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HORTICULTURAL ROCKWOOL AND DIATOMACEOUS EARTH IN PLANT PRODUCTION SYSTEMS

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Containerised plants were traditionally propagated and grown in soil-based media but there has been a major shift towards soilless media in the last 30 years. Peat, sawdust, pinebark, sand, vermiculite, and perlite are all used in a variety of mixes but the search for suitable ingredients continues. This paper deals with developments in the use of horticultural rockwool and diatomaceous earth as components of plant production systems.

HORTICULTURAL ROCKWOOL

This material was developed in Denmark in the late 1960's and has been used increasingly in Europe since the mid-1970's where the major usage is for growing greenhouse vegetables and flowers. Some use is made of rockwool for plant propagation in Europe but usually for plants which are subsequently grown on in a complete rockwool system.

Horticultural rockwool was not released onto the Australian market until 1982 and the material has mainly been used in plant propagation—particularly of Australian native plants—although some rockwool systems for cut flowers have been developed.

Biggs (1) described the manufacture and properties of horticul-

tural rockwool in 1982 and there is now a great deal of Australian industry experience with the material.

Blocks of various sizes are used for propagating a wide range of plants.

Propagation applications. It is important to understand the typical Australian nursery techniques which rockwool could replace. Cuttings are usually propagated under mist in sand-based media in trays or individual propagation tubes. Rooted cuttings are then potted into their final containers.

Initial commercial scale nursery propagation in rockwool was done where propagators were having problems either with striking or potting on. Examples of these were *Grevillea* 'Robyn Gordon' and miniature roses. Root production was very good in horticultural rockwool and losses after potting on were reduced to effectively zero although *Grevillea* 'Robyn Gordon' required careful management of the water content in the blocks.

The propagation of many Australian native plants at first had only mixed success as these plants require a well aerated rooting medium. Rockwool has very different properties from traditional media and requires different management techniques to ensure optimum plant growth. Waterlogging of the propagation blocks can be a real problem if traditional watering strategies are used and taller blocks were introduced to provide a more aerated environment.

Although the initial incentive for using rockwool propagation blocks was to solve problems, some propagators have looked upon the technique as a completely different propagation system and have modified their production systems to accommodate plants propagated in a different way.

It is now almost 4 years since horticultural rockwool was first used in Australian nurseries. Several hundred different plant species have been successfully propagated in a range of block sizes. The range of plants grown extends over flowers, indoor plants, vegetables, trees, shrubs, and Australian natives. Propagation has been initiated from a range of seeds, seedlings, tissue-cultured plantlets, hardwood and softwood cuttings.

Principles for successful use of rockwool for propagation.

- It is important to select the appropriate block size for the subject being propagated.
- Sheets of blocks which are to be moved for potting on should be supported in a seed tray.
- Blocks must be thoroughly wet before use. Complete wetting takes more water than anticipated.
- Rockwool is initially sterile but can easily be contaminated especially with diseases, unless rigorous hygiene measures are used.

- Insert cuttings only as far as necessary for support. Pushing them in too far places the bases of cuttings in a zone of lower air content.
- If liquid feeding is required then a complete feed including trace elements must be used. Normally plants are not fed before they have rooted but if nutrients are required from the start, e.g. with tissue-cultured plantlets, then the pH of the solution used for wetting the blocks should be lowered to counter the initial alkaline reaction. With rooted cuttings that have small roots it is advisable to water with nutrient solution before potting-on so that roots are encouraged to grow out into the potting medium.
- Control the water content (and hence air content) to a suitable percentage for the particular subject. Block height, depth of insertion of the cutting, drainage characteristics of the supporting surface on which the blocks stand, the method and frequency of watering—these all influence the water:air ratio.
- Consider and allow for the influence of the propagation system and environment on the blocks. Australian propagators have used rockwool blocks successfully in closed tents, misted tents, open bench systems, heated and unheated beds. Different systems have different effects on the behaviour of the blocks, e.g. heavy misting can cause disastrous waterlogging while open, heated benches increase evaporative drying.
- Pot up the cuttings as soon as roots emerge from the base of the block. This takes full advantage of the beneficial properties of the material and avoids the problem of roots growing into adjacent blocks. The simplest technique for separation is to split off a long row of blocks from the sheet and then tear off the individual blocks (similar to separating postage stamps.)
- When converting from another propagating medium to rockwool it is vitally important to recognise differences and to allow for them. For example, a recipe for failure would be to push water sensitive cuttings through to the bottom of blocks, place the blocks on a non-draining surface and then apply frequent, heavy mist.

Burton (2) and Donnan and Biggs (3) have reported propagation details for cuttings rooted in rockwool compared with 50:50 peat:perlite mixes while Ellyard, Ollerenshaw and Hadobas (4) have studied the medium specifically with Australian native plants. There is good evidence to suggest that cuttings in rockwool blocks produce roots more rapidly and can be potted at a very early stage.

Cuttings rooted in tubes using traditional flowable media need to produce roots systems sufficient to bind the medium together before they can be potted.

Drawbacks to using rockwool propagating blocks.

