# Hands Free Hydroponics

Practical application of publication *A Suspended Net-Pot, Non-Circulating Hydroponic Method for Commercial Production of Leafy, Romaine, and Semi-Head Lettuce* by B. A. Kratky
Department of Tropical Plant and Soil Sciences

Presentation by Stephen Lewis
Horticulturist- Kentucky State University Extension
Stephen.Lewis@kysu.edu

# What is the Kratky Method?

The Kratky method is a non-circulating hydroponic system used commercially to grow leafy and semi head lettuce

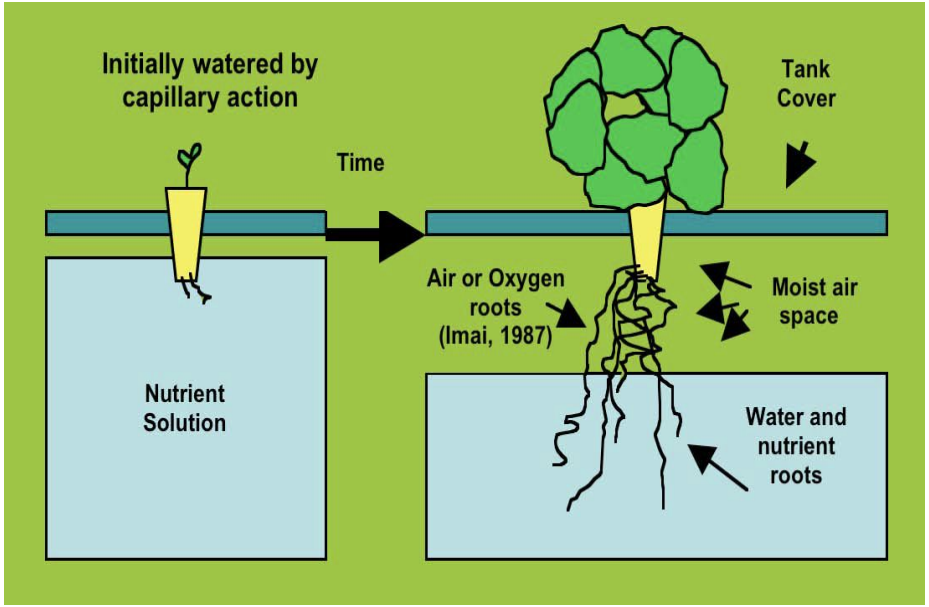
Non circulating means that it requires no electricity or pumps to circulate water through the system

The entire crop of lettuce is grown in a single application of water and nutrients
Can be adapted to grow other leafy green crops

Created by B.A. Kratky a horticulturalist from the University of Hawaii

# System Design

- The Kratky system is a deep water hydroponic system without the use of a pump
- Polyethylene lined tanks are filled to the top with nutrient solution
- A foam board is placed over the tank with holes to hold 2” net pots
- Seedlings are placed in net pots with the bottom third suspended in nutrient solution



# Growth Process

- The seedlings are watered from the bottom by capillary action
- As the water level declines in the tank air space is created between the water and the bottom of the plant
- Roots between the net pot and the surface of the solution become “oxygen roots” and take up air from the humid air layer between the tank cover and the nutrient solution.
- The crop is harvested before the nutrient solution is exhausted
- Then, the tank is cleaned and refilled with fresh nutrient solution and the process is repeated.

