The Nursery Papers

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Water retention efficiency of potting mixes

'Water retention efficiency' is the capacity of a potting mix to retain water from an overhead irrigation. This property influences nursery water consumption by determining how long pots must be irrigated to replace lost water. This *Nursery Paper* details the results of an Australia -wide survey on potting mixes and describes a simple procedure for nursery operators to do their own water retention efficiency testing.

Research, funded by the Nursery Industry Products Levy and Horticulture Australia Limited, indicates that the water retention efficiency (WRE) of commercially available potting mixes varies considerably.

The results suggest that the choice of potting mix can influence water consumption and the quantity of nutrient runoff produced from a sprinkler or drip irrigation.

Dr Geoff Cresswell carried out the research and developed a simple test for determining the WRE of a potting mix.

The problem

Overhead sprinkler irrigation is a relatively inefficient method of supplying water to potted plants.

Under normal circumstances, less than 25% of the water from a sprinkler is ultimately available to plant roots.

This is because more than 50% of the water falls on the ground between pots or on paths and other non-productive areas. A further 50% of the water entering the pot can also drain out of the pot before the next irrigation. With so much water missing the pot, the wastage increases the longer the irrigation is run. Mixes that take a long time to wet up add to the cost of production.

With this in mind, it may be cheaper to use a more expensive potting mix with better rewetting properties.

For more information on sprinkler layout and selection criteria, refer to The *Nursery Papers* 2000/10 and 2000/11.

The consequences

The low water application efficiency of sprinkler systems means that:

- Large volumes of irrigation water must be applied (at least four times the theoretical minimum).
- Drainage and storage systems must be constructed and maintained to collect the wastewater (runoff).
- Leaching losses from pots are high. This makes management of plant nutrition difficult, reduces the quality of recycled water and increases environmental problems.

The solution

There are three main ways of saving water where sprinklers are used.

1. Improved irrigation system design and operation. (More water reaching the pots more evenly).

2. Appropriate wastewater collection systems. (Less water lost in evaporation, runoff and deep drainage).

3. Improved potting mixes. (More of the water retained in the pot).

Strategies one and two above are well known to the industry and are addressed by the Waterwork courses and by publications such as 'Managing Water in Plant Nurseries' and the 'Nursery Industry Water Management Best Practice Guidelines'.

The water savings that can be obtained from using more water retentive media are less well understood. This is largely because there has not been an easy method of testing potting mixes for this property.

Potting mixes that save water

The volume of irrigation water used by a nursery is ultimately determined by how long it takes to rewet the potting mix. The quicker this can be done, the sooner the sprinklers can be turned off.

Reducing the length of the irrigation can produce significant water savings. For example, if a 30-minute irrigation can be shortened by 10 minutes, this will give approximately a 30% reduction in water use and an even larger decrease in runoff volume (up to 50%).

Can savings of this magnitude be obtained by using more water retentive media? Surveys of Australian potting mixes conducted in 1996 and 2001 suggest for many nurseries the answer may be yes.

