Water Quality and Fertilizer

by Sue Bottom, based on information from Courtney Hackney and Harry McElroy

Executive Summary. Two critical components of our local water quality are pH (a measure of how acidic or alkaline your water is) and conductivity (a measure of how many dissolved salts you have in your water). You want your water to have a pH below 7 (neutral) and ideally in the slightly acidic range (say 6 or 6.5). You want low conductivity. Rainwater and distilled water have a conductivity below 1 and most of the well water and public water supply (largely derived from wells in limestone) have conductivities between 300 and 800. The most practical alternative for our area water quality is to choose your fertilizer, amendments and potting media to adjust your water quality for optimum orchid growth and then flush the accumulated salts from your orchids once or twice a month. Use a water soluble fertilizer (about one quarter to one eighth strength) that will tend to acidify your water and have organic matter (like fir bark, coconut husks or redwood bark) in the potting mix to buffer the pH and generate acidity. To deal with the high dissolved salt levels, once or twice a month thoroughly flush your pots to leach out residual salts. This is much more cost effective than installing a water treatment system like a reverse osmosis unit or deionization system.

Your Source of Water. You must know the quality of your water to make sure you are delivering the nutrients required by your orchid for optimum growth.

Rainwater and Distilled Water – have very low conductivities, which is great. This pure water also has virtually no buffering capacity so the addition of fertilizer can cause precipitous drops in your pH and the water can end up with the acidity of vinegar, very deadly for your plants. If you are using this pure of water, you will need to use a fertilizer with calcium and magnesium and micronutrients because they are generally absent. The slow release Dynamite may be a better choice in fertilizer because it will not cause such an acidic water quality.

Well Water or Public Water Supply – in the St. Augustine area is high in hardness, total dissolved solids and electrical conductivity (somewhat similar but different measures of the salts present in the water) from the calcium carbonate dissolved from the shells and lime rock as well as alkaline, with a pH typically between 7 and 8, rarely more than 8.5. The calcium, magnesium and micronutrients will not be easily available to your orchids because the water is too alkaline. Another major potential concern would be the presence of sodium, which is toxic to your orchids and not particularly healthy for you. (Never use softened water unless your water softener uses potassium chloride instead of sodium chloride).

Water pH. The pH of water is a measure of the relative acidity (pH below 7) or alkalinity (pH above 7). Most orchids like a slightly acidic water. Not coincidentally, the macronutrients and micronutrients tend to be available at their optimum level at a slightly acidic pH, ideally between 6 and 6.5. Water soluble fertilizers added to the typical St. Augustine well waters will cause a drop in pH to the desired level of less than 7, but the salts in the fertilizer also cause a rise in the conductivity, a greater

Water Quality and Fertilizer

by Sue Bottom, based on information from Courtney Hackney and Harry McElroy

increase with increased fertilizer strength. If you want to be able to test your water, an aquarium store may sell pH strips, look for one that will measure a pH between 5 and 8 (pool stores will sell pH test kits but their lowest pH is 6.8). To measure the pH of your water, measure the pH of your raw water, water after the addition of fertilizer, and water draining from your pot. If the water exiting the pot has a pH between 5.8 and 6.5, your orchids should be very happy. If the pH is above 6.8, you may want to consider changing your fertilizer and/or potting media.

Potting Mix. The organic matter present in potting mixes will also affect the pH of the water in the orchid pot.

Sphagnum Moss – is a very water retentive medium that becomes so acidic (a pH of around 4) that bacteria and fungi cannot survive. It also breaks down fairly rapidly, with a life of one or perhaps two years. Some growers swear by sphagnum and others cannot successfully grow in sphagnum.

Organic Matter – like fir bark, coconut husk and redwood bark and to a lesser extent tree fern will increase the ability of your potting mix to hold some of the water and nutrients after you water so they will be available to the plant for a few days after you water. They will decompose over time and one of the byproducts of their decomposition is increased acidity. It is best to choose a fertilizer where the nitrogen is not in the urea form (which the bacteria will feed on and cause the organic matter to decompose more quickly). Better for the nitrogen to be in the ammonia or nitrate form which is available to the plant immediately. Redwood bark in particular generates acidity.

Lava Rock – has a large surface area allows it to hold a lot of water for later uptake by the orchid. It is inorganic and will not degrade over time but it will build up mineral deposits so it is important to flush the plant regularly.

