Hydroponic Leafy Greens

Grow with USask

University of Saskatchewan

The major advantage of hydroponics is the amount of plant mass you can produce in a small area. Roots don't need to sprawl and forage for nutrients in hydroponics like that of soil grown plants; instead they are immersed in all the nutrition they need.

A properly set up hydroponic system is easy to maintain. There is almost no weeding required and volumes of nutrient solution can be held in stock reservoirs making forgetting to water is a nonissue. Unlike soil or pot grown plants a hydroponic system can sustain plant growth for extended periods of time without maintenance; given there are no leaks and sufficient reservoirs of nutrient solution. Whole setups can easily be moved inside or outdoors to take advantage of seasonal changes.

Recirculating hydroponic systems are very water wise. When watering your garden there can be large losses of water through leaching, runoff and evaporation. A hydroponic system has no leaching or runoff and when set up correctly will have little evaporation. Water loss through evapotranspiration is the main loss of water in the hydroponic system. Recirculating hydroponic systems allow effective use of growing space and nutrients and are well suited to the indoor production of high value crops such as greens and herbs.

Hydroponic systems can easily be built up to counter height to elevate back strain and be more conducive for people gardening with mobility issues. They can be grown over concrete patios making use of spaces unsuitable for gardening as well as being wheelchair friendly.
Many leafy greens including lettuce and spinach have excellent potential for year-round indoor cropping and are tolerant to low light and cool temperatures.

A very important part of the hydroponic system is air. Roots need air for respiration. Hydroponic solutions must be aerated. If oxygen levels are depleted roots won't be able to grow and absorb nutrients; if levels get low enough, they will die. Aeration is easily accomplished with the use of an aquarium aerator. The nutrient tank should be opaque to keep algae from growing and using up the air and nutrients.

pH is important for helping plants absorb nutrients. A pH of 5 to 7 is sufficient to grow greens. Inexpensive pH test strips are available from local pet stores in the aquarium section. pH can be adjusted by using house hold vinegar.

Nutrient Management

There are many expensive hydroponic fertilizers that do a good job, but 1 gram per liter dry 20-20-20 fertilizer is sufficient for most leafy greens. 1 head of lettuce can be grown with less than 1 litre of water and 1 gram of 20-20-20-fertilizer. Other

fertilizers can work as well but it is important to check that they supply all the micronutrients needed for plant growth. Organic options are also available, but they are less concentrated and will need more nutrients to grow.
Fertilizer numbers are based on % of the nutrient (ie. Nitrogen) in the fertilizer. They are always listed in the following order: nitrogen, phosphorous and then potassium. When adjusting for an organic fertilizer that may be 2-1-6 it has 1/10th of the nitrogen that 20-20-20 has and will require 10 times as much fertilizer.

For the keen growers, there is a freeware program called hydrobuddy that will give nutrient recommendations and fertilizers that can be added to create customized nutrient recipes and optimum nutrient levels.

Algae tend to build up in hydroponic systems so it is important to limit light from penetrating the water. A thorough clean up of the entire production system at the end of each crop cycle is important for controlling algae and also to prevent disease problems. Clean up involves flushing out the system to remove any root material, scrubbing off any algae, rinsing with a dilute (5%) solution of bleach, followed by a final rinse with clean water.

There are several different forms of hydroponic but leafy greens grow well in either Floating Culture or Nutrient Film Hydroponic systems. Other more complex systems are required for crops with a larger plant mass.

Seedlings

- Choose seed of a suitable variety
- Use Rockwool plugs or Jiffy pots to grow transplants

Floating Culture

Floating culture is the simplest hydroponic method suitable for small herbaceous plants such as salad greens and herbs. Plants in the floating system sit in a Styrofoam raft floating inside of a container so that the raft can freely move with changing water levels. The raft has holes drilled in it that tightly fit the media used to germinate or root the transplants (rock wool or Jiffy pellets). Holes can be made using a hole saw that is slightly smaller than the diameter of the plug being pushed in place. Plugs are often friction fit. In the event the hole is too large, a tooth pick or skewer can be stuck through the plug to hold it in place. Seeds can be germinated in the raft system but it is convenient to germinate them under plastic domes and move them into the system once they are more established.

Top photo: plants in the floating system sit in a Styrofoam raft floating inside of a container so that the raft can freely move with changing water levels.
Bottom photo: The raft has holes drilled in it that tightly fit the media used to germinate or root the transplants

Parts Lists for Floating Culture System

- Sheet of 2 cm thick Styrofoam
- Nutrient Holding Tank – should be at least 30 cm deep and hold 1 L of nutrient solution for each lettuce plant being grown
- Aquarium aeration pump + air stone

Nutrient Film Technique (NFT)

In NFT systems plants are grown in troughs and a thin film of nutrient solution is kept circulating down the troughs and past the root system. There are commercial troughs available but troughs can be as simple as a section of a circular or rectangular eaves trough with holes cut in the top. Trough lengths are kept relatively short (<5m) to minimize nutrient and oxygen gradients. Troughs should be kept on a 1 -5% slope so that the nutrient solution runs down the trough and over the plants root system. At the end of each trough, the nutrient solution is gathered into a capture tank and then pumped back to the top of the channels using a small circulating pump. The nutrient solution is pumped through the production troughs at the rate of 1L/minute. Insufficient flow volumes result in depletion of nutrients and oxygen as the nutrient solution runs down each channel. Excessively high flow rates waste pumping capacity and may interfere with the uptake of certain nutrients. The 1L/min flow rate can be achieved by installing pressure compensated button-type emitters (available at irrigation supply stores) in the spaghetti tubes that supply each trough or can be achieved through the use of a valve to restrict flow to an appropriate rate. Emitters and valves can become plugged by plant debris or algae in the nutrient solution. Installing a 100 mesh in-line filter just upstream of the emitters will solve this plugging problem. Nutrient solution in the capture tank needs to be kept aerated using a small aquarium pump.

Parts Lists for NFT System

- Grow troughs – standard rectangular or circular eaves troughs work well although the materials used have not been made to Food Grade Standards
- Submersible water pump (10 L/min capacity is sufficient)
- 2 cm diam. PVC tube to carry nutrient solution from the reservoir to high end of the NFT system
- 100 mesh in-line filter – removes plant debris from the circulating nutrient solution
- 1 cm diam. spaghetti tubing - to take the nutrient solution from the PVC supply hose to each production trough
- 0.5 to 1L/min pressure compensated emitters – regulate the rate of flow of nutrient solution into each trough
- Nutrient holding tank
- Aquarium aeration pump and air stone