

## THE EFFECTS OF FOUR YEARS OF VARIABLE PREHARVEST IRRIGATION CUTOFF PERIODS ON PRUNE TREE PERFORMANCE

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### ABSTRACT

The effects of a fourth consecutive years of differential preharvest irrigation cutoff periods on prune tree performance were monitored in a commercial orchard in Tulare County. The irrigation cutoff regimes were 44, 37, 30, 23, 16, and 9 days prior to harvest in 1989. This season, extra water was applied beginning in late May to insure that the control trees were fully irrigated.

As in previous years, there were no statistically significant differences in seasonal fruit drop. The initial fruit load in the trees previously subjected to three years of about 45 days cutoff was lower than the control, presumably due to the carryover effects of less vegetative growth. Fruit yield and quality were only mildly influenced by the cutoff period. Soluble solids tended to be higher and dry ratios lower in the longer cutoff regimes.

### OBJECTIVES

To evaluate the influence of the fourth year of variable preharvest irrigation cutoff periods in a mature prune orchard on:

- 1) pre-harvest fruit drop,
- 2) fruit load and development, and
- 3) yield.

A primary objective for 1989 was meeting estimated orchard water use throughout the season as opposed to the apparent progressive deficit irrigation in the previous three years of the study.

### PROCEDURE

#### Site 1

A commercial orchard of French prune on Myroblan plum rootstock located in Tulare County was used for this project that began in 1986. The soil is a sandy loam. The experimental site is laid out as a randomized complete block design with 4 replications of the six cutoff regimes. Each replication contains 6 monitored trees that are isolated by border trees, which are managed the same as the adjacent monitored trees.

#### Irrigation management

A low volume sprinkler system with 2 sprinklers per tree is used to irrigate the orchard. The system is normally operated by the grower only on weekends to take advantage of off-peak power cost savings. However, applied water

during previous year has not met estimated orchard water use and predawn leaf water potential measurements verified that the control trees experienced some water stress as the season progressed. Therefore, we requested and the grower agreed to extend the weekly irrigation through Monday on selected weekends in order to meet estimated orchard ETc. Water meters on selected border row laterals were used to measure applied water.

Six irrigation cutoff regimes (treatments) were evaluated in 1989 with the timing based on having the latest cutoff as close as possible to harvest and weekly intervals between treatments (Table 1). Irrigation cutoff is accomplished by crimping the "spaghetti" tubes to the appropriate sprinklers.

Table 1. Irrigation cutoff regimes evaluated in 1988.

| Treatment no. | Date of last irrigation | Days prior to harvest |
|---------------|-------------------------|-----------------------|
| 1             | July 3                  | 44                    |
| 2             | July 10                 | 37                    |
| 3             | July 17                 | 30                    |
| 4             | July 24                 | 23                    |
| 5             | July 31                 | 16                    |
| 6             | August 7                | 9                     |

### Monitoring

Bimonthly counts of the fruit on the ground beneath each monitored tree which began on May 23, 1989 were used to determine fruit drop. After the counts were taken, the dropped fruit were raked to the middle of the drive rows in order to not interfere with subsequent drop measurements. Periodic predawn leaf water potential (one leaf per tree on each of three trees in three replications per treatment) were made to verify the adequacy on the control irrigation and tree water status response to irrigation cutoff.

At harvest, (August 16) the trees were mechanically shaken and individual tree yields were determined using a portable scale. To assess fresh and dry weights of individual fruit, a small net bag subsample of approximately 100 fruit was taken at harvest from each monitored tree. These bags were weighed in the field, removed to a commercial dryer, and then weighed again after drying. Another fruit sample taken at harvest was used to determine soluble solids and flesh pressure.

## RESULTS AND DISCUSSION

### Applied water versus orchard ETc

Estimated orchard ETc and applied water between March 15 and August 2 are compared in Fig. 1. The extra irrigation applied this year overcame the

deficits observed in previous years, as is evident by the fact that cumulative ETC and applied water through August 2 was 28.0 and 28.5 inches, respectively. Predawn leaf water potential measurements (Fig. 2) did not decrease with time in plots that were under full irrigation as in previous years. However, it appears that the extra irrigations should have begun in May as predawn leaf water potential in May were -0.8 to -0.9 MPa as compared with the -0.2 to -0.4 MPa values before and after this period.