# Materials List

1. 3 - 2x6x8ft Boards
2. 2.5” Deck Screws
3. 4x8 sheet of plywood ½” thick
4. 6 mil Plastic
5. ½”- 1”  Thick Polystyrene foam insulation board
6. 2” Hole saw
7. 2” Net Pots
8. Drill
9. Potting soil or planting cubes and seeds
10. (Seedlings)




# Grow Tanks

- Hydroponic lettuce is grown in tanks filled with nutrient solution (water plus a complete hydroponic fertilizer) instead of in soil, as is common with conventional field production
- Tanks are filled with 1.5–2 gallons of nutrient solution per plant prior to planting. Thus a tank designed to grow 50 heads of lettuce should have a liquid capacity in the range of 75–100 gallons.
- Common tank dimensions are 4x4ft, 4 x 8 ft and 4 x 16 ft

# Tank Construction

- A rectangular frame is constructed with 2 x 6 x 8ft lumber by fastening either side with 12 d nails or 2-½-inch deck screws
- A ½-inch or thicker plywood sheet is fastened to this frame and becomes the bottom of the tank.
- Lumber needed to build a 4 ft x 8 ft x 5 ½ in high tank:
  - 2 x 6 lumber-3 lengths of 8 ft
  - 4 x 8 ft sheet of plywood.
- Tanks should be constructed at a convenient working height (30–36 inches).
- A full 4x8x6” tank contains 92 gallons and weighs more than 800 pounds

# Tank Liner

- After the frame is constructed, it is lined with two layers of 6 mil plastic
- The tank is fill with water and any creases or folds on the bottom and sides are flattened

# Tank Cover Construction

- You will need a styrofoam board at least ½ inch thick
  - Thin boards will be too flimsy to support the weight of the plants
- Hole size will depend on the size of the net pot you intend to use
- Typically when growing lettuce and other plants 2” net pots are used
- You will need your hole saw with 2” bit
- Plants sit in net pots that are placed into the holes in the foam board


Lowe's
GreenGuard XPS
Extruded Polystyrene Insulation Board
Lowe's
Home Innovation
NGBS GREEN CERTIFIED
Seal and Insulate
with ENERGY STAR
MIAMI-DADE COUNTY
APPROVED

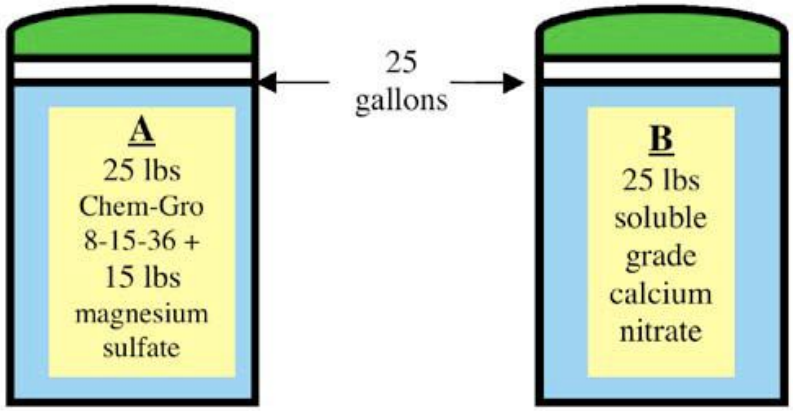

Lowe's
Lowe's
Kingspan
ASTM C 578, Type IV
Minimum 25 psi
Above & Below Grade Applications
Enhanced R-Value
Compliance:
Lowe's
Lowe's

# Planting Density

- The grower must determine the optimal planting density (the number of plants per square foot or the number of
- plants per tank.)
- Two common planting densities for lettuce are 1.5 and 1.9 plants per square foot, or 48 and 60 plants, respectively, per 4 x 8–ft tank
- Densities greater than two plants per square foot for larger head cultivars grown to mature head stage will often result in crowding
- Higher density plantings are usually done with smaller cultivars such as ‘Lollo Rossa’ or when plants are harvested at a younger stage. Growers are advised to compare several planting densities for their growing situation on a small scale before committing to a specific density for commercial-scale production
- Parameters to consider include quality, weight, size, shape, diseases, and crowding