- Some cuttings are too large and the propagation blocks split when the cuttings are inserted. Making a larger hole with a dibber stick before inserting the cuttings can help with these subjects.
- Propagating blocks are rarely suitable for holding plants for extended periods once they have rooted. Roots of plants which are fed regularly after rooting will soon grow into adjacent blocks. This makes it difficult to separate plants without tearing roots. Plants held for long periods tend to damp-off. Rockwool provides optimum benefits when cuttings are potted soon after rooting.
- Potting rockwool blocks into well-drained media can cause problems unless the medium is kept moist until roots have grown out into it.

There is probably a greater use in Australia of horticultural rockwool for ornamental plant propagation than anywhere else in the world. It has proved particularly useful in situations where propagators have experienced problems with "difficult-to-root" subjects but there are instances (2) where whole propagation systems have been re-structured following the introduction of rock-wool. There is great potential with the material for the propagation of plants for export to countries where organic based media are unacceptable. Horticultural rockwool is another resource in the tool kit of today's plant propagator.

DIATOMITE

Diatomite is a sedimentary rock which consists of the siliceous skeletal remains of tiny freshwater or marine animals called diatoms. When the animals died the skeletons sank to the sea or freshwater lake floor where very thick deposits gradually accumulated. Geological movements have relocated the deposits into land situations from where the diatomite can be mined. The deposits are up to 100 million years old. The major uses of diatomite are for swimming pool filters, as pet litter, as a carrier for pesticides, in dust formulations, and as an absorbent to soak up oil and other chemical spillages.

There is a large diatomite deposit at Barraba in northern New South Wales, Australia, and recent research has been directed at determining the suitability of the material when used in seedling and potting mixes. Trials compared the performance of diatomite as mined (raw ore fines) with calcined material produced by passing the raw ore fines through a coal-fired rotary kiln.

Seedling trials. Mixes with varying percentages of diatomite (two grades), peat, and vermiculite were compared with a 50:50 peat:vermiculite control for the germination and early growth of tomato and onion seeds. No significant differences were detected between seedling emergence and growth in any of the mixes. Growth was quite acceptable in mixes containing 50% by volume of either grade of diatomite.

Flowering pot plant trial. Marigolds were used as the test plant in a trial where diatomite was used in the potting mixes in conjunction with peat and vermiculite. Up to 50% of either raw ore fines or calcined diatomite was used in the mixes. Growth of the marigolds was commercially acceptable in all mixes but the best results were obtained in mixes containing the raw ore fines material. This is thought to be due to the fact that the untreated mined diatomite from Barraba contains 30 to 40% clay (kaolinite and halloyrite) which provides cation exchange capacity not exhibited by the calcined product.

Australian natives trial. Four Australian native plants were grown in two commercial potting mixes which were supplemented with 25% and 50% of two grades of diatomite. The plants used were *Callistemon* 'Kings Park Special', *Melaleuca armillaris*, *Grevillea obtusifolia*, and *Grevillea* 'Ivanhoe'.

Most plants grew at least as well in the mixes containing diatomite as in the straight commercial mixes. The exception was *Grevillea* 'Ivanhoe' which reacted extremely unfavourably in mixes containing 50% of the raw ore fines grade of diatomite.

Plant growth was best in mixes which contained calcined diatomite. The large calcined particles remained discrete throughout the trial and improved the drainage and aeration characteristics of the mixes. The raw ore fines product with the high clay fraction reduced water infiltration rate, drainage, and aeration.

Table 1. Plant height (cm) 6 months after potting.

	Mix 1					Mix 2				
	Neat	25% diatomite		50% diatomite		Neat	25% diatomite		50% diatomite	
Plant		calc[1]	rof[2]	calc[1]	rof[2]		calc[1]	rof[2]	calc[1]	rof[2]
Callistemon 'Kings Park Special'	39.50	62.00	57.00	67.00	49.00	71.00	67.00	60.00	72.00	64.00
Melaleuca armillaris	69.50	95.00	88.00	97.00	84.00	105.50	105.00	97.00	111.00	92.00
Grevillea 'Ivanhoe'	77.00	87.00	79.00	87.00	43.00	87.50	79.00	64.00	86.00	45.00
Grevillea obtusifolia	—	—	—	—	—	—	—	—	—	—

[1]Calcined diatomite
[2]Raw ore fines

Plant heights and dry weights 6 months after potting tube stock into the mixes are shown in Tables 1 and 2.

Results with Australian freshwater deposits of diatomite indicate that it can be incorporated up to 50% by volume into seedling and potting mixes. Vegetable seedlings and flowering marigolds performed well in all mixes but specific responses were detected with Australian natives. Further trials are being undertaken to see if preferential patterns can be determined.

Table 2. Shoot dry weight (g) 6 months after potting.

	Mix 1					Mix 2				
	Neat	25% diatomite		50% diatomite		Neat	25% diatomite		50% diatomite	
Plant		calc[1]	rof[2]	calc[1]	rof[2]		calc[1]	rof[2]	calc[1]	rof[2]
Callistemon 'King Park Special'	17.40	33.20	30.13	36.90	28.90	31.23	32.28	24.38	40.23	33.10
Melaleuca armillaris	30.90	51.13	37.98	57.08	42.50	46.26	54.03	42.58	50.36	39.65
Grevillea 'Ivanhoe'	38.44	48.70	42.76	58.35	10.50	41.75	46.83	47.95	49.16	16.30
Grevillea obtusifolia	19.78	25.68	24.00	27.98	25.73	24.00	25.95	21.45	17.50	died

[1]Calcined diatomite
[2]Raw ore fines

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