### Fruit load and drop

The 1989 initial tree fruit load varied somewhat between cutoff treatment with the most severe regime having a significantly lower value (Table 2). This suggests that the effects of three years of reduced vegetative growth and partial defoliation in this earliest cutoff treatments may be responsible for fewer fruiting positions. On the other hand, as was the case last year, the second longest cutoff period had the largest initial fruit load which we have previously attributed to possible increased flower set. The trend toward higher fruit loads for all but the most severe cutoff regimes seems to be consistent with this explanation. It's interesting to note that in 1988, the only cutoff regime to have significantly smaller trunk growth was the earliest (July 3) cutoff, which supports the conclusion that reduced vegetative growth may be responsible for the only case we observed of significantly lower initial fruit load. However, it's clear that most of the shoot growth necessary to produce the crop occurs prior to the cutoff dates evaluated in this study (Table 2).

Table 2. Fruit load and harvest parameters for 1989.

| Date of last irrigation | Initial fruit load (#/tree) | Total fruit drop (%) | Harvest weight (dry lbs/tree) | Dry ratio | Fruit count (dry fruit/lb) |
|-------------------------|-----------------------------|----------------------|-------------------------------|-----------|----------------------------|
| July 3                  | 2199 a                      | 23.3 a               | 34.8 a                        | 2.77 a    | 51.8 a                     |
| July 10                 | 4075 b                      | 16.6 a               | 62.5 b                        | 2.87 b    | 55.6 a                     |
| July 17                 | 3934 ab                     | 15.9 a               | 61.8 b                        | 2.91 bc   | 53.8 a                     |
| July 24                 | 3508 ab                     | 19.2 a               | 53.2 ab                       | 2.96 c    | 53.9 a                     |
| July 31                 | 3551 ab                     | 19.4 a               | 54.7 ab                       | 2.98 c    | 52.7 a                     |
| August 7                | 3268 ab                     | 19.9 a               | 52.1 ab                       | 2.97 c    | 50.9 a                     |

Fruit drop measured every two weeks from late May is shown in Figure 3. As in previous years, the rate of fruit drop was not strongly related to the cutoff treatments. Relatively high drop occurred starting in early July with maximum drop immediately prior to harvest. Maximum drop later in the season is consistent with observations made at the Gridley water deprivation site. Moreover, results from the first year of that study show that the initiation of water deprivation after mid June did not affect fruit drop, which supports the Tulare County study results. The mild water stress that

occurred in late May and early June did not trigger accelerated drop (Fig. 3). For the season, there were no significant differences in cumulative fruit drop between treatments.

#### Harvest data

Yields on a dry weight basis (Table 2) were significantly lower only in the longest cutoff period (July 3 though harvest). This reduction in yield was due to the previously mentioned low initial fruit load presumably resulting from less vegetative growth during previous seasons. Dry ratios tended to be related to the length of the cutoff period -- the longer the stress, the lower the dry ratio. However, again only the earliest cutoff had a significantly lower value.

Fruit size on a fresh weight basis was not affected by the cutoff regimes, with the exception of the July 10 treatment (23.8 vs. 26.8 gms/fruit for the control). However, dry weights in these plots were not significantly different due to a lower dry ratio for the July 10 cutoff. Soluble solids tended to be higher for the early cutoffs while flesh pressures were variable and showed no clear trend with respect to the cutoff periods.

Table 3. Individual fruit characteristics for 1989.

| Date of last irrigation | Fresh weight (gms/fruit) | Dry weight (gms/fruit) | Soluble solids (°brix) | Flesh pressure (lbs/in <sup>2</sup> ) |
|-------------------------|--------------------------|------------------------|------------------------|---------------------------------------|
| July 3                  | 24.5 ab                  | 8.76 a                 | 23.9 c                 | 1.93 a                                |
| July 10                 | 23.8 a                   | 8.17 a                 | 22.7 ab                | 2.55 a                                |
| July 17                 | 24.8 ab                  | 8.44 a                 | 22.3 ab                | 2.46 a                                |
| July 24                 | 25.6 ab                  | 8.42 a                 | 23.0 bc                | 2.32 a                                |
| July 31                 | 25.5 ab                  | 8.61 a                 | 21.8 a                 | 2.46 a                                |
| August 7                | 26.8 b                   | 8.92 a                 | 23.0 bc                | 2.05 a                                |

#### CONCLUSIONS

After four years of evaluating various irrigation cutoff periods that generally ranged from 45 to 10 days prior to harvest, no significant differences in fruit drop were found. Fruit drop was unaffected in 1989; a year when extra irrigation was applied in order to meet the orchard Etc. Maximum drop across all treatments occurred during times when predawn leaf water potential indicated that the trees were not under water stress. Based on this study and the first year results of the Gridley water deprivation plot, we conclude that mild to moderate water stress after mid June does not significantly influence fruit drop in prunes.

Fruit drop does not appear to be related to the current or previous season's crop load. The drop averaged 15, 18, and 19% for 1987, 1988, and 1989, respectively; years of varying crop load.

