RIO OSO YOUNG ORCHARD IRRIGATION MANAGEMENT WITH SOIL AND PLANT BASED MEASUREMENTS

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ABSTRACT

In 2006, a newly planted orchard showed extensive dieback problems related to wet soils resulting from the wet spring. A large number of trees needed to be replanted in 2007. Soil moisture sensors were installed in the poor and good growth areas of the orchard. Soil moisture monitoring data showed that in the poor growth area, little soil moisture extraction took place below the 1.5 foot depth while in the good growth area, soils dried down at all depths as the season progressed. Midday stem water potential measurements showed that trees tended to be slightly more stressed in the poor growth area compared to the good growth area. The combination of soil and plant based measurements were helpful in balancing the needs of the trees in the poor versus good growth areas while minimizing excessively wet soil conditions in either area.

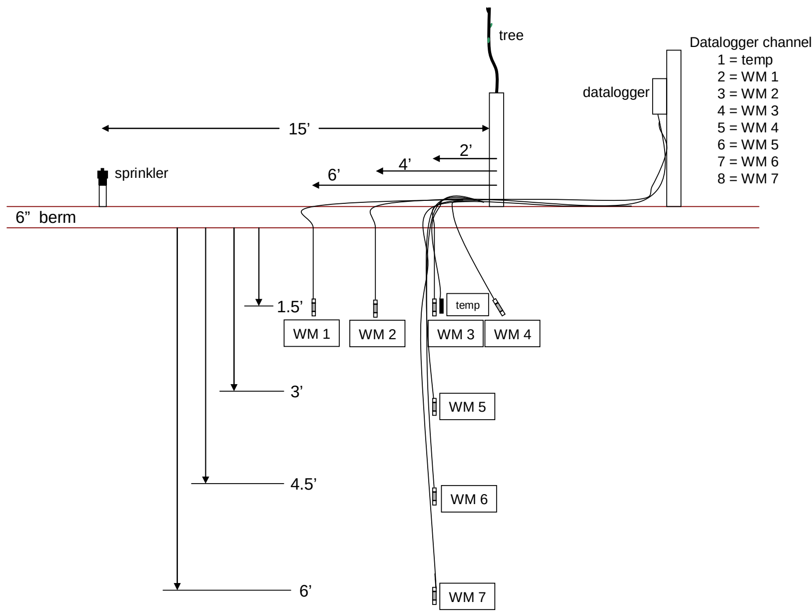
INTRODUCTION

A study was set up in a one year old Chandler orchard near Rio Oso in Sutter County. The study was designed to investigate the best methods of managing water on a young orchard that had shown problematic growth and tree dieback in excessively wet areas in 2006 following a wet spring. More than one hundred trees died in 2006 before the trial was initiated.

PROCEDURES

Two Watermark soil moisture monitoring stations were installed, the first in an area of the orchard that had good growth and another in an area that had poor growth the previous season.

Watermark sensors were installed in the pattern shown below near one tree in both the good and bad growth areas of the orchard. A temperature sensor was installed near WM 3 as shown in the diagram. Watermark sensors and soil temperature were logged on an hourly basis throughout the season.



Midday stem water potential was monitored approximately every 10 days during the growing season. The number of leaves formed and shoot length was measured on the longest shoot on each tree on July 26, 2007 and October 5, 2007.

RESULTS AND DISCUSSION

Soil Moisture and Midday Stem Water Potential

As the season progressed, the soil at the 1.5 foot depth directly in the rooting zone dried out rapidly in the poor growth area (Fig. 1a). This was followed by a drying at the 1.5 foot depth at a distance of 2 feet from the tree (Fig. 1a). At the poor soil site, the soil did not dry at the deeper depths, even by late in the summer suggesting the trees were fairly shallow rooted. In contrast, in the good growth area, the soil dried at the 1.5 foot depth under the tree first, followed by drying at the 3 and 4.5 foot depths 2 feet from the tree. This suggests that the trees in the good area were rooting deeper than those in the poor growth area.

Midday stem water potentials ran at lower (more negative values) in the poor growth area of the orchard (Fig. 1c) even though overall soil moisture was wetter in the poor compared to the good growing area (Fig. 1b,c). The grower reduced the water applications in the poor growth area from mid-June to early July to try to get the roots to penetrate deeper. This resulted in a steep drop in soil moisture at the 2' depth under the tree in the poor growth area (Fig. 1a) and a resulting steep drop in midday stem water potential (Fig. 1c). This suggests that most of the root water uptake was occurring in this limited soil volume. After water application was increased in the poor growth area in mid-July, soil moisture at the 2' level stabilized under the tree and increased 2' from the tree (Fig. 1a). The soil moisture levels never dropped below saturation at the 5' or 6.5' depths in the poor growth area (Fig 1a). In the good growth area, soil moisture decreased as the season progressed at all 3 depths and locations (Fig. 1c).

