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PASTURE AND FORAGE UTILIZATION

Dynamics of Tifton 85 pasture (*Cynodon dactylon L. Pers*) over seeded with cool season species, under continuous grazing

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ABSTRACT. This study aimed to evaluate the effects of oat or ryegrass over seeding on the productive characteristics and morphological composition of Tifton85 grass under continuous grazing. The three studied treatments were: Oat + Tifton85, Ryegrass + Tifton85 and Tifton85, distributed in a completely randomized design, constituting four replications of area per treatment. The Ryegrass + Tifton85 treatment presented a forage mass 27% superior to the Oat + Tifton85 treatment. The leaf percentage of Tifton85 was superior for the treatment Oat + Tifton85 (41%), while the percentage of stem + sheath was superior in the treatment Ryegrass + Tifton85 (64%). There was a higher percentage of Tifton85 leaves in the treatment Oat + Tifton85, while the Ryegrass + Tifton85 treatment presented a higher proportion of the stem + sheath constituent. Overfeeding species of temperate climate has proven to be a viable alternative, since it potentiates the weight gain of animals without damaging the productive re-establishment of Tifton85.

Keywords: forage; grazing; oat; ryegrass; tropical pasture.

Dinâmica da pastagem de Tifton85 (*Cynodon dactylon L. Pers*) sobressemeado com espécies hibernais, submetida a pastoreio contínuo

RESUMO. Objetivou-se, neste estudo, avaliar os efeitos da sobressemeadura de Aveia ou Azevém sobre as características produtivas e composição morfológica do capim Tifton85 mantido sobre pastoreio contínuo. Os três tratamentos estudados foram Aveia + Tifton85, Azevém + Tifton85 e Tifton85, distribuídos em delineamento inteiramente casualizado, constituindo quatro repetições de área por tratamento. O tratamento Azevém + Tifton85 apresentou massa de forragem 27% superior ao tratamento Aveia + Tifton85. O percentual de folha de Tifto85 foi superior para o tratamento Aveia + Tifton85 (41%), enquanto o percentual de colmo + bainha foi superior no tratamento Azevém + Tifton85 (64%). Observou-se maior percentual de folhas de Tifton85 no tratamento Aveia + Tifton85, enquanto o tratamento Azevém + Tifton85 apresentou maior proporção do constituinte colmo + bainha. A sobressemeadura de espécies de clima temperada mostrou-se alternativa viável, visto que potencializa o ganho de peso dos animais sem prejudicar o reestabelecimento produtivo do Tifton85.

Palavras-chave: aveia; azevém; consórcio; forragicultura; pastagem tropical.

Introduction

The current expansion of agricultural areas over those formerly occupied by livestock farming has been reshaping the productive landscape in the State of Rio Grande do Sul. The intensification of pastoral systems is one of the most striking transformations that began to use forage species that combine high growth rates with nutritional quality. This trend also prioritizes rational soil use and plant-animal interactions to achieve higher production levels (Alencar et al., 2008; Burns, 2008).

Cynodon grasses spread through rhizomes and stolons; thus demonstrating considerable resistance to oscillations in soil type, pH and cold tolerance (Costa et al., 2014; Marchesan et al., 2013). Although their productive characteristics have not yet been fully clarified, these characteristics have contributed to the expansion of cultivated area (Simöes et al., 2012).

In the State of Rio Grande do Sul, Tifton85 grass has shown good adaptation to the current productive systems used. However, this species, like the native field, slows down or stops its growth in fall/winter, especially because of reduced temperature.

In order to mitigate problems with forage seasonality, the use of over seeding of annual cool-season species is a practice that can make it feasible to meet this forage deficit, because by intercropping them with the already established pasture, of perennial behavior, it benefits the food condition of herds. Among the possible species to be intercropped are oats (*Avena strigosa* Scheb) and ryegrass (*Lolium multiflorum* Lam.), which have already shown a wide adaptation to the climatic conditions of the southern Brazil, besides of easy implementation, flexible management and high nutritional value (Pizzuti et al., 2012).

