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Bibliographic Review

Produção e composição química do capim elefante cv. pioneiro em diferentes alturas de resíduo – revisão de literatura

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Resumo

O trabalho tem como objetivo revisar trabalhos que avaliam as características agronômicas do capim elefante (*Pennisetum purpureum,* Schum) originário do continente africano, apresenta diversas maneiras de utilização, como feno, pastejo, silagem e capineira. Além do destaque pela produção de matéria seca por unidade de área, apresenta-se disseminado em diversos territórios brasileiros, sendo possível observar a produção da cultura, por resistir a condições climáticas adversas, porém com média exigência de fertilidade do solo. Quando bem manejado pode apresentar média de produção de fitomassa fresca de 300 Mg ha^{-1} sendo mais comum encontrar médias entre 20-35 Mg ha^{-1}. O método de plantio é por mudas, podendo ser feita em sulcos ou através de covas. Por apresentar crescimento cespitoso apresenta rápida elevação do meristema apical, ficando susceptível ao corte durante o pastejo, sendo um dos maiores insucessos da cultura. O capim elefante de forma geral apresenta altos teores de fibra na sua composição, tanto para fibra em detergente neutro como para fibra em detergente ácido, sendo 72,3% e 46,5% respectivamente em média, percebe-se que FDN e FDA aumentam com o avanço da idade, papel inverso ocorre com a quantidade de proteína bruta da forrageira, que diminui com o avanço da idade de rebrota.

Palavras chaves: épocas de colheita, proteína bruta, estrutura física da forragem, teores de matéria seca

Production and composition of chemical elephant grass cv. pioneer in different heights of waste - literature review

Abstract

The work aims to review studies evaluating the agronomic characteristics of elephant grass (*Pennisetum purpureum,* Schum) originating in Africa, it has several ways to use as hay, grazing, silage and capineira. Besides the attention for the production of dry matter per unit area is presented disseminated in several Brazilian territory, being possible to observe the production of culture, for resisting adverse weather conditions, but with average soil fertility requirement. When well managed can present fresh weight average production of 300 Mg ha^{-1} is more common to find averages between 20-35 Mg ha^{-1}. The planting method is by cuttings and can be done in grooves or through holes. By presenting cespitose growing has rapid rise of the apical meristem, getting cleavable during grazing, one of the biggest failures of culture. The elephant grass generally has high fiber content in its composition, both neutral detergent fiber as to acid detergent fiber, 72.3% and

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46.5% respectively on average, one realizes that NDF and ADF increase with advancing age, inverse role is with the amount of crude protein of fodder, which decreases with increasing age of regrowth.

Key words: crude protein, dry matter content, harvest season and physical structure of forage

Producción y composición química del pasto Elefante cv. Pionero en diferentes alturas de residuos - revisión de literatura

Resumen

El trabajo tiene como objetivo revisar los estudios que evalúan las características agronómicas del pasto elefante (*Pennisetum purpureum, Schum*) originario de lo continente africano, que tiene varias maneras de utilización como heno, pasto, ensilaje y capineira. Además del destaque por la producción de materia seca por unidad de área. Se presenta diseminado en varias partes del territorio brasileño, siendo posible observar la producción de la cultura por resistir a las condiciones climáticas adversas, pero con necesidades medias de la fertilidad del suelo. Cuando bien gestionada puede presentar una producción promedio de biomasa fresca de 30 Mg ha^{-1}, siendo más común encontrar promedios entre 20-35 Mg ha^{-1}. El método de siembra es por esquejes y se puede hacer en surcos o cuevas. Por presentar el crecimiento cespitoso tiene una rápida elevación de meristemo apical, siendo susceptible al corte durante el pastoreo, siendo este uno de los mayores problemas de la cultura. El pasto elefante en general, tiene alto contenido de fibra en su composición, tanto de fibra detergente neutro en cuanto a la fibra detergente ácido, 72,3% y 46,5%, respectivamente, en promedio, se percebe que FDN y FDA aumentan con el avanzo de la edad, papel es inverso ocurre con la cantidad de proteína cruda de la forraje de, que disminuye al aumentar la edad de rebrote.

Palabras clave: tiempo de la cosecha, proteína cruda, la estructura física del forraje, contenido de materia seca

Introduction

Brazil is a country of vast territory, with cultivable area of 366 million hectares, of which 40% of that total area is devoted to cultivation of various forage species in varied climates and soil types, so that livestock is predominantly is the basis of such fodder, consequently it is important to study these species, both in economic terms as scientific.

The elephant grass (*Pennisetum purpureum,* Schum.) has good climate adaptation and has been used extensively by many producers, both in the form of capineira as grazing regime. Shows continued growth with advancing age or even have plants over 3 feet tall.

