From Forest Nursery Notes, Summer 2011

92. © *Quercus virginiana* root attributes and lateral stability after planting at different depths. Gilman, E. F. and Grabosky, J. Urban Forestry & Urban Greening 10:3-9. 2011 .

Urban Forestry & Urban Greening 10 (2011) 3–9

Contents lists available at ScienceDirect

Urban Forestry & Urban Greening

journal homepage: www.elsevier.de/ufug

Quercus virginiana root attributes and lateral stability after planting at different depths

Edward F. Gilman[a,*], Jason Grabosky[b]

[a] *Environmental Horticulture Department, 1543 Fifield Hall, University of Florida, Gainesville, FL 32611-06, United States*
[b] *Ecology, Evolution and Natural Resources, Rutgers University, New Brunswick, NJ, United States*

ARTICLE INFO

Keywords:
Bending stress
Overturning bending moment
Root cross-sectional area
Root depth
Root flare
Tree settlement

ABSTRACT

Planting depth and irrigation can impact root and trunk growth following landscape installation in various soil types; however, impact on lateral tree stability is unknown. *Quercus virginiana* Mill. trees were installed at four landscape planting depths into a well drained sandy soil and grown for six years under two irrigation regimes. There was no impact of planting depth on trunk diameter or height in the first five growing seasons after planting; however, trees irrigated regularly had 10 mm larger trunk diameter than trees not irrigated. There was no impact of planting depth or irrigation on bending stress required to tilt trunks to 1°, 2° and 5° from vertical non-deformed start position six growing seasons after planting. Planting depth and irrigation also had no effect on diameter of the ten largest roots to a soil depth of 122 cm, which might explain why bending stress required to pull trees was similar for all planting depth and irrigation treatments. However, trees planted deeper had deeper roots measured 115 cm horizontally from trunk. Root cross-sectional area (CSA) 20–30 and 40–50 cm deep was positively correlated with bending stress six growing seasons after planting. Trees planted deep had some roots that ascended toward soil surface at a steeper angle than trees planted shallow, and had a deeper root flare and more roots growing over the flare that could potentially form stem girdling roots. Diameter of roots over the flare was not impacted by planting depth; however, trees irrigated for the duration of the study had more roots over main flare roots than trees not irrigated. Irrigation increased root number (>5 mm diameter) in the top 30 cm soil profile. Irrigation had no impact on any other measured root parameter. Trees planted deeper settled down below soil surface more than shallow planted trees.

Introduction

Reasons suggested for planting trees below grade in field soil include increased stability (Lyons et al., 1983), increased moisture retention for establishing trees (VanderSchaaf and South, 2003), simpler mechanical planting of forestry plots (Slocum and Maki, 1956; Harrington and Howell, 1998), reduced damage from herbicide (Reighard et al., 1985), reduced sprouting, and hiding the graft union on grafted trees (Watson and Hewitt, 2005). However, more recent studies have contradicted some of these concepts. For example, Sparks (2005) found that after 3 years, weakly developed lateral or brace roots on deeply planted *Carya illinoinensis* (Wangenh.) trees resulted in increased tilting or blowing over during a hurricane. Gilman and Grabosky (2004) showed that deeply planted trees can become more stressed (had reduced xylem turgor pressure) in the months after planting than those planted shallow. Arnold et al. (2007) showed deeply planted container grown trees had reduced survival compared to those planted shallow. In contrast, Day and Harris (2008) found no planting depth impact on survival or trunk growth in well drained silt loam soil first five years after planting from containers; however, there were more stem girdling roots on deeply planted trees. Broschat (1995) found that both growth and survival were lower when *Phoenix roebelinii* O'Brien palms were planted deeply.

Planting deeply into containers may be more problematic than planting deeply into field soil because roots in containers are deflected down, around, up, and back toward the trunk by the container wall (Gilman et al., 2010b). In several instances, roots grew tangent to and touched or became embedded into the trunk buried by soil. Wells et al. (2006) found that roots growing tangent to and touching the trunk can lead to tree death on *Prunus serrulata* Lindl. 'Kwanzan' seven years after planting. Roots growing over the flare close to the trunk from deep planted landscape sized trees in clay soil (Wells et al., 2006) may also result from deflection by compacted sides of planting holes (Zisa et al., 1980; Gilman et al., 1987) typical of urban soils. It is not clear if this occurs in other soil types.

Roots of nursery sized trees are likely to grow out and away from the trunk on trees planted into field soil (Hewitt and Watson, 2009)

* Corresponding author.
E-mail address: egilman@ufl.edu (E.F. Gilman).

1618-8667/$ – see front matter © 2010 Elsevier GmbH. All rights reserved.
doi:10.1016/j.ufug.2010.09.005