

### What are some features of hydroponic systems?

1. Water is used to deliver the nutrients.
2. Soil or potting mix is not used.
3. Plant roots are directly in water or are in water flowing over an inert substrate, such as gravel, coir, or fabric.
4. Water can be static (not flowing), flowing past the plants and discarded, or recirculated.



<http://www.offgridworld.com>

### What are aeroponics, aquaponics, and nutrient film technique?

**Aeroponics:** Plants are held in a frame, usually with a foam collar around the stem. The roots, which hang in the air, are sprayed every few minutes with nutrient solution.



**Aquaponics:** Plants are grown in water used to raise fish. The plants remove nutrients (fish waste) from the water.



**Nutrient film technique (NFT):** A type of hydroponics where plants are grown in sloped trays on fabric or gravel through which a film of nutrient solution is circulated.



### Why use a hydroponic system?

1. Potting soil might be unavailable or too expensive
2. More produced per square foot of greenhouse space
3. Potential to use less water or to combine with fish production

Table 2. Yields of vegetable crops grown hydroponically in desert greenhouses (CEA) and in open fields (OFA)

| Crop                 | Hydroponic CEA        |                | OFA <sup>z</sup>        |
|----------------------|-----------------------|----------------|-------------------------|
|                      | Yield/Crop<br>(MT/ha) | No. Crops/yr   | Total Yield<br>MT/ha/yr |
| Cucumber             | 300.0                 | 2              | 600.0                   |
| Eggplant             | 165.0                 | 2              | 330.0                   |
| Green bell peppers   | 250.0                 | 1              | 250.0                   |
| Colored bell peppers | 200.0                 | 1              | 200.0                   |
| Lettuce              | 31.0                  | 10             | 313.0                   |
| Tomato               | 550.0                 | 1 <sup>y</sup> | 550.0                   |

<sup>z</sup>Source: Knott (1966)

<sup>y</sup>Tomato crop grown in greenhouse cover 11 month period.

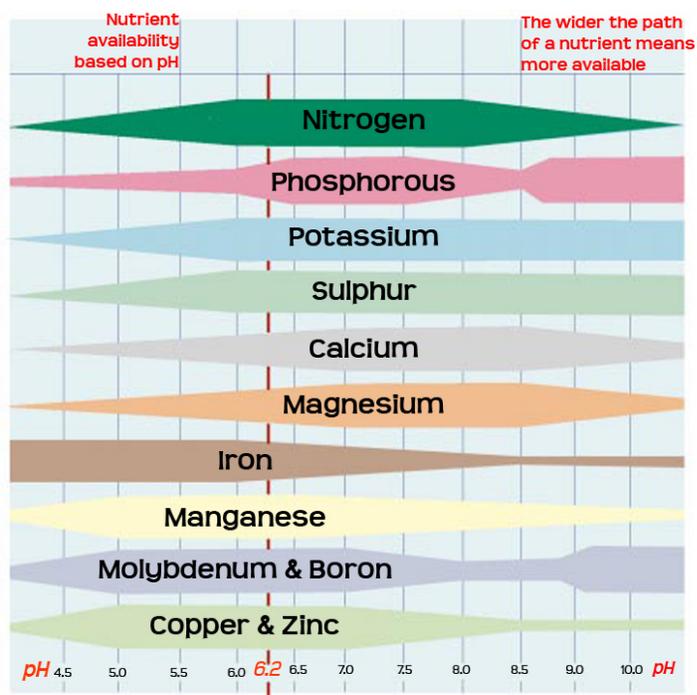
<http://ag.arizona.edu/ceac/sites/ag.arizona.edu.ceac/files/Merle%20overview.pdf>

## What are common challenges with hydroponic systems?

1. Nutrient deficiencies
2. Poor water quality
3. Pathogens
4. Insects and other pests

## Nutrient deficiencies, nutrient balance, and pH are all critical for success with hydroponics

1. Each type of nutrient deficiency causes characteristic symptoms on plant foliage. These symptoms can easily be found online.
2. Nutrient toxicities can also occur, particularly if micronutrient levels are too high.
3. The “inert” substrate used may leach nutrients and throw off the nutrient balance. Thoroughly rinsing the system with clean water prior to planting can alleviate this problem.
4. Nutrients can compete with each other for uptake by roots. For example, iron and manganese compete with each other.
5. pH affects availability of nutrients. Plants, pathogens, and algae can all affect nutrient solution pH, so this should be monitored with a pH meter or litmus paper.
6. Salt levels can become too high in hydroponic systems and, like pH, this can be easily monitored with an inexpensive meter.



