Pine Tree Substrate Construction for Optimal Water Holding Capacity and Air Space

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Significance to the Industry: This research demonstrates that amendments of peat moss, pine bark (PB) and sand to a pine tree substrate (PTS) can be used to improve the physical properties of PTS and plant growth in PTS. In this way PTS with larger particles (reduces grinding costs) can be used as the base for the substrate with the addition of other materials that increase water holding capacity. Another approach is to mix PTS of different particle sizes to produce a substrate with optimal physical properties.

Nature of Work: The use of a PTS produced by grinding loblolly pine trees (*Pinus taeda* L.) for the production of a wide variety of nursery and greenhouse crops has been demonstrated (1, 3, 6, 7, 8). The effect of the particle size of PTS—easily altered by the degree of grinding—on plant growth and physical properties such as container capacity (CC) and air space (AS), has been demonstrated (4, 5). Depending upon the particle size of PTS, blending materials such as peat moss, aged PB or sand with PTS should alter, CC, AS, and cation exchange capacity, pH and a number of other factors that could affect plant growth. This approach has not been investigated. Therefore, the purpose of this work was to evaluate the influence adding peat moss, PB, and sand to PTS with different particle sizes on substrate physical properties and the growth of marigold (*Tagetes erecta* Big. 'Inca Gold').

Substrates differing in particle size were prepared by further grinding coarse pine chips from loblolly pine (*Pinus taeda* L.) in a hammer mill fitted with different screen sizes: 4.76, 6.35, 9.54, and 15.8-mm (3/16, 1/4, 3/8, 5/8 inch). Each PTS was then amended with either, 25 % sand, 25 % peat, 25 % PB or 25 % PB and 10% sand by volume. Control treatments included peatlite (PL) (80% peat moss / 20% perlite (v/v) and 100% PB. Each substrate was amended with calcium sulfate ($CaS0_4$) at 0.6 $kg \cdot m^3$ (1 lb/yd^3). The peat moss and PB used for each substrate was amended with dolomitic limestone at 3.5 $kg \cdot m^{-3}$ (6 lbs/yd^3). Physical properties of each substrate were determined pre-plant on three replicate samples of each substrate using the North Carolina State University Porometer Method (2). On April 16 marigold seedlings (*Tagetes* erecta Big. 'Inca Gold') from 144 units plug trays were transplanted into 10-cm square (l L) plastic containers with the different substrates. Plants were glasshouse grown in Blacksburg, VA and fertilized at each watering with 300 $mg \cdot L^{-1}$ N from a Peters 20N-4.4P-16.6K Peat-Lite Special (The Scotts Co., Marysville, OH). On 14 May shoots were severed at the substrate surface, oven dried, and weighed.

Results and Discussion: Container capacity was higher in PTS 3/16 than in PTS 5/8, but AS was higher in PTS 5/8 than PTS 3/16 (Fig. 1). This reflects the finer particle sizes for PTS 3/16 versus PTS 5/8. Adding peat moss and PB, to PTS 3/16 and PTS 5/8 increased CC and decreased AS. However, adding sand did not affect CC but did decrease AS. Adding PB and peat moss to PTS 3/16 elevated CC to levels comparable to PL and above that of PB. Adding PB and peat moss to PTS 5/8 increased CC to that of PB but not to that of PL. Plant growth was reflective of the substrate's CC as affected by particle size and amendments. For example, shoot dry weight in PTS 3/16 and 5/8 was increased by the addition of sand, peat or PB (data not shown) and for PTS 3/16, growth was equal to PL and PB with the addition of peat, PB and PB/sand. Shoot dry weight was less with PTS 5/8 but the additions of sand, peat and PB increased growth above that of PTS 5/8. Why sand additions to PTS increased growth, but not CC is not understood. These results confirm previous work relating PTS particle size and growth (5) and show that growth can be improve by amending PTS with either sand, peat, and PB. The reason for this improvement in growth is most likely due to an increased CC of PTS (5) and in the case of PTS amended with peat moss and PB, increased growth may also stem from an increase in cation exchange capacity and improved nutrient availability in PTS.

