



**St. Augustine Orchid Society**

[www.staugorchidsociety.org](http://www.staugorchidsociety.org)

## **Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1**

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)



1. Roy Tokunaga of H&R Nurseries, dedicated to mastering the art of orchid growing.

*Roy Tokunaga of H&R Nurseries in Hawaii has spent countless hours during his orchid growing career trying to understand how the best growers grow their orchids, studying the science underlying cultural practices and experimenting with different approaches to test these theories. On a speaking tour that included a stop in St. Augustine, I had the pleasure of hosting Roy. What an education. Here are some of his insights on water quality and fertilizer usage in orchids and how to diagnose and correct media pH problems.*

Roy has given talks around the country on “Flower Boosting Orchids: Culture and Strategy for More Flowers” in which he talks about how to grow the strongest, most vigorous plants so they will reward you with the most blooms. Roy talks about the cultural practices that all the great orchid growers have in common.

**Light.** Give the plants as much light as they can tolerate and still look good. Light is the fuel orchids use to grow and store energy for future blooms. The amount of sugar orchids can produce increases with increased light and photosynthesis.

**Aeration.** Maintain air movement around the leaves and the roots. Many orchids evolved into epiphytes, growing in trees and their leaves and root structures have adapted to these conditions, so they are different from other plants. The roots absorb nutrients and moisture, exchange gases and can photosynthesize.

**Day Night Temperature Changes.** Provide a 10 to 30 degree change between the day and night time temperatures. The drop in night time temperature allows the orchid to store its energy for future blooms.

**Temperature.** Avoid extremes of temperature. Each orchid has its own comfort zone, some can tolerate lower or higher temperatures, though few orchids enjoy temperatures below 40F or above 95F.

**Absence of Pests and Disease.** Be vigilant in scouting for pests and disease, and make cultural changes or apply proper chemical controls. Bush snails alone can cause failure.

**Weed Free Growing Area.** Keep weeds out of the growing area. Weeds harbor vectors and plant pests.



## Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)

**Low Salt Levels in the Growing Media.** Flush the plants thoroughly with fresh water every other week during the growing season. Salts naturally present in the irrigation water or introduced by fertilizer can build up in the potting mix to dangerous levels.

**Media pH in 5 to 6.5 Range.** Maintain slightly acidic conditions around the roots. Some nutrients are most available to the plants in this pH range. Different growers have learned how to match their water quality to the fertilizer and potting media they use.



2. The most recent haul from H & R Nurseries. Roy's plants are always so healthy, they don't miss a beat, even after being repotted in lava rock with sphagnum top dressing for my shade house growing conditions. Fertilizing practices among different growers vary widely, there is no common thread between the best orchid growers. Roy talks about his experience growing orchids in bark in a shade house where orchids are watered by a combination of natural rainfall and low alkalinity public water. He found that even when using a basic Cal Mag fertilizer, the acidity around his roots dropped to unsafe levels within 6 to 9 months, so he counterbalanced this trend by adding dolomite to the pots to raise the pH. The supplemental calcium and magnesium present in the dolomite also helped boost plant growth. This solution worked for Roy given his conditions, but others with different water quality or growing conditions will have a different solution. The differences in the alkalinity of the irrigation waters explains many of the variations among the great growers in their choice of fertilizer and media.



## Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)

**Water Quality.** Orchids growing in the wild obtain most of the moisture from rainfall and dew, some from misty fogs. This water tends to be quite pure without appreciable dissolved salts. As the rainwater percolates through soil and rock strata or is carried down streams and rivers, minerals become dissolved in the water increasing the concentration of dissolved solids in the water. In general, orchids prefer a low soluble salt content and a low to moderate alkalinity, see Sidebar 1 for a discussion of water quality terms. The quality of water available to you for growing your orchids can vary widely, depending on its source. Understanding the quality of the water you use for your orchids will help you select the best fertilizer to provide the mineral nutrition in a form your plants can absorb. Most of the nutrients used by orchids are absorbed through the root system, so it is the conditions around the roots that control nutrient uptake.

**Root Zone pH.** Most orchids like to be grown under slightly acidic conditions. The pH in the substrate or potting medium rather than the pH of the irrigation water determines the availability of nutrients to your plant. If the root zone pH is too acidic, some nutrients become so soluble that concentrations become toxic to the plant. If the root zone pH is too basic, those nutrients can become unavailable to the plant thereby causing nutrient deficiencies. The major factors that influence the pH around the roots of your orchids are the alkalinity naturally present in your irrigation water, the type as well as the amount of organic matter in your potting mix and the fertilizer you use on your orchids.

*Impact of Irrigation Water Alkalinity on Substrate pH.* The alkalinity of your water quality has a large impact on the conditions that will prevail around the roots of your orchids. The alkalinity is basically a measure of the acid buffering capacity of your water. Low alkalinity waters will not be able to resist a drop in pH if acid from acidic reaction fertilizer or organic matter is introduced, while high alkalinity waters resist drops in pH from acidic reaction fertilizers and organic potting media.

*Impact of Organic Matter in Potting Mixes on Substrate pH.* The organic matter used in potting mixes can increase the acidity in the root zone. Raw sphagnum moss, peat moss and bark have a pH of around 4.4. As this organic matter degrades over time, additional acidity can be introduced to the root zone.

