



Hydroponic Vegetable Crops Research at Lincoln University




LINCOLN UNIVERSITY
HYDROPONIC GREENHOUSES

19 November 2004


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Egilla-01_09

Lincoln University Controlled Environment Hydroponic Facility (CEHF)



18 August 2004



LINCOLN UNIVERSITY
HYDROPONIC GREENHOUSES


19 November 2004

The hydroponic research facility completed in March 2005, consists of two types of glazing (polycarbonate and polyethylene covered structures, respectively).


Each equipped with both the NFT and Dutch Hydro-Bucket (Dutch-Pot) systems.

Egilla/ 2005.

The two hydroponic systems at Carver Research Farm



Liquid System
(Nutrient Film Technique)



Aeroponic System
(Dutch Hydro Bucket)







Both the NFT and Dutch-Pot systems are suitable for leafy or fruiting vegetable & herb crops.

Egilla/ 2005.

Lincoln University Hydroponic Research Program

- Goal:** To develop viable but sustainable methods of hydroponic vegetable and herb crops production under central Missouri conditions.
- Objectives:** To investigate improved production methods aimed at reducing production costs, increase crop yield, quality, and profit margin for limited resource hydroponic vegetable and herb growers in Missouri.

Nutrient Film Technique

Leaf lettuce

- Crops are planted along a PVC-based gutter along which-
- The roots tangle together within the gutter, which is fed a constant supply of nutrient-rich water.
- Often the stream is only a fraction of an inch deep, so as not to immerse the entire crop.
- The roots receive their nourishment from the stream of nutrients.
- Those parts of the plant resting above the water are exposed to fresh oxygen for better growth.

Aggregate Hydroponic System

- Utilizes various forms of solid substrates.
- These substrates serve as support media for the plant only.
- Plants do not derive their nutrition from the substrate.



Dutch Hydro Bucket

- Suitable for small to large scale hydroponic container gardening.
- May be used with Geolite/Hydroton, Itrapeat or Perlite to grow any type of plants.
- With a built in reservoir that maintains a small amount of water under the medium to protect plants in case of temporary irrigation failure.
- May any drip type irrigation system to feed plants.
- Hydro Bucket drains into a 1 ½ inch PVC pipe (good for excess nutrient collection).
- Beige may remain cooler than the black buckets in strong sunlight.



Aggregate Hydroponic Culture



Flood & Drain Hydroponic System



Crowding can be a problem. Careful plant selection and lighting is important.



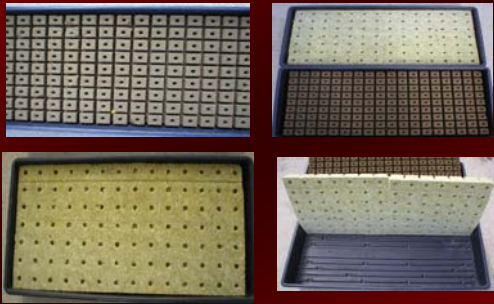
Portable Hydroponic Systems



Crops Grown in NFT & Aggregate System

- Arugula (*Eruca vesicaria* subsp.)
- Basil varieties (*Ocimum basilicum*)
- Beetroot (*Beta vulgaris* 'Bull's Blood')
- Chinese cabbage (*Brassica rapa* [chinensis group])
- Chives (*Allium schoenoprasum*)
- Cos Lettuce (*Lactuca sativa* L. var. longifolia)
- Eggplant (*Solanum integrifolium*)
- Kohlrabi (*Brassica oleracea* [Gonylodes group])
- Leaf mustard varieties (*Brassica oleracea*)
- Radish (*Raphanus sativus*)
- Rhubarb Chard [*Beta vulgaris* (Cicla group)]
- Sage (*Salvia officinalis*)
- Tomato Roma-VF variety (*Lycopersicon esculentum*)
- Collard (*Brassica oleracea*, Acephala group)
- Blueberry (*Vaccinium* sp.)

Oasis & Rockwool Slabs for Seed Propagation



Raising seedlings for hydroponic systems



Rockwool slabs and Oasis cubes are commonly used media for water culture systems like NFT



What follows is an overview of cropping trials from **Seedling Transplanting to Harvest**

Rhubarb Chard [*Beta vulgaris* (Cicla group)]

NFT **Rhubarb Chard** Production:
December 14, 2005-February 8, 2006.

