HORTICULTURAL ROCKWOOL AS A PROPAGATION MEDIUM

TONY BIGGS

Horticulture Centre, Hawkesbury Agricultural College
Richmond, New South Wales 2753

The following are important desirable characteristics of propagation media:

— The necessary physical consistency to support seeds during germination and cuttings during rooting.
— Freedom from pathogens and other harmful organisms.
— The ability to retain and release sufficient moisture for germination, rooting and, possibly, subsequent growth.
— Good drainage to prevent waterlogging and allow the presence of sufficient air for optimum root growth.
— Ease and low cost of preparation.
— Absence of chemical reactions which are deleterious to plant growth, e.g. very low or high pH values, and high salinity values.
— Presence of nutrients if seedlings or rooted cuttings are to be retained in the medium.
— Consistency from batch to batch.

Many characteristics are inter-related. Air and water retention properties are closely related and greatly influenced by the physical composition of the medium. Ease and cost of preparation; consistency from batch to batch and freedom from pathogens will all have a great influence on the overall cost of the medium. Other characteristics may be desirable and it is unlikely that any medium will be perfect in all respects. Compromises are needed depending on local conditions and situations.

The manufacture of rockwool. Rockwool has been produced as an acoustic and insulation material for about 50 years. The production technology has been modified but the end product has remained basically unchanged.

The raw materials are natural rocks such as basalt and limestone with metallurgical coke as fuel. The rocks and coke are weighed and fed into a type of blast furnace through which air is blown so that the coke burns.

At a temperature of approximately 1600°C the rocks melt producing a form of natural molten glass which is tapped off from the bottom of the furnace. A stream of molten rock is tapped from the furnace and flows onto a series of high speed rotors. These spin off molten droplets which lengthen into

fibres which are cooled by a blast of air. Chemical binder is sprayed into the air stream which also carries the fibres clear of the rotors and deposits them on a conveyor as a thick felt.

The felt is conveyed along a production line where it is pressed, hardened, trimmed and, finally, cut into slabs and packed. This is insulation rockwool — a sterile, firm, buff-coloured, fibrous felt.

Horticultural rockwool. Insulation rockwool — or fibre-glass for that matter — is useless for horticultural purposes. It is impossible to wet and does not have the correct physical properties. Several disappointments have occurred as a result of growers using ordinary insulation rockwool for horticultural purposes. Research into the manufacture and use of rockwool for horticultural purposes began in Denmark. The European material — "Grodan," (registered trade name of Grodania a/s, Hedehusene, Denmark) — has been in commercial use for over ten years. Currently it is largely used as blocks for plant propagation; in granulated form as an additive to potting mixtures and as wrapped cubes and slabs for soil-less production of a wide range of crops. Horticultural rockwool use in Denmark, the Netherlands and Britain has increased rapidly in recent years as peat quality and availability have decreased and soil pasteurisation/fumigation problems and costs have increased. Small quantities of the European material have been imported into Australia but the high volume : weight ratio makes large-scale shipment uneconomic. An Australian manufacturer of rockwool began trials nearly a year ago with a horticultural product and this material has recently been released onto the Australian market under the trade name "Growool," (registered trade name of C.S.R., Sydney, Australia.) Trial results have been very encouraging and comparable with the European product. Horticultural rockwool is different from other materials, however and — as such — requires a different approach. It has a number of potentially valuable uses in the Australian horticultural industry but the true value will only be realised if growers appreciate its place in the whole plant production system. Horticultural rockwool is a new product in the armory of Australian growers who must understand its properties and pay attention to the details necessary for successful use.

Properties of horticultural rockwool:

1. *Density*: Propagation blocks, wrapped cubes and growing slabs have a density of approximately 70kg/m^3. Consequently it is a very lightweight material. A carton containing 2240 propagation blocks weighs only about 10kg. Carefully monitored trials have been carried out with material of different densities. Lower densities are associated with

softer material which soon collapses during use while denser material is harder and more difficult for plant roots to penetrate.

2. *Sterility:* Horticultural rockwool is manufactured at 1600°C and, therefore, is free — in the first instance — from unwanted organisms. New material does not require pasteurisation or chemical fumigation and the propagation blocks, wrapped cubes and growing slabs are ready to use without any mixing.
3. *Reaction:* Fresh material produces a pH reading between 7.0 and 8.0 but it has no buffering capacity. Consequently it very quickly takes on the pH of any liquid (water or nutrient solution) with which it is watered.