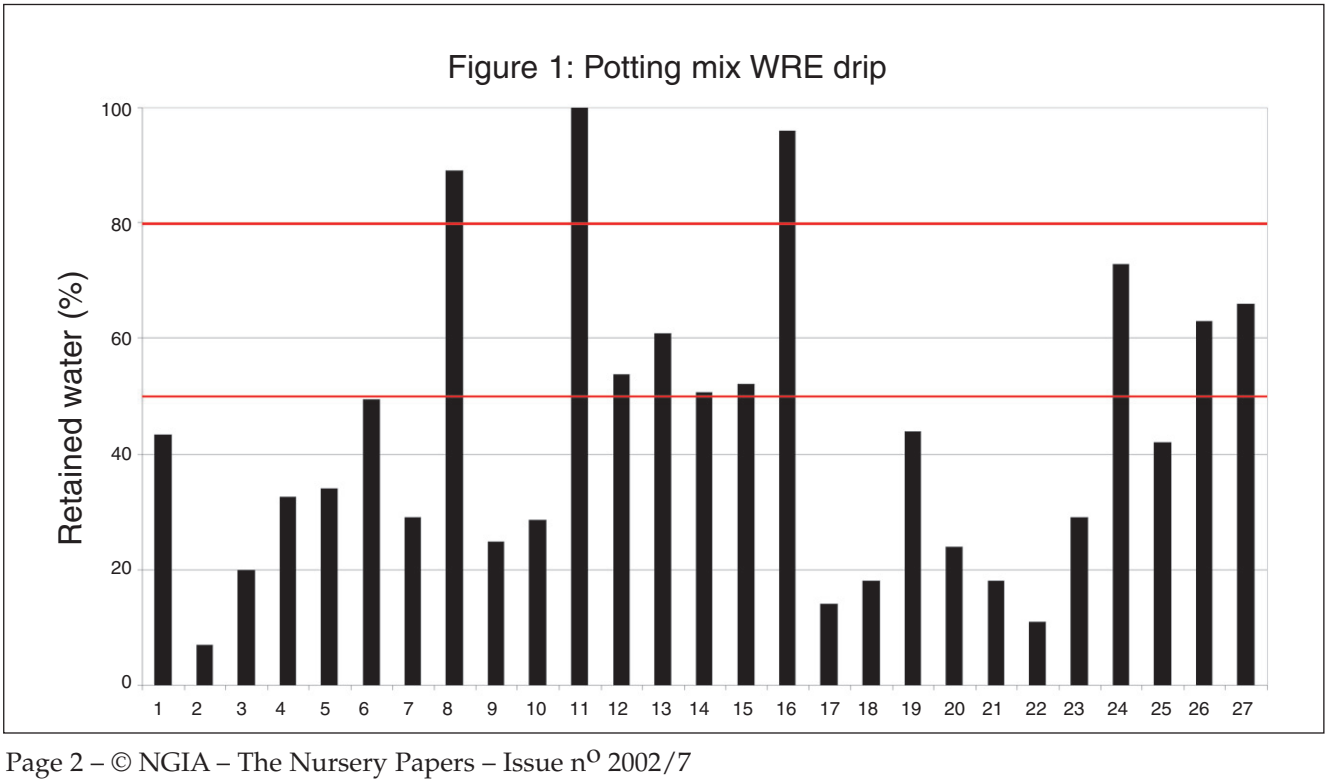
In these studies, WRE was determined by measuring the volume of water absorbed by a potting mix under standard conditions. A WRE of 100% indicates that all the water was retained in the mix. A WRE of 0% indicates that all the water drained from the mix.

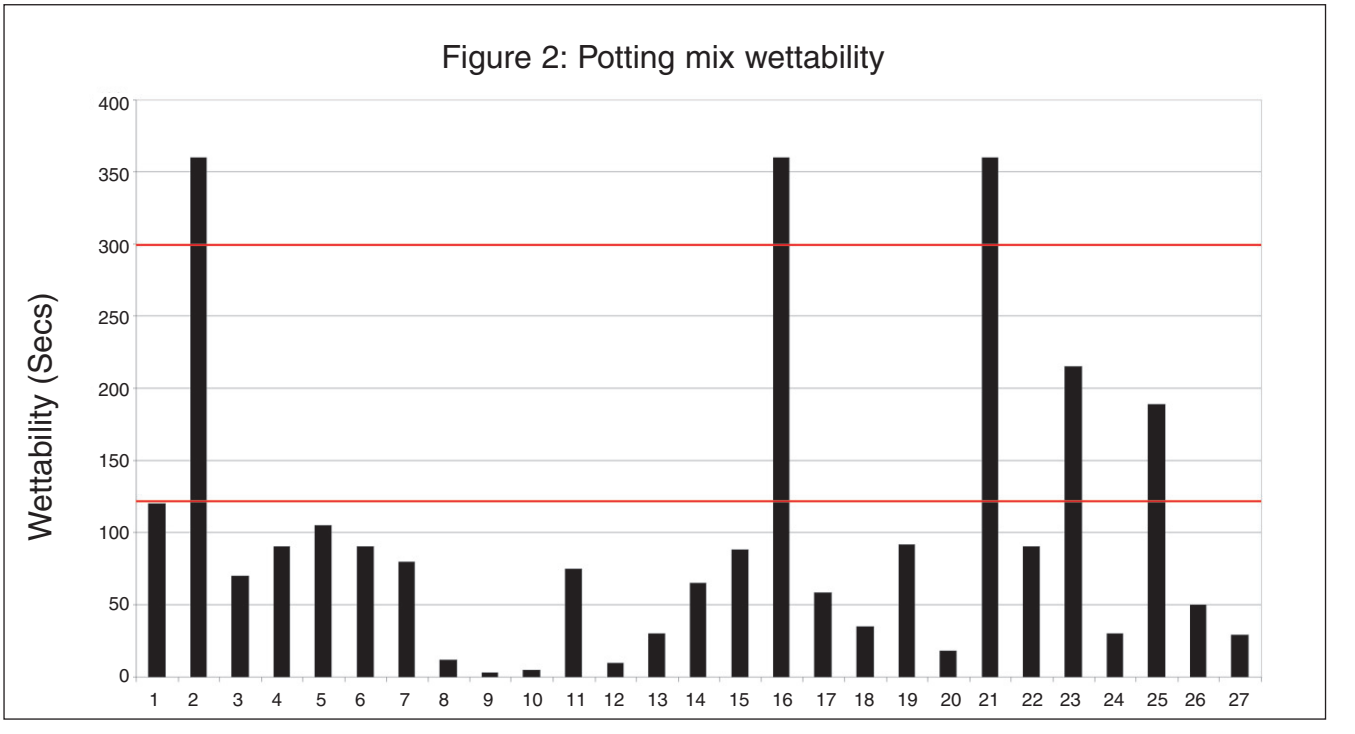
Large differences in WRE were observed between potting mixes. Of the 27 mixes tested, only 10 had a WRE over 50%. The three best mixes had a WRE better than 80% (only 20% of the applied water was lost as drainage).

