UFSM XIKA FW: SUGARCANE CULTIVAR FOR SOUTHERN BRAZIL

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Abstract

In Brazil, in view of the different soil and climatic conditions of the sugarcane-producing regions, a strategy of creating small breeding programs for the crop is being used. Since 2008, the sugarcane breeding program of the Federal University of Santa Maria (UFSM), has been developing new, better adapted and higher-yielding sugarcane cultivars for the climate conditions of the southern region of Brazil. Cultivar UFSM XIKA FW was developed at the Laboratories of Agroclimatology and Genetic Breeding and Plant Production of the UFSM, Campus Frederico Westphalen. It is the first mutation-induced sugarcane cultivar that was protected by the Ministry of Agriculture, Livestock and Food Supply, Brazil. The genotype used for mutation induction was cultivar IAC 87-3396, due to its good performance characteristics in the southern region. The mutation mechanism was induced in 2011, by immersing individual buds in a solution of the chemical mutagenic agent methyl methane sulfonate. The best genotypes were selected and tested in plant cane in 2013 and 2018 and in ratoon cane trials in 2014 and 2015. The new cultivar has a higher sugar production potential, and the mean yield of four years was 8.2 t ha^{-1} higher than that of the control, indicating a high yield potential.

Keywords: Mutagenic agents. Plant breeding. *Saccharum* spp.

1. Introduction

In Brazil, the different soil and climatic conditions of the sugarcane producing regions have led to a strategy of creating small breeding programs for the crop. This approach allows the selection of genotypes adapted to different environments, with production gains at the national level, since breeding in specific environments can shorten the development period of cane cultivars (Dinardo-Miranda et al. 2008).

According to Maluf et al. (2008), sugarcane is being cultivated in Rio Grande do Sul for a variety of purposes, for example, fodder, spirits, muscovado, and jaggery production, mostly without taking climatic factors and agronomic aspects into consideration. With the increasing demand for research, after the establishment of an Agricultural Zoning for sugarcane for ethanol production in 2008, research investments in the crop increased, to optimize cultivation and reduce the dependence on sugarcane-derived products from other Brazilian states.

Since 2008, the sugarcane breeding program of the Federal University of Santa Maria (UFSM), Campus Frederico Westphalen, has developed cultivars that are better adapted to the meteorological conditions of the southern region. Along the same line of sight, Maluf et al. (2008) and Cardoso and Sentelhas (2013), describe an increase in the world demand for sugar and ethanol, which will be pushing the area cultivated with sugarcane into agronomically and economically less privileged regions. In this sense, the objective of developing new cultivars for the southern region is highly topical.

2. Material and Methods

Cultivar UFSM XIKA FW was developed at the Federal University of Santa Maria, Campus Frederico Westphalen (27º39'56 "LS / 53º42'94" LW, at 490 m asl. The soil of the region is classified as Latossolo Vermelho Alumino Férrico (Embrapa 2006). According to Köppen's classification, the climate is Cfa (Alvares et al. 2013).

The genotype used for mutation induction was IAC87-3396. It was chosen for standing out among 19 sugarcane genotypes (IACSP93-6006, IAC91-2218, IAC87-3396, IAC91-5155, IAC91-2195, RB 855453, RB 855506, Nova Irai, Ligeirinha Roxa, Pernambucana, SP 716163, RB 785750, NA 56-79, IAC91-5035, RB 835089, RB 765418, Preguiçosa, Tucumã and Palhuda), for the traits Brix in cane juice (Consecana 2006) and stem weight per hectare, calculated by extrapolating the number of stems per meter and fresh stem weight to t ha^{-1}, according to the row spacing, assessed in the growing seasons of 2008, 2009 and 2010.

Mutation was induced in 2011, by immersing buds (stem length 3cm) separately in a 5-ppm solution of the chemical mutagenic agent Methyl Methane Sulfonate (MMS) for 12 hours, after which they were washed with distilled water to remove the rest of the agent. Thereafter, they were placed for one hour in 200 mg L^{-1} indole acetic acid, to stimulate bud rooting and then transferred to a sand bed in a greenhouse, where they were left to grow to a height of 0.3 m for approximately 60 days, and then transplanted to the field, still in 2011.

