

# Dialogues with Hugh: No. 5:

## Water First or Fertilise First?

*Dr Noel Grundon FAOC*

A dialogue is a conversation between two or more people. I am therefore pleased that the next two “Dialogues with Hugh” are in response to conversations with readers, that is “Dialogues with You”.

When I began growing orchids in the 1960’s as a raw beginner, the expert’s advice on watering and fertilising orchids in all orchid journals was to water your orchids first before applying any fertilisers. Over the intervening 50-odd years, that advice is still the one most commonly given to new growers. But as I came to know about the structure of orchid roots, and to observe the changes in the appearance of orchid roots growing on tree trunks as the first streams of rainwater flowed over them, I began to wonder if that advice made sense.

Surely those first streams of rainwater flowing down the tree trunk were the most heavily charged with dissolved nutrients from the supporting tree branches or organic materials on the trunk and branches? Surely the first streams of water would enter the orchid roots first? Surely the later streams of water would contain lower concentrations of dissolved nutrients? Could the later streams of water replace those first streams, and if they could replace them, would they wash out the high concentrations of nutrients in the first streams?

Could the advice of “Water first and fertilise second” be a **fact?**, or a **fable?**, or a **furphy?**

For years my search of orchid literature could not provide any definitive study into the rate of water and nutrient uptake by orchid roots that would provide an answer to the question -- “Water first or fertilise first?”. Re-

cently, in the newsletter of the Orchid Species Society of Victoria Inc., I noticed comment on an article by Gerhard Zotz and Arne Winkler (Zotz and Winkler, 2013) that might provide many answers. This article examined the role of the velamen, the outermost layer of the orchid root, in the uptake of water and mineral nutrients.

### *Structure of the root of epiphytic orchids*

Roots of terrestrial orchids have a similar structure or anatomy to those of other plants such as lilies, whereas those of epiphytic orchid species (and their hybrids) have a very different anatomy (Arditti, 1992). A characteristic typical of the roots of epiphytic orchids is the velamen, which is the outermost layer of the root, silvery-white to pale grey in colour when dry and greenish-white to dark grey in colour when wet. At maturity, the cells of the velamen are no longer alive and function as protective tissue. Inside the velamen are the live cells of the cortex, and inside them are the live cells of the stele. The stele contains the phloem cells that perform two-way transfer of organic materials from the roots to the stems and vice versa, and the xylem cells that perform one-way transfer of water and dissolved nutrients from the roots to the stem, leaves, flowers, and fruit. Arditti (1992) provides many cross-sectional views of the root structure of a number of orchid species for readers wanting further information.

### *Uptake and loss of water by the velamen of epiphytic orchids*

It had been suggested in 1940 by F.C. Wendt, cited by Zotz and Winkler, that the

dead cells of the velamen act to trap the first relatively nutrient-rich flush during a rainfall event. While others had made similar claims, data on the role of the velamen in the actual uptake of water, and any dissolved mineral nutrients, were unusually limited.

Zotz and Winkler used 11 orchids [*Miltonia x bluntii*, *Caularthron bilamellatum*, *Phalaenopsis* hybrid, *Oncidium ramosum* (Syn. *Gomesa ramosa*), *Dendrobium ochraceum*, *Dendrobium fimbriatum*, *Cattleya* (Syn. *Guarianthe*) *skinneri* f. *alba*, *Oncidium enderianum* (Syn. *Gomesa enderianum*), *Bifrenaria tyrianthina*, *Doritaenopsis* (Syn. *Phalaenopsis*) 'Malibu Queen'] to examine the uptake of water by velamen. They found that dry velamen filled very fast with water. After 15 seconds it was 82% saturated, and fully saturated after 1 minute. Water loss from fully saturated velamen was slow, and the velamen retained water for more than 1 hour in most tested orchids when they were grown in a greenhouse in conditions resembling those of tropical lowlands.

#### ***Uptake and loss of mineral nutrients by the velamen of epiphytic orchids***

Only one orchid, *Phalaenopsis*, was used to study the uptake of radioactive phosphate and radioactive rubidium (in nutrient uptake studies,  $Rb^+$  is an analogue for uptake of potassium). Rapid uptake occurred of phosphate and rubidium dissolved in the water in the velamen. This absorption occurred almost equally throughout the entire length of the root from the root tip to the root base. Radioactive phosphate added to the root tip was detected 5 cm further down the root after 2.5 hours, and in the stem after more than 8 hours. However, no comments were made about the possibility that freshly applied water would leach mineral nutrients from velamen saturated with water and mineral nutrients before the mineral nutrients could be moved into the stem.

#### ***The take home messages***

I am indebted to an anonymous member of the Orchid Species Society of Victoria Inc. for the following three take home messages (OSSV, 2015):

1. When watering, the roots of your mounted epiphytic orchids will be 80% saturated with water within 15 seconds and 100% saturated within 60 seconds. You don't need to water excessively to maximise your plants uptake of water, thus saving water.

2. Water evaporates slowly from the velamen. Thus if you have an automated watering system or misting system bear this in mind when setting the timer.

3. The velamen is a wonderful storage system for positively charged ions such as ammonium, many phosphates and trace elements thus supporting the proposal to fertilise with weak solutions. [Correction: A number of mineral nutrients including nitrates, phosphates, sulphates, borates, chlorides, and molybdates are negatively charged ions (Grundon, 2016). Fortunately, Zotz and Winkler used negatively charged phosphate and positively charged rubidium to show that the velamen can absorb and store ions of both electrical charge.: N. Grundon]

To these three messages, I would add two more:

4. "Water first and fertilise second", is it a **fact?**, or a **fable?**, or a **furphy?** Perhaps it is a furphy! If you wish to get mineral nutrients into the root, i.e. into the velamen, then fertilise first. Or better still, apply mineral nutrients with every watering as a weak solution of inorganic fertilisers.

5. Even if you employ the "weekly weakly" fertilising routine (i.e. fertilising each week with a weak solution of inorganic fertilisers), it is a good cultural practice to regularly flush the growing media, perhaps every 2 or 3 months, to remove any build-up of unused salts in the media.

**Dr Noel Grundon FAOC**

**References:**

- Arditti, J. (1992). *Fundamentals of Orchid Biology* (Chapter 8: Anatomy, p. 307-417); John Wiley & Sons, New York.
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- Zotz, G and Winkler, A. (2013). Aerial roots of epiphytic orchids: the velamen radicum and its role in water and nutrient uptake. *Oecologia* 171:733–741.

