Vegetable Tips

Hydroponics at Home

Michigan State University
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Hydroponics

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at the seedling stage of development. Cut a hole in the jar stopper, place the plant through the hole so roots are suspended in the solution and gently pack cotton around the stem to keep it in position. Leave a narrow, unpainted strip down the side of the jar so you can determine the water level without removing the plant.

In aggregate culture, the aggregate provides plant support. Using the aggregate method is similar to growing plants in a peat-lite medium in which various fertilizers and mineral elements have been incorporated. Aggregates that can be successfully used include the following:

- **Sand.** Fairly coarse sands are best, especially river or beach sands. A sieve size range of 14 to 100 mesh is good. Only half of the volume of sand should be able to pass through a 30-mesh screen. The other half should be made up of larger particles. Advice on sand sizes can usually be obtained from garden centers or suppliers who sell this material. Coarse white silica sand is available locally and is acceptable for sand culture.

- **Gravel.** Gravels include pebbles, crushed rock, crushed limestone or corals, silica gravel and slate chippings. Particle sizes of gravels range from 1/8 to 1/2 inch in diameter. For home hydroponics, a mixture of 25 percent coarse gravel, 30 percent fine gravel, 40 percent coarse sand and 5 percent fine sand should give good results.

- **Vermiculite.** Vermiculite should be standard garden grade. It can be used alone, but mixing it with an equal amount of coarse sand is better—it keeps the vermiculite from packing down and retaining too much water.

- **Perlite.** Perlite should also be standard grade. Perlite is very lightweight and shouldn’t be used with very large plants.

- **Broken bricks.** Bricks can be broken up quite easily with a heavy hammer. The largest sized pieces should not be larger than 1/2 inch. All sizes of chips and dust should be mixed together and placed in the container. Use safety goggles while breaking up bricks.

Sand and other aggregates should be rinsed thoroughly with a dilute acid solution, such as half-strength muriatic acid, then rinsed with water to remove any potential contaminants.

It is also wise to rinse the aggregates once every one to two weeks with water to avoid toxic salt buildup, especially if the volume of solution put through the system is low.

Aggregates differ in their water-holding capacity. Certain aggregates retain minimal amounts of water and consequently should be watered more frequently.

It should also be noted that the concentration of minerals in solution may be lower in an aggregate system than in a water system. In an aggregate system, new solution will be added frequently and excess solution is always leaching away. Frequently, 1/4 strength Hoagland solution is adequate for good growth and productivity in an aggregate system. In a water culture system using a Hoagland’s solution (see page 4), the nutrient concentrations are adjusted quite high—several times higher than in a normal soil solution—to sustain growth for an extended period of time.

A general aggregate setup consists of a trough containing the aggregate with a drain at one end. Nutrient solution is poured or pumped into the trough at one end, and when the trough is flooded, the solution is drained out of the other end. With a pump and return hose, this can be made into a continuous system.

Aggregate culture can also be adapted to individual plant containers. The container should be at least 8 inches deep and have drainage holes with stoppers. Fill the container with aggregate and place the plant or seedlings in the aggregate. The container should stand in a tray to catch any seepage around the stoppers. Sprinkle nutrient solution evenly and thoroughly on top of the aggregate (an old-fashioned watering can with a sprinkle spout works very well), and then drain immediately.

The frequency with which the nutrient solution should be applied to plants growing in an aggregate depends on many factors, such as the size and type of plants, stage of development, temperature, light intensity and water-holding capacity of the aggregate. Large, fast-growing plants will probably require several applications daily when the temperature is warm and the light intensity is high. Small or slow-growing plants can get by with fewer applications, perhaps only once or twice a week. The aggregate should not be allowed to dry out so much that the leaves wilt. This injures plants and slows the growth rate.
Toxicity Symptoms / Nutrient Deficiency

The Nutrient Solution

The nutrient solution must contain certain plant nutrients to ensure proper growth. Plants need a variety of nutrients for optimal growth. The nutrient solution should provide a balanced mix of these nutrients to support plant health. Nutrient imbalances can lead to various symptoms, such as stunted growth, yellow leaves, or wilting. Therefore, regular monitoring and adjustments are necessary to maintain optimal conditions for plant growth.

