Universidad Politécnica de Cartagena

# Improving yield and quality in baby leaf vegetables grown in floating system through management of nutrient solution

Juan A. Fernández

Departamento de Producción Vegetal

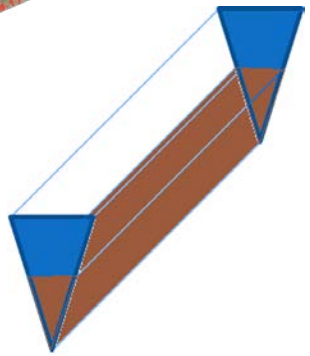
# Summary

- **Floating system**
- **Cultivation techniques**
  - **Aeration**
  - **Nitrate issue**
  - **Salinity**
  - **Se application**
- **Ongoing projects**

# Floating system

Plants are cultivated in trays of lightweight plastic material, like expanded polystyrene, floating on a bed of nutrient solution

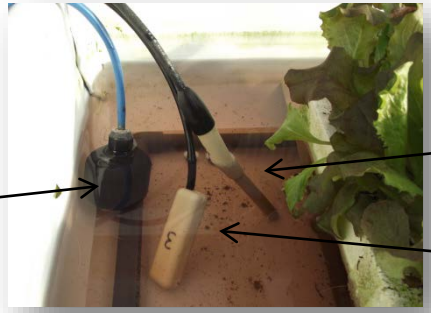
- Easy and inexpensive system
- High yields in little time
- High quality product (control nutrient solution)
- Clean and ready to be packed as a “ready-to-eat” vegetable



# The aeration of nutrient solution

## levels of aeration

No aeration (NA)  Low aeration (LA)  High aeration (HA)



