

SUMMER IRRIGATION OF ESTABLISHED OAK TREES

by Gary W. Hickman

Abstract. Two trials in California have shown that Valley oaks (*Quercus lobata*) are benefited by summer irrigation. In the first plot, 30 trees (\pm 125 years old) were near summer turf irrigation and 135 trees were not. In 1992, six years into a continuing drought, 28% of the non-irrigated trees were dead, while no trees near irrigation died. In a second plot, 11 of 12 irrigated trees had current year shoot growth of 5 to 31 cm, while only 2 of 12 non-irrigated trees showed similar results.

Many recommendations on irrigation of established native California oak trees caution against summer water application, especially near the base of the tree (1,2,3,5,9,10). Fungal diseases such as oak root fungus (*Armillaria mellea*) and crown rot (*Phytophthora* spp) are often associated with the death of oak trees under a condition of high soil moisture (5,6,7,10,11). Even though oaks are known to be drought tolerant, summer irrigation may be beneficial to oak trees, especially during periods of prolonged drought, if water is kept at least 3 m (10 ft) away from tree root crowns (5,7), or applied in the outer two-thirds of the root zone (1).

The purpose of this study was to test the validity of these recommendations and to present findings on the effects of summer irrigation on established oak trees.

Methods

Trial 1. A group of 165 native valley oak trees (*Quercus lobata*), growing in Oak Grove Regional Park near Stockton, California, were evaluated in 1988 using an oak tree hazard evaluation system that included an objective measure of tree vigor (8). The trees had an estimated average age of 125 years, based on a sampling of increment borings. The soil type in the park is a clay loam with a dense, root limiting calcareous layer at 35 cm (14 in). As a result of this relatively shallow soil, the trees have developed extensive but shallow root systems. Therefore, these trees may be quite

prone to water stress during periods of drought (4).

The average density of trees was 50 per hectare (20/ac) and they were distributed evenly throughout the test area. The region is currently experiencing a drought, with winter rainfall averaging only 58 percent of normal for the last six years.

The park was first developed in 1978, with sections designated as either landscaped or as natural areas. The landscaped areas received regular summer irrigation from sprinkler systems. The irrigation was applied between the months of March and October, four times per week at 45 minutes of irrigation. Water application rates were 5 cm (2 in) per week, approximating evapotranspiration (ET_o).

The natural areas were not irrigated. However, the root systems of some of the trees in the natural area extended into the landscaped areas and therefore received summer irrigation.

To study the effects of summer irrigation on these oaks, the trees were re-evaluated in 1992. Thirty trees located in the unirrigated natural areas were near irrigation, being within 2X dripline of the landscaped areas, and therefore received some irrigation water. The other 135 trees did not receive summer irrigation water.

Trial 2. A group of 24 native valley oaks were selected to study the effects of irrigation on improving vigor on drought-stressed trees. All trees were in a non-irrigated area of the same park and had generally poor vigor. Twelve trees received drip irrigation approximately 2 m (6 ft) from the trunk at the average rate of 0.25 cm (0.10 in) per hour for 30 hours in mid-July. Soil moisture sensors (Watermark, Irrrometer Co.) were placed in the soil at a depth of 35 cm (14 in), the depth to hardpan in the park. Irrigation continued until adequate moisture measured as < 10 centibars, was detected at that depth. The other 12 trees did

not receive supplemental irrigation.

Results

Trial 1. By 1992, 73% of the non-irrigated trees were in serious decline or dead. Significantly fewer, only 27%, of the trees near irrigation were in a similar condition, $X^2 = 20.58$, $P < .01$ (Table 1). Root sampling in the area for diseases did not show the presence of damaging pathogens, and no significant levels of insect pests above ground were found.

Trial 2. Results of the drip irrigation trial showed signs of improved tree growth by mid-August, four weeks after the application of supplemental irrigation (Table 2). Eight of 12 (67%) irrigated trees showed signs of new shoot growth ranging from five - 31 cm (2-12 in) in length. The 12 trees not receiving supplemental irrigation showed no signs of new shoot growth. After five weeks, 11 of 12 (92%) irrigated trees had new growth, while only 2 (17%) of the non-irrigated trees showed similar growth. One year after irrigation, 83% of the irrigated trees continued to show improved vigor over the 1988 ratings. Significantly less of the non-irrigated control trees showed an improved vigor. Only 8% of these trees in 1992 had an improved vigor rating since the 1988 evaluation and 92% showed no change or had declined, $X^2 = 10.47$, $P < .01$.

Table 1. Tree condition

Area	Good-Fair	Serious decline or dead	Total trees	% Serious decline or dead
1988				
Near irrigation	24	6	30	20.0
Non-irrigated	57	78	135	57.8
				$X^2 = 12.55$
				$P < .01$
1992				
Near irrigation	22	8	30	26.7
Non-irrigated	37	98	135	72.6
				$X^2 = 20.58$
				$P < .01$

Table 2. Drip irrigation trial

Irrigation	No new shoot growth	New shoot growth	Total trees	% New growth
4 weeks after irrigation				
Drip	4	8	12	66.7
None	12	0	12	0
				$X^2 = 9.19$
				$P < .01$
5 weeks after irrigation				
Drip	1	11	12	91.7
None	10	2	12	16.7
				$X^2 = 10.74$
				$P < .01$
Change in Vigor from 1988 to 1992				
	Improved growth	No change or decline	Total trees	% no change
Drip	10	2	12	16.7
None	1	11	12	91.7
				$X^2 = 10.74$
				$P < .01$

Conclusions

Under periods of prolonged drought, supplemental irrigation of established oak trees may prevent their decline and death. If irrigation water is applied well away from the tree root crown area but within the tree rooting zone, even frequent summer water application may not be detrimental to established oak trees.

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Résumé. En Californie, deux essais ont démontré que les chênes blancs de California (*Quercus lobata*) tiraient bénéfice d'une irrigation estivale. Sur le premier terrain d'essai, 30 arbres, âgés de plus ou moins 125 ans, se trouvaient près d'une pièce de gazon irriguée en été et 135 arbres ne l'étaient pas. En 1992, après six années de sécheresse continue, 28% des arbres non irrigués étaient morts alors qu'aucun arbre près du système d'irrigation était mort. Sur le second terrain, 11 des 12 arbres irrigués avaient une croissance annuelle courante des pousses de 5 à 31 cm, alors que seulement 2 des 12 arbres non irrigués affichaient des taux de croissance similaire.

Zusammenfassung. Zwei Versuche in Kalifornien haben gezeigt, daß Eichen (*Quercus lobata*) von der sommerlichen Bewässerung profitiert haben. In der ersten Versuchsvariante standen 30 Bäume (+/- 125 Jahre alt) in der Nähe eines im Sommer bewässerten Rasens, 135 Bäume dagegen nicht. Im Jahr 1992, sechs Jahre nach einer andauernde Dürre, waren 28% der nicht bewässerten Bäume abgestorben, während keiner der Bäume in der Nähe der Bewässerung tot war. In einer zweiten Versuchsvariante zeigten 11 von 12 bewässerten Bäumen ein Triebblängenwachstum von 5 bis 31 cm, hingegen zeigten nur 2 der 12 nicht bewässerten Bäume ähnliche Ergebnisse.