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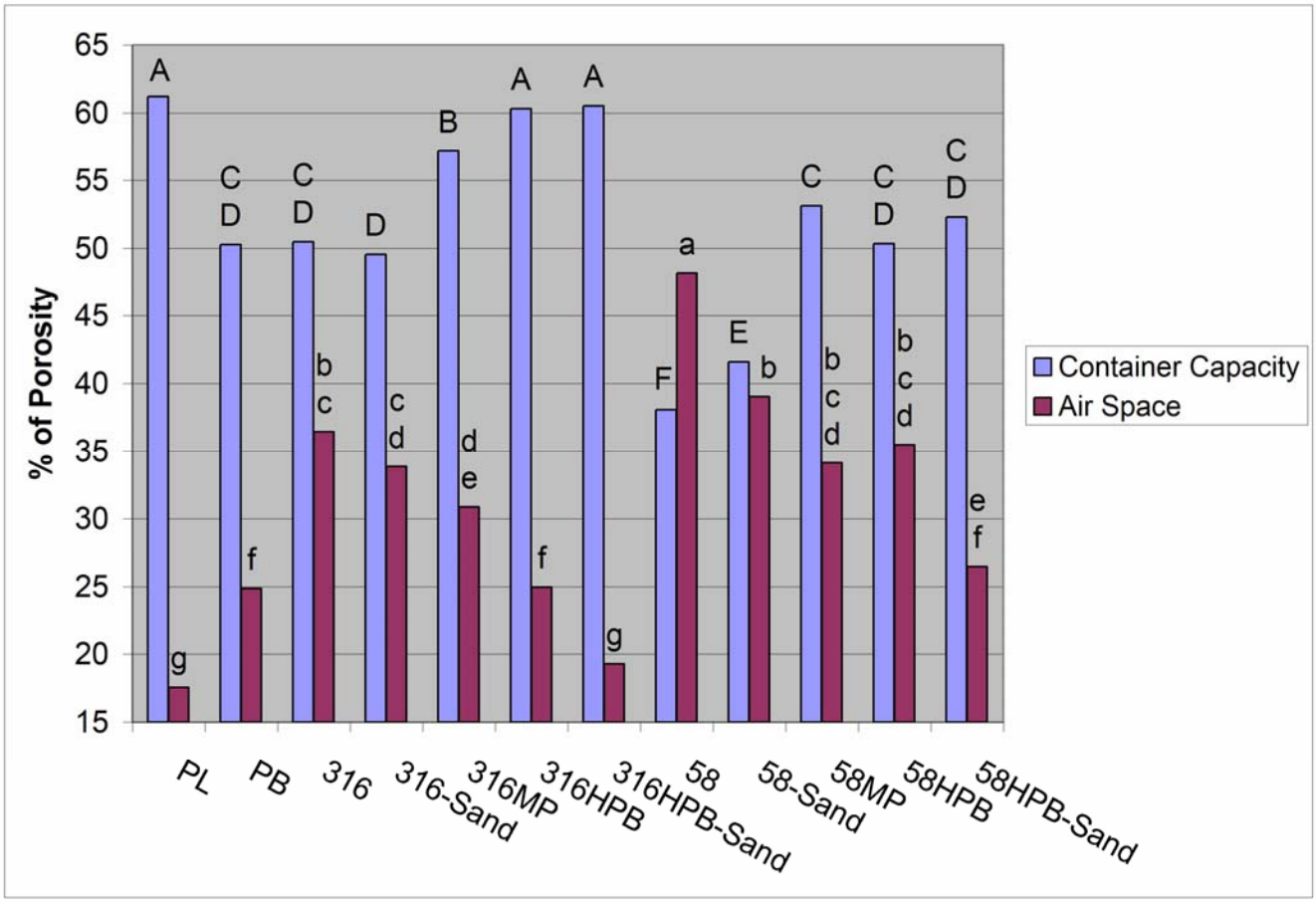

Figure 1. Effect of pine tree substrate (PTS) particle size and amendments of sand, pine bark (PB) and peat moss to PTS on percent container capacity and airspace. PL = peatlite (80% peat moss: 20% perlite, v/v); PB = aged PB; 316 and 58 = PTS ground to pass a 3/16 and 5/8 inch screen respectively; S =10 % sand by volume; MP = PTS mixed with 25% peat by volume; HPB = PTS prepared by hammering pine chips with 25% PB by volume; HPB-S = hammered with 25% PB and subsequently amended with 10% sand by volume. Bars with different letter indicate significant difference at $P \leq 0.05$ by Duncan's multiple range test. Upper case letters apply to container capacity and lower case letter apply to air space.