Hydroponics Information Guide

The term hydroponics refers to the practice of growing crops without soil, with the plants receiving their nourishment from water instead. In contrast to soil-based agriculture, where the plants are fed by extracting nutrients from the soil, the roots of hydroponically grown plants are bathed in a complete liquid plant food that contains all the nutrients the plants need.

In place of soil, some hydro systems use a medium to anchor the plants, such as rockwool, coconut fibers (known as coir), or perlite. Other systems contain no solid growing medium, with the roots bathing directly in the liquid. The common thread tying all hydro systems together is that the plants are receiving fertility from the nutrient solution, rather than soil.

Most hydroponic systems today are housed under cover, principally in greenhouses. Without the absorptive and buffering effects of soil, rainfall tends to dilute the nutrient solution and throw hydro systems out of adjustment. Of the hydro systems that are set up outdoors, most are located in arid parts of the world.

Hydroponic systems can be installed almost anywhere, and scaled to a footprint ranging from hundreds of acres down to hundreds of inches, depending on the needs of the grower. In addition, hydroponics can allow a grower to avert soilborne disease and fertility problems through bypassing the soil altogether. They can be situated anywhere, regardless of whether there is good soil or any soil at all — even in a vacant lot or building rooftop.

Johnny's Selected Seeds

Hydroponic Systems

Between commercially manufactured and homemade hydroponic systems, hydroponics systems can be configured in many different ways, but most hydro systems used to grow food crops fall into two main camps: those that do include a solid growing medium (also known as substrate) in place of soil, and those that do not (also known as liquid hydro systems). Regardless of the type of hydroponic system, seeds are usually sown in soilless plugs that are designed to hold the growing plant for the entire cropping cycle. The seeds of long-season fruiting crops are usually sown into small plugs that fit into a larger block, usually a 4"/10cm cube, to allow the seedling to grow larger before being transplanted into the production greenhouse. Shorter-cycle crops, such as lettuce and greens, are usually transplanted into the growing system in the original plug without being potted-on to the larger block. The most common materials used for propagation plugs and blocks are coir, rockwool, or inert foam, such as Oasis cubes.

NO SOLID MEDIUM/SUBSTRATE SYSTEMS

Hydroponic systems where the roots bathe directly in nutrient solution, without any type of solid soil substitute securing the plants, are known as liquid hydro systems. There are three main types:

Nutrient Film Technique (NFT). NFT systems use long gutters or troughs to hold the plants as they grow. Typically, there is a top on the gutter, with holes where the plants are placed. The roots grow in the gutters without any medium other than a small plug holding the plant. Nutrient solution is piped in at the top of the gutter, flows down, and drains at the bottom of the channel. The nutrient film refers to the thin layer of nutrient solution present in the channel where the roots grow.

Deep Water Culture (DWC). Another common method of hydroponic production that does not involve a solid growing medium, deep water culture involves growing crops in standing nutrient solution, with the roots dangling in the solution. Instead of channels, crops grow in tubs or basins, with the plants commonly anchored in floating rafts, with no medium other than the plugs holding the plants.

Aeroponics. Aeroponics is a third way crops can be grown without a medium. In aeroponics, the plugs holding the seedlings are suspended in systems where the roots dangle and are sprayed at regular intervals with nutrient solution, instead of being irrigated with liquid. Currently aeroponics is less common than NFT or DWC.