Initial fruit load can be lowered by very early season cutoff but only if vegetative growth is reduced and after early stress is imposed for multiple years. Fruit size and weight are only mildly reduced by early season cutoff. Dry ratios tend to be lower, and soluble solids tend to be higher, although the statistical significance of the latter two parameters varies from year to year.

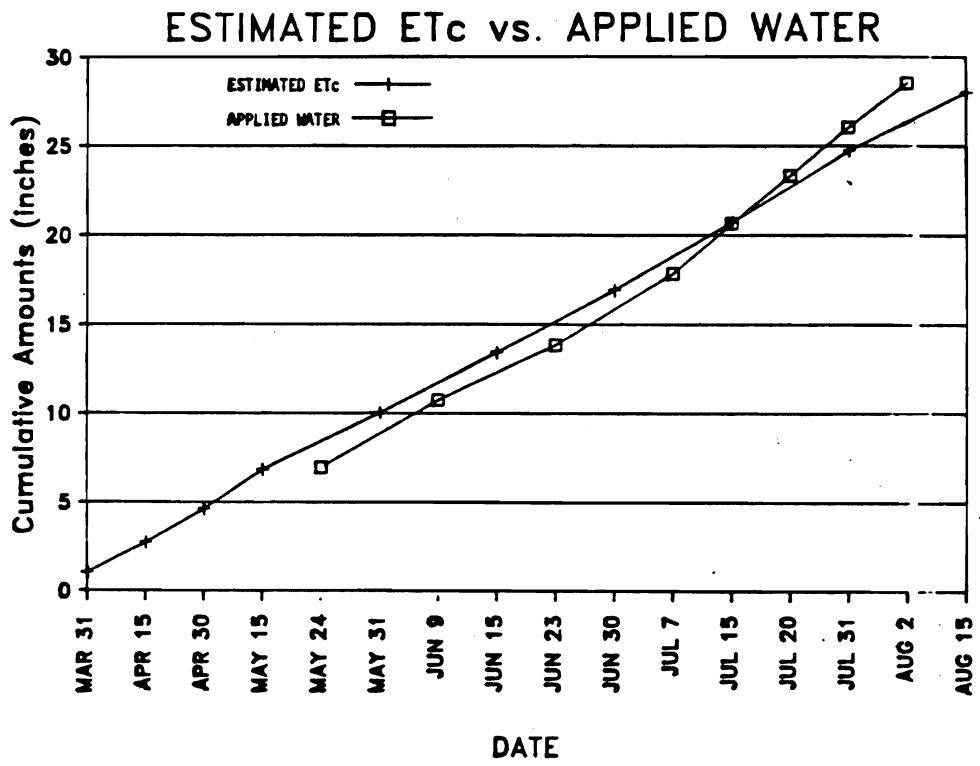


Figure 1. Cumulative applied water and estimated orchard water use (ETc) with time.

