Beaver Plastics

Technical Bulletin

Buffer Zone
Copperblock Nursery : Growing Medium

INTRODUCTION

The purpose of the growing medium in a Copperblock container is to

(a) provide support for the seedling and

(b) hold the nutrient solution for uptake by the roots

We have to appreciate plant growth and physiology when selecting and using a growing medium for raising loblolly in Copperblock trays.

The grower's objective is to have the seedling roots grow evenly throughout the plug. A healthy, dispersed root system will take up adequate moisture for transpiration and absorb mineral nutrients dissolved in the soil water and essential for growth.

• Water uptake is passive but mineral accumulation – where the concentration of nutrient ions in the root cells is greater than in the soil solution – requires the expenditure of metabolic energy i.e. respiration.

• For plant roots to respire they need oxygen – which they absorb from the air in the soil. Respiration releases carbon dioxide. If the oxygen content of the soil air reduces, anaerobic respiration begins and no energy is available for nutrient uptake.

• Respiration provides the energy for cell division and cell elongation in the root tips – by this growth the roots can disperse throughout the plug. Oxygen is required wherever there is a root tip. (you can change most other aspects after you start a crop, but not the air-filled porosity)

A buffer zone Copperblock loblolly nursery can be thought of as a hydroponic growing system – seedling growth controlled by fertigation depending on the nature of the growing medium.

> The single most important feature of growing medium management is AIR FILLED POROSITY **AFP**

COMPONENTS

Soilless growing media may have a very low CEC (cation exchange capacity) and require continuous fertigation or may have a high CEC requiring only intermittent fertigation alternating with irrigation.

STARTUP Fertigation with every irrigation is safe and CEC is not an important aspect of the growing medium.

Alternating fertigation, with a high CEC growing medium, is influenced by pH. Cation availability is optimum in the range pH 5 – 6.

> **The target for Copperblock loblolly growing media is 30% AFP v/v (range limits: 25% to 40%)**

Peat moss – Peat is the largely organic residues of plants, incompletely decomposed through lack of oxygen. Peat moss is usually partly decomposed Sphagnum moss species (others are Hypnum peat moss; reed peat; sedge peat).

On a volume basis sphagnum peat moss can hold 48% water after draining (WHC) and still have 25% AFP. Sedge peat has 20% AFP and 32% WHC. Sphagnum peat moss is hydrophobic when dry and becomes increasingly difficult to rewet – a wetting agent is usually added to irrigation.

Sphagnum peat moss CEC range : 100 – 180 meq/100g

Peat moss is classified as Light or Dark: Light peat moss has the higher AFP but lower CEC, dark peat moss has the higher CEC but lower AFP.

EC (electrical conductivity) of sphagnum peat moss 0.85 mS/cm ; sedge peat 0.35 mS/cm (see the Tech.Bull. on Fertilizers).

C:N ratio ~45:1 – high lignin content – decomposes slowly with little nitrogen drawdown.

Sphagnum peat moss pH ranges from 3 to 4 and is calcium deficient. Hypnum peat moss pH ranges from 5 to 7 and is usually calcium sufficient.

Peat is graded :
- coarse (all particles > 2.38mm)
- medium (all particles between 2.38 and 0.84mm)
- fine (all particles < 0.84mm)

Copperblock growers use fine grade to ensure sticks are removed ("stick" = anything > ¼ x 1 ins or longer than 2¾ ins)

> A 1½" stick can bridge halfway down a 415 cavity.

Weed seeds – sphagnum peatmoss is virtually free of weed seed. But know the history of the shipment – peatmoss is usually vacuumed off the exposed surface of a bog, a few inches per year, over several years. A newly opened peat bog may be contaminated with weed seed.

Peat moss is compressed during packaging to half its normal volume. When bales are opened the peatmoss expands in the mixing and filling process.

Pine Bark with a resinous smell should not be used before composting. Pine bark may be aged (will draw down more N) or composted, management is easier with composted bark.

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Pine Bark Compost (PBC)

Pine barks are typically composted 5 weeks to 5 months reducing the C:N ratio from 300 down to 45:1 – there will be a continuing need for nitrogen as decomposition continues in the mix.