SOLID MEDIUM/SUBSTRATE SYSTEMS

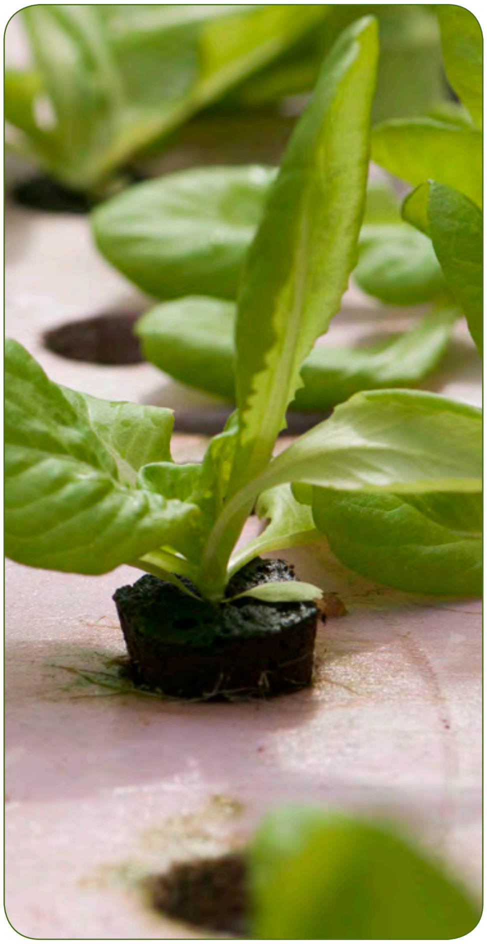
Hydro systems using a medium can be divided broadly into container culture and slab culture. The medium holding the plant in hydro systems can be composed of a wide range of inert materials, including rockwool, coir, sand, perlite, sawdust, wood chips, or others.

Container Culture. Container culture refers to the use of containers to hold the loose, soilless medium in which the plants grow. The containers can be anything from buckets, pots, or grow-bags specifically manufactured to hold plants, to repurposed bags, buckets, or other alternatives.

Slab Culture. In slab culture, plants are grown in long, flat slabs of media that are made specifically for this purpose. The most commonly available materials for slabs are rockwool and coco coir. The size of the slabs vary by crop and conditions, but they are typically a couple of inches deep, a foot or so wide, and a few feet long. Each slab is designed to house multiple plants growing from its top, with the number of plants depending on the type of crop. Slabs are usually wrapped in plastic or biodegradable film, to contain the nutrient solution. Individual slabs are laid end-to-end to form a row.

One big difference between liquid and substrate hydroponic systems is that substrate systems usually require one emitter per plant, to deliver the nutrient solution to the roots. This is in contrast to liquid hydroponics, where the nutrient solution is contained in the root zone by the channel or the basin, depending on the system.

Aquaponics. This methodology involves growing crops with the recycled nutrient waste from aquaculture. The nutrient solution is derived directly from water used to raise fish or other aquatic animals. The nutrients in the waste from the animals are used to feed the crops, creating an efficient food production system. Aquaponic systems can be integrated with any of the above hydro systems. The aquaculture waste is the source of fertility, and the hydro system of choice, whether NFT, DWC, or otherwise, is the method of delivery.



PLANTING PROGRAMS — SCHEDULING WHAT TO PLANT AND WHEN

In areas with cold winters and moderate summers, fruiting crops are usually started in the winter or early spring and terminated the following fall or winter. In areas with summers that are prohibitively hot for growing, the opposite crop schedule is often used. Seedlings are started in the summer, transplanted into the greenhouse after the hottest weather has passed, and grown through the winter to be terminated the following year before the hottest weather.

Lettuce, greens, herbs, microgreens, and shoots can be scheduled for as many short production cycles as the growing season permits. Varieties may need to be modified with the changing seasons to allow year-round production of any given crop.

SPECIALTY HYDROPONIC TECHNIQUES: MULTISEEDING AND LIVING HARVESTS OF LETTUCE, GREENS, AND HERBS

The "living harvest" concept is one to which hydroponics is especially well-suited. Since plants can be quickly and efficiently removed from the system with their roots intact, growers are harvesting lettuce, greens, and herbs by pulling them out of the system and selling them without cutting. The main advantage of this method is the prolonged shelf life, as the damp roots continue to feed the plant. Produce sold in this fashion is usually packaged in clamshells or individually bagged, to protect other produce from contact with the roots and nutrient solution.

