RB varieties: a major contribution to the sugarcane industry in Brazil

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Abstract   In the 2015/2016 cane crushing season in Brazil 650 Mt of sugarcane was processed from about 9 Mha. Six states played a key role in this production; São Paulo with 53% of the national cane production, followed by Goiás (10%), Minas Gerais (9%), Paraná (7%), Mato Grosso do Sul (7%) and Alagoas (4%). 68% of the sugarcane area was grown with RB varieties, which were originally developed by the former PLANALSUCAR, now named RIDESA. In the last 45 years (1970-2015), 94 RB varieties have been released. RB72454 was the largest contribution from PLANALSUCAR to Brazilian agriculture because it had broad adaptation to different climates and soils, and was parent of 25 other commercial varieties. Some other varieties from PLANALSUCAR/RIDESA portfolio are also noteworthy. RB855156 is the earliest maturing variety of all cultivars in Brazil, with high cane quality in the first months of harvest in the Brazilian central-south region. RB867515 is the best adapted variety for marginal environments, and was 25% of harvested area in 2015. RB92579 is adapted to the northeast region, producing 30-40% more cane than other varieties in that region and it is also highly responsive to irrigation. RB966928 shows suitability for mechanization harvesting and planting due to its agronomic traits, especially its ratooning ability. In 2015 the variety census for São Paulo state indicated the four most planted varieties were RB966928 (18%), RB867515 (16%), RB92579 (10%) and RB855156 (7.8%), indicating the ongoing importance of RIDESA varieties in coming years. RIDESA released 16 new varieties in 2015; each of these may contribute to different environmental conditions, including variability in maturity time, and resistance to major diseases. RIDESA hopes to maintain genetic diversity and continue to contribute to increased yields in the Brazilian sugarcane crop.

Key words   Elite varieties, early maturing, ratooning ability, disease resistance, environmental adaptation

INTRODUCTION

Brazil is the world's largest producer of sugarcane, with a most recent harvest of 739 Mt, followed by India with 341 Mt, China with 125 Mt, and Thailand with 100 Mt (FAO 2013). Brazil is the world's largest producer and exporter of sugar and ethanol, with the lowest production costs among the main competitors in the international market. In 2015, Brazil exported more than 2 Mt of sugar, equivalent to US$600 million, and the United States, South Korea and Japan were the largest importers of Brazilian ethanol (CONAB 2015). In Brazil, sugarcane ranks third in importance, after soybean and maize. Currently, it is estimated that the area planted with this energy crop occupies about 9 Mha, spread over almost all states (Morais *et al.* 2015). The main producing regions of Brazil are the central-south, accounting for approximately 90% of the sugarcane produced, and the northeast, which despite being a region with high water deficit, is responsible for around 10% of national production. Among the producing states, São Paulo state stands out, accounting for 52% of the total area of sugarcane in the country. Together, these regions produced about 35 Mt of sugar and more than 29 GL of ethanol in 2015. Currently, the national average yield is 73.2 t/ha, 3.9% higher than last season. The central-west region had the highest average productivity of the country (77.8 t/ha) and the states of the northeast had the lowest average yield (54.4 t/ha). This low yield is a reflection of water restriction and lower crop management expertise of those growers (CONAB 2015). The importance of sugarcane breeding programs in Brazil for the maintenance of yield and contributing genetic material of high yield potential, among other important traits, is clear.

AGRICULTURAL CONTEXT: DISEASES AND PESTS

In Brazilian sugarcane most diseases are managed with genetic resistance. Thus, it is desirable that newly released cultivars have suitable resistance to the major sugarcane diseases. However, a variety can have a suitable resistance while not being immune, i.e. it may still be infected by a disease and suffer some damage (Maccheroni and Matsuoka 2006; Santos and Borém 2013).

The disease of most concern in Brazilian sugarcane currently is orange rust, caused by the fungus *Puccinia kuehnii*. Its recent detection in the country in 2009 (Barbasso *et al.* 2010) and its damage potential in susceptible varieties are the main reasons for such concern.