AFP 30 - 40%
WHC 25 - 35%v/v BD <12lbs/ft^3
pH 3.9 – 5.9
EC 0.22 - 0.96 mS/cm
CEC 53 meq/100g

Testing AFP
Fill one Copperblock tray with soilless medium as usual. Select one cavity and close the drain hole with your thumb. Add water until the surface glistens. Remove your thumb and collect the water that drains.
Fill an empty cavity with water to the same level as the growing medium to determine the volume of growing medium.

Vol drained water ÷ vol growing medium X 100 = AFP%

Pine Tree Substrate (PTS) manufactured from chipped and hammermilled (¼" screen) freshly harvested loblolly pine logs. The C:N ratio is high and an additional 100 ppm N is advised.

AFP 31%v/v
WHC 48% pH 5.8 EC 1.45 mS/cm

Coir dust. The coir fiber pith or coir dust produced as a by-product when coconut husks are processed for the extraction of long fibers (there are no sticks!). Hydrophilic (wets easily) – and can hold up to 9 times its dry weight (5½ lbs/ft^3) in water. (a ⅓ ft^3 brick uses 1 gallon of water to expand to 1.5 ft^3. Add coir dust to the mix to improve wettability. The capillarity of coir dust aids in redistribution of moisture added by irrigation.

pH 5.0 – 6.8 less lime required than with sphagnum peat moss.

C:N ratio 100:1 = more N drawdown than sphagnum peat moss but less than composted bark or sawdust. The high lignin (31%) makes it slow to decompose.

AFP 15%
WHC 52% CEC 60–130 meq/100g EC 0.5–0.8 mS/cm

It contains significant potassium (0.4% DWt). If EC > 1.0 mS/cm leach strongly with the first irrigation.

Coir dust can suppress Rhizoctonia – damping off disease.

AMENDMENTS:

Vermiculite - grades #1(coarse) - #4 (fine): Bulk density 7lbs/ft^3 has a high water-holding capacity, high CEC 82 – 150 meq/100g and neutral pH. Grade 3 is used to increase AFP and WHC of a mix.

Perlite has a low water holding capacity (19%), low CEC (1.5 – 3.5 meq/100g) and neutral pH. Perlite itself has 60% AFP so is used to improve aeration in a mix.

Styrolite™ growing media amendment is lightweight, large particle size – used to increase AFP, does not raise WHC. see the Beaver Plastics Bulletin on Styrolite

Sawdust has a high C:N ratio 1,000 - 310:1 and needs to be composted for at least 6 weeks, usually longer to reduce the ratio to ~100:1 and still requires additional nitrogen fertilization in the mix. depending on particle size sawdust has AFP 47% and WHC 39%.

Puffed rice hulls – (of recent interest) – Rice hulls are hydrophobic but Puffed rice hulls are hydrophilic. PRH are pH neutral, light and useful to increase drainage and aeration. Nitrogen draw-down must be avoided. Composted rice hulls will have a pH 5.7 – 6.2 and potassium will be significant. C:N 120:1

The objective, for the Copperblock nursery, is to have air-filled pores to the bottom of each cavity, shortly after irrigation or rainfall.

AFP vs WHC

Air Filled Porosity is due to the **macropores** between particles in the growing medium – where the adsorption forces binding water to the surface of the particles cannot resist the force of gravity drawing the water down.

Water Holding Capacity is mostly due to the **micropores** between and within particles in the growing medium – where water adsorbed to the surfaces fills the micropore.

However, there is no fixed limit between micro- and macro-pores. Even large pores can form a capillary and hold water against the pull of gravity. The weight of the water column is proportional to the square of the tube diameter – so a narrow tube will support a higher column than a wide tube.

A glass capillary tube 0.5mm in diameter will lift a ~2.8mm column of water.

MIXING

Mixes – are not essential – loblolly seedlings can be grown perfectly well in Copperblock trays with hammermilled (¼" screen) pine needle litter as the growing medium. A mix should target AFP, accommodate irrigation constraints and assist nutrient regimes. A growing medium mix for loblolly in Copperblock trays can be composed of one or more components, amendments and additives e.g. lime (add 3lbs/yd^3 dolomitic lime).

