Figure 1. Five-gallon container stock of blue, valley and coast live oak planted in Spring, 1997 and irrigated eqally for the first year after planting. Beginning in the summer of 1998, the trees were divided into three groups receiving no irrigation or irrigation at 0.25 ET_0 or 0.5 ET_0.

Assessing the Influence of Irrigation and Treeshelters on the Root Development of Three California Oak Species

Laurence R. Costello and Douglas D. McCreary

Project Summary

Guidelines for the natural and artificial regeneration of native oaks in California have been based largely on research identifying optimal conditions for top or canopy growth. Few studies have investigated the influence of cultural practices on root development. Recent research, however, suggests that factors which enhance top growth do not necessarily enhance root development. This study is investigating the effects of two cultural practices (irrigation and treeshelters) on the root development of two stock types of three native California oak species. Root mass and distribution will be measured and shoot-root ratios established for each of the species and treatment combinations. Information regarding irrigation and treeshelter effects on the rooting patterns of oaks will be very helpful in developing guidelines for optimizing oak growth both above- and below-ground. This information will have application to the management of other tree species in urban and wildland areas.

Perspective: Work for years 1, 2, and 3 is complete. Work for the final year (4) is planned for October, 2000. This will involve complete root excavations and measurements of root distribution, fresh weight and dry weight.

Objectives

1) To characterize the root system size and distribution of blue (*Quercus douglasii*), valley (*Q. lobata*), and coast live (*Q. agrifolia*) oaks grown for 3 years in an agricultural field soil from both acorns and 5-gallon container stock.

2) To assess the effects of irrigation levels on root and top development of the three oak species and two stock types.

3) To evaluate the effects of treeshelters and irrigation levels on the root and top development of acorn stock for each of the species.

4) To demonstrate for horticultural professionals and the general public the most up-to-date, research-based procedures for planting, establishing, and growing oaks.

Accomplishments

Objectives 1-3: As in years 2 and 3, year 4 has largely been a “maintenance” year. Trees and acorns planted in year 1 at the Bay Area Research and Extension Center (BAREC) have been maintained as needed. Both stock types were irrigated at treatment levels (0, 0.25, and 0.5 ET_0) and the plot was periodically mowed and treated to control weeds. Soil moisture levels were monitored on a periodic basis.

Survival has continued at the same level as in previous years: 82% for acorn stock and 100% for con-

Table. 1. Trunk diameter (mm) of container stock (spring, 2000).

Irrigation Level	0	0.25 ET_0	0.5 ET_0
Blue oak	66	65	66
Coast live oak	105	131	125
Valley oak	100	86	105

tainer stock. Trunk diameter data taken in spring, 2000, show that all plants have grown substantially (Table. 1), but treatment effects are inconsistent across species.

Monitor plants of both container and acorn stock were excavated in August, 1999, to provide an assessment of root size and distribution. Root systems of two coast live oak in the acorn plot (one with a treeshelter and one without) were exposed, while 3 plants (one of each species) in the container plot were excavated. Unlike previous years, however, excavations were made using an Air-Spadeä (Concept Engineering Group, Inc., Verona, PA). The Air Spadeä is a hand-held tool connected to a compressor that produces a jet of air moving at approximately 1,800 feet per second which dislodges soil around roots. It has been used successfully in several other root excavation projects. This tool will be used for excavations in fall, 2000.

1999 excavations indicated that root development in all container species was substantial, both in biomass and depth. Relatively large diameter roots (2 cm or more) were found at depths of 3 and 4 feet. Although some horizontally-oriented roots were found, most roots developed a vertical orientation. Collectively, the root systems developed an architecture much like an inverted "V" shape.

Objective 4: To continue to serve our educational objective, this study was a featured part of the 1999 Annual Turf and Landscape Field Day at BAREC. As in previous years, we excavated monitor plants in both the container and acorn plots to show root development. Comparisons to root size and distribution in years 1 - 3 were made.

Laurence R. Costello is Environmental Horticulture Advisor, University of California Cooperative Extension, San Mateo and San Francisco Counties. Douglas D. McCreary is Natural Resource Specialist, Integrated Hardwood and Range Management Program, Sierra Foothill Research and Extension Center.