1991 Annual Report

Project No. 91-I3 - Irrigation Cutoff and Drought Irrigation Strategy Effects on Almond

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Objectives:

Cutoff Experiment: To evaluate the effects of eight preharvest irrigation cutoff periods on long-term sustained tree productivity of cvs. Non Pareil and Carmel. Emphasis is placed on how water stress influences the plant processes that affect the yield components.

Drought Irrigation Strategy Experiment: To evaluate irrigation management regimes for a single drought year. Assuming that 16 acre-inches/acre of water were available, four strategies that applied water at different rates and times of the year were imposed in 1989. The trees were returned to full irrigation in 1990 and 1991 to assess tree recover from a single year of drought.

Methods:

Cutoff Experiment: This work was conducted in cooperation with Paramount Farming Co. in Kern Co. Preharvest cutoff treatments range from 52 to 4 days before tree shaking for the Non Pareil. As soon as possible after Non Pareil harvest, postharvest irrigation was begun. This resulted in the Carmel trees in all preharvest treatments receiving a total of 1.8 acre-inches/acre of water (hereafter called inches) immediately before harvest. In other words, the Carmel trees had the same preharvest irrigation cutoff dates as the Non Pareil trees and coupled with the later harvest, resulted in longer preharvest cutoff durations than the Non Pareils. However, since the postharvest irrigations were geared to the main cv. (Non Pareil), the Carmels received some water before harvest.

After imposing the preharvest irrigation cutoff regimes in 1989 and harvesting the trees, the six original replications were divided into two sets of three each. The first set received full postharvest irrigation and the

second set received no postharvest water in 1989. In 1990 and 1991, the same preharvest cutoff regimes were followed by full postharvest irrigation in all replications. Data on the effects of postharvest water stress will be discussed in next year's report. The data shown herein are from trees that received full postharvest irrigation for the three years of this project.

Previous Findings:

For the first two years of this experiment, the length of the preharvest cutoff duration had no significant influence on total kernel yield provided that the trees received full postharvest irrigation. However, hull splitting was decreased in direct relation to the cutoff duration. There was a dramatic decrease in fruit set--the evolution of flowers to nuts--as a result of the postharvest water deprivation. The greatest decrease (a 96% reduction in fruit set) occurred when the earliest preharvest irrigation cutoff (53 days before harvest that applied 21 inches of water) was also deprived of postharvest water, although significant decreases in fruit set were observed when all cutoffs of 25 days or more were followed by no postharvest water. There were no significant effects of the preharvest irrigation cutoff regimes on bloom or fruit set when full postharvest irrigation was applied. It must be emphasized that the experimental orchard has a shallow, relatively low water holding capacity soil. Thus, water stress increases rapidly when water is withheld.

Drought Strategy Experiment: This work took place in Fresno Co. and began in 1989 with the application of four regimes that each applied a total of 16 inches. They ranged from applying all the water early in the season (mid June cutoff) to irrigating with small amounts until the 16 inches of water ran out in late August. Total kernel yields were lower in 1989 when all the water was applied early due to smaller individual kernel size. Although the trees were returned to full irrigation (38 inches) in 1990, total kernel yields were quite low in the trees that received only early water in 1989. Yields in 1990 were significantly higher where water had been stretched out through late August of the previous year. Yields and nut quality were also assessed in 1991.

Third Year (1991) Results

Cutoff Experiment -- cv. Non Pareil

Non Pareil yield and yield component data are shown in Table 1. In 1991, we observed lower nut loads in the earlier cutoff treatments; generally 32 days or more. It must be emphasized that this is the first time that this important yield component (nut load) has been negatively impacted by the

preharvest irrigation regimes. This translated into significantly lower total kernel yields for the early cutoffs. As was true in previous years, hull splitting was reduced in proportion to the duration of the preharvest cutoff. For example, with 17.5 inches of preharvest applied water (52 day cutoff) versus 31 inches for the control, there were 38% and 100% full hull split nuts at harvest, respectively. Due to the lower nut loads with the early cutoff and its compensatory effect on individual nut size, we did not observe the clear reduction in nut size in relation to cutoff duration as in previous years when nut loads were similar.

