Bangladesh J. Sugarcane, 8 : 75 - 76. July, 1986

Physiological Responses of *Saccharum* species to Anoxic Flooding Stress

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The survival of plants during flooding or anaerobic condition has received considerable attention recently. It has been recognized that the adaptation of plants to flooding or anoxia is accomplished through anatomical and metabolic features. There are at least two predominant theories on metabolic adaptation to flooding. One is based on observations that some flooded plants have high Alcohol Dehydrogenase (ADH) activity in their roots, providing a compensatory energy source in theabsence of aerobic respiration. The second theory argues that the least tolerant species have high ADH actitiy and alcoholic fermentation with a resultant accumulation of toxic ethanol (Keeley, 1979; John and Greenway, 1976). Some authorities claim that tolerant species alter cabon metabolism so that non-toxic products such as malate accumulate in stead of toxic ethanol(Crawford,1977).The present work was undertaken to investigate the possible metabolic adaptation of five species of *Saccharum* and one commercial hybrid of sugarcane in order to select genotypes with superior adaptation to flooding.

Representatives of five species of the genus *Saccharum,* viz., S. *spontaneum* (SP), *S. sinense* (SN), *S. barberi* (BB). *S. robustum* (RB), *S. officinarum* (OF), and commercial hybrid (CH) CP65-357 were grown under green house conditions in full strength Hoagland solution. Plants under anoxic treatment were continually flashed with nitrogen gas while the aerated controls were bubbled with air. Roots were harvested under ice at 3, 10, 20, 30 days for enzyme activity and metabolites determinations. Extraction and assay of ADH were done according to John and Greenway (1976). For ethanol and malate determinations, separate root samples were fixed in liquid nitrogen, deproteinized, neutralized and analysed enzymatically according to Bergmeyer (1974). Sucrose, glucose and fructose were determined by HPLC using a 60 cm Aminex-Q 150S (K+) column (Bio-Rad) combined with a 30 cm Synchropak ASC column.

Saccharum spp. are of interest because they have a broad range of tolerance to an-oxia.The commercial hybrid CP65-357, *S. spontaneum* and *S. sinense* showed a small decrease in growth through 30 days of anaerobic treatment, whereas, the leaves of *S. officinarum* and *S. robustum* turned yellowish and growth ceased by day 20. All the species had increased in ADH, ethanol, malate, and sucrose during anoxia. The present data indicate that the carbohydrate supply for anaerobic glycolysis was not limiting. Presently we can not conclude whether the increase in surcose, glucose, and fructose was due to a decrease in glycolysis which then decreased root growth, or whether a decrease in root growth lessened the demand for cell wall synthesis and thereby increased soluble sugars. It is probably that plants have evolved several mechanisms to survive anaerobic stress.

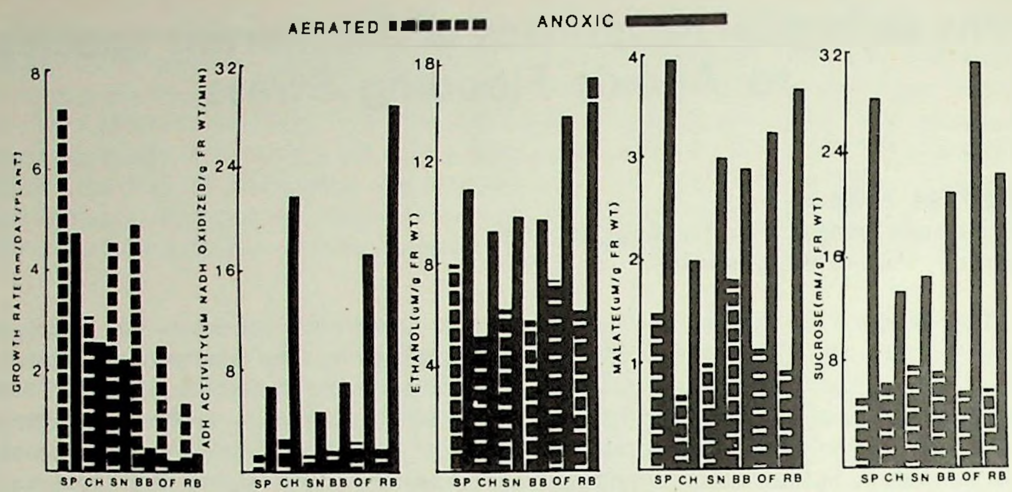

Figure 1. Growth rate, enzyme activity, ethanol, malate and sucrose concentration in five species of *Saccharum* and one commercial hybrid grown under aerated and anoxic nutrient culture.

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