EVALUATION OF PHYSIOLOGY OF MATURITY OF SUGARCANE (*Saccharum Spp* Hybrid) UNDER ELEVATED ATMOSPHERIC CO_2 AND TEMPERATURE

BY

R. M. DHAMMIKA SRIMATHI RATHNAYAKA

DEPARTMENT OF AGRICULTURAL BIOLOGY
FACULTY OF AGRICULTURE
EASTERN UNIVERSITY
SRI LANKA

2018

ABSTRACT

Increased atmospheric [CO_2] and consequent increases in temperature are two prominent features of climate change, a major challenge to crops. The rise in atmospheric [CO_2] together with potential global warming and changes in precipitation will undoubtedly have a significant economical and ecological impacts on many agricultural crop plants. In concern with this, an experiment was conducted at the Sugarcane Research Institute, Uda-Walawe, Sri Lanka in 2018 to evaluate the effects of elevated atmospheric [CO_2] and elevated temperature on the physiology of selected sugarcane varieties; Co775, SL 71 30, SL 83 06, SL 88 116, SL 90 6237, SL 92 4918, SL 96 128 and SL 96 328 at maturity stage. The experiment was laid out in the Split Plot Design with five treatments in the main-plots and eight varieties in sub-plots. These treatments and variety combinations were replicated thrice. Crops were grown in transparent open top chambers (3m diameter, 4m height) and open field conditions. In chambers, CO_2 concentration levels were maintained at ~400ppm and 665ppm and temperatures were maintained at ~34 and 37 °C in ambient and elevated conditions respectively. Open field condition was maintained as the control treatment.

There were significant ($p<0.05$) differences between treatments in the tested physiological parameters. However, there was no significant ($p>0.05$) difference between treatments in the leaf area. It was also found that there were significant ($p<0.05$) differences between varieties in all the tested parameters except relative leaf water content. There were significant ($p<0.05$) interactions between treatments and varieties in net photosynthesis rate, stomatal conductance, instantaneous water use efficiency, transpiration rate, total soluble solids in cane juice (brix%) and sap flow rate. However, no significant ($p>0.05$) interactions were found in leaf water potential, relative water content, chlorophyll content and sap flow rate.

Under elevated CO_2 with elevated temperature (CETE) highest net photosynthesis rate (19.4μ mole $m^{-2}s^{-1}$) was obtained by the variety SL 92 4918 and the minimum (11.50 μ mole $m^{-2}S^{-1}$) was found in the Co775. The highest stomatal conductance (0.18scm^{-1}) was found in the variety SL 90 6237 and the lowest (0.10 scm^{-1}) was found in the varieties Co775 and SL 96 328. The highest transpiration rate (3.32mg H_2O m^2 s^{-1}) was obtained in the SL 92 4918 and the lowest (2.62mg H_2O m^2 s^{-1}) was found in the Co775. The maximum instantaneous water use efficiency (6.07) was recorded in the variety SL 92 4918 and the lowest (4.43) was found in the Co775.

The highest (19bar) leaf water potential was found in the open field condition and the lowest (16.88bar) was found in the elevated CO_2 and atmospheric temperature (CETA) treatment. The highest (19.47bars) performance on leaf water potential was shown by the variety SL 88 116 and the lowest (14.63bars) was found in the SL 90 6237. The highest chlorophyll content (30.6) was found in the treatment CETA and the lowest (24.85) was found in the open field condition. SL 90 6237 has shown the highest (30.72) chlorophyll value and the lowest (26.47) was found in SL 88 116. The maximum (17.89) amounts of Total Soluble Solids was observed in the open field condition and the minimum (13.72) was observed where the treatment received ambient CO_2 and elevated temperature.

Hence, it was observed that depending on the variety, elevated CO_2 alone increased the net photosynthesis rate, while decreasing stomatal conductance and Instantaneous Water Use Efficiency. Elevated temperature alone increased transpiration rate and stomatal conductance. Ambient CO_2 with ambient temperature decreased net photosynthesis rate and instantaneous water use efficiency. Elevated CO_2 with elevated temperature decreased stomatal conductance.

TABLE OF CONTENTS

Page No