*Impact of Fertilizer on Substrate pH.* Fertilizers are a complex assemblage of mined and manufactured compounds some of which will alter the pH in the root zone. Fertilizers high in ammoniacal nitrogen tend to produce an acidic reaction dropping root zone pH while the nitrate form of nitrogen tends to produce a basic reaction increasing root zone pH.

Given the potential for complex interactions, there is a need for a simple diagnostic to guide decisions about fertilizers and supplements. The decision flow chart in Figure 1 provides some guidance on the initial selection of the best fertilizer and verification that the nutrition program is working.



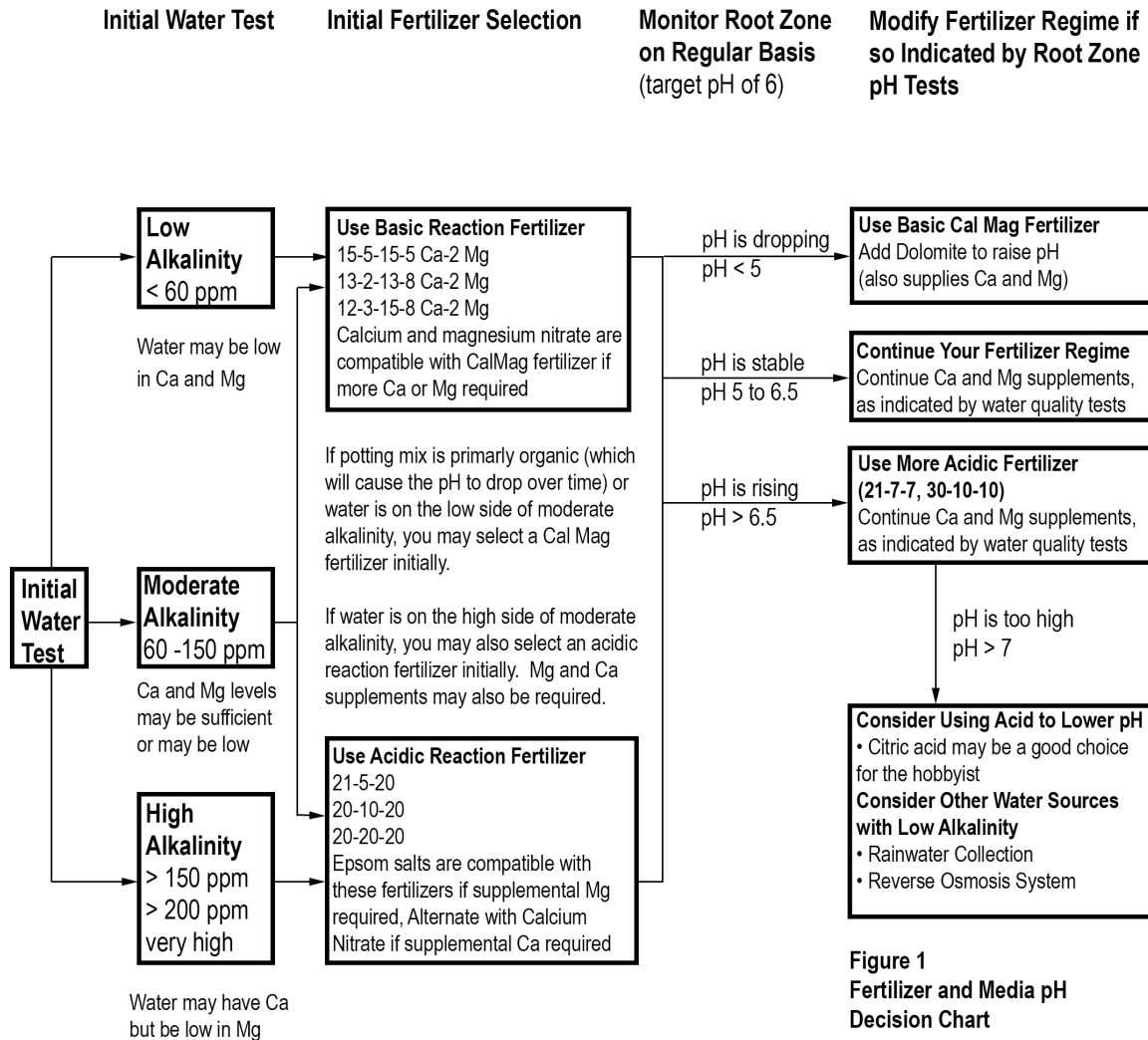


**St. Augustine Orchid Society**

[www.staugorchidsociety.org](http://www.staugorchidsociety.org)

## Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)



