NUTRIENT SOLUTION TESTING

The traditional method of growing horticultural crops is in ‘soil’ media with fertilisers added to provide nutrients for growth and production.

Rapid development of alternative growing methods occurred during World War 2 when fresh produce was required by troops stationed in non-arable areas (unsuitable soil) or where local produce was grown in soil fertilised with human sewage (a disease risk). The alternative methods developed are generally described as ‘hydroponic systems’ where essential nutrients are dissolved to form a solution and added to irrigation water for plants growing in a ‘soil-less’ media. There are many variations of these growing systems however the most common ones used by commercial growers are:

- **Drip systems** where the dilute nutrient solution is dripped onto the base of plants supported by an inert media such as pumice, sand, perlite, rockwool, sawdust, coconut fibre or composted bark. Nutrient solution drainage may be either collected for recirculation or ‘run to waste’.
- **NFT systems** where the plants are supported so that the roots dangle into a pipe or channel through which nutrient solution is pumped continuously.
- **Ebb and Flow systems** where the plants are supported by an inert media in a trough that is temporarily flooded with nutrient solution.
- **Aeroponics** where the roots hang in the air and are misted with nutrient solution.

Analysis of the Nutrient Solution - Objective

Successful growing systems require the appropriate delivery of water, light, heat, air and adequate concentrations of the essential nutrient elements required throughout the growing cycle of the crop.

Interpretation of Nutrient Solution analysis results is influenced by the choice of crop grown, environmental variables such as light and temperature, the type of hydroponic growing system and how the sample is taken. Drip type systems are often sampled to compare the feed solution with the drainage solution. NFT and Ebb and Flow systems are often sampled to determine the nutrient composition and any changes in the balance of nutrients that occur in the recycled solution.

Analysis of the Nutrient Solution – Terms Used

- pH is a measure of the acidity (and alkalinity) of the nutrient solution. This should be appropriate for the plants grown and also suitable for maintenance of the solubility of all nutrient components.
- Electrical Conductivity represents the total concentration of dissolved salts (includes nutrients) and is reported as CF units (CF units can be converted to mS/cm by dividing by 10).
- Nitrate-Nitrogen and other elements are reported as concentrations of elemental equivalents reported as mg/L which is ‘parts per million’ on a weight/volume basis.
- Sum of Anions and Sum of Cations is a comparison of the chemical equivalents of negatively charged ions (anions including P, S, NO3, Cl) with positively charged ions (cations including K, Ca, Mg, Na) and these 2 sums should be similar if the analysis conducted has reported all of the major element components as the components of a nutrient solution should theoretically be a balance of cations and anions.

Sampling Method

Rinse a clean container (250 mL capacity) at least twice with the solution to be submitted. Fill the container to within 2 cm of the top, seal and send to the laboratory with the Analysis Request Sheet immediately for ‘Nutrient Solution’ analysis.

Contact the laboratory or visit the Hill Labs web site for a copy of the Analysis Request Form, other information and sampling materials as required.

For more information, freephone 0508 HILL LAB 44 555 22 mail@hill-labs.co.nz hill-labs.co.nz

Interpretation of Results

The optimum ranges for nutrient solutions are influenced by the type of hydroponic growing system used, water-holding capacity of the media (if any), the crop grown and environmental factors such as light intensity and temperature. On this basis, the laboratory provides generalised guideline levels based on the requirements of tomato plants in a typical NFT growing system. Other crops grown in different hydroponic systems may have different optimum levels that may also change seasonally.

Basic Analysis	Unit	Target	Typical Normal
pH	-	6	5.8 – 6.6
Conductivity	(CF units)	30	15 – 45
Nitrate-N	(mg/L)	200	100 – 300
Phosphorus	(mg/L)	50	25 – 75
Potassium	(mg/L)	300	150 – 450
Sulphur	(mg/L)	80	40 – 120
Calcium	(mg/L)	150	100 – 350
Magnesium	(mg/L)	50	25 – 75
Sodium	(mg/L)	<30	10 – 60
Iron	(mg/L)	3.0	2 – 10
Manganese	(mg/L)	1.0	0.4 – 5.0
Zinc	(mg/L)	0.1	0.1 – 3.0
Copper	(mg/L)	0.5	0.1 – 1.0
Boron	(mg/L)	0.2	0.2 – 1.5
Chloride	(mg/L)	<30	5 – 80

Additional Tests	Unit	Target	Typical Normal
Ammonium-N	(mg/L)	<5	1.0 – 20
Silica	(mg/L)	20	5.0 – 50
Molybdenum	(mg/L)	0.1	0.05 – 1.0

Test results reported are the sum of the soluble nutrient/salts content of the feed water and the fertiliser added.

Bicarbonate Testing in NFT Solution

At Hill Labs we are not able to offer Bicarbonate testing on a NFT solution. Bicarbonate activity is typically determined by calculating alkalinity measurements. This calculation assumes that alkalinity is primarily caused by hydroxides, carbonates, or bicarbonates. However, this assumption does not hold true if there are other buffering compounds present, such as phosphates.

In NFT solutions, boron and phosphorus are commonly present in the form of borate and phosphate compounds. These compounds contribute to alkalinity readings and possess buffering potential. Consequently, performing bicarbonate calculations on these solutions will yield inaccurate results as the calculated value will not represent the true bicarbonate content.

Water Quality

The pH, alkalinity, hardness, salts (sodium and chloride), trace elements (boron, iron, manganese) content of the feed water should be researched before commitment to using it in any hydroponic growing system. The simple rule is that the best results are obtained from using ‘pure’ water. Any dissolved impurities in the water should be present at levels that are lower than the nutrient solution specifications. Treatment options are available to reduce levels of potentially insoluble iron and manganese and to correct pH, alkalinity and hardness. Impurities that are most difficult to manage are dissolved sodium, chloride and boron. Town water supplies are not always appropriate for hydroponic growing systems without further treatment. Where surface water (river, lake) is used, investigate the risk of contamination from all possible sources within the catchment, such as herbicide applications.

The Irrigation Water Profile test on the feed water is recommended where this information is not available. Analysis of water and nutrient solutions for heavy metals and pesticide residues is also available from Hill Labs.

Hill Labs does not provide consultancy regarding water treatment or nutrient solution formulations. Analytical test results can be forwarded to the consultant of your choice as appropriate.

References

- NFT Technique of Growing Crops, Dr A Cooper, Grower Books, London 1976
- Analysis of Peat and NFT for Tomatoes, MAFF notes, United Kingdom
- Nutrient Solution Formulation for Hydroponic Tomatoes in Florida, University of Florida IFAS Extension, CV216
- Growing Plants Without Soil, JC Schmidt, JM Gerber, JW Courter, Circular 844, University of Illinois.
- Basic Hydroponic Systems & How They Work, Simply Hydroponics & Organics on-line (prohyd@simplyhydro.com), Largo, Florida.