

Introduction to Plant Nutrients

Welcome to the Plant Nutrition Guide for the Food Rising Mini-Farm Grow Box.

My name is Mike Adams, and I developed this system based on the Non-Circulating Hydroponics principles taught by Prof. B. Kratky at the Univ. of Hawaii.

I'm also the lab director at a Forensic Food Lab where I test food, supplements and water for heavy metal contaminants such as lead, cadmium, mercury and arsenic. This lab runs an Agilent 7700X ICP-MS instrument which can detect elements with precision of 1 part per billion. (That's 1/1000th of 1 part per million!)

In 2014, I conducted exhausted ICP-MS testing of off-the-shelf plant nutrition formulas purchased at common retail stores, and I found that many of them were heavily contaminated with lead and cadmium. This concerned me greatly, as I did not want to grow my food in a nutrient formula containing alarming concentrations of toxic heavy metals. For the record, lead causes mental retardation and cadmium causes cardiovascular problems and skin disorders.

Ultimately, I realized I would have to develop my own nutrient formulas using ultra-clean ingredients from the cleanest sources in the world. This led to several months of testing raw material samples from many different countries, including Israel, Canada, Denmark, the United States, Chile and many others.

By testing these raw materials using ICP-MS instrumentation, I was able to identify the cleanest sources of plant nutrient materials available in the world today. I then combined these raw materials to create Ultra-Clean Super Plant Food formulas which are extraordinarily low in toxic elements while boasting much higher levels of beneficial nutrients that nearly all people need in higher concentrations (such as zinc, which boosts immune function, and organic selenium, which is an anti-cancer mineral).

We specifically avoided using any raw materials from China, due to China's worsening pollution and contamination problems.

The result is the world's cleanest plant nutrient formulas for hydroponics. By using these formulas correctly, you can grow the world's most nutrient-rich plants while also avoiding toxic heavy metals that can damage your health.

The food you grow using these formulas will have far higher concentrations of beneficial minerals than nearly all store-bought produce. Even growing something as simple as lettuce can produce mineral-rich foods that can substantially support and enhance your overall health by providing your body with the nutrients that are typically missing in most other foods.

Everything you grow in these UltraClean Super Plant Food nutrients will be healthier, more mineral rich and cleaner than plants grown in lower grade nutrients. You will also discover that this enhances the pest resistance, disease resistance and drought resistance of the plants you're growing! Healthy minerals, after all, boost the health of not just humans but also the food plants that humans consume. (Mineral deficiencies lead to disease in all living systems, including plants, animals and humans.)

SUPER SIMPLE PLANT NUTRIENT INSTRUCTIONS

UltraClean Super Plant Food mixes come as follows:

(http://www.supplysource.com/Ultraclean-Super-Plant-Food_c_50.html)

1. The plant mix, such as a "lettuce" formula. This plant mix contains the micro nutrients (trace minerals), potassium nitrate, monopotassium phosphate and other key nutrients needed by your plant.

2. The CalMag mix. This contains just three nutrients: Calcium Nitrate, Magnesium Nitrate and Iron EDTA.

Rule of thumb: For every gallon of water you use in the system, you will add just slightly under 1 teaspoon of plant mix + 1 teaspoon of CalMag.

This rule of thumb will vary significantly if you are in a very hot, dry climate, in which case you will need to add far more water than nutrients as your plants mature, due to the fact that your plants are transpiring a lot of water but not using a proportionate quantity of nutrients.

This is why you need a TDS meter to monitor the ppm (parts per million) of your nutrients. Over time, you will gain enough experience to almost never need the TDS meter, but for first-time growers, it is a very valuable tool.

Recommended TDS meter at Amazon.com (about \$10): <http://www.amazon.com/gp/product/B00M19UR4W>

INSTRUCTIONS FOR THE 3.5 GALLON WATER RESERVOIR:

For the 3.5 gallon water reservoir (white pail), add water and nutrients as follows:

- Fill the pail 1/2 full with water.
- Add 3 level teaspoons of plant mix. Stir until dissolved.
- Add 3 levels teaspoons of CalMag mix. Stir until dissolved.
- Fill the remainder of the pail all the way full.