However, when used in grazing regime, its growth habit can limit its use due to rapid elongation and maturation of the stem, often reaching to heights beyond the reach of animals. And some of the crucial points for the successful management of this kind would be to maintain the greatest possible number of points of growth and herbage accumulation within the limits of reach of the animals, ensuring that do not compromise the pasture persistence (VEIGA, 1994).

There is close relationship between the production of dry matter per hectare and plant management time, and as it promotes the increase in waste high, there is a decrease in production due to reduced harvest efficiency. However, as there is a greater recovery sheets, improvements in nutritional quality of biomass (EZEQUIEL e FAVORETTO, 2000).

The variation of the residue height can also influence the quality of harvested forage. According to VAN SOEST (1982), the closer to the ground cuts the fiber neutral detergent tend to be higher because of the greater amount of fibrous material removed. Still, it is expected to find lower fiber content, acid detergent fiber and neutral detergent farthest residues were ground due to the higher proportion of leaves in relation to the stem fraction.

Forage with very low residual height present fiber neutral detergent over 60% crude protein and low of 6% under the conditions of capineira, providing smaller particle passage rate, which leads to increased filling of the rumen (Forbes, 1995), as well as reduced dry matter intake (CHILIBROSTE et al., 2000).

Because the elephant grass be used to cut most of the time, some researchers differ on recommendations by the height of the waste to be adopted. GOMIDE (1997) recommends cut manually or mechanically residue with 20-30 cm tall. According MOZZER (1993), the best time of residue will always be close to the ground, given that the low cut is responsible for more vigorous plant growth, since higher courts leave much residue, hinder the subsequent cuts; Furthermore, auxiliary buds, exhibit intense after cutting shoots, although very weak. Nevertheless, WERNER et al. (1966) found better results using higher courts (60-70 cm).

In addition to identifying the most appropriate waste time, harvest time is a factor that can interfere with the force of regrowth (Andrade &Gomide, 1971) and number of tillers (VIANA et al., 1979).

SALES et al. (2014) working with elephant grass cv. Pioneer with two residue heights (30 and 50 cm) and two light traps (95 and 100%), recommends cutting 50 cm from the ground to light interception 95%. Wijitphan et al. (2009) evaluated four different cutting heights (0, 5, 10 and 15 cm), recommended residual height of 15 cm and 35-day interval between cuts. Since COSTA et al. (2006) found that residue 15 cm reconciled better quality and biomass production, were analyzed three different heights (0, 10, 15 cm).

Thus, the objective of this study was to conduct a literature review of the different residues were the elephant grass management associated production and nutritional quality.

Development

Botanical and classification of elephant grass

Elephant grass is originally from Africa, with the highest genetic variability territories regions of Guinea, Mozambique, Angola, Zimbabwe and southern Kenya, where there are fertile valleys, with annual rainfall of 1000 mm (BRUNKEN, 1977). It is a grass of great importance since it presents with high production, and several ways to use as hay, grazing, silage and capineira (VILELA, 2009).

The first botanical description was the date 1827 (TCACENCO and BOTREL, 1997), but over time his rating has gone through several changes, and now the elephant grass belonging to Graminae or Poaceae, subfamily Panicoideae, Paniceae tribe, gener Pennisetum, species *P. purpureum*, Schumacher and Penicillaria section (PEREIRA et al., 2001).

Napier grass has erect stems arranged in clumps or not, which are filled with a juicy parenchyma, to 2 cm in diameter, with internodes of up to 20 cm, with dark or pale green leaf, inflorescence with silky panicles 15 cm long on average and can reach 3 to 5 meters tall when present in a natural habitat. Presents spikelets bifloradas, equipped with two flowers or groups of two flowers. Presents development of air and basal tillers, forming dense clumps, but are not able to cover the soil (JACQUES, 1994).

QUEIROZ FILHO et al. (2000) under score the prominent position for the production of dry matter (DM) per unit area and is widespread throughout Brazil, by withstand harsh weather conditions such as moderate drought and cold.

Agronomic characteristics and management

According VILELA (2009) is a plant that requires soils of medium to high fertility, sensitive to cold, and does not tolerate high humidity with soil. The great annual rainfall is 1,500 mm, highlighting the importance of distribution throughout the year, as the forage has low resistance to drought and the land where there is predisposition to waterlogging. However, NASCIMENTO et al. (2008) point out that the species has great environmental resistance to inclement weather and also the different types of management, determining their productive potential.

The optimum temperature for the forage varies between 25 and 40°C, the minimum temperature is around 15°C. The indicated altitude ranges from sea level to 2,000 m, and the limit latitude is 10°N and 20°S (VILELA, 2009).

The elephant grass is a forage crop fairly resistant to disease, but *Helmintosporium sacchari* is a foliar disease caused by fungi that cause white spots with oval and elliptical shape, which can damage the culture (VILELA, 2009). With regard to pest attack, the leafhopper pastures (*Liturata Mahanarva*) is the major insect pest that brings harm to the elephant grass, making occurs decrease in production rates (AUAD et al., 2006).

