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NUTRITIONAL COMPOSITION OF CUBA OM-22 HYBRID GRASS (Pennisetum *purpureum Schumach x Pennisetum glaucum L.)* AT THREE CUTTING AGES

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Summary

At INIAP's Central Experimental Station of the Ecuadorian Amazon, the nutritional composition of the forage Pennisetum purpureum Schumach x Pennisetum glaucum L was evaluated. (Cuba OM-22) at different cut-off ages (30, 45 and 60 days). It was availableo 12 plots of 6m2 each of approximately six months of establishment, was used a diseño de bloques comtamente al a zar (DBCA) with three treatments and four repetitions, the variables were subjected to a analysis of variance, the means were evaluated with Tukey's test at 0.05%, in addition a regression and correlation analysis was performed. Allthe variables studied except dry matter and acid detergent lignin presented significant and highly significant differences; at 30 days of cut-off, the highest nutritional values were found, ash (19.04%), ethereal extract (2.84%), protein (14.20%), FDA (34.67%) and FDN (56.29%). It is concluded that in the forage Cuba OM-22, at 30 days of cutting age presents the highest nutritional values, however, it is considered necessary an adequate management of the crop to guarantee the agronomic development and the persistence of the crop.

Key words: Forage potential, Cutting age, Nutritional variables, Bromatological analysis.

Summary

Introduction

In the Ecuadorian Amazon Region (SAR), one of the main factors limiting the progress of sustainable livestock production is the low availability and low nutritional quality of pastures (Ramírez et al., 2008). However,in recent years the improvement of the generic area has generated forage varieties that have adapted to the environmental conditions of different ecosystems (Guaicha, 2015). The Institute of Animal Science of Cuba through the genetic improvement program obtained new varieties of the genus *Pennisetum* with characteristics superior totheirparents (Martínez et al., 2010). One of the forages generated and that has entered Ecuador is the Cuba OM-22, a grass that has generated interest in farmers due to the agronomic and nutritional characteristics presented in other countries with a warm climate. Cuba OM-22

comes from an in vitro cross between Cuba CT-169 (Pennisetum *purpureum Schumach*) and Millo perla (*Pennisetum glaucum Tiffton Late*) (Palma and Raudez, 2018).

The Cuba OM-22 is a promising species, which can increase the number of larger livestock units (LU) per unit area (Nieto and Caicedo, 2012), therefore the nutritional value of forages is a transcendental factor, since it should cover the requirements of animals and thus obtain great productivity (Trujillo and Uriarte, 2009). The bromatological composition was established due to the fact that the effectiveness of the feed value of animals depends on the chemical composition of the food they eat, the principle of this analysis is to determine the content of dry matter, ether extract, crude protein, ash and fiber in the feed (Mcdonald, 1995 cited by Janeta, 2015).

The content of the cell walls of grasses is determined by techniques with detergents developed by Van Soest, where they separate the plant cell into fractions such as detergent fiber acidad (FDA) and neutral detergent fiber (FND), the first is part of the cell wall composed of cellulose and lignin, while the second fraction is composed of all the components of the cell wall plus hemicellulose (Ribeiro & Moreira, 2000 cited by Janeta, 2015).

Most cattle ranchers in the Ecuadorian Amazon do notknow the nutritional value of forages at harvest, but rather use it according to the amount of biomass produced (Barén and Centeno, 2017). However, the age of defoliation influences forage yields. The long periods of cutting cause a deficit in the nutrition of ruminants since the availability mainly of protein and soluble carbohydrates is relatively low, in addition there is greater accumulation of fiber and consequently decrease in nutritional value and consumption; and The content of cell walls and other indigestible fractions increases and therefore digestibility decreases (Costa et al., 2007).

Due to the lack of knowledge of the nutritional value of the hybrid Cuba OM-22 in the Amazon Eregion, there is a need to assess the nutritional composition at three cutting ages (30, 45 and 60 days) and thus determine the ideal harvest age, which allows to offer the animals, f Ores with high nutritional values, which contribute to a better productivity of livestock.

