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MEMORANDUM

FOR : The Regional Directors
Regions 2, 3, 4A, 5, 6, 9, 12, 13, NCR and NIR

FROM : The Director

SUBJECT : **FMB TECHNICAL BULLETIN NO. 22, GROWING MEDIA FOR MECHANIZED CONTAINER TREE NURSERY**

DATE : MAY 18, 2016

I. This Technical Bulletin

This Technical Bulletin on growing media will provide some information on the advantages and benefits of using organic materials such as coco peat, rice hull, sawdust, etc. as growing media components for the production of seedlings at the MMFN sites.

It also explains the many factors to consider that are related to the physical properties of the growing media that will directly affect root growth and development such water, air (oxygen), and texture or sometimes called the air/water/porosity relationship or “penetrability”. Another important factor to consider is the weight of the growing media as this would greatly affect the transport of the planting stock.

II. Users of the Technical Bulletin

The users of the Technical Bulletin are the Nursery Managers, Growers, Assistant Growers and readers who plan to start and operate a nursery for native plants as well as exotic plants in the tropics.

III. The Growing Media

A. Introduction

The growing media commonly used in forest nurseries in the Philippines is a mixture of clay, compost and sand. Soils are generally unsatisfactory for the production of plants in containers because soils do not provide the aeration, drainage and water holding capacity required. Furthermore, soil is ten to fifty times heavier than coco peat, bark, sawdust and other growing media components. This excess weight can significantly add efforts in handling because the potting bag would be much heavier.

In general, soil has fine texture that makes the growing media drain more slowly and has less air space than other media components. High clay content causes the media to shrink and crack when it dries and eventually damage the root especially the root hairs of the seedlings.

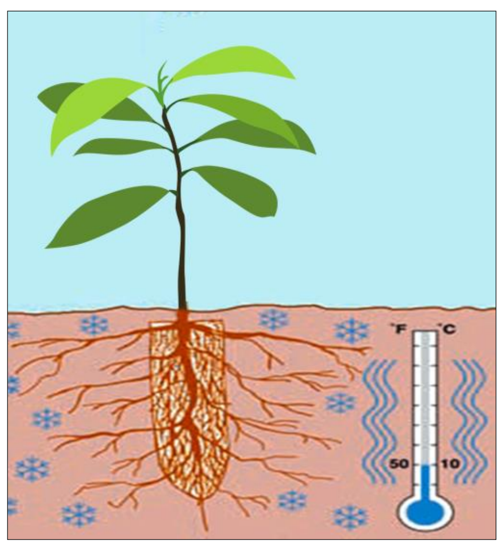
B. Physical Properties of the Growing Media

The most important thing to remember about the physical properties of the growing media is the air/water/porosity relationship or “penetrability”.

Water - How much water can the media hold without water-logging. The choice of media will also depend on the degree of water movement. The faster the water movement, the better the roots will perform**.**

Air – The cell volume is occupied by the solid matter and the liquids which are the water and gases. These liquids are found in the "spaces" or pores and their volume, as a percentage of the total volume, is called porosity. Air-filled porosity (AFP) is necessary to allow air to enter and leave the media. Even before absorbing water and nutrients, the roots must respire or “breathe”. If the media hold too much water, the roots will suffocate.

Texture – This refers to how the media feel in your hand. If, for example, the media can be rolled and made into a ball, then, the media contain a lot of clay. If it is gritty and crumby, then the media contain a lot of sand which adds porosity, but decreases the ability of the media to hold water and nutrient because sand does not hold water.



When the seedling is planted, the fine, dense root system immediately starts to spread. It efficiently gathers an immediate source of nutrients to foster vigorous growth. The seedling is able to quickly establish itself. This is called the Root Growth Potential (RGP).

The physical properties of the media “dominate” the young roots - dictating how fast and far the roots can grow. High porosity encourages rapid root growth and allows the root system to take over the container. Poor aeration produces slow root growth and can delay the roots from complete exploration of the container.