Considerable efforts were made to determine the source of the reduced nut load with the early cutoffs this year. A battery of measurements was made of fruiting characteristics on single branches in the late winter and early spring. No significant differences were found in spur density, nut density, spur length, and nuts per spur (Table 2). Only mild statistical differences were found in bloom density, fruit set, and nut per unit spur length (Table 2). We believe that the reduced nut loads were the result of less fruitwood growth and more shoot dieback with the early cutoffs. Table 3 shows that for the 1990 and 1991 seasons, the total increase in trunk cross-sectional area was inversely related to the duration of irrigation cutoff. For example, there was a 37% reduction in trunk growth relative to the control with the 52 day cutoff. Trunk growth is usually related to shoot growth. Thus, reduced vegetative growth resulted in fewer fruiting positions. Due to partial leaf defoliation of the tree canopies resulting from the early cutoffs, sunlight penetration into the interior of the tree likely enhanced shoot dieback, also reducing fruiting positions.

As in previous years, there was no increase in bark damage even though the trees were irrigated only four days before shaking. We believe that even this short time is sufficient with the shallow soil to harden the bark. Trees on deep soils that do not go into water stress as rapidly would be more subject to bark damage with late irrigation.

Webspinning spider mites were counted in May and June before the imposition of water stress in 1991. There was a direct correlation between mite abundance and the duration of the 1990 preharvest cutoff duration; the earlier the 1990 cutoff, the higher the 1991 mite population. Investigation of this phenomenon is continuing.

Cutoff Experiment -- cv. Carmel

It should be emphasized that the irrigation management in this experiment was geared to the Non Pareil trees. This means that the cutoff dates were set depending on the projected shaking date for the Non Pareils. After the Non Pareil harvest, postharvest water was applied as soon as possible to all

trees in the orchard. This resulted in 1.8 inches of water being applied to the Carmel trees in about the 2 week period between Non Pareil harvest and Carmel shaking. This occurred in all the Carmel cutoff treatments.

Kernel yield in the third year of the experiment was significantly lower in the Carmel trees that had irrigation cutoff on July 29 or earlier (Table 4). This corresponds to Non Pareil cutoff durations of no more than 11 days. However, the magnitude of the reductions in yield were less with the Carmel trees relative to the Non Pareils (Table 4). For example, the longest cutoff duration initiated on June 25 resulted in about a 36% reduction in Carmel yield while the same treatment reduced third year Non Pareil yield by 62%. This difference in cv. response to preharvest water deprivation was due primarily to less reduction in Carmel nut load; the individual kernel weights were reduced by similar percentages. Thus, Carmel trees appear to more tolerant of sustained preharvest water deprivation than Non Pareil trees. However, it should be emphasized that our earlier work showed that long preharvest cutoff durations **followed by no postharvest water** resulted in some tree death with the Carmels while adjacent Non Pareils survived.

As with the Non Pareils, our branch measurements of flowering and fruiting behavior generally showed no significant differences between preharvest cutoff treatments. The exception was fruit set where cutoffs on July 8 or earlier resulted in significantly lower fruit set (Table 5). Since fruit set in the Non Pareil trees was highly variable and showed no trend with respect to preharvest cutoff duration, concluding that fruit set is primarily responsible for lower sustained nut loads as a result of early cutoffs is dangerous. However, we have been unable to identify other factors with our individual branch measurements.

Although total water deprivation periods were the same for given cutoff treatments in both cvs. Carmel and Non Pareil, all of this period occurred prior to harvest with the Carmels. On the other hand, some of this period took place during the shaking and harvest with the Non Pareils. We believe that this difference in the timing of the water deprivation period accounted for the greater impact on hull splitting with the Carmels. Cutoffs on July 22 and earlier significantly reduced hull splitting. For example, the July 22 cutoff resulted in 29.4% of the harvested Carmel nuts being full hull splits vs. 73.5% for the August 12 (control) cutoff. These cutoff dates impacted hull splitting in the Non Pareils to a much lesser extent; the Non Pareil full hull split percentages were 87.3 and 99.6 for the two above mentioned cutoff dates, respectively.

Overall Summary of Three Year Cutoff Experiment:

Although Non Pareil total kernel yields were reduced in the early cutoffs this third year, there were no significant differences in average nut load or yield over the three years of this project (Table 3). This is because nut loads and yields were somewhat higher for the early cutoff treatments last year (Figure 1). Individual kernel weights tended to be less for the early cutoffs (Tables 3 and 6).

The important yield components over the three years where preharvest cutoffs were followed by full postharvest irrigation in all years are shown in Figures 1-6. Decreased Non Pareil kernel yields with the early cutoffs (32 days or more) that occurred in year three primarily due to lower nut loads indicates that: 1) the effects of preharvest water deprivation on yields of this most heavily planted almond cv. may not be observed for at least two years after the deprivation due to less shoot (fruitwood) growth, and 2) even with a shallow soil, preharvest cutoffs up to 25 days (about a 6 inch reduction in applied preharvest water), no significant effects on total kernel yield are likely over a 3 year period. However, hull splitting will be somewhat less.

