Tensiometer Driven Irrigation System Trial

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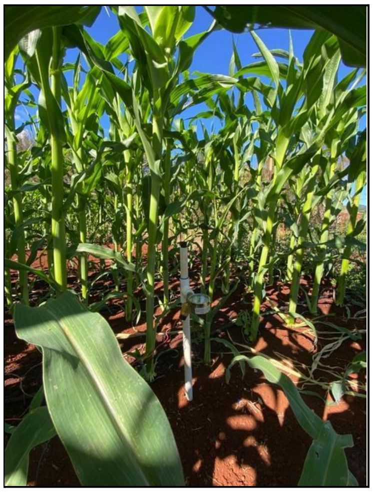
Introduction



Irrigation management in commercial agriculture is a common concern. After identifying how to install an irrigation system the next question is how much water to provide the crop with. There are many different ways to quantify crop water needs including the use of weather or evapotranspiration models as well as physically measuring the moisture in the soil near the plant roots. In many cases weather models require a large initial investment in order to set up a weather station. It may also require additional crop specific information which may not exist and can be costly to identify. Soil moisture may be a cheaper alternative and can be measured in many different ways including the use of tensiometers, Time-Domain Reflectometry (TDR) or capacitance sensors.

Tensiometers measure the physical pressure required to pull water out of the soil. As soil dries and moisture decreases the tension or pressure increases and as it wets and moisture increases the pressure decreases. In most soils, pressures exceeding 60kPa may represent a permanent wilting point or the point that no water is available for the plant roots to absorb. Pressures between 60kPa and 20kPa represent the plant's need for irrigation and pressures between 20kPa and 10kPa represent field capacity or the maximum amount of water that the soil can hold before becoming saturated.

The experiment conducted at the Poamoho Research Station was intended to compare a recommended corn irrigation requirement (Kelley, 2016) of 2inches (54,000gals/acre) of water per day vs. an automated tensiometer driven irrigation system set to withhold daily irrigation unless the tensiometer exceeds 30kPa. The tensiometer was designed by UC Davis Researcher Dr. Michael Cahn and built at the Poamoho station. An additional Irrometer Tensiometer Auto Vacuum Switch was attached to the tensiometer and connected to a Hunter Node irrigation controller. GPI water meters were attached to measure the total volume of water supplied to each treatment. Corn was selected as the test crop and "Hawaiian Supersweet #9" was selected as the test variety. The seeds were direct-seeded in May 2021 and spaced 8-inches between plants, 2-feet between rows with five rows per plot. Each treatment was replicated four times and treatments were spaced six feet apart to minimize irrigation intrusion from neighboring treatments. Corn was fertilized weekly with urea at a rate of 135g for a total of 1,080g of Urea (80lbs of N

per Acre). Corn was harvested August 2021 and measured for individual ear fresh weight and Brix readings.

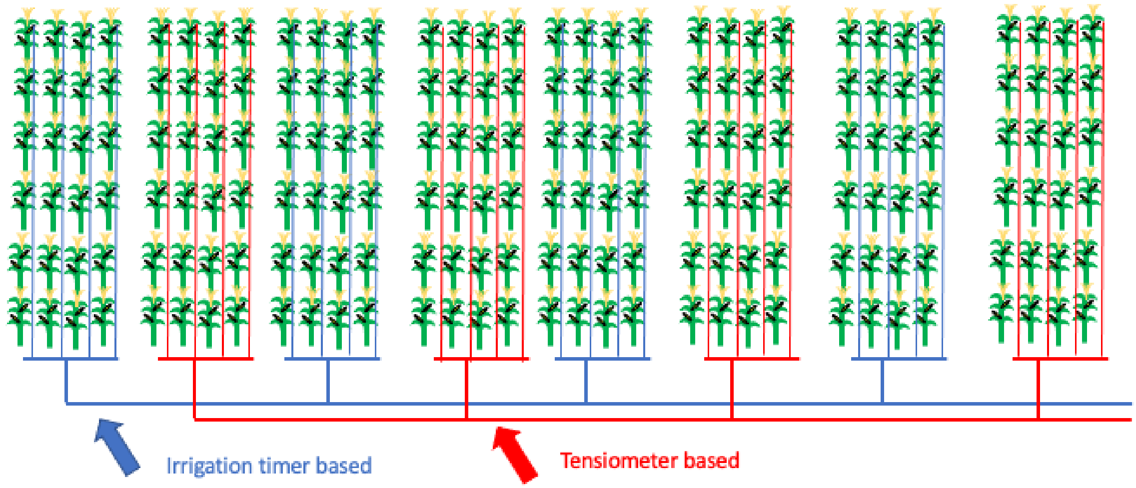


Figure 1. Field Layout

Observations

Yield and Quality

Data shown in Fig. 2 and 3 suggest that there were no significant statistical differences in average fresh corn weight as well as % Brix. However, treatments managed under tensiometer driven irrigation had numerically higher values for both fresh weight and % Brix.