**Figure 1  
Fertilizer and Media pH  
Decision Chart**

**Ca - Calcium Mg - Magnesium**

### Notes:

1. Basic Reaction Fertilizers - like Cal Mag fertilizers have a higher proportion of nitrogen in the nitrate form, tend to slightly increase root zone pH, supplies supplemental Ca and Mg.
2. Acid Reaction Fertilizers - like 21-5-20 and 20-10-20 have a higher proportion of nitrogen in the ammonium form, tend to decrease root zone pH. Many of these fertilizers do not contain calcium or magnesium so supplements may be required.
3. Your initial water test should include calcium and magnesium content to see if supplementation is required. Calcium levels should be 40 to 100 ppm and magnesium levels should be 20 to 50 ppm.
4. Dolomite - source of calcium and magnesium, will tend to increase root zone pH. Fine Agricultural Grade 65, ½ tsp (0.25 ml) per 4 inch (10 cm) pot to raise pH for 6 months to 1 year, contains calcium and magnesium carbonates.
5. Gypsum - Calcium Sulfate, source of calcium, will not affect root zone pH. Slightly soluble in water, incorporate into media.
6. Epsom Salts (Magnesium Sulfate) - Water soluble, source of magnesium, will not affect root zone pH, ¼ tsp/gal (0.3 ml/l) supplies 34 ppm magnesium and 44 ppm sulfur.
7. Magnesium Nitrate (10-0-0) - Water soluble, source of magnesium, will tend to increase root zone pH, 1 tsp/gal (1.3 ml/l) supplies 32 ppm magnesium and 35 ppm nitrogen
8. Calcium Nitrate (16-0-0) - Water soluble, source of calcium, will tend to increase root zone pH, ¼ tsp/gal (0.3 ml/l) supplies 69 ppm calcium and 58 ppm nitrogen.



## Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)

**Select Your Fertilizer Based on Your Water Quality.** The first step in selecting the right water soluble fertilizer is knowing your water type. Your local Orchid Society may be able to help with the water quality testing; some tips for Orchid Societies are provided in Sidebar 2. There are many fertilizers available online and from specialty nursery supply companies. Some different Peters fertilizers suitable for different water qualities are listed in Sidebar 3 to provide you with an indication of the variations in fertilizer formulations. The Peters fertilizers are listed in order of increasing acidic reaction, as noted in the third column.

The more alkalinity or buffering capacity that is present in the water, the more you'll want to use a fertilizer with an acidic reaction to help maintain media pH in the desirable slightly acidic range. Some approximate guidelines are given in Table 1.

Table 1 – Approximate Guidelines for Matching Fertilizers with Water Alkalinity				
Alkalinity to Provide Stable Root Zone pH (ppm CaCO <sub>3</sub> )	Potential Acidity or Basicity (Calcium Carbonate Equivalency, lb/ton)	Percent of Total Nitrogen, that is in the		Some Suitable Fertilizers
		Acidic Form (ammonium plus urea)	Basic Form (nitrate)	
30 – 60	>150 basic	<15%	>85%	13-2-13, 14-0-14
60 – 120	150 basic to 150 acidic	20 – 30%	70 – 80%	17-5-17 or 20-10-20 alternated with 14-0-14, or 20-10-20 alternated with 15-0-15
150 – 250	150 – 500 acidic	40%	60%	20-10-20, 21-5-20
200 – 300	>500 acidic	>50%	<50%	20-20-20, 25-10-10
Source: Argo and Fisher. 2002. <i>Understanding pH Management for Container Grown Crops</i>				

**Pure water** sources like rainwater and reverse osmosis water have a very low alkalinity (< 60 ppm) and probably don't have much naturally occurring calcium or magnesium. Some well waters may also supply relatively pure water depending on the stratum in which the well is screened, like granites and sandstones. For this type of water, a Cal Mag type fertilizer is preferred because it has a basic reaction with most of the nitrogen in the nitrate form and it also contains supplemental calcium and magnesium.

**Moderate alkalinity** waters (60 to 150 ppm) may be provided by your public utility, surface water reservoirs and some wells. A water quality analysis is required to determine the alkalinity as well as whether the calcium and magnesium content is sufficient or should be supplied with fertilizers. If the alkalinity is on the low side, a Cal Mag fertilizer with a basic reaction is probably best, particularly if an organic potting mix is used. A Cal Mag fertilizer also supplies calcium and magnesium. With a more alkaline water, a fertilizer with an acidic reaction may be preferable to make whatever naturally occurring calcium and



St. Augustine Orchid Society

[www.staugorchidsociety.org](http://www.staugorchidsociety.org)

## Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)

magnesium that may be present more available to the plant. With moderate alkalinity water, the two fertilizer types can also be alternated. Calcium and magnesium supplements may be required if not supplied in the water or fertilizer.

*High alkalinity* water (> 150 ppm) commonly occurs in wells screened in calcium carbonate bearing strata like limestone or shell. These waters may have sufficient calcium and/or magnesium but the calcium and magnesium may not be available to the plant until the pH is dropped into the acidic range. For high alkalinity water, an acidic reaction fertilizer containing much of its nitrogen in the ammonium form can help neutralize some of the impact of the high alkalinity. Epsom salts can be added to supply supplemental magnesium if the natural magnesium levels are low.



3. What a joy to walk through your growing area with Roy Tokunaga. To be able to ask those questions others haven't been able to answer and get practical suggestions on things you can do differently to become a better grower, invaluable!

**Fertilizer Application Rates.** The optimum fertilizer application rate depends on the types of orchids you grow, how quickly they are growing, the characteristics of the potting mix and how frequently you fertilize. Roy recommends that hobbyists use a maximum rate of 1 tsp/gallon (1.3 ml/l) per week during the summer and a minimum rate of 1/4 tsp/gal (0.3 ml/l) per week during the winter, when growing in bright light under warm conditions.

**Orchid Types.** One study showed that cattleyas are relatively light feeders preferring around 50 ppm nitrogen while phalaenopsis and cymbidiums are heavier feeders requiring around 100 ppm nitrogen for best growth (Poole and Sheehan). Another study about growing the best phalaenopsis recommends an application rate of 150 to 200 ppm nitrogen (Wang et al.).