Second Recovery Year (1991) Drought Irrigation Strategy Experiment Results:

In 1991 (the second year of full irrigation following the simulated drought in 1989), the Non Pareil trees stressed in 1989 still generally showed some carryover effects of the stress on nut production (Table 7). An exception to this was the '89 treatment that applied all water early in the season; the treatment that resulted in the greatest yield loss in 1990. In 1991, this treatment had production similar to the control. We believe this was due to an alternate bearing response to the light nut load in 1990.

As in the first recovery year (1990), there were no carry over effects of the drought year irrigation on hull splitting (Table 7).

Overall Summary of Drought Irrigation Strategy Experiment:

The success of a single year drought irrigation program that stresses the trees during the season must be measured not just by production in the drought year but also in following seasons. Our data clearly shows that the major impact of a poor drought irrigation strategy occurs in the year following the single season drought (Table 7). For example, when all of the 16 inches of water was applied early in the season during the drought year, yield was only reduced by about 18% due entirely to a smaller individual nut size. Even though the trees were returned to full irrigation

the following season, the yield with that particular drought year management suffered a 67% reduction the following season. That can be compared with yield reductions in the treatments that stretched the 20 inches through harvest of the drought year (irrigating at a rate of 50% ETc) of 12% and 26%, in the drought and following season, respectively.

It's clear from our data the summarizes average production over the 1989-91 period (Table 7) that under the conditions of this single season drought simulation experiment--mature, clean cultivated trees grown on a deep, relatively high water holding capacity soil--that stretching out limited water supplies through or just after harvest is the best drought irrigation strategy in terms of minimizing yield losses. Applying the water earlier in the drought year resulted in an average kernel loss of about 200 lb/acre per season over the drought and subsequent two recovery seasons in relation to best performing drought irrigation strategies (the "stretch" treatments). Strategies that stretched the water in the drought year also resulted in the greatest hull splitting in the year that water stress was imposed.

Table 1. Third year (1991) yield component data for trees with different preharvest cutoff periods that received full postharvest irrigation in 1989 and 1990. Data are for Non Pareils.

Last preharvest irrigation	Cutoff duration (days)	Cumulative preharvest applied water (inches)	Nut load (#/tree)	Mean individual kernel weight (gm)	Total kernel yield (lbs/acre)	Nut Quality		
						Full hull split	Partial hull split	Hull tight
						-- (% of tree nut load) --		
Jun 25	52	17.5	3272a*	1.19	573a	38.3a	33.0a	29.5b
Jul 1	46	19.3	4411ab	1.36	903ab	65.7abc	10.7c	23.6ab
Jul 8	39	21.1	4364ab	1.30	854a	58.9ab	22.1b	19.0ab
Jul 15	32	22.9	4484ab	1.33	896ab	78.7bc	11.9c	9.4ab
Jul 22	25	25.6	7087cd	1.18	1281abc	87.3bc	6.4c	6.3ab
Jul 29	18	27.4	5035abc	1.15	924ab	93.3bc	3.2c	3.5ab
Aug 5	11	29.2	6847bcd	1.35	1421bc	98.5c	0.6c	1.0a
Aug 12	4	31.0	7772d	1.26	1498c	99.6c	0.0c	0.4a
				NSD				

* Numbers not followed by the same letter are significnatly different than others in the same column at the 5% confidence level using Duncan's multiple range test.

Table 2. Third year (1991) fruiting characteristics for trees with different preharvest cutoff periods that received full postharvest irrigation in 1989 and 1990. Data are for Non Pareils.

Preharvest cutoff duration (days)	Shoot diameter 60 cm from tip (mm)	Spur density (#/60 cm)	Bloom density (#/60 cm)	Nut density (#/60 cm)	Fruit set (%)	Mean spur length (mm)	Nuts per spur (#)	Nuts per unit spur length (#/mm)
52	7.51	11.8	28.5a*	8.0	28.2bc	27.5	0.687	0.291ab
46	8.87	13.3	27.8a	8.8	31.6c	32.4	0.703	0.269ab
39	7.64	12.4	30.3a	7.4	24.5abc	34.1	0.603	0.230a
32	7.53	12.8	29.3a	7.8	26.7abc	29.2	0.660	0.288ab
25	8.76	11.7	35.7ab	10.4	29.2abc	31.7	0.887	0.365ab
18	9.26	14.3	48.4b	9.6	19.8a	25.4	0.663	0.389b
11	9.13	14.7	38.9ab	11.1	28.5bc	30.1	0.763	0.359ab
4	7.80	11.0	30.0a	9.11	30.7c	28.8	0.923	0.346ab
	NSD	NSD		NSD		NSD	NSD	

* Numbers not followed by the same letter are significnatly different than others in the same column at the 5% confidence level using Duncan's multiple range test.

