Blue oak, coast live oak, and valley oak acorns were planted in January, 1997. Treeshelters were placed over half the acorns, while the other half were left unsheltered. Irrigation treatments will begin in summer, 1998. (Fig. 1)

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

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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 will investigate 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.

Accomplishments

The objectives of this study are four-fold:

1. To characterize the root system size and distribution of blue (*Quercus douglasii*), valley (*Q. lobata*), and coast live (*Q. agrifolia*) oaks grown (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 will be described relative to these objectives.

Objective 1: Year-1 work focused on the aquisition and planting of both acorn and container stock for each of the three oak species being studied. Acorn stock (pregerminated) was planted on Jan. 15, 1997, at the Bay Area Research and Extension Center, using seed collected from a single source for each species (Fig. 1). Three main plots (irrigation treatments) were replicated 4 times. Within main plots, 8 acorns of each species were planted, with half the acorns being covered with a treeshelter and half remaining uncovered. Acorns were planted on 4-foot centers, with 8-feet separating main plots. A single row of acorns were planted around the entire plot to serve as buffer plants.

Container stock was planted on March 6, 1997 (Fig 2). Plants were obtained from All Seasons Wholesale Nursery, Elk Grove, CA, in (approximately) 5-gallon containers. Plants were certified to be from a single seed source for each species. Eight randomized complete blocks of species (3) and irrigation treatments (3) were established (10 ft. x 10 ft. spacing). All plants were hand-watered immediately after planting and staked as needed.

Survival of both stock types has been good. All container plants have survived, while approximately 82% of acorn stock survived (coast live oak - 88%, valley oak - 82%, and blue oak - 73%). Acorns without

Blue oak, coast live oak, and valley oak trees (5-gallon container stock) were planted in spring, 1997. All trees were irrigated equally during their first year. During the summer, 1998, one third of the trees will be irrigated at 0.5 ETo, one third at 0.25 ETo, and one third will not be irrigated. (Fig. 2)

treeshelters had a slightly higher survival percentage (84%) than those with treeshelters (81%). By mid-August, valley oaks were significantly taller (24 inches) than coast live oaks (15 inches) and blue oaks (10 inches). Plants in treeshelters were significantly taller (21 inches) than those without shelters (12 inches).

To establish initial shoot-root ratios for container stock, an additional 6 plants of each species (not planted) were sectioned, dried and weighed. Measurements found the following ratios for each species: valley oak - 1.8, coast live oak - 2.6, and blue oak - 1.2. Post-treatment dry weights will show changes in shoot-root ratios after 3 years of growth in field soil. A second set of plants (8) of each species are being maintained in containers and also will be harvested and weighed after 3 years.

Objective 2: An irrigation system was installed in both container and acorn plots approximately two months after planting. A pressure compensating emitter system was used to ensure uniform water distribution for each irrigation treatment (3). System design and equipment specifications were made by the Urban Farmer Store, San Francisco, CA. Separate valves equipped with flow meters were installed for each treatment, while a six-station irrigation clock was set to automatically activate scheduled irrigations. Flow meters will provide an exact measure of the amount of water applied within each irrigation treatment. Initially, all plants were irrigated at reference evapotranspiration (ETo) levels, then after August 15, irrigation was set at 0.5 ETo (1.25 gal. per week for container stock and 0.30 gal. per week for acorn stock). Irrigation treatments for all plots (0.5 ETo, 0.25 ETo, and 0 ETo) will begin in 1998. Soil samples have been analyzed for basic physical and chemical properties (DANR Lab, UCD) and bulk density samples were taken at 5 locations and two depths.

Objective 3: As noted in Objective 1, treeshelters (Tubex, 4 ft.) were installed in acorn plots immediately after planting. Half of all acorns have treeshelters and half do not. Height measurements indicated that seedlings with treeshelters have significantly greater growth than unsheltered seedlings. Interactions with irrigation will be evaluated after year 2 and year 3. Excavation of single seedlings with and without treeshelters found a substantially deeper and larger root mass for the unsheltered seedling (3 ft. deep) compared to the sheltered seedling (1.5 ft. deep). Although this is a singular observation, it is consistent with previous reports.

Objective 4: On three separate occasions we have used the plot to meet our fourth objective (education). The annual Turf and Landscape Field Day in August attracted approximately 200 landscape professionals from around the Bay Area. Our oak study was a featured part of the landscape tour. Using buffer plants in

After 8 months, this oak seedling had developed a tap root which was three feet deep. (Fig. 3)

the acorn plot and "demonstration" plants in the container plot, we excavated root systems to show root development during the first year for each stock type. This turned out to be of great interest since the contrast between the deep tap-root system of the acorn stock and the shallow lateral root system of the container stock was very apparent (Figs. 3 and 4). Also, there was a noticeable difference between the seedling root system with the treeshelter and that without a shelter (as noted in Objective 3). In September, Nancy Garrison (Farm Advisor, Santa Clara County) hosted a meeting for Master Gardeners (and interested others) which focused on oak culture. Our plot was a key part of this meeting as it serve as a point of discussion of practices relevant to the successful establishment of oaks. Finally, the study was presented to Urban Horticulture Advisors during their workgroup meeting at BAREC in October. This was an excellent opportunity to describe the study to individuals who can extend the information around the state.

Irrigation treatments will be initiated in the spring, 1998, and measurements of growth will be made at the end of the growing season. In addition, a "side" study for demonstration purposes has been proposed: an evaluation of the effect of irrigation on root development of acorn stock during the first year of growth. We are interested in learning whether irrigation has an impact on rooting depth during this period. A set of acorns (coast live oak) will be planted in January and half will receive irrigation during the year and half will not. Prior to the annual Field Day in August, we will excavate both groups and compare root development. Field Day participants will be able to observe any differences in root depth and/or mass. This is a progress report

After almost 6 months, this container oak had several roots growing into the field soil. Roots were going laterally from the rootball and somewhat downward. (Fig. 4)

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