This will produce a water + nutrient mix with approximately 1200ppm of nutrients. A TDS tester may show a higher number because it is measuring the 1200ppm of the nutrients PLUS the original ppm of your water, added together.

INSTRUCTIONS FOR THE START OF THE GROW BOX:

For the grow box bin, you will nearly fill it with water when you first start new seeds. (After that, the automatic float valve will provide self-water function.) Follow these instructions for most seedlings:

- Fill the bin 1/2 full with water.
- Add 5 level teaspoons of plant mix. Stir until dissolved.
- Add 5 levels teaspoons of CalMag mix. Stir until dissolved.
- Fill the remainder of the bin until the water level is covering the bottom third of the net pots when the grow box lid is attached. (The net pots must be partially submersed in water in order to wick water to the plant seeds and early roots.)

This will produce a water + nutrient mix with approximately 1200ppm of nutrients. A TDS tester may show a higher number because it is measuring the 1200ppm of the nutrients PLUS the original ppm of your water, added together.

TESTING AND ADJUSTING YOUR WATER PH LEVEL

It's important to also measure and adjust the pH level of your water. Fortunately, it's very simple to do: just acquire pH test strips (paper strips) from Amazon.com or any hydroponics supplier. Some people prefer to use liquid pH testing drops, which are also readily available and very affordable. Most plants will survive pH ranges from 5.5 - 7.5, but you'll get better results if you narrow the pH range to fit the plants you're growing.

Here's a list of pH ranges, found on SimplyHydro.com.

Note that this is the pH *after* you add plant nutrients.

Beans 6.0-6.5

Broccoli 6.0-6.5

Cabbage 6.5-7.5

Cantaloupe 6.5-6.8

Carrots 5.8-6.4

Chives 6.0-6.5

Cucumbers 5.8-6.0

Garlic 6.0-6.5

Lettuce 6.0-6.5

Onions 6.5-7.0

Peas 6.0-6.8

Pumpkin 5.0-6.5

Radish 6.0-7.0

Strawberries 5.5-6.5

Tomatoes 5.5-6.5

Here's how to adjust the pH to achieve the proper range:

- If your pH is too low, it's too ACIDIC, and you need to add baking soda to make it more alkaline (to raise the pH level). Simply stir in a teaspoon of baking soda, one at a time, until you reach the desired pH.
- If your pH is too high, it's too ALKALINE, and you need to add white vinegar to make it more acidic (to lower the pH level). Simply stir in a teaspoon of white vinegar, one at a time, until you reach the desired pH.

Recommended pH testing products (very affordable)