Mineral Nutrition. The combination of water and fertilizer will determine the mineral nutrition supplied to your plants. Table 1 lists some minimum and maximum concentrations of the macronutrients (nutrients your plants need in high concentrations: nitrogen, phosphorous, potassium, calcium, magnesium and sulfur) and micronutrients (nutrients you plants need in low concentrations: boron, iron, manganese, zinc, copper and molybdenum) required for slipper orchids, assuming a continuous feeding program (at least weekly). If you fertilize on a periodic basis (less than weekly), the nutrient concentrations could be perhaps twice as high and if you fertilize with each watering, the nutrient concentration could be perhaps half as high. At a practical level, if you are using a balanced low urea commercial fertilizer at a rate of 50 to 100 ppm nitrogen, your likely only serious mineral nutritional concerns are calcium and magnesium levels and the pH of your irrigation mix. Orchids grown in bark probably require twice that nitrogen level to compensate for the nitrogen consumed in bark decomposition.

Water Quality and Fertilizer

by Sue Bottom, based on information from Courtney Hackney and Harry McElroy

Table 1 Mineral Nutrition for Slipper Orchids		
Element	Minimum, ppm	Maximum, ppm
Macronutrients		
Nitrogen, N	60	100
Phosphorus, P	30	50
Potassium, K	60	100
Calcium, Ca	30	50
Magnesium, Mg	15	30
Sulfur, S	15	25
Micronutrients		
Boron, B	trace	< 0.8
Iron, Fe	>0.5	2
Manganese, Mn	> 0.2	2
Zinc, Zn	1	2
Copper, Cu	trace	< 0.2
Molybdenum, Mo	trace	<0.05
Source: Bob and Lynn Wellenstein, AnTec Laboratory		

Fertilization Rates. As a general rule, most commercial orchid growers use an application rate of 100 ppm N with heavy feeders like vandas and cymbidiums receiving more, say 125 ppm N, and phrags less, say 75 ppm. Using these high rates will cause faster growth but it is possible the plant will be more susceptible to fungal and bacterial diseases. For a mixed collection, 70 ppm N should work well for weekly feeding. To calculate your total dissolved solids (TDS) and nitrogen concentration, get the N-P-K concentration (minus any urea) from the product formulation and enter it into this calculator. Try to keep the TDS below around 200 ppm and adjust your fertilizer addition rate (teaspoons of fertilizer per gallon of water) to attain your desired nitrogen ppm. The best way to achieve this is to use a very dilute fertilizer. Then flush your pots religiously, once or twice a month, with your raw water. Water the plant until water runs out the bottom of the pot and then water some more. This will dissolve the salts. Wait 15 to 60 minutes and then repeat this flushing procedure, this will flush the dissolved salts out of your pot.

Micronutrients – With well water or public water derived from wells in limestone, there are probably plenty of micronutrients present. The problem is the plant cannot use these micronutrients if the water is too alkaline, so you must make the water

Water Quality and Fertilizer

by Sue Bottom, based on information from Courtney Hackney and Harry McElroy

acidic through the soluble fertilizers and organic matter you use in your potting mix. Once you can lower the pH to below 7, the plant can use the micronutrients present and you do not need to use a specially formulated fertilizer.

Slow Release Fertilizers – like Dynamite (not Osmocote) are great cause they will last for 6 months or so and will give a low dose of fertilizer (about 10 ppm N) to your plant each time you water, it will not significantly lower the pH of your water. Use a half teaspoon or so per plant in April when new growth begins. For vandas, you can add some to a bag made with panty hose, surround it with a bit of sphagnum moss and tie this to the stem above the roots.

Calcium and Magnesium – You can use a fertilizer that contains calcium and magnesium and/or make sure your pH in water/fertilizer mix is below 7 so that the naturally present calcium and magnesium are available to your orchid. Paphiopedilums love a slightly alkaline environment and extra calcium and magnesium. Mix a few tablespoons of dolomitic lime in a gallon of water and water your paphs. Add a teaspoon of the lime to the top of the pot each month and watch your paphs jump out of the pot.