Considering the above, the goal of this study was to evaluate the effects of oat or ryegrass over seeding on the productive characteristics and morphological composition of Tifton85 grass, as well as the performance of steers kept on these pastures.

Material and methods

The present study was conducted at the Beef Cattle Breeding Laboratory, Department of Animal Science, Federal University of Santa Maria, municipality of Santa Maria, Central Depression of Rio Grande do Sul, located at 95 meters altitude, latitude 29º43' South and longitude 53º42" West. The soil of the experimental area belongs to the São Pedro mapping unit, classified as Arsenic Dystrophic Red Argisol and the regional climate is subtropical with humid and hot summer, according to the Köppen classification (Köppen & Geiger, 1928). The chemical analysis of the soil collected before the onset of the experiment showed the following values: pH in water = 4.8; % clay = 19.0 m V^{-1}; P = 18.0 mg dm^{-3}; K = 168.0 mg dm^{-3}; % OM = 3.5 m V^{-1}; Al = 0.7 $cmol_c$ dm^{-3}; Ca = 4.2 $cmol_c$ dm^{-3}; Mg = 1.7 $cmol_c$ dm^{-3}; base saturation = 45.2% and Al saturation: 10.0%.

The experimental area corresponded to 2.64 hectares of Tifton85 (*Cynodon dactylon* x *C. nlemfuensis*) divided into 12 paddocks of approximately 0.22 hectares each. Four paddocks were seeded with black Oat (*Avena strigosa* Schreb), four paddocks were seeded with Ryegrass (*Lolium multiflorum* Lam.) and another four paddocks were kept as a control, being thus designated the three treatments: Oats + Tifton85, Ryegrass + Tifton85 and Tifton85 (control).

The Tifton85 pasture, prior to the onset of the experiment, was mowed to facilitate the management of seeding and the germination of the annual species. Oat seeding occurred on June 14th with a density of 60 kg ha^{-1} (300 plants m^{-2}) and ryegrass on June 15th with a density of 20 kg ha^{-1} (100 plants m^{-2}). Both species were seeded with no-till, with a disk seeder, at a depth of approximately 2 cm. In the basal fertilization, 120 kg ha^{-1} N-P-K fertilizer 5-20-20 formula was applied at planting and 60 kg ha^{-1} as top-dressing (August 28th). The amount of nitrogen applied as top-dressing was 45 kg ha^{-1} on August 28th and October 10th. On Tifton 85, 120 kg ha^{-1} N-P-K fertilizer 5-20-20 formula was applied as top-dressing on August 28th and October 10th and 22.5 kg ha^{-1} nitrogen on October 10th. Figure 1 illustrates the average rainfall and temperature observed during the experimental period.

Twelve Nellore x Charolais steers with average age and initial mean weight of 9 months and 217 kg, whose daily weight gain was 0.677 kg day^{-1}, were used. The animals had free access to water and mineralization, and the weight was monitored every 28 days for calculating the animal load and time of pasture use. The use of oat pasture totaled 91 days (August 9th to November 15th), and the ryegrass pasture, 77 days (September 06th to November 22nd). Steers were allowed to enter the control paddock (Tifton85) when it presented an accumulation rate close to 50 kg DM day^{-1}, which occurred on September 13rd, being evaluated until October 22nd, totaling 70 days of evaluation for the purpose of comparison with the other treatments.

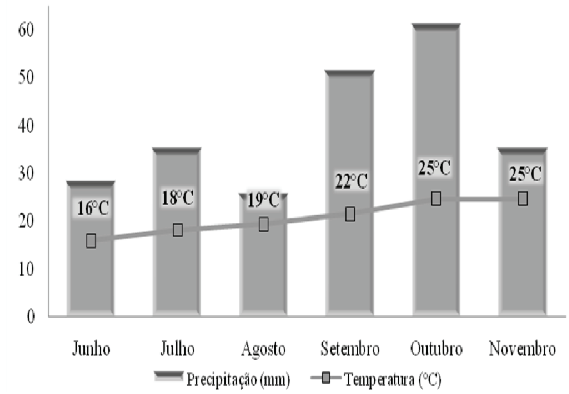

Figure 1. Average temperature (ºC) and rainfall (mm) observed during the experimental period.
Source: Instituto Nacional de Meteorologia [INMET]. (2012).