Materials and methods

The study was conducted at the Central Experimental Station of the Ecuadorian Amazon (EECA) of the National Institute of Agricultural Research (INIAP), located at 285 meters above sea level (6°52'35.87" W, 0°21'20.63" S,) in the canton Joya de los Sachas, province of Orellana, Ecuador. TheECA E is located in the tropical humid forest zone, with an average annual temperature of 24°C, an annual rainfall ranging from 3000 to 4000 mm, a relative humidity of 91.5%, flat to almost flat topography a , clay loam soil with an average level of fertility and two to four percent organic matter (IGM, 2019).

The experimental units were made up of 12 plots of 6 m ^{2} each, approximately 6 months of establishment. We worked with threetreatments and four repetitions.

The effect of three cut-off ages 30, 45 and 60 days on Cuba OM-22 grass was evaluated; for this purpose, a fully qualified Block A (DBCA) design was used, the assay was adjusted to the following additive linear model:

$Yij = \mu + Ti + \beta j + €ij$

Where:

Yij = Value of the parameter in determination.

μ = Media general.

Ti = Effect of the i-ésimos treatments.

βj = Effect of the j-th blocks.

€ij = Error effect.

In theproximal analysis was determined dry matter, p rotein, ceniza, f ibra and exether tract (%), in the análisis of paredes cellular networks identified the fibra acid detergent, neutral detergent fiber, lignin acid detergent (%). The results were analyzed with an analysis of variance and the comparison of means was made with Tukey's test at 0.05, the statistical package InfoStat 2018 was used.

The weeds existing inthe plots were removed manually 15 days after the equalization cut and after each cut made. For the nutritional analysis we worked with four blocks per treatment, homogeneous samples (1 kg) were taken in each cut of the complete plant. The forage samples were transported to the food quality laboratory of the INIAP-EECA, where they were previously chopped, wrapped in paper bags and dried in an oven at 65 ° C for 48 hours and then ground to a diameter of 1 mm for proximal analysis (humidity, ash, protein, fat, fiber %) and cell walls (acid detergent fiber%, neutral detergent fibre %, Lignin acidic detergentto %).

Proximate analysis, %

The bromatological analysis was performed based on the methodology described in volumes I and II of the AOAC (2012) 19th edition. The dry matter was determined with the help of a Mermmert SN 55 forced air stove at 65 ° C to obtain a constant weight (934.01), crude protein by the Kjeldahl method (979.09), by the gravimetry method ash (942.05), crude fiber (962.09) and ethereal extract (2003.06) were determined.

Analysis of ***cellular networks, %***

The determination of p aredes cellular was executed por means of gravimetry. For this purpose, Van Soest's scheme, described in volume I of the AOAC (2012) 19th Edition, was used. Acid detergent fibre and lignin using method number 973.18, while neutral detergent fibre using method 2002.04.

Results and Discussion

Dry matter, %

In the dry matter analysis of the Cuba OM-22 hybrid, there were no significant differences ($P > 0.05$) between the cut-off ages (Table 1) but numerical differences, with the highest content in the plots cut at 45 days with 12.91 %.

Table 1. Nutritional assessment of the hybrid grass Cuba OM-22 (Pennisetum *purpureum Schumach x Pennisetum glaucum L.*) at different cut-off ages.

VARIABLES	CUT-OFF DAYS								
	T1		T2		T3		E.E.	Prob.	Itself.
Dry matter %	12,85	a	12,91	a	12,14	a	0,07	0,6800	ns
Protein %	14,20	a	9,07	b	11,38	ab	0,66	0,0043	**
Ethereal Extract %	2,84	a	1,99	b	2,00	b	0,16	0,0136	*
Ash %	19,04	a	18,26	a	16,19	b	0,47	0,0124	*
Fiber %	28,42	a	32,05	b	32,20	b	0,67	0,012	*
FDN %	56,29	a	59,39	b	61,68	c	0,65	0,0032	**
FDA %	34,67	a	37,09	b	39,15	c	0,24	0,0001	**
LAD %	5,65	a	4,43	a	6,18	a	0,14	0,2217	ns