For several important diseases, namely ratoon stunting disease, smut, sugarcane mosaic virus and leaf scald, a combination of both planting of resistant varieties and planting material from a nursery of healthy seed cane is used in management (Santos and Borém 2013). For brown rust and orange rust the use of resistant varieties is sufficient (Magarey 2000).

Brazilian sugarcane is also affected by many pests; the most important are the sugarcane borer (*Diatraea saccharalis*), the sugarcane root froghopper (*Mahanarva fimbriolata*) and, more recently, the sugarcane weevil (*Sphenophorus levis*). Other regional or sporadic pests that can cause damage occasionally are termites (mainly *Heterotermes tenuis*), leaf-cutting ants (*Migdolus fryanus*), the giant sugarcane borer (*Telchin licus*), and the sugarcane leaf froghopper (*Mahanarva posticata*) (Santos and Borém 2013).

SUGARCANE BREEDING IN BRAZIL AND RB VARIETIES HISTORY

There are three main breeding programs in Brazil: Sugarcane Technology Center (CTC varieties), a private company, Instituto Agronômico de Campinas (IAC varieties), supported by the government of São Paulo state, and the Inter-University Network for the Sugar and Ethanol Development (RIDESA - RB varieties), supported by the federal government.

The RB program began on 29 July 1971 as PLANALSUCAR (National Sugarcane Breeding Program), in order to promote improvements in the field and sugar factories. The institute was organized into five main centers, spread across the main sugarcane growing regions in Brazil. The PLANALSUCAR Germplasm Bank was under the responsibility of the Experimental Station of Sugarcane in Alagoas state, firstly established as an independent experimental station (1967) and later absorbed by PLANALSUCAR. The Germplasm Bank is located at Serra do Ouro (Murici, Alagoas, Brazil, 09°13'S, 35°50'W). This collection initially had 220 accessions from different origins, and currently has around 3,039 accessions (Barbosa 2014; Daros *et al.* 2015).

The sugarcane industry was impacted in 1988 when the ethanol subsidy policy ended. In 1990, the federal government closed IAA (Sugar and Alcohol Institute) activities, and as a consequence PLANALSUCAR suspended its activities temporarily. However, the program was not extinguished because the Federal University of Alagoas (UFAL), Paraná (UFPR), Rural de Pernambuco (UFRPE), Rural do Rio de Janeiro (UFRRJ), São Carlos-SP (UFSCar), Sergipe (UFS) and Viçosa-MG (UFV), inherited PLANALSUCAR staff and structure, creating RIDESA. This network was later expanded with the inclusion of three universities: Federal universities of Goiás (UFG), Mato Grosso (UFMT) and Piauí (UFPI).

In the PLANALSUCAR to RIDESA transition created differences with the most important being the funding system. Previously the federal government funded most of the research, but in the new model the funding is provided by sugarcane mills, distilleries and growers' association. To illustrate the success of the model, in the 1990/1991 crushing season, RB varieties were grown on only 5% of the sugarcane area in Brazil, while in the last harvest season (2014/2015) this proportion reached 68%.

THE MAIN RB VARIETIES RELEASED TO THE SUGARCANE INDUSTRY IN BRAZIL

The first RB varieties released were derived from crosses made in 1970 by PLANALSUCAR – this generated seven varieties. After that, another 12 varieties were released, with RB72454 the most important in that period. Released nationally in 1987, this variety had wide adaptability to different weather conditions and Brazil's soils, particularly to soils of low fertility, in addition to good agronomic qualities and resistance to brown rust, the major disease at that time. For many years it was the most widely planted variety in Brazil, and in 1995 22.1% of the total area cultivated to sugarcane grew this variety. However, the area reduced to 4.7% in 2010, due to productivity losses by mechanical harvesting and its

susceptibility to orange rust. It has also been an important parent in breeding, and was the parent of 25 RB cultivars (Daros *et al.* 2015).

In 1989, PLANALSUCAR started a project looking for early ripening varieties. After PLANALSUCAR transitioned to RIDESA the Federal University of São Carlos (UFSCar) continued this work and released seven early varieties, among them RB855156. Currently, this variety is one of the most important at the start of the harvesting season. In addition to its early harvesting suitability, this variety is one that shows good performance under mechanical planting, has great tillering, especially in ratoon cane, and has resistance to major diseases. In 2014, this variety occupied 4.9% of the state of São Paulo.

