Project No. 93-I5 - Regulated/Control Deficit Irrigation for Almonds

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Objectives: To test RDI strategies that apply seasonal totals of 22, 28 and 34 acre-inches/acre (deficits of 18, 12, and 6 acre-inches/acre/year, respectively) on cvs. Non Pareil and Carmel in a multiyear field study on shallow rooted, microsprinkler-irrigated trees.

Results:

Regulated deficit irrigation (RDI) is a technique that purposely stresses trees are specific times of the season. While stress is normally considered detrimental to tree performance, we believe that there are periods during the season in almonds when the trees are tolerant of stress. Thus, the successful RDI regime saves water while not reducing nut yields or quality. The goal of this project is to develop the optimal RDI regime for almonds; an irrigation strategy that can be used regardless of water availability. Additionally, useful drought irrigation information will be produced.

The experimental site is a mature orchard on microsprinklers located near McFarland in Kern Co. Potential orchard water use (ETc) is about 40 acre-inches/acre (hereafter referred to as inches). Ten irrigation treatments (including the control) each replicated 6 times were initiated in 1993. Three seasonal irrigation amounts (22, 28, and 34 inches), each applied with 3 different stress timing regimes, are being evaluated (Table 1). The "A" treatments impose the stress primarily before harvest and emphasize reserving water for some postharvest irrigation, the "B" treatments do just the opposite; emphasizing preharvest irrigation and save relatively little water for postharvest, while the "C" treatments impose the stress over the entire season. Regardless of the seasonal irrigation amount, care is taken to provide as much water as possible in the 4 week period just before and after harvest. This is to enhance hull split and successful floral bud development, respectively.

Previous work has shown that hull splitting is reduced by early preharvest irrigation cutoff. Surprisingly, we observed no decrease in hull splitting with NonPareil in any of our treatments (Table 2). While hull splitting was excellent with the control (97% full hull split), it actually increased in some of the RDI regimes. For example, 28A and 28B had 99.3% full hull split. We attribute this to applying relatively large amounts of water in the 4 week period before harvest.

Individual kernel weight was lower when less water was applied preharvest (Table 2). This was particularly evident in the "A" regimes. For example, 22A was 1.05 gm/kernel compared with 1.32 gm/kernel for the control. Stress during nut development resulted in a smaller nut; both shell and kernel. The fact that there was no difference in the shell/kernel ratio confirms this observation. Smaller nuts translate into smaller yields. While measured meat yields tended to be lower in the reduced irrigation regimes, they were not statistical less than the control (Table 2). Clearly, to maximize nut size, avoid stress during nut development. With limited water supplies, emphasizing preharvest irrigation to maximize nut size must be weighed against applying water just before and after harvest to promote successful flower bud development. Observations of flowering and fruit set next season are required to assess which approach is best.

Mummy nuts, those left in the trees after mechanical shaking, tended to be **less** for the reduced irrigation treatments (Table 2). This again may be due to applying relatively high irrigation amounts in the 4 week period before harvest and confirms our previous observation that severe stress during this period is required to increase mummies.

We anticipated that the more severe RDI regimes would make nut processing more difficult and possible reduce nut quality. In order to evaluate this, we collected field samples large enough follow through a commercial huller. The output of meats and in-shell nuts from each treatment was then USDA evaluated at a commercial processor. This season, nut quality was not reduced. Chipped, broken, and rejected nuts varied little across treatments (Table 2). We attribute this to the excellent hull splitting.

Additionally measurements were taken of mite levels, tree barking, NOW, and kernel shrivel (data not shown). No significant differences were observed.

It must be emphasized that this report covers first year results and additional study years are required to evaluate the efficacy of the RDI regimes.

Table 1. Almond regulated deficit irrigation (RDI) treatments.

