It Ain't Just Dirt©

R. Christian Cash
Associate Professor of Plant Science, State University of New York – Cobleskill College
Cobleskill, New York 12043 U.S.A.
Email: cashc@cobleskill.edu

INTRODUCTION

Rooting of cuttings and growth of seedlings is dependent upon providing proper environmental conditions for root growth and anchorage for plants. The decisions include selecting the appropriate media components, type of pot, pot filling technique, and watering methods.

What Do Roots Need? The rooting process requires the presence of water and oxygen in a medium. Water is necessary to keep plants hydrated, allow for nutrient uptake, and for metabolic processes, which maintain cell processes. Oxygen is required for the process of respiration to occur in a rooting environment. For a root to function the proper balance of water and gas exchange must be provided. In addition to the necessary water and gas exchange, roots require appropriate temperatures for growth and nutrients available upon root initiation.

WHAT IS A MEDIUM? A medium is a substrate that provides for growth of roots. William Fonteno writes in the Ball Grower's Guide for Greenhouse Crops, "A major misconception is that media are responsible for setting up the air and water relations for the root system… actually, media account for only 25% of this responsibility. Seventy-five percent of the air and water relations for a plant … is controlled by the grower." In essence this is saying the grower chooses a substrate to grow in and manipulates it to provide the proper environment for rooting.

What Are the Properties of Media? Media are identified by physical and chemical characteristics. The physical characteristics include bulk density (weight per unit volume), porosity (air space), and moisture retention (water cohesion). The higher the bulk density the more anchorage a plant will usually have. Porosity or air space is necessary to provide gas exchange but also to provide room for roots to grow. Moisture needs to be retained and is affected by gravitational pull and cohesion of water to particles. The smaller the particles, the more water holding a medium will have.

The chemical characteristics of media of most significance are pH, cation exchange capacity (CEC), and soluble salt levels. The pH level of a medium will determine availability of nutrients. Cation exchange capacity is a measure of the nutrient-holding capability of a medium. Soluble salt levels identify mineral content of soil solutions and are detrimental if levels are too high.

Does Blending of Components Change Function of That Component? As Fonteno noted, "making media is similar to making soup." The sum of the components is not always equal to the parts. When media are mixed together they produce an entirely new product. A grower should be able to predict performance of a blended medium, but often mistakes are made. A simple example is the addition

of sand to improve drainage. Sand may provide drainage but it may in many cases decrease oxygen content of a medium by filling in air space in a medium.

GROWER DECISIONS. HOW DOES A GROWER OBTAIN OPTIMUM GAS EXCHANGE AND WATER IN A MEDIUM?

Medium Particle Size. Many growers have excellent success with media with single particle sizes. Single particle size provides for uniform drainage and water holding of a medium. When fine materials are blended with coarse materials this will usually decrease air space and increase water holding.

Container Height. The height of the container chosen will affect air and water relations. As medium depth increases, the column of water in a medium is subject to greater gravitation forces and thus more drainage. Deep media are relatively oxygenated at the surface while saturated at the base of the media. Shallow media have more consistent moisture throughout.

Pot Filling Activities. The method utilized to fill pots can significantly impact the function of medium air and water space. The actions of loose filling pots, tamping pots after they are filled or compressing media in a pot will change the air and water relationship of a medium. Loose filling will usually impart more air space, tamping will reduce air space and increase water holding, while compressing filled pots will give less air space in the upper portion of a medium.

Dry Pot Filling Versus Wet Pot Filling. If pots are filled with a dry medium and later moistened, this will often cause loss of air space. Many organic media will swell with application of water. If the medium swells in a pot it has no place to go except to fill the air space. Pre-moistening is most preferred so that characteristics of the medium are stabilized prior to use.

Use of Wetting Agents. Numerous growers utilize wetting agents as media additives. Wetting agents, which reduce surface tension of water, will assist media in absorption of water and relieve media of excessive moisture.

Long-Term Integrity of a Medium. Some media such as organic media will decompose over time. This decomposition will reduce air space for gas exchange, reduce space for roots, and increase water holding.

How Is Consistency Maintained in Working With Media? Employees need to be trained. If each employee is doing work slightly different the result will be variable quality. If all are trained than variation should be minimized.

COMMON MEDIA

Peat Moss. Peat moss is one of the most commonly known and used products. It has low pH and good water, air, and nutrient holding. Peat moss varies with location it is collected from, materials it is composed of, processing methods of harvest, and cut of the product. A fine cut is often desirable for seedling starting, while a coarser cut is desired for cuttings production.

Perlite. Perlite is an inorganic product that is available in various grades of size. Perlite is generally associated with improving drainage of media but can be utilized as a stand-alone medium.

Vermiculite. Vermiculite is an inorganic medium available in various grades from course to fine. Vermiculite has improved water holding and nutrient holding over perlite. Vermiculite does have aeration issues if it is compressed. This product, once compressed, will not "bounce back."