In 1997, the Federal University of Viçosa (UFV) as part of RIDESA released RB867515. This variety is currently the most widely planted in Brazil and indeed in the world. It has better performance in dystrophic and sandy soils, allowing the expansion of the sugarcane area into marginal conditions. In 2015, this variety reached about 25% of the total area cultivated with sugarcane in Brazil, with good industrial and agronomic characteristics and resistance to major diseases.

In 2003, the Federal University of Alagoas (UFAL), located in the northeast of Brazil, where sugarcane covers an area of about 1 Mha, released RB92579. In this region, summers have high temperatures with a strong water deficiency. Productivity was historically lower in the northeast production compared with the south-central region, at below 60 t/ha. However, the release of this new variety has delivered a 30-40% yield gain compared to the other varieties. This has made a remarkable contribution to the competitiveness of many companies in this region (Daros *et al.* 2015).

More recently, in 2010, under the responsibility of the Federal University of Paraná (UFPR), RB966928 was released. With the increase of mechanical harvesting in the country, which in 2015 reached around 95% of the total area, the need for varieties adapted to this system was considered in launching this new variety. It has exhibited adaptation to different production environments, high productivity, excellent ratooning ability, and is suitable for mechanical harvesting. Due to its industrial and agronomic characteristics, 6 years after its release it now is the most planted variety in the south-central region of the country.

Finally, in 2015 RIDESA released 16 new varieties for the sugarcane industry in Brazil. These varieties will continue contributing to the sustainability and economic viability of the industry in Brazil.

SUGARCANE VARIETY CENSUS

The range of varieties for planting allows opportunity for best matching available varieties with specific soils, climate conditions, and management, seeking optimal genotype by environment interaction effects (Bassinello *et al.* 1981). A suitable varietal management can provide higher yields without additional costs to the growers (Lima and Barbosa 1996).

Annually, sugarcane breeding programs perform a variety census at the sugar and ethanol mills in order to determine the varieties with greater acceptance among growers and to help decisions on which varieties to plant.

As São Paulo plays an important role for Brazilian production, the Federal University of São Carlos (UFSCar) performs a variety census in the states of São Paulo and Mato Grosso do Sul every year. In 2015, 138 mills answered the census, comprising an area of 3,925,754 ha, which corresponds to 73% of the sugarcane area in these two states in the 2015/16 harvest (CONAB 2015). RB varieties had a 65% share of the total area surveyed, followed by the SP varieties (19%), CTC (13%), IAC (2%) and CV (1%). Considering the planting area, RB varieties had a 65% share, followed by CTC varieties (19%), SP (9%), IAC (3%), CV (2%) and other varieties (2%).

The five most cultivated varieties were: RB867515 (26%), RB966928 (9.7%), SP81-3250 (8.1%), RB855453 (6%) and RB855156 (5.8%). Considering only the planting area, the five most planted varieties were RB966928 (17.3%), RB867515 (16.7%), RB92579 (9.2%), RB855156 (8.5%) and CTC4 (7.7%).

The varieties RB966928, RB867515 and RB855156 stood out with good acceptance both in total area and in planting area. Two other varieties, RB855453 and SP81-3250, were among the five most cultivated, but they were not among the five most planted; however, RB855453 still has a good acceptance in the studied region, being the sixth most planted. On the other hand, SP81-3250, due to its susceptibility to the orange rust, is being replaced by varieties with higher resistance. RB92579 (sixth most cultivated and third most planted) and CTC4 (tenth most cultivated and fifth most planted) should increase in coming years, since they were among the five most planted varieties.

The results clear show that the RB varieties predominate in the sugarcane area in São Paulo and Mato Grosso do Sul; with the varieties RB966928, RB867515, RB855156, RB92579, CTC4 and RB855453 expected to dominate in near-future harvests in these two states.

