

# THE BRAZILIAN SUGARCANE R&D ENVIRONMENT

*Recently, a contingency of ten SASRI staff attended the XXVIII International Society of Sugar Cane Technologists (ISSCT) Congress in São Paulo, Brazil. SASRI's Research Manager, Dr Derek Watt shares his insights on research and development within the Brazilian sugar industry.*

**W**ITH APPROXIMATELY 9.5 MILLION HECTARES UNDER SUGARCANE CULTIVATION AND DELIVERING 25% OF WORLD SUGAR PRODUCTION AND 50% OF WORLD SUGAR EXPORTS, THE BRAZILIAN SUGARCANE INDUSTRY IS OF A STAGGERING SCALE. OF COURSE, NOT ONLY IS BRAZIL THE WORLD'S LARGEST SUGAR PRODUCER BUT THE BRASILEIROS ALSO DOMINATE IN BIOETHANOL, PRODUCING 20% OF GLOBAL BIOETHANOL AND DELIVERING 20% OF WORLD EXPORTS IN THIS COMMODITY. THIS LATTER CAPACITY IS THE ENVY OF MANY COUNTRIES, PARTICULARLY GIVEN THAT 45% OF BRAZILIAN ENERGY SUPPLY IS FROM RENEWABLE SOURCES, WITH SUGARCANE CONTRIBUTING ALMOST 18% OF THE COUNTRY'S ENERGY REQUIREMENTS.

## **Variety Improvement R&D**

Unsurprisingly, the scale and level of diversification of current

Brazilian sugarcane operations, as well as the potential for expansion<sup>1</sup> and the fact that 60% of the crush is miller-cum-planter derived, have attracted the attention of key multinational agro-technology companies, including Syngenta and Monsanto. Both companies have invested in sugarcane improvement operations in Brazil, potentially competing with the three existing programmes, viz. Centro de Tecnologia Canavieira (CTC), Centro Avançado de Tecnologia do Agronegócio Cana (Instituto Agronômico de Campinas [IAC]) and Rede Interuniversitária para o Desenvolvimento do Setor Sucroenergético (RIDESA).

To-date, the sugarcane varieties cultivated in Brazil have been developed by CTC (SP and CTC varieties), IAC (CB and IAC varieties) and RIDESA (RB varieties), with

those from CTC currently occupying approximately 8.7 million hectares (95%) of the industry.

It is within this context that the XXVII ISSCT Congress in São Paulo and associated pre-congress tour around São Paulo State (Ribeirão Preto and Piracicaba) to a family owned and managed estate (Agro Pastoral Paschoal Campenelli S/A), IAC and CTC provided invaluable insights into the opportunities and challenges facing R&D service provision within the Brazilian sugarcane industry.

## **Brazilian Sugarcane R&D Models: Past and Present**

Brazilian sugarcane research and development (R&D) is located within a mixed oversight and funding

model, with there being no unified industry-funded R&D organisation or function equivalent to SASRI or BSES Ltd (incorporated into Sugar Research Australia as of 1 July 2013). Investment in sugarcane R&D has been through private entities (e.g. CTC was founded and continues to be supported by Copersucar), state government (e.g. IAC of the São Paulo State) or federal government (e.g. RIDESA, which comprises a constellation of universities).

Given the entry in recent years of the giant agro-technology multinational companies into the Brazilian sugarcane R&D landscape, it was unsurprising during the ISSCT Congress to observe the shifts that have occurred very recently within the local sugarcane R&D paradigm. The increased competition for market-share, particularly for improved sugarcane varieties for both the sucrose and bioethanol markets, prompted CTC to adopt a revised business model, which was revealed by Dr William Burnquist (Director of Breeding [including genetic engineering and marker-assisted breeding]) during the pre-congress visit to CTC and in his plenary address at Congress.