# Fertilization

- Most commercial lettuce and greens growers use a general purpose mix (5-12-36) combined with magnesium sulfate and calcium nitrate
- Other hydroponic formulas are also acceptable, but stock solutions must be prepared based upon the manufacturer's instructions
- Stock Fertilizer Solution is mixed in two separate tanks to keep certain chemicals from reacting
    - Tank A contains the general purpose mix with magnesium sulfate added
    - Tank B contains calcium nitrate



# Making the Stock Solution

- To make the stock solution A you will add 1lb of General Purpose Mix and 0.6lb of Magnesium Sulfate to 1 gallon of water
- To make stock solution B you will add 1lb of Calcium Nitrate to 1 gallon of water
- Nutrients from the two stock solutions (concentrated fertilizer solutions) are added to tanks in equal parts
  - ½ ounce of each fertilizer stock solution is added per gallon of water in the tank
  - A 90 gallon tank will require 45 ounces of solution A and 45 ounces of solution B for a total of 90 ounces
    - 1 gallon of stock solution A + 1 gallon of stock solution B = 256 ounces
    - This will be enough fertilizer for 2 -90 gallon lettuce tanks with 60 ounces left

# Measuring pH

- The acidity or alkalinity of the nutrient solution is measured in pH units
- When the pH is below 4.0 or above 7.0 nutrient availability and uptake are affected
- Availabilities of manganese (Mn), copper (Cu), zinc (Zn), and iron (Fe) are decreased at a **high pH**
- Availabilities of phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg) are decreased at a l**ow pH**
- The recommended pH range for between **5.5 and 6.5**
- A pH meter is the most common way of measuring pH
- All pH meters need periodic calibration, as an inaccurate reading could result fertilization mistakes
- Inexpensive pH test kits with a pH range of 4.0–8.5 are also available and may be used alone or in addition to a pH meter and are good enough for most growers and hobbyists. Growers may also use pH paper strips to monitor nutrient solution