SUGARCANE PRODUCTION IN THE NORTHEAST

The sugarcane crop in the northeast region of Brazil has great socio-economic importance and is strategic for energy production. The region is one of the traditional producers in Brazil, with 979,000 ha harvested in the 2014/2015 crop season, crushing 55.7 Mt of sugarcane, producing 3.58 Mt of sugar and 2.08 GL of ethanol, and generating electricity in almost all sugarcane mills (CONAB 2015).

Before 1970, the average yield northeastern region was less than 45 t/ha, with an average yield of less than 90 kg of total recoverable sugars per tonne of cane. At that time, growers used to grow foreign varieties, Co, CP and B varieties, or the old Brazilian varieties, i.e. developed before 1970s (CB or IAC varieties). Currently, the average yield is around 60 t/ha, with 140 kg total recoverable sugars per tonne of cane. There was major change in the adoption of technologies in those areas, especially the cultivation of modern RB varieties (Barbosa *et al.* 2008), which currently occupy 68% of the northeastern area (Daros *et al.* 2015). In this region, the most representative soil is an oxisol clay of medium texture and the sugarcane is grown in the three major environments: Atlantic rainforest, cerrado (tropical savanna) and caatinga (type of desert vegetation), where more than 80% of the northeastern sugarcane plantations are located in the tableland (strip of land which begins in the state of Sergipe and extends up to Rio Grande do Norte state, contained by the Atlantic rainforest). In this region, temperatures are very high, with average annual rainfall of 1,200-2,100 mm, depending on the micro-region, and with irregular distribution of rain. Two seasons are distinguished: the rainy season, which usually meets the water requirements of the crop, but associated with lower temperatures and lower solar radiation; and a dry season, corresponding to the crushing season, where the combination of water shortages, higher temperatures and increased sunlight is common.

BREEDING ACHIEVEMENTS IN BRAZIL

Genetic improvement is a key component for any productive sugarcane industry. In sugarcane, major contributions may occur through the development of broadly adapted varieties, the expansion of the harvesting season with different ripening varieties, genetic resistance to diseases, and an increase in genetic diversity in sugarcane growing areas, among others. Between 1975 and 2010, Brazil's sugarcane productivity increased by 66% in cane yield (Dal-Bianco 2012), with a gain in average total recoverable sugars per tonne of cane of about 4% per year. These gains are due to the use of new technologies, both in agriculture and in mills, as well as genetic improvement. In many countries it is reported that 50% of the productivity gain is due to the continuous substitution rate for other more productive varieties (Daros *et al.* 2015).

Considering that in 2015 the sugarcane crop contributed 18.1% of the country's energy needs (through ethanol and bioelectricity) and that RB varieties accounted for about 68% of Brazilian sugarcane fields, it is clear the Federal Universities belonging to RIDESA have made a strong and decisive contribution to about 12.3% of the energy matrix of Brazil, probably the largest contribution in the world (Daros *et al.* 2015).

NEW CONCEPT IN BRAZIL: ENERGY CANE

Biomass is currently one of the most important sources for energy production and is considered one of the main alternatives to the diversification of the energy sources in many countries, contributing to a reduction of dependence on fossil fuels (ANEEL 2008). With the increasing interest in sugarcane biomass as a renewable energy source, some breeding programs are investing in developing a different type of cane: one with high fiber content, low sucrose content and high biomass productivity (Kim and Day 2011; Ming *et al.* 2006). In 2004, the first biorefinery in South America was established in Alagoas state for the production of cellulosic ethanol from residues from mechanized harvesting and surplus bagasse. Since 2007 the Sugarcane Breeding Program of RIDESA/UFAL has been developing RB energy cane varieties based on S. *spontaneum* represented in the Serra do Ouro germplasm bank. Energy cane can be classified in two types: firstly one that has a sugar content around 15% and with a fibre content greater than current cultivars of up to 18%. This type will be to meet the current needs of the Brazilian sugar-energy industry for the production of sugar, ethanol and electricity. The second type has a low sucrose content (6%) and fiber close to 25%. This energy cane type will provide a large supply of steam, heat, thermal and electrical energy. In addition to these purposes, these second types will be used in biorefineries

for second-generation ethanol production (cellulosic ethanol). Progress to date in this component of the breeding program of RIDESA/UFAL has been successful and it is expected in coming years that RB- energy cultivars will be developed that can meet the rising demand of companies for the production of cellulosic ethanol, bioelectricity and various biochemicals.

