BRS Sarandi: a new Andropogon gayanus cultivar for tropical pastures

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Abstract. BRS Sarandi is adapted to low and medium fertility soils. It has a medium-high height, with a semi-erect growth habit and a high total number of tillers. The annual productivity of dry matter is 11 t ha-1, concentrated in the rainy season (90%). Of the total DM produced, 60% are leaves. The levels of crude protein (CP), in vitro dry matter digestibility (IVDMD), neutral detergent fiber (NDF) and acid detergent fiber (ADF) are, on average, 8.7, 56.5, 66.7 and 38.2%, respectively. . The average daily weight gain was 0.7 kg/head/day, the gain per was and 1.7 kg ha-1 day with no supplementation except for mineral salt. The weight gain per area (AG) reached 15 @/ha/year with an average stocking rate of 2.5 AU. BRS Sarandi was registered in the Brazilian Cultivar Registry (Registro Nacional de Cultivares - RNC/MAPA) and is protected in the National Cultivar Protection System (Sistema Nacional de Proteção de Cultivares - SNPC/MAPA).

Introduction

The area of cultivated pastures in the Brazilian territory represents 150 million hectares (IBGE 2021), with four species of the genus *Urochloa* (*U. brizantha, U. decumbens, U. humidicola, U. ruziziensis*, previously included in Brachiaria) occupying approximately 85% of this total (Barcelos et al. 2001). Approximately 88% of the tropical forage seeds produced and commercialized in Brazil are from cultivars of these four species, followed by the species *Megathyrsus maximus* (syn. *Panicum maximum*). Except for *U. ruziziensis*, which is allogamous, the other three species of *Urochloa* and *Megathyrsus* have apomictic reproduction (Valle and Savidan 1996, Valle et al. 2009), so their cultivars are seed clones, generally with low genetic variability. This concentration of few species, cultivated in such large areas, associated with little variability within each species, represents a high-risk situation to the national livestock production systems. The grass *Andropogon gayanus* Kunth is originated from Africa, and is described as polymorphic, with four botanical varieties, of which the bisquamulatus being considered highly productive, well adapted to tropical savannas (Grof and Thomas 1984) and widely used in caatinga, savanna and forest areas (Silva et al. 2014). The species has a basic number of chromosomes n = 10, naturally occurring as diploids (2n = 2x = 20), and tetraploids (2n = 4x = 40), being allogamous (Gould 1956) and anemophilous (Ferguson 1981). Selection has been limited to varieties squamulatus and bisquamulatus (Forster 1962), and cytogenetic reports indicate this variety is tetraploid (Okoli and Olorode 1983). It is, therefore, recalcitrant to the development and maintenance of inbred lines, produced from self-pollination. As a mandatory allogamous species, populations are highly heterozygous, phenotypically heterogeneous and their improvement requires strategies and methods different from those used in the improvement of autogamous and apomictic plants. *Andropogon gayanus* is a short-day species, which presents intense flowering when the photoperiod varies between 12 and 8 hours (Tompsett 1976). It is very drought-tolerant and intolerant to waterlogging (Baruch 1994), it is highly productive in soils with low fertility and high aluminum saturation (Amézquita et al. 1990), and presents fast growth, good forage accumulation and palatability (Resende et al. 2015). It responds positively to mycorrhiza colonization, mainly under low levels of phosphorus (Salinas, 1985). It is resistant to burning (Toledo and Fisher 1990) and grows well in systems integrated with legumes and other perennial species, such as eucalyptus, when in arrangements that provide moderate shade (Amésquita 1990, Toledo and Fisher 1990, Harmand 2003). There is some history of crop selection and breeding in South America, mainly based on CIAT introductions from Nigeria. Selection efforts led to the release of two varieties by Embrapa in Brazil: “Planaltina”, with spittlebug resistance and good adaptation to acid and low-fertility savanna soils, in 1980; and “Baetí”, selected for greater early vigor in the field, in 1994.

