PRELIMINARY EVALUATION OF *Paspalum pauciciliatum*: SEASONAL PRODUCTION AND NITROGEN RESPONSE

AVALIAÇÃO PRELIMINAR DE *Paspalum pauciciliatum*: PRODUÇÃO ESTACIONAL E RESPOSTA AO NITROGÊNIO

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SUMMARY

It was aimed to evaluate agronomical aspects of prostrate dallisgrass (*Paspalum pauciciliatum*), a native grass forage, cultivated in the field and submitted to defoliation and four nitrogen doses (zero, 4 x 12.5, 4 x 25 and 4 x 50 kg of N/ha/cutting) in the field between August/2004 and June/2005. The establishment was done from vegetative cuttings in 5 m rows in the end of the winter. The fertilizing-N took place in the spring-summer and the plants were monthly cut at 5 cm stubble. The final harvest was in the fall, 113 d after the last summer cutting and 143 d after the last N application. The dry matter (DM) production did not was affected by nitrogen fertilization in the warm season. Nitrogen increased linearly the horizontal spread in the establishment period (0.416 cm/kg N/ha), crude protein (0.0192%/kg N/ha) and diary dry matter production in the fall (51.28 kg DM/kg N/ha). The nitrogen reduced the ADF average content (-0.022%/kg N/ha). The good forage production (3,104 kg DM/ha) and adequate chemical composition (CP= 12.2%; ADF= 43.4%; NDF= 66.2%; hemicelluloses= 22.7%) in the fall indicate the use of species in stockpiling management. The species has attributes that recommends its inclusion on the breeding program: DM production in the warm season (4,416 kg/ha), regrowth rate (17 to 56.5 kg DM/ha/day), leaf contribution in the harvested forage (50% in spring-summer and 100% in fall), good chemical composition (CP=12.2-15.9%; ADF= 40.3-43.4%; NDF= 62.2-73.5%), tolerance to summer drought and lower temperature in the fall.

KEY-WORDS: Chemical composition. Dry matter. Prostrate dallisgrass.

RESUMO

Objetivou-se avaliar aspectos morfofisiológicos e bromatológicos de uma gramínea forrageira nativa, o capim melador-prostrado (*Paspalum pauciciliatum*), submetida a quatro doses de nitrogênio (zero, 4 x 12.5, 4 x 25 e 4 x 50 kg de N/ha). As plantas foram estabelecidas em linhas de 5 m e por mudas. A adubação-N ocorreu na primavera-verão, quando as plantas foram cortadas a cada 30 dias deixando-se 5 cm de resíduo. A colheita final ocorreu no término do outono, 113 dias após o último corte e 143 dias após a última aplicação de N. O nitrogênio não afetou a produção de matéria seca (MS) na estação quente, mas aumentou linearmente a expansão horizontal no período de estabelecimento (0,416 cm/kg N/ha), teor médio de proteína bruta (0,0192%/kg N/ha), produção diária de matéria seca outono (51,28 kg MS/kg N/ha). O nitrogênio reduziu o teor de FDA (-0,022%/kg N/ha). A boa produção de forragem (3.104 kg MS/ha) e a composição química (PB= 12,2%; FDA= 43,4%; FDN= 66,2%; hemicelulose= 22,7%) no outono indicam seu uso para diferimento. A espécie possui atributos que recomendam sua inclusão nos programas de melhoramento, tais como: produção de matéria seca total na estação quente de 4.416 kg/ha, taxas de rebrota de 17 a 56,5 kg MS/ha/dia, contribuição de folhas de 50% na primavera-verão e de 100% no outono, adequada composição química (PB=12,2-15,9%; FDA= 40,3-43,4%; FDN= 62,2-73,5%), boa tolerância à estiagem no verão e à redução das temperaturas no outono.

PALAVRAS-CHAVE: Composição química. Matéria seca. Melador-prostrado.

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INTRODUCTION

The success of a forage research or development and improvement program is usually dependent on the availability of adapted, productive and appropriate forage germplasm for selection of promising lines (HANSON & LAZIER, 1988). In the initial phase it is suggested evaluating parameters related to environmental adaptation, seasonal productivity and recording a limited number of desirable traits to a particular use (SCHULTZE-KRAFT & ‘t MANNETJE, 2000).