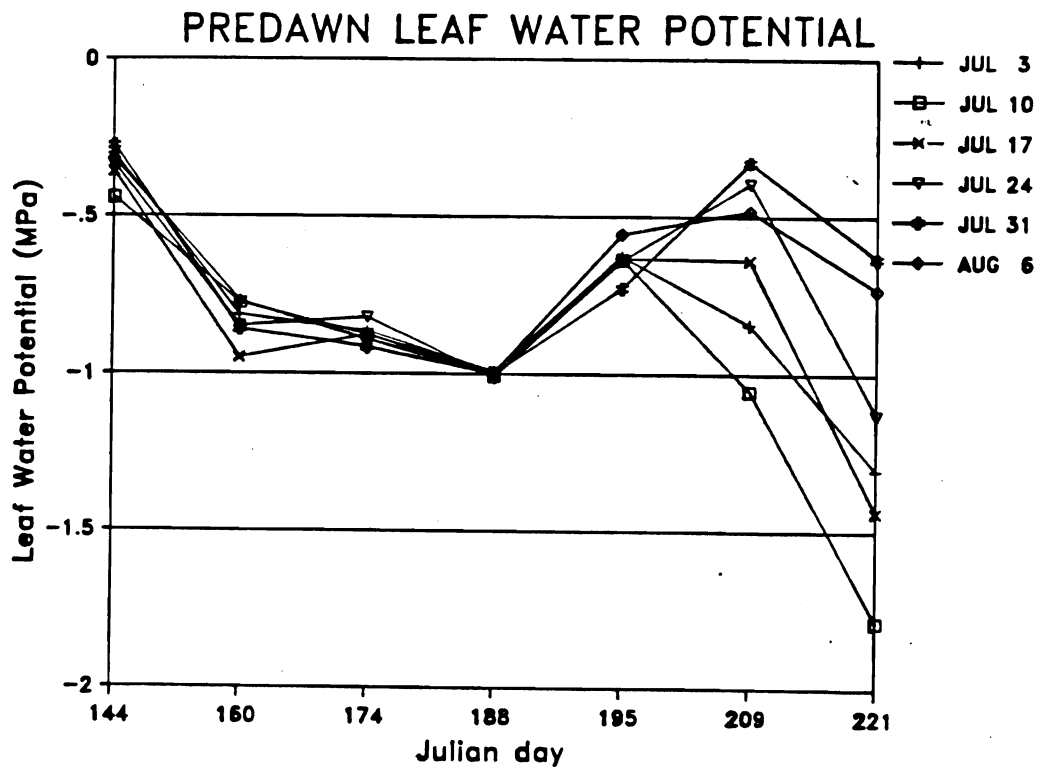


Figure 2. Predawn leaf water potential with time over the season.

# PRUNE IRRIGATION CUT-OFF

SEASONAL FRUIT DROP: 1989

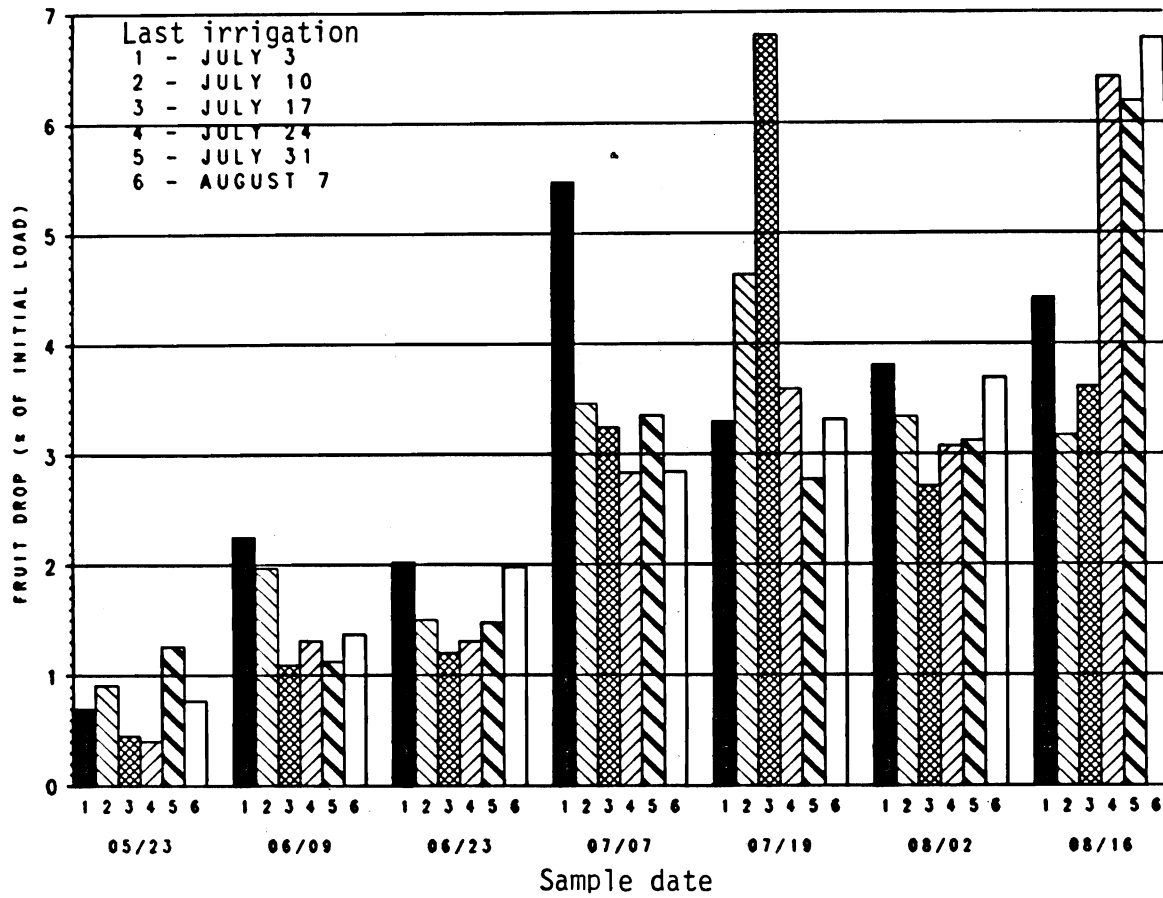


Figure 3. Bimonthly fruit drop expressed as the percentage of the initial fruit load for the 6 irrigation cutoff dates.