MEDIA FOR CUTTING PROPAGATION

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The range of media used in cutting propagation is almost as great as the number of propagators in existence. This might suggest to the casual observer that media type is not important to the striking of cuttings. However, nothing could be further from the truth, except in the case of some cultivars that will strike root regardless of their ill treatment.

In general, cutting media should satisfy certain physical, chemical, and biological criteria as well as those of availability, consistency of quality, and ease of use by the propagator. In addition, other factors such as climate, cultivar, and housing for cuttings will also have some influence on selection of suitable media ingredients. Cost of ingredients should be of secondary importance in structuring successful propagation media.

PHYSICAL PROPERTIES

Media should provide adequate physical support for cuttings as well as good aeration, water holding capacity, and free drainage. Media should also be reasonably light, easy to handle and easy to stick cuttings into. Ingredients should not degrade on mixing or during use.

The size and shape of media particles as well as the compaction of the medium determines the amount and size of air spaces, or pores, between particles. Large round or irregularly shaped particles give bigger air spaces than flat, plate-like and very small particles, thus allowing for greater movement of air and water through the medium. A mixture of particles ranging in size from about 1mm to 5mm is suitable, with inclusion of finer particles of peat or composted pine bark. Ingredients such as perlite, expanded plastic foam beads, pumice, vermiculite, and scoria also have air spaces inside individual particles.

The importance of air spaces is three-fold. They allow for:

1) Good aeration of developing root systems which will absorb oxygen and release carbon dioxide
2) Penetration and drainage of water that is also vital for root growth, and
3) Space for roots to grow.

Suitable media should have at least 27% available air space spread throughout its volume. Optimum amounts will vary for different cultivars with, for example, some aerial rooting plants requiring much more. Heavy misting can also increase the need for a higher percentage of air porosity. The formation of callus tissue requires air but over-development of callus can occur with excessive aeration. In general, an upper limit of about 35 to 40% is advisable.

Available air space can be measured as follows:

1. Line the propagation pot or tray with thin plastic.
2. Fill to normal depth with a measured volume of moist, but not too wet, medium.
3. Pour water into medium until water level reaches surface of medium.
4. Cut a hole in the plastic and collect and measure water draining from the medium.

This volume of water is roughly the volume available as air space in the medium in that container. The percentage air space is thus equal to:

$$\frac{\text{volume of water}}{\text{volume of medium}} \quad X100$$

Sticking of cuttings into media can be made easier by light watering and then poking holes with a dibble stick, or cutting a trench with a knife. The medium should not be firmed down too heavily as this will reduce available air space.

Water holding capacity can be increased by the addition of peat or fine composted pine bark. Peat is a strong water absorber and can be used in varying proportions with free draining ingredients to achieve a desired moisture content in the medium. Fine composted pine bark, while not considered a water absorber, has the ability to store water between its fine particles and can be used in a similar way.

Many plants in the Australian Myrtaceae family grow best with a wet medium while Proteaceae, Epacridaceae, and softer, more succulent plants on the whole grow better with a drier medium.

More peat or fine pine bark can be added in hot, dry climates and during summer, with less added in cool, moist climates, and in winter. Media under heavy misting may need to be drier, i.e. contain less peat or pine bark, than media under fogging. Similarly, media on heated beds may need to be wetter than media on unheated beds. Where drying out is a problem, wetting agents can be incorporated during mixing to enable easier re-wetting.

CHEMICAL PROPERTIES

The chemical requirements of satisfactory media are that they be low in salts, chemically stable during use, and have a pH in the range of 4 to 6 and have some cation exchange capacity. While many plants root well at higher pH levels others, such as those in the Proteaceae, Epacridaceae, and Ericaceae families perform better if the medium pH is in the range of 4 to 5. Media can be made more alkaline (pH raised) by the addition of lime, and more acid (pH lowered) by increasing the proportion of low pH ingredients, such as peat or composted pine bark.

Water quality is important. Alkaline water or water containing impurities can alter the chemical or biological status of the medium with regular watering, misting, or fogging. If necessary rain water or deionized water should be used.

BIOLOGICAL PROPERTIES

Media should be as free as possible of biologically active substances and organisms such as weed seed, spores, insects, larvae, and any pathogenic materials. Some ingredients such as sand, soils, and peat should be pasteurized or chemically treated before use. Others such as perlite, plastic foams, and rockwool are sterile and need no treatment if correctly manufactured and stored. Properly composted pine bark is self-sterilizing.

FERTILIZERS

In general, fertilizers are not readily absorbed or used by cuttings until roots starts to develop. Fertilizers incorporated in media or applied as liquid feed often help to promote growth of undesirable organisms in cutting trays and sometimes promote growth of cutting foliage in preference to roots. However, some very slow to root cultivars may be kept in better condition by the occasional application of a dilute foliar feed.

As soon as cuttings are sufficiently rooted they should be potted into a medium containing fertilizer, or maintained by liquid feed in cutting trays, until potted. Where cuttings are struck in individual pots, liquid feeding should commence as soon as roots develop, or if cultivars strike very quickly, slow-release fertilizers can be incorporated in the medium.

MEDIA INGREDIENTS

Propagators can select from an enormous range of ingredients in developing their "ideal" medium. Some of the most readily available and commonly used are discussed below:

Bark: As a renewable resource, bark is of increasing importance to propagators. The most commonly used is that of *Pinus radiata*, which is available in huge quantities in Southern Australia. It can be milled to desired particle size from dust up to several centimetres in cross section. Bark milled from younger trees, up to 16 years, is often more plate-like in particle shape, which is not ideal for water penetration and drainage, as surface particles tend to lie flat reducing water and air entry to the medium.