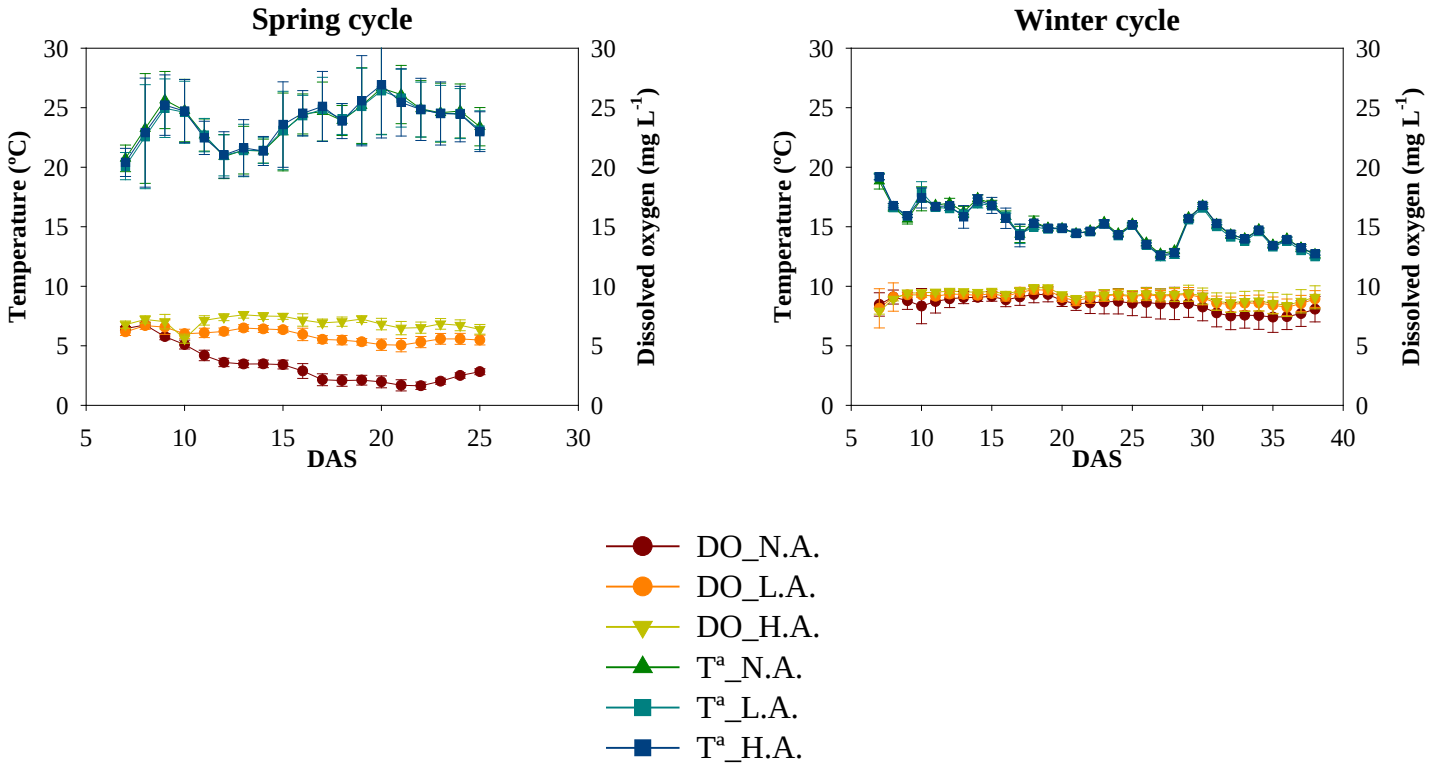
pH probe

Dissolved $O_2$ probe

T and Ec probe

# The aeration of nutrient solution

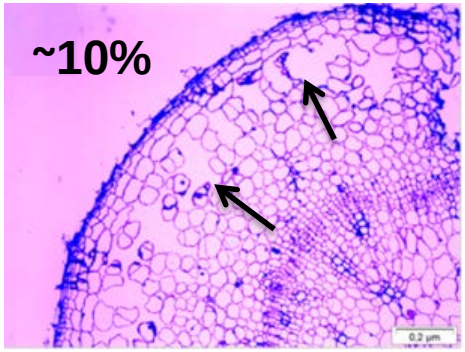
## Watercress: Dissolved oxigen and Temperature



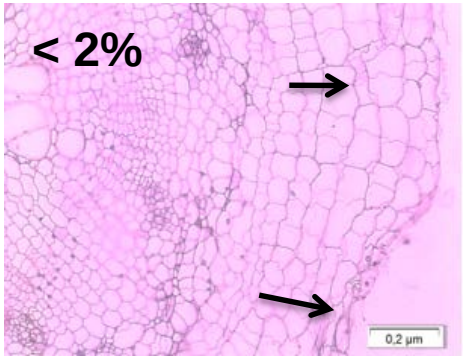
# The aeration of nutrient solution

## Anatomical adaptations growing in no aeration conditions

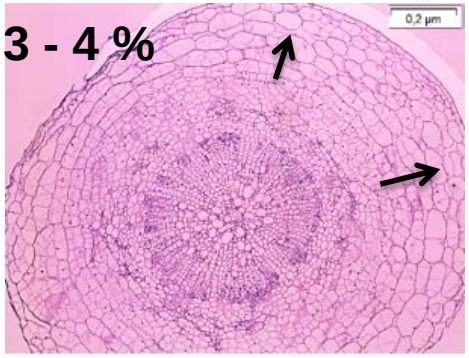
**Purslane**




**Watercress**




**Lettuce**

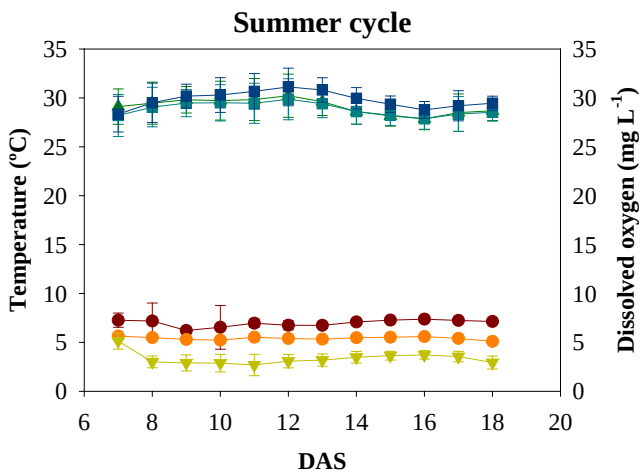


# The aeration of nutrient solution

## Yield (Kg/m$^2$)

| | Purslane | Watercress | Lettuce |
|---|---|---|---|
| No aeration | 1.68 – 3.09 | 2.90 – 3.20 | 0.79 – 2.26 |
| Low aeration | 1.66 – 3.73 | 3.12 – 3.60 | 1.08 – 2.46 |
| High aeration | 2.09 – 5.06 | 2.90 – 3.65 | 1.40 – 2.65 |

