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J. Mattera
INTA, Argentina

O. Scheneiter
INTA, Argentina

I. Cattoni
INTA, Argentina

E. Pacente
INTA, Argentina

P. Barletta
INTA, Argentina

See next page for additional authors

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Presenter Information

J. Mattera, O. Scheneiter, I. Cattoni, E. Pacente, P. Barletta, and O. Bertín

Forage accumulation and quality of three contrasting ecotypes of tall fescue (*Schedonorus arundinaceus*) managed under frequent defoliation

Mattera^{*, J.}; Scheneiter^{†, O.}; Cattoni^{†, I.}; Pacente^{†, E.}; Barletta^{†, P.}; Bertín^{†, O.}

^{*,†} INTA, EEA Pergamino

Key words: Defoliation; temperate grasses; nutritive value

Abstract

In the past, tall fescue ecotypes were compared under intermediate management defoliation frequency, but now has station, Argentina (-33 ° 56 'S, -60 ° 33' W) in autumn 2016, on a typical Argiudoll soil. The treatments were cultivars representing three ecotypes of tall fescue: (i) - Mediterranean (cv. Flecha), (ii) - Intermediate (cv. Royal Q 100) and (iii) - Continental (cv. Lujan INTA). Each plot consisted of 7 rows 6.0 m long, 0.2 m apart (8.4m² plot size) arranged in a randomized complete block design with 4 replicates. The first cut was done at the end of September when pastures reached > 90 % of soil cover. The following six cuts were done when thermal time was 550°±50°C degree days (base temperature=4°C). The forage accumulation was determined by cutting with a mowing machine the central 5 m² of each plot, at a height of 0.05 m. A sample (0.250 g) was taken to analyze in vitro dry matter digestibility (IVDIG), crude protein (CP), neutral detergent fiber (NDF) and NDF digestibility (NDFDIG). Mixed model was applied to consider ecotype and time effects. Ecotype*time interaction was significant for all variables (p<0.0001) except for forage accumulation. The values ranged between 491 and 2,625 kg DM ha⁻¹ for forage accumulation, while IVDIG ranged between 57.2 and 68.7%, CP between 11.5 and 19.1%, NDF between 45.5 and 62.8% and NDFDIG between 26 and 65.3%. The Mediterranean ecotype produced less forage but in many cuts with higher CP. In many cuts, IVDIG was higher in the Continental ecotype associated with less leaf diseases.

Introduction

Tall fescue is the most used temperate perennial grass in the Argentina Humid Pampa due to its wide ecological adaptation (Scheneiter et al. 2016) with moderate to high forage accumulation depending on the environment. Tall fescue differs from other temperate grasses (orchard grass and perennial ryegrass) due to its greater adaptation to warm environments (Reed et al., 1996) and tolerance to summer drought (Anderson et al., 1982). Tall fescue has four ecotypes: i) Mediterranean, ii) Intermediate, iii) Continental and iv) Rhizomatous which vary in seasonal growth rates and persistency strategies. In this way, the Continental ecotype has higher growth in spring and summer and lower in winter than the Mediterranean ecotype (Mazzanti y Arosteguy, 1985). In addition, there are variations in the morphology, with reduced plant size and tiller number for the Mediterranean ecotype (Assuero et al. 2000). At Pergamino, in the North of Buenos Aires Province (Humid Pampa), tall fescue ecotypes have shown differences in forage accumulation and quality (Bertín et al., 1990). The differences in the forage quality among ecotypes were detected in winter and summer, without differences in spring. However, in the last years, new tall fescue cultivars have been released so it is necessary to update this information with present recommended practices. The current defoliation criterion prioritizes the production of green leaves, avoiding the accumulation of dead material through the use of leaf lifespan (Lemaire et al. 2009). The objective of this work was to evaluate the accumulation and quality of the forage of three ecotypes of tall fescue in the first production year, under frequent defoliation.

