GREENAIR PRODUCTS

NUTRIENTS / FERTILIZERS

ELEMENTAL / INORGANIC FERTILIZATION

The term "inorganic" defines a substance as a non-living material neither of plant or animal origin, generally referring to matter not containing carbon. All organic structures are composed of inorganic compounds and will eventually degrade back to this original elemental form. Pure inorganic elements and combinations thereof, are the foundation of all living things (and otherwise) on this planet. The mysterious interactions of these elements somehow manage to create or at least sustain life and all things of substance. When used in a horticultural context, it describes the type of feeding program which utilizes basic elemental complexes as mineral salts. Many of these elements are known to be essential for normal plant growth. When these elements are in solution they become available (to some degree) for plants to absorb, either in their pure form or as ions of simple compounds. All essential substances necessary for plant functions can be manufactured by the plant from these inorganic elements. When these elements are combined into compatible compounds, they are referred to as chemical fertilizers. These carefully balanced nutrient blends allow us to provide pure and precise allocations of mineral elements and encourage the type of plant response desired. Hydroponic techniques have proven that pure elemental solutions are the most dependable and predictable way to insure optimum productivity. These methods allow us to totally isolate and contain a complete grow system. Solutions may be circulated and recovered and re- proportioned for subsequent use. This can mean tremendous benefits in terms of ecology, productivity, economy, and application.

Chemical fertilizers have undeservingly been given a bad rap because they have been associated with large scale wasteful misuse. This has resulted in the contamination of soils and water supplies. This is not the fault of the chemical, rather the management thereof. Another unfair association is that of pesticides, fungicides, herbicides, inoculates, and preservatives etc., of which chemical fertilizers have no relationship.

ORGANIC FERTILIZATION

The scientific definition of organic is "any chemical compound containing carbon". A more common interpretation is any substance derived from living organisms, plant or animal. The concept of organic gardening usually implies that, the essential elements required for plant nutrition will be attained by decomposing matter. This process occurs in nature when a plant or animal expires or sheds tissue which is then systematically acted upon by organisms and environmental conditions. These influences range from abrasion, dissolution, combustion, chemical reduction, to consumption by man or animals. When organic matter is consumed and digested by microorganisms (primarily bacterium), it is broken down and released as enzymes of proteins, starches, vitamins, hormones and other such metabolites. Some of these compounds can be taken up into the plant and stored, or selectively utilized by the plant for metabolic functions. These processes of plant chemistry are very complex electrochemical interactions which take place in a series of stages, in an infinite chain of events not yet fully defined by science. The end result of all of this is to provide pure inorganic elements which are the building blocks of all life.

FERTILIZER INTERPRETATION

Fertilizer formulations are defined and listed by manufacturers in percentages, and termed the "guaranteed analysis". The law requires these values be presented in a somewhat ambiguous fashion. First on the label are the percentages for the nitrogen, phosphorus, and potassium (NPK). They are rounded down to the next whole number. The nitrogen (N) is given as total combined elemental nitrogen, and is further defined as nitrate (NO3) or ammonium (NH4). Phosphorus is listed as phosphoric anhydride (P2O5), when the actual phosphorus (P) is less than 44% of that figure. The remaining 56% of that molecule is oxygen. Example: 10% P2O5 is only 4.4% as P. Potassium is listed as potash (potassium oxide) or (K2O), and only 83% of the listed value is actual elemental potassium (K). All other minerals are listed as elemental and should represent actual content. Below the guaranteed analysis, will be a list of compounds which were used in this formula and contain, at minimum, the values listed. However, just because a mineral is in content, does not assure that it is in a form free and available to the plant. These must otherwise be defined as water soluble. Inferior or improperly combined nutrient compounds can render some of the listed elements useless for immediate uptake.

Nutrient values, though listed as percentages, are generally measured in parts per million (ppm). This is to say, that there is one part of a given substance to each 999,999 parts of all other content. In other words, if you divide whatever you have into one million pieces, one of them would be one ppm. To convert percentage to ppm, multiply by 10,000, or move the decimal 4 spaces to the right. Example: 1% = 10,000 ppm.