**Growth Rate.** The growth rate affects nutrient demand, plants grown in a bright greenhouse require more nutrients than those on a shady window sill. The fertilizer needs for many genera during the summer growing season are perhaps twice or quadruple that required during the winter resting months.

**Potting Mix.** Sphagnum moss and peat-based blends retain nutrients and are difficult to flush, so recommended application rates may be half of that recommended for a more freely draining mix.





St. Augustine Orchid Society

[www.staugorchidsociety.org](http://www.staugorchidsociety.org)

## Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)

**Fertilizing Frequency.** The frequency of fertilizing varies widely among individuals; some fertilize with each watering several times a week, some once a week, and others monthly. If you fertilize your cattleyas twice a week at full strength you could be grossly overfeeding them while some commercial growers with phalaenopsis potted in sphagnum moss fertilize at full strength with every watering but they only water every three weeks.

A recommended fertilizer dosage rate must be matched to the frequency of fertilizing for it to be meaningful. Some general guidelines for the hobbyist are given in Table 2. If you have a mixed collection, you can provide supplemental nutrition by top dressing or interlaying the potting media with timed release fertilizer for the heavy feeders like the Catasetinae.

Table 2 - General Fertilizer Application Rates for the Hobbyist

Frequency of Fertilizing	Fertilizing in Summer		Fertilizing in Winter	
	Strength	Nitrogen (ppm)	Dosage	Nitrogen (ppm)
Continuous Feed with Frequent Watering	1/4 strength	50 - 80	1/8 strength	25 - 40
Weekly	1/2 strength	100 - 160	1/4 strength	50 - 80
Monthly	full strength	190 - 320	1/2 strength	100 - 160

Note: Assuming full strength is 1 tsp/gal (1.3 ml/l), the range of nitrogen concentrations from two different fertilizers at various strengths is calculated. The lower value in ppm is from a 15-5-15 Cal Mag fertilizer and the upper value is based on a 21-5-20 fertilizer.

Source: *Peters Complete Product Use Guide*

**Calcium and Magnesium Supplementation.** As a practical matter for the normal hobbyist, if you match the acidifying effect of your water soluble fertilizer to the alkalinity of your irrigation water and apply 50 to 100 ppm nitrogen weekly, your likely only serious mineral nutritional concerns are calcium and magnesium which may not be provided by some of the more commonly available fertilizers. Set a target desirable level of around 40 to 100 ppm calcium and 20 to 50 ppm magnesium in your irrigation water. If there is not naturally occurring calcium and magnesium, you will have to supply it either via your fertilizer or additives.

**Cal Mag Fertilizers.** The easiest way to supply your plants with the calcium and magnesium they need is to use Cal Mag fertilizers. If the Cal Mag fertilizer does not provide sufficient magnesium, you can supplement with magnesium nitrate. These nitrate based fertilizers are incompatible with many phosphate containing fertilizers as well as Epsom salts. If mixed together in high concentrations in injector or siphonex systems, an insoluble calcium-rich sludge will settle in the bottom of the mixing tank rather than being fed to your plants.



St. Augustine Orchid Society

[www.staugorchidsociety.org](http://www.staugorchidsociety.org)

## Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)

**Water Soluble Supplements.** There are a variety of chemicals that can be used to provide additional calcium and magnesium, although the chemical forms are not always compatible with one another or certain fertilizers. As a simple rule, do not mix any of these products with other fertilizers in a tank for delivery with an injector or siphonex system unless you are sure they are compatible materials.



4. Orchid shows are a great place to find different fertilizers and supplements packaged in small quantities.

- *Calcium nitrate* is a widely available water soluble fertilizer with the formula 16-0-0 that supplies additional calcium and nitrogen. At a rate of  $\frac{1}{4}$  tsp/gal (0.3 ml/l), it will supply 69 ppm calcium and 58 ppm nitrogen. Do not mix concentrates of standard phosphate fertilizers with calcium nitrate or an insoluble calcium phosphate sludge will form.

- *Magnesium nitrate*, available from nursery supply outlets with the formula 10-0-0, can be used as a supplemental source of magnesium and nitrogen. At a rate of 1 tsp/gal (1.3





## Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)

ml/l), it will supply 32 ppm magnesium and 35 ppm nitrogen. Magnesium nitrate is compatible with other fertilizers and supplements.

- *Epsom salts*, with the chemical formula magnesium sulfate, is widely available at many retail outlets. It can be used as a water soluble fertilizer supplement that supplies 34 ppm magnesium and 44 ppm sulfur at a rate of ¼ tsp/gal (0.3 ml/l). The horticultural grade is more easy to dissolve in concentrate tanks. Do not mix concentrates of fertilizers containing calcium (Cal Mag fertilizer, calcium nitrate) with Epsom salts because an insoluble calcium sulfate sludge will form.

*Top Dressing.* Dolomitic lime can be used as top dressing or incorporated into your potting mix and will supply calcium and magnesium for many months as well as increase the pH of the potting mix. Look for a powdered form, referred to as Fine Agricultural Grade 65 at horticultural outlets. Gypsum, composed of calcium sulfate, is sparingly soluble in water. It is occasionally used in small amounts as a source of calcium in potting mixes because it does not affect media pH.