Methods and Study Site

The experiment was carried out for one year (from May 2016 to May 2017) in the Northwest of Buenos Aires province, at INTA Pergamino Research Experimental Station ($-33^{\circ} 57'$, $-60^{\circ} 33'$), Argentina. The climate at Pergamino is temperate humid with an annual average temperature of 16.6°C , being the average temperature of the coldest month (July) 9.8°C , and the average of the warmest (January) 23.3°C . Average rainfall is 986 mm (period 1967-2017). During the experimental period, precipitation was above the long-term average (1147 mm in 2016; 1130 mm in 2017). The experiment was established on a Typic Argiudoll soil and agriculture capacity ($\text{pH}=5.2$; organic matter=3.1 % and extractable phosphorus = 12.7 mg kg^{-1}). The treatments were cultivars of three ecotypes of tall fescue: (i) - Mediterranean (cv. Flecha), (ii) - Intermediate (cv. Royal Q 100) and (iii) - Continental (cv. Lujan INTA). Each plot consisted of 7 rows 6.0 m long, 0.2 m apart (8.4 m^2 plot size) arranged in a randomized complete block design with 4 replicates. The first cut was at the end of September when treatments reached $> 90\%$ of soil cover (thermal time accumulated = 1,024 degree days). The following six cuts were done when thermal time was $550^{\circ}\pm 50^{\circ}\text{C}$ degree days (base temperature = 4°C) according to tall fescue leaf lifespan (Lemaire et al., 2009) to avoid natural senescence. The forage accumulation was determined by cutting with a mowing machine the central 5 m^2 of each plot, at a height of 0.05 m. All fresh material was weighed and an aliquot of 250 g per plot was taken to estimate dry matter content. The sample was dried to constant weight in a forced drying oven at 60°C . The dried sample was used to analyse the quality of the forage through *in vitro* dry matter digestibility (IVDIG), crude protein (CP), neutral detergent fiber (NDF) and NDF digestibility (NDFDIG). The dynamics of forage accumulation and quality variables were analysed with a mixed model with randomised complete block design and repeated measures considering ecotype and time effects. DGC test was used to detect differences between treatments ($p < 0.05$). All statistical analyses were performed by using InfoStat 2017 software for Windows (Di Rienzo et al. 2018).

Results

Forage accumulation ranged between 491 and 2,625 kg DM ha^{-1} (Figure 1). There was no ecotype by time interaction. The Mediterranean ecotype produced less forage during all the growing season ($p < 0.0001$). In contrast, the Continental and Intermediate ecotypes had similar forage accumulation overall the season except in the fifth cut (31/01/16) where the Continental ecotype produced more forage than the Intermediate ecotype. Time effects were also significant with the peak of growth in spring, especially in November, where tall fescue plants began the reproductive phase (data not shown). The forage accumulation decreased as the summer progressed for all ecotypes.

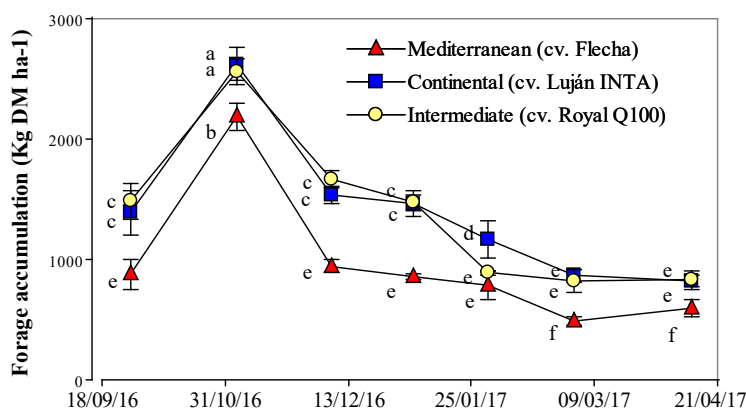


Figure 1. Forage accumulation of three contrasting ecotypes of tall fescue: Mediterranean (cv. Flecha), Continental (cv. Luján INTA), and Intermediate (cv. Royal Q100) during the first production year. Values are means \pm SE of four replicates. Lowercase letters represent comparison among dates and ecotypes. All comparisons were performed by DGC test ($p \leq 0.05$).

There was interaction ecotype by time for quality variables ($p < 0.0001$). *In vitro* dry matter digestibility ranged between 57.2 and 68.7% (Figure 2A) and there was no a defined pattern, however in many cuts the Continental ecotype has the highest IVDIG, especially as the summer progressed. The NDF content ranged between 45.5 and 62.8% (Figure 2B) whereas NDFDIG ranged between 26.0 and 65.3% (Figure 2C). NDF increased after the first cut, with higher NDF in the last two cuts, and the differences between ecotypes were occasional and of low magnitude. The digestibility of the NDF (NDFDIG) was lowest in the first cut. After, the NDFDIG increased and, in the majority of sampling dates was higher for the Continental ecotype. CP ranged between 11.5 and 19.1% (Figure 2D), in contrast to the other quality variables for CP was higher for the Mediterranean ecotype in many cuts (spring and early summer).

