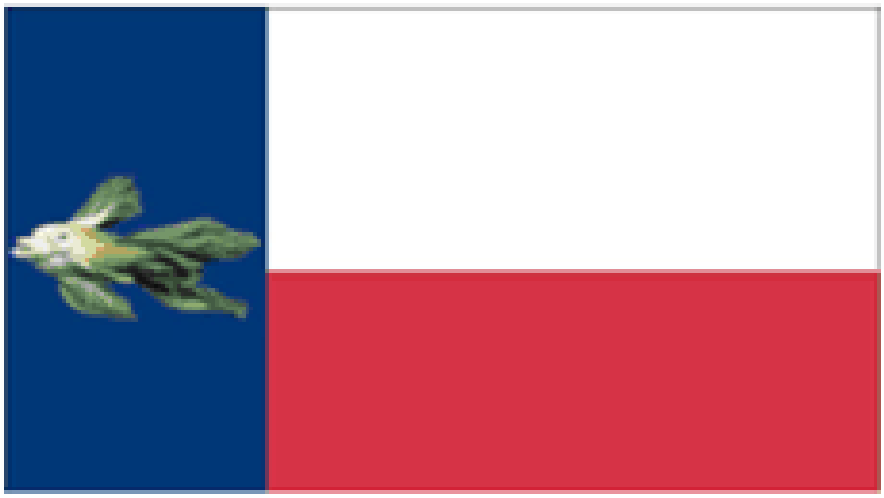
Aquaponic Insect And Nutrient Deficiencies



The Texas Aquaponic and TransFarming Meetup Group

(Adapted from the Texas Aquaponic Guide)

The Relationship Between Plant Nutrients and Pest Insects

It is well known that insects tend to attack plants that are stressed and weak. These plants are often compromised by a lack of water or a nutrient deficiency. Watering methods in traditional gardens allow water and nutrients to literally wash straight into the ground, through the garden. This makes it difficult to keep plants healthy, at least in a sustainable fashion. This of course is compounded by the Texas heat.

Fortunately, with Aquaponics plant hydration is seldom an issue. And as long as a good quality fish food is being fed the fish, the nutrient needs of the plants are usually realized.

But many factors can alter these healthy conditions. For example, extended hot or cold temperatures, poor feed quality, a pH imbalance, large fish population, or excessive nutrient requirements due to fruiting plants. These conditions can compromise the nutritional value of the plants and weaken them thus making them more susceptible to attacks from opportunistic insects.

This publication will outline some of the primary plant nutrient deficiencies and explain how to identify which nutrient may be lacking. Additionally, we will explore some of the insects that tend to compromise Aquaponics while learning about some desirable insects that prey on them.

Aquaponic Nutrient Deficiencies

Different plants have different nutrient requirements. Some may need more of one mineral and less of another. Any deficiency in any of these nutrients can cause a wide range of symptoms depending upon the plant. Because this can get confusing, it is always a good idea to find a comprehensive reference source that outlines plant deficiencies. A Companion to Plant Physiology, Fifth Edition by Lincoln Taiz and Eduardo Zeiger is a great reference and has color pictures of plants under various types of nutrient stress.

