



Nursery & Garden Industry
Queensland

Water Quality Testing in Production Nurseries

Due to the large variations likely to be encountered in surface, underground or drainage waters, regular monitoring of water quality is a must. Regular water testing is one of the easiest things that nurseries can do to manage their water quality, and knowing the physical, biological and chemical characteristics of a water source is an absolute necessity.

The following outlines some considerations for regularly testing water sources:

- *Water testing for pH and Electrical Conductivity (EC) can easily be carried out on-farm.*
- *Testing gives confidence that the production system is not compromised with sub-standard water quality.*
- *Testing allows monitoring of water quality over time, and enables any changes to be made before they become major problems.*
- *When changes are made to the growing system, the effects can be measured on how these changes influence the quality of drainage water, and corrective measures can be applied if necessary.*
- *In recycling systems the quality of the irrigation water can be measured over time and corrective actions applied.*
- *Knowing in advance if the pH is drifting, or EC is increasing enables the situation to be corrected before a catastrophe occurs. If the water is not tested it is only a guess as to what its quality is.*
- *If irrigation water has fluctuating levels of conductivity or pH, regular monitoring allows this to be managed more effectively.*
- *A full elemental water analysis shows all elements, and indicates any that are too high or too low for satisfactory plant growth. Results of analytical water tests can be useful in determining if water needs to have additional treatment to make it suitable for irrigation.*



- *Irrigation water supplies should have a complete water analysis conducted at regular intervals to identify any seasonal, emerging or broader issues.*

It is recommended that all production nurseries monitor their wastewater, whether that water is entering a recycling pond or is flowing into a passing waterway. Regular measurement of pH, EC, nitrate and phosphate expose excessive nutrient leaching often caused by overwatering.

The results of testing on water that leaves the property gives a record of water quality flowing back into the environment. This is called 'release water quality', and EcoHort™ provides guidelines for operators as to the acceptable limits for pH, EC, nitrates and phosphates. This information can be used to demonstrate to environmental agencies the quality of water leaving the property. If there is a problem with water quality downstream of the nursery, and there is no record of the quality of water as it leaves the property, it may be assumed that you are to blame.

What should I be testing my water for?

Water tests need to show how water quality changes as it passes through the production system and exits the property. Simple on-site tests such as EC, pH, nitrate and phosphate effectively show how the quality of the water changes as it is used in the nursery.

How often should I test my water?

This depends on individual circumstances and requirements. A good starting point is to test pH and EC monthly. From this it may be decided to

test more frequently if it is found that water quality varies considerably from test to test.

Knowing when to conduct a full analysis of the water to evaluate its characteristics is equally important. In essence it is considered wise to test irrigation water during mid-winter, mid-summer, and at the end of the driest and wettest periods of the year.

Isn't testing costly?

The basic on-site tests for pH, EC, nitrate and phosphate can be done using simple, robust equipment which reduces the cost significantly.

Collecting samples

To obtain meaningful results, samples should be taken so that they accurately represent the quality of the water being sampled. Water quality at the edge of a dam can vary significantly to that at the foot valve, 60 cm under the surface of the water in the middle of the dam.

The location within the production system which the irrigation water is sampled from depends on what information is required. If the quality of water prior to treatment needs to be known so that treatments can be determined, the sample needs to be taken directly from the water source. The best place to take it from is at the pump, as this is representative of the water quality that will be used. Any hose that the water is collected from should be run for a couple of minutes before the sample is taken, as the quality of the water can change if it has been held within the reticulation system for any length of time. If the sample cannot be taken from the pump, then a sample may be taken from the edge of the water source, clear of any vegetation, and as close to the pump intake as possible, but it should be remembered that this may not be representative of the water at the inlet.

If the water quality after treatment needs to be known, the sample would be taken after treatment or in the growing area. The sample should be taken from the same point each time so that comparisons can be made between samples and over time.

A plastic, bottled water container, with a screw top lid, of approximately 600 mL capacity is an ideal container to collect the sample and send away for analysis. Avoid using bottles that have held carbonated water, soft drink, juice or milk, as the acids, phosphates and other elements from the original contents may have impregnated the plastic and may contaminate the sample.

To collect the sample, the container should be rinsed 3 times with the water to be sampled to make sure any residues are removed. The sample is then collected, taking care to minimise aeration of the sample, as the carbon dioxide in the air will slightly acidify it. The bottle should be filled to the top to prevent any air being left in the bottle. The sample should be stored in a refrigerator at 1-4°C until despatch, not be exposed to sunlight, and should be tested as soon as possible after collection.

If the amount of iron in the water needs to be tested, a second sample that is acidified should also be sent. If an acidified sample is not provided, the reported results may indicate a much lower level of iron than is actually present in the water. This is due to the aeration of the sample which occurs during collection, transport and analysis causing the iron to become insoluble. Laboratories only test for soluble iron, so this can affect the result significantly. Acidification of the sample prevents the iron from becoming insoluble, thus enabling the amount of soluble iron in the water to be tested. Technical grade hydrochloric acid is recommended to minimise contamination of the sample. Add 6 mL of 10% hydrochloric acid/100 mL of sample (or 2 mL concentrated acid/100 mL) to the bottle immediately after taking the water sample. Another method which could be used to determine approximate iron levels is to use test strips or other colorimetric indicators. These can be used on-site, thus minimising the effect of aeration on the test result.

For laboratory analysis, once the sample is collected, the submission sheet is filled out, and the sample sent as soon as possible using Express Post or a courier. Some laboratories have a range

of different tests that they use, so be sure to specify the most complete analysis, particularly bicarbonate, HCO_3 , or total alkalinity. These parameters are a measure of the water's ability to change the pH of growing media, or cause residues on containers and foliage.

