COMPREHENSIVE PROJECT REPORT
1991-92

Project No. 91-H3 - Effects of Water Supply and Irrigation Strategies on Almonds

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Objectives: (1) Determine the relationship between seasonal consumptive water use and the growth, yield and quality of almonds. (2) Evaluate irrigation strategies to maximize plant performance given limited water supply on a short term and sustained basis. (3) Further define crop coefficients (K_c) to be used for advanced irrigation scheduling techniques.

Interpretive Summary:

California almond orchards are highly dependent on adequate irrigation for production of acceptable and consistent yields of a quality crop. Quantity and proper timing of irrigation water is of paramount importance in regards not only to yield and quality, but to orchard longevity, disease suppression, and insect damage control. From a grower's perspective, enhanced irrigation management can also reduce energy use and optimize available water use. These incentives have been reemphasized by drought conditions in the mid-1970's and over the past few years.

Recent reports of studies concerning grapes and other deciduous trees indicate that providing less than full consumptive water use can have minimal impact on sustained production and quality. For deficit irrigation to be successful, however, a deficit irrigation strategy must be defined which can provide water during the sensitive vegetative and reproductive growth stages. This project directly addresses this topic.

Determining the relationship between consumptive water use and almond performance on a sustained basis requires imposition and evaluation of treatments over more than one season. This study is being conducted in cooperation with San Joaquin Delta College, using part of their teaching farm orchard near Manteca, California. The soil is a sandy loam irrigated by a solid set sprinkler system able to irrigate individual plots. Our study area incorporates a 10-acre block of 11-year-old trees, arranged in alternating rows of three varieties -- Peerless, Price, and Nonpareil. All measurements are made on the Nonpareil variety.

Imposed treatments include one treatment which provides water for full consumptive use (100% ET) and four treatments which provide for less than full water use (70% and 50% ET) on a seasonal basis while imposing water deficits during either mid-season or postharvest. A sixth treatment (PII or plant-indicated irrigation) utilizes leaf water potential as an indicator of plant

water status for scheduling irrigations throughout the entire season, rather than using set values of water use and static times of deficit imposition. Treatments were imposed beginning in the 1990 season.

Table 1.

Treatment	Percent Seasonal Use	Consumptive Water Use (in)	Average Yield (lbs of kernels/acre)	Percent Hull split 7/25/90	Percent Hull split 8/6/90	Percent Hull-tights
1 (100% use)	100	38.0	3,867 A *	0.3 A	40 A B	0.0 A
2 (70% use) (postharvest deficit)	75	28.3	3,053 B C	1.2 A	43 A B	0.6 A
3 (70% use) (midseason deficit)	67	25.3	2,837 C	0.3 A	79 A	1.0 A
4 (50% use) (midseason and postharvest deficit)	54	20.4	2,881 B C	0.5 A	73 A	1.0 A
5 (50% use) (midseason deficit)	53	20.1	2,783 C	0.3 A	18 B	50.2 B
6 (PII)	67	25.4	3,482 A B	0.5 A	18 B	1.5 A
P-value			0.001	0.516	0.000	0.000
C.V.			15%	152%	65%	225%

* Common letters among means within runs denote no significant difference at $P \leq 0.05$.

Second year (1991) results indicate that yields were significantly affected by irrigation amount and strategy (Table 1). This differs drastically from the uniform yields seen in the first year of imposed treatments (1990). The full water use treatment (T1) produced a significantly greater yield than those of all other treatments except for the plant-indicated irrigation treatment (T6), which also exhibited a high yield. Both treatments which imposed mid-season water deficits (T3, T5) produced lower yields than their counterpart treatments which used similar amounts of water, but imposed water deficits during late season/postharvest (T2, T6). Although the differences were not statistically significant, no support can be found for a strategy which favors midseason deficits in lieu of postharvest deficits.

There was little difference in initial time of hull split between treatments, but irrigation strategy does seem to have an effect on hull split progression, as indicated by higher early August hull split percentages in T3 and T4 plots and significantly lower percentages in the T5 and PII plots. Irrigation water was applied to the PII treatment (T6) near the 8/6/91 hull split reading, at which time hull split occurred rapidly. However, the 50%, midseason deficit treatment (T5) showed a significantly large number of hull-tights at harvest. Approximately half of the nuts harvested from the T5 plots were hull-tights.

No significant differences were seen in other quality parameters of the 1991 harvest. Incidences of worms, mold, ant damage, shrivels, and doubles were similar throughout all treatments

(Table 2), and these results are comparable to the quality parameter results of the 1990 season. Nuts from the harvest were also examined for incidence of green-tip, and while this phenomenon was observed in samples from all plots, no significant difference due to irrigation treatment was found. Also, no significant differences in pruning weights and trunk circumferences were seen.

Table 2.

Treatment	Percent					
	Worms	Mold	Ant Damage	Shrivels	Doubles	Green-Tip
1	0.8	0.0	0.0	0.6	2.5	11.3
2	2.1	0.0	0.0	0.8	0.6	10.5
3	0.2	0.0	0.2	1.5	1.3	15.3
4	1.7	0.0	0.8	0.4	1.5	8.0
5	0.8	0.0	0.2	1.8	0.4	15.7
6	1.2	0.6	0.4	0.8	1.0	12.5
	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

n.s. denotes no significant difference between means at $P \leq 0.05$.

Bloom and set counts were performed. Significant differences were not found between treatments. High variability was noted within treatments in the amount of bloom per 60 cm. of branch length.

The number of nuts per tree (nut load) is responsible for most of the yield reductions (Table 3), although significant reductions in nut weight is also a factor. This information leads one to assume that the lack of growth and production of fruit wood is the preeminent cause of water-induced yield reductions.

Table 3.

Regression	R^2 Value
Yield vs. Nut Load	82.6%
Yield vs. Nut Weight	52.4%

<u>Summary</u>:

After two years of imposed irrigation strategy, we find significant differences in yield, progression of hull split, and number of hull-tights. No differences were found in quality parameters. Yield differences are a result of less nuts per tree, as well as of decreased nut weight. The only deficit irrigation strategy able to yield comparably to the full water treatment is T6, the plant-indicated irrigation strategy.