*Flush Pots Regularly* - Flush your pots religiously, at least once or twice a month or better yet with each irrigation. 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 help flush some of the dissolved salts out of your pot. The harder your water and the more you fertilize, the greater the need to flush salts from around the root zone. Without a regular flushing program, all pots will eventually accumulate salts from the repeated wet dry cycle as the salts precipitate and the water evaporates or is absorbed by the plants.

**Check the Root Zone pH to Verify Your Fertilizer Regime.** If your water has very low or very high alkalinity, consider making periodically checks of the root zone pH to make sure the acidity is in the proper range for good growth. Different ornamental plants differ in their nutritional needs and their ideal pH ranges can be generally classified based on their efficiency at taking up micronutrients (Argo and Fisher).

*Iron Inefficient Group* (or so-called Petunia Group) - is prone to iron deficiency at high pH particularly if nutrient levels are low or media pH is high, so they should be grown at a slightly acidic pH of 5.4 to 6.2 to increase the solubility of micronutrients.

*General Group* – grow at a moderate pH of 5.8 to 6.4

*Iron Efficient Group* (or so called Geranium Group) – is prone to iron and manganese toxicity at low pH particularly when grown with high nutrient levels, so they should be grown at a slightly higher pH of 6.0 to 6.6 to limit micronutrient toxicity.



## Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)

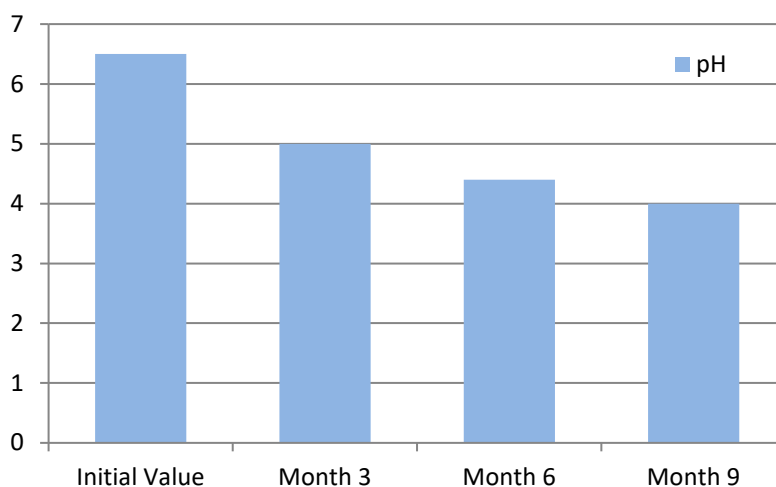
There is no published ideal pH for orchids and given their geographical diversity, orchids undoubtedly thrive in a range of media pH. Orchids growing on limestone outcrops seem to prefer higher pH conditions while those orchids thriving in decaying organic matter obviously enjoy more acidic conditions. There may be ideal pH ranges for various types of orchids and you may be able to quantify a preferred pH range for the orchids you grow. As a starting point for a mixed collection, you can use a target pH range of 5 to 6.5 when using the saturation test procedure described in Sidebar 4. This test provides you with a fairly simple way to evaluate the interactions between your water quality, fertilizer and media and whether any corrective actions might be desirable.

- If the pH is in the 5 to 6.5 range, your combination of water, potting mix and fertilizer is working. Continue your fertilizer regime.
- If the pH drops below 5, it is becoming too acidic. You can top dress pots with dolomite or switch to a fertilizer with a more basic reaction.
- If the pH climbs above 6.5 it is becoming too basic. You can try a fertilizer that has a more acidic reaction or consider using more acidic potting materials.

If the pH is consistently over 7 and you have tried switching fertilizers and mixes, you may have to consider adding acid to lower the irrigation water pH or mixing your water with low alkalinity water like rainwater or think about installing a reverse osmosis system.

**Some Case Histories.** Different areas of the country have very different water quality. Roy at H&R found that with a very low alkalinity water, dolomitic lime applications are necessary to keep the root zone from becoming too acidic. Alan Koch at Gold Country found that his high alkalinity water makes acid injection necessary to keep the media from becoming too basic.

**Change in pH Over Time**





**St. Augustine Orchid Society**

[www.staugorchidsociety.org](http://www.staugorchidsociety.org)

## **Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1**

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)

*Results at H&R Nurseries.* Roy has been busy testing out different fertilizer formulations, nutrient supplementation with Epsom salts and calcium nitrate, always checking the impact of these changes on root zone pH to make sure the pH doesn't drop below 4.5 or rise above 6.5. He uses about half city water, with a pH of 7.8 and very low alkalinity, 50 ppm and half rainwater, that has no alkalinity. Roy's mix consists of bark, perlite and peat that has a pH of about 4.4. He adds dolomite to his media so he has a start pH of 6.5. He tested the root ball pH at 3 month intervals. The interactions between the low alkalinity water, fertilizer and organic matter pushed the pH down to a pH of 4 within 9 months, so more dolomite was added to return the pH to 6.5.

*Results at Gold Country Orchids.* Alan Koch of Gold Country Orchids in the Sacramento area has a different situation. Alan has beautifully grown plants, many grown in the highest AAAAA grade of long fibered New Zealand sphagnum moss. His irrigation water has a very high alkalinity, well in excess of 200 ppm, so he uses a high acidity generating fertilizer similar to 20-20-20 (his fertilizer is specially formulated based on semiannual water quality test data). Even with the acid reaction fertilizer, the pH of the root ball of sphagnum moss can rise to about 8 after 6 months. Alan has to inject acid into his irrigation water in order to maintain root zone pH in the desired range.