The pH level can be easily checked using a pH meter. The ideal pH range for most plants is 6.0 to 6.5. If the pH is too high or too low, adjustments can be made to the nutrient solution to correct it. Plants require a range of nutrients, including macro and micro nutrients, to thrive. A nutrient deficiency can lead to specific symptoms, such as chlorosis (yellowing) or stunted growth, depending on the nutrient lacking.

The nutrient solution is typically prepared by dissolving nutrients in water, often using a nutrient solution mix or fertilizer. The concentration of nutrients in the solution can vary depending on the specific needs of the plants. It is important to monitor the pH and nutrient levels regularly to ensure the nutrient solution is balanced and optimal for plant growth.

The nutrient solution is sometimes supplemented with trace elements such as iron, manganese, copper, and zinc, which are essential for plant health but are present in small quantities in other nutrients. These trace elements can be added as chelates to ensure they are readily available to the plants. The nutrient solution is then applied to the roots to ensure the plants receive the necessary nutrients for healthy growth.

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Deficiency Symptoms:

- Stunted growth and light or chlorotic foliage.
- Lower leaves with interveinal chlorosis, browning leaf edges.
- Tilt of shoot dies, interveinal chlorosis on upper leaves.
- Lower leaves with interveinal bleaching or chlorosis and dark green veins; leaf margins may curl; leaves eventually die.
- Lower leaves develop interveinal chlorosis with green veins.

Toxicity Symptoms:

- Long internodes; crispy stem.
- Dark leaf edges.
- Dark brown leaf veins; also iron deficiency symptoms because too much manganese inhibits iron uptake.
- Copper deficiency symptoms.
- Necrosis of leaf edges.

Copper: Veinal chlorosis starting in the middle leaves; a few leaves suddenly wilt and die and then a few more higher up, etc.

Zinc: Malformation of leaves—leaves become asymmetric.

Boron: Dieback of shoot resulting in witch’s broom effect; flowers are deformed when open; stems and petioles become brittle.

Nitrogen: Necrosis of leaf edges.

Phosphorus: Stunted, very dark green foliage; lower leaves may become yellow between veins; monocots may have purple veins.

Calcium: Lower leaves with interveinal chlorosis; browning leaf edges.

Magnesium: Lower leaves with interveinal bleaching or chlorosis and dark green veins; leaf margins may curl; leaves eventually die.

Sulfur: Light green upper leaves with veins lighter than surrounding tissue.

Iron: Upper leaves develop interveinal chlorosis with green veins.

Manganese: Also interveinal chlorosis of upper leaves but veins have wider green bands; upper leaves may also have necrotic spots.

Recognize stress signs. Some common nutrient deficiency and toxicity symptoms are listed below.
### Microelements

**Table 2.**

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Amount of stock solution (1 gal of water)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnesium sulfate</td>
<td>1/4 cup</td>
</tr>
<tr>
<td>Zinc sulfate</td>
<td>1 tsp</td>
</tr>
<tr>
<td>Copper sulfate</td>
<td>1/2 tsp</td>
</tr>
<tr>
<td>Iron (CuSO₄·5H₂O)</td>
<td>1 tsp</td>
</tr>
</tbody>
</table>

**Table 1.**

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Amount for 25 gal of nutrient solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium</td>
<td>1 quart OR 10 level tablespoons</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>3 cups (of powdered salt)</td>
</tr>
<tr>
<td>Calcium</td>
<td>1 cup (monobasic)</td>
</tr>
</tbody>
</table>

**Supplies Sources of Hydroponic**

Also, like suppliers, some of the books on hydroponics contain magnesium and potassium. If they do not say so, they may be several sources. Suppliers and catalogues are available. Chemical suppliers and catalogues may carry the hydroponic media, the essential nutrient solutions, and the equipment. Sources of hydroponic chemicals and equipment can be obtained from several places. Carbon centers and hydroponic supplies can be obtained.
References


Schwarz, M. 1967. “Gravel Culture Home Unit.” HortScience 2(1):22-23. (Hydroponics Department, Negev Institute for Arid Zone Research, Beersheba, Israel.)