Table 3. Summary of three year average values (1989-91) for trunk growth and the primary yield components for the eight preharvest cutoff durations. All cutoff regimes received full postharvest irrigation each year. Data are for Non Pareils.

Cutoff duration (days)	Increase in trunk cross-sectional area[1/] (cm^2)	Nut load (#/tree)	Individual kernel weight (gm)	Total kernel yield (lbs/acre)
52	70.8a*	8643	1.08a	1384
46	92.7ab	9474	1.11ac	1552
39	75.9a	8652	1.13abc	1456
32	94.1ab	7872	1.18abc	1388
25	85.3ab	9526	1.15abc	1684
18	79.4ab	8340	1.13abc	1455
11	102.1ab	8368	1.24b	1574
4	112.0b	9534	1.21bc	1723
		NSD		NSD

[1/] Total for 1990 and 1991 seasons.

* Numbers not followed by the same letter are significantly different than others in the same column at the 5% confidence level using Duncan's multiple range test.

Table 4. Carmel third year (1991) yield component data for the 8 preharvest cutoff regimes. All treatments received full postharvest irrigation in 1989 and 1990.

					Mean		Nut quality (hull split)		
	Preharvest	Cutoff	Cumulative		individual	Total kernel			
	cutoff	duration	applied water	Nut load	kernel weight	yield	Full split	Partial split	Hull tight
Treatment	date	(days)	(inches)	(#/tree)	(gm)	(lb/acre)	(----% of tree nut load----)		
1	Jun-25	64	19.3	11441 a	0.97 a	1595 a	27.2 ab	13.5 a	59.3 bc
2	Jul-01	58	21.1	12862 abc	1.00 a	1944 abc	21.4 ab	15.3 a	63.3 c
3	Jul-08	51	22.9	11327 a	1.10 ab	1710 ab	16.4 a	27.4 b	56.3 abc
4	Jul-15	44	24.7	11889 ab	1.08 ab	1881 abc	29.6 ab	16.7 ab	53.7 abc
5	Jul-22	37	27.4	13283 abc	1.12 ab	2088 bc	29.4 ab	11.3 a	59.3 bc
6	Jul-29	30	29.2	13528 abc	1.01 a	2062 c	56.8 bc	8.20 a	35.0 abc
7	Aug-05	23	31.0	14074 bc	1.21 b	2517 d	69.1 c	5.71 a	25.2 ab
8	Aug-12	16	32.8	15266 c	1.09 ab	2482 d	73.5 c	4.58 a	22.0 a

Numbers not followed by the same letter are significantly different than others in the same column at the 5% confidence level using Duncan's multiple range test. NSD indicates no significant difference.

Table 5. Carmel fruiting characteristics taken during year 3 (1991). All treatments received full postharvest irrigation in 1989 and 1990.

	Preharvest	Shoot diameter							
	cutoff	60 cm from	Spur density	Bloom density	Nut density	Fruit set	Mean spur	Nuts /spur	Nuts /unit spur
Treatment	duration(days)	tip(mm)	(#/60 cm)	(#/60 cm)	(#/60 cm)	(%)	length(mm)	(#)	length(#/mm)
1	64	7.74	16.4	53.0	13.9	26.3 abc	24.0	0.85	0.58
2	58	9.28	17.0	63.7	14.5	22.7 a	29.4	0.85	0.49
3	51	8.03	20.1	66.9	16.5	24.7 ab	30.0	0.82	0.55
4	44	7.61	15.9	50.3	18.4	36.6 d	31.2	1.16	0.59
5	37	8.81	17.0	50.9	16.9	33.3 bcd	28.6	1.00	0.59
6	30	9.31	17.3	56.6	19.4	34.3 bcd	31.5	1.12	0.61
7	23	9.11	18.4	51.7	16.2	31.3 abcd	27.1	0.88	0.60
8	16	7.78	17.3	50.7	17.6	34.8 cd	20.7	1.02	0.85
		NSD	NSD	NSD	NSD		NSD	NSD	NSD

Numbers not followed by the same letter are significantly different than others in the same column at the 5% confidence level using Duncan's multiple range test. NSD indicates no significant difference.