Now a private for-profit company, CTC has 150 shareholders comprising milling and distilling companies and holds R&D service contracts, including variety provision, with 190 mills (representing 60-75% of Brazil's crushing capacity). Variety provision is conducted on a royalty basis, with one-third of the value captured from

cultivation of the varieties being paid to CTC. Profits earned from this income will be invested in R&D to enhance innovation and technology delivery to customers. CTC has a bold vision of 15 million hectares being planted to SP and CTC varieties. To realise this vision, the technology centre has implemented aggressive breeding strategies: accelerated breeding to produce new varieties in eight years and targeted selection of varieties for the Cerrado (the wooded grassland region of south-central Brazil that occupies 20% of the country's territory), which is the major area of sugarcane expansion.

### ***Points for Reflection: Variety Development and Industry Expansion***

The Brazilian industry and CTC, in particular, should take comfort in having Bill Burnquist and his skilled team at the helm of this significant variety improvement initiative to support the expansion programme. However, despite such clearly apparent competence and vision, there are aspects of this audacious plan that may give pause for thought if considered from a South African perspective. The first of these is in the area of biorisk mitigation. The accelerated variety selection strategy appears not to provide opportunity for the conventional period of pest and disease (P&D) resistance screening; a potential risk that may be exacerbated by an apparent lack of overarching P&D monitoring structures, particularly with regard to seedcane quality (although P&D pressure in

the region of São Paulo State visited was remarkably and enviably low). The second area for reflection is the aggressive expansion into the Cerrado, in that the impact of humans on the habitat and biodiversity of this biome exceeds that on the Amazon rainforest. Although a large area (80%) of the Cerrado has already been cleared, primarily for cattle ranching (less than 3% is currently protected by law), it was surprising that environmental management and targeted rehabilitation of the biome during either brownfield or greenfield sugarcane expansion did not feature more prominently on the ISSCT Congress programme.

In the coming years, much will be learned though monitoring trends in the market share occupied by varieties provided by CTC, IAC, RIDESA, Canavialis-Monsanto and Syngenta, as well the factors impacting on renewal of variety contracts. In particular, the swing in the Brazilian variety disposition that will inevitably result from GM commercialisation will be of interest, given that three of the major players in Brazilian variety improvement have access to important GM technologies: Monsanto-Canavialis, Syngenta and CTC (through licence agreements with BASF and Bayer CropScience). Also of note is that, similar to SASRI, CTC have curtailed their gene discovery programme and have elected to pursue GM commercialisation through technology licensing agreements with IP holders, while maintaining in-house capacity (expertise and infrastructure) for conducting

the genetic engineering of their proprietary sugarcane germplasm.

### **Renewable Energy R&D**

Although Brazil comfortably leads the way in bioethanol production from sugarcane-derived brix, CTC in 2007 commenced R&D into optimising second-generation (2G) bioethanol production from sugarcane biomass, with bagasse serving as the primary feedstock and trash as fuel for boilers. During the ISSCT pre-congress visit to the technology centre, the infrastructure and processes used in the R&D phase were viewed and discussed. The optimised process uses a standard steam explosion approach to facilitate separation of

the cellulose, hemi-cellulose and lignin, with the subsequent deployment of conventional Novozyme cellulases. However, CTC have developed yeasts that use both hexoses and pentoses as substrates during fermentation.

The true novelty of the CTC 2G bioethanol technology is that it is incorporated as a module within existing first-generation (1G) bioethanol plants. The bagasse-derived liquor enters the 1G ethanol stream for fermentation at the mill and is anticipated to increase ethanol yields by 30%. A pilot plant is under development at the nearby São Manuel mill at a cost of USD 38.5 million. The pilot plant will have a bagasse throughput of 8 tons/hr and the capacity

to produce three million litres of ethanol per year. The São Manuel installation will be used to finalise research before commercialisation of the technology in 2016. In commercial applications of the technology, CTC predict a seven year period for return on investment. 

<sup>1</sup> *The Brazilian sugarcane industry may feasibly expand to occupy 64.7 million hectares, representing 7.5% of the Brazilian territory (currently it occupies 1%).*

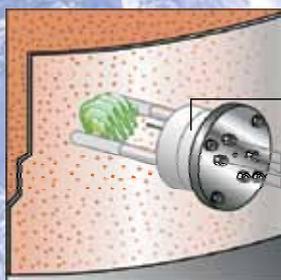
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