Media and Its Relationship to Plant Growth

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I have only a page or two to cover this topic which in many schools and colleges requires an entire quarter or semester of 50 to 75 or more hours. My remarks will therefore be directed to certain specifics of media and their relationships to crop growth without giving you a great amount of indepth detail. I'm hopeful that my comments will get you to thinking about what I present. Pique your curiosity so that you seek greater understanding of these items. All of my comments are directed to the production of bedding plants in containers.

Container production is unique so let's spend a few minutes on this. Container grown plants have greatly restricted volumes of media in which they grow. Their root systems are necessarily restricted. However, unlike field grown plants, each container grown plant has the same amount of media available which reduces the competition for water and nutrients.

Because the container does greatly restrict growth of roots and also presents certain unnatural physical limitations on that growth, unmodified field soils can never be used in the production of container grown crops. This is primarily due to the loss of long capillary channels that drain the upper layers of the field soil and allow for the proper mix of oxygen and water to the plant roots.

Field soils must therefore be modified with media that will result in the formation of large pore spaces. These may be organic and/or inorganic. Usually a combination of organic and inorganic amendments is used to obtain the desired physical characteristics of good drainage and aeration.

Before we explore these amendments let's list the **requirements of a good growing medium.** I use the singular medium but it is really the plural media because several components are used.

A good growing media should:

1. Provide mechanical support to hold the plant upright.
2. Serve as a reservoir for water and make it available for growth.
3. Provide proper aeration and drainage.
4. Serve as a source of nutrients for the plant.
5. Preferably be free of insects, disease organisms and noxious weed seeds.
6. Be of consistent quality from batch to batch.
7. Be economically available.

All of these are important to the successful production of high quality plants. This production takes place in two stages—first is seed germination and the second is the growing-on stage. As we explore these two areas of plant growth and how media affects each, we shall weave into our story comments about the various amendments we made reference to earlier.

Seed germination has certain requirements that must be fulfilled to ensure success. These are provided by media that ensures a:

— supply of moisture
— adequate aeration to provide the high oxygen needs of the seed
— superb drainage which affects aeration
— warm temperatures, usually applied as bottom heat
— light or darkness depending on the crop's requirements
— free of insects and diseases
— of such consistency as to allow easy removal of the seedlings with the least damage to the root system

Notice that I did not list a supply of nutrients as being required; except for orchids, seeds have their own stored nutrient supply that carries them through the germination stages. They do need nutrients to grow and develop and we'll talk about that in a few minutes.

The seeds we use to grow bedding plants come in many shapes and sizes. Although you all have sown tens of thousands of various kinds, I wonder how many of you have ever given much thought to the size of those seeds and the media you used for germination?

Before starting I would ask, do you know the stages a seed goes through during germination? First the seed must imbibe water. Before anything else starts to happen moisture must get into that seed. This process is called imbibition. Upon entry of moisture through the seed coat and the micropyle, a small opening in the seed coat, the seed begins to respire. This respiration requires great amounts and a continuous flow of oxygen to provide the energy for growth. It is through respiration this energy is released from the stored food in the seed.

Both the moisture and the oxygen are provided by means of the media surrounding the seed. For each of these to enter the seed there must be an intimate relation between the seed and the environment provided by the germination medium.

Moisture is made available to the seed as both a liquid and vapor. The porosity of the media is determined by the particle sizes of the individual amendments and how closely they are spaced. If the media is made up of many small particles packed closely together it may contain much more moisture than is desired to the exclusion of much needed oxygen for respiration.

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Media (continued)

If the media is made up of large particles loosely packed it may not contain enough water to ensure meeting the needs of the germinating seeds.

Compare each of the seed types with the particular amendment. Examples of the smallest seeds are petunias, next largest alyssum, then geraniums and the largest marigolds. Think of the needed germination requirements and how these will be provided by the sphagnum peat moss, vermiculite, perlite, shale or the 1-1-1 peat moss, vermiculite bark mixture.

It is quite obvious that small size seed is going to be lost if you try to germinate it in a coarse particle size medium. Petunias in a bark mixture would have a difficult time to obtain the needed moisture because this mix has very large, twisting, discontinuous pore spaces through which the water must move either as a fluid or in thin films over each particle surface. If there is the least amount of stress put on the seed because of drying of this mix the films break and the seed is deprived of essential moisture. A lack of moisture during the critical germination process is probably the greatest cause of germination failures.

If you were germinating some large seed like coffee then a coarse medium would probably be ok to use. It would have lots of contact with many media particles from which it could extract moisture. For the petunias and similar small seed a combination of peat moss and relatively fine vermiculite or perlite would be preferred. That is the kind of mix we have in the trade today. Even with a fine media small seeds should not be buried so deep as to be out of reach of needed oxygen.

So for seed germination the medium should be compatible in size with the type seed and more importantly the size of the seed.

What of the growing-on stage? All of the requirements for seed germination with the exception of bottom heat, but the addition of nutrients are needed for growing on plants to sale.

The water holding capacity is determined by the materials used to make up the media. Sphagnum peat moss and vermiculite can hold up to 10 to 20 times their weight in water. Perlite and bark mixes hold considerably less. The particle size of each has a significant part in the water holding capacity of the matrix. As mentioned earlier, fine particle size media have smaller porosities than large particle media and thereby hold more moisture. If the particle size is too small the air (oxygen): water ratio may be thrown out of balance.

