SCIENTIFIC NOTE

Crude protein content in hybrids of *Paspalum* evaluated in the Pampa Biome of Southern Brazil

Contenido de proteína bruta en híbridos de *Paspalum* evaluados en el Bioma de Pampa en el sur de Brasil

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ABSTRACT

The use of forage species adapted to the local environment allows an easier management, and greater production and stability. It also allows the conservation of the natural genetic resources, and the reduction of the costs and risks of production that further result in higher sustainability of the system. Forage quality may not be considered as important as biomass production in many forage systems. However, when forage plants constitute most or all of the ruminant diet it assumes substantially greater importance. Therefore, the goal of this study was to evaluate the crude protein (CP) content of hybrids of *P. plicatulum* x *P. guenoarum*, in a region of Southern Brazil in the Pampa biome. The hybrids evaluated were: 10202, 1020104, 102084, 102080, 1020133, 102058, 102069 (*P. plicatulum* "4PT" x *P. guenoarum* "Azulão"), 103063, 10308, 103042, 103040, 103061, 103077, 103087, 103093, 103031, 103020, 103084, and 103037 (*P. plicatulum* "4PT" x *P. guenoarum* "Baio"). The CP analyzes were performed on the leaves of the genotypes in each harvest. The hybrid 102069 "Azulão" presented the best CP content (16.4%) compared to the other genotypes in both years. These results are encouraging for forage breeding studies with species of the genus *Paspalum*.

Key words: forage plants, forage quality, forage breeding.

RESUMEN

El uso de especies forrajeras adaptadas al entorno local permite un manejo más sencillo y una mayor producción y estabilidad. También permite la conservación de los recursos genéticos naturales, la reducción de los costos y riesgos de producción, lo que resulta en una mayor sostenibilidad del sistema. La calidad del forraje no puede considerarse tan importante como la producción de biomasa en muchos sistemas forrajeros. Sin embargo, cuando las plantas forrajeras constituyen la mayor parte o la totalidad de la dieta para rumiantes, asume una importancia sustancialmente mayor. Por lo tanto, el objetivo de este estudio fue evaluar el contenido de proteína cruda (PC) de los híbridos de *P. plicatulum* x *P. guenoarum*, en una región del sur de Brasil en el bioma de Pampa. Los híbridos evaluados fueron: 10202, 1020104, 102084, 102080, 1020133, 102058, 102069 (*P. plicatulum* "4PT" x *P. guenoarum* "Azulão"), 103063, 10308, 103042, 103040, 103061, 103087, 103093, 103031, 103020, 103084 y 103037 (*P. plicatulum* "4PT" x *P. guenoarum* "Baio"). Los análisis de PC se realizaron en las hojas de los genotipos en cada cosecha. El híbrido 102069 presentó el mejor contenido de PC en comparación con los otros genotipos en ambos años. Estos resultados son alentadores para los estudios de cría de forrajes con especies del género *Paspalum*.

Palabras clave: plantas forrajeras, calidad del forraje, mejoramiento de forrajeras.

Introduction

Worldwide, forage plants are the cheapest way to produce and provide food to animals, enabling meat and milk production at low costs (Follett *et al*., 2001). Species of the genus *Paspalum* are the most important forage constituents of the natural grasslands in South America (Novo *et al*., 2016). The greatest diversity of species is found in the Central and Southern regions of Brazil and Paraguay, Eastern Bolivia and Northeastern Argentina; therefore, intraspecific and interspecific variability is high (Sartor *et al*., 2009). *Paspalum* species occur in most of the herbaceous communities in the distinct Brazilian ecosystems. It has suitable characteristics to be used for grazing as well as beneficial chemical composition for ruminant production (Valls, 2000).

The use of forage species adapted to the local environment allows an easier management, and greater production and stability. It also allows the conservation of the natural

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genetic resources and the reduction of the costs and risks of production, resulting in higher sustainability of the system (Townsend, 2008).

The quality of forage plants is a factor that greatly affects the productivity of grazing ruminants. Therefore, evaluation of the crude protein (CP) content plays a very important role in the qualitative analysis of forages. In diets that do not provide a minimum of 7% of CP in the dry matter, the recycled urea is not enough to meet the nitrogen demand of rumen microorganisms, resulting in a decreased feed intake and digestibility (Van Soest, 1994). These factors determine the amount of ingested nutrients, which are necessary to meet the maintenance and production requirements of the animals (Gomide, 1993). The selection of genotypes with greater forage production, forage quality and wide adaptability to diverse environments is one of the main goals in forage breeding programs.