One variation on this technique involves planting multiple seeds into a single plug to deliver multiheaded living produce to the customer. For example, two or more seeds of lettuce, basil, and/or greens of contrasting colors can be planted into the same plug, so the customer receives a multicolored living "bunch."

The Growing Differences *Hydro v. Soil*

Concerted Management. As with any other engineered system, hydroponic growing only works as well as the system is designed and managed. Unlike some field crops that can grow with little attention for extended periods of time, hydroponic systems require management on a daily basis. Instead of building up the soil and inputting fertility at the beginning of the crop cycle, soilless crops are typically fertilized every day, at every watering. With smaller root volumes and less buffering capacity than soil-grown crops, if a pump or timer fails or nutrient solution goes out of balance, the negative consequences for the hydroponically grown crop can occur rapidly and be drastic.

Fertility Programs. Hydro system fertility requirements vary widely on the basis of crop, growing environment, regional and seasonal factors. Success of the crop is dependent on having a nutrient solution that matches all of those factors. Beginning hydro growers are encouraged to use a complete fertility program that has been designed by the manufacturer with their circumstances in mind. Once they have an idea of how the crops should perform, more experienced growers can blend their own custom fertilizers from single elements.

Popular Crops

The most popular food crops for hydroponic production are tomatoes, lettuce, cucumbers, greens, peppers, eggplant, herbs, microgreens, and shoots. These crops fall into one of two main production models: one long harvest or multiple quick harvests. For example, fruiting crops such as tomatoes, cucumbers, peppers, and eggplant are typically raised for a long season of up to a year, and the same plants are harvested many times for an overall high yield. Crops such as lettuce, greens, herbs, and microgreens are significantly quicker-cycle crops, which provide a high overall yield by being planted and harvested many times over the course of a season.

System Choice

Technically, one can grow nearly any crop in any hydro system. However, systems that use media, such as **slab or bucket culture**, are most popular for the fruiting crops: tomatoes, cucumbers, peppers, and eggplant. **Liquid systems** are the most popular for leafy crops such as lettuce, greens, and herbs. **NFT** systems are the most popular for microgreens and shoots.

EQUIPMENT & SUPPLIES

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HOW TO CHOOSE VARIETIES SUITED FOR HYDROPONICS

Together with excellent flavor and appearance, crops best suited for hydroponics share certain characteristics. In fruiting crops, a high level of vigor is important to keep the plants strong over a long season. Being resistant to blossom end rot is important in the solanaceous crops, since fast-growing fruits can be susceptible to this disorder. Resistance to diseases common in various growing regions will help keep the plants healthy. Having an open plant habit that promotes air flow can be equally important, as fruiting crops are frequently planted densely in greenhouses. And last but not least, breeding and selection to make sure the varieties thrive in hydroponic conditions are important.

The features that make lettuce, greens, and herbs suitable for hydroponics include resistance to diseases common in the greenhouse for leafy crops, such as downy mildew. Tip burn resistance is important as well, as this disorder can be a problem in rapidly growing greens, especially lettuce. Resistance to bolting is also important.

When it comes to form, varieties that are dense and compact will allow you to fit more plants into a given space. Lettuce and greens crops that have a head-type growth habit will yield more than open, leafy types in hydro systems. That is a big advantage of Salanova-type lettuces, enabling salad mix production in hydro systems. Before Salanova, it was difficult to achieve good yields of high-quality salad mix hydroponically because it is not possible to densely seed in a line as is typical for field production of salad mix. For greens, yield varies widely by species; varieties must be chosen carefully to ensure the yield is sufficiently high in a plug system to justify the expense.

Microgreens and shoots, with their short crop cycles, are well suited to hydroponic culture because they rarely need fertility inputs. They are commonly grown in a modified NFT system, with a piece of burlap or other fabric type material lining the gutter to secure the roots. The microgreens may then be harvested by cutting the stems to provide loose microgreens, or cutting the medium, to provide a square of rooted, living product.