Nutrient Deficiencies. Table 2 addresses the macronutrients and micronutrients, their primary function in the plant, signs of deficiency and excess, whether an element is translocatable in the plant and whether an excess of one mineral can cause a deficiency in another mineral. This table can be used to diagnose any deficiency in your fertilizer program. An element's translocatability in the plant is important in diagnosing deficiencies. If it is translocatable, the plant can remove it from tissue in one area and transport it for use in another, so symptoms of deficiency typically occur in the more expendable older tissue. Conversely, if the element is not translocatable, then the deficiency will show more in the new growing area of the plant. If you are fertilizing, the most likely cause of a mineral deficiency is the loss of the roots of the plant leaving the plant unable to absorb the needed nutrient levels.

Table 2
Signs of Deficiency or Excess of Mineral Elements

Mineral Elements	Primary Functions in Plant	Signs of Deficiency	Trans-locatable?	Signs of Excess	Deficiency Induced by Excess of:
Macronutrients					
Nitrogen, N	Growth of green (leaf and stem) portions of plant	Reduced growth, vigor, chlorosis of older leaves first, premature leaf drop	Yes	Soft growth, spindly growth, leaf curl, reduced flowering, symptoms of potassium deficiency	Potassium Phosphorus

Water Quality and Fertilizer

by Sue Bottom, based on information from Courtney Hackney and Harry McElroy

Table 2
Signs of Deficiency or Excess of Mineral Elements

Mineral Elements	Primary Functions in Plant	Signs of Deficiency	Trans-locatable?	Signs of Excess	Deficiency Induced by Excess of:
Phosphorus, P	Essential for root growth, flowering and seed production	Older leaves affected first, an increase in anthocyanin pigment and a dark blue green coloration, sometimes with necrotic areas and stunting	Yes	Symptoms of nitrogen, zinc and iron deficiencies	
Potassium, K	Root growth, sugar and starch production, cell membrane integrity	Dwarfing, chlorosis of older leaves first, leaf curling	Yes	Symptons of nitrogen, magnesium, calcium, iron, zinc, copper and manganese deficiencies	Nitrogen Sodium
Calcium, Ca	Cell wall formation, cell division, enzyme catalyst, neutralization of toxic metabolites	Poor growth, deformed or chlorotic newer leaves, blackened areas at leaf ends and new growths with a leading yellow edge, stunted, shortened roots, dead root tips	Slightly	Symptoms of magnesium deficiency	Potassium Sodium Magnesium
Magnesium, Mg	Chlorophyll and protein production, carbohydrate metabolism, enzyme activation	Interveinal and marginal chlorosis starting in the older leaves, increase in appearance of anthocyanin in leaves, necrotic spotting	Yes	Symptoms of calcium deficiency	Potassium Sodium Calcium Zinc
Sulfur, S	Protein formation, photosynthesis and nitrogen metabolism	Root stunting, general chlorosis starting with younger leaves	No		
Micronutrients					

Water Quality and Fertilizer

by Sue Bottom, based on information from Courtney Hackney and Harry McElroy

Table 2
Signs of Deficiency or Excess of Mineral Elements

Mineral Elements	Primary Functions in Plant	Signs of Deficiency	Trans-locatable?	Signs of Excess	Deficiency Induced by Excess of:
Boron, B	Sugar transport, DNA synthesis	Death of meristematic tissue, root stunting, no flower formation	No	Interveinal leaf necrosis	Calcium
Iron, Fe	Component of cytochromes and ferrodoxin, synthesis of chlorphyll	Interveinal chlorosis of newer leaves	No		Potassium Phosphorus Zinc Copper
Manganese, Mn	Enzyme activation in respiration and nitrogen metabolism	Interveinal chlorotic and necrotic spotting	No	Stunting, necrotic spotting of leaves	Potassium
Zinc, Zn	Trytophan synthesis, electron carrier protein in chloroplast	Smaller, distorted leaves, stunting, interveinal chlorosis of older leaves, white necrotic spotting, rosetting	No	Symptoms of magnesium and iron deficiencies	Potassium Phosphorus
Copper, Cu	Enzyme component, electron carrier protein in chloroplast	Stunted misshapen growth	No	Symptoms of magnesium and iron deficiencies	Potassium
Molybdenum, Mo	Nitrogen and potassium metabolism	Chlorotic interveinal mottling, marginal necrosis, folding of the leaf, no flower formation	Slightly		

Source: Bob and Lynn Wellenstein, AnTec Laboratory