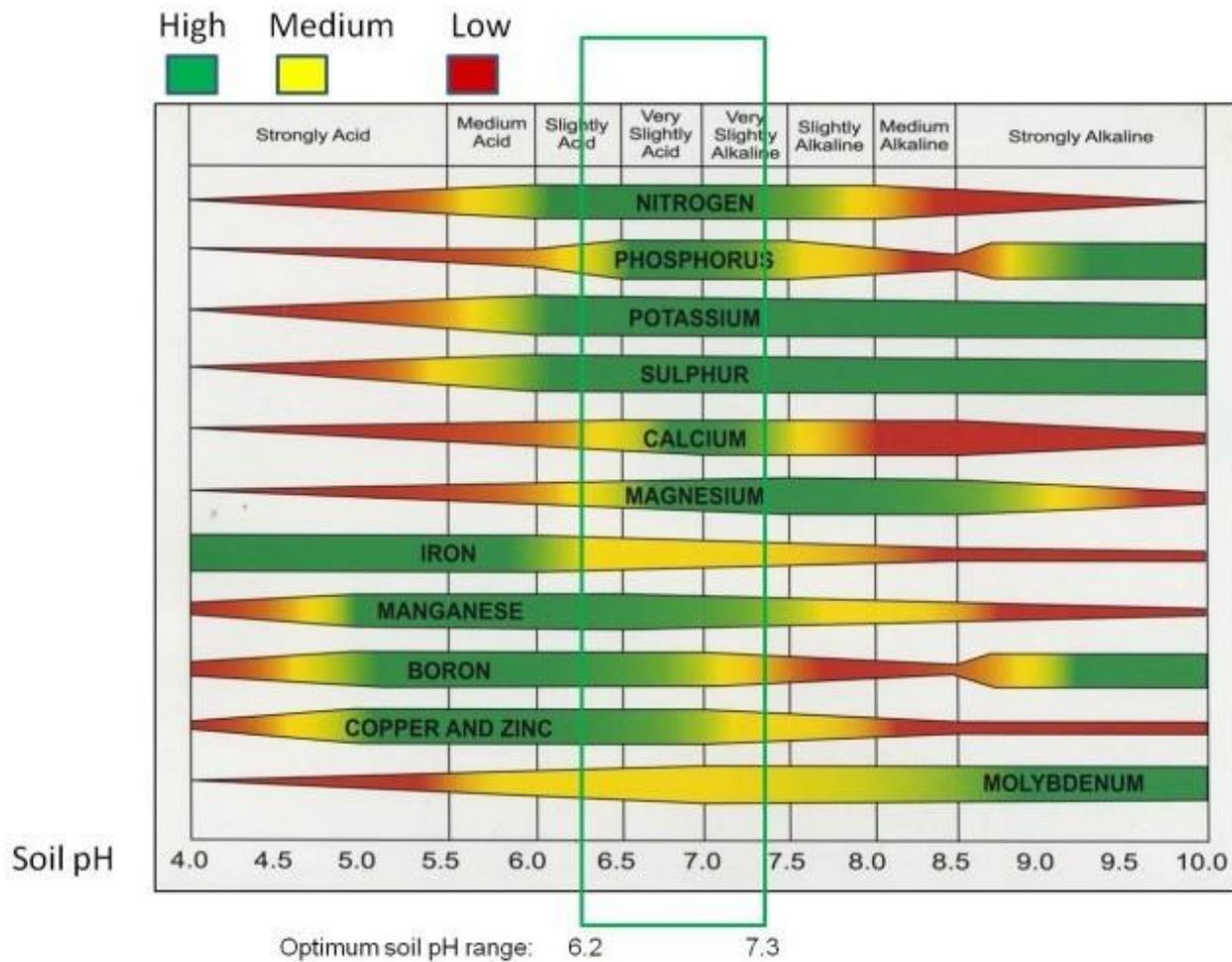
General Hydroponics PH Test Indicator, 8-Ounce

<http://www.amazon.com/General-Hydroponics-Test-Indicator-8-Ounce/dp/B003Y3F34I>

Micro Essential Labs pHydrion Urine and Saliva ph test paper , 15 ft roll with dispenser and chart.

ph range 5.5-8.0 <http://www.amazon.com/Essential-pHydrion-Saliva-dispenser-5-5-8-0/dp/B0001SR4NM>

How soil pH affects availability of plant nutrients



UNDERSTANDING PLANT NUTRIENT BASICS:

All plants share common needs for specific nutrients and minerals. The three most common nutrients used in conventional agriculture are:

N = Nitrogen. This is the "fuel" that plants use as an energy source.

P = Phosphorous. This mineral supports crucial plant physiology functions that keep it alive.

K = Potassium. Without potassium plants could not transport water or even succeed with photosynthesis (converting sunlight into plant energy).

In conventional farming, these three nutrients are added to crops in large quantities. But trace minerals are almost never added: molybdenum, boron, chromium, zinc, selenium and so on. As a result, most conventional crops utterly lack the trace minerals which are also crucial for plant health and human health.