Shoot Growth

The increase in number of leaves on the longest shoot from July to October was fairly uniform in the good growth area trees with most shoots ending up with between 35-45 leaves (Fig. 2a). In the poor growth area, two out of five trees had substantially less leaves than the others by October (Fig. 2b). Overall by the final leaf count date of October 5, 2007, there were an average of 40.4 leaves on the longest shoot in the good growth area versus 41 leaves in the poor growth area. It should be noted here that 5 of the 7 trees in the poor growth site were replants and hence one rather than two years of age. Of the two trees in the poor growth area that had the smallest number of leaves by the end of the season, one was a one year old tree and one was two years old. All trees in the good growth area were two years of age.

The time between the generation of two leaves is know as the plastochron and averaged about 3 days early in the season for both the poor and good growth areas (data not shown) but by late summer, the seasonal average was 4.86 days in the poor growth area and 4.43 days in the good growth area (Table 1). Although the leaves were formed somewhat slower in the poor growth area, they had a longer internode (Table 1). Part of these differences might be due to the tree age differences in the two areas noted above.

PRELIMINARY CONCLUSIONS

The results of this trial are encouraging since the problematic growth in the poor growth area was increased greatly compared to the 2006 season and there was little or no tree loss in 2007, unlike in 2006 when a substantial number of trees had to be replanted. This study will continue in 2008 in order to monitor conditions in the poor growth area to see if careful water management can get around the limitations of the site due to shallow rooting conditions in this area.

ACKNOWLEDGEMENTS

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Table 1. Number of leaves, plastochron, and internode spacing for the poor and good growth areas in 2007. The plastochron is the time between the generation of two leaves.

Site	*Number of leaves/shoot*	*Plastochron (#days/leaf)*	*cm/internode*
Poor growth area	**40.7**	**4.86**	**7.17**
Good growth area	**34.9**	**4.43**	**4.80**