It is much easier to handle the problems that might be caused by a low alkalinity water source than those associated with high alkalinity waters. For those lucky enough to have a water supply that is naturally low in alkalinity, use of a basic reaction fertilizer like a Cal Mag fertilizer can help counteract the tendency for the pH to drop over time. If the pH does drop below desirable levels, the concern is that trace elements will be too soluble and cause micronutrient toxicity. The fix is easy. Simply top dress pots with some dolomitic lime. If your water has a moderate alkalinity and you choose your fertilizer and potting media based on your water quality, the pH in the potting media will most likely be maintained in the generally acceptable pH range of 5 to 6.5. For those with highly alkaline water, you run the risk of having nutrient deficiencies because the nutrients that are present may not in a form that can be absorbed by the plant. You can try to counterbalance the high alkalinity by choosing a fertilizer with an acidic reaction. Of course, if you apply fertilizer at one quarter strength, the potential acidification from the fertilizer will likewise be reduced to one quarter. You can include organic matter like bark and sphagnum moss in your mixes, they tend to be acidic and will generate additional acidity as they break down. But if the pH in your potting mix continues to rise despite these simple solutions, the next steps are more difficult, either consider acidification or find a new source of water. Some simple tests of your root zone pH can help you verify the effectiveness of your fertilization program and whether any changes are warranted.

**Acknowledgements:** Many thanks to Roy Tokunaga, for all his knowledge so freely shared with orchid growers of all levels of experience. This article is a summary of his insights in





## Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)

diagnosing and correcting cultural problems associated with media pH. Roy credits the classic five-part series of articles entitled *Understanding pH Management and Plant Nutrition* written by Dr. Bill Argo for his understanding of the issue. If you are interested in learning more about water quality, read and then reread Bill Argo's articles, you'll learn something new each time.

### Citations and Additional Reading

Argo, Bill. Understanding pH Management and Plant Nutrition, *Journal of the International Phalaenopsis Alliance*, Part 1 - Introduction, 2003, Vol. 12(4). Part 2 - Water Quality, 2004, Vol. 13(1). Part 3 - Fertilizers, 2004, Vol. 13(2). Part 4 - Substrates, 2004, Vol. 13(3). Part 5 - Choosing the Best Fertilizers, 2004, Vol. 13(4). Accessed online 11/14/16: <http://www.staugorchidsociety.org/culture-water.htm>.

Argo, William R. and Paul R. Fisher. 2002. Understanding pH Management for Container Grown Crops. Meister Publishing. Willoughby, Ohio.

Camberato, Diane M., Roberto G. Lopez, and Michael V. Mickelbart. 2009. *pH and Electrical Conductivity Measurements in Soilless Substrates*. Purdue University, Purdue University Cooperative Extension Service: West Lafayette, Indiana. Publication HO-237-W. Accessed 11/15/16: <https://www.extension.purdue.edu/extmedia/ho/ho-237-w.pdf>

Faust, James E., and Elizabeth Will. *Irrigation Water Quality for Greenhouse Production*, University of Tennessee, Agricultural Extension Service, PB 1617.

Faust, James E., and Elizabeth Will. *Plant Nutrition and Fertilizers for Greenhouse Production*, University of Tennessee, Agricultural Extension Service, PB 1616.

*Peters Complete Product Use Guide*,  
available online at <http://everris.us.com/peters-complete-product-use-guide-usa>

*Peters ABC Selection System*,  
available online at <http://everris.us.com/plant-nutrition/water-soluble-fertilizers>

Poole, Hugh A. and Thomas J. Sheehan. 1982, Mineral Nutrition of Orchids. *Orchid Biology: Reviews and Perspectives*, Joseph Arditti editor, 2:195:195-212. Cornell University Press, Ithaca.

Sheehan, Thomas J. 2002. Physiological Disorders of Orchids, p.7. In: *Orchid Pests and Diseases*. Rev. Ed., T.J. Watson editor, American Orchid Society, Delray Beach, Florida.

Wang, Yin-Tung, Matthew Blanchard, Robert Lopez and Erik Runkle. 2007. Growing the Best Phalaenopsis Part 2: Media, Transplanting, Water and Nutrient Requirements. 76(2):106-111.



St. Augustine Orchid Society

[www.staugorchidsociety.org](http://www.staugorchidsociety.org)

## Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)

### Sidebar 1 Water Quality Terms

There are certain water quality terms that are used when discussing orchid plant nutrition:

**pH** - A direct measurement of how acidic or basic the irrigation water is. A pH of 7 is neutral, a pH of less than 7 is acidic and a pH of more than 7 is basic. The pH of the water around the roots of your orchid will determine how available nutrients are to your plant.

**Alkalinity** - The concentration of compounds in the irrigation water that can neutralize acidic compounds, generally bicarbonates and carbonates. Alkalinity is a critical water quality component because it can buffer the impact of acidic influences and keep the root zone pH in the desired range of 5 to 6.5, thus preventing micronutrient toxicity at low pH and micronutrient deficiency at high pH.

