

WATER USE EFFICIENCY FOR BIOMASS AND ENERGY IN SUGARCANE CROP

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Sugar cane crop stands out as one of the main crops in Brazil. In the new areas of sugarcane expansion industry (SP west, MS, MT, GO, MG, BA, AM, MA and PI) it is observed periods of more intensive drought in the soil throughout the year, being of fundamental importance to consider the water-plant relations to obtain economic productivity. This project under development in the Biosystems Engineering Department at the University of Sao Paulo (ESALQ / USP), aims to present to the sugar cane breeding programs in Brazil, the current rates of water productivity into Biomass conversion (biomass kg / m evapotranspired H₂O) and Energy conversion (MJ of energy / m H₂O evapotranspired) for the main varieties under different maturation strategies and water levels in the soil. The development of this project will also identify the maximum sucrose content for different varieties and parameterized the physiological model CANEGRO, aiming its application to the production environments of ETH Bioenergy Clusters. This research project is based on a research platform called "PAC-CANA" where it is possible to quantify precisely and continuously the water use efficiency of plants under controlled conditions.

SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

The sugarcane industry is currently facing an industrial and agricultural crisis. The use of irrigation systems is imposed as an alternative of higher productivity, but requires considerable investments and water resources. Based on the hypothesis that there is for each variety of sugar sugarcane, a more appropriate combination between irrigation depth and intensity water deficit during ripening, in order to maximize productivity, the aim of this work was to evaluate the effect of four irrigation depths and four levels of water stress during ripening, for eight drip irrigated sugarcane varieties, analyzing the variables related to quality and productivity per area unit, as well as quantifying productivity per unit of evapotranspired water (water productivity). Treatments were arranged in a factorial design (4x4x8) with split-split-plot with three replicates, totaling 128 treatments and 384 plots, and the plots consist of a box with about 330 liters of soil containing two plants. The evaluated irrigation depths (L50, L75 and L100 L125) were variations in the fraction applied over time, relative to the treatment L100, where soil moisture remained close to field capacity (θ_{cc}) throughout the experiment. Each tested variety had its own reference L100. The intensities of water deficit during maturation were evaluated for M1 (moderate water deficit of long duration), M2 (intensive water deficit of long duration), M3 (no water deficit) and M4 (severe water deficit of short duration). The sugarcane yield (TCH) was favored by the combination L100 and M3, regardless of the studied variety, with an estimated average value of 232.2 t ha⁻¹. Among the varieties, V4 had the highest TCH, with average of averaging 250.4 t ha⁻¹ for L100. Sugar yield (RBA) is directly linked to sugarcane yield and is also favored by the combination of L100 and M3, with an average value of 23.4 t ha⁻¹. The V1, V2, V4 and V6 varieties, for irrigation depth L100, did not differ significantly for RBA and had the highest average, 23.9 t ha⁻¹. The water productivity in sugar and biomass differed in 4 and 2 variety groups, respectively, and was independent of the adopted irrigation depth and maturation management. Breeding techniques in sugarcane related to water use efficiency (WUE) focused on 1G ethanol were successful, but new traits need to be considered for WUE in 2G ethanol.

MAIN PUBLICATIONS

- Barbosa FS. 2015. Productivity of sugarcane under drip irrigation: interactions between varieties, irrigation depths and water deficit intensity at the maturation phase. PhD Thesis USP / Agricultural Systems Engineering.
- Lizcano JVL. 2015. Specific heat, energy and ash from sugarcane biomass under drip irrigation, for different varieties, irrigation depths and maturation processes. Master thesis USP / Agricultural Systems Engineering.
- Barros THS. 2015. Water use efficiency of sugarcane under drip irrigation based on gas exchange measurements (IRGA): photosynthesis and transpiration. Master thesis USP / Agricultural Systems Engineering.
- Maschio R. 2015. Water right flow rate calculation for irrigated sugarcane in Brazil: Influence of the irrigation criteria and probability levels adopted (evapotranspiration and precipitation). PhD Thesis USP / Agricultural Systems Engineering.
- Fraga Júnior EFF. 2015. Water management considerations on productivity and quality of sugarcane seedlings in the formation of bud chips nursery. PhD Thesis USP / Agricultural Systems Engineering.
- Perin V. 2014. Differentiation of canopy temperature in sugarcane crop based on varieties and soil water availability. Scientific Initiation Program IC1 ESALQ/ USP – LEB.
- Oliveira LR. 2014. Chlorophyll indexes for sugarcane varieties under different soil water availability. Scientific Initiation Program Scientific Initiation Program IC1 ESALQ/ USP – LEB.
- Scanavini JG. 2014. Irrigation strategies for sugarcane nurseries with seedlings coming from micropropagation process (Biofactory). Master thesis USP / Agricultural Systems Engineering.

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