Summer

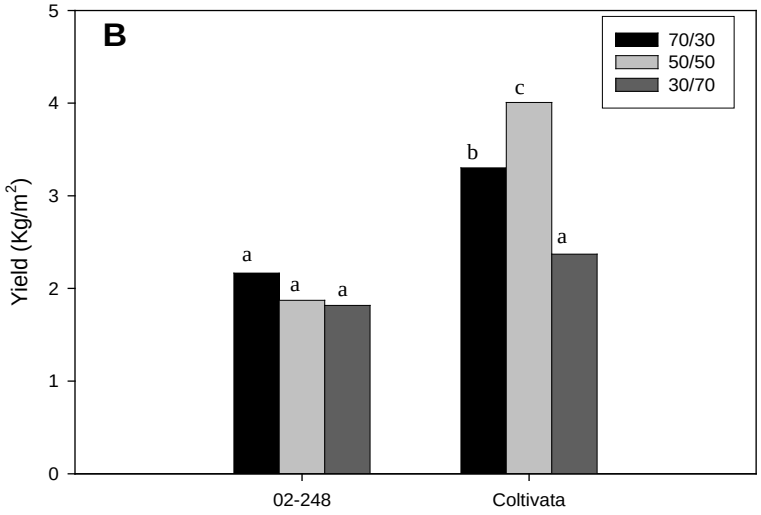


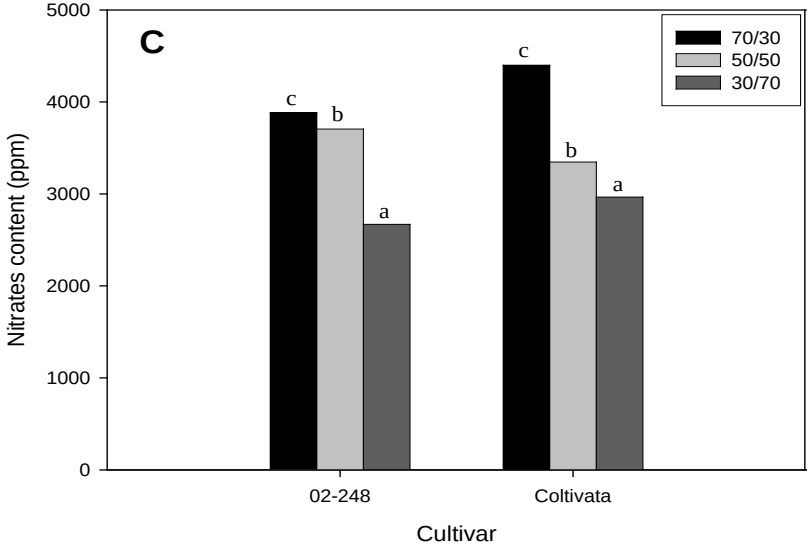
# The aeration of nutrient solution

The sensibility to oxygen depletion depends on the species and on the growing cycle. The lack of oxygen reduces yield and nitrate content and increases the phytochemical compounds. For this reason, it is necessary to look for a compromise situation in which the quality of the product as a ready to eat could increase without affecting the yield

# The nitrate issue

## The Influence of Nitrate/ammonium Ratio on Nitrate Content in Rocket




Fernández et al. (2007)

# The nitrate issue

**How to control nitrate:**

- ✓ using N-$NH_4^+$ below toxicity according to species
- ✓ nitrogen starvation before harvest
- ✓ N threshold according to species and season

- **In general, a N concentration around 8-12 mmol $L^{-1}$ leads to high yield and limits $NO_3^-$ accumulation**
- **a supply between 40 and 60% of N as N-$NH_4^+$ limits $NO_3^-$ accumulation**