   The pH has not caused problems in propagation provided the blocks are properly managed. An initial and thorough soaking in water is essential before sowing seed or inserting cuttings. The use of plain water is then perfectly acceptable during propagation until root development occurs when a dilute and complete nutrient solution must be used at every watering. Crops grown in wrapped cubes and growing slabs must be liquid fed continually.
4. *Cation exchange capacity:* Horticultural rockwool has virtually no cation exchange capacity and consequently there is no absorption or exchange of nutrient ions from solution. Thus it is necessary to liquid feed with a complete nutrient solution when plants are held in horticultural rockwool after propagation or when the material is used for hydroponic crop productin systems.
5. *Physical characteristics:* Freshly produced, dry horticultural rockwool has 3%-4% of the volume occupied by rockwool fibres. The remaining 96%-97% consists of trapped air which accounts for the value of basic rockwool for insulation purposes. The direction of fibre lay in the product influences behaviour. Propagation blocks and wrapped growing cubes have vertically oriented fibres which give physical strength and reduce the tendency to collapse. Growing slabs are sufficiently large (surface area and depth) that collapsing is not a problem.

   Root growth between adjacent propagation blocks was a problem since damage occurred when the blocks were separated. The problem has been reduced, however, by the machining of vertical air gaps around the blocks during fabrication. A hole is also formed in the centre of the top of each block to indicate where seeds, seedlings or cuttings should be inserted.
6. *Water-holding ability:* Dry horticultural rockwool has a very high percentage of air spaces which fill with water

when the material is immersed. A single sheet of propagation blocks measuring 266mm × 152mm × 40mm requires about 1.5 litres for saturation.

It is important that the initial wetting is completely uniform and it has been clearly demonstrated that immersion is the most satisfactory method of treating propagation blocks. Sheets of blocks must be placed in a container, e.g. a seed tray, for immersion since sheets of saturated blocks are very difficult to handle. Virtually all the water in the material is available to plants and this is an important difference between horticultural rockwool and the majority of other growing media.

The high percentage availability has a potential danger, however, since plants will change from turgid to wilted very rapidly when the water has all been taken up. Watering with small quantities at regular intervals is desirable and, once again, it is a question of growers becoming familiar with a different material.

Allowing the rockwool to dry out or liquid feeding with nutrient solutions which have high electrical conductivities can lead to an accumulation of soluble salts. Regular monitoring with an electrical conductivity meter will indicate the salt build-up which is easily leached out by applying ordinary water.

7. *Air:water characteristics*: These are important advantages of horticultural rockwool but careful management is required to maximise the benefits. Immersion of dry material results in all the air spaces being filled with water. Free drainage due to gravity occurs when the rockwool is placed on a non-absorbent surface and the material soon reaches field capacity. At this point the percentages of air and water depend on the thickness of the material. Thin material has a high percentage of spaces remaining full of water while thick material has a similar situation at the base but much more air at the top. Consequently we can expect a water-air gradient through the material since rockwool has poor capillary action. It is important to understand this gradient particularly when cuttings are inserted. Insertion too deep will put the cutting base into constantly wet conditions while shallow insertion can mean that insufficient water is available.

Propagators can also influence the waterholding — and, therefore, the air holding — capacity of the material by the type of surface on which the blocks stand. Absorbent or free draining surfaces, such as sand or perlite, produce drier conditions within the blocks and similar results occur

when the blocks are placed in slatted seed trays which allow free air movement below the material. Placing the blocks on non-absorbent surfaces, such as polyethylene sheeting, prevents water loss and keeps the material wet.

Misting propagation systems are often set to provide short bursts of water at frequent intervals. This can cause over-wetting of propagation blocks and result in plant losses. It is desirable to reduce the misting frequency unless the blocks are on a very free draining surface. Alternatively the blocks may be placed in a closed case or tent propagation system when misting is either non-existent or less frequent.

Consequently the propagator is able to influence the air: water ratio within the blocks according to the subject being propagated.

8. *Consistency of product:* Horticultural rockwool is manufactured by an industrial process with carefully controlled raw material inputs. Quality control testing of the product is standard procedure and specifications have been established which allow product consistency to be maintained. Consequently the grower knows how successive batches of the material are likely to perform.
9. *Degradation:* Rockwool is manufactured from rocks and degrades in exactly the same ways. It is, therefore, a natural material with a long life. It can be incorporated into outdoor soils or growing media for containerised plants when the improved aeration and drainage are often beneficial to growth.
10. *Suitability for a production systems approach:* Propagation blocks allow the propagated plants to be moved on with a minimum of root disturbance. A "pot into pot" system is possible when rockwool propagation blocks are placed into previously formed holes in growing cubes. Alternatively the block can be hand or machine potted on into a conventional potting mix.