C. Penetrability

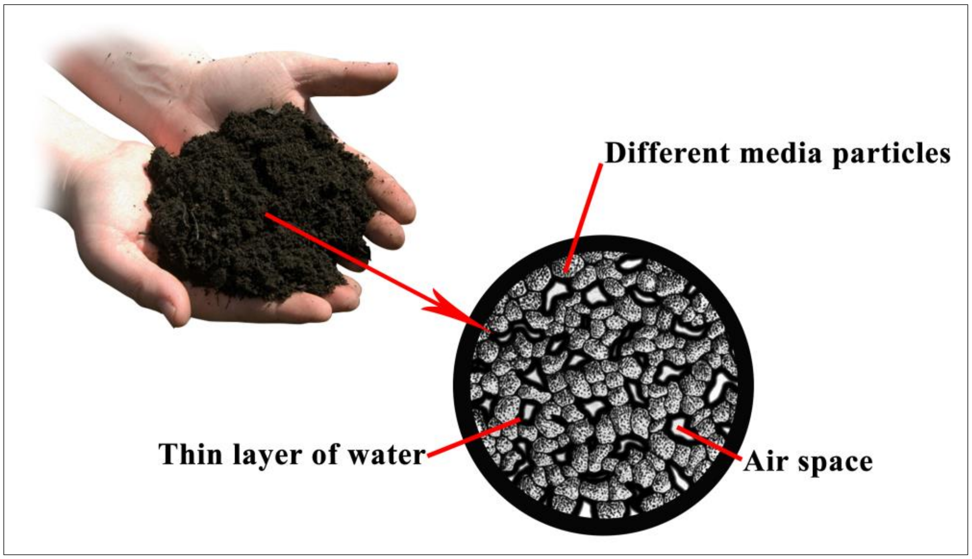
The root system must be able to explore or penetrate the growing media and subsequently the soil environment after outplanting. The choice of growing media will depend on the degree of water movement desired such as the quicker the turnover of water, the better the roots will perform. Water must move within the media to eliminate waste of respiration and unused mineral salts and to maintain the correct electric conductivity (EC) and pH concentration in the surrounding environment of the roots and root hairs.

D. Soil Porosity

The role of solids is to give the optimum porosity to the growing media, with enough air and water and to ensure the best possible contact between roots and growing media. The loss of porosity means the loss of spaces which diminishes air or oxygen. Roots must respire in order to be productive and if their need for respiration is satisfied, they produce more roots.

Maintaining porosity is one of the most crucial aspects of plant propagation. Irrigation and fertilization can be adjusted to increase the amount of water and nutrients but the amount of air present in the mix cannot be increased. Air porosity is fixed at the time of seeding and decreases over time as the growing medium decomposes. Maintaining good aeration of the growing media will increase the movement of water and nutrients for the development of a good root system.

The important parts of the growing media are the ***air space*** and the ***available water*** which depend mainly on the particle size in the mix.



A good substrate has different size particles – this allow good air and water movement

IV. The Soilless Media

The "soil" used in modern container nurseries is actually an artificial media that is a blend of organic and inorganic components. It contains minimal or no actual soil but includes various combinations of physical ingredients such as coco peat, composted sawdust, rice hull plus some amounts of slow-release or controlled-release fertilizers and mychorrhizae.

The primary purpose of a soilless media is to provide a lightweight media that hold water and nutrients and allow air exchange to and from the roots. A soilless media can be easily manipulated to produce the media with physical properties such as texture, porosity, aeration and water holding capacity. Soilless media is environmentally friendly because most of the media components are by-products of other industries. It is important that the rooting zone is provided with sufficient oxygen and moisture so that the growing media could drain freely.

The weight of the media affects the transporting of the seedlings to the planting site. The media should be light in weight to facilitate transport but at the same time, hold the seedlings firmly in place.

A. Components used in Soilless Media

To improve soil porosity, several “soilless” growing media have been developed. The following is a description of some of the most commonly used components for the production of seedling and other nursery crops. The two major groups of soilless medium and their components are:

Organic: coco peat, rice hull, sawdust, wood bark, bagasse
Inorganic: sand, vermiculite, perlite, expanded polystyrene **(**styrofoam bead)

1. Organic Materials

a. Coco Peat

Coco peat is rapidly becoming one of the most popular growing media in the world and may soon be the most popular. Research showed that it is the first totally “organic” media that offers top performance in nurseries and greenhouses.

Coco peat is a by-product in the production of coco fiber extracted from the husk of coconut and used in a wide range of domestic products including floor mats, door mats, brushes, mattress filling, and nets for soil erosion control in mined-out areas and slope stabilization in road construction.

Coco peat has a high capacity for retaining air, nutrients and water. It can maintain a large oxygen capacity and superior water-holding ability. Coco peat can hold 900 percent or 9 times of its weight in water. It has been found out that coco peat contains some mineral elements especially phosphorus and potassium.

b. Rice hull (raw)

Rice hulls are lesser known and underutilized media component in most parts of the world, but they have proven to be as effective as gravel for the production of nursery crops. Rice hulls are inexpensive by-product of rice production. The elongated shape of rice hull allows the individual hulls to cross connect and create larger pores, thus, it has a higher rate of air-filled pores (aeration) and drainage.

c. Rice hull (carbonized)

A common belief is that carbonized rice hull helps with drainage, in fact, the reverse can occur. When carbonized rice hull is added to coco peat, it can fill in many of the narrow spaces between coco peat particles, thereby reducing spaces for water resulting to loss of moisture as well as oxygen.

d. Sawdust

Sawdust has also been widely used as a growing media component. Sawdust generally has a high Calcium (C): Nitrogen (N) ratio and poor water holding capacity, but can be improved through composting.

e. Barks

Barks are by-products of the wood industry. Suitable particle sized of barks can be obtained by using screens. The physical properties of bark are similar to moss. Barks provide drainage & aeration.

f. Bagasse

Bagasse is a waste by-product of the sugar industry. It may be shredded or composted to produce a material that can increase the aeration and drainage properties of the growing medium. It has a high sugar content that can increase rapid decomposition after it is incorporated into the growing media, hence, its use is limited.