BIOTECHNOLOGICAL ROUTE

Sugarcane biotechnology has been receiving considerable attention over the last few years. Interaction with biotechnology and conventional sugarcane breeding relies on two main concepts: marker-assisted breeding and transgenic varieties. However, in both situations, prior work is required (e.g., transcriptome and linkage mapping), which is especially difficult for sugarcane due to its polyploid nature.

Considering gene discovery studies using transcriptome approaches, researchers from RB program are attempting to determine insights about gene networks involved in cell-wall metabolism (Ferreira *et al.* 2016), *de novo* transcriptome sequencing in sugarcane varieties widely used as parents in Brazilian Breeding Programs (Cardoso-Silva *et al.* 2014) and transcriptome studies for EST collections (Vettore *et al.* 2001). Another approach is to find associations between molecular markers and phenotype values for quantitative traits. Association studies has been reported, a Brazilian example can be exemplified by Barreto *et al.* (2015). Linkage mapping with full-sib progeny has been done over two decades but published genetic maps are still incomplete and unsaturated. Several molecular marker systems have been used, from RFLP, AFLP and EST-SST (Pastina *et al.* 2010) to genotyping-by-sequencing (GBS) by *Illumina* HiSeq (Balsalobre *et al.* 2014). Best options may be to consider models that use molecular markers with higher allele dosage (Hotta *et al.* 2010) and such methods are under development. The use of Marker Assisted Selection (MAS) in sugarcane breeding is a challenging task. A potential example of MAS has been reported in sugarcane, the *Bru-1* haplotypes, which can be used in the identification of durable rust resistance gene in sugarcane germplasm (Costet *et al.* 2012).

Development of transgenic varieties is also hindered by several processes that must be optimized, e.g. low transformation efficiency, transgene inactivation, somaclonal variation and difficulties in backcrossing (Hotta *et al.* 2010). In general, transgene expression must be better controlled and stability must be achieved which may be challenging in a polyploidy context. The difficulties of sugarcane transformation reduce the speed in which candidate genes can be tested (Dal-Bianco *et al.* 2012). Although, there are difficulties in obtaining sugarcane GM, some transgenic events are in the approval stage for commercial release.

Finally, we consider that biotechnology will reveal insights that will certainly help in the future breeding. However, the challenge of this work is related to the complexity of sugarcane genome.

REFERENCES

ANEEL 2008. *Atlas de energia elétrica do Brasil*. Brasília, 236.

Balsalobre TWA, Pereira GS, Mollinari M, *et al.* 2014. Assessment of allelic dosage of SNPs markers for construction genetic linkage map in sugarcane. In: 60º Congresso Brasileiro de Genética, 2014.

Bassinelo AI, Oliveira FSS, Velho P, Matsuoka S. 1981. *Manejo varietal em cana-de-açúcar*. IAA/PLANALSUCAR, 34p.

Barbasso D; Jordão H; Maccheroni W, Boldini J, Bressiani J, Sanguino A. 2010. First report of *Puccinia kuehnii*, causal agent of orange rust of sugarcane in Brazil. *Plant Disease* 94: doi: http://dx.doi.org/10.1094/PDIS-94-9-1170C.

Barbosa GVS, *et al.* 2008. Desempenho agroindustrial e censo de variedades de cana-de-açúcar cultivadas no Estado de Alagoas. In: *Congresso nacional da STAB*. Sociedade dos Técnicos Açucareiros e Alcooleiros do Brasil, 464-470.

Barbosa, MHP; Resende, MDV; Dias, LAS; *et al.*. 2012. Genetic improvement of sugar cane for bioenergy: the Brazilian experience in network research with RIDESA. *Crop Breeding and Applied Biotechnology* 12: 87-98.

Barreto FZ, Balsalobre TW, Gazaffi R, *et al.* 2015. Genetic diversity and association mapping for brix in Brazilian Panel of Sugarcane Genotypes. In: 11th Germplasm and Breeding & 8th Molecular Biology Workshops (ISSCT).