When well managed can present average production of fresh biomass 300 Mg per hectare per year, and more common to find average dry matter yield between 20-35 Mg per hectare per year (MOSS 1964).

LIMA et al. (2010) state that is a perennial forage, high-potential dry biomass production and

chemical composition, as well as being currently being touted as solution for better animal's diet and increase production.

The forage dry matter production has low digestibility in winter, because it contains high levels of nondigestible fibers (JACQUES, 1994).

Culture implantation

Napier grass has the required specifications spacing, pits of size and quality of seedlings. According VILELA (2009), soil preparation should be done by eliminating lumps and stumps, with subsequent plowing and harrowing, making the homogeneous soil. Soil testing at this time, it is extremely important to ensure the development of culture, making the necessary corrections, and planting can be done by hand or using machinery.

The planting method determines the cost of implementation as well as the layout and plant population in the area. It can be made into grooves or through holes. When the choice is made by planting furrows, ALCANTARA and BUFARAH, (1983), report that these should have a depth of 10 to 15 cm, placing the stem in a standing position with tip.

The spacing between grooves has been described in up to 1.2 meters (JACQUES, 1994). There are more recent studies recommend that the smallest spacings from 0.5 to 1.0 m between rows (GOMIDE, 1997). However, MACHADO et al. (1996) concluded that 0.25 x 0.25 meters between plants in the row has higher production levels in the first cut, crude protein, plant population and canopy closure.

Regarding quality seedlings, MARTINS and FONSECA (1998), infer that the stem should have on average 100 days, already showing lateral buds, but no budding clue. The best seedlings are obtained from the lower 2/3 of the stem, and old seedlings should be avoided, but when used are placed in larger quantities furrow (LOPES, 2004).

Use of forage

Management must take into account the physiological and morphological characteristics of the plant. SANTOS (1995) explains that plants with cespitose growth habit, such as elephant grass, characterized by having rapid rise of the apical meristem, which is extremely cleavable during grazing. With the elimination of the apical meristem, the regrowth decreases, reducing production and increasing the chances of invasion by weeds. When the apical meristem is preserved, regrowth is faster than when it is expected the development of lateral and basal buds. A major crop failures is constant elimination of apical meristem.

Another important physiological feature of this plant is its tillering habit. All tillers grow together, seven days after cutting, thus having all the same physiological age (CORSI, 1972).

The tillers laterals arising from these gems are called side tillers and its main feature the lowest elongation rate of the stem, which means small increase in apical meristem. Because of these conditions, there is hardly elimination of apical meristem. Therefore it is recommended that during the first cut occurs the removal of the apical meristem so that there is the development of lateral buds (SANTOS, 1995).

Waste of time related to the fresh biomass production and dry

Because the elephant grassbe used for foraging in most cases, there are differences as to waste the time of recommendations to be adopted.

SANTOS et al. (2001a) evaluated four different residue heights (0, 15, 30 and 45 cm) and two harvest seasons (rainy season and dry season), in northeastern Brazil using elephant grass cv. Roxo. The authors found significant effect of the residues were in relation to the production of total fresh weight (17.17 Mg ha^{-1}), total dry matter (3.31 Mg ha^{-1}) and culm dry biomass (1.0 t ha^{-1}), the results presented by the authors showed that the extent to which the waste is increased when there is a reduction in biomass production. It was also demonstrated that when the residue was 0 cm to the soil occurred a greater production of dry matter compared to residues 30 and 45 cm, reaching a 33% reduction in annual production of fresh biomass and 60% for the production of dry matter of the stem, but in that work the nutritional quality of the collected material has not been evaluated.

MOTA et al. (2011) observed that with residual height of 50 cm and light interception of 95% produced an average of 10.9 Mg dry matter per year when evaluated several cultivars. These same authors could observe that the height of waste and frequency of harvest intensely influenced the productivity index and nutritional pasture values.

When referring to the elephant grass, is important to stress the relevance of this kind as

the residue of height and range of cuts, since these two parameters are interrelated (ACUNHA and COELHO, 1997).

MARTINS (1969), points out that when using frequent cuts, they should be made the highest, and when the intervals between cuts are less frequent, we obtain higher yields if they are lower.

COSTA et al. (2006), working with the cultivar Mott in 4 seasons of harvest and 3 residues were observed that with increasing intervals between court there was a significant increase in productive forage production, where the highest values were obtained in 84 intervals with cuts days with an average of 27.78 Mg ha^{-1} fresh weight.

CARVALHO et al. (1972) showed that 75 day intervals showed higher dry matter of residues 15 cm from the ground, while at 45 days intervals, the best response was 30 cm in height residue.