The respiration of plant roots depends on a constant supply of oxygen and results in a continuous release of carbon dioxide. Plants obtain this oxygen via media pore spaces as it diffuses from the air. Without good air exchange these gases would accumulate, inhibit root activities and finally kill the roots. At high media moisture content with low oxygen levels, microorganisms could effectively compete with plant roots for oxygen. This is especially true of high organic media because of the abundance of microorganisms they contain.

The total volume of air filled pore space in media required for adequate aeration has been found to vary between five and 10% by volume. Below these levels plant growth is limited by reduced oxygen movement to the roots. Generally our soilless (peatlite based) mixes have more than sufficient aeration—20 to 25% by volume if they are not overwatered.

The watering process itself serves to renew the oxygen in media. As water flows down through the media it pushes the stale gases out in front and they are removed by drainage. At the same time the infiltration of the water pulls in fresh air from the atmosphere via suction forces. This occurs each time water is applied.

If the media is too densely packed or too fine particle size the infiltration of water may be so slow as to deprive the roots of needed oxygen. Under high sunlight conditions this lack of needed oxygen may result in a short period of stress, perhaps for an hour or two. Indications are that such stress may limit plant performance. A continuing repetition, daily occurance of such stress conditions may severely impede growth of the crop.

Similar stress conditions may occur in early spring when bedding plants are started and set on cold ground. Cold water used for irrigation is more viscous than warm water. Container media are already cold from their ground locations, when watered with cold water drainage is impeded and results in an extended period of root submergence. As little as two to three hours of oxygen deprivation may have a long lasting effect on subsequent growth.

Media depth also plays an important part in drainage. Shallow bedding plant containers frequently develop a perched water table in the bottom of the container. This is a situation where there is 100% of the pore spaces filled with water. Roots will not grow where there is no air. This situation often exists with newly planted seedlings. Their root systems are not large enough to take up all the water available in the media. After they have grown some the perched water table problem ceases to exist.

The choice of media may have an important influence on plant growth due to its nutrient content. Vermiculite has a relatively large amount of available potassium, some calcium and magnesium. It also has good cation exchange content and some buffering capacity. The CEC effect results in a holding and release of nutrients as needed by plants. The buffering capacity modifies changes in pH.

The pH of the media has an important role in making nutrients available to plants. In mineral soils the optimum pH is around 6.0 to 6.5. Twenty years ago soil scientists at Michigan State University showed the optimal pH in organic soils to be around 5.5 to 6.0. Should the pH get below 5.0 certain ions such as aluminum and manganese may become toxic. Likewise above pH 7.0 iron may become deficient.

Although vermiculite has several positive aspects about its chemical characteristics, other media do not. Perlite is light in weight and sterilized as a result of its manufacturing process the same as vermiculite. Perlite contains relatively large amounts of aluminum, sodium and some fluoride. None of these need be troubling since the aluminum and sodium are easily eliminated by leaching. In addition to being leached, the fluoride can be tied-up by an application of lime to bring the pH to around 6.0.

In some media certain biologically active synthetic organic molecules, pesticides, herbicides and growth retardants may react unfavorably. These reactions may result in a temporary immobility or non-function of the compound. The growth retardant A-REST when applied as a media drench to wood-bark media is tied up by the bark.

Since many of these compounds were developed for use on soil based media in which the clay fraction immobilizes part of the material, their use on soilless media may not have the same results. Small scale trials should be *made before the entire crop* is subjected to treatment. Just in case something goes wrong.

High soluble salts or the effects of overfertilization on greenhouse plants is well known. The higher the salt level the greater the restriction on growth. Media with a low cation exchange capacity will not support high salt levels without plant injury. On our 2:1 ratio of water:media salinity test a maximum of 2.0 mmhos on mineral soils and 3.5 mmhos on peat-lite media can be tolerated.

Salt injury may be due to high osmotic concentration or specific ion toxicity or a combination of both. A high osmotic concentration is much more damaging when the media is kept on the dry side. By keeping it moist the danger of injury is reduced because the salts are kept diluted.

Sodium and chloride ions are much more damaging to plants than calcium or sulphate ions. Be selective in the fertilizers you use.

When growing in soilless media the phosphorus ion is leached as rapidly as is nitrate nitrogen and potassium. Phosphorus must therefore be applied on a regular basis. In soil based media phosphorus is temporarily fixed by the clay colloid and later released for plants' use.

If wood-bark media contain bark that has been inadequately composted, then a nitrogen deficiency may occur. Microorganisms use nitrogen as their energy source in breaking down the cellulose of the wood. They can take it up more effectively than plant roots.

Of all the soilless media on the market today there is only one that I know that has more than a starter supply of contained fertilizer. There are only enough nutrients in the other media to get the plants growing. Depending on the frequency of irrigation it is absolutely necessary to begin a regular fertilizing program within two to three weeks after transplanting.

Tie It Up!

Ribbon usage is regaining popularity each year, but remember the heritage of ribbon when incorporating it in a design. Ribbon was first used as a pretty way of tying things together, not just as an add on. Ribbons were used to tie various bundles of flowers together, to tie lids to boxes and to tie blossoms on hair combs and brooches. To adapt this look, place your ribbons strategically on the flowers and containers. The tasteful blending of ribbons with flowers is the mark of a superior designer.

The most important look for ribbons used in weddings this year is lots and lots of string-thin shower ribbon. Select the double-faced satin ribbon in the teeniest width available. Use it voluptuously and charge for it accordingly. Good ribbons add distinction to flowers, but they are costly. Judicious use of expensive ribbons, however, makes the arrangement far more memorable than extravagant use of cheap ribbons.