Steiner *et al*. (2017) obtained higher forage production with two native ecotypes of *P. guenoarum* and two ecotypes of *P. notatum* compared to the cultivar "Pensacola" (*P. notatum)* which demonstrates the possibility to use native ecotypes as cultivated pastures. Forage quality may not be considered as important as biomass production in many forage systems. However, when forage plants constitute most or all of the ruminants' diet it assumes substantially greater importance (Brink *et al*., 2015). Therefore, the goal of this study was to evaluate the CP content of hybrids of *P. plicatulum* x *P. guenoarum* in a region of Southern Brazil in the Pampa biome.

Materials and methods

The experiment was carried out in the state of Rio Grande do Sul, in the municipality of El dorado do Sul, Depressão Central region, Brazil (30°05' S, 51°39' W, 40 m a.s.l.) during two growing seasons, from February to April 2013 and from February to April 2014. The average annual temperature varied from 8.5-8.7°C (June and July, coldest months) to 29.4-30.2°C (January and February, hottest months). The average annual rainfall was approximately 1445 mm (Bergamaschi *et al*., 2013). Nitrogen fertilizer (as urea) was applied in the amounts of 180 and 130 kg ha^{-1} of N in 2013 and 2014, respectively.

Artificial hybridizations were performed in greenhouse by the Forage Plants Breeding Group at the Department of Forage Plants and Agrometeorology (DPFA) of the Federal University of Rio Grande do Sul (UFRGS). Hybrids obtained from these crosses were previously evaluated in the field (individual plants) during the summer of 2010 and throughout the year 2011. The genotypes with the highest forage production were selected to compose the present study (Forage Plants Breeding Group, 2013). The hybrids evaluated were: 10202, 1020104, 102084, 102080, 1020133, 102058, and 102069, which resulted from crosses between *Paspalum plicatulum* "4PT" x *P. guenoarum* "Azulão", and the hybrids 103063, 10308, 103042, 103040, 103061, 103077, 103087, 103093, 103031, 103020, 103084, and 103037, which resulted from crosses between *P. plicatulum* "4PT" x *P. guenoarum* "Baio". The parents ("4PT", "Azulão" and "Baio") and the cultivar "Aruana" (*Megathyrsus maximus)* were used as controls. "Azulão" and "Baio" are native to the state of Rio Grande do Sul, Southern Brazil, while ecotype "4PT" is native to Corrientes, Argentina. "Aruana" is a warm-season grass used in animal production systems in Brazil.

Five clonal plants of each genotype were planted, spaced by 20 cm, in a 1 m row. Each row was planted 50 cm apart. The experimental design was a randomized complete block (RCBD) with four replicates. The plants were harvested when 80% of the genotypes reached 35 cm height, leaving a 15 cm stubble height. The harvests were carried out on February and March 2013 and February and April 2014. The plant samples were separated into leaves, stems and inflorescences. Subsequently, the samples of the plant components were placed to dry in a forced air circulation oven at 55°C for 72 h to obtain the dry matter weights, which were used to determine the CP content.

The CP analyzes were performed on the leaves of the genotypes in each harvest. The CP content was determined according to the methods proposed by AOAC (1984) in the Animal Nutrition Laboratory of Embrapa Pecuária Sul. The data were submitted to analysis of variance (ANOVA) and an F test at 5% probability using SAS software (SAS Institute, 2002). When differences between genotypes were observed, a means comparison was performed using Scott-Knott test at 5% probability.

Results and discussion

There was significant genotype x harvest interaction ($P<0.05$) for CP content in both years. At the harvest performed in February 2013, the CP content ranged from 11.4% (102084 and 103031) to 16.3% for hybrid 102069 (Tab. 1). Higher CP content values were observed with the hybrids 102069, 102080 and 10308 compared to the ecotypes "4PT", "Azulão" and "Baio" and cultivar "Aruana". In April 2013,

the CP content ranged from 11.1% for hybrid 102080, to 18.5% (103042). In this harvest, hybrids 103042 and 102069 had higher CP content than the ecotypes "4PT", "Azulão" and "Baio" and cultivar "Aruana" (control). At the harvest performed in February 2014, the CP content ranged from 10.9% (103084) to 17.8% for hybrid 102069. Higher values for CP content were observed at the second harvest in 2014 (April) ranging from 12.8% (103087) to 20.4% (102069). In both harvests of 2014, the hybrid 102069 showed higher CP content than ecotypes "4PT", "Azulão" and "Baio" and cultivar "Aruana".

The CP content observed in some *Paspalum* interspecific hybrids was higher compared to other studies reported in the literature. Echevarria *et al.* (2016) evaluated *Urochloa* interspecific hybrid BRS RB331 Ipyporã and observed a CP content of 13.8%. Evaluating species of *Megathyrsus maximus*, *Urochloa brizantha* and *Urochloa decumbens*, Lima *et al.* (2018) reported CP contents of 10.2, 4.1 and 10.8% respectively. In a study with acessions of *Paspalum atratum* Swallen and *Paspalum lenticulare* Kunth, Marcon *et al.* (2018) observed CP content of 10.1 and 10.8% respectively.