T1 (30 days cut); T2 (45 days cut); T3 (60 days cut)Prob. > 0.05, no statistical differences; Prob. ≤ 0.05, there are significant differences; Prob. ≤ 0.01, there are highly significant differences. Means with different letters in the rows differ significantly according to Tukey (P<0.05);E.E. (Standard Error); Prob. (Fisher's probability); Sig. (significance). FDN (Neutral Detergent Fiber); FDA (Acid Detergent Fiber); LAD (Lignin Detergent Acid)

The values found are slightly lower than those reported by Ramírez et al., (2008), who mention that the hybrid Cuba CT-169 in a rainy period has a dry matter content of 13.30% at 30 days and 13.52% at 45 days of harvest; and higher than those mentioned by Araya and Boschini (2005) that reported in the King grass at 70 days of regrowth 10.63% of dry matter in the whole plant; this allows us to affirm that the dry matter content of the whole plant of Cuba OM22 is within an acceptable range, although its moisture content is constant because the whole plant was analyzed and this perhaps influenced this parameter, as well as the climatic conditions presented in the RAE before each evaluation.

Protein, %

Table 1 shows that the protein content presents highly significant statistical differences (P< 0.01), reaching its maximum level at 30 days of cut-off (14.2%). In the study conducted by Chacón and Vargas (2009) King grass reached 9.56% crude protein at 60 days of regrowth, while Barrón et al., (2009), obtained 8.67% protein in the same pasture at the eighth week. The percentages reached in the last cut in the hybrid under study are above those reported by the authors, due to the nutritional characteristics of Cuba OM-22, crop management or the influence of the environmental factor. In this same topic, Valenciaga et al., (2001) mentions that the clone Cuba CT-115 at 65 days of regrowth reached a protein content of 11.38% in the whole plant, this value being equal tol reported at 60 days of cut in Cuba OM-22. Therefore the percentage of protein of this forage is interesting in conditions of the RAE.

Graph 1 shows that the protein content presents a highly significant quadratic model regression that deduces that, starting from an intercept of 46.76%, the protein content decreases as the age of regrowth advances by 1.58%, to finally increase by 0.02% of protein in lor higher of the harvest period; In addition, there is a coefficient of determination of 75.28% and a correlation of 0.86, which means that as the harvest time elapses the protein content will be affected by 75.28% and the remaining 24.72% will be due to other factors not estimated in this study.

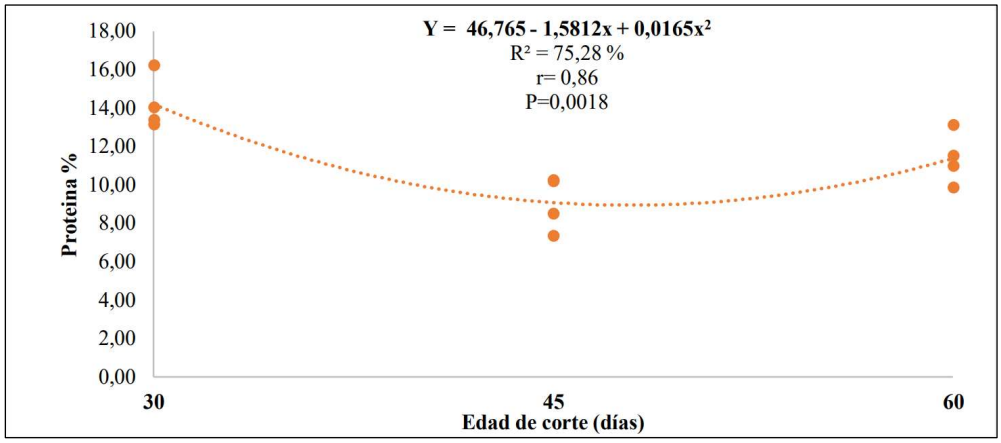

Figure 1. Trend of the cut-off age with respect to the protein content of Cuba OM-22

Ether extract, %

Table 1 shows that thepercentages of fat in the different ages of cutting the Cuba OM-22 grass present significant differences (P< 0.0 5), between the treatments, highlighting thatat 30 days of cutting there is the highest percentage (2.84%), a value similar to those reported by Barén and Centeno (2017) who obtained in the same species of grass 2.98% and 3.08% fat at 45 and 60 days of cutting rspectively.