Cardoso-Silva CB, Costa EA, Mancini MC, *et al.* 2014. De novo assembly and transcriptome analysis of contrasting sugarcane varieties. *Plos One* 9: doi:dx.doi.org/10.1371/journal.pone.0088462.

CONAB. 2015. Acompanhamento da safra brasileira: cana-de-açúcar. 65 pp. Accessed: 10 March 2016. http://www.conab.gov.br/OlalaCMS/uploads/arquivos/16_02_23_17_34_53_boletim_cana_portugues_-_3o_lev_-_15-16.pdf.

Costet L, Le Cunff L, Royaert S, *et al.* 2012. Haplotype structure around *Bru1* reveals a narrow genetic basis for brown rust resistance in modern sugarcane cultivars. *Theoretical and Applied Genetics* 25: 825-836.

Dal-Bianco M, Carneiro MS, Hotta CT, *et al.* 2012. Sugarcane improvement: How far can we go? *Current Opinion in Biotechnology* 23: 265-270.

Daros, E; Oliveira RA; Barbosa GVS. 2015. 45 anos de variedades RB de cana-de-açúcar: 25 anos de Ridesa. Graciosa, 156 p.

FAO. 2013. Food and Agriculture Organization of the United Nations. Accessed: 22 March 2016. http://faostat3.fao.org/download/Q/QC/E.

Ferreira SS, Hotta CT, Poelking VGC, *et al.* 2016. Co-expression network analysis reveals transcription factors associated to cell wall biosynthesis in sugarcane. *Plant Molecular Biology* 90: 1-27.

Hotta CT, Souza AP, Margarido GRA, *et al.* 2010. The biotechnology roadmap for sugarcane improvement. *Tropical Plant Biology* 3: 75-87.

Kim M, Day DF. 2011. Composition of sugar cane, energy cane, and sweet sorghum suitable for ethanol production at Louisiana sugar mills. *Journal of Industrial Microbiology and Biotechnology* 38: 803-807.

Lima LFN, Barbosa GVS. 1996. Interação de genótipos de cana-de-açúcar (*Saccharum* spp.) com ambientes de cultivo na Usina Caeté. In: Anais 6° Congresso Nacional da STAB. Maceió. p.213-223.

Maccheroni W, Matsuoka S. 2006. Manejo das principais doenças da cana-de-açúcar. In: Atualização em produção de cana-de-açúcar. p. 239-256.

Magarey RC. 2000. Orange rust. In: *A guide to sugarcane diseases*. CIRAD, Montpellier. pp. 121-125.

Ming R, Moore PH, Wu KK, *et al.* 2006. Sugarcane improvement through breeding and biotechnology. *Plant Breeding Reviews* 27: 15-118.

Morais LK, Aguiar MS, Silva PA, *et al.* 2015. Breeding of sugarcane. In: *Industrial Crops: Breeding for BioEnergy and Bioproducts*, pp. 29-42.

Pastina MM, Pinto LR, Oliveira KM, *et al.* 2010. Molecular mapping of complex traits. In: *Genetics, Genomics and Breeding of Sugarcane*. 1 ed. CRC Press, Baco Raton. Pp. 117-148.

Santos F, Borém A. 2013. Cana-de-açúcar: do plantio à colheita. UFV, 57 pp.

Vettore AL, Silva FR, Kemper EL, Arruda P. 2001. The libraries that made SUCEST. *Genetics and Molecular Biology* 24: 1-4.

