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Developing a Low-Risk, Recyclable Cutting Medium©

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INTRODUCTION

Nonrenewable products such as perlite, sphagnum peat, and sand have been the mainstay of propagation media. Concerns about the long-term viability of their use, and the health risks associated with the use of perlite in particular, have prompted a search for alternatives by staff in the nursery at the Australian National Botanic Gardens (ANBG).

The ANBG nursery has used a combination of a coarse grade of perlite (P500) and coir (fine grade) (5 : 1, v/v) as a cutting propagation medium since 1990. Coir is a renewable resource and has the added advantage of being easy to rewet, unlike sphagnum peat. This combination has all the right characteristics for promoting root growth on cuttings of the wide range of Australian plants propagated by the nursery each year.

In January 2006, pine bark and rice hulls were identified as potential ingredients that are inexpensive, safe to use, and made from renewable resources and that might be suitable for substituting for perlite.

WHAT IS PERLITE AND WHY IS THERE A PROBLEM?

Perlite is a porous siliceous material produced by heating a natural volcanic glass to 1200 °C (Handreck and Black, 2005), which makes it expand to form small, almost weightless, bubbles. It is classified as chemically inert and has a pH of approximately 7. Perlite is easily crushed, and as a result there is always dust present when the product is dry.

Nursery staff are required to wear dust masks and goggles when handling dry perlite. In theory the key to safe handling is to keep the perlite damp at all times. However, because it is so light weight, it is easy to spill, it blows around freely, it is easily washed out of pots and punnets, and when it gets on to floors it is easily crushed and becomes part of the dust.

Although not classified as hazardous in the Material Safety Data Sheets supplied by manufacturers, it is suggested that for safe use when handling to:

- Do not breathe the dust.
- Use only in well ventilated areas.
- Keep container in a well ventilated place.
- Immediately remove all contaminated clothing.

Acute health effects may be abrasion and mild discomfort to the eyes, and if inhaled, it may cause discomfort to the upper respiratory tract.

In the nursery at the ANBG, all used perlite is collected in plastic garbage bags, kept moist, and disposed of in a hopper, which is sent to the landfill.

INVESTIGATING OTHER MEDIA OPTIONS

In early 2006 it was decided to try and find out if there were other products that could be used as a substitute for perlite, either individually or in combination, while continuing to use coir as the water-holding portion of the medium.

The criteria used to identify suitable ingredients were:

- Suitability for propagating plants (i.e., has no toxic residues/phytotoxic characteristics).
- An air-filled porosity between 25%–40%.
- An ability to hold sufficient water to maintain turgidity in cuttings until roots form, and be easily wet and re-wet.
- Ready availability.
- Be a renewable resource.
- Sterile, or able to be pasteurised/sterilised (all cutting media are steam sterilised in the ANBG nursery).
- Be nontoxic and able to be handled safely.

The two products identified were pine bark and rice hulls, which were being used for other purposes within the nursery. The pine bark (5–8 mm) was a high quality composted product originally purchased for orchid mixes, and the rice hulls had been purchased as a bulking agent for use with the nursery's composting toilet. Both products are nontoxic and could be handled safely, although it was necessary to wear a dusk mask when removing the rice hulls from the bag. Manganese toxicity has been identified as a possible problem with the use of rice hulls at a pH of less than 5, but this was not going to be an issue in our situation.

Pine Bark and Rice Hulls in Cutting Media. Both products have been used extensively in potting media. A literature search produced evidence suggesting that pine bark and rice hulls could be used successfully as a cutting medium as well (Gordon, 1992; Evans, 2004). Rice hulls are known to break down very slowly, hold little water, and improve aeration (Handreck and Black, 2005). Pine bark had been used as a principal ingredient for cutting media in some horticultural training institutions in Victoria, Australia, because of concerns posed by the health risks associated with the use of perlite.

Testing and Uniformity. Air-filled porosity tests were carried out on: perlite (P500), pine bark (*Pinus radiata* composted 5–8 mm), and rice hulls (fresh) individually and combinations of pine bark and rice hulls with coir (fine grade). All four products appeared to be quite uniform.