Composting with added nitrogen deactivates harmful toxins, increases cation exchange capacity, wettability and water holding capacity, and eliminates the nitrogen drawdown problem experienced with raw sawdusts and barks. During composting, temperatures reach levels at which harmful pathogens are destroyed.

Composted bark has a pH of 4 to 5.5, is of reproducible quality and chemically stable. It has some fungus suppressing ability particularly towards *Fusarium*, *Phytophthora*, and *Pythium*, and is light and easy to handle.

If used as a major constituent in propagation media, at least 80% of the particles should be in the range of 2 to 5mm. However media of this nature can hold too much water for many Australian species, and is prone to algal growth on the media surface. If the medium dries out it can be difficult to re-wet.

Finer bark of particle size 3mm and less has proved an excellent constituent when combined in the ratio of one part of bark to 3 or 4 of expanded polystyrene foam beads. This medium has been used very successfully with Australian Proteaceae and many other plants growing best with drier media. Cuttings rooted in bark develop good root systems, and rooted cuttings can be removed from the medium with minimal root damage.

Fine composted bark has the potential to partially or fully replace peat in other propagation media and propagators should experiment with its use.

Rockwool: Rockwool is available in both block and granular form. Little work has been done with granulated rockwool; however rockwool blocks have been extensively used in both conventional and hydroponic propagation. Rockwool provides a fairly wet medium with low air porosity. It is useful for moisture requiring cuttings but others tend to aerially root above the rockwool and often decay below the surface. Rockwool could be of use in fog propagation where media wetness is less than that under misting.

Expanded Polystyrene Foam Beads: This material is chemically inert and provides excellent aeration because of its spherical particle shape. Particles contain a lot of air sealed inside them and are consequently very light. Foam has no cation exchange capacity so this must be provided by other ingredients in the mix. The ideal particle size is about 3mm. This material has formed an excellent medium when mixed with fine composted pine bark in the ratio of 3 or 4 parts of foam to one part of bark, the higher proportion of foam giving a drier medium for winter or cool climate use. Water holding capacity, drainage, and aeration are excellent in these proportions. Media consisting of foam and peat in similar proportions have not performed as well.

As polystyrene is a chloro-fluoro-carbon, its use may be limited for environmental reasons, but a similar safe substance would be of enormous use in propagation.

Sand: Sand for propagation is usually of the quartz type and often dug from river beds. Quartz sand is stable, does not release minerals, and has no cation exchange capacity. It is abrasive on mixing equipment and very heavy to handle. Propagation sand should be sharp and of particle size from about 1 to 4mm to allow good drainage and aeration. It should be free of clay, lime, salts, and organic matter. Beach sand is not suitable unless salt is thoroughly washed out. Crushed rock is frequently mixed with sharp sand and may release some nutrient minerals in small quantities. Sand should be washed and sterilized before use.

Peat is usually mixed with sand in varying proportions to improve cation exchange and give better root systems. Sand used alone often promotes brittle roots, which are easily broken when rooted cuttings are removed from the medium.

Peat: Peat used in propagation is usually the form taken from sphagnum bogs. Partially decomposed sphagnum moss has the ability to store up to about 20 times its own weight in water, depending on the age and hence state of decomposition of the moss. Younger, less decomposed peat, has less water holding capacity but has the advantage of giving better aeration.

Peat usually has a pH in the range of 3 to 4 and has a good cation exchange capacity. While peat is an excellent propagation material, it is quite variable, depending on its source and sometimes the season of digging and subsequent treatment. Some peats have high levels of salts, some are mixed with soil and some may contain weed seeds, spores, and other undesirable organisms. Recently, some have been found to be radioactive. Peat should be sterilized before use. In the proportions of one part peat to 3 or 4 parts of perlite, or 2 to 4 parts of sand, it combines to give a range of well-tested media for Australian conditions. Peat is a dwindling and very expensive resource for propagators, who should be experimenting with substitutes.

Perlite: Perlite is produced from a crushed, glass-like volcanic rock. When heated to about 1000 °C it expands rapidly, developing a very porous structure containing both sealed and unsealed air spaces. It is very light, is chemically inert, with a pH of about 7, has no cation exchange capacity and has some aeration and water-holding capacity. Breathing masks should be used when handling dry perlite as bags often contain perlite dust. Dust should not be used in media as it tends to set as an almost impervious base.

The grade known as P500, with particle sizes from about 3 to 5mm, or a coarser grade for more aeration, should be used either alone or in conjunction with peat, where lower pH or increased water holding is required. Root systems are usually less brittle and coarse when peat is included in the medium. For most Australian plants, one part peat to about 4 or more parts of perlite is suitable.

Foam Sponges: A range of ''sponges'' is becoming available to the propagator. These are sterile, of light weight and consistent quality. They offer good aeration, drainage, and water holding capacity. However, each type needs a different watering regime, and some offer fertilizer release. Propagators should experiment with their use, particularly as media in which to grow rooted cuttings for export.

Aeroponics: Fogging systems for humidifying cutting foliage are also being used to replace media. This method has been found successful for many aerial-rooting plants and is being trialled for plants which normally root in media. Fogging offers good aeration and sufficient water and humidity. Cuttings are stuck through holes in a plastic sheet supported by a frame. Very dilute concentrations of rooting hormones can be supplied in the fog underneath the cuttings on a regular basis. Fungicides and liquid fertilizers can be similarly supplied when needed. The root systems developed appear to be good. This technique needs a lot of experimentation and may be an ideal way of rooting cuttings for export.

CONCLUSIONS

The major conventional media ingredients, as well as some fairly new and innovative ones have been discussed. The message I would like to convey is that traditional media and methods can often be improved by thoughtful propagators who are willing to experiment.