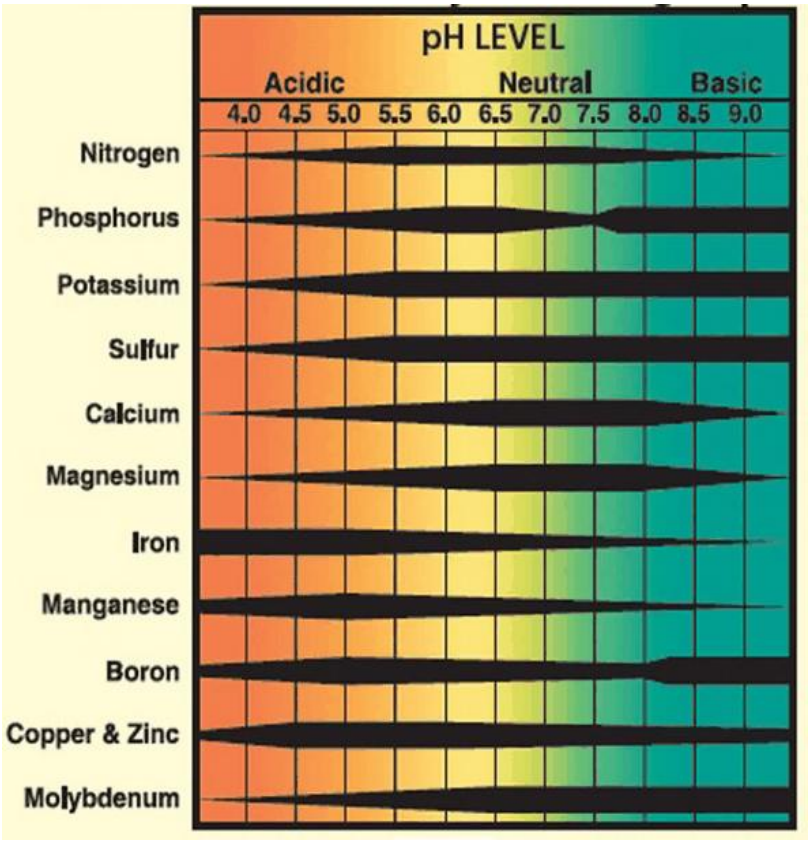
With Aquaponics, systemic problems with the plants are not uncommon. When *all* the plants appear to be in the same condition, this is an indication that you have an overall system problem. This could be due to a nutrient deficiency, lack of oxygen, water chemistry imbalance, pH problem or temperature extremes.

With any of these scenarios, the best course of action is to test the water, both physically (with testing kit), and by using your senses. Then determine the best course of action. If the cause of the plant stress is a consistent nutrient deficiency, check the contents of the fish food and ensure the availability of nutrients.

If you determine the cause of plant distress is a nutrient deficiency, it may be easily corrected using a broad spectrum liquid seaweed extract such as Maxicrop. Liquid seaweed adds essential micronutrients which may not be available in your fish food. Be sure to dilute the seaweed first in up to 5 gallons of water and pour it into the plant trough. Remember, with fish everything is done slowly to minimize the impact. Adding the supplements over a period of time is even better. Avoid using fish emulsion which is basically ground up fish and can overload the system.

A Note on pH and it's Impact on Nutrient Absorption

From the chart below, observe that at too low or high a pH level, certain nutrients cannot be absorbed.



Without a proper pH balance within your Aquaponic system, that is, within a range between 6.5 to 7.5 things will be compromised in terms of plant nutrient uptake. Ideal pH for Aquaponics is between 6.8 and 7.2. The following assumes these parameters are met.

More than you know about the Nutrients

In defining plant nutrients, there are several "splits". Following is a description of the most relative definitions to healthy plant growth. Know that you do not need an in-depth understanding of these aspects for

Aquaponics, just a fundamental understanding. What follows is more intended to give you a "springboard" towards more information if you desire more information. In terms of Aquaponics, "Split Four" is probably the most significant in determining a nutrient deficiency in your plants.

Split One

Roughly, there are 16 chemical elements known to be important to a plant's health. These are divided into two main groups: **non-mineral** and **mineral** nutrients.

Non-mineral nutrients are hydrogen (H), oxygen (O), and carbon (C). These are found in air and water and required for photosynthesis (making things with light). Go figure…

The remaining 13 elements are known as mineral nutrients. The remainder of this publication will focus on these nutrients.

Split Two

Mineral nutrients are divided into two major categories, **macronutrients** and **micronutrients**. Macronutrients are needed in larger quantities, while micronutrients are needed in trace quantities for healthy plant growth.

Split Three

Macronutrients are further broken into two more groups, **primary** and **secondary** nutrients. The primary nutrients are nitrogen (N), phosphorus (P), and potassium (K), and are often denoted as "N-P-K" when describing fertilizers. The secondary nutrients are calcium (Ca), magnesium (Mg), and sulfur (S).

