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Planting depth and soil amendments affect growth of *Quercus virginiana* Mill.

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ABSTRACT

The effect of planting depth, defined as the location of the root collar relative to soil surface, is of particular concern for tree growth, development, and performance in the landscape and seems to be dependent on soil conditions. The objective of this study was to determine the effect of three planting depths and four soil amendments on live oak (*Quercus virginiana* Mill.) growth and visual quality. Trees were planted with root collars at one of three planting depths (grade, 7.6 cm above grade, or 7.6 cm below grade). Soil amendments were: incorporated sand (30% by volume), incorporated composted peat (30% by volume), sandy topsoil in raised (20 cm) bed, and native sandy loam soil (control). Planting at grade or below grade resulted in 0% mortality, while planting live oak trees above grade resulted in 12.5% mortality. The container produced trees were top-heavy (high shoot:root ratio) and were thus susceptible to wind damage when planted above grade. Trunk diameter growth and relative growth rate were smaller when trees were planted with root collars below grade compared to those planted above grade or at grade. Visual quality of live oak roots was improved when trees were planted in raised beds with sandy topsoil compared to the control soil. Shoot visual quality was improved when trees were planted in the incorporated sand and raised beds with sandy topsoil compared to the control and incorporated peat sections. Thus, it is recommended to plant live oaks with the root collar at grade and in sandy top soils in raised beds to improve tree quality after establishment.

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Introduction

Soil conditions are of particular importance for tree transplanting success in urban environments. Important soil conditions to consider during transplanting include soil pH, texture, and organic matter composition and/or location of soil nutrient pools (Consolly, 2007) as these factors may interact to affect soil structure, water-holding capacity, aeration, drainage, nutrient availability and/or toxicity, root penetration, and growth (Schenk and Jackson, 2002). A common practice to improve existing soil conditions at transplanting is the incorporation of organic or inorganic amendments to improve the physical, chemical, and/or biological properties of soil (Bunt, 1988; Scheiber et al., 2007) which may affect water use efficiency and availability (Pausas et al., 2004). Incorporation of inorganic and organic soil amendments has been shown to inconsistently affect tree growth (Nemec and Lee, 1992; Hodge, 1995). Typical soil amendments may vary widely in their composition and effectiveness, depending on type, source, and/or location (Bunt, 1988; Harris and Bassuk, 1993; Consolly, 2007). Bigelow et al. (2004) reported that inorganic amendments (including calcined clay, diatomaceous earth, and zeolite) and sphagnum peat moss lowered the bulk density and increased water retention when incorporated into three different sand classes (fine, medium, and coarse). The inorganically amended sands had greater total porosity (capillary porosity), but this did not increase the available water holding capacity (Bigelow et al., 2004). Amending medium and coarse sands with sphagnum peat moss increased the available water holding capacity (Bigelow et al., 2004).

Variability in planting depth, specifically the location of the root collar relative to soil grade, may also affect plant responses to soil conditions and/or amendments, due to physical/chemical impedance of root growth, and/or nutrient deficiency or toxicity (Arnold et al., 2005; Wells et al., 2006). In addition, optimum planting depth may vary among species and may be dependent on cultural practices and/or environmental conditions (Drilias et al., 1982; Pirone et al., 1988; Browne and Tilt, 1992; Ball, 1999; Gilman

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