Developing a Method for Saving Substantial Amounts of Irrigation Water After Harvest in Early Maturing Peach Orchards

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INTRODUCTION

In the past we have conducted numerous studies in the area of imposing water stress after harvest on May and June ripening peach and nectarine varieties. We have shown it is possible to cut back irrigations at least 50% without hurting productivity, fruit quality or tree health. On the other hand, it is possible to overdo this treatment under some situations and have problems with defoliation, gumming, mites, fruit doubling and deep sutures. This project was initiated to evaluate a method of monitoring stress in trees that might indicate when stress is becoming severe enough to cause these problems. Research from several different countries has shown stem water potential (SWP) to be one of the best methods for doing this. The instrument used to measure SWP is called the pressure chamber and is very simple to operate. A portable, pump-up model is now available for growers and consultants to use. We have had extensive experience with SWP in peach orchards and have found the values to be quite consistent from year to year. Based on our research and the results of a scientist in Israel, we have hypothesized that as long as SWP readings are kept higher (less stressed) than -20 bars, peach tree health and productivity and fruit quality will not be compromised. This hypothesis was tested in a block of Crimson Lady (late May harvest) peach trees where 7 different irrigation treatments were imposed.

MATERIALS AND METHODS

The experiment was conducted in an orchard of Crimson Lady peach trees surrounding the lysimeter. The lysimeter was built in 1986 and has been used to measure tree water use and to control irrigation of the surrounding trees. The field was planted with 1200 Crimson Lady peach trees in 1999 and grown uniformly for 4 years. The trees were planted 6 ft apart in 16 ft rows and trained to a perpendicular "V". Each tree has an individual fanjet emitter with an output of about 6 gals/hr. Seven irrigation regimes were imposed after harvest in late May, 2004 (Table 1). In addition, all the trees in the block were mechanically topped to 11' on June 1. Similar treatments were imposed in 2003, but without the mechanical topping. Evaluation of the treatments was made by measuring canopy light interception, soil water content, midday stem water potential, leaf nutrient content in July and dormant pruning weights. Notes were also made of defoliation, mite damage, shoot dieback and gumming. In 2005, additional measurements of flowering, fruit set, doubling, deep sutures, yield and fruit size will be taken.

RESULTS AND DISCUSSION

Regrowth resulting from the mechanical topping procedure was substantially different among the various treatments. The fully irrigated control had 4 to 5 feet of growth, while the stress treatments had growth proportional to the amount of stress imposed. The most severe treatment (#7) had very little regrowth and had a much more open canopy by the end of the season. The dormant pruning weights (Table 2) reflect these differences in vegetative growth. Patterns of soil water content (Fig. 1) also reflect the treatment effects as expected. As water stress was imposed on a given treatment, its soil water content very quickly dropped to low levels and then recovered when full irrigation was restored.

July leaf nutrient contents were significantly affected by the treatments (Table 3). Water stress tended to reduce the concentration of most the nutrients including N, P, K, S, Ca, Mg, B and Cu. The Continual Fast Stress treatment (#7) and the Early Fast Stress treatment (#3) were particularly low in these nutrients and even marginally deficient in B. However, there were no deficiency symptoms obvious in any of the treatments. There were some mild symptoms of Mn deficiency randomly throughout the field as Mn levels were close to the deficiency threshold in all treatments.

Until flowering, yield and fruit quality data are collected in 2005, it is not possible to fully compare all the treatments. However, a preliminary evaluation can be made. First, the Continual Fast Stress treatment (#7) appears to have too many problems induced by the severe stress. Gumming and dead shoots were observed on some trees and the nutritional effects noted above are of concern. Mites were not a major problem in 2004, but in 2003 this treatment had extensive mite damage that led to some defoliation. Nevertheless, under conditions of extreme water shortage for a year or two, this treatment could be a viable option. By the end of the season in 2004, the trees generally looked healthy enough to produce a full crop in 2005.