The genus *Paspalum* is one of the most important of the native grasslands and many species from Brazil are used in breeding programs in other countries. Dallisgrass (*Paspalum dilatatum* Poir.) is one of them. Recently, cv. Sabine’ dallisgrass has been released by the USDA-ARS (BURSON et al., 2009).

Prostrate dallisgrass (*Paspalum pauciciliatum* Herter; syn= *Paspalum dilatatum* var. *pauciciliatum* Parodi) is an important warm-season perennial apomitic grass (2n = 40) well distributed in the South of Brazil and its forage value was evaluated in the USA (SHAW et al., 1965, BURTON & WILSON, 1991). It is more prostrate than common dallisgrass and its main limitation is poor seed production and susceptibility to ergot (BURSON &WATSON, 1995).

Burton & Wilson (1991) released the germplasm 1 (PI548066) of the prostrate dallisgrass, emphasizing its superiority in relation to the common one, as for the persistence, production and resistance to leaf diseases. Studies in Brazil referred to intense flowering, phyllocron varied from 175 to 345 degrees-day (DD), with 665-1281 DD of leaf duration and the 9.3-13.7 cm of leaf length of prostrate dallisgrass (SANTOS, 2003). Under nitrogen fertilization (0 to 448 kg/ha/year), the species produced more forage in relation to the common one due to faster growth in summer (HART & BURTON, 1966). According to these authors, prostrate dallisgrass had better adaptation to wet and poorly drained area, with the first growth near to the ground and much of forage was above the height cutting.

Performance of common dallisgrass to fertilization is unclear but Wilkinson & Langdale (1974) indicated response to N up to 150 kg/ha on sandy soils and up to 225 kg/ha on heavier soils. Baréa (2005) reported maximum forage production of “Virasoro” dallisgrass biotype with 150 kg N/ha in relation to 50 and 200 kg N/ha on a clay soil.

This study aimed to evaluate the seasonal production and chemical composition of prostrate dallisgrass as function of nitrogen fertilization in order to identify its forage potential and subsidize management practices.

MATERIAL AND METHODS

The investigation was conducted between August 2004 and June 2005, at the Universidade de Passo Fundo, Rio Grande do Sul, Southern Brazil (28 15'S, 52 24"W and 687 m altitude) on well drained clay soil, with pH of 5.5, organic matter of 2.5%, 15 mg/dm^3 P and 148 mg/dm^3 K. The climate is temperate humid subtropical (Cfa), with average annual temperature of 22ºC (MORENO, 1961). The monthly temperature and precipitation during the experiment are presented in Figure 1 as the regional normal.

Considering the absence of seeds, fifteen vegetative cuttings spaced 50 cm within the row were planted on August 19th of 2004, in single-row 5 m plots with 1.5 m apart. The design was a randomized complete-block using five replications. Four nitrogen treatments from 0 to 200 kg N/ha/warm season (0= control, 4 x 12.5= 50, 4 x 25 kg= 100 and 4 x 50= 200 kg/ha) were applied in four times: October 14th, after a standardization cut, November 16th, December 16th and January 12th, following the three cuttings. No nitrogen was applied after the last summer cutting (February 10th) and 113 days after (June 3rd) that, another cutting was done in order to evaluate the fall production. Urea was used as source of nitrogen and the fertilizer was applied in the row side and incorporated with a hoe 5 cm deep. The spontaneous vegetation inter-row was taken by hoe weeding.

Plots were harvest at 5 cm stubble with garden scissors and the forage was weighed in the field. None to 100% of the harvested and dried forage was returned to the plots. Subsamples from each row were collected and oven dried at 60ºC to determine dry matter (DM) percentage. These samples were ground with a Wiley mill equipped with a 1-mm screen and analyzed for crude protein (CP), neutral detergent fiber (NDF), and acid detergent fiber (ADF) by near infrared reflectance spectrometry (NIRS). Herbage within the 50 cm strip from the center of each plot was collected for determination of leafiness. Other measures included canopy height (vegetative; vegetative + reproductive profile), horizontal spread, harvested vegetative canopy, plot area (plant height x horizontal spread), dry matter (DM) production (DM/ha = plot DM production x 10,000 m^2 / area plot), leaf DM production, regrowth rate (RR = DM production/ day interval between cuttings), and biomass allocation in leaf, culms and inflorescence. Data were submitted to variance analysis in factorial design with subdivided plots in time, with the nitrogen doses as the main plot and the cuttings as the subplot. The means were compared by Tukey test at the 5% of significance. The statistical analyses were done with SISVAR program (FERREIRA, 2000).