Sometimes called the minor elements or trace elements, the micronutrients are boron (B), copper (Cu), iron (Fe), chloride (Cl), manganese (Mn), molybdenum (Mo) and zinc (Zn).

Split Four

The following information is probably the most important in determining a plants nutrient deficiency. Certain elements have properties that allow them

to migrate through a plant or stay "planted" where they are within the plant. They are known as **mobile** and **immobile** nutrients.

Just as the term implies, mobile nutrients move around inside the plant. If the plant is deficient in a mobile nutrient, the symptoms will show up in the *older* leaves first. Think about it…

This is due to these nutrients re-locating to the new growth to function where they are most needed. This leaves the old leaves "high and dry" as there are no nutrients to support them, so the symptoms will show up there first. This is a clue!

Again, just as the term implies, immobile nutrients don't move once they have been utilized in plant growth. This means that when there is a deficiency of these nutrients, the deficiency shows up in the newer leaves first, while the older once appear fine. This is another clue!

Ok, what is the point of "mobile" vs. "immobile" nutrients? They help indicate the nutrients which are lacking and the symptoms are displayed by how the plant reacts to the deficiency. Below is a chart listing the 13 elements essential to healthy plant growth. Using the information provided under "Split Four" you should, through observation, be able to determine your plants deficiency.

Mobile Nutrients	Immobile Nutrients
Nitrogen	Iron
Phosphorus	Calcium
Magnesium	Copper
Potassium	Zinc
Chloride	Sulfur
Molybdenum	Manganese
	Boron

NOTE: As mentioned previously, with Aquaponics, a good seaweed extract should correct any nutrient deficiencies.

Fish Uptakes of Iron, Potassium and Calcium

In Aquaponics, of the 16 elements essential to healthy plant growth, generally only iron, potassium, and calcium must be supplemented. This is due to the fact that fish tend to absorb these nutrients and don't release them back via their waste.

From the Texas Greenhouse Management Handbook, symptoms of these nutritional deficiencies are described as follows:

Iron Deficiency

Iron (Fe) Deficiency - Starts with interveinal chlorotic (yellow color on leaves), mottling (spot or blotch of color), of immature leaves. In severe cases, new leaves completely lack chlorophyll but have little or no necrotic (dead) spots. The chlorotic mottling on immature leaves may start first near the bases of the leaflets so that the middle of the leaf appears to have a yellow streak.

Potassium (K) Deficiency - Older leaves of the plant show interveinal chlorosis and marginal necrotic spots or scorching which progresses inward and also upward toward younger leaves as the deficiency becomes more severe.

Potassium Deficiency

Calcium Deficiency

Calcium (Ca) Deficiency - From slight chlorosis to brown or black scorching of new leaf tips and die-back of growing points. The scorched and die-back portion of tissue is very slow to dry so that it does not crumble easily.

Always use "chelated" iron when supplementing an Aquaponics system. Even at a higher pH, chelation helps keep the iron in a more usable form for the plants. To supplement calcium or potassium, either calcium hydroxide or potassium hydroxide will help maintain a proper pH level while providing the missing potassium and calcium nutrients. These are added separately from the chelated iron.

Always dilute these elements with plenty of water. It is not recommended you pour them directly into the fish tank. Adding them via the plant trough will minimize shock to the fish. Again, remember with fish, everything is done slowly to minimize the impact. Adding these supplements over a period of time is even better.

Aquaponic Insects

Insects are a natural and necessary part of nature. While many are beneficial to a healthy food growing eco-system, some must be kept under control. In conventional gardening, there are many chemical solutions, both organic and not, that can be applied to the plants without interfering with the garden plants. But with Aquaponics, extreme care must be taken not to introduce anything detrimental to the fish. Therefore when planning your crop, it is desirable to plan ahead to try and minimize these pests. One way is try and populate your system with pest resistant plant varieties. Be sure and prune your plants of dead debris. Also, keep a close eye out for pests as early detection is key to keeping your plants healthy.

While the range of insect pests is vast, below is a list of some of the most common in Aquaponics. There are myriad resources available for more information, such as GardenInsects.com. Always keep in mind, a natural solution is always preferable to a chemical one when it comes to Aquaponics.