In their study, Barén and Centeno (2017) obtained in the Cuba OM-22 clone at 45 and 60 days of cutting a fat percentage of 2.98% and 3.08% respectively. Chacón and Vargas (2009), indicate that King grass shows a reduction in the ethereal extract fraction when reaching maturity, presenting at 60, 75 and 90 days of regrowth 1.41%, 1.37% and 1.29% relatively. The data presented above are similar to those of this research, the slight variations in fat content are due to the difference between the harvest ages of the forages in addition to the conditions of the environment in which these studies were carried out.

In the regression analysis, a second model was established, which was highly significant. The regression coefficient was 74.93% and the correlation coefficient was 0.86, that is, 25.07% depends not on the cut-off age but on other factors outside the study. The equation $Y = 7.09 - 0.1988x + 0.0019x^2$, deduces that, starting from an intercept of 7.09% fat is reduced by 0.19% until day 45 and then increases to 0.0019% until day 60.

Ash, %

The ash content or mineral fraction of the entire plant of Cuba OM-22, registers significant differences (P< 0.05), between treatments (Table 1), witnessing the highest ranges at 30 and 45 days of regrowth with 19.04 % and 18.25 % of ashes respectively. The mineral content decreases with the age of the grass because it occurs in greater quantities in young cultivars and in the growth stage, especially in leaves, young shoots and root extremes; the mineral decrease as the grass ages is related to its vegetative development, that is, because of the lower presence of leaves on the stems (Ramírez et al., 2008), which is ratified by Chacón and Vargas (2009), in their research carried out on King grass at various ages of regrowth.

According to the regression analysis regarding the percentage of ashes, it has a highly significant linear trend, which infers that, starting from an intercept of 22.11%, the mineral part is reduced by 0.09% as the state of maturity of the forage increases. A correlation coefficient of 66.99% is presented, which means that the remaining 33.01% depends on other factors; There is also a correlation coefficient of 0.81.

Fibre, %

The values reached in the fiber fraction according to the cut-off age, presented significant differences (P< 0.0 5) (Table 1), the highestfiber content was manifested in the mean of T1 (30 cut-off days) with 28.42%; The fiber increases as the age of regrowth advances, this coincides with studies carried out in different forage species. The fiber fraction is considered an indicator of nutritional quality, which is why pastures with lower content of this fraction are more digestible and consumed than pastures with a higher amount of fiber (Sánchez, 2007).

Carrasco et al., (2002), when comparing two grazing rest times in the hybrid CT-115 (Pennisetum purpureum) in a little rainy period obtained 31.74 and 34.42% of crude fiber at 45 and 60 days. In their study, Barén and Centeno (2017) indicate that Cuba OM-22 has 32.19% and 34.77% crude fiber at 45 and 60 days of regrowth in their order. Ramírez and Pérez (2006), mention that maralfalfa grass at 45 and 60 days of cutting contains 35.61 and 41.49% fiber. In this same topic, Caballero et al., (2016), when evaluating various grasses of the tropics, mention that during a rainy period (60 days of regrowth) the percentage of fiber of king grasses, CT-169 and CT-115 in the part of the leaves and their stems were 36.88%, 40.72%; 37.95%, 39.50% and 36.67%, 39.61% respectively.

The fiber content obtained in the three cutting ages in Cuba OM-2 are below those reported by the authors, due to the bromatological characteristics of the cultivar, this demonstrates the nutritional quality of this hybrid since this fraction causes the synthesis of structural carbohydrates to increase and the digestion coefficient is affected.

A highly significant quadratic regression was also determined, which has a regression coefficient of 72.28% and a correlation of 0.85. This regression indicates that starting from an intercept of 10.72%, the fibrous content increases by 0.82% after 45 days, and finally decreases to 0.007% of fiber after 60 days of cutting.