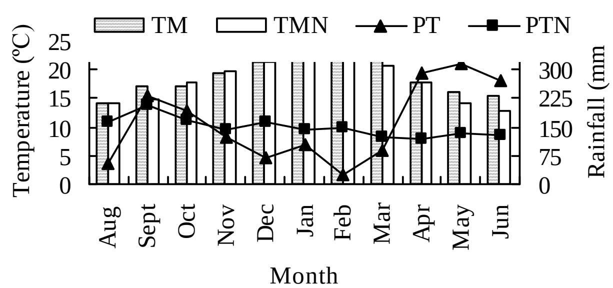

Figure 1- Mean monthly temperatures and total precipitation of the experimental period 2004-05 (TM; PN) and the normal regional (TN; PTN). Source: www.cnpt.embrapa.br.

RESULTS AND DISCUSSION

Prostrate dallisgrass presented an early and long flowering period and symptoms of ergot, caused by *Claviceps paspali*, were verified. This is the principal disease of dallisgrass except to Virasoro biotype (COSTA & SCHEFFER-BASSO, 2003). The long flowering time is a characteristic of dallisgrass in the South of Brazil (BARÉA et al., 2005).

The nitrogen affected the prostrate dallisgrass performance in several morphophysiological and chemical traits, as simple effect (vegetative profile and ADF) or according to harvest time (horizontal spread, leaf DM production, crude protein content). In the harvest time average, the nitrogen increased the vegetative canopy height (total and harvested) (Figure 2). Prostrate dallisgrass canopy was kept about 50 cm as long as the warm season and the maximum was verified in February, at the peak of flowering (Figure 3). In spring-summer about 75% of vegetative canopy was harvested, and in the fall approximately 65%.

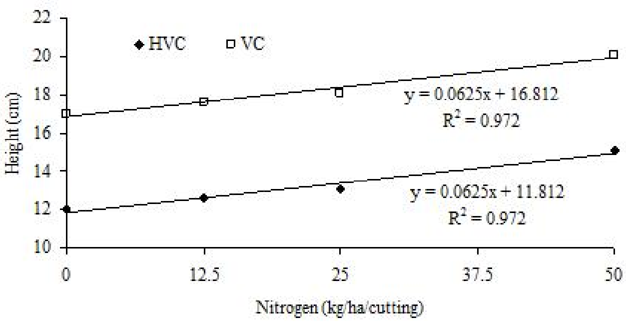

Figure 2 - Canopy vegetative height (total= VC; harvested= HVC) of prostrate dallisgrass as function of nitrogen fertilization.

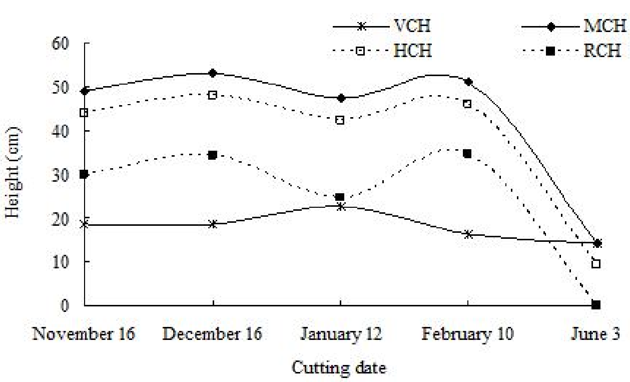

Figure 3 - Seasonal canopy height (VCH = leaves+culms; MCH, maximum height = leaves+culms+inflorescences; RCH = reproductive canopy; HCH= harvested canopy).

In general, nitrogen fertilization increased the horizontal spread, especially in the establishment period (Figure 4). The average of plant unilateral spread was about 11 cm per month. With the increase of the horizontal spread, the row diameter reached the largest value (136 cm) already in early spring with the highest N doses. The nitrogen applied in this phase can be an important factor to help the lateral growth of the stand. The rapid plant growth reduces the establishment of undesirable plants, provides greater absorption of solar radiation and helps to maintain the soil moisture.

