Media Properties©

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INTRODUCTION

This is a "back-to-basics" talk. I will briefly highlight the most important properties that any growing medium must have. You must have quantitative data for these properties for any growing medium you use or are thinking of using. Time constraints do not permit me to discuss the properties flowability, bulk density, sulfur supply, potassium supply, salinity, and cost.

AIR-FILLED POROSITY AND WATER-HOLDING CAPACITY

Air-filled porosity (AFP) is defined as the percentage of a growing medium that is air space when that medium has just finished draining from saturation. This is the minimum amount of air space that the medium will have. As it dries, the percentage of air space increases.

The AFP of a medium cannot be altered during a growing season, so it is critically important that it is right before potting.

The AFP of a medium is a function of the height of the medium in its container. The taller the container, the higher is the air-filled porosity. For example, a medium that has an AFP of 15% in a container that is 12 cm high might be measured to have an AFP of 9% in a container that is 5 cm high. This effect of height must be kept in mind if you use the same medium in containers of different heights.

Mainly the proportion of fine particles in a medium controls air-filled porosity. The larger the proportion of fines, the lower the AFP (and the higher the water-holding capacity).

Almost every country has its own standard method for measuring AFP. In Europe, suction devices are used to extract water from the medium at 10-, 50-, and 100-cm water suction. Air-filled porosity is taken to be the air space at 10-cm suction. This is roughly equivalent to the air space when the medium is in a container 20 cm high. An advantage of suction devices is that they provide information about the water-supplying ability of the medium. The major disadvantage is that a determination takes something like 2 weeks. Many other countries use much quicker methods.

In Australia and New Zealand, we determine AFP in 12-cm-high containers. The number produced is directly applicable to 125 to 150 mm pots in which a majority of general plant lines are produced. A starting AFP in the range 15% to 30% is desirable. The lower end of the range is appropriate for most summer production and the upper end of the range is desirable in wet and cold climates. A reasonable compromise for crops that grow through several seasons is in the 20% to 25% range.

For those that grow in taller containers, choose a medium with an AFP in the 10% to 15% range as determined at 12 cm height.

Water-holding capacity decreases as AFP increases. If water-holding capacity must be maximized, to minimize irrigation frequency, the AFP of the medium will have to be at the lower end of the acceptable range. Water-holding capacity can be increased with minimal effect on AFP by including materials in the mix that hold much water within their particles. Coir fiber dust and peat are examples of such materials.

Many seedlings are produced in shallow containers. Because a high level of water supply is essential, AFP is generally rather lower than the ranges given above. In fact, for plugs, the AFP of the medium in the plugs is often less than 4%. Growth is possible only because oxygen can reach roots from both the top and bottom of the cells. More discussion and examples are given in Handreck and Black (2002).

WETTABILITY

Most of the organic materials that form the base of soilless potting mixes are either water-repellent as produced, or they develop water repellence (and hence poor wettability) during residence in containers. The simplest way to prevent the decreased plant growth that is often produced by poor wettability is to include in the mix a wetting agent of proven effectiveness and longevity. I regard such an inclusion to be essential for production during summer.

pH

This is another property that must be set before potting. It can be altered later if necessary, but at some cost and possible loss of production.

The optimum starting pH for most plants grown in nurseries is in the 5.5 to about 6.3 range (slightly acid). A starting pH for the so-called acid-loving plants can be in the range 5 to 5.5. Cuttings also root best in a medium with a pH in this range. Hydrangeas that are to have blue flowers require a medium that has a pH in the range about 4.8 to 5.1, and a source of aluminium. There is absolutely no need to grow plants that were native to calcareous (alkaline) soils in a soilless medium that is alkaline. These plants also grow best in such media at a pH of around 6. They must receive a continuing high supply of calcium.

Most of the organic components of the media used in Australian and New Zealand are initially acidic. Their pH must be raised during media production. Balance between calcium and magnesium is achieved by using a mixture of calcium carbonate and dolomite, or some other combination of calcium and magnesium liming materials.