Correct Project Number: 90-I2

Project No. 91-I3 - Irrigation Cutoff and Drought Irrigation Strategy Effects on Almond

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Objectives:

1) Cutoff Experiment: To evaluate the effects of eight preharvest irrigation cutoff periods on long-term sustained almond tree productivity. Emphasis is placed on how water stress influences the plant processes that affect the yield components and tree bark damage through mechanical shaking.
2) Drought Irrigation Strategy Experiment: To evaluate irrigation management regimes for a single drought year. Assuming that 16 acre-inches/acre of water were available, four strategies that applied water at different rates and times of the year were imposed in 1989. The trees were returned to full irrigation in 1990 to assess tree recover from a single year of drought.

Interpretive Summary:

Background and Previous Findings:

Cutoff Experiment: This work is being conducted in cooperation with Paramount Farming Co. in Kern Co. Both cvs. Non Pareil and Carmel are being studied but for brevity, only Non Pareil data are reported here. Preharvest cutoff treatments range from 52 to 4 days before tree shaking. After imposing the preharvest irrigation cutoff regimes in 1989 and harvesting the trees, the six original replications were divided into two sets of three each. The first set received full postharvest irrigation and the second set received no postharvest water in 1989. In 1990 and 1991, the same preharvest cutoff regimes were followed by full postharvest irrigation in all replications.

For the first two years of this experiment, there were no significant effects of preharvest cutoff duration on total kernel yield provided that the trees received full postharvest irrigation. Hull splitting was decreased in direct relation to the cutoff duration. There was a dramatic decrease in fruit set--the evolution of flowers to nuts--as a result of the postharvest water deprivation. The greatest decrease (a 96% reduction in fruit set) occurred with the earliest preharvest irrigation cutoff (53 days before harvest that applied 21 inches of water) although significant decreases in fruit set were observed with all cutoffs of 25 days or more were followed by no postharvest water. There were no significant effects of the preharvest irrigation cutoff regimes on bloom or fruit set when full postharvest irrigation was applied. It must be emphasized that the experimental orchard has a shallow, relatively low water holding capacity soil. Thus, water stress increases rapidly when water is withheld.

Drought Strategy Experiment: This work took place in Fresno Co. and began in 1989 with the application of four regimes that each applied a total of 16 acre-inches/acre. They ranged from applying all the water early in the season (mid June cutoff) to irrigating with small amounts until the 16 inches of water ran out in late August. Total kernel yields were lower in 1989 when all the water was applied early due to smaller individual kernel size. Although the trees were returned to full irrigation (38 acre-inches/acre) in 1990, total kernel yields were quite low in the trees that received only early water in 1989. Yields in 1990 were significantly higher where water had been stretched out through late August of the previous year. Yields and nut quality were also assessed in 1991 but will not be reported here.

Third Year (1991) Results:

Cutoff Experiment: Yield and yield component data are shown in Table 1. In 1991, we observed lower nut loads in the earlier cutoff treatments; generally 32 days or more. It must be emphasized that this is the first time that an important yield component has been negatively impacted by the preharvest irrigation regimes. This translated into significantly lower total kernel yields for the early cutoffs. As was true in previous years, hull splitting was reduced in proportion to the duration of the preharvest cutoff. For example, with 17.5 inches of preharvest applied water (52 day cutoff) versus 31 inches for the control, there were 38% and 100% full hull split nuts at harvest, respectively. Due to the lower nut loads with the early cutoff and its compensatory effect on individual nut size, we did not observe the clear reduction in nut size in relation to cutoff duration as in previous years when nut loads were similar.

Considerable efforts were made to determine the source of the reduced nut load with the early cutoffs this year. A battery of measurements was made of fruiting characteristics on single branches in the late winter and early spring. No significant differences were found in spur density, nut density, spur length, and nuts per spur (Table 2). Only mild statistical differences were found in bloom density, fruit set,

and nut per unit spur length (Table 2). We believe that the reduced nut loads were the result of less fruitwood growth and more shoot dieback with the early cutoffs. Table 3 shows that for the 1990 and 1991 seasons, the total increase in trunk cross-sectional area was inversely related to the duration of irrigation cutoff. For example, there was a 37% reduction in trunk growth relative to the control with the 52 day cutoff. Trunk growth is usually related to shoot growth. Thus, reduced vegetative growth resulted in fewer fruiting positions. Due to partial leaf defoliation of the tree canopies resulting from the early cutoffs, sunlight penetration into the interior of the tree likely enhanced shoot dieback, also reducing fruiting positions.