***A trick: Sometimes it is easier just to lift the plant out of the plant trough and set it inside the fish tank and leave it there for about 20 minutes. Pests that don't drown will likely be a tasty treat for the fish*. This will feed the fish, hydrate the plant, and usually rid a localized problem.**

Pest Insects

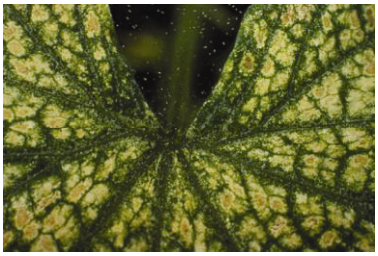
Caterpillars are voracious little creatures that can take a plant out in very short order. Inspect your plants regularly and look for ragged leaf edges or holes. If you don't have some of the beneficial insects present, such as predatory wasps, pick them off by hand and feed them to your fish. They will love it.

Aphids, also known as plant lice, are not only hard to see, but multiply very quickly. They suck the sap out of tender plant leaves and can weaken and stunt its growth. This often causes leaves to curl or wilt, and as a result delay fruit or flower production. Additionally, they excrete a sticky, clear substance called "honeydew" that can interfere with photosynthesis. *Ladybugs, lacewings, parasitic wasps, and damselflies will all feed on aphids*.

Thrips are small, elongated, clear-bodied insects most often found in opened flowers. While direct plant damage from these insects is minimal (except on onions), they are known to transmit viruses. *Lacewings are known to control these pests*.

Mealybugs, also known as woolly aphids, are some of the most destructive of garden pests. They are a scale-like insect coated with a powdery/mealy/waxy secretion and feed on plant juices which stunts growth and can kill the plant. Their nests appear as fluff-like tufts. They, like aphids, produce "honeydew" which can interfere

with photosynthesis. Prune or cut the plant parts where infestation is severe. *Lady bugs and lacewings can help control mealybugs*.



Spider mites are tiny and barely visible with the naked eye. The damage they cause is easy to recognize. Leaves that have mite damage appear "bronze" or "silver" because of the damage to the green tissue. A characteristic web is often present on leaves and young shoots. During hot weather, mite populations increase rapidly. *Lacewings and damselflies are good deterrents to spider mites.*

Leaf miners are actually maggots usually about 1/8 inch thick when hatching. They are very difficult to see prior to the damage they cause, but the maggot will usually be visible inside the leaf it is burrowing through. Leaf miners burrow through leaves leaving brown and light green trails of dead tissue behind them. This eventually will cause the leaf to stop functioning. *Several species of parasitic wasps will eat them.* If you do not have these predator wasps present, crush the maggots inside leaves with your fingers. Cut infested leaves off your plant and either burn them or dispose of them far away from the Aquaponic system or other gardens.

Whiteflies are very small winged insects. They appear as white dots on the underside of the leaf. They are easy to recognize as they take flight when you shake or tap the leaf. Like mealybugs and aphids, they reduce plant vigor by sap-feeding and allow growth of sooty mold on the honeydew they produce. In severe cases, infested leaves also take on a chlorotic look. Certain wasps can be used to eradicate whiteflies.

Beneficial Insects

Ladybugs feed on aphids and a variety of other soft-bodied insects. They can be bought in bulk at gardening stores and added to your Aquaponic system. It is best to add the ladybugs at night.

Damsel bugs are tan-colored, winged bugs. They feed on many pest insects such as aphids, caterpillars (corn earworm, corn borer, cabbageworm, and some armyworms), leafhoppers, sawfly larvae, mites, asparagus beetles, and moth eggs. They are very desirable to have in your plant troughs.

Lacewings also feed on aphids and a variety of other soft-bodied insects. Lacewing larvae attack the eggs of a wide variety of pest insects such as aphids, spider mites, sweet potato & greenhouse whitefly, mealybugs, leafhoppers, and the caterpillars of most pest moths. Lacewings are also known to control thrips.