The 2 treatments that imposed stress in August and September (#4 and 5) also did not look very promising. First, they still had abundant regrowth after harvest since they were fully irrigated for 2 months. When stress was imposed, there was substantial defoliation, especially in the lower and inside parts of the tree. Some fruiting shoots were completely devoid of leaves and likely will not be fruitful in 2005. Second, the timing of stress tends to produce many doubles and deep sutures in the next year. Even though Crimson Lady is not very prone to doubling, this could be a major problem with some other varieties.

The 2 treatments that looked most promising were #2 and #6. Both reduced vegetative growth noticeably but did not show signs of severe stress such as gumming, shoot death, mite damage or premature defoliation. Measurements of stem water potential were significantly different from the control (Fig. 2), but the readings never exceeded -20 bars. This supports our original hypothesis that the pressure chamber can be used as an irrigation management tool with an action threshold of -20 bars. Using this tool, it should be possible to control postharvest water stress on early maturing varieties, thus saving water and pruning costs without hurting yield, fruit quality or tree health.

Table 1. Irrigation treatments imposed on Crimson Lady peach trees in 2004. All treatments received 100% ET through harvest in late May and during non-stress periods. Each treatment was replicated 6 times.

Treatment		
Number	Name	Description
1	Control	Fully irrigated with 100% ET
2	Early Slow Stress	Irrigation at 25% ET in June & July
3	Early Fast Stress	Irrigation cut off in June & July
4	Late Slow Stress	Irrigation at 25% ET in August & September
5	Late Fast Stress	Irrigation cut off in August & September
6	Continual Slow Stress	Irrigation at 50% ET from June to September
7	Continual Fast Stress	No irrigation after harvest except 1 week in early August

Table 2. Dormant pruning weights from Crimson Lady peach trees subjected to different postharvest water stress treatments. See Table 1 for treatment details.

Treatment	**Pruning Weights (Kg/tree)**
1	9.0 a
2.	5.4 c
3	4.1 cd
4	7.5 b
5	7.3 b
6	5.0 c
7	3.2 d

Table 3. The effect of irrigation treatments on Crimson Lady peach leaf nutrients. Leaves were collected on July 6, 2004. See Table 1 for treatment details.

	Nutrient										
Treatment	N	P	K	S	Ca	Mg	B	Zn	Mn	Fe	Cu
	(%)	(%)	(%)	(ppm)	(%)	(%)	(ppm)	(ppm)	(ppm)	(ppm)	(ppm)
1	3.2 ab	.22 a-c	2.4 ab	1717 a	2.5 bc	.76 ab	41 b	15	26	132	7.9 a
2	3.0 b-d	.21 b-d	2.5 a	1567 bc	2.3 c	.68 cd	31 c	15	27	149	6.9 bc
3	2.9 b-d	.18 d	2.2 d	1473 c	2.3 c	.68 cd	25 d	15	25	137	5.8 d
4	2.9 b-d	.24 a	2.4 ab	1615 ab	2.7 ab	.77 a	47 a	15	26	130	7.4 ab
5	2.8 cd	.23 ab	2.6 a	1603 ab	2.8 a	.71 b-d	46 a	14	28	141	7.3 ab
6	3.0 a-c	.20 b-d	2.3 b	1658 ab	2.5 bc	.73 a-c	32 c	13	24	144	7.7 ab
7	2.7 d	.19 cd	2.2 b	1460 c	2.3 c	.67 d	27 d	15	26	146	6.4 cd