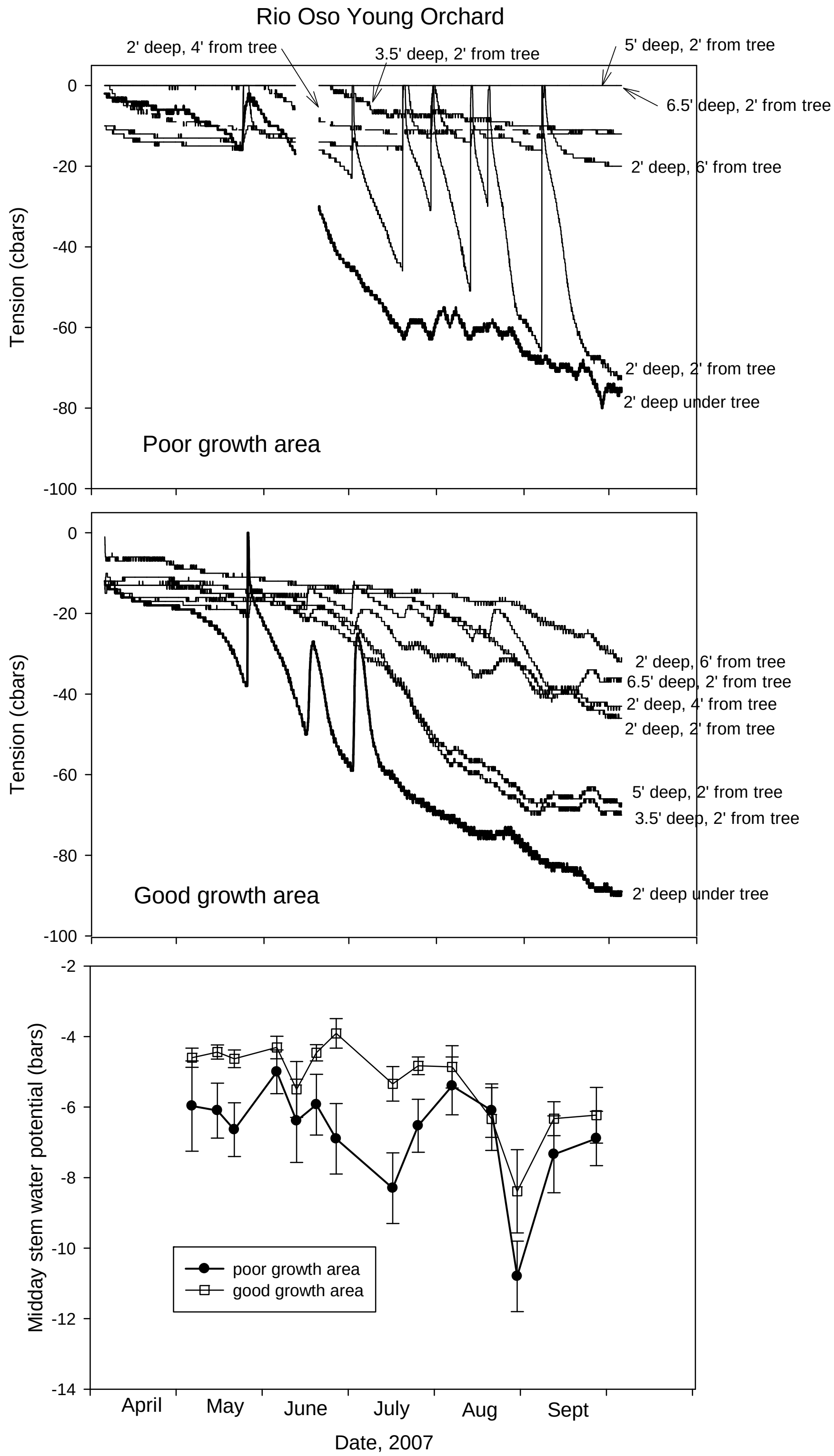

Fig. 1. Soil moisture tension in a) poor growth area, b) good growth area and c) midday stem water potential in the poor and good growth areas over the 2007 growing season.

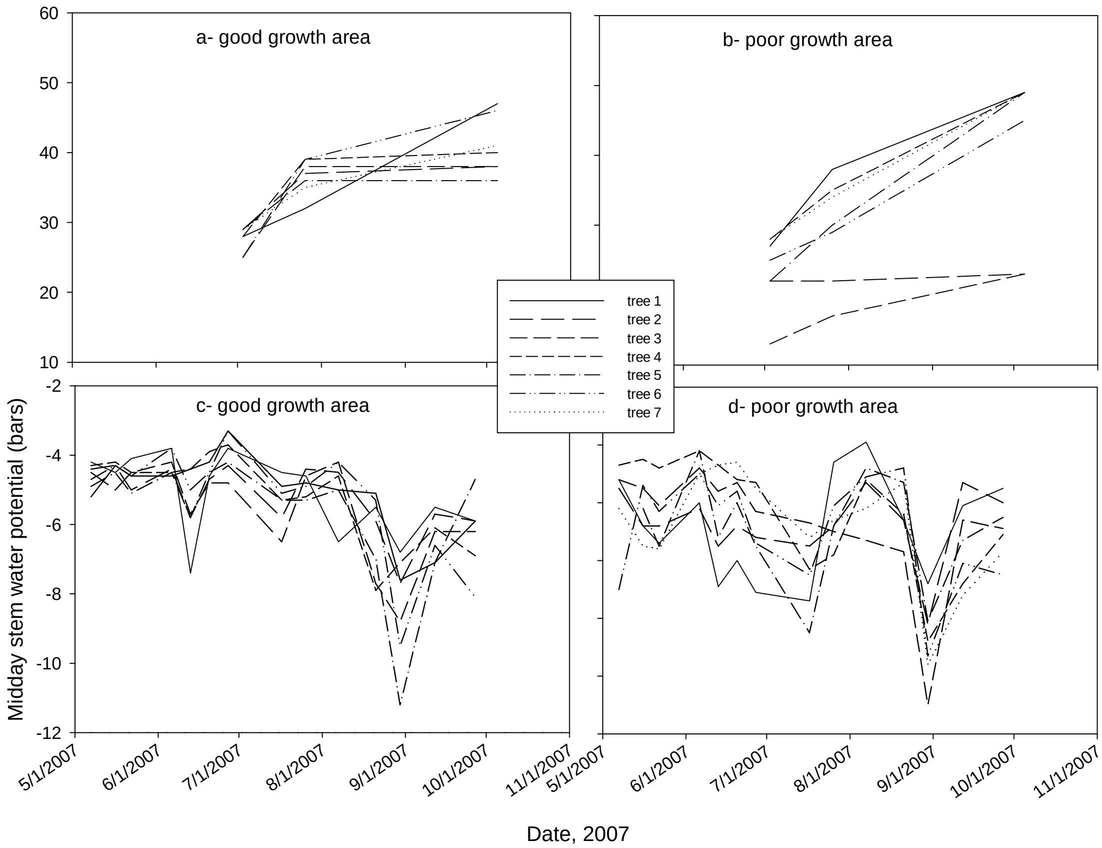

Fig. 2. Seasonal pattern of number of leaves on longest shoot in a) good growth area, b) poor growth area and midday stem water potential in c) good growth area and d) poor growth area.