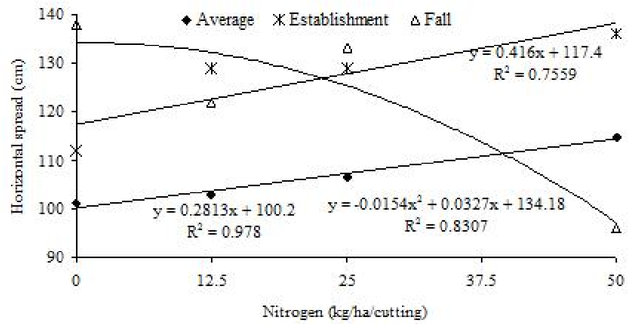

Figure 4 - Horizontal spread of prostrate dallisgrass in the period average, establishment and fall time as function of nitrogen fertilization.

However, in the fall, the relationship between nitrogen and spread was negative and there was about 30% reduction in relation to warm season. Possibly the highest heights obtained under higher nitrogen doses caused lower radiation levels at soil level, reducing the stolon growth. In a mixture of grasses with white trefoil (*Trifolium repens* L.), Höglind (1996) observed the reduction in the number of growing points in the stolons of the legume and attributed partly this result to decreased of the radiation in the sward, caused by the stimulating effect of N on grass growth. Hart & Burton (1966) observed that at higher nitrogen rates (0 to 448 kg N/ha), the faster growth of prostrate dallisgrass became apparent somewhat earlier, but also disappeared earlier in late summer. Without added nitrogen, prostrate dallisgrass grew consistently faster than common dallisgrass during the peak growing season.

The yield in the warm season was not affected by N fertilization. Only in the fall was there a positive relation between nitrogen and DM production (Figure 5) in spite of lower temperatures and none nitrogen application after the last summer cutting. According to Mundy (1999), during the winter, growth rates of perennial grasses are limited by low mineralization rates of soil N and so potentially highly responsive to applied N.

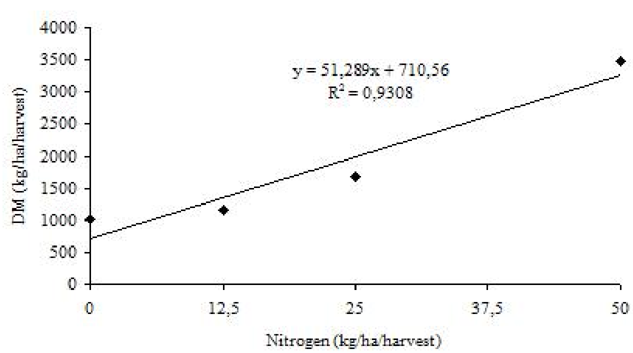

Figure 5 - Dry matter production of prostrate dallisgrass in the fall as function of nitrogen fertilization in the spring-summer.

The canopy harvested in the fall was 113 days old and was composed exclusively by leaves. The response index (maximum yield DM-200 kg N/ha/maximum yield DM–control) was high and about 3.50. A linear nitrogen response up to applications of 135 kg N/ha in dallisgrass was observed by Colman & Lazenby (1970) and Colman et al. (1974). The authors pointedthat splitting nitrogen rates into a number of smaller applications in common dallisgrass had little effect on total herbage yield or distribution of DM production compared with single topdressing.

Some explanations for the absence of N response considering the yield in the warm season would be due the low rainfall in summer, January and February (Figure 1), the short interval-30 days between cuttings, the low stubble (5 cm), and the fact of having been the establishment year. Beaty et al. (1980) proposed the last hypothesis verifying the low production of *Paspalum notatum* to nitrogen fertilization increase. They considered that the N acts in the tillering increase and that the restrict growth point number, in recently established plants, limits to N response. Factors that reduce the grass growth, such as frequent harvesting and soil water deficits, reduce the proportion of fertilizer N recovered in the herbage (MORRISON et al., 1980).

