



Figure 1. 3-D model (left) and 2-D root distribution projection for *Fraxinus* 3-13.

Selection and Propagation of Deep-rooted Ornamental Trees for Urban Environments

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Introduction

Ornamental trees in urban environments provide myriad biological, physical, economical and sociological benefits. Trees: 1) provide a habitat for a wide range of animal life, 2) function as a cleansing mechanism for polluted air, 3) shade houses and other structures thus reducing the need for electrically powered air conditioners during the summer and 4) provide an environment in which human beings can connect with nature. However, some trees have root systems that cause damage to sidewalks, curbs and gutters. This damage is the result of planting trees in planting areas that are too small or too narrow and/or the tree's inherent tendency to have shallow, horizontally oriented roots. This problem is of major proportions in many cities in California. In a survey of cities in the Bay Area in 1984, 60% of the street trees were estimated to have caused some or severe damage. A more recent survey of sidewalks in San Jose, CA, found the estimated repair cost for tree related damage to be \$14.3 million and annual concrete repair costs attributed to tree damage range from \$0.18

to \$13.65 per tree. It=s apparent that even a partial solution to this problem would result in substantial savings for city residents and governments.

The overall objective of this research project was to identify, select and propagate appropriate urban tree species with vertically oriented root systems that won=t displace sidewalks and curbs. Phase 1 involved a survey of northern California cities to identify species for study. That resulted in the selection of *Fraxinus uhdei*, *Pistacia chinensis* and *Zelkova serrata* as test species. Phase 2 focused on the field planting, identification and quantification of individuals in each of the three species having root systems that were either shallow-rooted or deep-rooted. Phase 3 will now determine whether vegetatively propagated individuals from trees with known root architecture characteristics will maintain that trait.

Materials and Methods

Fifty, seed-propagated liners each of *Fraxinus uhdei*, *Pistacia chinensis* and *Zelkova serrata* were planted in field plots in Davis. In late 1998, the root systems of half the trees of each species were exposed using a newly developed supersonic air technique (Gross, personal communication). Each root system was marked and photographed from 3-4 angles. The photographs were scanned and imported into PhotoModeler Pro 3.0 (**Eos Systems, Inc.**) computer

Table 1. Vegetative propagation and transplanting summary for selected trees of *Fraxinus uhdei*, *Zelkova serrata* and *Pistacia chinensis*.

Species	Selection	Root Architecture Description	Number of Vegetatively Propagated Trees	Number of Trees Planted (8/24/2001)
<i>Fraxinus uhdei</i>	2Frax8	deep	11	9
A	2Frax9	shallow	11	9
A	2Frax10	shallow	11	9
A	3Frax13	deep	15	9
<i>Zelkova serrata</i>	2Zelk2	deep	3	-
A	2Zelk4	shallow	14	9
A	2Zelk6	shallow	1	-
A	2Zelk9	deep	14	9
<i>Pistacia chinensis</i>	3Pist7	deep	0	-
A	3Pist10	deep	3	-
A	3Pist14	shallow	0	-
A	3Pist15	shallow	2	-

software for the creation of three-dimensional models. The 3-D models were used to determine the vertical orientation angles of each tree's major roots (Figure 1). Those individual trees having the largest (shallow-rooted) and smallest (deep-rooted) mean vertical angle from the soil surface were selected for vegetative propagation by cuttings and subsequent field trial in Phase 3.

Results and Discussion

Table 1 summarizes the vegetative propagation and transplanting progress of Phase 3 of this project. There were significant differences in the ability of the various individual trees within and between species to form adventitious roots. All four *Fraxinus* selections

rooted easily (Table 1). Only two (2Zelk4, 2Zelk9) of the *Zelkova* selections rooted easily while the other two (2Zelk2, 2Zelk6) did not. To date (8/27/2001), the *Pistacia chinensis* selections have not been successfully propagated from cuttings after two attempts (August, 2000; April 2001). Another attempt will be made in August, 2001. After these cuttings are taken the *Pistacia* and *Zelkova* trees will be cut back to a single stump for future cutting attempts from coppice re-growth.

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