

Orchid Myths – Urea

by Sue Bottom, sbottom15@hotmail.com



1. Alan Koch of Gold Country Orchids loves to talk about orchids. His ideas on growing orchids are sometimes a bit out of the mainstream, but his plants speak for themselves.

I never had so much fun learning how little I knew about something I thought I understood than I did at the kitchen counter with Alan Koch après our Orchid Club meeting. I have read and oft repeated that urea fertilizers should be avoided. Does the form of nitrogen make a difference? The short answer is yes. Some urea in the fertilizer is fine, use a fertilizer that has more than half of the nitrogen in the nitrate form and less than half in the ammonium form. Now for the long answer.

Forms of Nitrogen. There are many water soluble fertilizers labeled for use as orchid food, though the formulations are very different. If you read fertilizer labels, you've noticed that the percentages of nitrate nitrogen, ammoniacal nitrogen and urea nitrogen are listed. The forms of nitrogen in fertilizers and how they are used by orchids are summarized in Table 1.

Table 1 – Different Forms of Nitrogen in Fertilizers			
	Nitrate Nitrogen	Ammonium Nitrogen	Urea Nitrogen
Chemical Formula	NO_3^-	NH_4^+	$\text{CO}(\text{NH}_2)_2$
Availability to the Plant	Immediately available for uptake by the roots	Immediately available for uptake by the roots	Must be converted to ammonium by the enzyme urease in the orchid roots and microorganisms in the root zone
Impact on Substrate pH	Basic reaction, causes an increase in root zone pH when absorbed by the roots	Acidic reaction, causes a decrease in root zone pH when absorbed by the roots and when converted to nitrate by nitrifying bacteria in the root zone	Acidic reaction, causes a decrease in root zone pH when converted to ammonium by microorganisms

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	Nitrate Nitrogen	Ammonium Nitrogen	Urea Nitrogen
Leachability through the Substrate	Easily flushed through the pot and lost if not absorbed by the roots	Can be absorbed by the roots and adsorbed onto organic matter for subsequent uptake or conversion to nitrate, particularly in mixes having a high cation exchange capacity	Easily flushed through the pot and lost if not absorbed by the roots or not converted to the ammonium form by microorganisms in the root zone
Note: Whether or not urea can be taken up directly by roots is the subject of some debate. The ease with which urea is converted into ammonium nitrogen is the subject of more debate, but to the extent that urea can be converted into ammonium, ammonium and urea are often grouped together and referred to as ammoniacal nitrogen.			

A quick search on Amazon.com reveals some common orchid fertilizer brands. There is the Sun Bulb Better Gro Orchid Plus with a 20-14-13 formula that touts the fact that it is urea free. The Grow More brands of orchid fertilizers have various formulations such as a 20-20-20, 20-10-20 and 30-10-10; some formulas say they are urea free and others say they contain a variety of nitrogen forms. The Jack's Classic Orchid Special has a 30-10-10 formula in which virtually all the nitrogen is in the urea form while Jack's Professional Orchid Fertilizers contain no urea. What gives?



2. Fertilizer companies are in the business of selling fertilizers. Don't buy a fertilizer just because the label has the word orchid on it. Learn which fertilizer is best for your water quality and growing conditions or ask your local orchid society for a recommendation.

Conversion of Urea to Ammonium Nitrogen. The basic issue is whether or not your orchid is able to absorb urea directly into the roots. Most debates on urea revolve around whether it is converted into usable ammonium nitrogen by the microorganisms present in the root zone or it is simply flushed out of the pot never to be seen again. You can find a full spectrum of opinions about how long it takes to convert urea to ammonium, with estimates ranging from over a year to a matter of hours or days. The scientific literature suggests the conversion is fairly rapid. One study involving bark showed that 71% of the urea applied was hydrolyzed to ammonium within 24 hr and 95% within 40 hr (Wright, 1987).

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3. Orchids mounted directly onto a wooden surface probably have the smallest population of microorganisms in the root zone so urea fertilizers may be flushed from the roots before the urea can be converted into ammonium for uptake by the plant.



4. A little moss or other organic matter around the roots of mounted orchids may create a microenvironment where microorganisms can grow more easily facilitating the conversion of urea to ammonium, so some of the urea can be used by the plant.