Methods and Study Site

Evidence of significant genetic variability, ranging from moderate to high in populations from the cultivar Planaltina, has been reported for number of days until flowering, number of reproductive stems, dry matter productivity, leaf width, leaf blade percentage, in vitro digestibility, stem and leaf protein, plant height, internode length, among several other characteristics (Miles and Grof 1990). With these characteristics, conventional methods of genetic improvement of populations have great potential to develop varieties that will provide real alternatives to reduce the risks associated with Brazilian pastures. The breeding program of *Andropogon gayanus* at Embrapa Cerrados was resumed in the rainy season of 2009/2010, with the planting of eight populations originated from the cultivar Planaltina, collected from different locations in the Brazilian Cerrado and Semi-Arid regions. A total of 500 plants from each of the eight populations were planted in blocks, constituting the initial generation in which the selection process started by mass selection. Five selection cycles (years) were carried out with phenotypic selection for a simple hereditary characteristic. Phenotypic selection is used for characteristics that can be observed visually, directly, without any quantitative measurement. Plants with desired characteristics are selected from a population and crossed with each other in polycross blocks in order to increase their frequency with each generation of selection. The selection criteria adopted sought the development of a new population of Andropogon with high tillering number and vigor, increased leaf to stem ratio and semi-erect growth habit of the plants when compared to cultivars Planaltina and Baetí. Open pollination seeds were collected from all fifth-generation plants and were planted in a block for recombination and initial seed multiplication in 2014. Seeds of this population were used for the trials to establish value of cultivation and use (VCU) for cultivar registration and DUS (Distinctness, Uniformity and Stability). This population originated the new cultivar of *Andropogon gayanus*, named BRS Sarandi. The VCU trial was conducted in Planaltina/DF (lat 15º 60.03'' S; long 47º 71.04'' W, alt 1050m asl), in a dark red oxisol (62% clay), over two growing seasons (April 2015 to April 2017), in small plots (3 x 4m), compared to cultivars Planaltina and Baetí. Dry matter yield (DMY) was evaluated under cuts, with forage harvested at 15 cm stuble height. Harvest frequency varied from 40 to 56 days in the rainy season (regrowth from October to April) and from 60 to 120 days in the dry season (regrowth from April to October). Responses to three doses of phosphorus (20, 60 and 240 kg P2O5/ha) and two doses of lime (0 and 1.1 t ha-1) were tested comparing cultivars BRS Sarandi and cv. Planaltina. Limestone (PRNT = 80%) and phosphorus (Triple Superphosphate) were applied when preparing the soil in a total area before planting. The test was conducted for 1 year (2017/2018) with four harvests with a stubble height of 20 cm. Throughout the experimental, the equivalent of 100 kg/ha/year of N and K2O were applied, using the formulation 20-0-20. The average daily weight gain (ADG) of male Nellore cattle, with initial average weight of 250-330 kg, was evaluated in BRS Sarandi pastures, between April 2018 and April 2020, on a grazing trial at Embrapa Cerrados in Planaltina, DF. The cattle was kept at three stocking rates, 1, 2 and 3 AU/ha in each of the three paddocks (1.5 ha), under continuous stocking management, with three replications.

Results and Discussion

Morpho-agronomic characteristics

The most important characteristics that differentiated BRS Sarandi from Baetí and Planaltina cultivars were the higher frequency of plants with a higher proportion of leaves, smaller canopy height, semi-erect growth habit, greater number of tillers, lower and more compact canopy, more hairy leaves and more intense and shorter length of the floral axis.

DMY and forage nutritive value

In the first year, two harvests were carried: 1) at the end of the rainy season (establishment phase - April 2015); 2) at end of the dry season (September 2015). During the second year, four harvests were made in the rainy season and one harvest was performed in the middle of the dry season, since the regrowth of the second half of the dry season was negligible, due to the severity of the drought. For all harvests, the

morphological composition was evaluated (leaf blade, stem and dead material). Ground cover and canopy height were also recorded. The occurrence and severity of the attack by pests and diseases were monitored. Whole plant samples and the leaf and stem fraction were analyzed to determine their nutritive value (crude protein, digestibility and fibrous fractions). The average annual DMY of BRS Sarandi was 10.9 t ha-1/year, and was similar to the other cultivars (average of 10.3-11.0 t ha-1/year). The seasonality of forage production is quite marked (90% in the rainy season). The highest proportion of leaf blades in the forage of BRS Sarandi was more evident in the early years and at the time of flowering (rainy to dry season transition). In general, the proportion of leaves (blade/stem ratio) in Andropogon gayanus cultivars is lower in the rainy season, given the higher growth rate. Even so, in BRS Sarandi the proportion of leaf blades is above 50%. The nutritive value of the whole plant of BRS Sarandi was superior to cv. Planaltina in relation to the fibrous fractions (NDF, ADF, Cellulose), both in the rainy and dry seasons. During the rainy season, averages CP and IVOMD did not differ between cultivars, reaching values of 9.7 and 53.3, respectively. Compared to the cv. Baetí, the forage nutritive value is very similar, presenting differences only to the ADF contents. During the dry season, the nutritive value of the BRS Sarandi was higher, than cultivars Baetíe and Planaltina, except for the crude protein content. Regarding the nutritive values of leaf blades, there were no differences among cultivars, in both the rainy and dry periods, except for ADF and cellulose, where BRS Sarandi was superior. Thus, the higher nutritive value of the whole plant of BRS Sarandi for some of the characteristics (NDF, FDA, Cellulose) is more due to its higher proportion of leaf blades, a fraction whose nutritive value is higher than the values of the stems.

Responses to limestone and phosphorous fertilization

Total dry matter yield was affected only by the doses of phosphorus. The cultivars showed similar average yields and responded equally to the application of phosphate fertilizer. The results demonstrate that BRS Sarandi has the same soil fertility requirements as cv. Planaltina, as well as the same capacity to respond to phosphorus. In addition, no response to the application of limestone was observed.