Growing healthy plants requires more than just N, P and K. True plant health comes from a full spectrum of nutrients, which includes trace minerals or "micro minerals" as they are sometimes called in hydroponics.

FACT: The ocean is full of trace minerals. Sea water contains at least 92 elements. Every element has a different function in human physiology. Some farmers use sea water concentrates on their crops to boost plant health from the trace minerals.

PLANTS "EAT" MOLECULES

Many of the nutritional molecules consumed by plants provide more than one element. A chemical compound consists of chains of atoms bonded together through principles of chemistry such as "covalent bonding." For example, the chemical compound "potassium nitrate" combines potassium and nitrogen into a complex molecule.

Monopotassium Phosphate, similarly, is a simple combination of potassium and phosphate. The "mono" simple means "one." This refers to the ratio of atoms in the chemical structure of the molecule.

Although this is a simplified explanation, when plant roots come into contact with these molecules, they "eat" them by assimilating the elements that the molecules are made of. Plants "eat" potassium nitrate, for example, to assimilate both the potassium and the nitrogen -- nutrients they need to survive and grow.

Plants extract carbon from the air to create physical structures such as leaves, stems and roots. They quite literally "grab" carbon molecules out of the air and convert them into physical objects that allow the plant to grow. This is why plants are known to consume carbon dioxide. (CO₂)

PLANT NUTRIENT MIXES

UltraClean Super Plant Food mixes come as follows:

1. The plant mix, such as a "lettuce" formula. This plant mix contains the micro nutrients (trace minerals), potassium nitrate, monopotassium phosphate and other key nutrients needed by your plant.
2. The CalMag mix. This contains just three nutrients: Calcium Nitrate, Magnesium Nitrate and Iron EDTA.

NOTE: All the nutrients in UltraClean Super Plant Food are water soluble. They are designed, in other words, to almost completely dissolve in water and stay in solution. After adding them to a water reservoir, you will need to vigorously stir the water to dissolve the nutrients. Over time, you may notice a very small amount of un-dissolved nutrients (about 1% of the total nutrient mass) in the bottom of the reservoir pail. This is normal and not a concern.

As a rule of thumb, you will typically use these formulas together in a 1:1 ratio for more common plants. However, the ratios and concentrations of these nutrients varies considerably when growing plants that bloom (such as strawberries or tomatoes). "Grow" and "bloom" cycles of plants have different nutrient needs, which we will cover later.

Why is the CalMag separate from the general plant mix? Calcium and magnesium often need to be added in ratios other than 1:1. Keeping the nutrient mixes separated allows you to control the ratios that you add to the nutrients.

TIP: If you have multiple grow boxes connected to a single water reservoir, make sure you are growing all the same type of plants. For example, if you are feeding your water reservoir lettuce mix plant nutrients, you want to make sure all the grow boxes connected to that water reservoir are growing lettuce, not something different such as green peppers.

TIP: Lettuce is the easiest crop to grow, and it's the crop we recommend you begin with. It's also the most forgiving on nutrient concentrations and ratios.

HOW TO MIX THE NUTRIENTS FOR SEEDLINGS

Target TDS = 1200 + your original water source

Step 1) Measure the TDS of your source water. Using a TDS meter, find out the ppm (which means the parts per million of Total Dissolve Solids) in your source water. A lower number is better, indicating "cleaner" water.

Step 2) Add 1200 to that number. This gives you a "target" ppm of TDS in your final water.

Step 3) Add dry nutrients in small quantities in a 1:1 ratio of the plant formula and the CalMag formula, until the ppm of your water reaches the target ppm. (Make sure you vigorously stir the water as you are doing this to fully dissolve the nutrients.)

HOW TO MIX NUTRIENTS FOR MATURE PLANTS

Target TDS = 1500 + your original water source

Mature plants benefit from a higher nutrient concentration in the water. Use the same method described above, but aim for 1500 ppm instead of 1200.