The best genotypes were selected and tested in plant cane in 2013 and 2018, and in ratoon cane trials (second cut) in 2014 and 2015. In the field experiment, the mutants were distributed in a randomized block design with four replications. Each plot consisted of four 4-meter rows spaced 1.2 meters apart, at a plant spacing of 1.0 meter. The plants grown on two meters of the two central rows were used for analysis of the productivity variables and two stems per plot for soluble solids analysis. For all growing seasons, the seedlings were produced in a greenhouse in June, transplanted to the field in October and harvested in May, before chilling. Fertilization was applied, according to the technical indications for the crop in the states of RS and SC (Sociedade Brasileira de Ciência do Solo 2004). Pests and diseases were not controlled, and weeds were controlled by hand weeding.

The following traits were traits analyzed in 2013, 2014, 2015 and 2018: Brix of the base, middle and apex parts of the plant, where the Brix levels were determined with a refractometer (Consecana 2006); Brix in cane juice, quantification of the juice soluble solids, with a refractometer (Consecana 2006); number of stems per meter in the plant row; stem weight, measured as the mean weight of two stems on an analytical scale; and stem yield, calculated by extrapolating number of stems per meter and fresh stem weight to t ha^{-1}, according to the row spacing.

Based on these data, a new cultivar with the desired traits was selected and protected by the Ministry of Agriculture, Livestock and Food Supply (MAPA, no. 20160021-SNPC), after field evaluations in 2013, 2014 and 2015. Thereafter, the new cultivar was evaluated in 2018 in Frederico Westphalen and will be tested in 2019 and 2020 at two locations in Rio Grande do Sul before registration for cultivation.

3. Results and Discussion

Cultivar UFSM XIKA was the first sugarcane cultivar obtained by induced mutation in Brazil that was protected by the Ministry of Agriculture, Livestock and Food Supply. The new cultivar is clearly distinguishable from the cultivar of origin (IAC87-3396), based on differences in stem color, length and shape and amount of wax. The node color differs in the ring and waxy zone, aside from differences with regard to

bud protrusion, leaf blade width, auricle type, blade joint color, amount of hairiness of the leaf sheath and sugarcane heart length.

Analysis of variance detected no interaction between cultivar and year ($p < 0.05$), for any of the evaluated traits. There was a significant difference between cultivars for Brix of the plant base, Brix of the middle plant third, number of stems per meter and stem weight. For the traits Brix of the plant apex, Brix in juice and stem yield there was no significant difference.

The means of the traits for the two cultivars (Table 1) showed that the total soluble solids parameters (Brix degrees) of cultivar UFSM XIKA FW were higher than of IAC87 3396 (1° Brix of the plant base and 0.7 ° Brix of the middle plant third), indicating that cultivar UFSM XIKA FW is more promising for sugar production than cultivar IAC87 3396. These results are important, for example, with a view to the planning of sugar and ethanol production.

Table 1. Performance of cultivar UFSM XIKA FW with regard to Brix of the plant base (BB), Brix of the middle plant third (BM), Brix of the plant apex (BA), Brix in juice (BJ); number of stems per meter (NS), stem weight (SW) and stem yield (YD) in the 4-year test means. Frederico Westphalen, RS, 2020.

Cultivar	BB -	BM -	BA -	BJ -	NS (Unit)	SW (g)	YD (t ha^{-1})
UFSM XIKA FW	19.5[a]	18.9[a]	16.7[ns]	18.0[ns]	15.9[a]	1683.8[b]	176.4[a]
IAC87-3396	18.5[b]	18.2[b]	16.0	17.5	12.9[b]	1942.6[a]	168.2[a]
CV (%)	3.01	4.12	12.62	3.34	16.20	17.05	19.93

Means followed by the same lowercase letter in a column do not differ significantly from each other by the Scott & Knott grouping test at 5% error probability. [ns] - not significant.

The yield of the new cultivar was directly related to the number of stems per meter and stem weight. The values of these traits were significantly higher than those of the control cultivar. This confirms the results of Brasileiro et al. (2013), where a direct correlation between the number of stems and stem weight and yield was reported. In the 4-year mean, the yield of cultivar UFSM XIKA FW was higher, demonstrating a high yield potential, but not significantly different from that of the control.

The descriptors used in the evaluation procedures for protection showed that cultivar UFSM XIKA FW has an upright growth habit and tall plant height, dark green leaves and a broad leaf blade, generating a dense leaf volume, that contributes to a good row canopy closure, protecting the buds and suppressing weeds.

4. Conclusions

Cultivar UFSM XIKA, first sugarcane cultivar obtained by induced mutation in Brazil, with higher Brix of the plant base, Brix of the middle plant third and number of stems per meter in relation to the control.

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