Yet another approach is to grow plants from propagation through to harvest in a rockwool system. This technique is being used increasingly in Europe and forms the subject of another paper later in this Conference.

Using horticultural rockwool for propagation. Propagation blocks made from Australian horticultural rockwool are sold in sheets measuring 266mm × 152mm × 40mm. Each sheet comprises 28 blocks each measuring 38mm × 38mm × 40mm high. The blocks have vertically orientated rockwool fibres and are partially separated by vertical cuts which are to reduce the likelihood of roots growing from one block into the

next. A small hole on the top surface of each block indicates the centre.

The propagation blocks are suitable for direct seeding with large seeds such as cucumber, zucchini, melon, sweet corn, legumes, etc. Seedlings of tomato, capsicum, aubergine, lettuce, etc. can be pricked out into the blocks and grown on into young plants. A wide range of softwood and semi-hardwood cuttings have been successfully propagated in rockwool propagation blocks. Blocks may be used with either misting or closed case (polyethylene tent) systems of propagation. The system used will be governed by the plant subject being propagated. The water holding and drainage properties of the blocks are influenced by the type of propagation system and by the surface on which the blocks stand. Reference to these factors has already been made previously (Properties of horticultural rockwool).

The blocks must be thoroughly soaked before seeds, seedlings or cuttings are inserted. Sheets of blocks are easily handled in seed trays and a standard Australian tray holds 56 blocks (2 × 28 block sheets). The easiest way of saturating the blocks is to immerse them, in the trays, in a container of water or nutrient solution.

Soaking blocks with water is quite acceptable when cuttings are to be inserted since nutrients are not required until roots have formed. Blocks which are to be used for seed germination can also be soaked in water but liquid feeding is necessary once germination has occurred. When blocks are to receive pricked out seedlings they must be soaked initially in a complete nutrient solution.

Cuttings are easily inserted into the pre-punched holes. Seeds are inserted in the same way but there is every merit in germinating them before insertion. Larger holes are made either with an individual dibber or with a specially prepared multiple dibber board.

Cuttings root quickly and seedlings establish rapidly in rockwool propagation blocks. The young roots soon reach the outside of the block but the air gaps reduce rooting into adjacent blocks. Seedlings or cuttings propagated in rockwool blocks should be potted quickly and then will require little feeding in the blocks. Delays may occur, however, and plants must then be watered with a complete and balanced nutrient solution which contains all the necessary plant nutrients including micronutrients. During potting-on the individual rockwool blocks are torn away from the sheet. Separation of the blocks is easier when they are thoroughly wet.

Cuttings or seedlings are usually potted up into the usual

potting mix. Roots emerge readily from the rockwool blocks into all standard potting mixtures. Plants propagated in rockwool blocks may be hand potted or put through potting machines. Growers who use hydroponic systems may wish to put up the young plants into wrapped cubes which have previously cut holes for the purpose. Plants are then grown on in these cubes until they are set out in the hydroponic system.

A wide range of plants have been successfully propagated from either seed or cuttings in Australian horticultural rockwool. The material also shows promise as a medium in which to establish tissue cultured plants when they are taken out of the propagating flasks.

Interest has also been shown in using rockwool as a propagation and growing medium for plants which are intended for export to countries where the import of soil and similar growing media is not permitted.

INTRODUCING STUDENTS TO PLANT TISSUE CULTURE

ROSEMARY LEWIS

25 Brereton Street
Garran, A.C.T. 2605

I believe that tissue culture is something that is here to stay and something that all horticulturists should be aware of. So what are we doing about it in the classroom? Just that — making students aware of the benefits and the problems it presents and giving them an idea of the laboratory work involved.

We only have 4 hours in our curriculum allotted to this topic, and, because most of our students are not doing this type of work and laboratory techniques and hygiene are so important, I divide them into 2 hours each of theory and practical. Of course, there are students who do more practical work but this has to be apart from normal school hours.

The theory I tackle on a "what, when, why, who, and how basis."

The "WHAT," of course, covers not only a basic definition but also the fact that tissue culture is a term of convenience covering both techniques like, *in vitro*, micro-propagation, and mericloning, and also different parts of the plant — protoplast, cell, tissue and organ culture. I think it may be this rather loose descriptive term that causes some of the criticism — on the one hand it is praised as a marvelous method for the exact reproduction of clones (18); on the other, a scientist extolls it as a wonderful source of variation (8). Both are true but the