



(Left) A Greenhouse full of hydroponics

Sources and Further Information:

Cornell Controlled Environment Agriculture:
<http://www.cornellcea.com/>

¹Nutrient Solution Necessities for Hydroponics:
<http://www.greenhouse.cornell.edu/crops/factsheets/hydroponic-recipes.pdf>

²An Introduction to Small-Scale Home Hydroponics:
<http://www.backwoodshome.com/an-introduction-to-small-scale-home-hydroponics/>

³Basic Hydroponics and How They Work:
<http://manatee.ifas.ufl.edu/sustainability/hydroponics/Basic%20Hydroponic%20Systems%20and%20How%20They%20Work.pdf>

Hydroponics vs. Soil Farming:
<http://www.epicgardening.com/hydroponics-vs-soil>

Farming in Monmouth County:
Grown in Monmouth Website:
Mcapps.co.monmouth.nj.us/gim/

Rutgers Cooperative Extension of Monmouth County:
Njaes.rutgers.edu/county/quickinfo.asp?Monmouth

Monmouth County Farmland Preservation Program:
<https://co.monmouth.nj.us/page.aspx?ID=2982>

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ECO-TIPS: Hydroponic Growing



What is a Hydroponic System?

Hydroponic growing is a soilless method of growing plants using mineral nutrient solutions in water offers farmers and gardeners new opportunities. Growing in popularity across the country, hydroponic operations can be as small as a single countertop plant or as large as a commercial greenhouse operation.

Hydroponics allow for an extended or year-round growing season, the ability to grow plants at a greater density, and at times, a reduced growing cycle. This can provide excellent benefits for the commercial or individual vegetable grower. Hydroponic systems provide controlled exposure to the elements. Temperature and lighting can be regulated and nutrients are delivered directly to the plant's roots, giving the grower greater control over the growth of the plant, thereby reducing the variables which could result in crop failure.

Nutrient Solutions

In a hydroponic system, the nutrient enriched water must provide all macro and micronutrients necessary for plant growth. Several suppliers provide hydroponic fertilizer mixes. It is important to use solutions that are intended for soilless growth. Soil fertilizers do not contain the additional micro-nutrients found in hydroponic fertilizers, as these micro-nutrients are generally present in soil. Advantages of soilless growing are the elimination of many soil bacteria threats and the greater control in nutrient application, but new challenges, such as water-borne diseases, could arise.

Some nutrient solutions may be marked as one of three basic categories: grow formula, blossom formula, or fruiting formula; there are also several available additives for specific plants and purposes. Growth formula is intended for initial growth of a plant, and may be all that is ever necessary for growing salad greens. Blossom formula may help with later growth stages depending upon the type of plant, while fruiting formula will aid in the growth of the fruit.¹

For larger scale operations, a lab analysis of the water source, including alkalinity, electric conductivity, and concentration of specific elements, may be beneficial in designing your fertilizer program. According to Cornell University, "Closed" systems, which continually re-use their water, ideally feature an electric conductivity of <math><0.25 \text{ mS/cm}</math>. Higher measures may result in salt buildup in the water delivery system. The alkalinity measure will influence the mineral solution's pH stability, which in turn influences the solubility of minerals to be delivered to the plant.¹



(Above) A Hydroponic water monitoring system

Choosing a Hydroponic System:

A hydroponic system can be as simple as a new use for an old aquarium, or as complicated as constructing a series of troughs, towers or ponds inside a greenhouse. The size and technical complexity of your hydroponic growing system depends on your scope and budget. Typical hydroponic systems will feature a plant, something to hold the plant, a reservoir to hold the nutrient solution, and a light source. Variations and additions to this basic set up are nearly endless. A water pump to circulate water and an air pump to aerate the water are likely necessary for most hydroponic operations and may be acquired relatively inexpensively for hobby-oriented set ups. Larger-scale systems may be more complicated in order to deliver nutrients to a larger number of plants.

"Solution cultures", or water-cultures, feature the plant growing directly in the nutrient solution. Seedlings will likely have to sprout out of water before transferring to a water culture. A simple water culture may feature plants sitting on a Styrofoam tray floating directly on a pool of nutrient solution. Solution cultures are excellent choices for fast-growing water-loving plants, such as green, leafy vegetables, like lettuces. A submerged pump connected to a timer may be used in an "Ebb & Flow" system, which temporarily floods the growth tray with nutrient solution before draining the solution back to the reservoir. Alternatively, a Nutrient Film Technique (NFT) pumps a constant flow of nutrient solution to the roots through the growth tray before draining back to the reservoir.

"Medium Cultures" feature a solid, non-soil medium for roots to bind to, such as Perlite, Vermiculite, Pro-Mix or coconut fiber. The nutrient solution is delivered to the plant roots through a wick or drip line system. Plants within the medium may be potted individually, or multiple plants may be placed in a bed or linear trough. In these systems, the nutrient solution is generally supplied to the growing medium through a wick or a drip line system. There are several different types of hydroponic systems available for larger scale, home or commercial use. These systems may be more intricate and more technologically

advanced than the low tech systems previously described. If considering an investment in a larger-scale hydroponic system, one should carefully consider their options, budget, and desired product before consulting a professional or agriculture extension specialist.



(Above) A grid of plants in soilless substrate

Ideas for Hobbyists & Teachers

Low-tech Hydroponics are excellent options for home growing hobbyists and classrooms, as they extend the growing season through the winter. Personal hydroponic systems can provide a continuous supply of fresh herbs or vegetables. Design ideas for smaller-scale hydroponics include:

- Place a gravel-filled clay pot over an aquarium tank, with water pumped from the tank to the gravel bed.²
- Set 2" diameter plastic net pots into lengths of 3" plastic pipe, laid over a sizeable plastic container. Use an electric timer and water pump to periodically flood the pipe with nutrient solution from the plastic container, allowing the water to return to the container at the other end of the pipe.²
- Set leafy green, water-loving plants on a floating tray, such as Styrofoam, to sit directly in the reservoir of nutrient water with roots falling through holes in the tray³

(Right) An example of an aquarium-based hydroponic system