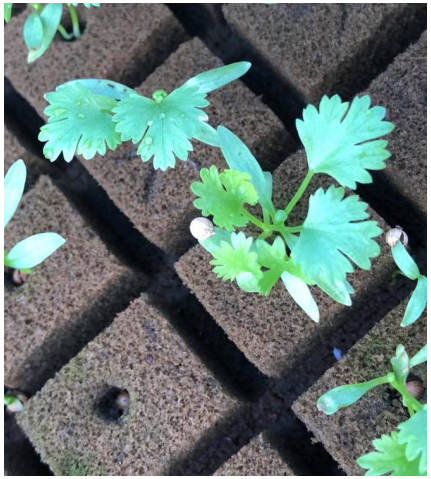


# Measuring EC

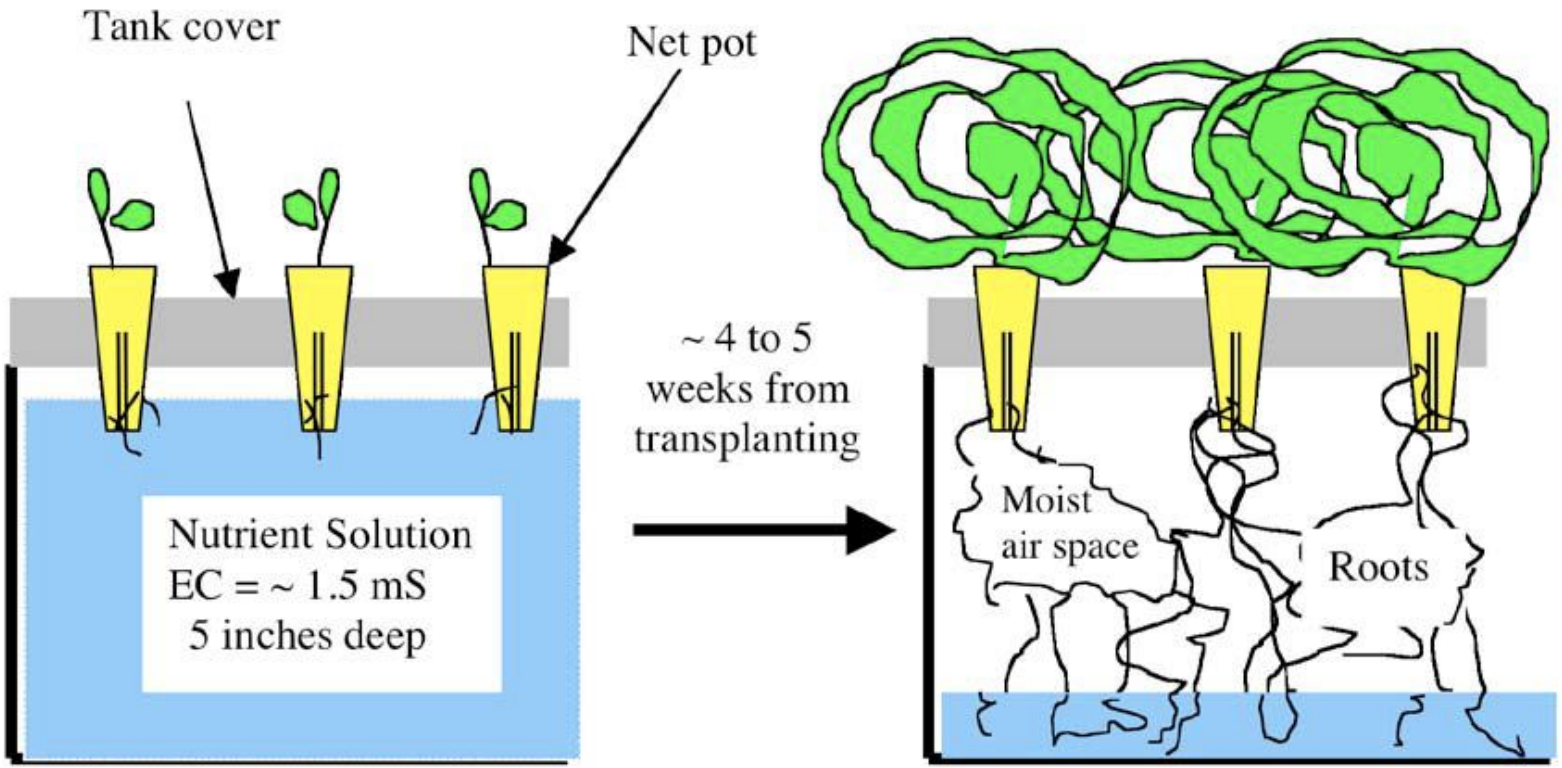
- EC is the electro-conductivity or salinity of the solution
- An EC meter measures electrical conductivity of all ions in solution, and it does not distinguish between individual ions. There can be a low level of an individual ion even if there is a high EC reading, and this can cause decreased yield or quality.
- EC meter is a very useful instrument when the grower applies a widely used commercial hydroponic lettuce fertilizer formulation.
- When measuring EC here are some things to remember:
    - Inaccurate readings may occur with poorly mixed solutions. Higher readings are often found at the bottom of the tank.
    - EC meters give higher readings when the nutrient solution temperature increases.
    - EC readings of the nutrient solution tend to rise during hot weather, during cool weather the EC tends to decrease
- Recommended electrical conductivities range from **1.0-1.5mS** during hot weather to **1.6-2.5 mS** in cool weather but experience is usually the final basis for determining the exact solution concentration

# Selecting Plants

- Most growers choose to start plants from seeds, however if time is a factor transplants can be used
- Seeds are grown in cell trays instead of sowing directly into the grow tank, this way the most uniform plants are selected and germination percentage is maximized
    - A 50-cell tray makes 2” plugs
- Growers can choose to start seeds in a soil based media or use a non soil growing medium like rockwool or oasis cubes
- When seedlings are ready, they are transplanted into the grow tanks