Advanced Plant Nutrient Information



The following plant nutrition guide offers detailed guidance on nutrient concentrations and pH levels for different types of plants as well as their growth stages.

The plant nutrient recommendations below are based on adding nutrients to 10 gallons of water. Divide the recommendations by 3 if you are using a 3.5 gallon pail (water reservoir) which ships with the systems.

Always test the ppm of your water + nutrient solutions to keep them within a proper range. Typically, starting plants (sprouting seeds, or growing very young starts) should use a lower concentration of nutrients such as 1200 ppm. Mature plants usually require higher concentrations, around 1500 - 1600 ppm.

REVIEW:

ppm = parts per million. You can assess the parts per million of the nutrients in your water by using a low-cost TDS meter purchased for about \$10 - \$15 from Amazon.com.

pH = Acid/Alkaline level. Low pH is more acidic. High pH is more alkaline. Most plants prefer a pH between 6.0 and 7.0, but they can usually survive in a range of 5.5 to 7.5.

Units Conversion:

For the CalMag Plant Food, 1 tablespoon = 14 grams

For all plant fertilizer formulas (Lettuce, Strawberry, etc.), 1 tablespoon = 18 grams

LETTUCE:

pH target = 6.4 - 6.7 during growth stage / 6.0 - 6.5 during seeding stages

Lettuce Plant Food 8-15-36:

- Use 45 grams per 10 gallons of water during all stages of plant growth

CalMag Plant Food:

- Use 30 grams per 10 gallons of water during growth stage
- Use 40 grams per 10 gallons of water during bolting stage

TOMATO:

pH target = 6.4 - 6.6 during growth stage / 6.1 - 6.3 during blooming (flowering) stage

Tomato Fertilizer 4-18-38:

- Use 45 grams per 10 gallons of water during all stages of plant growth

CalMag Plant Food:

- Use 30 grams per 10 gallons of water during growth stage
- Use 40 grams per 10 gallons of water during blooming stage

Potassium Nitrate:

- You may optionally add 2 grams per 10 gallons of water during the blooming stage to boost nitrogen levels

STRAWBERRIES:

pH target = 6.5 - 6.8 during all stages of plant life

Strawberry Fertilizer 8-12-32:

- Use 11 grams per 10 gallons of water during growth stage
- Use 17 grams per 10 gallons of water during blooming stage

CalMag Plant Food:

- Use 12 grams per 10 gallons of water during growth stage
- Use 23 grams per 10 gallons of water during blooming stage

CUCUMBER:

pH target = 6.4 - 6.7 during all stages of plant life

Cucumber Fertilizer 8-16-36:

- Use 45 grams per 10 gallons of water during all stages of plant growth

CalMag Plant Food:

- Use 30 grams per 10 gallons of water during growth stage
- Use 40 grams per 10 gallons of water during blooming

Calcium Nitrate:

- You may optionally add 10 grams per 10 gallons of water during the blooming stage

PEPPERS:

pH target = 6.2 - 6.5 during growth stage / 5.8 - 6.2 during blooming stage

Pepper and Herb Fertilizer 11-11-40:

- Use 23 grams per 10 gallons of water during all stages

CalMag Plant Food:

- Use 30 grams per 10 gallons of water during growth stage
- Use 40 grams per 10 gallons of water during blooming stage

HERBS:

pH target = 6.2 - 6.5 during growth stage / 5.8 - 6.2 during blooming stage

Pepper and Herb Fertilizer 11-11-40:

- Use 11 grams per 10 gallons of water during all stages

CalMag Plant Food::

- Use 14 grams per 10 gallons of water during growth stage
- Use 23 grams per 10 gallons of water during blooming stage

Additional Nitrogen::

- Recommended to add nitrogen for herbs. Can use either calcium nitrate or potassium nitrate at around 2 grams per 10 gallons of water.