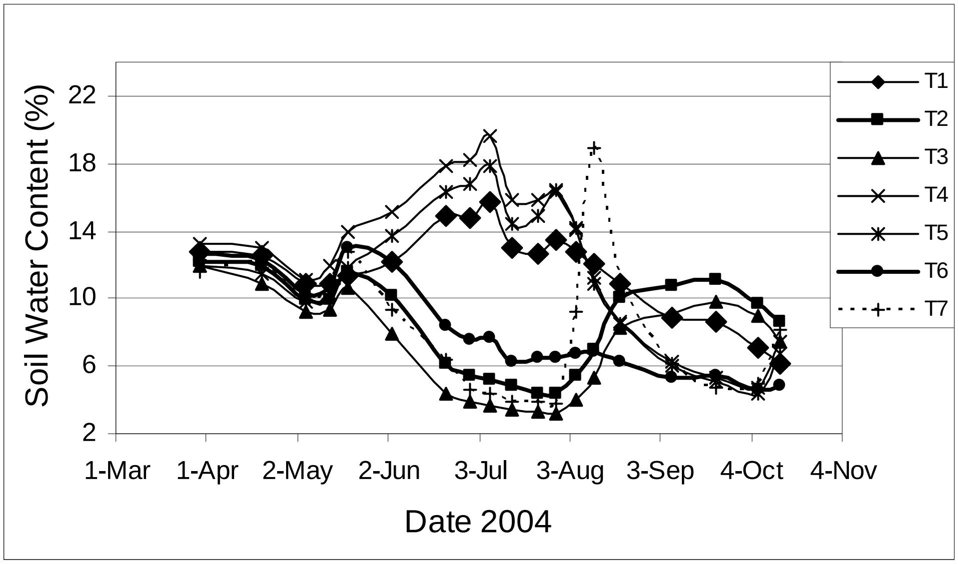

Figure 1. Patterns of soil water content in the top 2.5' of soil for the Crimson Lady postharvest water stress experiment. See Table 1 for treatment details.

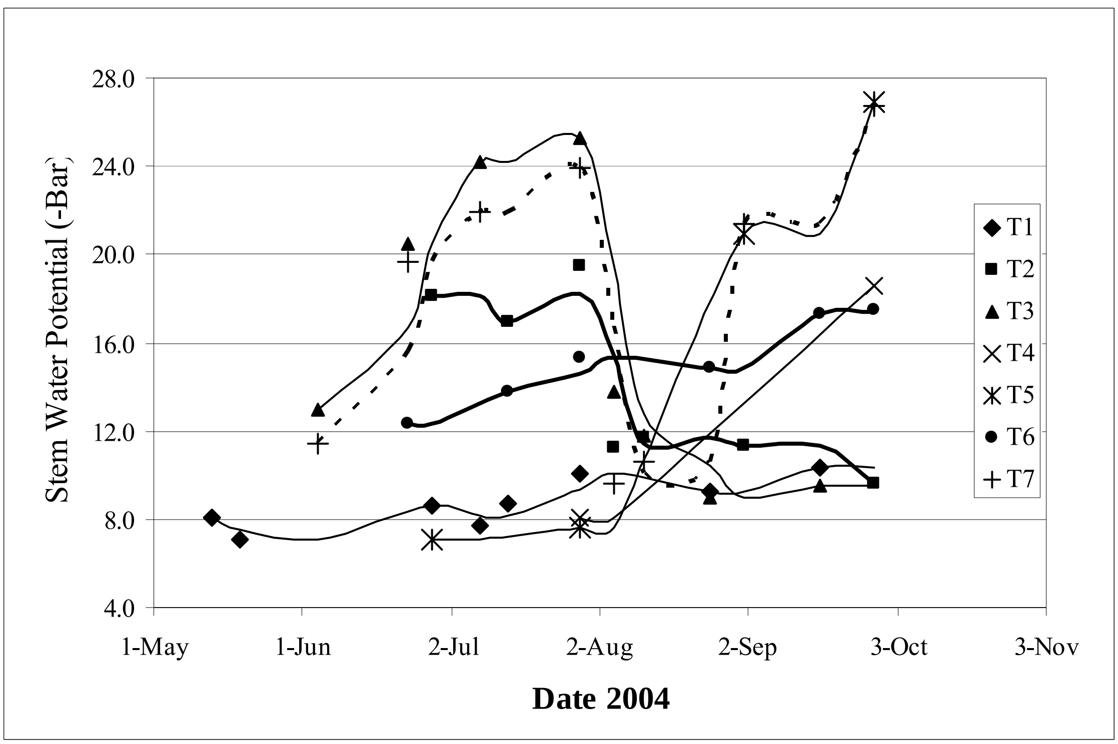

Figure 2. Patterns of stem water potential for the Crimson Lady postharvest water stress experiment in 2004. See Table 1 for treatment details.