Grazing responses and beef production

The average ADG was 1.10 kg/head/day in the rainy season (December-April; 101 days) and 0.68 kg/head/day in the transition period between the rainy and dry seasons (April-June; 83 days), with higher values for the lowest stocking rate in the rainy season and the opposite occurring in the rainy-dry transition period. The average gain per area (GA) was 3 and 2 kg LW/ha/day in the rainy season and in the transition to the dry period, respectively. When considering the two seasons together (101 + 83 days), the total GA was 225 kg carcass LW/ha/year, with higher values for the highest stocking rate in both seasons. Throughout the experiment, the average canopy height remained lower in BRS Sarandi pastures maintained at a higher stocking rate. The flowering of BRS Sarandi occurred on April and there was an increase in stems at the expense of leaves in the canopy in the rainy-dry transition period. On that occasion, even with a higher stocking rate, the lower canopy of BRS Sarandi promoted better conditions for the consumption of forage. The lower canopy on the higher stocking rate also promoted an increase in CP, and probably positively influenced GMD during the transition phase.

Conclusions

BRS Sarandi is recommended for use in pure or mixed pastures with legumes in the Cerrado region, in low to medium fertility soils, with a texture ranging from sandy to clayey. Its use should preferably occur in cow-calf and stocker operations, with a major contribution to the forage supply occurring in the rainy season. Since it presents a rapid regrowth after the first rains, its use should be prioritized in the property early in the following months: October, November, December and January.

References

Amézquita MC, Pizarro EA and Toledo JM (1990) Range of adaptation of Andropogon gayanus. In Toledo JM, Vera R, Lascano C and Lenné JM (eds.) Andropogon gayanus Kunth: A grass for tropical acid soils. CIAT, Cali, p. 37-64.

Barcellos AO, Vilela L and Lupinacci (2001) Produção animal a pasto: desafios e opotunidades. In: Encontro nacional do boi verde e a pecuária sustentável. Sindicato Rural de Uberlândia, Uberlândia, p. 29-64.

Baruch Z (1994) Responses to drought and flooding in tropical forage grasses. 1. Biomass allocation, leaf growth and mineral nutrients. Plant Soil 164: 87-96.

Ferguson JE (1981) Perspectivas da Produção de Sementes de Andropogon gayanus. Revista Brasileira de Sementes 3: 175-193.

Grof B and Thomaz D (1984) Agronomic evaluation of grasses in the tropical Savannas of South America. Centro Internacional de Agricultura Tropical (CIAT), Cali, p. 31.

Gould FW (1956) Chromosome counts and cytotaxonomic notes on grasses in the tribe Andropogoneae. American Journal of Botany 43: 395–404.

Harmand JM (2003) Tree-root systems and herbaceous species-characteristics under tree species introduced into grazing lands in subhumid Cameroon. Agroforestry Systems 59: 131–140.

IBGE (2021) Séries históricas e estatísticas: 1970 a 2006. Available at: <http://seriesestatisticas.ibge.gov.br/series.aspx?vcodigo=AGRO03&t=utilizacao-terras-ha>. Accessed on January 09, 2021.

Miles JW and Grof B (1990) Genetics and plant breeding of Andropogon gayanus. In Toledo JM, Vera R, Lascano C and Lenné JM (eds.) Andropogon gayanus Kunth: A grass for tropical acid soils. CIAT, Cali, Colombia, p.19-35.

Okoli BE and Olorode O (1983) Cytogenetic studies in the Andropogon gayanus-a. Tectorum complex (Gramineae). Botanical Journal of the Linnean Society 87: 263-271.

Resende RMS, Jank L, Valle CB, Barrios SCL and Santos MF (2015) Melhoramento de forrageiras tropicais. In: Simpósio de pastagem e forragicultura do Campo das Vertentes. UFSJ, São João del Rei, p. 114-130.

Salinas JG (1985) Importance of VA mycorrhizae for phosphorus supply to pasture plants in tropical Oxisols. Plant and Soil 84: 347-360.

Silva DC, Alves AA, Lacerda MSB, Moreira Filho MA, Oliveira ME and Lafayette EA (2014) Valor nutritivo do capim-Andropogon em quatro idades de rebrota em período chuvoso. Revista Brasileira de Saúde e Produção Animal 15: 626-636.

Toledo JM and Fisher MJ (1990) Physiological aspects of Andropogon gayanus and its compatibility with legumes. In Toledo JM, Vera R, Lascano C and Lenné JM (eds.) Andropogon gayanus Kunth: A grass for tropical acid soils. CIAT, Cali, p.65-98.

Tompsett PB (1976) Factors Affecting the Flowering of Andropogon gayanus Kunth. Responses to Photoperiod, Temperature and Growth Regulators. Annals of Botany 40: 695-705.

Valle CB and SavidanYH (1996) Genetics, cytogenetics and reproductive biology of Brachiaria. In: Miles JW, Maass BL and Valle CB (eds.) Brachiaria: biology, agronomy and improvement. CIAT, Cali, p. 147-163.

Valle CB, Jank L and Resende RMS (2009) O melhoramento de forrageiras tropicais no Brasil. Available at: <http://ainfo.cnptia.embrapa.br/digital/bitstream/item/39156/1/Boas-Praticas-Agropecuarias-Portal-Dia-de-Campo.pdf>. Accessed on January 09, 2021.