DATES	CONTROL	34A		34B		34C		28A		28B		28C		22A		22B		22C	
	Normal	RDI	App.	RDI	App.	RDI	App.	RDI	App.	RDI	App.	RDI	App.	RDI	App.	RDI	App.	RDI	App.
	ETc	%	Water	%	Water	%	Water	%	Water	%	Water	%	Water	%	Water	%	Water	%	Water
	(inches)		(inches)		(inches)		(inches)		(inches)		(inches)		(inches)		(inches)		(inches)		(inches)
Mar 1-15	0.5	100	0.5	100	0.5	85	0.5	100	0.5	100	0.5	70	0.4	100	0.5	100	0.5	55	0.3
Mar 16-31	1.1	100	1.1	100	1.1	85	1.0	100	1.1	100	1.1	70	0.8	100	1.1	100	1.1	55	0.6
Apr 1-15	1.4	100	1.4	100	1.4	85	1.2	100	1.4	100	1.4	70	1.0	100	1.4	100	1.4	55	0.8
Apr 16-30	1.8	100	1.8	100	1.8	85	1.5	100	1.8	100	1.8	70	1.2	50	0.9	50	0.9	55	1.0
May 1-15	2.3	100	2.3	100	2.3	85	2.0	50	1.1	100	2.3	70	1.6	50	1.1	50	1.1	55	1.3
May 16-31	3.0	100	3.0	100	3.0	85	2.6	50	1.5	100	3.0	70	2.1	50	1.5	50	1.5	55	1.7
Jun 1-15	3.2	50	1.6	100	3.2	85	2.7	50	1.6	50	1.6	70	2.2	50	1.6	50	1.6	55	1.7
Jun 16-30	3.4	50	1.7	100	3.4	85	2.9	50	1.7	50	1.7	70	2.3	50	1.7	50	1.7	55	1.8
Jul 1-15	3.8	50	1.9	50	1.9	85	3.2	50	1.9	50	1.9	70	2.6	0	0.0	50	1.9	55	2.1
Jul 16-31	3.9	100	3.9	100	3.9	85	3.3	50	2.0	50	2.0	70	2.7	50	2.0	50	2.0	55	2.2
Aug 1-15	3.4	100	3.4	100	3.4	85	2.9	100	3.4	100	3.4	70	2.4	50	1.7	100	3.4	55	1.9
Harvest																			
Aug 16-31	3.3	100	3.3	100	3.3	85	2.8	100	3.3	100	3.3	70	2.3	100	3.3	100	3.3	55	1.8
Sept. 1-15	2.7	100	2.7	100	2.7	85	2.3	100	2.7	100	2.7	70	1.9	100	2.7	50	1.3	55	1.5
Sept. 16-30	2.2	100	2.2	100	2.2	85	1.9	100	2.2	50	1.1	70	1.5	100	2.2	0	0.0	55	1.2
Oct 1-15	1.5	100	1.5	0	0.0	85	1.3	100	1.5	0	0.0	70	1.1	50	0.8	0	0.0	55	0.8
Oct 16-31	1.1	100	1.1	0	0.0	85	1.0	50	0.6	0	0.0	70	0.8	0	0.0	0	0.0	55	0.6
Nov 1-15	0.6	100	0.6	0	0.0	85	0.5	0	0.0	0	0.0	70	0.4	0	0.0	0	0.0	55	0.3
TOTAL	**39.3**		**34.1**		**34.1**		**33.4**		**28.3**		**27.8**		**27.5**		**22.5**		**21.8**		**21.6**

Table 2. Nut quality and yield parameters.

Treatment	<- - -Hull Splitting- - ->			<- - -Individual Nut Full Split- - ->			Stick	Total	<- - - - -After Huller 1/- - - - ->		
	Full Split (%)	Part. Split (%)	Hull Tight (%)	Kernel Wt. (gm)	Shell Wt. (gm)	Shell/ Kernel Ratio	Tights i.e. Mummies (#/tree)	Kernel Yield (lb/acre)	Foreign Material (%)	Chipped or Broken (%)	Rejects (%)
22A	98.1	0.6 *	1.3	1.05 *	0.50 *	0.48	66	1324	9.63	4.20	0.83
22B	98.8	0.6 *	0.6	1.14 *	0.53 *	0.46	59 *	1292	7.92	1.53	0.41
22C	99.0 *	0.5 *	0.5	1.11 *	0.60	0.55	82	1579	5.34	3.70	0.82
28A	99.3 *	0.3 *	0.4 *	1.09 *	0.55 *	0.53	90	1458	7.07	1.93	0.81
28B	99.3 *	0.2 *	0.5	1.20	0.61	0.51	103	1528	5.73	3.36	1.28
28C	98.7	0.5 *	0.8	1.17 *	0.60	0.53	123	1424	7.10	4.78	1.19
34A	99.2 *	0.2 *	0.5	1.13 *	0.60	0.55	131	1400	5.82	2.42	NA
34B	99.3 *	0.3 *	0.4	1.22	0.60	0.50	146	1280	6.38	5.70	1.08
34C	97.0	1.8	1.2	1.29	0.62	0.49	139	1469	7.38	4.24	1.12
Control	97.0	2.1	0.9	1.32	0.64	0.49	131	1644	5.51	5.29	1.07
						NS		NS			

* indicates significantly different than Control at the 5% confidence level using Duncan's multiple range test.

1/ USDA analysis of field sample composited from all 6 reps per treatment; therefore, no statistical analysis.