# Growth period after transplanting



# Harvesting

- Early morning is the best time for harvesting plants.
- Hands must be washed well before harvesting, especially after a toilet visit. Lettuce is eaten raw, and the customer trusts that they are buying a clean and safe product.
- Leaves may be trimmed as necessary. The lettuce may be placed in a plastic produce bag, a hard plastic container, or a box if taken to a restaurant. Sanitize hard plastic containers before use. Use new plastic bags, not reused ones. Use new cardboard boxes,
- particularly if the lettuce has not first been placed in plastic bags.
- After harvesting, the net pots should be cleaned
    - It may be easier to allow the roots to remain in the net pots and decay for 1–2 weeks, which will facilitate removal of plant debris and medium from the net pots.
      The net pots can be soaked in a 10-percent bleach solution, rinsed, and dried before reuse

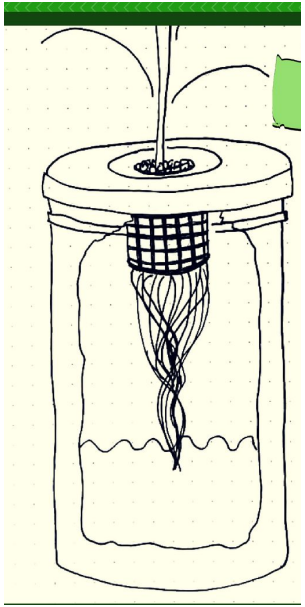
- The tank cover should be cleaned and any leave debris removed.
- Normally, the tank does not need to be rinsed with water. New nutrient solution is added to the tank
  and the growing cycle is repeated
- Leaf lettuce varieties can be cut at the base and will grow back!

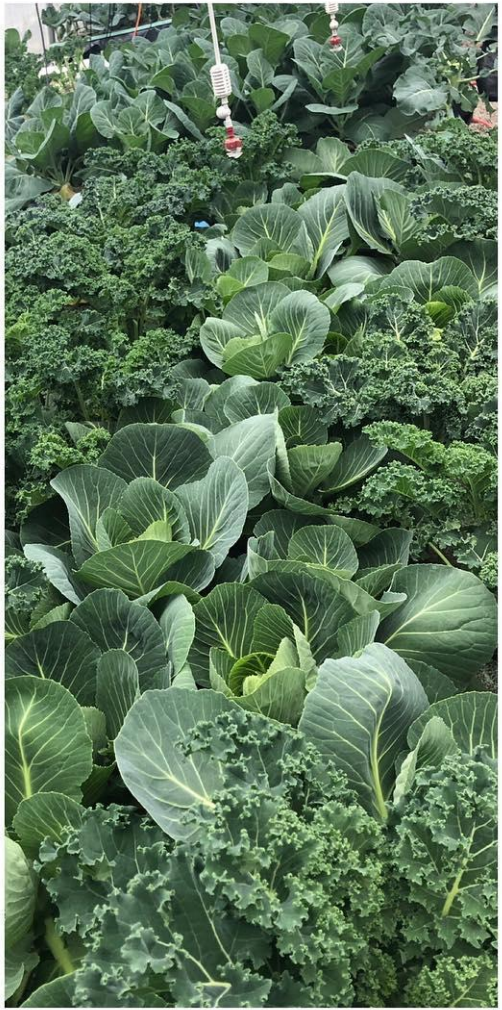
# Adaptations

- Many growers use kratky hydroponics outdoors, potentially exposing the system to rain
- Rain will cause the system to fill up with water, killing the oxygen roots that thrive in the air space between the solution surface and the bottom of the net pot
- If using the system outside, a shelter needs to be built to prevent rain from entering the grow tanks

# Adaptations

- Other plants can be grown in this system with similar nutrient requirements
  - Kale, Collards, Cabbabe, Broccoli and other cole crops
  - Basil, cucumbers
- Smaller versions of the design can be made using the same principles





# THANK YOU!