Rhubarb chard 54 days after transfer into NFT system



Cos Lettuce (*Lactuca sativa* L. var. longifolia 'Cimmaron')

NFT Cos Lettuce Production:
March 10-April 12, 2006

Growth and quality of cos lettuce grown with All-Purpose Hydroponic Nutrient (9-4-15) under polycarbonate & polyethylene glazing 32 days after transfer to NFT system



Growth and quality of cos lettuce grown with Peters Excel-Cal-Mag (15-5-15) under polycarbonate & polyethylene glazing 32 days after transfer to NFT system

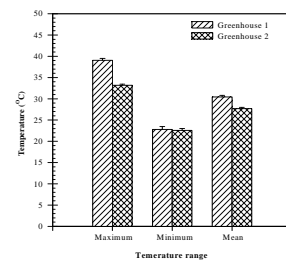


Growth and quality of cos lettuce grown with Peters Peat-Lite Special (15-16-17) under hard-wall & polyethylene glazing 32 days after transfer to NFT system



July Temperature

Figure 1. Greenhouse temperature in July 2005.



Mixed Cropping of Herbs & Beetroot

Arugula (*Eruca vesicaria* subsp.)
Ceaser Basil (*Ocimum basilicum*)
Beetroot (*Beta vulgaris* 'Bull's Blood')

Mixed Crop of Arugula & Beetroot



Mixed Crop of Arugula, Beetroot & Basil



- 'Astro' is preferred by growers because it
- is an attractive, serrated cut leaf cultivar.
- produces high yields of whole leaf arugula.
- slow to bolt yet vigorous plants for clipping, and bunching.
- has a distinctive nutty flavor, and attractive medium green color.

Mixed Crop of Arugula, Beetroot & Basil



What is the effect of the more vigorous cultivars on the growth, and development of the other plants in a mixed cropping system?

Mixed Cropping of Basil (*Ocimum basilicum*) Cultivars

- Dwarf basil
- Purple ruffles
- Sweet dani

Mixed Cropping of Basil (*Ocimum basilicum*) Cultivars



- Dwarf Basil -An annual, very aromatic basil with tiny leaves produced on a dwarf globe shaped plant. Plants grow to 8-10" and hold very well without flowering.
- Sweet Dani -An aromatic herb, lemon scented basil desirable for both its culinary and decorative uses. The lemon scent is much stronger than other lemon basil and the plants has an upright, rounded habit, reaching 26" in height at maturity. Sweet Dani can be cut back and trimmed several times with excellent re-growth.
- Purple Ruffles -An ornamental variety that produces fragrant, ruffled, deep purple leaves and light pink flowers. The vigorous, well-branched plants are 18-24" tall. A popular item for adding a different color to pesto, salads and vinegars. Approximately 5% of the plants have purple/green leaves.

Layout in Mixed Cropped NFT System



- The three cultivars of basil were established in alternate blocks of two rows per cultivar.

Growth Habit of three Basil Cultivars



- 'Sweet Dani' and 'Dwarf Basil' exhibit similar vigor, whereas 'Purple Ruffles' is slow growing.

Growing Media Effect on Fruit Yield of Roma Tomato



- The experiment consisted of two growing media x four blocks x 6 replications per block (2 x 4 x 6). N = 24 plants per growing medium.
- The experiment was replicated under polycarbonate and polyethylene glazing.
- Final fresh weight yield was greater in fritted clay compared to perlite.
- Type of growing medium had no effect on the rate of ripening.

Growing Media Effect on Fruit Ripening of Roma Tomato



Regardless of growing medium fruits did not ripen uniformly.

Leaf mustard [*Brassica juncea* (L.) Czern.]

NFT Leaf Mustard Production
Oct. 12 to Dec. 12, 2006.

Leaf Mustard: The crop

Leaf mustard (*Brassica juncea* (L.) Czern.) also referred to as 'Mustard greens', Indian mustard, 'Rai' or 'Brown mustard' belongs to the family **brassicaceae** (formally Cruciferae; same family as cabbage, broccoli, brussels sprouts and cauliflower).

Six-day Old Seedlings of Leaf Mustard



- The two cultivars of leaf mustard differ in seedling vigor.
- Seed propagation medium must be selected very carefully where germination is slow and seedling vigor is poor.

Leaf Mustard Seedlings at Transplanting



20 days after sowing in oasis cubes, seedlings were transplanted into NFT system.



Leaf mustard 'Savannah' 23 days after Transplanting.

'Red Giant' & 'Savannah'



Leaf Mustard at Harvest



- Savannah' an F₁ hybrid from Harris™ Seeds, grows into a large erect plant with round, deep green leaves. It is a broadleaf tender green crop that is reported to bolt at a much slower rate than open pollinated cultivars, and matures in 35 days.
- 'Red Giant' from Harris™ Seeds is a 40-day maturing cultivar. It has large savoy leaves that are deep purplish-red with white mid-rib. The thick, tender leaves have moderate mustard pungency, and leaf color tend to intensify at lower temperature.