NUTRIENT SOLUTIONS

Check solution level. Sufficient quantity must be available to maintain stable solution properties. A small reservoir will require more frequent amendments to keep the nutrient concentrations and pH within the acceptable range. The two most important of these properties is ionic strength and acid balance respectively the concentration of soluble salts (nutrient elements) and PH, which is the acid/ base balance that regulates the interactions and availability of these elements.

FERTILIZER CONCENTRATION

Fertilizer concentrations can be easily measured with inexpensive electronic meters. Element concentrations can be measured by their ability to conduct electricity through a solution. Since every element in a multi- element solution has a different conductivity factor, these measurements are only approximate. Pure water will not conduct current, but as you add elemental salts conductivity increases proportionately. Simple electronic meters can measure this value and interpret it as total dissolved solids (TDS). Nutrient solution concentrations suitable for plant nourishment generally range between 500 and 2000 parts per million (ppm).If the solution concentration is to high, the internal osmotic systems can reverse and actually dehydrate the plant. For general purpose, try to maintain a moderate value of approximately 800 to 1200 ppm. These levels can be affected by plant absorption or by water evaporation. As the plants use the nutrients, the solution weakens, but as the water evaporates from the solution, the salt concentration increases. Adjust values by either adding fertilizer or diluting with water. Use lukewarm water and try to maintain a solution temperature between 60 and 80 degrees. Use a complete and soluble high quality hydroponic fertilizer according to recommendations on label.

NUTRIENT SOLUTION PH

Solution pH (potential hydrogen) is extremely critical and must be checked often to maintain a nearly neutral balance. Variations either way will affect the breakdown and solubility of the nutrient compounds. Acceptable values vary slightly with different plants; grow mediums, and hydroponic systems. Generally desirable readings range from 5.5 (slightly acid) to 7.0 (neutral). For general purposes, try to maintain a value of 6.5 and make a correction if readings vary +/- a half point. The tolerance range therefore is 6.0 to 7.0. Use pH up and down adjusters carefully and mix in slowly and completely. Fertilizers, when added will usually lower the solutions pH value. Most of the time, as solutions are used by plants, the pH will raise, and additions of fertilizer, or a pH down adjuster will be needed. It is preferable to adjust water pH before adding fertilizer, once you are familiar with what adjustments will be required. Solution pH can be determined either by a reagent color comparison method or with an electronic test meter.

SOLUTION MAINTENANCE

Solutions should be topped off and corrected routinely keep the solution water level constant and use an electronic conductivity meter to determine how much additional fertilizer will need to be provided. Tanks, trays and plumbing should be cleaned and rinsed periodically to remove algae, excess nutrient salts, and possible viral or fungal pathogens. A 5% sodium hypochlorite solution (bleach) should be used to sterilize the system between crops. Monthly leaching (rinsing) of substrate (grow medium) by clear watering is advised to reduce accumulation of soluble salts, and avoid a toxic buildup of immobile trace elements.

NUTRIENT SOLUTION COMPOSITION

The values below provide a guideline of acceptable limits. Values deficient or in excess of those shown could result in poor plant health.

Values generally considered desirable for elements in nutrient solutions as ppm.

NUTRIENT SOLUTION COMPOSITION

ELEMENT	LIMITS	AVERAGE
Nitrogen	150-1000ppm	250ppm
Calcium	100-500ppm	200ppm
Magnesium	50-100ppm	75ppm
Phosphorus	50-100ppm	80ppm
Potassium	100-400ppm	300ppm
Sulfur	200-1000ppm	400ppm
Copper	0.1-0.5ppm	0.2ppm
Boron	0.5-5.0ppm	1.0ppm
Iron	2.0-10ppm	5.0ppm
Manganese	0.5-5.0ppm	0.02ppm
Molybdenum	0.01-0.05ppm	0.02ppm
Zinc	0.5-1.0ppm	0.5pmm

SOLUBLE SALTS RANGE CHART

Electrical conductivity (EC)as millisiemen (mS) and total dissolved solids (TDS) as parts per million (PPM)

Range	EC as mS	TDS as PPM
Desirable	0.75 to 2.0	500 to 1300
Permissible (with potential for concern)	2.0 to 3.0	1300 to 2000
Probable salt damage	above 3.0	above 2000

For nutrient solutions determinations one mS (millisiemen) or one mMho/cm2 is equivalent to approximately 650ppm total dissolved solids