There are few studies about fertilization response of native plants and there are doubts about the nitrogen use efficiency. Previous research has found that in a natural pasture the fractionation of N in doses equal or lower than 100 kg N/ha/yr does not benefit DM production (SILVA et al., 1996). *Paspalum regnelli* Mez. did not respond to increasing from 100 to 300 kg N/ha but the yield was higher in relation to the absence of fertilization (PRIMAVESI et al., 2008). ´t MANNETJE & SHAW (1972) obtained linear response to N (0 to 336 kg N/ha/year) in *Paspalum plicatulum.* The mean response was 23 kg/ha/year/kg N and it was related to summer rainfall. TOWNSEND (2008) verified no nitrogen response of a *P. guenoarum* Arechav. biotype in the first year and better productions in the following year. However, he observed a quadratic response to 360 kg N/ha (4 x 90 kg/ha) in *Paspalum lividum* Trin. ex Schltdl., species with similar growth habit to prostrate dallisgrass.

In this study, there was an expressive and positive effect of N in horizontal spread by stolon elongation. In the future, studies about the biomass allocation in stolons could help to elucidate the prostrate dallisgrass response to N. Nabinger et al. (2003) observed that *P. notatum* var. *latiflorum* Döll allocated in root and rhizomes, 15, 30, 39 e 54% when submitted to 38, 75, 150 e 300 mg N/pot, respectively. Santos et al. (2005) verified in the same species and *P. lividum*, allocation of 65 e 84% in roots, rhizomes and stolons. This suggests that the underground system and stolons are important sinks in *Paspalum* spp.

The total production (7,300 kg DM/ha/year) obtained along eight months was similar to the one related by Venuto et al. (2003) in the USA, 7,000 and 11,300 kg DM/ha/year with 150 kg N/ha/year. In spite of the decrease in summer rainfall, the prostrate dallisgrass showed excellent persistence and growing during that time (Figure 6). The maximum regrowth rate (56 kg DM/ha/day) occurred in mid summer, which suggests a good tolerance to low rainfall (Figure 1). In this season, there was an intense flowering and the highest growth rate was due the culm elongation. The regrowth rates were similar to found in other studies. Cassidy (1971) obtained growth increases when nitrogen at 224 kg/ha was applied during early summer in a pasture composed by dallisgrass, *Axonopus* spp. and white clover. The growth rate of dallisgrass increased from 7.8 to 56 kg DM/ha per day when applied at the top of its growing season.

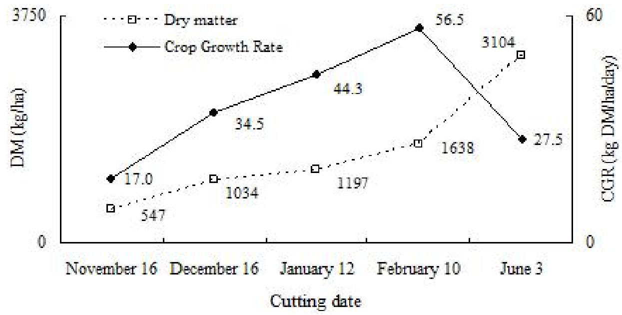

Figure 6- Seasonal dry matter and crop growth rate (CGR) of prostrate dallisgrass in the nitrogen dose average.

Skerman & Riveros (1992) referred that 89 kg N/ha applied in early autumn increased the DM production from 39.2 to 54.9 kg/ha per day and in late fall, from 20.2 to 31.4 kg/ha per day. The use of strategic applications of nitrogen to paspalum can thus play an important role in extending the grazing season of this grass.

The production obtained in the fall (3,479 kg DM/ha) in this study, considering that it was based in the residual nitrogen, indicates the species as a good option to stockpiled forage in this critical season. The chemical analysis showed a good crude protein content and above minimum limit to ruminants (7%), considering the 113 days regrowth in this season (Table 1). The effect of stockpiled on DM yield and

Table 1 - Chemical composition (DMC= dry matter content) of prostrate dallisgrass in the nitrogen dosis average

Harvest time	DMC	CP	ADF	NDF	Hemice-lluloses
			%		
Spring					
November 16th	23.0c	15.9a	40.3c	69.0b	28.7c
December 16th	26.9b	13.8b	41.9b	72.9a	31.0b
Summer					
January 12th	24.7c	14.3b	41.0bc	73.5a	32.4a
February 10th	27.8b	14.5b	41.7b	71.8a	30.0bc
Fall					
June 3rd	32.8a	12.2c	43.4a	66.2c	22.7d

Means followed by the same letter in the column do not differ by Tukey test at 5%.

chemical composition of *Paspalum* genotypes during dry season was evaluated an experiment conducted in Porto Velho, Brazil (COSTA et al., 2009). The data indicated the feasibility of differing grazing of the genotypes during the rainy season to provide forage for herd supplementation in the dry season.