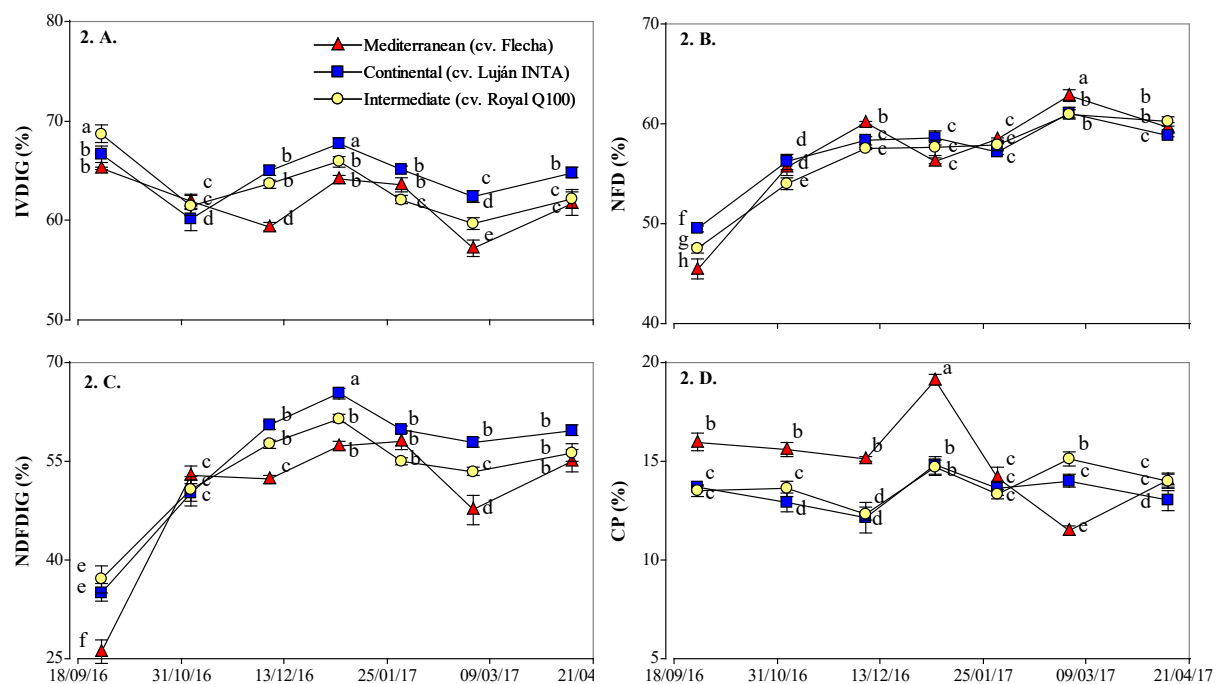


Figure 2. Quality of three contrasting ecotypes of tall fescue: Mediterranean (cv. Flecha), Continental (cv. Luján INTA), and Intermediate (cv. Royal Q100) during the first production year. A. *In vitro* digestibility (IVDIG). B. Neutral detergent fiber content (NDF). C. NDF digestibility (NDFDIG). D. Crude protein content (CP). Values are means \pm SE of four replicates. Lowercase letters represent comparison among dates and ecotypes. All comparisons were performed by DGC test ($p \leq 0.05$).

Discussion

During the first production year, the seasonal forage accumulation dynamics of the three tall fescue ecotypes was similar, and this could be associated with the fact that the evaluation period did not include the winter season when it is expected that the Mediterranean ecotype increases its growth rate in comparison with other ecotypes. However, the germplasm effect determined that under the same defoliation management the Mediterranean ecotype produced less forage all over the period.

Forage quality was studied through diverse attributes. Although the values were in the range of a previous report (Bertin et al. 1990) the behaviour was different. In that report they found a progressive decrease from winter/spring to summer. Interestingly in the present experiment, quality reductions in summer were less intense, this pattern was observed especially for IVDIG and CP. This could be due to the use of the recommended defoliation management practices that avoid natural leaf senescence. In contrast, the NDF and its digestibility increased both as the time progressed, and in same way they compensate in their effects, because the increase in the cell wall content was accompanied with the increase in its digestibility. The ecotype effects were different depending on the variable, a better forage quality in terms of IVDIG and NDFDIG was for the Continental ecotype followed by the Intermediate and lower for the Mediterranean ecotype. This probably was due to morphological differences between ecotypes as mentioned by Assuero et al. (2000) and to a better performance in the Continental ecotype to leaf diseases i.e. rust (data not shown). In

contrast, the Mediterranean ecotype had higher CP than the other ecotypes, probably due to less forage production and lower dilution of plant nitrogen content.

These results highlight the influence of germplasm in both forage accumulation and its quality. Although important seasonal variations the Continental ecotype under this scheme of defoliation management showed a better performance in both production and quality than the Mediterranean ecotype. However, the selection of more productive cultivars of the Mediterranean ecotype would be interesting to increase forage production during the winter.

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