Coir. Coir is a coconut pith product. It has excellent water holding, aeration, and nutrient holding and is a fairly stable product. This medium is very similar to peat moss in its performance. The texture of the product makes it different from peat, which can affect root growth.

Sand. Coarse builders sand has been a standard of propagators for years. Quartz sand can be sterilized and re-used and is often affordable. Problems arise from sand in that it is not found to be consistent in particle shape, particle size, composition, cleanliness, salt content, and a host of other factors.

Pumice. Pumice is another product like sand or perlite. It provides excellent drainage and a texture that many growers find works well for them. The most common problem with the product is expense associated with acquiring it.

Bark. Bark is a common component of media. Properly composted bark provides many opportunities for drainage, water holding, and nutrient holding. Bark has a very good buffer and will resist changes. As with many organics, decomposition of the bark and salt accumulation can be an issue.

Rockwool. Rockwool is a melted spun rock, which by itself has water-retention properties similar to peat moss, but its water-release rate is different from that of peat. Rockwool is commonly used as a medium amendment or is manufactured in slabs or bricks with pre-determined aeration properties.

Other. Oasis, calcined clay, compost, Styrofoam, and many other products have been utilized as media.

Growers' Comments. George Cuzzolino the grower for Plainview Growers in Pompton Plains, New Jersey, comments that he looks for media that provides "easy wetting but dries well." His media are for soft succulent crops such as poinsettia and annual plug production. He requires a medium that is stable with no pH swings and holds up well. He specifically indicates that he needs a product that is easy to use with automated equipment and will be able to be shipped well. Many shipping companies have destroyed his crops. George indicated a preference for the Jiffy (Jiffy International AS) product Preforma. He prefers this product because, when compressed, it springs back to life, much like a sponge. This he has found is his shipping-friendly product.

ADDITIONAL GROWER DECISIONS

Now that the media issues have been decided, there are other issues that need to be addressed at sticking time for cuttings.

Depth of Sticking and Length of Cuttings. The depth of sticking of cuttings is a function of the medium composition and the location where roots emerge from a cutting. Rooting may develop from near vascular ring areas or from callus areas. As such, proper conditions need to be provided to those areas to encourage roots to develop. A simple analysis of rooting response may tell the propagator how the

medium is functioning. If rooting occurs high up on a cutting and the base of the cutting is rotting this indicates that the oxygen content is correct at the surface of the medium. Lower in the medium oxygen content is too low and water content is probably too high. Certain cuttings will only root where they have been wounded. So, if roots are occurring only at the base of a cutting, this is probably the case. If cuttings are rooting the entire length of the cutting, optimum conditions are being provided throughout the rooting medium.

Wounding. There are many theories as to why wounding encourages rooting. They range from wounding allows more uptake of water at the site of damage to rooting stimulates activity of cells. Wounding is commonly effective on woody tissue. One of the possible reasons for this is that woody tissue is lignified and difficult for newly emerging roots to penetrate. The process of wounding will remove the physical barrier of lignified tissue and allow rooting to occur.

Spacing. Issues outside of the needs of the plant primarily determine spacing of cuttings. If cuttings are to be direct stuck and shipped in that container, the spacing is determined by the container size. If cuttings are rooted in a propagation bench, they are often placed in close proximity to each other. The advantage of close spacing is that humidity is relatively uniform in close spacing, and cuttings will provide shading to each other. The limitation to close spacing is that lack of air circulation can negatively impact growth and encourage onset of disease.

Fertilization. Fertilization of cuttings is an issue that requires the grower to have product objectives. George Cuzzolino indicates, due to his water and shipping needs, he prefers calcium-based fertilizer. He indicates that the plants develop darker green color for him and ship tougher than plants that are fertilized with ammonium-based fertilizers. The ammonium-based fertilizers give his plants undesirable stretch and softness.

In addition to growth issues, application of fertilizers with nitrogen may encourage algae growth in the medium or greenhouse. The algae will plug up air space and may encourage the onset of fungus gnats, neither of which is desirable.

CONCLUSION

Deciding on a medium to use for rooting of plants or growth of seedlings requires the grower to consider the needs of the plant, the needs of the customer, and the ability of the grower to efficiently provide the components and environment that will stimulate rooting and later growth. The primary objective is to provide a rooting environment that recognizes the optimum water retention and oxygen needs of rooting.

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LITERATURE CITED

Cuzzolino, G. September 2006. Personal communication. Plainview Growers, 229 Farm Road, Pompton Plains, New Jersey 07444.

Fenteno, W. 1996. Growing media types and physical and chemical properties, pp 93–94. In: Reed, David, Ed. A grower's guide to water, media, and nutrition for greenhouse crops; Ball Publishing, Batavia, Illinois.