As in previous years, there was no increase in bark damage even though the trees were irrigated only four days before shaking. We believe that even this short time is sufficient with the shallow soil to harden the bark. Trees on deep soils that do not go into water stress as rapidly would be more subject to bark damage with late irrigation.

Webspinning spider mites were counted in May and June before the imposition of water stress in 1991. There was a direct correlation between mite abundance and the duration of the 1990 preharvest cutoff duration; the earlier the 1990 cutoff, the higher the 1991 mite population. Investigation of this phenomenon is continuing.

Overall Summary of Three Year Experiment:

Although total kernel yields were reduced in the early cutoffs this third year, there were no significant differences in average nut load or yield over the three years of this project (Table 3). This is because nut loads and yields were somewhat higher for the early cutoff treatments last year (Figure 1). Individual kernel weights tended to be less for the early cutoffs (Table 3).

The important yield components over the three years where preharvest cutoffs were followed by full postharvest irrigation in all years are shown in Figures 1-3. Decreased kernel yields with the early cutoffs (32 days or more) that occurred in year three primarily due to lower nut loads indicates that: 1) the effects of preharvest water deprivation on yields may not be observed in a spur bearing species for at least two years after the deprivation due to less shoot (fruitwood) growth, and 2) even with a shallow soil, preharvest cutoffs up to 25 days (about a 6 inch reduction in applied preharvest water) have no significant effects on total kernel yield, although hull splitting will be reduced.

Table 1. Third year (1991) yield component data for trees with different preharvest cutoff periods that received full postharvest irrigation in 1989 and 1990.

Last preharvest irrigation	Cutoff duration (days)	Cumulative preharvest applied water (inches)	Nut load (#/tree)	Mean individual kernel weight (gm)	Total kernel yield (lbs/acre)	Nut Quality		
						Full hull split -- (% of	Partial hull split tree nut	Hull tight load) --
Jun 25	52	17.5	3272a*	1.19	573a	38.3a	33.0a	29.5b
Jul 1	46	19.3	4411ab	1.36	903ab	65.7abc	10.7c	23.6ab
Jul 8	39	21.1	4364ab	1.30	854a	58.9ab	22.1b	19.0ab
Jul 15	32	22.9	4484ab	1.33	896ab	78.7bc	11.9c	9.4ab
Jul 22	25	25.6	7087cd	1.18	1281abc	87.3bc	6.4c	6.3ab
Jul 29	18	27.4	5035abc	1.15	924ab	93.3bc	3.2c	3.5ab
Aug 5	11	29.2	6847bcd	1.35	1421bc	98.5c	0.6c	1.0a
Aug 12	4	31.0	7772d	1.26	1498c	99.6c	0.0c	0.4a
				NSD				

* Numbers not followed by the same letter are significnatly different than others in the same column at the 5% confidence level using Duncan's multiple range test.

Table 2. Third year (1991) fruiting characteristics for trees with different preharvest cutoff periods that received full postharvest irrigation in 1989 and 1990.

Preharvest cutoff duration (days)	Shoot diameter 60 cm from tip (mm)	Spur density (#/60 cm)	Bloom density (#/60 cm)	Nut density (#/60 cm)	Fruit set (%)	Mean spur length (mm)	Nuts per spur (#)	Nuts per unit spur length (#/mm)
52	7.51	11.8	28.5a*	8.0	28.2bc	27.5	0.687	0.291ab
46	8.87	13.3	27.8a	8.8	31.6c	32.4	0.703	0.269ab
39	7.64	12.4	30.3a	7.4	24.5abc	34.1	0.603	0.230a
32	7.53	12.8	29.3a	7.8	26.7abc	29.2	0.660	0.288ab
25	8.76	11.7	35.7ab	10.4	29.2abc	31.7	0.887	0.365ab
18	9.26	14.3	48.4b	9.6	19.8a	25.4	0.663	0.389b
11	9.13	14.7	38.9ab	11.1	28.5bc	30.1	0.763	0.359ab
4	7.80	11.0	30.0a	9.11	30.7c	28.8	0.923	0.346ab
	NSD	NSD		NSD		NSD	NSD	

* Numbers not followed by the same letter are significnatly different than others in the same column at the 5% confidence level using Duncan's multiple range test.

Table 3. Summary of three year average values (1989-91) for trunk growth and the primary yield components for the eight preharvest cutoff durations. All cutoff regimes received full postharvest irrigation each year.