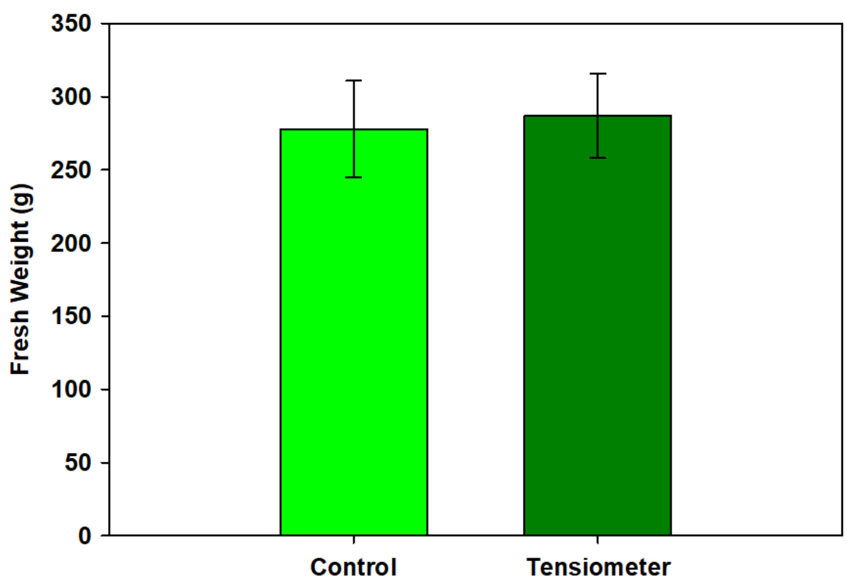


Figure 2. Mean individual ear fresh weight for corn harvested August 4, 2021 at the Poamoho Research Station. Error bars represent standard deviation from the means. n=10.

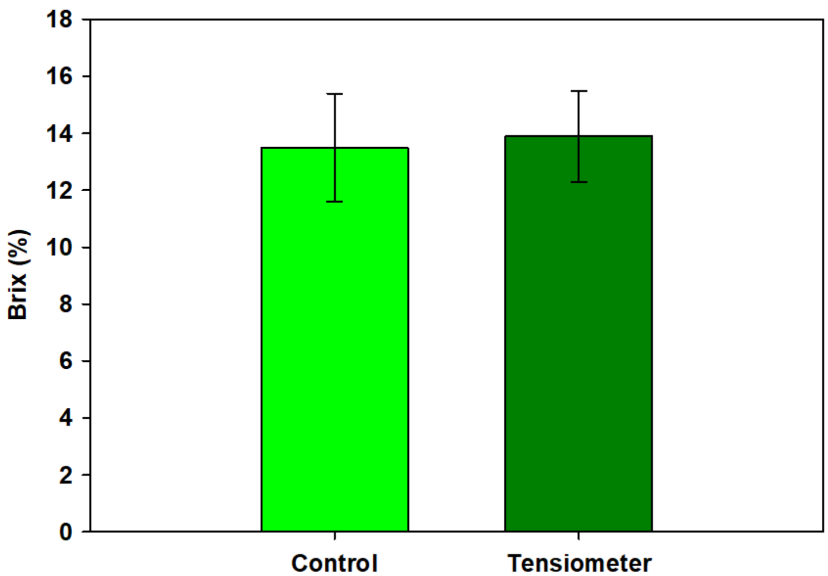


Figure 3. Mean individual ear % Brix for corn harvested August 4, 2021 at the Poamoho Research Station. Error bars represent standard deviation from the means. n=5.

<u>Irrigation Impact</u>

Fig. 4 shows the total volume of water applied to the control treatment which received 2in of water per day. The 8,014.34 gal applied to the control treatment is equivalent to 581,841 gal per acre per crop. Fig. 5 shows the total volume of water applied to the tensiometer treatment which was maintained near 30kPa. The 7,050.03 gal applied to the tensiometer treatment is equivalent to 511,832 gal per acre per crop. This suggests that 70,009 gal of water per acre per crop would be saved if a tensiometer driven irrigation system was used over the recommended rate of 2-inches per day.

Figure 4. Total volume of water applied to the control treatment.

Figure 5. Total volume of water applied to the tensiometer treatment.

References

Kelley, L. Peak Water Use Needs for Corn. Michigan State University. 2016. https://www.canr.msu.edu/news/peak_water_use_needs_for_corn. Accessed May 2021

Cahn, M. Do it Yourself (DIY) Tensiometer. UC Davis. 2019. https://ucanr.edu/blogs/blogcore/postdetail.cfm?postnum=30042. Accessed May 2021.