Hydroponic Solutions for Backyard or Classroom Systems

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September 2022
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Food sustainability is important when living in an island state like Hawai'i. Growing food close to home helps to advance food security. If you don't have a yard with soil or a large area to grow, you can still support the food growing movement, by growing food hydroponically. Crop productivity per square meter of a hydroponic unit is greater than a soil-based system, and also more water efficient (Samangooei, et al. 2016). Access to soil-based systems is becoming more difficult in residential and school settings due to urbanization.

Dr. Bernard Kratky of the University of Hawai'i at Mānoa, College of Tropical Agriculture and Human Resources (CTAHR) developed a system called the non-circulating hydroponic method or static hydroponics. The static hydroponic method is simple and easy for the user. There is no need for electricity or moving parts.

Photo 1. Seedlings started 3 weeks in advance

Seedlings:

Two to three weeks prior to starting your static hydroponic system, seeds should be planted. Seeds can be started in potting mix, compost, or hydroponic cubes (**Photo 1).** For our trial, we started seedlings in a standard potting mix (Promix Premium Moisture Potting Mix) and Osmocote, a slow-release fertilizer. Organic fertilizers can also be used in the starter mix.

Hydroponic Reservoir

For this trial, we created a hydroponic tank or reservoir to hold the nutrient solution using a 5 gallon container from a home improvement store (**Photo 2**). In accordance with Dr. Kratky's recommendations, our hydroponic tank was filled with water and a three part solution: Calcium Nitrate, Epsom Salt (Magnesium sulfate), and Hydrogarden's Chem-Grow Lettuce Formula 8-15-36. For each gallon of water, we added one teaspoon (tsp) of Hydrogarden's Chem-Grow Lettuce Formula 8-15-36,

Photo 2. Containers purchased from a home improvement store were used to evaluate various water-soluble solutions.

1 tsp of calcium nitrate and ½ tsp magnesium sulfate. We have found it is best to make a slurry first of each fertilizer separately, before adding fertilizers to the main reservoir to minimize precipitation of nutrients or the development of solids.

We compared Dr. Kratky's solution with a new Lettuce Fertilizer 8-15-36 from Greenway Biotech, Inc. available on Amazon. In accordance with the instructions, we mixed ½ tsp of Greenway Biotech, Inc. Lettuce Fertilizer 8-15-36 per gallon of water (2.5 tsp total). Because the recommended Greenway Biotech CalMag was not available, we supplemented the Greenway solution with 1 tsp of calcium nitrate and 1 tsp of magnesium sulfate to the 5 gallon reservoir. We also compared Dr. Kratky's recommended solution to Miracle Grow, as Miracle Grow is an easy to acquire water soluble fertilizer available in most garden stores. We supplemented the Miracle Grow fertilizer with 1 tsp of magnesium sulfate / 5 gallons.

Net Pots

We drilled 2 inch holes into the cover of our 5 gallon plastic containers using a hole saw (**Photo 3**). We found it helpful to run the hole saw in reverse to make the holes. We dropped commercial 2" net pots into the holes. For school or home gardens, plastic containers like Keurig® cups or other available material can be used to hold the seedlings above the hydroponic solution. Holes should be cut or drilled into the bottom of the plastic cups so the plant roots can access the hydroponics solution.

Photo 3. A two-inch hole saw was used to drill holes for the net pot.

After the seedlings are dropped into the solution, you "set it and forget it" until the crop is ready to harvest. After 3-4 weeks, you can harvest the whole plant by removing the head all at once, or you can harvest the mature leaves as needed and allow the crop to continue to grow until the solution runs out.

Preliminary Results

Two containers were used for each treatment. Preliminary results showed that the lettuce grown using the Greenway Biotech Inc. Lettuce Fertilizer did comparatively well to Dr. Kratky's recommended solution (**Photo 4**). The Hydrogarden's Chem-Grow Lettuce Formula

Photo 4. Hydrogarden's Chem-Grow Lettuce Formula 8-15-36 (left), Miracle Grow (center) and Greenway Biotech Inc. Lettuce Fertilizer 8-15-36 (right).

visually did better than the Greenway Biotech Inc. Lettuce Fertilizer solution in color and overall growth (**Photo 5 & 6**). Miracle Grow, while easily available, was not a good water soluble solution for this static hydroponic system, as we suspect many of the nutrients in the solution were not conducive for this type of growing system or crop.

Access to small quantities of hydroponic fertilizers is the bottle neck to long term adoption by school programs and gardeners. Shipping cost to Hawaii can also affect decision making. Depending on your location, Hydrogarden's Chem-Grow Lettuce Formula and Greenway Biotech Inc. Lettuce Fertilizer can be purchased online and shipped to your doorstep. Supplements such as Calcium Nitrate can be obtained locally or online. Magnesium Sulfate or epsom salt can be purchased in small quantities in garden stores and pharmacies.

Example (Bulk prices obtained September 2022. Companies sell smaller quantities)

- Hydrogarden's Chem-Grow Lettuce Formula 8-15-36: $134.10/ 25 pound bag with shipping ($5.36/ pound)
- Greenway Biotech, Inc. Lettuce Fertilizer 8-15-36: $246.58 / 25 pound bag with shipping ($9.86/ pound)
- Calcium nitrate: $43.60 / 50 pound bag ($0.87 / pound)
- Magnesium sulfate: $21.50 / 55 pound bag ($0.39 / pound)

Estimated Cost Per Head of Lettuce

- Hydrogarden's Chem-Grow Lettuce Formula + supplements= **$0.05/ head of lettuce**
- Greenway Biotech, Inc. Lettuce Fertilizer + supplements= **$0.09/ head of lettuce**

Photo 5 & 6 . Hydrogarden's Chem-Grow Lettuce Formula 8-15-36 (left) and Greenway Biotech, Inc. Lettuce Fertilizer 8-15-36 (right).

Photo 7. Example of mature lettuce grown in a 1-gallon container using the Kratky system.

Future Work

Hydroponics is so versatile that food crops could be grown anywhere with a light source: a home, apartment, school classroom, space, etc. Future work may include evaluating commercial products by Miracle-Grow (Aerogarden, etc.) and other garden store formulations which are readily available for the backyard gardener or classroom teacher. Dr. Kratky's 3-part hydroponic solution for non-circulating hydroponic systems is a proven technology that works on small to large scale systems. *Gardeners or school systems may opt to team up with other interested groups to split the fertilizer and associated expenses.* One gallon units are perfect for school programs to show youth how food crops can be grown in soilless systems (**Photo 7**). Larger units can also be created using plastic containers or made using plywood, a hydroponic liner, and cover (**Photo 8, 9 and 10**) for year round production.

Go to http://go.hawaii.edu/vm2 to download a visual step-by-step instruction sheet for a simple one-gallon static hydroponics system.

Photo 8, 9 and 10. Example of larger units made out of plastic containers, plywood boxes, Styrofoam, etc.

References

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