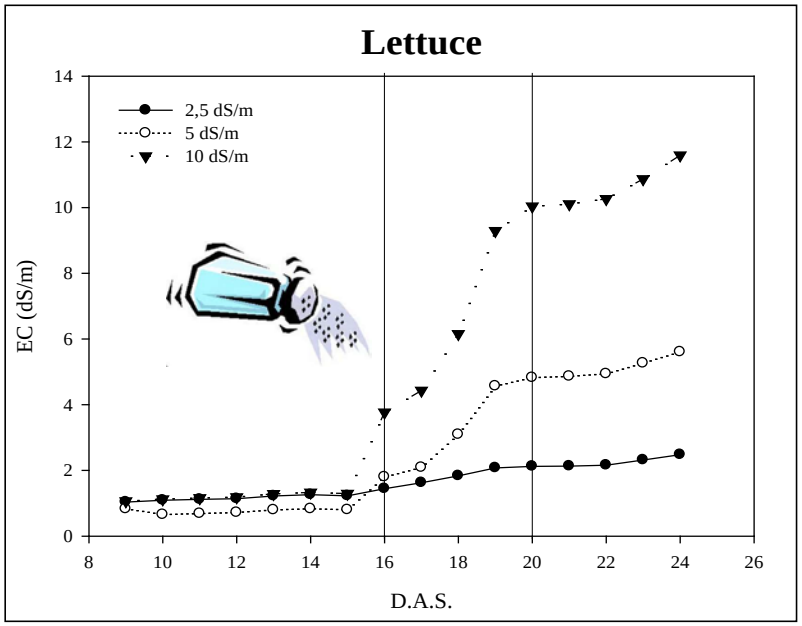
# The salinity effect

## Levels of salinity

Control: 2.5 dS/m
Medium salinity: 5 dS/m
High salinity: 10 dS/m

Adding NaCl at 14 Das, during 5 days

EC was monitored by Campbell CS547A probes



# The salinity effect

## Watercress

- Specific leaf area ↑
- Yield ↓
- $Ca^{2+}$ and $K^{+}$ ↓
- $Na^{+}$ and $Cl^{-}$ ↑
- Nitrate ↓
- Antioxidant capacity ↑
- Total phenols ↑

## Green lettuce cv. Ganeria

- Specific leaf area ↑
- Root Ø ↓
- $Ca^{2+}$ and $K^{+}$ ↓
- $Na^{+}$ and $Cl^{-}$ ↑
- Nitrate ↓
- Antioxidant capacity ↑
- Total phenols ↑

## Red lettuce cv. Faradia

- Specific leaf area ↑
- Yield ↓
- Root Ø ↓
- $Ca^{2+}$ and $K^{+}$ ↓
- $Na^{+}$ and $Cl^{-}$ ↑
- Nitrate ↓
- Antioxidant capacity ↑
- Total phenols ↑

# The salinity effect

In general, the salinity affects plant growth reducing crop yield. In addition, salinity improves the quality of the final product, because leaf nitrate concentration is reduced and the content of functional phytochemicals are increased

# The application of Se

## Rates of Se

Control: No Se
Medium: 10 $\mu$mol $L^{-1}$ Se
High: 30 $\mu$mol $L^{-1}$ Se

Adding $Na_2SeO_3$ at 7 Das

# The application of Se

In general, the Se addition affects plant growth increasing the number of leaves. In addition, it improves the quality of the final product, because Se concentration is increased, leaf nitrate concentration is reduced and the phenolic content is increased

# USE OF SUPPRESSIVE COMPOST AND THEIR BIOLOGICAL EXTRACTS TO PRODUCE HIGH QUALITY AND SUSTAINABLE BABY LEAF ROCKET AND LETTUCE IN SOIL AND IN TRAY SYSTEMS

CSIC
Consejo Superior de Investigaciones Científicas
Centro de Edafología y Biología Aplicada del Segura

Universidad Politécnica de Cartagena

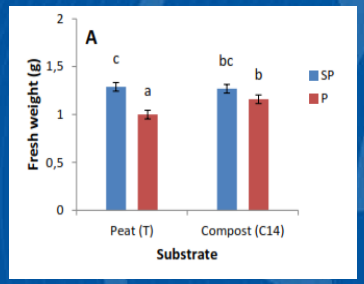
Non-infected lettuce (SP)

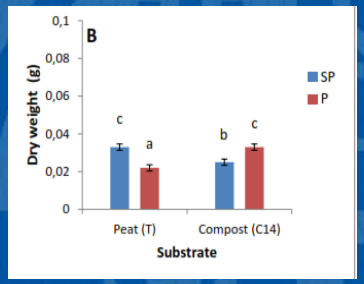
Infected lettuce (P)

