

INTERNATIONAL CONSORTIUM FOR SUGARCANE MODELLING

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1. INTRODUCTION

The International Consortium for Sugarcane Modelling (ICSM) was established in 2006 and is an international partnership of research and other organizations that have an interest in sugarcane simulation modelling. Current members are Centre de Cooperation Internationale en Recherche Agronomique pour le Développement (CIRAD), Chiang Mai University (Thailand), Commonwealth Scientific and Industrial Research Organisation (CSIRO), South African Sugarcane Research Institute (SASRI), Sugar Cane Growers Cooperative from Florida (SCGC), Sugar Research Australia Limited (SRA), Sugar Research Institute of Fiji (SRIF), and Zimbabwe Sugar Association Experiment Station (ZSAES). The current memorandum of understanding (MoU) is in place until November 2022.

The goal of the ICSM is to promote the development and application of sugarcane simulation models. Key objectives are to coordinate efforts and generate resources for sugarcane modelling projects, and to promote and enable the sharing of knowledge, information and data in the field of sugarcane modelling.

2. ICSM PROJECT ON “MODELLING WORLD-WIDE GXE INTERACTION”

A group of ICSM members (CIRAD, Florida SCGC, SASRI, ZSAES,) is conducting research to gain a better understanding of the physiological mechanisms underlying the genetic variation in sugarcane crop response to environmental factors. Crop canopy development, radiation interception, biomass accumulation and partitioning of genetically diverse cultivars grown in diverse environments are monitored using a standardized trial and measurement protocol. The ultimate goal is to develop improved concepts for simulating genetic control of crop response to environmental factors, and to implement these in sugarcane models, with a view to use them to support crop improvement programs, worldwide. The hypothesis is that realistic models with accurate trait parameter values can be used to identify important traits and their ideal values for given environments (including future climates).

Growth analysis experiments were conducted from 2013 to 2016 (plant and ratoon crops) in Pongola, South Africa; Chiredzi, Zimbabwe; La Mare, Reunion Island; and Belle Glade, Florida, USA using different cultivars (N41, R570 and CP88-1762 at all sites, and HoCP96-540, Q183, ZN7 and NCo376 at some sites). Data collected include soil chemical and physical data, weather data, crop management data, shoot emergence, tiller population and height, leaf dimensions and appearance, fractional radiation interception, dry aboveground biomass component weights and stalk composition at harvest. This data were used to:

- characterise crop development and growth for the different cultivars and environments,
- to evaluate current theories/understanding of genetic (G) and environmental (E) control of sugarcane development and growth, and
- propose new concepts for G and E control of crop development and growth.

Interesting findings include:

- Final yields showed significant E and GxE variation; dry above-ground biomass and stalk yields were highest in La Mare and lowest in Pongola,
- Cultivar rankings in stalk dry mass for the common cultivars (N41, R570, CP88-1762) varied significantly between Es.
- Significant E variation in phenotypic parameters describing germination, tillering and timing of the onset of stalk growth (OSG) revealed shortcomings in the underlying modelling concepts.
- Significant G variation was found for germination rate, leaf appearance rate and canopy development rate per unit thermal time (TT), and maximum radiation use efficiency, indicating strong G control of the associated underlying processes, and
- Solar radiation was found to influence tillering rate per unit TT, and TT to OSG, challenging the current theory of TT as the sole driver of these processes.

This work was captured in a scientific paper (Jones et al., 2019a) that was submitted to Field Crop Research and is currently under review.

A second companion paper (Jones et al., 2019b) is in preparation and aims to evaluate three sugarcane models (APSIM-Sugar, DSSAT-Canegro and Mosaic) for simulating G effects on crop development and growth using the ICSM data set. This paper will report on:

- Estimation of genetic trait parameter values (model calibration),
- Statistical evaluation of model performance for predicting G and E effects on canopy cover, aboveground dry biomass and stalk yields, and
- Identification of model strengths and weaknesses for simulating genetic control of crop growth and development processes.

For the remainder of the project (2019-2020) the focus will be on the development of an improved model for simulating G and E effects on crop growth, and evaluating its potential for supporting sugarcane breeding.

3. ICSM BUSINESS MEETING

The last ICSM business meeting was held at Mount Edgecombe on 27 June 2017. It was hoped to hold a business meeting in 2018 in Reunion Island to coincide with the ISSCT Agronomy workshop, but this did not materialize due to too few members attending this event. We will explore the possibility to hold a business meeting to coincide with ISSCT Congress to be held in Tucuman, Argentina from 31 August to 8 September 2019.

4. REFERENCES

- Jones MR, Singels A, Chinorumba S, Patton A, Poser C, Singh M, Martiné JF, Christina M, Shine J, Annandale J, and Hammer G (2019a). Exploring process-level genotypic and environmental effects on sugarcane yield using a global experimental dataset. Field Crops Research [under revision].
- Jones MR, Singels A, Chinorumba S, Patton A, Poser C, Singh M, Martiné JF, Christina M, Shine J, Annandale J, and Hammer G (2019b). Evaluating process-based sugarcane models for simulating GxE effects observed in a global dataset. Field Crops Research/Agric Systems [under prep].

<https://sasri.sasa.org.za/agronomy/icsm/index.php>

