Dialogues with Hugh: No. 4 - Is pH Important to Orchids?

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ADVISE is often provided in club newsletters on how to adjust the pH of the potting medium. As a result, some orchid growers get most concerned about providing the correct pH for their orchids. Although pH is much spoken about, it may not be well understood. So what is pH? What does pH mean to an orchid?

A little theory – What is pH?

According to Wikipedia (https://en.wikipedia.org/wiki/PH), "pH is a numeric scale used to specify the acidity or alkalinity of an aqueous solution" (i.e. of pure water or of a solution of chemicals dissolved in water). In the term pH, the "H" refers to the hydrogen ion, written as H^+. The term "p" refers to the activity of H^+.

The pH scale reads from 0.0 to 14.0. Solutions with a pH less than 7.0 are acidic while solutions with a pH greater than 7.0 are alkaline. Pure water, when boiled to drive out any dissolved carbon dioxide, has a pH of 7.0 -- it is neutral being neither acidic nor alkaline; water left open to the atmosphere absorbs carbon dioxide and has an acidic pH as low as 5.6 because the dissolved carbon dioxide forms carbonic acid:

i.e. $CO_2 + H_2O = H_2CO_3$

The term 'pH' applies only to solutions of water and chemicals dissolved in water or other solvents. Solids have no real pH until they dissolve. When chemical salts, such as those in fertilisers, dissolve in water, they alter the activity of H^+ ions in the water, and thereby alter the pH of the resultant solution.

So much for theory, but what pH best suits orchids?

Roots take up nutrient elements from a chemical 'soup' of positively charged cations (e.g. K^+) and negatively charged anions (e.g. SO_4^{2-}). To function at their best, roots must be provided with a medium that supplies the cations and anions at a pH that best suits the root environment of that species.

Each species has its own preferred pH range for its root environment. It is often stated in the popular literature of club newsletters that most orchid species prefer a pH range just below neutral, from 6.0 to 6.5.

But this may be a wee bit of a ***fable!***

When we consider those species that grow in limestone areas of alkaline pH, such as many species of *Paphiopedilum*, they beg an answer to the question – "Do they prefer alkaline conditions from 7.5 to 8.5 because they grow in limestone areas?" Or is that belief a **furphy**? Many species of *Paphiopedilum* are humus epiphytes or humus lithophytes where the pH of the humus may well be acidic. Also, do only bog-loving terrestrials prefer an acidic pH, perhaps from 3.5 to 4.5?

To try to settle the question – "To what pH should I adjust my potting medium?" – studies have been completed on the pH preferred by genera for seed germination *in vitro*, and the pH of the medium that orchids grow *in situ* in the wild. The results of some of these studies are summarised in Table 1. In addition, Withner (1959) reported that the pH of many orchid media in successful commercial use in USA were acidic – sphagnum peat moss, 3.30; osmunda fiber, 4.0 to 5.35; fir bark, 4.3 to 6.0.

These data show the extremely wide variation between genera and even within genera that some orchids prefer for germination of their seed *in vitro* and for growth and production of flowers in various media in cul-

Orchid	pH	Medium	Reference
Cypripedium calceolus	5.0 to 5.6	*in vitro* seed germination	Table 14.1; Arditti, 1992
Cypripedium calceolus	7.1 to 7.4	*in situ* in wild	Table 14.1; Arditti, 1992
Paphiopedilum	5.0 to 5.6	*in vitro* seed germination	Table 14.1; Arditti, 1992
Paphiopedilum	5.5 to 6.5	*in situ* in media	Table 14.3; Arditti, 1992
Cattleya	4.0	*in situ* in media	Table 14.3; Arditti, 1992
Cymbidium	5.0	*in situ* in media	Table 14.3; Arditti, 1992
Cymbidium	6.0 to 6.5	*in situ* in media (Dos Pueblos Orchid Co.)	Withner, 1959
Phalaenopsis	4.7	*in situ* in media	Table 14.3; Arditti, 1992
Phalaenopsis	4.4 to 4.6	Better seed pod growth in hydroponics	Withner, 1959
Phalaenopsis	4.8 to 5.0	Better flower production in hydroponics	Withner, 1959

Table 1: Preferred pH of some orchids for *in vitro* seed germination and *in situ* growth in media or the wild.

tivation and *in situ* in the wild. With all these somewhat conflicting results, just how critical is pH for the growing orchid? It certainly appears that many orchids prefer media with an acidic pH, perhaps near 5.5 to 6.5. However many genera may be able to tolerate a much wider pH range that many growers are prepared to admit.

