ABSTRACT

Fourth year crop water use (ET) of 'Chico' walnuts in both high and conventional density plantings is being evaluated in a 2.5 acre experimental plot at the Kearney Agricultural Center. Canopy development and tree productivity is also under study. Due to the size and variability of the soil water storage data set component of the soil water balance, ET estimates are incomplete. Efforts continue to develop this information.

Canopy growth, as reflected by the midday shaded area of the orchard floor, increased two and five fold between May 6 and October 11 in the hedgerow and normal density planting, respectively. Fourth year nut yield in the close-planted trees was nearly 600% greater than that of the conventional density trees (1921 versus 348 lbs/acre). Individual nut weight was slightly less in the hedgerow planting apparently due to the greater fruiting density.

OBJECTIVES

A long term goal of this project is to determine the crop water use (ET) from planting to orchard maturity of walnut trees planted on close and conventional spacings. Relationships between developing orchard ET and tree productivity will also be established. Another future goal is to evaluate plant water stress effects on tree performance. This will be accomplished by initiating differential deficit irrigations in 1986 on plots established in the high density planting.

The 1985 objectives were to measure orchard ET and crop productivity of fourth year trees on hedgerow and normal spacings.

PROCEDURE

This work is being conducted in a four year old block of 'Chico' trees located at the Kearney Agricultural Center in Fresno County. A 2.5 acre orchard is divided into high (11 x 22 ft) and conventional (22 x 22 ft) density sections, each equipped with independent low volume sprinkler systems for controlled water management. The sprinklers are positioned in the tree rows 5.5 ft from each tree and apply water (5.4 gph) in a circular pattern 9 ft in diameter.

Two trees in each planting density are intensively instrumented with a total of 68 neutron probe access tubes installed in a grid pattern to a 10 ft depth.

Each plot was irrigated two or three times per week, with the duration of application set to apply the amount of water consistent with currently available information on deciduous tree ET. Adjustment was made to account for the degree of canopy cover of the orchard floor. The amount of water applied was measured with water meters.
Orchard ET was estimated by means of a water balance, that included applied water, soil water storage, and deep percolation. The changes in soil water storage were subtracted from the amounts of water applied between neutron probe readings. Deep percolation was calculated with previously-determined relationships between soil hydraulic conductivity (K) and soil water content (θv) from each intensively instrumented site, assuming a unit hydraulic gradient.

Unfortunately, functional relationships between K and θv have been established only for the 5 ft depth; a shortcoming that will be addressed later. Orchard ET estimates for each monitoring period were divided by corresponding CIMIS reference ET values from a nearby weather station to determine crop coefficients (Kc).

Canopy development was evaluated by measuring the shaded area of the orchard floor at 1:00 p.m. on May 6, June 11, July 10, August 5, and October 11 in both planting densities. Measurements were taken by counting the shaded squares of a grid matrix drawn on a tarp and placed beneath the trees.

The trees were harvested on September 17-18 with a commercial shaker and tarps. After field weights were determined, subsamples were taken and oven dried in order to calculate dry in-shell yields and nut component weights.

RESULTS AND DISCUSSION

Initial orchard ET estimates varied widely over the season. Due to the lack of hydraulic conductivity data for the 10 ft depth (the bottom of the monitored profile), initial ET estimates calculated from the soil water balance over the 10 ft profile neglected deep percolation. This may be responsible for much of the observed variability in the ET data. Since the previously-determined K versus θv relationships apply to the soil at the 5 ft depth, our next effort will be to calculate a soil water balance over a 5 ft profile, thus including deep percolation. We are confident that further analysis will result in fourth year ET estimates consistent with the accuracy limits of the soil water balance technique.

Canopy growth was rapid during 1985 under both planting densities, as evidenced by the periodic measurements of midday orchard floor shading presented in Figure 1. Between May 6 and October 11, the high density canopy cover nearly doubled (34 to 65%), and the shaded area of the conventionally-spaced trees increased over five fold (9 to 46%). The greater canopy growth rate in the conventional density may be due to the relatively small crop load as well as to the hedgerow configuration partially masking some vegetative growth.

The hedgerow planting nut production was nearly six fold greater than the normally-spaced trees (1921 and 348 lb/acre, respectively). Even on a per tree basis, high density yield was almost three times that of the low density planting. Thus, the relatively large hedgerow yield was due to both a greater number of fruiting positions per tree and higher tree density. Individual nut weight was about 9% less in the hedgerow trees (10.26 versus 11.29 gm/nut), presumably
due to the greater fruiting density.

CONCLUSIONS

Efforts continue to analyze the soil water storage component of the water balance approach being utilized to estimate the ET of fourth year 'Chico' walnuts. The size and variability of this data set and the necessity to quantify deep percolation make this a difficult and time consuming process.

Canopy growth, as reflected by midday shaded area of the orchard floor, increased two and five fold in the hedgerow and normal density plantings, respectively, between May 6 and October 11. Nut yield in the close-planted trees was nearly 600% greater than that of the conventional density trees due to both greater fruiting positions per tree and the number of trees per acre. This relative yield difference is the same as observed last season. Individual nut weight was slightly less in the hedgerow planting due to the greater fruiting density.
Figure 1. Canopy development in 1985 as reflected by the percent shaded area of the orchard floor measured at midday.