Air-filled porosity tests were all carried out using the basic method set out in Handreck and Black (2005), and the cutting punnet (85 mm high × 95 mm^2 top tapered to 70 mm^2 base with a volume of 540 ml) used in the ANBG nursery for all cutting propagation.

Results of air-filled porosity tests:

- Perlite (P500) = at least 49%
- Perlite (P500)/Coir (5 : 1, v/v) = 37%
- Pine bark (*Pinus radiata* composted 5–8 mm) = 34%
- Rice hulls = 46%
- Rice hulls/coir (5 : 1, v/v) = 50%
- Rice hulls/coir (5 : 2, v/v) = 47%

CUTTING TRIALS/COMPARISONS

Each year, the ANBG nursery propagates over 500 Australian plant taxa to maintain in ground and potted collections. In March 2006, nursery staff started a propagation trial to test the alternative cutting media — initially with pine bark and

later with a combination of rice hulls and coir. In each case, where sufficient cuttings were available, half of the cuttings were placed in punnets containing pine bark and the other half in punnets containing perlite (P500)/coir (5 : 1, v/v) using the perlite/coir as a control.

Perlite/Coir and Pine Bark.

Results.
Between March and July 2006, cutting trial trials were carried out on 216 taxa.
Taxa where cuttings rooted:

- Perlite/coir (5 : 1, v/v) = 204.
- Pine bark = 164.

Comments/Discussion

- Whereas cuttings rooted in both media in most cases, more cuttings rooted in the perlite/coir medium.

Comparisons.

- The pine bark medium had to be watered more frequently.
- It was difficult to insert the cuttings in the pine bark medium, especially when the cuttings had soft stems.
- Cuttings stuck in the pine bark were often slow to strike in comparison to the perlite/coir media.

Conclusions.
The difficulty in inserting the cuttings into the media was identified as a major drawback; however the cuttings that developed roots had grown on well, and the media was thought to be suitable for propagating a wide range of taxa.

Perlite/Coir and Rice Hulls/Coir. Perlite (49%) and rice hulls (46%) had similar air-filled porosities, and therefore it was assumed that rice hulls could be substituted for perlite at a ratio of (5 : 1, v/v) with coir. However, the initial trial with rice hulls/coir (5 : 1, v/v) proved to be too open, and the cuttings desiccated within a couple of days of sticking. The addition of more coir bringing the ratio of rice hulls and coir to (5 : 2, v/v) was found to be sufficient to prevent desiccation.

Results. Between July and Sept. 2006, 84 taxa were propagated using perlite/coir (5 : 1, v/v) and rice hulls/coir (5 : 2, v/v).
Taxa where cuttings rooted:

- Perlite/coir (5 : 1, v/v) = 70.
- Rice hulls/coir (5 : 2, v/v) = 64.

Comments/Discussion.

- Overall, more cuttings rooted and in a wider range of taxa in the perlite/coir medium, but in most cases cuttings struck equally in both media.

Comparisons.

- Cuttings in the rice hulls/coir media generally rooted more quickly.
- Ease/difficulty of insertion of cuttings was rated equally between the two media.
- The rice hulls/coir media needed to be watered more often.

Conclusions. The rice hulls and coir (5 : 2, v/v) medium was thought to be very suitable, although with an air-filled porosity of 47% it required more regular watering than the perlite and coir mix (5 : 1, v/v).

OVERALL CONCLUSIONS

- Both pine bark and rice hulls in combination with coir were found to be suitable for propagating a wide range of Australian plants.
- Pine bark and rice hulls/coir could be safely handled and recycled through composting systems.

The results of the cutting trials carried out during Year 2006 suggest that the combination perlite and coir mix (5 : 1, v/v) is still better than either of the two "organic" combinations tried so far. However, the combined issues of management of the dust and disposal of used media make the use of perlite a far less attractive option. As a result, ANBG nursery staff will continue to trial different combinations of pine bark, rice hulls, and coir and only use the perlite and coir medium for difficult-to-root taxa.

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