The low fall-NDF of harvested forage in relation to the spring and summer was a result of absence of inflorescences and it was composed only of vegetative culms + leaves (Figure 7). The good forage production and chemical composition in the fall recommend its use in stockpile management.

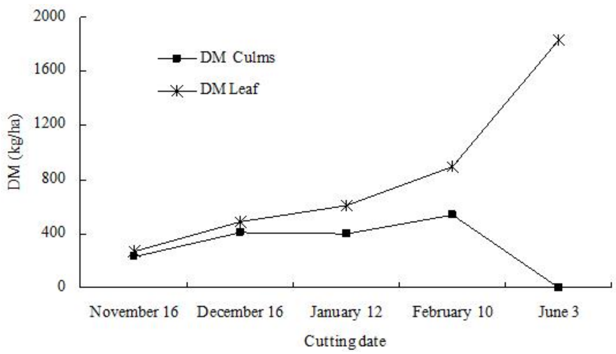

Figure 7- Seasonal dry matter production of leaf and culms of prostrate dallisgrass (Spring-Summer= November to February; Fall= June).

Nitrogen fertilization increased the crude protein and decrease ADF content (Figure 8), which was in accordance to Hart & Burton (1966). The nutritive value is similar to the related one by Venuto et al. (2003) with the same species. In Passo Fundo, Brazil, Baréa et al. (2007) pointed between 10.7 to 18.6% (CP), 66.4 to 71.8% (NDF) e 40.6 to 46.8% (ADF) to dallisgrass biotype Virasoro. In *Paspalum regnelli* nitrogen fertilization increased CP content from 12.7 to 17.3% (PRIMAVESI et al., 2008).

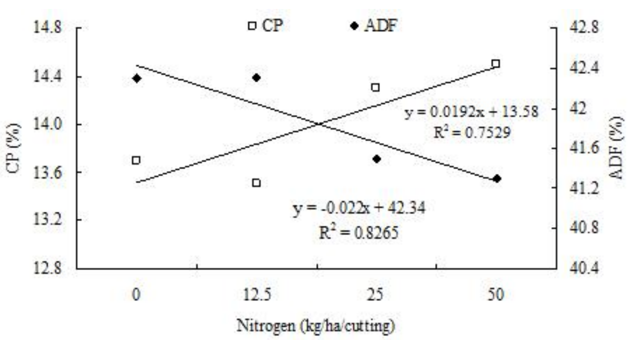

Figure 8- Crude protein and acid detergent fiber of prostrate dallisgrass in the period average.

The biomass allocation explained the good chemical composition (Figure 9) as approximately two-thirds of the protein in forage is in the leaves. Prostrate dallisgrass was superior in relation to Virasoro dallisgrass (BARÉA et al., 2007) which showed smaller leaf contribution (28-32% in spring).

Besides the preliminary evaluation, nitrogen fertilization of prostrate dallisgrass improves the plant establishment and nutritive value, as well the leaf dry matter yield in the fall. The good forage production and chemical composition in the fall indicate its use in stockpiled management. Prostrate dallisgrass has attributes that recommend its inclusion on the breeding program as a good leaf contribution, adequate chemical composition to ruminants, good tolerance to dry weather and low temperature. However, it is important other studies in order to evaluate the response to nitrogen, production and persistence at long term.

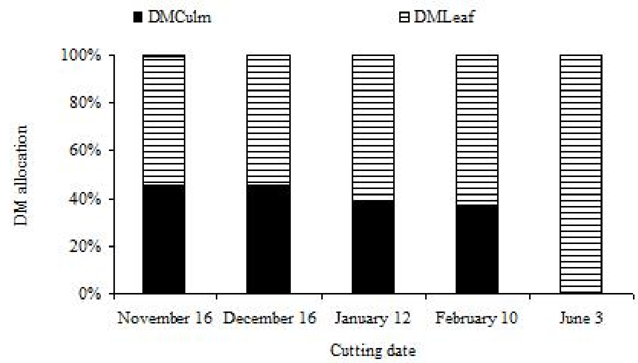

Figure 9- Seasonal dry matter allocation of prostrate dallisgrass in the nitrogen dose average.

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