Cutoff duration (days)	Increase in trunk cross-sectional area[1/] (cm^2)	Nut load (#/tree)	Individual kernel weight (gm)	Total kernel yield (lbs/acre)
52	70.8a*	8643	1.08a	1384
46	92.7ab	9474	1.11ac	1552
39	75.9a	8652	1.13abc	1456
32	94.1ab	7872	1.18abc	1388
25	85.3ab	9526	1.15abc	1684
18	79.4ab	8340	1.13abc	1455
11	102.1ab	8368	1.24b	1574
4	112.0b	9534	1.21bc	1723
		NSD		NSD

[1/] Total for 1990 and 1991 seasons.

* Numbers not followed by the same letter are significantly different than others in the same column at the 5% confidence level using Duncan's multiple range test.

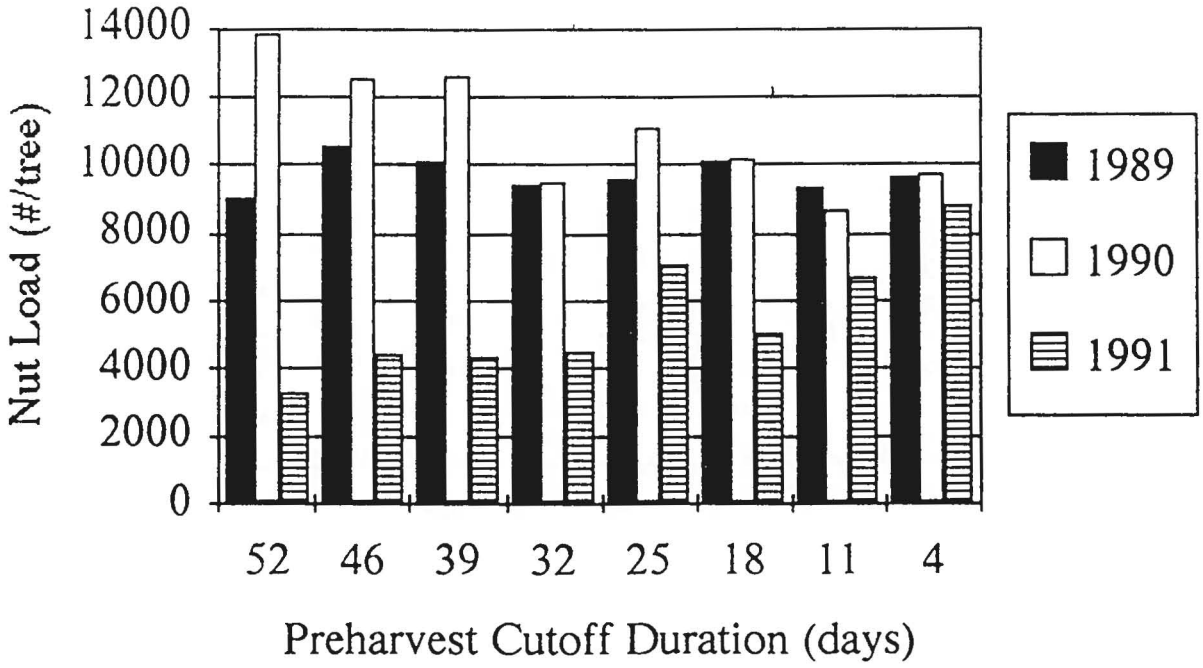

Figure 1. Tree nut load for the 8 preharvest cutoff regimes for each of the 3 experimental years. All preharvest cutoff durations received full postharvest irrigation.

