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Comparative analysis of physiological characteristics and yield components in sugarcane cultivars

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Abstract

Sugarcane in an important crop due to the economic value of its products. Physiological characteristics and yield components of sugarcane were studied in three field-grown sugarcane cultivars B 63118, POJ 2878 and Ja 60-5. Three growth stages were identified: formative phase (until 140 DAP), grand growth (140–300 DAP) and maturity (after 300 DAP). Results indicated that cultivars showed contrasting yield mainly after 300 DAP. At ripening, the most productive cultivar (Ja 60-5) achieved higher leaf area, an optimum leaf area index for light interception, a high and stable net assimilation rate and an elevated leaf area and biomass duration. In addition, this cultivar showed the higher density and lower area of leaf sieve elements as compared with other, which could influence the high translocation rate (1.85 cm min^{-1}) at 8 MAP. The higher efficiency of this process in Ja 60-5 might also be supported by a higher (15–25%) apparent free space of stem parenchyma as compared with POJ 2878 and B 63118. Our results suggest that Ja 60-5 reduced carbon partitioned to foliar respiration which led to a higher partitioning of sucrose to stems evidenced by a higher Pol%.

Keywords: Growth analysis; Partitioning; *Saccharum* spp.; Sugarcane; Yield components

1. Introduction

Sugarcane (*Saccharum* spp. hybrids), is one of the most productive plant species known, since it can potentially produce from 41.1 (Cheeroo-Nayamuth et al., 2000) to about 65 tonnes of dry weight ha^{-1} $year^{-1}$ (Bakker, 1999). Crop growth duration can vary from 9 months to 36 months (Evensen et al., 1997). Sugarcane is a C_4 plant that produces multiple tillers, each having numerous nodes separated by internodes. The internodes consist of sucrose storing parenchyma cells and vascular tissue, with the stem being the major sink for photosynthates (sucrose) (Moore, 1987; Australian Government, 2004).

Sugarcane stem tissues have been studied over many years since its maturation is characterized by the accumulation of sucrose in developing internodes (Glasziou and Gaylor, 1972; Moore, 1995). In addition, some recent studies have been motivated by the discovery of the endophyte *Gluconacetobacter diazotrophicus* living in the stem apoplast (Dong et al., 1994; Tejera et al., 2006). The percentage of sucrose in sugarcane juice (with a pH of 4.9–5.5), usually referred to, in the sugar industry, as the polarization value (Pol), varies from 8 to 15% (Tewari et al., 2003).

Studies of carbon partitioning in sugarcane have focused primarily on the sugar pool, and have revealed that a cycle of a rapid sucrose synthesis and degradation exists in sugarcane (Komor et al., 1996; Vorster and Botha, 1999). Others non-sucrose metabolic pathways have also proved to be significant sinks. These include the water insoluble compounds (assumed to be primarily fibre) and the respiratory pathway (Whittaker and Botha, 1997). It has been suggested that total allocation to these pathways decreases with the tissue maturation and at the same time a concomitant rise in partitioning of sucrose to the stem parenchyma occurs (Whittaker and Botha, 1997).

In not mature tissue, proteins and fibre are the competing sinks with sucrose for incoming carbon (Bindon and Botha, 2002).

Field conducted studies in order to determine the factors responsible for yield variation in sugarcane have been carried out in some countries, where this plant is extensively cultivated

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