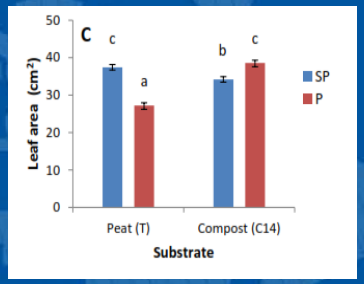
Styrofloat

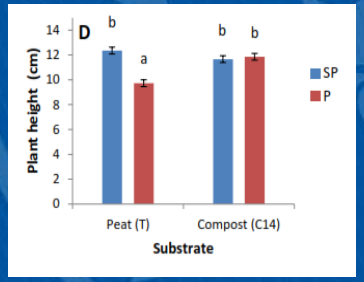
Baby leaf lettuce

| | Compost 9 | Compost 11 | Compost 14 |
|---|---|---|---|
| Mud pepper | 24 | 24 | |
| Garlic | 3 | 3 | |
| Almond | 5 | 5 | |
| Pruning | 29 | 29 | 12 |
| Carrot | 36 | 36 | |
| Pepper | 3 | 3 | |
| Tomato | | | 71 |
| Onion | | | 17 |
| Inoculum | | *Aspergillus niger* | |



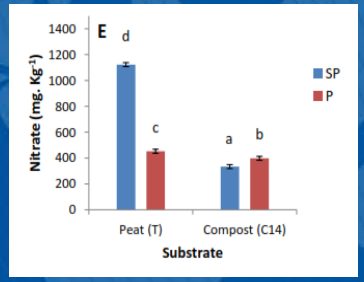




**Figure1.** Fresh weight (A), dry weight (B), leaf area (C), plant height (D) and nitrate content (e) of lettuce ´Antoria´ for the combination of infection and substrate. Different letters indicate significant differences (P< 0.05).

EUROLEGUME 2014-2017

## Task 5.2 Biological nitrogen fixation focused investigations

5.2.1: Detection of genotypes and cropping system influence on soil properties

- Specie: cowpea
- Cultivars: Black-eyed pea and Grey-eyed pea
- Cropping system: rotation
- Management practice: conventional and organic
- Non legume specie: broccoli
- crop cycles: 3

- Specie: faba bean
- Cultivars: Muchamiel and Palenca
- Cropping system: rotation
- Management practice: conventional and organic
- Non legume specie: melon
- Crop cycles: 2

- Parameters: organic matter, microbial activity, carbon and nitrogen content

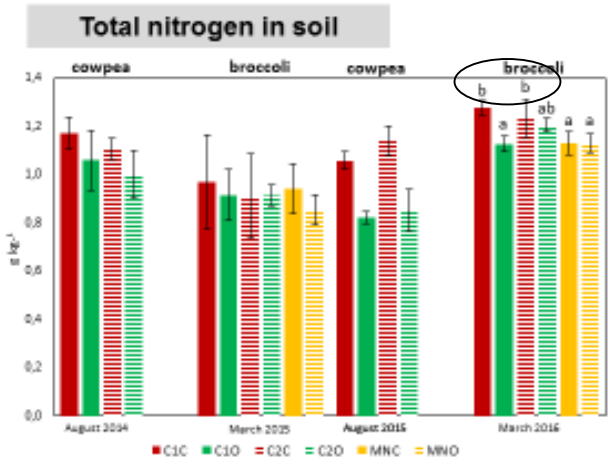
# Enhancing of legumes growing in Europe through sustainable cropping for protein supply for food and feed (7th Framework Programme project nº 613781)

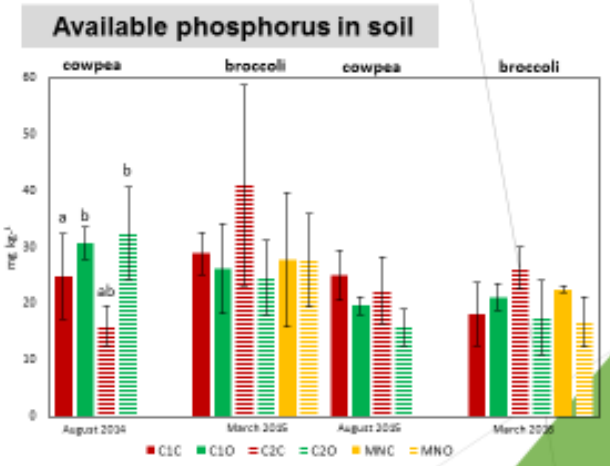
EUROLEGUME 2014-2017

## Task 5.2 Biological nitrogen fixation focused investigations

5.2.1: Detection of genotypes and cropping system influence on soil properties

**Rotation cowpea-broccoli**



THANK YOU FOR
YOUR ATTENTION