**Soluble Salts** - The salts dissolved in your irrigation water, measured as Electrical Conductivity (EC, in mS/cm or mmhos/cm) or Total Dissolved Solids (TDS, in ppm). Excessive salts can cause root tip burn so a low soluble salt content is desirable. The higher the soluble salt level, the more important it is to flush pots to leach salts away from the root zone. The relationship between EC and TDS is dependent on the anions and cations present in the water. A measured EC value of 1 mS/cm is equivalent to somewhere between 500 and 700 ppm TDS. Reasonable approximations can be calculated using factors ranging from 640 to 700 ppm TDS being equal to 1 mS/cm EC.

Qualitative Assessment of Water Quality	Electrical Conductivity (mS/cm)	Total Dissolved Solids (ppm)
Best Quality	< 0.25	< 175
Good Quality	0.25 – 0.75	175 – 525
Use with Caution	0.75 – 1.25	525 – 875
Find a New Water Source	> 1.25	> 875
Source: <i>Physiological Disorders of Orchids</i> by Thomas Sheehan		

**Calcium** - A secondary macronutrient required in large quantities by young growing tissues, strengthening stems and promoting strong overall plant growth, that may or may not be present in your water or fertilizer. Irrigation water should have 40 to 100 ppm calcium.

**Magnesium** - A secondary macronutrient that is an important component of chlorophyll, the green pigment that is responsible for photosynthesis, that may or may not be present in your water or fertilizer. Irrigation waters should have 20 to 50 ppm magnesium.

**Sodium** - A potentially toxic substance that may be present in irrigation water from natural sources or introduced by a home water softener. Irrigation water ideally should contain less than 10 ppm sodium. Levels above 50 ppm are considered potentially harmful.

**Water Types** - Natural water supplies can be categorized into basic water types based on relative alkalinity levels and associated ranges of naturally occurring calcium. Very low alkalinity waters (< 60 ppm) and moderately low alkalinity waters (60 – 150 ppm) may or may not contain sufficient naturally occurring calcium, while moderately high alkalinity (150 – 200 ppm) and very high alkalinity waters (> 200 ppm) waters typically are high in calcium because the alkalinity is caused by the naturally occurring calcium bicarbonate and calcium carbonate in the water.



## Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)

### Sidebar 2 - How an Orchid Society Can Help Members Understand Their Water Quality

Besides having fun, one of the primary goals of an Orchid Society is to help its members grow the healthiest, most profusely blooming orchids possible. Arming members with the tools to understand their water quality and what fertilizers and supplements will benefit their growing conditions is a great way to accomplish this goal. Some suggestions:

**Find the Mover and Shaker.** Find that detail oriented person who is comfortable with basic chemistry and let him or her spearhead the project for the club.

**Identify the Different Water Sources.** You many have a general idea what the local sources of water are, so compile it into a one-page form. Then pass it around on a clipboard for members to enter their information. It might look something like this:

What Is the Source of Water You Use for Your Orchids?						
Name	Zip Code	Rain Water	Shallow Well	Artesian Well	City / County	Other or Comments
Bottom	32086					Pond in Summer
Bottom	32086		x			Well in Winter
If you have an analysis of your water, will you forward it to <a href="mailto:info@staugorchidsociety.org">info@staugorchidsociety.org</a> ?						

**Assemble Water Quality Data for Different Sources of Water.** For the various sources of water, pull whatever information that is easily available together. For public water supplies, you can call the water utility department and explain you're doing a survey for local orchid growers and can they please supply you with this type of information:

Local Public Water Supplies						
Treatment Plant	pH (units)	Alkalinity (ppm)	Calcium (ppm)	Magnesium (ppm)	TDS (ppm)	Sodium (ppm)
Main Plant	8.6	26	47	27	610	84
City of St Aug	8.8	36	46	25	410	33

Compile similar information on any water tests forwarded to you from your members for their individual wells or water supplies. If your data set is incomplete, obtain water samples from representative water supplies and send them off for an irrigation water analysis, about \$40, to a local lab. If you send samples to [J.R. Peters](#), they will throw in a fertilizer recommendation with the analysis.

**Select Fertilizers for Each Water Type.** Based on the fertilizer selection tools discussed in the full text of this article, identify which fertilizers and supplements are good for each water type.

**Perform Confirmatory Testing at Meeting.** For a fun and interactive discussion, have your members bring samples of their water to the meeting where you test it for pH and alkalinity, using the WaterWorks™ pH and Total Alkalinity Test Strips (make sure the expiration date on the strips has not passed and follow testing instructions faithfully, the strips must be read in less than 15 seconds to be accurate). Then you can compile the data for distribution via email or your website.

Name	Source of Water	pH (units)	Alkalinity (ppm)	Cal Mag Fertilizer	21-5-20 Fertilizer plus Epsom Salts
Bell	County	8	120	x	x
Bottom	Pond	6	< 80	x	
Bottom	Well Water	8.5	> 200		x
Use basic Cal Mag fertilizer if alkalinity is very low (<60 ppm) and acid generating formula with Epsom salts if high (>150 ppm). For moderate alkalinity (60 – 150 ppm), Cal Mag fertilizer may be best at the low end and 21-5-20 fertilizer may be best at the high end of alkalinity, or the two fertilizers can be alternated.					





## Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)

### Sidebar 3 - Technical Details Showing Differences Between Peters Fertilizer Formulations

Everris has an [online fertilizer selection tool](http://everris.us.com/tools-and-calculators) (<http://everris.us.com/tools-and-calculators>) to help you choose amongst different Peters fertilizers. You can also download a [selection guide](http://everris.us.com/peters-complete-product-use-guide-usa) (<http://everris.us.com/peters-complete-product-use-guide-usa>) with detailed information about their fertilizers. Different fertilizers, their suitability for a given water type and the potential basicity and acidity of the fertilizer are summarized below.