At the same time the sample is taken, it may be beneficial to test a similar sample for EC, pH, nitrate, phosphate and iron with the equipment used on-site, to verify the accuracy of the equipment used at the business.

Before collecting and sending the sample, contact the laboratory for specific instructions on collection, packaging and despatch. Turn around for samples should be about 7 days.

Water testing records

When measuring water quality, record the results. This will build into a permanent record of the sound management of the resource. Too often growers have a testing programme, and if the results fall 'within the range' they do not bother recording the result. At the very least this means there is no proof of the tests having been done if there is an environmental problem.

What do the different measurements mean and what is an acceptable level?

There are many factors which determine the quality of irrigation water, some of which include; alkalinity, pH and the level of soluble salts. Poor water quality can interfere with plant water and nutrient uptake and can lead to slow growth, leaf damage, leaf margin scorch, root injury, residues on leaves and reduced plant health.

When growers are asked what their water is like, they often respond with comments like, 'I know it's salty', or 'It has a high EC', or 'I know I have a high pH', or, 'it's as good as spring water but has a low pH'. Assessing test results for a range of parameters against standards allows comparisons to be made between different water sources and identify changes over time.



Electrical Conductivity (EC) is a measure of the total salts in the water. This test does not identify which salts are present, only the total amount. As the conductivity rises, symptoms such as slow growth, leaf and root burning and death may occur.

Plants vary in their sensitivity to EC. If the EC of irrigation water rises to unacceptable levels, it may be necessary to blend the high EC water with another water source of better quality to reduce the overall EC, or use reverse osmosis to remove the salts entirely. EC is a simple test that, with the right equipment, can easily and quickly be conducted regularly on-farm.

EC is quoted in microSiemens per centimetre ($\mu\text{S}/\text{cm}$) or in deciSiemens per metre (dS/m). $1,000 \mu\text{S}/\text{cm}$ is equal to $1 \text{ dS}/\text{m}$, e.g., $300 \mu\text{S}/\text{cm} = 0.3 \text{ dS}/\text{m}$.

In nursery production, EC measures the combined effect of EC levels in the water as well as the EC derived from fertiliser applications. High EC values can sometimes be found in underground water supplies from bores and wells, and elevated EC values can be present in recycled irrigation water due to fertiliser residues. The maximum level for irrigation, drainage, and release water for Nursery Industry Best Management Practice (BMP) is $1.0 \text{ dS}/\text{m}$.

pH is the measure of how acid or alkaline the water is. pH is a measure of the hydrogen ions in solution. The pH scale is logarithmic with a change of one pH unit resulting in a tenfold change in the

concentration of hydrogen ions, e.g., a pH change from 6.0 to 5.0 means there are 10 times as many hydrogen ions in the pH 5.0 as there are in the pH 6.0. The full pH range is 0 (most acid) through to 14 (most alkaline).

Hydrogen ions play a part in most of the chemical reactions in water and soil, and their concentration influences the solubility of fertilisers and availability of nutrients. A pH that is too high (alkaline) can result in nutrient deficiencies, and a pH that is too low (acid) may result in micronutrient toxicities and injury to the root system.

pH is also extremely important when disinfecting water for irrigation using oxidising agents. Effective chlorine disinfection of irrigation water is dependent on the pH level of the water to be treated being below pH 7.5.

BMP guidelines for irrigation, drainage, and release water are for pH to be between 5.5 and 7.0. Irrigation water that is kept between these levels will maintain the nutrient balance, prevent scale formation in irrigation equipment and provide effective chemical disinfection.

Nitrate and phosphate levels in water are the main nutrients that indicate nutrient pollution. It can also be beneficial to know this if water is being recycled, as high levels can be a significant source of nutrients. Under EcoHort® guidelines, maximum levels for nitrate have been set at 100 ppm in irrigation and recycled water, and less than 40 ppm in water released from the property. For phosphate, the levels are a maximum of 40 ppm in irrigation and recycled water, and less than 15 ppm in water released off the property.

Alkalinity is a measure of bicarbonates, carbonates, and hydroxides in irrigation water that have acid neutralising affects. Another way to think of alkalinity in irrigation water is calling it 'liquid lime'. If water has a high alkalinity, it has the potential to increase growing media pH over time, because 'liquid lime' is being applied in the irrigation water. Water with high pH does not always equate to high alkalinity.

Alkalinity needs to be managed in some circumstances because of its ability to neutralise the acidity in the growing media. Inversely, it may need to be added to prevent or manage decreases in growing media pH over time.

Test results for alkalinity are generally expressed in milligrams per litre (mg/l). Increasing levels of calcium carbonate may cause the growing media pH to rise to unacceptable levels, particularly in longer term crops, and high bicarbonate levels may lead to increasing problems with plant growth and residues on foliage.

Four factors to consider if it is necessary to manage irrigation water alkalinity are:

- The length of the crop growth cycle
- The upper pH limit the crop can tolerate
- The volume of the growing media the crop is being grown in
- The duration and frequency of irrigation.

Hardness is a measure of the combined content of calcium and magnesium in the water. Water hardness is generally associated with high alkalinity, but not always.

Further information on the interpretation of water test results can be found on the NGIQ Technical Information Library web page at <http://www.ngiq.asn.au/technical-information/>, or in the NIASA guidelines.

More information on water quality for nursery container production irrigation can be found in the publication 'Managing Water in Plant Nurseries'.

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