The WRE of six of the mixes was <20% (more than 80% of the applied water was lost as drainage).

There can be little doubt that a nursery using a mix with a WRE <20% would make significant savings in water by switching to a mix with a WRE >80%.

But surely it is possible to pick the poorest mixes without testing? This does not seem to be the case, as





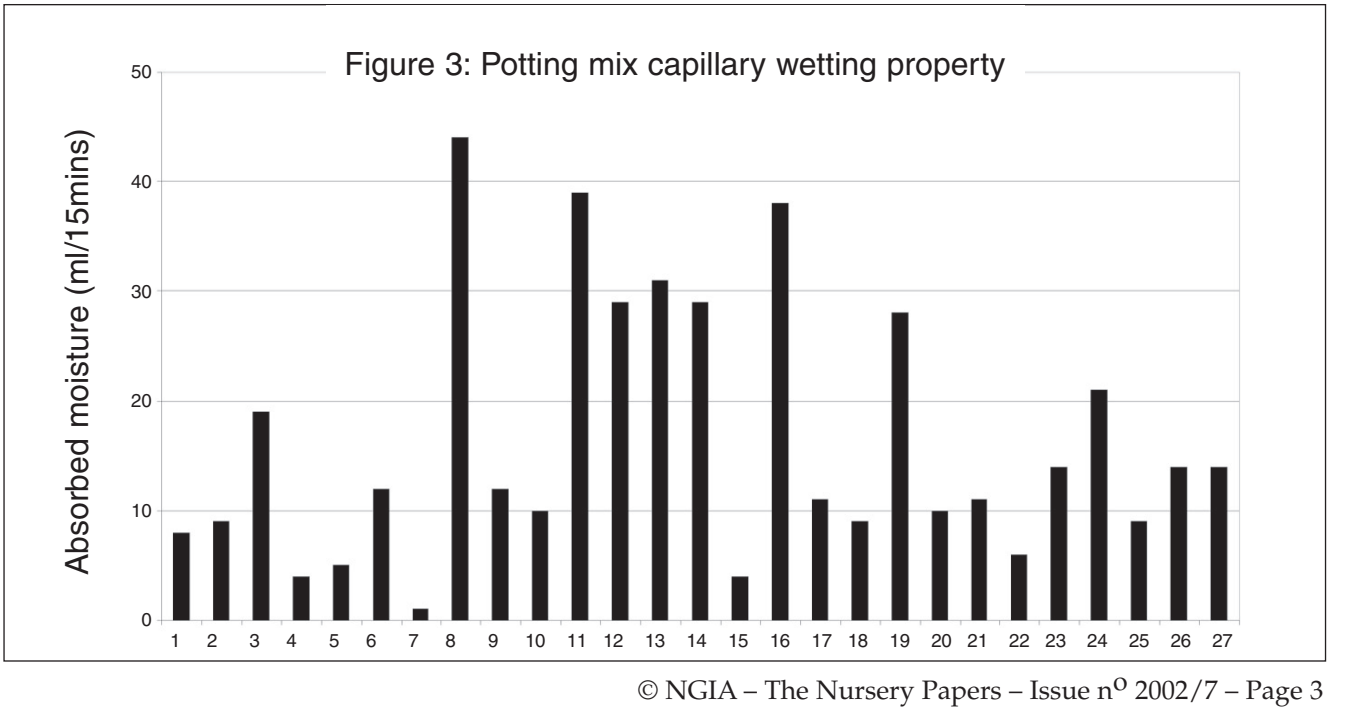
most of the surveyed mixes are standard commercial products and so are acceptable to the market.