You know intuitively that the population of microorganisms is probably greater in a soilless peat or bark based mix than in an inorganic mix and certainly greater than around a mount or in a basket with no media, so the conversion of urea to ammonium is likely to be greater in bark and soilless potting mixes than in mounted orchids. If most of your orchids are mounted, a high urea fertilizer may not supply the expected amount of nitrogen because low populations of microorganisms won't convert much of the urea to the usable ammonium or nitrate forms so most of the urea will probably just wash away. Perhaps your potting mix is sterile when you first repot your orchids, but orchids growing with potting media around the roots have likely developed a population of microorganisms that can convert urea to ammonium, and the more organic matter present in the mix, the greater the expected rate of conversion from urea to ammonium and ultimately nitrate nitrogen. While some of the urea may wash through the pot unused, this is probably also true of some of the nitrate nitrogen you apply.



5. Potting mixes may be nearly sterile when you repot, but over time the microbial population will develop, and you may selectively encourage growth by adding biofungicides or organic fertilizers after potting.



6. Plants grown in organic mixes containing mostly bark or peat likely have developed a healthy microbial population that helps mediate the conversion from urea to ammonium.



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Ammoniacal vs. Nitrate Nitrogen. More important than the presence or absence of urea is the relative proportion of nitrate nitrogen to ammoniacal nitrogen (ammonium plus urea are lumped together and called ammoniacal nitrogen). Ammoniacal nitrogen tends to produce lush, soft growth more susceptible to disease while nitrate nitrogen promotes sturdier growth. Nitrifying bacteria in the substrate are very effective at converting ammonium to the nitrate form except when temperatures drop below 60F, the potting mix is too wet or the potting mix pH is too low, and this can potentially allow ammonium levels to build up which may result in ammonium toxicity. One study concluded that a minimum 1:1 ratio of nitrate to ammoniacal nitrogen and preferably a 3:1 nitrate to ammonium ratio improves vegetative growth and flowering in Phalaenopsis (Wang, 2008).

Choose Your Fertilizer Based on Your Water Quality. Your water quality is one of the factors you should consider when selecting your fertilizer. If you have a naturally soft water with low alkalinity and total dissolved solids, your fertilizer of choice is probably one that is primarily nitrate nitrogen because the high nitrate content will result in a slightly basic reaction around your roots. So if you use rainwater or reverse osmosis water, your public water supply is from reservoirs in clean recharge areas or your well is drilled in granite, your water probably has a very low pH, low total dissolved solids content and low buffering capacity so you should seek out high nitrate fertilizers. For these pure water sources, avoid fertilizers with an acidic reaction like those containing more than 25% of the nitrogen in the ammoniacal form because it can cause precipitous drops in the pH around your roots. A good Cal Mag fertilizer is probably a good choice for waters with an alkalinity below 150 ppm. Some potentially suitable fertilizers for pure water are listed in Table 2.

Table 2- Fertilizers Suitable for Naturally Soft Water

Formula N-P-K-Ca-Mg	Fertilizer Name and Potential Source	Forms of Nitrogen
12-3-15-7-2 w/ micronutrients	Jacks Professional Orchid RO Water - available in 25 lb bags from nursery supply and online sources	0.4% ammoniacal (0% urea) 11.6% nitrate
15-5-15-5-2 w/ micronutrients	Peters Excel Cal Mag Special - available in 25 lb bags from nursery supply and online sources	3.2% ammoniacal (2.1% urea) 11.8% nitrate
13-3-15-8-2 w/ micronutrients	MSU Orchid Fertilizer for RO/Rain Water - available in small quantities from FirstRays.com and rePotMe.com	0.7% ammoniacal (0% urea) 12.5% nitrate
<p>Note: This table lists some fertilizers suitable for water which is naturally soft, less than 150 ppm alkalinity. Do not water your orchids with tap water that has been softened because the sodium from your water softener is toxic to your orchids. Some fertilizer manufacturers lump together the urea and ammonia nitrogen and report the sum as ammoniacal nitrogen.</p>		

On the other hand, if you have hard water with high alkalinity and high total dissolved solids, you should probably use a fertilizer that will cause an acidic reaction around the roots so the naturally occurring calcium and other supplied nutrients will be more available to your plant. You'll look for a fertilizer with up to half the nitrogen in the ammoniacal form. Some potentially suitable fertilizers are listed in Table 3.