[http://hawaiianhorticulture.com/food\\_grade\\_products.html](http://hawaiianhorticulture.com/food_grade_products.html)

### **Water quality is crucial for success with hydroponics**

1. *Pythium* and other waterborne pathogens can be introduced into a greenhouse through surface water. Well water or tap water is usually free of plant pathogens.
2. Surface water increases the risk of food-borne human pathogens becoming established in the hydroponic system. Bacterial pathogens, such as Salmonella, survive well in water.
3. It may be impossible to solubilize the nutrient solution in hard water. Hard water will also cause calcium carbonate deposits to form inside the hydroponic system and will damage pumps. Sometimes softened or distilled water must be used.

### **Foliar pathogens can cause disease in hydroponic systems**

1. The same pathogens that cause disease in potting-soil based systems affect hydroponic plants. Our experience with potato includes:
  - a. Early Blight
  - b. Powdery Mildew
  - c. Reduced white mold, probably because sclerotia were surviving on greenhouse floor and spores do not reach hydroponic plants, which are about 3.5 feet off the floor.
2. Treatment challenges and solutions:
  - a. Plants are closer together, so it is difficult to spray the foliage with fungicides or to see the damage caused by disease
  - b. We have learned when and where disease is most likely to appear, so can be more proactive



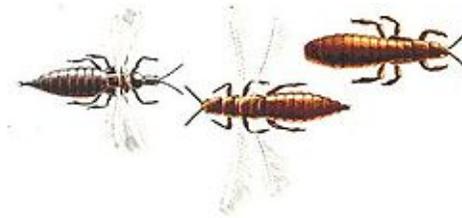


## **Insects and other pests can cause losses in hydroponic systems**

1. Aphids: usually not very damaging alone, but can spread plant viruses.
2. Thrips: cause leaf damage and can spread plant viruses.
3. Mites: cause leaf damage and difficult to eradicate.
4. Tobacco hornworms: will eat potato tubers developing in hydroponic systems.

To control insects:

- a. Insecticides – follow label directions.
- b. Remove damaged plants.
- c. Produce in late winter/early spring when insect populations are low. Insects and diseases are more difficult to control July-Sept.
- d. Use silver plastic mulch as part of NFT system to repel insects.



## **Algae will contaminate and clog hydroponic systems.**

To control algae, cover all portions of system where water is flowing from light with black plastic, foil, or panda plastic (two sided light-proof plastic with a white top).

## **General management suggestions to reduce damage caused by disease and insects:**

### **Sanitation**

1. Remove dead leaves from plants and greenhouse.
2. Remove diseased plants from the system.
3. Sanitize the system between crops.

### **Exclusion**

1. Do not bring diseased plants into your greenhouse
2. Do not go from a garden or field into a greenhouse.
3. For larger greenhouses, use a double-door entrance for the greenhouse.
4. Keep specific clothes for the greenhouse (lab coat, boots) and change when entering into the greenhouse.
5. Use insect-excluding screens over the fans going into a greenhouse.

### **Avoidance**

1. Hydroponic systems will be most productive when planted in late winter/early spring and planting at this time avoids high spore and insect populations coming in from outside.
2. Try not to plant July-Sept, if possible. Insect and disease pressure outside is higher and more pest and disease problems will occur.
3. Use only high quality water (tap water or quality well water). Surface water will contain pythium spores and will cause root rot. There may also be a food safety risk when using surface water.