Pastures were managed under continuous grazing method and variable stocking rate, using the *Put and Take* technique (Mott & Lucas, 1952). Forage mass was quantified by the double sampling method (Wilm, Costello, & Klipple, 1944), considering the two intercropped species (Oat + Tifton85 and/or Ryegrass + Tifton85), carried out at the beginning of the grazing period and afterwards every 15 days. In each repetition, five cuts of 0.0625 m² each were made close to the ground, and 20 visual estimates. At the same time, samples were taken from the pastures to perform the morphological and botanical assessment by manual separation of the species (Oat, Ryegrass and Tifton85) and the components: leaf, stem + sheath and dead matter.

The other subsamples were dried in a forced ventilation oven at 55ºC for 72 hours for the estimation of dry matter (DM). Other species were not quantified because they were not present. The animal load, expressed in kg BW ha^{-1}, was calculated from the sum of the weight of the test animals, plus the weight of the regulators and multiplied by the number of days on the pasture divided by the number of days of the period, according to the formula:

$$\text{Animal load} = \text{Pt} + (\text{Pr x D}) / \text{NDP}$$

where: Pt: average weight of test animals; Pr: weight of regulator animals; D: number of days that regulator animals remained on the pasture; NDP: number of days in the period.

The daily accumulation rate of pasture was estimated every 21 days using a grazing exclusion cage per paddock and calculated by means of the equation described by Campbell (1966), estimated the growth rate of the two species (Oat + Tifton85 and Ryegrass + Tifton85), according to the formula:

$$T_j = (G_i - F_g\ (i-1)) / n$$

where: T_j = daily DM accumulation rate ha^{-1}, in period j; G_i = mean amount of DM ha^{-1} at two sites in the evaluation i-1; n = number of days in the period.

The design was completely randomized, with four replications, paddocks per treatment. The mathematical model corresponds to: $Y_{ij(k)} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ij(k)},$ where $Y_{ij(k)}$ = is the dependent variable; μ = mean of all observations; α_i= effect of *i-th* period; β_j = effect of *j-th* treatment; $(\alpha\beta)_{ij}$ = interaction between period and treatment; $\varepsilon_{ij(k)}$ = residual random error, NID $(0, \sigma 2)$. Data were tested by analysis of variance and F-test, using the MIXED procedure, whose criterion for choosing the best covariance structure was the lowest AIC. When differences were detected between the means, these were compared by Student's test with $p = 0.05$ significance and the variables were analyzed for normality by the Shapiro-Wilk test. All analyses were run using SAS 9.2 statistical software.

Results and discussion

The morphological composition of the pasture (Table 1) was influenced by the over seeded species. The Oat + Tifton85 treatment showed a greater ($p < 0.05$) percentage of leaf (41%) of Tifton85, while the Ryegrass + Tifton85 treatment, greater ($p < 0.05$) percentage of stem + sheath (64%) of Tifton 85. Thus, values of leaf: stem ratio were 0.70 and 0.55 for the respective treatments, close to the mean values of 0.81 and 0.68 reported by Neres et al. (2012) and Marchesan et al. (2013), respectively. Gomes et al. (2015) observed an average leaf: stem ratio of 1.08 (Tifton85) and 1.53 (Oats + Tifton85), which may be related to absence of grazing, different from the present study. Sanches et al. (2015) verified that Tifton 85 can present a leaf: stem ratio of 1.8 and in the presence of oat, values higher than 2, in a study evaluating irrigated and non-irrigated systems, whose pasture was not under continuous grazing. In this same study, the percentage of dead matter was close to 10%, similar to the data of the present study ($p > 0.05$).

Compared to other tropical grasses, Tifton85 presented anatomical characteristics indicative of species with better nutritional value, because the lower proportions of poorly digested tissues in the leaf and stem, combined with the high proportions of mesophyll and parenchyma, reflected in larger areas digested, even on blades and stems at a more advanced stage of development. This reinforces the importance of a good amount of leaves, because this structural component concentrates most of the nutrients of the plant available to the animals (Valente et al., 2011).