2. Inorganic Materials

a. Sand

Sands range in particle size from 0.05mm to 2.0mm in diameter. They do little to improve the physical properties of a growing media and may result in reduced drainage and aeration. Medium size and coarse sand particles are those which provide optimum adjustments in medium texture. Although sand is generally the least expensive of all inorganic amendments it is also the heaviest. This may result in prohibitive transportation costs. Sand is a valuable amendment for growing media when used in small amount.

b. Perlite

Perlite is a volcanic rock heated to approximately 980 Centigrade. The result is a light, porous powdery substance. Its lightness and uniformity make perlite very useful for increasing aeration and drainage but does not hold water and nutrients as well as vermiculite.

Perlite is very dusty when dry and has a tendency to float to the top of a container during irrigation. It has also been shown that perlite contains potentially toxic levels of fluorine that can cause fluoride burn on some plants. Although costs are moderate, perlite is an effective amendment for growing medium.

c. Vermiculite

Vermiculite is a sterile, lightweight mica mineral produced by heating to approximately 745ºC. The expanded, plate-like particles which are formed have a very high water holding capacity and aid in aeration and drainage. Vermiculite has excellent exchange and buffering capacities as well as the ability to supply potassium and magnesium. Vermiculite collapses with time its chemical and physical properties are useful in container medium.

d. Expanded Polystyrene (styro beads)

Polystyrene beads are bi-product of polystyrene processing and are highly resistant to decomposition. When mixed in a growing media, it increases aeration and drainage, Polystyrene may be broken down by high temperatures and by some chemicals.

B. Recommended or Suggested Artificial Mixes

Mix	**Coco Peat**	**Whole Rice Hulls**	**Sawdust**	**Soil**
1	5 parts	1 part	-	--
2	5 parts	1 part	-	1 part
3	5 parts	1 part	1 part	1 part

Note: Volume or weight can be used as a unit of measure as long as it is consistent but volume is preferable. The small amount of garden soil can serve as a binder for the rice hull and coco peat.

Rice hull can be sprayed with fungicide to prevent Botrytis or Gray mold that causes damping off.

C. Computation of Media Volume

Assumptions:

Cell volume per tray:
100 cell tray = 90 cc x 100 = 9000 cc
49 cell tray = 125 cc x 49 = 6125 cc

Tray type/Media Volume	1,000 trays	10,000 trays	100, 000 trays
100-cell	9.0 cu m	90.0 cu m	900 cu m
49-cell	6.1 cu m	61.5 cu m	615 cu m

D. Mixing the Growing Media

The procedure should be to thoroughly mix the components without destroying their physical structures because over-mixing reduces porosity, which would impede root growth and can lead to the development of root diseases. Some nurseries mix the components by hand on the floor using shovel then move the soil mixture using a soil conveyor to a bin that supplies a container filling equipment called tray filler.

There are several types of mixing equipment that are commercially available in the market or fabricated that can produce a more-uniform growing media. Some nurseries use cement mixers to mix small batches of medium. Medium-sized nurseries usually use a batch mixer that uses paddles to mix 1 to 3 cu m of growing media at one time.

While mixing the components of the growing media, mix in water gradually and carefully. To determine the correct amount of water applied, perform the “Charmin” test which is like squeezing a roll of Charmin toilet paper. If the media sticks together without falling apart you have enough H2O! There should not be any excess of water dripping out when one gives the media a squeeze.


E. Add-ons:

1. ***Mychorrhiza or beneficial fungi***

Many tree species have a special symbiosis, or beneficial relationship between a fungus and the tree roots. This symbiotic relationship is called “mycorrhiza”. The mycorrhiza helps the plant absorb water and nutrients, and protects the roots from diseases. These fungi cling to the roots as little nodules or bundles. The fungi increase the ability of the plants to use nitrogen gas between the medium particles. The rate is 1 kilogram of mychorrhiza for every sack of growing medium component.

2. ***Controlled-release fertilizer (CRF)***

If available, controlled-release fertilizer can be incorporated in the growing medium. Follow label instruction or manufacturer’s recommendations (dosage).

Finally, as a good nursery practice, always clean up!

FOR THE REFERENCE AND GUIDANCE OF ALL CONCERNED.

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