Peters Fertilizers Ranked in Order of Increasing Acidic Fertilizer Reaction			
Fertilizer Name	Formula N-P-K % nitrate nitrogen Ca, Mg micronutrients	Description	Fertilizer Reaction Pounds of potential acidity or basicity per ton of fertilizer
Peters Excel 13-2-13 Plug and Bedding Plant Special <sup>1</sup>	13-2-13 93% nitrate N 6 Ca, 3 Mg micronutrients	All-purpose formulation combines high nitrate and low phosphate with extra calcium and magnesium. Most effective for irrigation water having an alkalinity below 150 ppm.	335 Basicity
Peters Excel 15-5-15 Cal Mag Special <sup>1</sup>	15-5-15 79% nitrate N 5 Ca, 2 Mg micronutrients	All-purpose formulation combines high nitrate and low phosphate with extra calcium and magnesium. Ideal for irrigation water having an alkalinity of 60 to 150 ppm.	131 Basicity
Peters Excel 17-3-17 Peat Lite Neutral Cal Mag <sup>1</sup>	17-3-17 76% nitrate N 4 Ca, 1.5 Mg micronutrients	All-purpose formulation produces a nearly neutral reaction to help maintain steady pH in growing media. Ideal for water having an alkalinity below 150 ppm.	27 Basicity
Peters Professional 15-5-25 Peat Lite Flowering Crop Special <sup>2</sup>	15-5-25 71% nitrate N 0 Ca, 2.5 Mg micronutrients	High-nitrate, low-phosphate formula with extra magnesium. Effective for all water types, stand-alone product formulation for water having alkalinity above 150 ppm.	48 Acidity
Peters Excel Multi Purpose 21-5-20 <sup>2,3</sup>	21-5-20 60% nitrate N 0 Ca, 0 Mg micronutrients	Moderately acidic formulation serves as an all-purpose fertilizer, appropriate for water having an alkalinity over 60 ppm.	300 Acidity
Peters Professional 18-8-17 Peat Lite High Mag Special <sup>2</sup>	18-8-17 59% nitrate N 0 Ca, 2.5 Mg micronutrients	Extra magnesium to maintain deep green foliage. Effective for all water types, stand-alone product formulation for water having alkalinity above 150 ppm.	381 Acidity
Peters Professional 20-10- 20 Peat Lite Special <sup>2,3</sup>	20-10-20 60% nitrate - 0.15 Mg micronutrients	Acidifying action corrects an overload of excessive pH in growing media.	415 Acidity
Peters Professional 20-20- 20 Ag & Landscape Special <sup>2,3</sup>	20-20-20 28% nitrate N 0 Ca, 0 Mg micronutrients	Acidifying action can help combat excessively high pH in growing media.	570 Acidity
<sup>1</sup> Fertilizer for those with low to moderately low alkalinity water (alkalinity below 150 ppm)			
<sup>2</sup> Fertilizer for those with moderately high to high alkalinity water (alkalinity above 150 ppm).			
<sup>3</sup> May have to supplement with Epsom salts, which is compatible and may be added with this fertilizer, to provide enough magnesium. Calcium nitrate is incompatible with this fertilizer and Epsom salts.			
Source: <i>Peters Complete Product Use Guide</i> , available online at <a href="http://everris.us.com/peters-complete-product-use-guide-usa">http://everris.us.com/peters-complete-product-use-guide-usa</a>			



**St. Augustine Orchid Society**

[www.staugorchidsociety.org](http://www.staugorchidsociety.org)

## Choosing Your Fertilizer Based on Your Water Quality Understanding Orchids with Roy Tokunaga – Part 1

by Sue Bottom, [sbottom15@hotmail.com](mailto:sbottom15@hotmail.com)

### Sidebar 4 - Saturation Test for Root Zone pH



1. Dendrobium has been in a bark, perlite and peat mix for 1 year.



2. Saturation test is performed on entire root ball, media and roots.



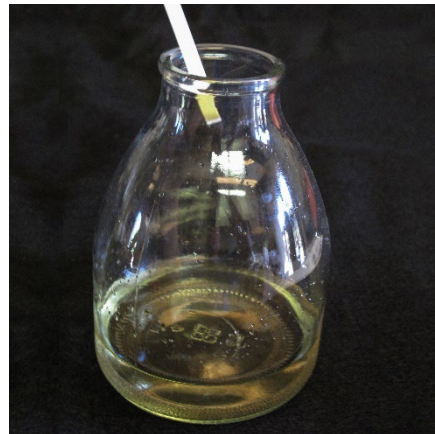
3. Place entire root ball in plastic bag.



4. Return plastic bag to pot and add distilled water to media, fill to about  $\frac{3}{4}$  full, let sit 30 minutes. Keep time consistent between tests.



5. After 30 minutes, remove root ball from bag. Pour water through coffee filter into paper cup or glassware, and dip pH test strip into solution.



6. Liquid can be tested for pH using pH Indicator strips from [www.phytotechlab.com](http://www.phytotechlab.com). These have a pH range of 4.0 to 7.0 at 0.4 increments.

Source: Adapted from *pH Management and Plant Nutrition*, Part 4 – Substrates, Bill Argo.