Mei Qing Choi

- Pak Choi cabbage variety
- (*Brassica rapa* [chinensis group])

Mei Qing Choi cabbage after 1 week in NFT culture



Mei Qing Choi cabbage at 150 mg/L N from Peters Excel (N-P₂O₄-K₂O: 15-5-15) after 62 days in NFT



Mei Qing Choi cabbage at 200 mg/L N from Peters Excel (N-P₂O₄-K₂O: 15-5-15) after 62 days in NFT



Mei Qing Choi cabbage at 100 mg/L N from Peters Excel (N-P₂O₄-K₂O: 15-5-15) after 73 days in NFT

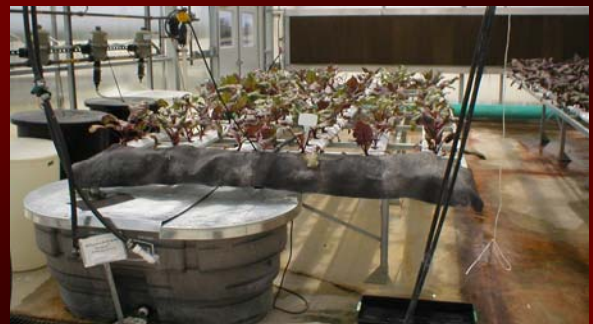


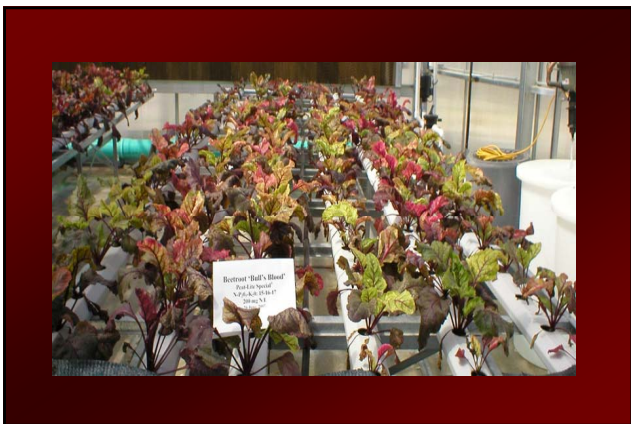
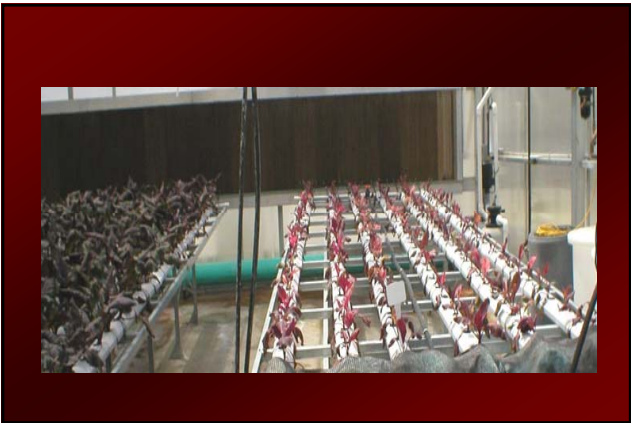
Beetroot

Garden Beet, Red Beet
■ (*Beta vulgaris* 'Bull's Blood')



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Collard
Collard (*Brassica oleracea*,
Acephala group)



Collard: 17th December 2008, Day of the 2nd Harvest



Collard: 3rd January 2009, 17 Days after the 2nd Harvest



Collard: 3rd January 2009, 17 Days after the 2nd Harvest



Blueberry (*Vaccinium sp.*)

Hydroponic Trial

Bluecrop, Duke, Elliot, Legacy, Reka

All are mid-season ripening crops.
Fruiting is from March through August.

Growth Transition of Blueberry under GH Condition



Oct. 22, 2008



Jan 03, 2008

Hydroponic Blueberry



June to August foliage under GH conditions

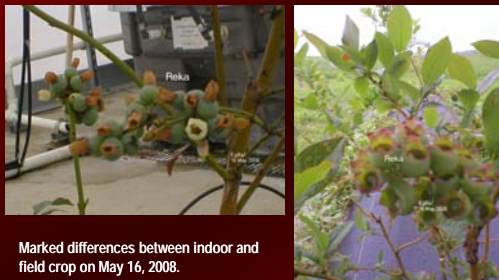
Blueberry Cultivars



Blueberry Cultivars cont'd...



Reka (Hydroponic) vs. Field



Marked differences between indoor and field crop on May 16, 2008.

Acknowledgements

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The End