HERBICIDES

Our herbicide program entails a granular application at the time of transplanting to larger containers. Because we are dealing with unestablished plants, we use Scott's Ornamental Herbicide II. In 60 to 90 days we will make a second application. We also try to be diligent about keeping our bands around the pads and cold frame houses sprayed with Roundup.

In propagation we do not apply herbicide until the plants are well established and there is no danger of phytotoxicity. We apply Scott's Corral under plastic in the winter months.

CONCLUSION

The trends we see in tree production are that more and more growers want cultivars and unusual plants. They are looking for uniformity. We are also having growers requesting larger liners such as a size of 11 liter (3-gal).

We continue to strive to produce the best liner on the market today. We thank all of our customers who have stayed with us through the years and welcome those who want to join us.

Clay as a Pine Bark Substrate Amendment: Past, Present, and Future©

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Soilless substrates are used extensively nationwide to produce containerized ornamental crops. The primary substrate components in the southeastern United States nursery industry are pine bark and sand. This porous, primarily inert, media provides the physical characteristics for maximum plant growth. A salable plant is quickly produced in a pine bark substrate in conjunction with high nutrient and water inputs. However, nutrient- and water-use efficiencies for these inputs are low due to the inert porous nature of the substrate. Water- and nutrient-use efficiency is a concern for growers due to increasing local, state, and federal regulation for water use, water availability, and regional environmental impact.

Substrate amendments increase bulk density, available water, air space, or nutrient retention. Amendments may also be used to replace limited substrate components, such as nonrenewable resources, i.e., peat moss. Substrate amendments that offer these attributes have been studied at length, resulting in some new products integrating into the industry.

Inorganic amendments range widely in physical and chemical composition. Soil is a component that was used readily in the past, but was discontinued due to high bulk density, inconsistent quality, and associated pathogens (Handreck and Black, 2002). Sand is the primary inorganic amendment or component in the southeastern United States. Course, sharp sands (0.25 mm–2 mm) increase bulk density, aeration, and water-holding capacity (Reed, 1996). Calcined or expanded clay and zeolite have been used to replace sand or other inorganic components in Europe. Clay minerals increase percolation rate, drainage, and air space (Reed, 1996). Calcined palygorskite clay has been shown to increase pH-buffering capacity, reduce available phosphorus and subsequent leaching, and provide aluminum (Al) at pH 4.5–4.9 (Handreck and Black, 2002). Earlier studies focused on the effects of clay minerals as an amendment for peat-based substrates with little research being conducted with a pine-bark-based media.

Laiche and Nash (1990) conducted research using arkalite (sic), a lightweight clay aggregate, or sand as the inorganic substrate component. Water extractable nutrients were compared from substrates consisting of pine bark and screened, crushed, or blended arkillite at a 4 organic : 1 inorganic ratio. The incorporation of arkillite into the substrate resulted in increased extractable Na or Ca and decreased Mg or K. These changes were most notable for crushed clay. Warren and Bilderback (1992) compared rates 0, 27, 54, 67, 81 $kg \cdot m^{-3}$ (46, 91, 113, 137 lb/yd^3) of arcillite in a pine bark substrate and found that arcillite incorporation resulted in a change in pore size distribution that increased available water curvilinearly and decreased air space linearly, but did not affect total porosity. Ammonium, P, or K concentration decreased with increasing arcillite rate. However, plant growth of *Rhododendron* 'Sunglow' increased curvilinearly with arcillite, the optimum rate being 57 $kg \cdot m^{-3}$ (96 lb/yd^3). This increased growth was hypothesized to be the result of more P, K, and Mg root absorption and increased available water in the substrate.

Industrial clay minerals, palygorskite and smectites, which have been used as an absorbent, fertilizer carrier, and barrier clays (Murray, 2000) have recently been studied as amendments for pine-bark-based soilless substrates. The most poplar size for the agriculture industry is 24/48 mesh size. This material, however, is actually composed of particle sizes passed between 20/60 mesh sieves (0.85–0.25 mm) (Moll and Goss, 1997). Industrial clay minerals are also dried at 121 °C (250 °F) and described as Regular Volatile Material (RVM)(Moll and Goss, 1997) and referred to here as pasteurized. The dried product can be subjected to further heating [≤ 800 °C (≤ 1500 °F)] and classified as a Low Volatile Material (LVM), which is calcined, or fixed.

Ruter (2003) investigated P-binding of palygorskite from Georgia at various particle sizes when used to amend an 8 pine bark (PB) : 1 sand (v/v) substrate. He reported that with controlled-release fertilizers (CRF) there was a 61%, 76%, or 74% reduction of inorganic phosphorus leached when using particle sizes > 3.36 mm, < 1.00 mm, or a spectrum of particle sizes ranging from < 1.00 and > 3.36 mm, respectively. Owen et al. (2003) investigated pine bark amended with palygorskite bentonite industrial mineral from Georgia at 8% (v/v) with one of either two particle sizes (mesh sizes 5/20 or 24/48) that had been pretreated at one of two temperatures (calcined or pasteurized). An additional substrate was added to represent the industry standard [8 pine bark: 1 sand (v/v)]. *Cotoneaster* ×*suecicus* 'Skogholm' (syn. *C. dammeri* 'Skogholm') shoot and root dry weights were unaffected by any of the treatments. Mean daily irrigation volume applied per container was decreased from 9% to 18% by the clay treatments compared to 8 pine bark : 1 sand (v/v) substrate. The smallest particle size (24/48) decreased mean daily water application by ≈ 0.4 $L \cdot d^{-1}$ compared to the industry standard. When extrapolated over a growing season [May through September (153 days)] this is equivalent to approximately 370,309 L per production hectare (≈ 100,000 gal per production acre) of water savings. Substrate water buffering capacity determined as a function of stomatal conductance was greater in smaller particle size (24/48) calcined clay. Stomatal conductance was greater with plants grown in substrate amended with smaller particle size (24/48) calcined clay, compared to the other treatments, up to 19 h without water. Owen et al. (2003) conducted a second study to determine the optimum rate of clay comparing 0%, 8%, 12%, 16%, 20% (by volume). 'Skogholm' cotoneaster weight and net photosynthesis both fit curvilinear models as a function of clay amendment rate. A 39% increase occurred in total dry weight when the clay amendment rate increased from 0% to 12%. However, as the clay rate increased from 12% to 20% top dry weight decreased 20%. Clay amendment rates produced a quadratic relationship with maximum net photosynthesis and plant growth at clay rates of 12% and 11%, respectively.

Ongoing research is reporting the potential benefits of using industrial mineral aggregates in pine substrates, however there is still a need for further research. Future research is needed to compare products to investigate a greater variety of particle sizes to increase cost effectiveness and other potential sources of mineral aggregates. Multiple species growth and nutritional content need to be evaluated in clay-amended substrates due to the limited amount of ornamental crops investigated to date. A greater understanding of phosphorous speciation in clay-amended substrates is needed to gain a greater understanding of environmental and plant impact. Calcined industrial minerals as soilless substrate amendment may increase water and nutrient retention in containerized production, increase containerized crop production efficiency, and alleviate environmental concerns.

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