Praying Mantids, or mantis, are carnivorous insects that feed primarily on other insects such as fruit flies, crickets, beetles, moths and bees. However, it is not uncommon for larger mantids to consume small reptiles, birds and even small mammals. Yeowch!

Wasps and bees help pollinate fruiting plants. Some wasps feed on insects, caterpillars and other pests. Bees tend to congregate on media bed systems, especially during hot months. Beware, while they are beneficial, if threatened they will sting.

Texas TransFarming Builder Series Supplement

Water Conservation with TransFarming and Aquaponics

Here in Texas we face myriad obstacles to growing food in a "sustainable" fashion. What does sustainable mean? Well, it has a lot to do with producing food in a manner that is not interrupted by "outside influences". One of the major outside influences here in Texas is the weather – long seasons of heat, extended periods of cold, rapid changes between those two conditions, and no rain in between.

The entire premise of TransFarming was started on the realization the weather here in Texas can be brutal and a different approach must be taken to combat the elements in light of our modern challenges.

At the core of all this is water. Without water, nothing prospers. TransFarming is about "re-thinking" traditional gardening methods to address *regional environmental challenges* like droughts and water restrictions, while keeping in mind techniques for prosperous food production. These approaches involve growing food in ways that conserve water.

Weather wise, not much has changed from the days of our ancestors, but they used vastly different approaches to dealing with the climate than we do today. Following are a few techniques used to conserve water on a TransFarm.

Wicking Beds

Wicking beds have proven to be a viable solution to the Texas heat and water conservation. These simple structures, based on a raised bed garden, incorporate a reservoir underneath the bed to store water. The garden is watered through an exposed pipe which then wicks water upward through the soil to the roots where water is needed the most. There is minimal evaporation.



Traditional Raised Bed Gardens

Traditional raised bed gardening involves selecting the correct structure and materials for a specific outcome base on environmental factors such as shading, sun path, wind direction and desired crop. Additionally, soil composition will play a very large part in crop success and water conservation. A simple small hoop house may be desirable to protect from direct sun and winter cold.



Aquaponics

Aquaponics is the combination of aquaculture (fish farming) and hydroponics (soilless plant production). With Aquaponics, the nutrient-rich water that results from raising fish provides a source of natural fertilizer for the growing plants. As the plants consume the nutrients, they help to purify the water in

which the fish live. A natural microbial process keeps both the fish and plants healthy, and helps sustain an environment where all can thrive. Both the plants and fish are harvested.



HugelKulture

A HugelKulture is a type of raised bed garden that allows one to use organic materials that are too big to go in the compost. Over time, that is 3- 5 years, the materials in the bed decompose, and provide a slow release of nutrients for garden plants.

Because of its three-dimensionality, a HugelKulture raised bed garden combines the multiple functions of rainwater harvesting, catchment, and irrigation using no cistern, pumps, or pvc pipes. Done properly, there may be no need to water all summer!



Keyhole Gardens

A keyhole garden uses the same principle as a HugelKulture in that decomposing matter is used to absorb and retain water in the soil. Large amounts of "rotting" wood and kitchen scraps are used in the soil which is stacked within layers of cardboard and paper. Kitchen scraps are also added to the bed via a foot-wide tube which nourishes the entire system. A wedge

is cut in the circular bed to access the tube, which makes the garden look like a keyhole when viewed from above.



Hoop House/Monkey Huts

One of the major concerns with growing food (and fish) in the winter is the cold. The wind does not help much either. Greenhouses are expensive, and any constructed structures tend to be somewhat permanent.

Enter the simple Monkey Hut. These structures are by their very nature flexible, and designed to withstand strong wind and rain (dust too). Built correctly, they are easily dis-assembled in the Spring, or used to support a shade cloth in the Summer.



Vermiculture and Constructing a Worm Bin

Worm Composting is an excellent way to create organic matter for gardens and Aquaponic systems. They can be added directly to gardens and Aquaponic media systems, and also used to feed fish and chickens. Worms are important in the garden because they aerate the soil which helps lock in moisture. Worm farming includes choosing a worm and bin type, setting up the worm composting bin, maintaining the system, harvesting compost and worms, making and using worm tea, and such activities.