Drift of pH to an unacceptable level during a growing period can be prevented through use of appropriate ratios of ammonium/urea and nitrate in the fertilizers used, with ammonium/urea decreasing pH and nitrate increasing pH. Correcting excessive acidity is achieved by topdressing with solid liming materials or drenching with preparations such as liquid dolomite. If medium pH has risen to above 6.5 (and is causing iron deficiency), switching to a highly acidifying fertilizer may lower it sufficiently, but if there has been much accumulation of lime in the mix (from irrigation water of high alkalinity) lowering pH is almost impossible. Sprays of iron chelates may help.

NUTRIENTS

Nitrogen Drawdown. Media that have wood wastes (bark, sawdusts, shredded green organics, coir fiber dust) as their main component are steadily decomposed in containers by microbial action. In using the carbon of the wastes, the microbes use soluble nitrogen (and phosphorus). They therefore compete with plants for these soluble nutrients. As most growers use more than enough phosphorus to satisfy both microbes and plants, nitrogen use by microbes (nitrogen drawdown) is the main concern.

Thoroughly composted and cured pine bark has a low level of nitrogen drawdown. Coir fiber dust and blond peat have a similarly low level. In contrast, lightly composted bark and some hardwood sawdusts can have a very high demand for nitrogen during the first couple of months after potting. Enough nitrogen must be supplied to satisfy both microbes and plants, otherwise the plants will not get enough for optimum growth rates.

A major problem in the past, and still sometimes now, has been marked variation in nitrogen drawdown between batches of medium. Unless the level of nitrogen drawdown is known before potting, it is not possible to supply the right amount of nitrogen to plants in successive batches of such variable medium. At least in the eastern and central states of Australia, such major variation is now largely a thing of the past as most media suppliers have learnt to consistently produce media based on composted pine bark with minimal variation in nitrogen drawdown.

The nitrogen drawdown index (NDI) test provides a rough measure of nitrogen drawdown in a medium at the time of testing. By itself, it does not provide information about the future movement in nitrogen drawdown. But coupled with information about the composting history of the bark and the percentage of wood in it, the NDI test can give reliable information as a basis for a fertilizer program.

Phosphorus Supply. The amount of phosphorus used by plants is generally between 0.12 and 0.18 of the amount of nitrogen they use. It is wasteful and potentially polluting to supply phosphorus at higher rates. In fact, flowering tends to be reduced if phosphorus supply is excessively high.

Additions of soluble phosphorus to soilless media before potting should generally not exceed the equivalent of 0.5 $kg \cdot m^{-3}$ of single superphosphate. Even with this amount, the first irrigation will probably leach a considerable proportion of it from the container. All that is necessary is a small amount to provide phosphorus that can be immediately contacted by roots as they grow into the medium.

A low supply of phosphorus (of the order of 0.07 of required N supply) is a powerful way of minimizing the stretching of seedlings and optimizing their production of roots.

Trace Elements. Two methods are available for supplying trace elements to plants in soilless media. One requires the addition to the medium itself of salts of trace elements in amounts that will supply enough of each to plants for at least 12 months. The other allows the ongoing fertilizer program to supply trace elements. Many growers, usually by default, use a combination of these two methods.

For crops that will reach saleable size within 12 months, it is entirely adequate to include all the trace elements in a pre-planting charge into the growing medium. There is no need to supply more later. A typical such charge of iron, copper, and zinc will in fact last for much longer than 12 months, because these nutrients are held fairly firmly by organic components of soilless media. So long as pH remains in the optimum range, they will remain available to plant roots. In contrast, manganese and boron are steadily leached from the medium under typical irrigation practice. The more acidic the medium, the faster will be the leaching. Re-application at around 12 months is recommended, unless analysis shows that this is not necessary. For these longer-term crops, use of a fertilizer that contains trace elements is the simplest way of ensuring continuing supply.

LITERATURE CITED

Handreck, K.A. and **N.D. Black.** 2002. Growing media for ornamental plants and turf. 3rd ed. University of New South Wales Press, Sydney, N.S.W.