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Table 3- Fertilizers Suitable for Hard Water (may need to add supplemental calcium or magnesium)		
Formula N-P-K-Ca-Mg	Fertilizer Name and Potential Source	Forms of Nitrogen
16-4-20-3-1 w/ micronutrients	Jacks Professional Orchid Well Water - available in 25 lb bags from nursery supply and online sources	3.8% ammoniacal (0% urea) 12.2% nitrate
21-5-20-0-0 w/ micronutrients	Peters Excel Multi Purpose - available in 25 lb bags from nursery supply and online sources	8.3% ammoniacal (1.1% urea) 12.7% nitrate
20-14-13-0-1 w/ micronutrients	Better Gro Orchid Plus – may be available in local nurseries and big box stores	9.4% ammoniacal (0% urea) 10.6% nitrate
19-4-23-2-0 w/ micronutrients	MSU Orchid Fertilizer for Well Water - available in small quantities from FirstRays.com and rePotMe.com	5.7% ammoniacal (0% urea) 13.6% nitrate
Note: This table lists some fertilizers suitable for water which has an alkalinity greater than 150 ppm. Some fertilizer manufacturers lump together the urea and ammonia nitrogen and report the sum as ammoniacal nitrogen. High salt content in the root zone is the enemy of your orchids and hard water has lots of dissolved salts present even before you add fertilizer, so flush salts from the pots regularly.		

If you don't know what the quality of your water is or what fertilizer to choose, ask your local Orchid Society for advice or send a sample of your water to [J.R. Peters](#). For around \$40 you can obtain a water analysis and then ask them to recommend a suitable fertilizer based on your actual water testing results.

Rather than focusing on the urea content when selecting a fertilizer, do a mental calculation of how much of the nitrogen is in the ammoniacal form (ammonium plus urea) versus how much is in the nitrate form. As a general rule, select a fertilizer with less than half the nitrogen in the ammoniacal form. If your water source is fairly pure with low alkalinity, use a fertilizer with less than a quarter of the nitrogen in the ammoniacal form. I'll continue to use low urea formulations in my root zone feeding program using a predominantly nitrate formulation when watering out of the rain fed pond in the summer and an acid generating fertilizer containing about 40% of the total nitrogen in the ammoniacal form when using high alkalinity well water in the winter. Whatever form of nitrogen works best for your water and your orchids, make sure your plants are also receiving enough calcium and magnesium.

Citations and Additional Reading:

Argo, B., Blackmore Company, Understanding pH management and plant nutrition, 2003, *Journal of the International Phalaenopsis Alliance*, Vol. 13 (2).

Elliott, G., 1984. Urea hydrolysis in potting media. *Journal of the American Society for Horticultural Science*. 111(6):862-866.

Mattson, N., R. Leatherwood, and C. Peters. Nitrogen: all forms are not equal. Cornell University Cooperative Extension. accessed 8/1/15
http://www.greenhouse.cornell.edu/crops/factsheets/nitrogen_form.pdf



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Peters, C. and K. Kackley, 2006, Anatomy of a water soluble fertilizer label, *Association of Horticultural Professionals OFA Bulletin*. September/October 2006 Number 898.

Peters Complete Product Use Guide, accessed 8/1/15 <http://everris.us.com/peters-complete-product-use-guide-usa>

Peters ABC Selection System, accessed 5/1/16 <http://everris.us.com/plant-nutrition/water-soluble-fertilizers>

Trepanier, M., M. Pierre-Lamy, and B. Dansereau. 2009, *Phalaenopsis* can absorb urea directly through their roots. *Plant and Soil* 319, 95-100

Wang, Y., 2008, High $\text{NO}_3\text{-N}$ to $\text{NH}_4\text{-N}$ ratios promote growth and flowering of a hybrid *Phalaenopsis* grown in two root substrates. *HortScience* 43,350-353

Wang, Y., 1996, Effects of Six Fertilizers on Vegetative Growth and Flowering of *Phalaenopsis* Orchids. *Scientia Horticulturae*. 65, 191–197.

Wright, R. D., 1987, Nitrogen availability from urea in a pine bark medium, *HortScience* 22(1),70-72.