Common mixes:	
Peat/vermiculite	**80:20**
Peat/perlite	**80:20**
Peat/sawdust	**80:20**
Peat/PBC	**75:25**

STARTUP

Start with a pre-mix (formulated for forestry). But ask for the details: AFP; WHC; EC; pH; CEC and all nutrients added. Know the components.

Ask for a warranty on sticks and on weed seeds.

Batch mixing – used for production up to 300 blks/hr (~100ft3/hr) Peat bales may need pre-breaking and fluffing, coir dust will need pre-hydration, sawdust may need pre-screening. The batch mixer should operate only long enough to achieve an even distribution of all materials including added moisture – longer mixing may cause damage e.g. compression of vermiculite, pulverizing peat fibres.

The second most important feature of growing medium management is CONSISTENCY

ENDUP

Continuous mixing

For efficient operation at 900 blks/hr (11yd^3/hr) an automated continuous mixing line is essential and can be managed by a single operator.

CONTINUOUS MIXING LINE – DRUM MIXER TO THE LEFT.

Mix Moisture Test – Squeeze a handful hard – no drop should fall, but your hand should be damp.

FILLING

The most difficult operation in a Copperblock nursery is block filling. All the close attention to media selection and mixing can be ruined by poor, inconsistent filling.

Target fill per cavity –
(a) no large air pockets
(b) target AFP
(c) target quantity nutrients (if added)

Copperblocks require careful filling as the coating can slow the filling process.

Check the AFP. – Develop a mental relationship between compaction and target AFP. Conduct continuous finger tests of compaction and intermittent tests of AFP.

STARTUP

Manual fill – Copperblock trays can be manually filled by spreading an excess of growing medium over the block surface and then dropping the container a few inches onto a flat surface. Repeat to achieve target fill. Repeat, consistently, for every Copperblock tray.

Check the AFP.

Batch filling – A simple advance that can serve a demand for ~ 300blks/hr – a few Copperblock trays laid on a vibrator table with growing medium spread by hand. Vibration or drops (produced by off-set cams) are set to achieve target fill.

Check the AFP.

ENDUP

Continuous fill – for production rates up to 900 blks/hr. This can be fully automated, controlled by a precision seeder and limited by detectors on the mixing line. A single operator can manage the filling-seeding line.

CONTINUOUS FILLER

Caution – Loading the filler hopper by conveyor can lead to separation of controlled release fertilizer (CRF) prills (grain silo physics). If CRF is added to the mix, more moisture may be needed to hold the prills.

Photo Note: the power conveyor feeds Copperblock trays from the right.

The roller conveyor provides downwards pressure to maintain traction. Cavity filling and compaction of the growing medium is dictated by the time the container spends in the filler and the vibration intensity of that conveyor.

TAMPING (DIBBLING)

The final operation before seeding will:
(a) provide room for seed cover
(b) help the seed to be centered

Between filling and tamping the Copperblock trays must be brushed free of surplus growing medium – to improve hygiene in the nursery.

STARTUP

Manual dibbling – can be achieved with a simple dibble-board designed for the Copperblock model in use. The dibble-board pins should extend ½ in with a convex apex of ¼ in. The pin diameter should be 1/16 in less than the cavity top diameter.

Loblolly seed requires a target dibble depth of ½ in – for the seed + seed cover.

ENDUP

Roller dibbling – may be passive or powered – designed for the specific Copperblock tray – and the dibble depth can be adjusted.

A POWERED DRUM DIBBLER.

AFP is an average!
– the photo (below right) shows the increase in WHC lower down in a pot that was filled with a uniform mix, irrigated and allowed to drain. The AFP correspondingly reduces with depth.

This is due to the range of capillaries – with the narrowest (micropores) holding water to the top and the widest (macropores) supporting the shortest columns of water.

Evaporation from the drain hole of a Copperblock cavity provides aeration for root growth at the very bottom of the cavity.

A zone immediately above the drain is the most difficult to aerate and can result in poor root development in this zone.

Solution –

- Fill with the driest medium (that will still be retained)
- Use the least possible vibration (to get the greatest AFP at the base of the cavity)
- Tamp (dibble) to compress the upper layer.

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