Table 1. Means, standard error (SE) and probability (Prob) of the percentage of morphological and botanical composition of Tifton85 pasture over seeded with Oat or Ryegrass.

Variables	Treatments			SE	Prob
	Oat + Tifton85	Ryegrass + Tifton85	Tifton85		
Tifton85	33b	57a	-	9.1	0.0005
Leaf	41a	35b	34b	1.6	0.0001
Stem + sheath	59 b	64 a	56 b	6.9	0.0035
Dead matter	-	-	11	1.2	0.174
Oat	56A	-	-	8.4	0.0043
Leaf	27	-	-	-	-
Stem + sheath	87	-	-	-	-
Dead matter	11	-	-	1.2	0.174
Ryegrass	-	34B	-	8.4	0.0043
Leaf	-	51	-	-	-
Stem + sheath	-	68	-	-	-
Dead matter	-	9	-	1.2	0.174

Means followed by different lowercase letters in the same row are significantly different by Student's test ($p<0.05$). Means followed by different uppercase letters in the same column are significantly different by Student's test. Source: Prepared by the authors.

From the evaluation of the botanical composition of the pasture, we can observe the superiority ($p < 0.05$) in the participation of oat (56%) compared to ryegrass (34%) quantified throughout the work. It is possible that seeding density of 20 kg seed ha^{-1} contributed to lesser participation of ryegrass compared to Tifton85, since other authors have used 30 kg (Hahn, Mühl, Feldmann, Werlang, & Hennecka, 2015) and 35 kg seed ha^{-1} (Olivo et al., 2010) in works with over seeding using these species.

Analyzing Figure 2, it is possible to verify the superiority ($p < 0.05$) in the participation of oat in the first 28 days of evaluation in the botanical composition of the pasture (45%). The lower temperatures recorded in this period (Figure 1) justify the higher productivity of oat, anticipating the grazing of the animals and, with that, resulting in the highest percentage of Tifton 85 leaf listed in Table 1. This was not observed in the ryegrass + Tifton 85 treatment possibly by the later cycle, which coincided with the growth of tropical forage, favoring higher forage production (Table 2) and the productive reestablishment of Tifton 85.

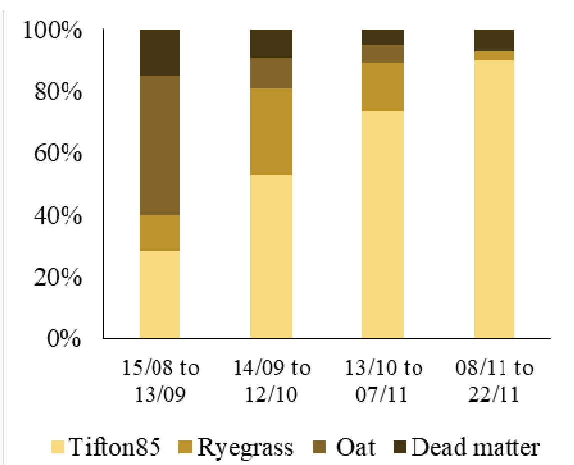

Figure 2. Botanical composition of the pasture during the experimental period.

Table 2. Mean and standard error (SE) of forage production and performance of steers kept on pasture of Tifton85 over seeded with cool-season species.

Variables	Treatments			SE	Prob
	Oat + Tifton 85	Ryegrass + Tifton 85	Tifton 85		
[1]FM, kg DM ha^{-1}	3591b	4886a	621a	0.004	0.038
[2]AR, kg DM ha^{-1} day^{-1}	79.7b	63b	96.3a	0.043	0.002
[3]AL, kg BW ha^{-1}	1556	1666	1576	132.9	.70
[4]Grazing, days	91a	77b	70b	3.120	0.042

[1]FM: Forage mass; [2]AR: Accumulation rate; [3]AL: Animal load; [4]Grazing days oat + Tifton 85 (09/08 to 15/11), ryegrass + Tifton 85 (06/09 to 22/11) and Tifton 85 (13/09 to 22/11). Means followed by different letters in the same row are significantly different by Student's test ($p < 0.05$).