Neutral Detergent Fiber (NDF), %

Table 1 shows that there are highly significant statistical differences (P< 0.01) between treatments. The best percentage of FDN (56.29%) corresponds to T1 (30 days of cut) since the digestibility coefficient is reduced when there is a higher content of this fraction; which is corroborated by (Elizondo, 2017) who states that the increase in the content of FDN in The course of the harvest age is due to the decrease in the number of leaves on the stems. However, the average values of the FDN fraction obtained in this study are lower than those reported by Chacón and Vargas (2009) who found levels of 73.78% at 60 days after cutting King grass (Pennisetum purpureum cv.) . However, it is proposed that the inferiority of the FDN fraction in the Cuba OM-22 grass is mainly due to the nutritional goodness of the hybrid, the environmental factor (climate, soil) and the management of the crop.

In the regression analysis, a highly significant linear trend is established, which infers that, starting from an intercept of 51.03%, the neutral detergent fiber (NDF) rises by 0.17% for each unit of change (cut-off days), also shows a high coefficient of determination of 81.50% and a correlation of 0.90 between the NDF and the age of regrowth, That is to say that the remaining 18.5% depends on factors unrelated to this research.

Acid Detergent Fiber (FDA), %

In the FDA's analysis of variance of Cuba OM-22, there were highly significant statistical differences (P< 0.01) between ages; the lowest FDA content was found in the 30-day plots with 34.67% (Table 1). There is an increase in FDA as the harvest age of the forage advances, as in the case of FDN; this similar behavior (increase according to the age of regrowth) occurs because the FDA component plus hemicellulose is part of the neutral detergent fiber (FOSS, 2018) and therefore shows the same event. With what happened, it can be affirmed that this is due to the ontogenic processes of the grass, which affect the bromatological composition and cell walls (Chacón and Vargas, 2009).

The regression analysis, the acid detergent fiber fraction of the Cuba OM-22 grass and the different ages of regrowth have a highly significant linear trend that interprets that, starting from an intercept of 30.25%, the FDA rises by 0.14% for each unit of change until 60 days of cut. In addition, a coefficient of determination of 95.76% and a high correlation index of 0.97 were achieved, that is, the remaining 4.24% depends on other factors that are not related to the cut-off age.

Lignin Acid Detergent (LDA), %

The analysis of variance reported no statistical differences between treatments (P>0.05) (Table 1). However, there is an increase in the fractions FDA and FDN with passing the age of regrowth, but thisdid not happen in the LDA, although the values between the cut-off ages are not very distant. Ramírez et al., (2008) indicates that the Cuba 22 hybrid until a certain age (90 days) stores little lignin like the clones CT-115 and CT-169 unlike the rest of the pastures of the genus Pennisetum, which makes Cuba OM-22 a great option to be used as a forage bank since the lignin content is an indicator of forage digestion.

Similar results were reported by Fortes et al., (2012) who found that the lignin content of Cuba CT-115 during two months of evaluation did not present much difference, having in the part of the leaves 4.3% at 30 days and 5.7% at 90 days, with an increase of 1.4% during the evaluation time; the part of the stems showed 6.1% at 30 days of regrowth and the 6.9% at 90 days, with an increase of 0.8% in LDA at the end of the evaluation period. Valenciaga et al., (2001) state that at 65 days of regrowth the hybrid CT-115 has 4.22% LDA in the stems and 3.97% in the whole plant.

Conclusions

The cut-off age at which the forage Cuba MO-22 presents the highest nutritional value is at 30 days of regrowth registering a protein content of 14.20%, ethereal extract 2.84%, ash 19.04%, fiber 28.42%, acceptable cell walls (56.29% FDN, 34.67% FDA and 5.65% LDA), so to obtain good results in the crop it will be necessary to carry out an adequate management of the meadow that guarantees the agronomic development and the persistence of the crop, and thus make the Cuba OM-22 grass a good forage alternative for the Ecuadorian Amazon Region.

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