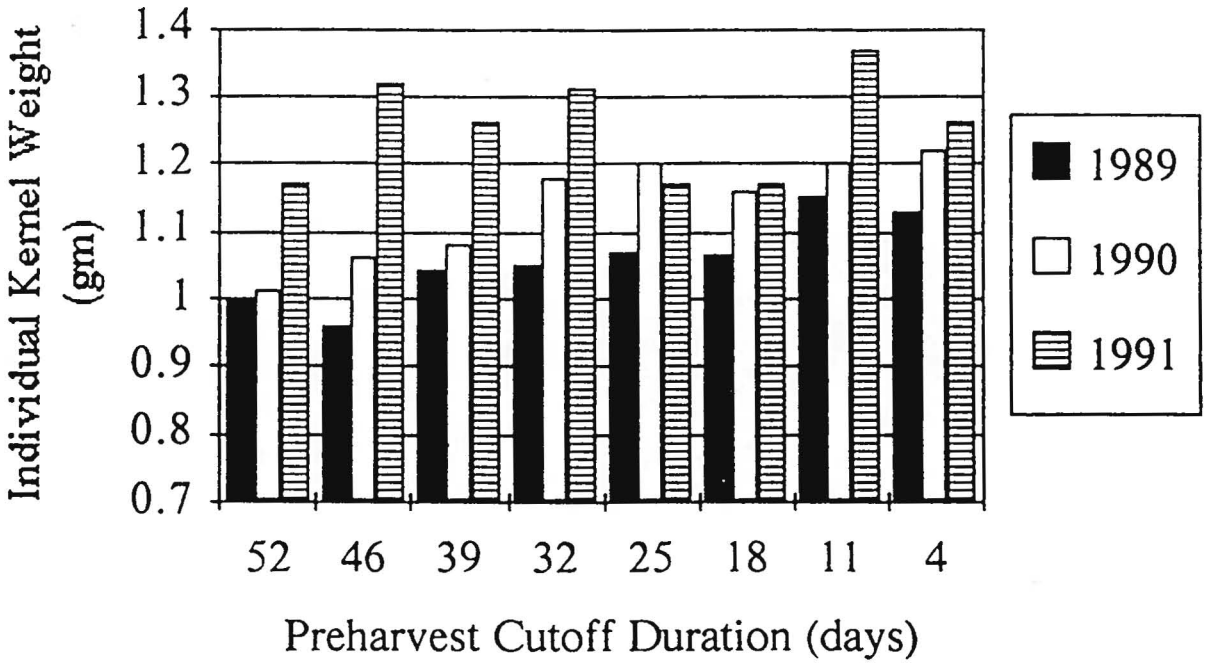

Figure 2. Individual kernel weight (field dried) for the 8 preharvest cutoff regimes for each of the 3 experimental years.

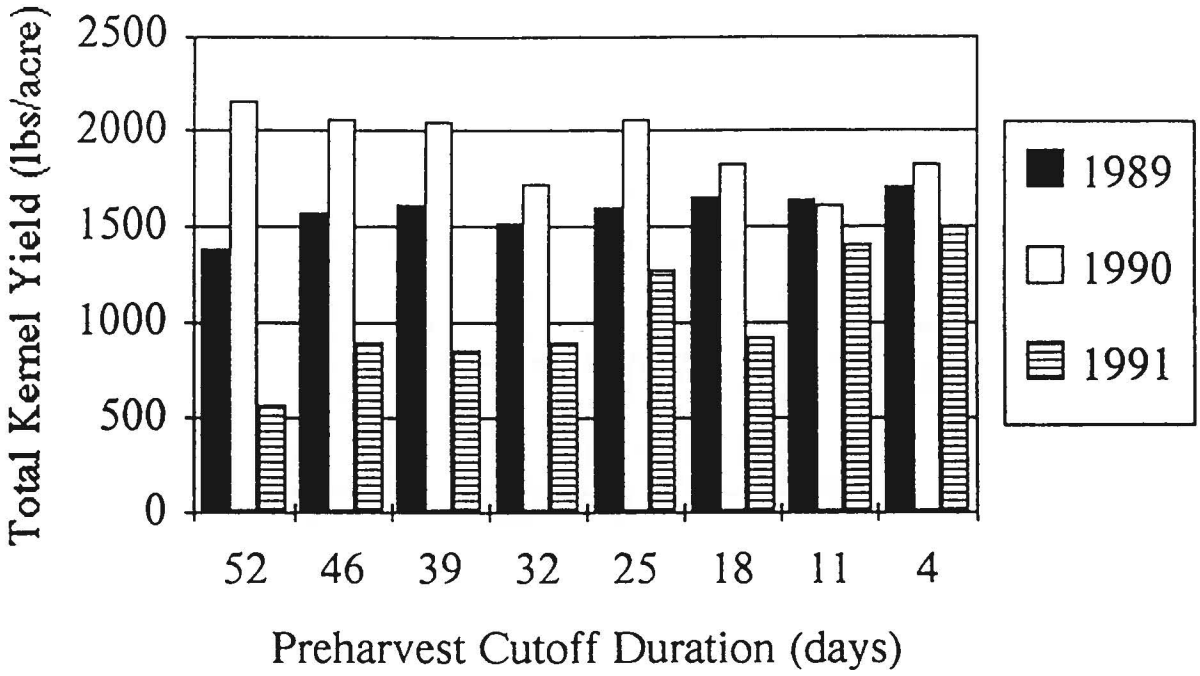

Figure 3. Total kernel yield (field dried) for the 8 preharvest cutoff regimes for each of the 3 experimental years.