Variétés RB: une contribution majeure à l'industrie cannière au Brésil

Résumé. Durant la campagne sucrière 2015/2016 au Brésil, 650 Mt de canne à été broyée représentant une superficie d'environ 9 Mha. Six Etats ont joué un rôle clé dans cette production: São Paulo avec 53% de la production nationale, suivi par Goiás (10%), Minas Gerais (9%), Paraná (7%), Mato Grosso do Sul (7%) et Alagoas (4%). Soixante-huit pourcent (68%) de la superficie sous canne ont été cultivé sous des variétés RB, qui ont été développées par l'ex-Planalsucar, maintenant appelé RIDESA. Au cours des ces 45 dernières années (1970-2015), 94 variétés RB ont été homologuées. La variété RB72454 apporta la plus grande contribution de Planalsucar à l'industrie sucrière du Brésil, car elle avait une large aire d'adaptation à différents zones agro-climatiques et types de sols, et était le géniteur de 25 autres variétés commerciales. D'autres variétés produites par Planalsucar/RIDESA sont également intéressantes. La RB855156 est la variété la plus précoce de tous les cultivars au Brésil, avec une bonne qualité du jus durant les premiers mois de la récolte dans la région centre-sud du Brésil. La RB867515 est la variété la mieux adaptée pour les zones marginaux, et elle occupa 25% de la superficie récoltée en 2015. La RB92579 est adaptée à la région nord-est, produisant 30-40% de plus que les autres variétés. Elle répond bien à l'irrigation. La RB966928 montre une aptitude à la plantation ainsi qu'à la récolte mécanique en raison de ses caractéristiques agronomiques, en particulier sa tenue en repousses. En 2015, le recensement variétal pour l'État de São Paulo a indiqué que les quatre variétés les plus cultivées étaient RB966928 (18%), RB867515 (16%), RB92579 (10%) et RB855156 (7,8%), confirmant l'importance des variétés produites par RIDESA au cours des années à venir. RIDESA a homologué 16 nouvelles variétés en 2015; chacune pouvant contribuer à augmenter la productivité dans différents environnements, à différents dates de coupe, et résistantes aux principales maladies. RIDESA maintiendra la diversité génétique afin de contribuer à l'augmentation de la productivité sucrière au Brésil.

Mots-clés: Variétés élites, maturation précoce, capacité de repousses, résistance aux maladies, adaptation aux environnements

Variedades RB: una importante contribución a la industria de la caña de azúcar en Brasil

Resumen. En Brasil, en la temporada de molienda de caña 2015/2016 fueron procesadas 650 millones de toneladas de caña de azúcar cosechadas en aproximadamente 9 millones de hectáreas. Seis estados jugaron un papel clave en esta producción; Sao Paulo con el 53% de la producción nacional de caña, seguido de Goiás (10%), Minas Gerais (9%), Paraná (7%), Mato Grosso del Sur (7%) y Alagoas (4%). El 68% de la superficie se cultiva con variedades RB, que fueron desarrollados originalmente por el ex PLANALSUCAR, ahora llamado RIDESA. En los últimos 45 años (1970-2015), 94 variedades RB han sido liberadas. La variedad RB72454 fue la mayor contribución de PLANALSUCAR a la agricultura brasileña porque tenía amplia adaptación a diferentes ambientes y suelos, y fue padre de otras 25 variedades comerciales. Otras variedades del grupo PLANALSUCAR/RIDESA también son dignas de mención como la RB855156 que es la variedad más temprana en maduración en Brasil, con una alta calidad de la caña en los primeros meses de la cosecha en la región centro-sur. RB867515 es la variedad que mejor se adapta a ambientes marginales y alcanzó del 25% de la superficie cosechada en 2015. RB92579 está adaptada a la región noreste y produce 30 a 40% más caña que otras variedades de esa región y también responde a la irrigación. La variedad RB966928 muestra aptitud para la cosecha y la siembra mecanizada debido a sus características agronómicas, especialmente su capacidad de rebrote. En el censo varietal del estado de Sao Paulo en el 2015 se indica que las cuatro variedades más sembradas fueron RB966928 (18%), RB867515 (16%), RB92579 (10%) y RB855156 (7,8%), lo que indica la importancia actual de las variedades de RIDESA en los próximos años. RIDESA ha liberado 16 nuevas variedades en el año 2015; cada uno de éstas puede contribuir en las diferentes condiciones ambientales, incluyendo la variabilidad en el tiempo de madurez, y la resistencia a las principales enfermedades. RIDESA espera mantener la diversidad genética y seguir contribuyendo al aumento de los rendimientos en el cultivo de caña de azúcar de Brasil.

Palabras clave: Variedades élites, maduración temprana, capacidad de rebrote, resistencia fitosanitarias, adaptación ambiental