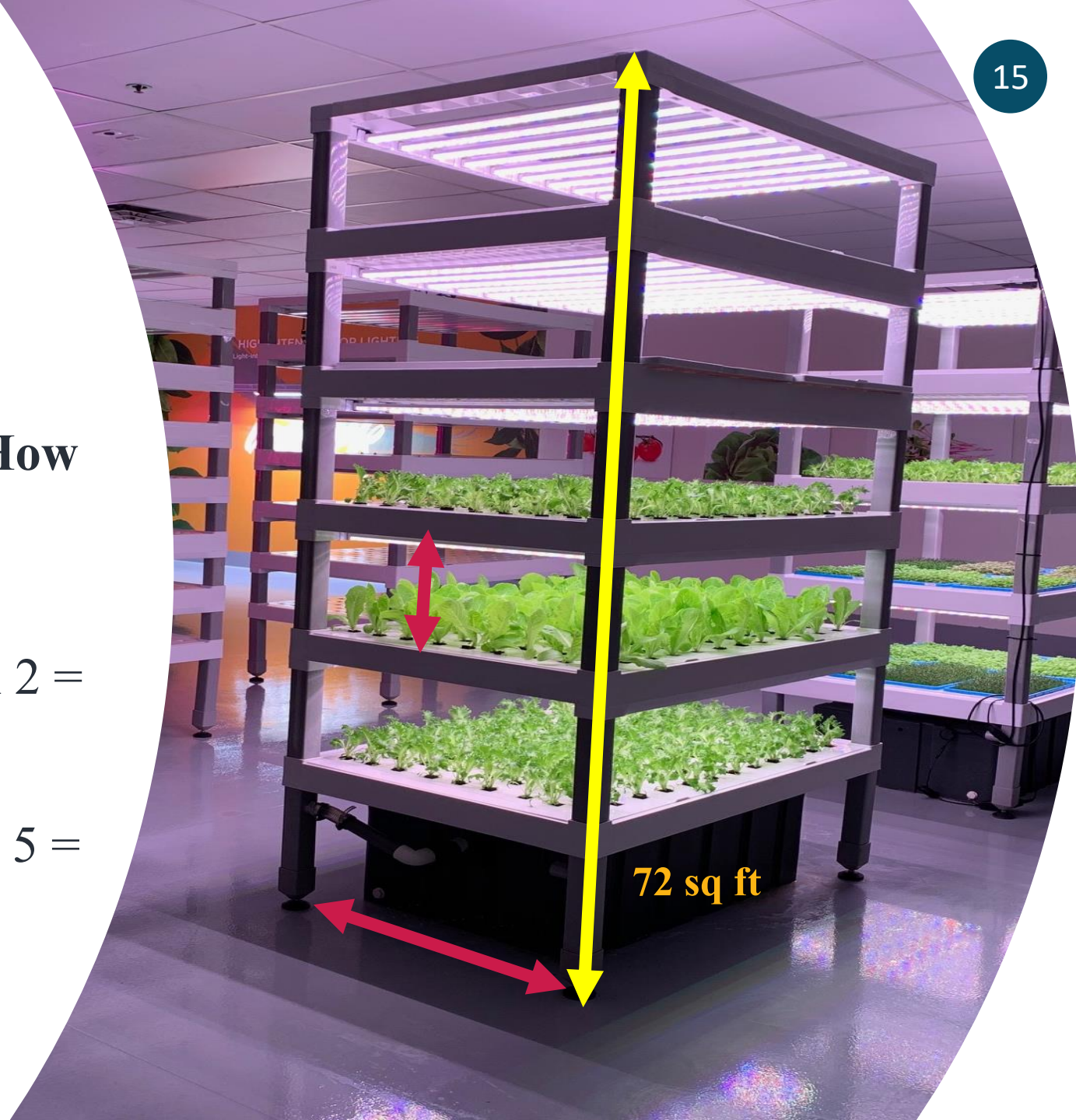
Grow beds -0.91m x 1.22m

How many plants sites per grow bed? How about per module?

The math is simple!

If using a 54-plant-site raft, there are $54 \times 2 = 108$ plants per grow bed.

For a 5 grow bed module, that'll be $108 \times 5 = 540$ plant sites.