The survey has shown that existing tests used for the Australian Potting Mix Standard such as wettability are of little value in identifying the best and worst mixes (Figure 2).

The relatively low WRE of many mixes was not due to poor wettability. Only five mixes failed to meet the wettability standard for a premium grade potting mix indicated by the lower red line in Figure 2. Three mixes did fail the standard for a general-purpose mix. One of these, mix 16, had the second highest WRE. In this case, the sample only became hydrophobic when it was oven dried for the wettability test.

A newly developed test for capillary wetting indicates that potting mixes also vary considerably in this property (Figure 3). Capillary processes are responsible for the wicking movement of moisture in mixes.

The property is particularly important when pots are subirrigated, which is becoming more common



A simple test for WRE

Materials required:

- A standard container made from a 135 millmetre length of 60 mm internal diameter PVC pipe. Cover one end with flyscreen mesh to retain the potting mix.
- A plastic funnel.
- A beaker or plastic cup. The opening should be large enough to accept the sample container.
- A measuring cylinder.

Preparing the potting mix:

1. Measure out 360 millilitres of moist potting mix.
2. Dry the potting mix (This can be done by spreading the material on a plastic sheet in the sun).
3. Spray the dry mix with 40 ml of fresh water and store in a sealed container over night shaking occasionally.

Testing the mix:

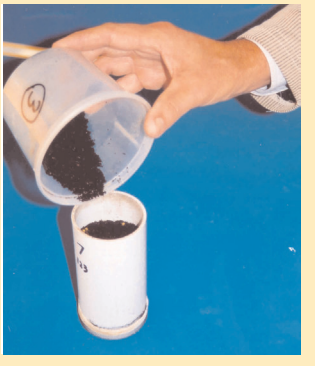
1. Pour the moist potting mix into the test container.
2. Drop the container three times onto a solid surface from a height of three centimetres to consolidate the mix. Carefully press down the surface of the mix to make the density more consistent with the remainder of the mix.
3. Place a tumbler under the test container to collect any leachate.
4. Using the funnel, apply 100 ml of distilled water to the surface of the mix. This should take about four seconds.
5. Allow the test vessel to drain for 15 minutes or until it has stopped dripping.
6. Measure the volume of leachate collected in the tumbler.

Calculating WRE:

WRE (%) = 100 – leachate volume (ml).

a) A standard container made from 135mm length of 60 mm internal diameter PVC pipe covered with a fly screen mesh to retain the potting mix.

b) 360 millilitres of previously dried potting mix being sprayed with 40 ml of fresh water.



c) After overnight storage and occasional shaking, the potting mix is poured into the standard container.

d) 100 ml of water is carefully applied to the potting mix and the plastic cup underneath the standard container catches all leachate.

because of the increased efficiency. Capillary wetting is also important when drip irrigation is used as it helps to spread the water through the mix. Without this property, only the mix directly under an emitter would be wet.

Benefits

Without a simple means of testing WRE, it is unreasonable to expect potting mix manufacturers to consistently produce water efficient media. A test for WRE therefore has implications both for the development of improved mixes and for the quality assurance of mixes generally.

Acknowledgements

This *Nursery Paper* was written by Dr Geoff Cresswell of Cresswell Horticultural Services.

The bottom line

Potting mixes can significantly influence water consumption and nutrient runoff, especially where sprinkler or drip irrigation is used. Switching to a high WRE potting mix is a relatively inexpensive means of improving water and fertiliser use efficiency.

For more information

The final report on this project will be available from Horticulture Australia Limited after June 2002, phone: (02) 8295 2300, and quote project NY00006.

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