Scheduling Apple Irrigations with Infrared Thermometers

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Introduction

The purpose of irrigation scheduling is to increase irrigation efficiency by balancing the quantity of water applied with the amount that the crop actually uses. By improving irrigation efficiency, we can conserve water, conserve energy (i.e. pumping costs), and reduce the possibility of leaching contaminants such as nitrates and pesticies into the groundwater.

The method of irrigation scheduling used here incorporates leaf temperature (as measured by the infrared thermometer), net solar radiation, relative humidity of the air, and air temperature. This information is used to determine the plant temperature stress index (PTSI) and thus indicate the need for irrigation.

Materials and Methods

Western Gold Orchard, located near Bonita, AZ (Graham County), was chosen for the experimental plot. The orchard wasplanted in 1983 with Red Delicious, Golden Delicious, and Granny Smith apples. Three irrigation regimes were determined (wet, medium, and dry) using the plant temperature stress index (PTSI) developed in 1988. When PTSI reached 0.1, rows designated as "wet" regime were irrigated. When PTSI reached 0.3, rows designated "medium" regime were irrigated. When PTSI reached 0.5, rows designated "dry" regime were irrigated. All rows in the orchard were irrigated prior to the start of the experiment. Two varieties of apples were analyzed -- Granny Smith and Red Delicious. Four rows of each variety were subjected to each of the irrigation regimes. Trees were read with the infrared thermometer, beginning 6/14/89, three times a week, until 10/12/89. Wet bulb and dry bulb temperatures were taken at each reading. Readings were taken between 11 am and 1 pm, on days where there were no clouds. Two trees in each row, tree #10 and tree #50 from the north end, were read. Two readings, east and west, were taken for each tree.

Red Delicious apples were harvested 9/19/89. A random sample of 40 lbs. was collected from each row. Apples were picked from all sides of trees, from tree #10 to tree #50. Each box of apples was graded for size; fruit diameter was rated less than 2.5 inches, 2.5 to 3 inches, or greater than 3 inches. Three apples from each box were analyzed for firmness, starch, and soluble solids. Procedures outlined in the Apple Maturity Program Handbook (Wenatchee, Washington, 1986) were followed.

Granny Smith apples were harvested 10/12/89. Sampling techniques were the same as noted for Red Delicious apples.

Results

Red Delicious: The relationship between PTSI, adjusted packed boxes per acre, the number of irrigations, and total water cost is shown in Table 1. There was no difference between "medium" and "dry" treatments. However, the increased yield for the "wet" treatment, 272 boxes per acre, cost only $10 more than the "medium" treatment, which yielded 220 boxes per acre. The "wet" treatment also resulted in a greater number of apples in the 2.5 - 3 inch size category than the drier irrigation regimes (Table 2).

Granny Smith: The relationship between PTSI, adjusted packed boxes per acre, number of irrigations, and total water cost is shown in Table 3. The results are similar to those found for Red Delicious. The increased yield for the "wet" treatment, 315 boxes per acre, cost $20 more than the "medium" treatment, which yielded 258 boxes per acre. There was no difference in the size categories according to irrigation regime (Table 5).

Table 1. The relationship between the plant temperature stress index (PTSI) and adjusted packed boxes per acre (APB)[a], the number of irrigations, water applied, and total water cost[b], for "Red Delicious" apples grown in Bonita, AZ, in 1989.

PTSI**	APB	# Irr.	Water Applied (in/ac)	Water Cost
.04 B	272	9	22.7 (51.0)	$89.85
.34 A	220	8	20.2 (45.4)	$79.96
.33 A	204	7	17.6 (39.7)	$69.67

a: Based on 16 packed boxes per bin and 201 trees per acre.

b: Based on $47.50/acre ft. of water.

**: Means followed by same letter are not significant at 0.01 level.

Table 2. The relationship between the PTSI and apple size (% of total adjusted packed boxes) for "Red Delicious" apples grown in Bonita, AZ, in 1989.

PTSI	<2-1/2"	2-1/2"-3.0"	>3.0"
.04	5.8	55.8	38.5
.34	19.6	70.8	9.6
.33	14.4	66.5	19.1

Table 3. The relationship between the plant temperature stress index (PTSI) and adjusted packed boxes per acre (APB)[a], the number of irrigations, water applied, and total water cost[b], for "Granny Smith" apples grown in Bonita, AZ, in 1989.

PTSI**	APB	# Irr.	Water Applied (in/ac)	Water Cost
.04 B	315	10	25.2 (56.7)	$99.75
.23 A	258	8	20.2 (45.4)	$79.96
.35 A	242	7	17.6 (39.7)	$69.67

a: Based on 16 packed boxes per bin and 201 trees per acre.

b: Based on $47.50/acre ft. of water.

**: Means followed by same letter are not significant at 0.01 level.

Table 4. The relationship between the PTSI and apple size (% of total adjusted packed boxes) for "Granny Smith" apples grown in Bonita, AZ, in 1989.

PTSI	<2-1/2"	2-1/2"-3.0"	>3.0"
.04	5.2	70.6	25.6
.23	8.0	73.4	18.6
.35	18.5	67.6	13.9