Reviewing literature data (Table 1) on different cultivars of elephant grass and different treatments (residues were and interval between cuts), in relation to the fresh weight and dry production parameters there is a wide range of results.

Were six evaluated by different authors work, and the breadth of result is visible with respect to production of dry matter, being obtained by COSTA et al. (2006) the highest value with an average of 20.80 Mg ha^{-1} of dry matter per hectare at the time of resíduode 15 cm. The lower production was found by DALL'AGNOL et al. (2004), 0.76 t ha^{-1} of dry matter per hectare in the residue 50cm in height.

It is also possible to observe the difference in assessment as to heights ranging from 0 to 45 cm. SANTOS et al. (2001a) working with Roxo with four different heights residue, observed greater production of fresh weight at residue close to the ground, or zero inches, decreasing production according to the increase in waste time even behavior with the production of dry matter. In the study conducted by ACUNHA and COELHO (1997), Mott to grow, there was the same result found by SANTOS et al. (2001a), with higher production of fresh biomass in closer to ground level, but with different results regarding the production of dry matter, which was higher in the distant residue soil, same behavior occurred in studies by other authors reviewed in this work (WIJITPHAN et al., 2009; DALL'AGNOL et al., 2004; SALES et al., 2014; COSTA et al., 2006), which showed higher dry matter yield in more distant waste ground, it is noteworthy that that is currently being evaluated only the production of fresh and dried weights and not the nutritional quality of forage.

Residue height on the chemical composition of the forage

Occurs existing large variation in chemical composition parameters, not only for the elephant grass, but for all forage plants. The chemical composition varies according to several factors, the most important being the species and cultivar, age of the plant, days of growth, defoliation intensity and level of fertilization.

The elephant grass generally has high fiber content in its composition, both neutral detergent fiber (NDF) and for acid detergent fiber (ADF), 72.3% and 46.5% respectively. The evaluation of the fibers, as NDF is related to dry matter intake and ADF is correlated with dry matter digestibility is important (KAYONGO MOLE et al., 1974; CECATO, 1993).

Evaluating the different ages of regrowth (WIJITPHAN et al., 2009; DALL'AGNOL et al., 2004; SALES et al., 2014;COSTA et al., 2006), elephant grass, one realizes that NDF and ADF increase with advancing age, opposite role is with the amount of crude protein forage, which decreases with increasing age of regrowth. This is due to the relationship stem / leaf, since when the plant is younger it has high leaf weight ratio, or has a higher amount of sheet relative to the amount of stalk, and the reverse is also true when the forage becomes older increases the leaf/stem ratio, with higher amount of stem in relation to the amount of sheet (LIMA et al., 2010). According VIRGUEZ (1966), when you have a better relationship stem/leaf, has a genotype of lower productivity and the opposite also occurs, a worse relationship stem/leaf is common in forage that has the highest productivity.

SANTOS et al. (2001b) evaluated four different residues were above the ground, in the chemical composition of elephant grass cv. plant Roxo, dry and wet seasons, there was no significant interaction effect between age and the residues were either with the residues were each other, for all the variables studied.

Table 1. Fresh biomass production (FBP) and dry matter production (DMP) in different work on cutting height.

Authors	Cultivate	Treatment			FBP (Mg ha^{-1})	DMP (Mg ha^{-1})	Average	
		Height residue (cm)	Interval cuts (days)	Number of cuts			FBP(Mg ha^{-1})	DMP(Mg ha^{-1})
	Roxo	0; 15; 30; 45	60; 90	5	20,94; 17,82; 15,88; 14,02	3,75; 3,65; 3,01; 2,82	17,16	3,30
ACUNHA and COELHO, (1997)	Mott	0;10;15	28; 56; 84; 112; 140	5	24,05; 22,45;23,08	4,63;4,41;4,54	23,20	4,53
WIJITPHAN et al., (2009)	King grass	0;5;10;15	70	1	-	5,97; 6,09; 6,33; 6,49	-	6,23
DALL'ÁGNOL et al., (2004)	Camerron	50	21	9	-	0,76	-	0,76
SALES et al., (2014)	Pioneiro	30;50	-	-	-	0,86; 1,26	-	1,06
COSTA et al., (2006)	Mott	5; 10; 15	42; 56; 70; 84	44	-	18,36; 20,86; 23,20	-	20,80
Average	**-**	**-**			**-**	**-**	**20,18**	**6,12**

Source: Prepared by the author

Conclusion

With this study it is possible to point the importance of elephant grass as forage, taking into account the morphological and physiological characteristics of each grow. When handled correctly in the category fertility and waste time, it has a high production capacity of dry matter per hectare, which makes this a great alternative pasture for intensive animal production systems, given the fact that, by its attributes can be used in different regions and climatic conditions of the country.

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