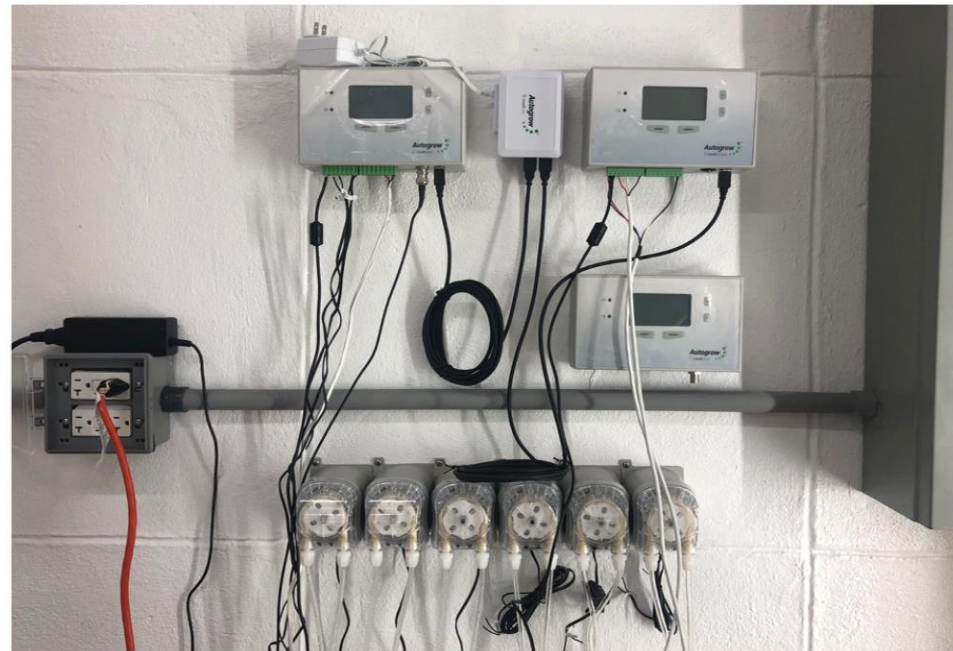








Intellidose



Injection system

- ph level
- EC
- Quantity of nutrients in solution
- Temperature
- Water pumping
- Air temperature
- Relative Humidity
- Light level
- CO₂ level
- Outside temperature
- Intruder detect
- Lamp over-temperature detect



Results

Germination rate if substrate is taking in consideration

- 98% oasis and cocopeat
- 52% foam



Results

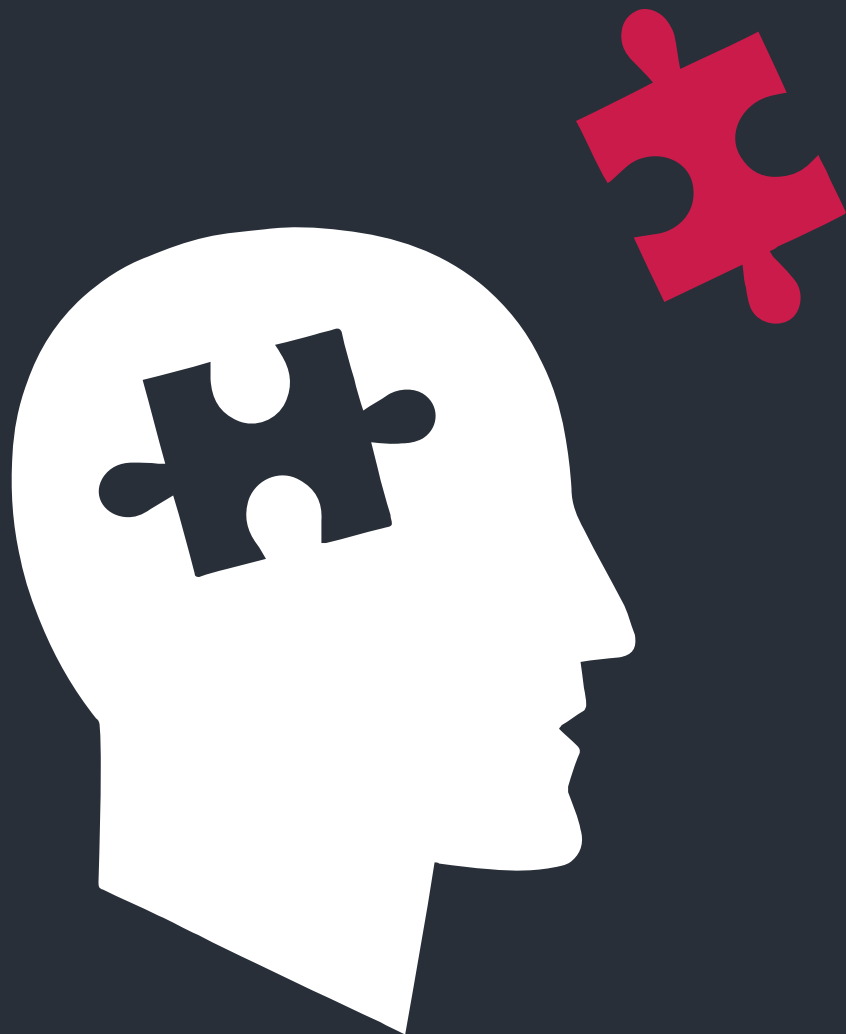
	Weight (g)			Length (cm)		
	Max	Min	Ave	Max	Min	Ave
Sananbio	92a	0a	27.4a	21.5a	3a	12.2a
ZipGrow	30b	0a	6.6b	18b	1b	8.9b

Project Impacts



- Since April 2019:
 - **Audience**
 - CCA students + 350
 - Hourly Employees – 3 undergrads students (2 SAGA and 1 ECON)
 - Five farmers
 - High school students
 - EEA Lajas visitors
 - **Improvement of Facilities**
 - Garden near by the ICP
 - Audio System for the conference room
 - Building itself

Learning Tools



- Digital Agriculture
- Smart technology
- Climate smart technology
- Concept of indoor crop production
- Ag Innovation
- Incorporation of new practices in curricula labs
- Management

Conclusions and Future work



Ag technology: Simple, productive, time efficient, can be manage from a mobile device, expensive



Sananbio system seems to have a better production per sq ft.



Future work:

Estimation of energy cost; economical analyses
Evaluation of different crops



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