The CP content is an important trait for the selection and improvement of nutritional characteristics in forage plants. Steiner *et al.* (2017) described mean values of 14.7% and 14.2% for CP content from "Azulão" and "Baio", respectively. The findings in this research revealed that there were hybrids with higher CP content than the ecotypes used as parents and the commercial cultivar, especially hybrid 102069 that had superior CP content in all harvests and years. The National Academies of Sciences, Engineering, and Medicine (2016) recommends 12% of CP for finishing cattle. Therefore, it can be considered that CP values found for some hybrids and its progenitors are satisfactory for cattle weight gain even in the most demanding classes.

Average across genotypes and higher CP content values were observed on April 2014 when compared to the other harvests (Tab. 1).

TABLE 1. Crude protein content (%) of leaf blade samples of interspecific hybrids and ecotypes of the genus *Paspalum*, and the cultivar "Aruana" evaluated in Eldorado do Sul, RS, Brazil.

Genotypes	Harvest				
	February 13	April 13	February 14	April 14	Mean
102069	16.3 C-a	15.7 C-b	17.8 B-a	20.4 A-a	17.6
102080	15.4 A-b	11.1 C-f	13.5 B-c	15.4 A-c	13.9
10308	15.1 A-b	13.3 B-d	13.3 B-c	15.0 A-c	14.2
102058	14,5 B-c	12.9 C-d	14.0 B-b	16.2 A-b	14.4
103042	14.4 C-c	18.5 A-a	13.7 D-c	16.3 B-b	15.7
10104	14.1 B-c	12.6 C-e	14.8 A-b	14.8 A-c	14.1
103087	12.7 A-e	12.3 A-e	11.6 B-e	12.8 A-e	12.4
103077	13.9 B-c	12.8 C-d	13.9 B-c	16.2 A-b	14.2
"4PT"	13.8 B-d	12.9 C-d	13.6 B-c	15.0 A-c	13.8
"Azulão"	13.7 C-d	12.8 D-d	14.4 B-b	16.4 A-b	14.3
103061	13.6 A-d	12.3 B-e	12.3 B-d	13.6 A-d	13.0
10202	13.5 C-d	12.6 D-e	14.1 B-b	14.8 A-c	13.8
103093	13.3 C-d	14.2 B-c	14.4 B-b	15.2 A-c	14.3
103037	13.3 B-d	12.4 C-e	13.4 B-c	15.8 A-b	13.7
103063	13.1 B-e	13.3 B-d	12.7 B-d	14.9 A-c	13.5
"Baio"	14.0 B-c	14.0 B-c	14.2 B-b	15.3 A-c	14.4
1020133	12.5 C-e	12.3 C-e	13.6 B-c	14.3 A-d	13.2
103040	12.3 C-e	13.1 B-d	13.0 B-c	14.8 A-c	13.3
103084	12.3 B-e	11.5 C-f	10.9 C-f	13.3 A-e	12.0
103020	11.9 B-f	12.1 B-e	12.6 B-d	13.7 A-d	12.6
"Aruana"	11.9 B-f	12.5 B-e	12.4 B-d	13.2 A-e	12.5
102084	11.4 C-f	12.6 B-e	13.7 A-c	13.4 A-e	12.8
103031	11.4 D-f	12.2 C-e	13.6 B-c	14.5 A-c	12.9
Mean	13.4	13.0	13.5	15.0	13.8

Means followed by the same lowercase letters in rows and uppercase letters in columns do not differ by the Scott-Knott test at 5% probability.

This result can be attributed to cumulative effect of the nitrogen application in the second year, which may have provided benefits to increase CP content of the genotypes. Pereira *et al*. (2011), evaluating ecotypes of *P. guenoarum* and *P. lepton* (ex-*nicorae*), also observed the variation in the CP content between harvests and related it to the effect of nitrogen fertilization to increase CP.

The improvement of *Paspalum* species through artificial hybridization can be an important tool to obtain novel genetic resources with higher CP for pasture-based livestock production.

Conclusions

The hybrid 102069 (*Paspalum plicatulum* "4PT" x *P. guenoarum* "Azulão") presented the best CP content compared to the other genotypes in both years. These results are encouraging for forage breeding studies with species of the genus *Paspalum*. Promising hybrids can be used in new crossings in order to continue to increase forage nutritional characteristics or to be released as new cultivars. The hybrid 102069 will be used in coming evaluations within the Forage Plants Breeding Program of UFRGS. Since the hybrid progeny may include individuals for the sexual or apomictic type of reproduction, it is important to evaluate the reproductive biology of these hybrids. This analysis is already in progress.

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