pH and nutrient availability

There is a well-known relationship between pH and the availability of elemental mineral nutrients in a soil, or an aqueous solution, or an orchid potting medium (Figure 1). Yes, pH does affect the availability of mineral elements from fertilisers. But it is the interpretation of the graphs in Figure 1 that needs to be understood in order to answer the question of "how pH affects nutrient supply and the correct pH for orchid culture". In Figure 1, consider the phosphorus (P) data. Thus, at pHs below about 6.5 and between about 8.0 and 8.5, there is a lower percentage of the total P that is available for plant uptake. Between about pH 6.5 to 8.0 and above about pH 8.5, the percentage of the total P that is available is at its maximum.

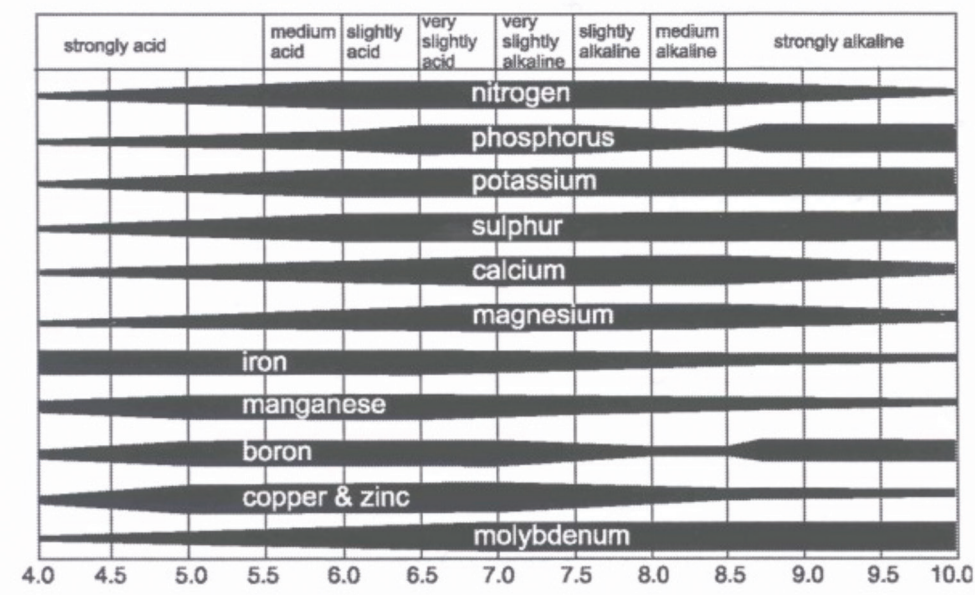
In so far as an orchid or any plant is concerned, it is not the percentage of the total P that is available that is important. Rather, it is how much P or the total amount of P that is important, in terms of grams or milligrams of P. For example, should the amount of P (i.e. mg of P) between pH 7.0 to 7.5 be less than what the orchid requires for good growth, it does not matter if all of the P is available at this pH, the plant will still not grow well. Likewise, at pH 5.0, when only about 25% of the total P may be available, if that amount of P is more than the orchid needs for good growth, the plant will be well grown.

Readers seeking a comprehensive and no-nonsense explanation of this effect and

why it has little practical significance for growing orchids are directed to the following URL from First Rays Orchids: http://firstrays.com/free-information/feeding-and-watering/fertilizer-information/ph-nutrient-availability/.

Perhaps the take home message is that while orchids, in general, prefer a slightly acidic pH, they may be able to tolerate a wider pH range in the potting medium provided that the amount of mineral nutrients in the fertiliser solutions (i.e. mg of element) is above what they need for good growth.

Figure 1: Effect of soil pH on nutrient availability: the width of each bar indicates the percentage of the total element that is available.
(From: http://www.avocadosource.com/tools/FertCalc_files/pH.htm)



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References:

Arditti, J. (1992). *Fundamentals of Orchid Biology* (Chapter 14: Ecology; Table 14-1 and Table 14-3, p. 591-592); John Wylie & Sons, New York.

Withner, C.L. (1959); *Orchid Physiology*; pp. 315-360; Tables 8.5; 8.6; 8.7; In: *The Orchids: A Scientific Survey*; The Ronald Press Co., New York. Ed. Carl. L. Withner (1959).