The pasture accumulation rate is directly related to its productive indices, such as forage mass and support capacity (animal load), and some of the main factors responsible for this variable are rainfall, temperature, luminosity and fertilization (Premazzi, Monteiro, & Oliveira, 2011; Scheffer-Basso, Scherer, & Ellwanger, 2008). It can be concluded from figure 1 that the lowest rainfall was verified in August (below 30 mm) and that average temperatures (above 16°C) were not limiting, according to literature, to forage growth in Tifton85. Especially from September, when the rainfall averages were 50, 60 and 30 mm, while the temperatures remained above 20ºC, within the optimal zone of growth for tropical species.

In the period from 14/09 to 12/10, there was a higher percentage of ryegrass compared to oat, due to the shorter cycle of this species, representing 28.5% of pasture versus 10% of oats. Silva et al. (2012) also reported a reduction in oat participation with the advance of experimental periods, with no participation of any of the cultivars evaluated in October when intercropped with African star. Nevertheless, Tifton85 represented 53% botanical composition, surpassing ryegrass production, justifying the higher forage mass production of Ryegrass + Tifton85 treatment (Table 2). In the subsequent periods, the participation of Tifton85 in the pasture composition was 74 and 90%, respectively, demonstrating full reestablishment in relation to the cool season species and the crop practices.

The average forage mass production of the Ryegrass + Tifton85 treatment (4,886 kg DM ha^{-1}) was 27% higher ($p < 0.05$) than the Oat + Tifton85 treatment (3,591 kg DM ha^{-1}) (Table 2), possibly related to the greater participation of Tifton 85 in this treatment (57%) compared to that in the Oat + Tifton85 treatment (33%) (Figure 2).

The average forage mass production of the Tifton85 treatment was 4,621 kg DM ha^{-1}, not statistically different from the Ryegrass + Tifton85 treatment. These data corroborate with data provided by (Hahn et al., 2015), which in intercropping with both oats and with ryegrass increased dry biomass production from 16.68 mg ha^{-1} (Tifton85) to 34.97 mg ha^{-1} (Oat + Tifton85) and 51.98 mg ha^{-1} (Ryegrass + Tifton85). Lower forage mass values were found by Sanches et al. (2015) who worked with Tifton85 over seeded with three cultivars of oat, whose average forage mass production was 1,880 kg DM ha^{-1}. In this same study, the mean of Tifton85 was 1,906.4 kg DM ha^{-1}. This inferiority can be attributed to the lower forage mass remaining after the grazing periods, since the pre-grazing criterion adopted was the sward height.

The pasture growth rate depends on several environmental factors, such as climate, fertilization and management, due to the specific physiology of each species. As shown in Table 2, there was no difference in the daily growth between Oat + Tifton

85 and Ryegrass + Tifton85 treatments (71.3 kg DM ha^{-1} day^{-1}). Tifton 85, because it is C4 species, presents physiological peculiarities that provide higher daily biomass accumulation, such as higher photosynthetic rate (Sollenberger, 2008). In this work, the average daily accumulation rate of Tifton85 was 96.3 kg DM ha^{-1} day^{-1}.

There was a difference ($p < 0.05$) in the time of use with animals from the areas planted with winter forages from June to November 2012 (Table 1). The combination of oat + Tifton 85 resulted in a longer time of use ($p < 0.05$), 91 grazing days, with 55 days for oat establishment. In the intercropping with ryegrass, the period of use did not differ significantly from the control area (Tifton85), there was a difference of only seven days from the entry of the animals, 77 and 70 grazing days for the Ryegrass + Tifton85 and Tifton85 treatments, respectively.

Conclusion

Oat over seeding implies a higher percentage of Tifton85 leaf and ryegrass over seeding results in a higher percentage of stem + sheath of Tifton85. Over seeding cool-season species in Tifton85 pasture does not impair the productive characteristics of this forage, proving to be a sustainable and productive forage production strategy.

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