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Bauab Brunetti, Henrique; da Rocha Carvalho, Lucas; Barbosa Chiavegato, Marília; Carneiro da Silva, Sila

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Sward structure, light interception and herbage accumulation in forage peanut cv. Belmonte subjected to strategies of intermittent grazing management

Henrique Bauab Brunetti, Lucas da Rocha Carvalho, Marília Barbosa Chiavegato and Sila Carneiro da Silva*

*Laboratório de Plantas Forrageiras, Departamento de Zootecnia, Escola Superior de Agricultura "Luiz de Queiroz", Av. Pádua Dias, 11, Cx. Postal 9, 13418-900, Piracicaba, São Paulo, Brazil. *Autor for correspondence. E-mail: siladasilva@usp.br*

ABSTRACT. Nitrogen fertilization ensures productivity and persistency of pastures, but may be expensive. Perennial forage peanut, becomes an interesting alternative for N supply. Little is known about its use under grazing. The objective of this study was to evaluate regrowth process of forage peanut using an experimental protocol analogous to tropical forage grasses under rotational grazing. Treatments corresponded to two pre- (95% and maximum canopy light interception – $LI_{95\%}$ and LI_{Max}) and two post-grazing (post-grazing heights of 40 and 60% of pre-grazing height) conditions, in a 2x2 factorial arrangement in a randomized complete block design (n = 4). Targets of LI pre-grazing affected pre-grazing height and LI post-grazing. The residual sward LAI did not vary, resulting in similar grazing interval. Greater rates and total herbage accumulation were recorded for LI_{Max} target, consequence of the greater accumulation of stolons at the lower strata of the swards. Greater percentage of leaflets was recorded for the $LI_{95\%}$ target. Given the stoloniferous growth habit of forage peanut, stolon accumulation in the lower strata of the sward do not represent a limitation to leaf accumulation and morphological composition. The greater pre-grazing sward height associated with the LI_{Max} target facilitate herbage prehension and intake, further investigation is needed.

Keywords: intermittent stocking, sward structure, pre-grazing height, botanical/morphological composition, grazing management.

Estrutura do dossel, interceptação de luz e acúmulo de forragem em amendoim-forrageiro cv. Belmonte submetido a estratégias de pastejo rotativo

RESUMO. A adubação nitrogenada assegura produtividade e persistência de pastagens, mas pode ser onerosa. O amendoim forrageiro é alternativa, porém são escassas informações sobre seu manejo sob pastejo. Objetivou-se avaliar o processo de rebrotação do amendoim forrageiro, utilizando procedimento análogo ao utilizado para gramíneas tropicais sob pastejo rotativo. Os tratamentos corresponderam a combinações entre duas condições pré-pastejo (95% e máxima interceptação luminosa pelo dossel – $IL_{95\%}$ e $IL_{Máx}$) e duas condições pós-pastejo (alturas de 40 e 60% da altura pré-pastejo), segundo arranjo fatorial 2x2 e delineamento de blocos completos casualizados (n = 4). A IL pré-pastejo afetou a altura pré-pastejo e IL pós-pastejo. O IAF residual não variou entre tratamentos, resultando em intervalo entre pastejos semelhantes. Maior taxa e acúmulo de forragem foram verificados para a meta $IL_{Máx}$, devido ao maior acúmulo de estolões nos estratos inferiores. Maior porcentagem de folíolos foi verificada para a meta $IL_{95\%}$. Devido ao seu hábito de crescimento estolonífero, o acúmulo de estolões do amendoim forrageiro em estratos inferiores do dossel não comprometeu o acúmulo de folhas nos estratos superiores. Maior altura de entrada nos pastos manejados com a meta $IL_{Máx}$ pode representar maior facilidade de preensão e consumo de forragem, fato que necessita de estudos adicionais.

Palavras-chave: lotação intermitente, estrutura do pasto, altura pré-pastejo, composição botânica/morfológica, manejo do pastejo.

Introduction

Nitrogen is the most important nutrient for plant development. This nutrient integrates essential nucleic acids, amino acids, and the chlorophyll molecule (Stitt & Krapp, 1999). For that reason, nitrogen fertilization in pastures has been used to improve or maintain grasslands productivity. However, nitrogen fertilization has been overused, resulting in high production costs and environmental impacts, such as increase in

greenhouse gas emissions, loss of biodiversity (Schulze et al., 2009; Stoate et al., 2009), contamination and eutrophication of lakes and groundwater (Di & Cameron, 2002). In this context, the use of legumes arises as an alternative to increase N supply, via biological N_2 fixation, which represents a sustainable N addition to production systems. Legumes are high in N content and digestibility, and therefore can increase nutritional value of the consumed forage (Barcellos, Ramos, Vilela, Junior, & Bueno, 2008), potentially resulting in increased animal performance and system productivity (Euclides, Macedo, & Oliveira, 1998).

Forage peanut is a tropical legume (*Arachis pintoi* Krapovickas & Gregory cv. Belmonte) with great persistence in low fertility soils (Bowman & Wilson, 1996), increased productivity, and nutritional value (Villarreal et al., 2005). It has also been recognized for shading tolerance (Andrade, Valentim, Costa Carneiro, & Vaz, 2004), which allows for great performance under mixed grass/legume pastures (Jones, 1993), and high biological nitrogen fixation potential (Miranda, Vieira, & Cadisch, 2003).

Although forage legumes add great value to grasslands ecosystems, little is known about its biology and ecology under grazing. Knowledge on the grazing effects on legumes biology and ecology are essential for determination of grazing strategies that maximize legumes natural growth pathway and perennation, which ensure legumes persistence and productivity, as well as, animal nutritional needs (Silva & Nascimento Júnior, 2007).

Under rotational grazing, recent studies focused on tropical grasses have shown that light interception (LI) is the best criteria to determine ideal grazing events, during regrowth (Barbosa et al., 2007; Carnevalli et al., 2006; Zanini, Santos, & Sbrissia, 2012). Optimal net forage accumulation (i.e. forage production) is obtained when balance between plant death and growth is maximum. This scenario is met when the sward intercepts 95% of photosynthetic active radiation (PAR), during the linear phase of the regrowth curve (Parsons, Leafe, Collett, Penning, & Lewis, 1983). Above the 95% LI target, the sward growth shifts, resulting in increased stem proportion and dead material accumulation (Silva et al., 2009). It has been shown that the LI criteria can be applied based on forage height, which facilitates its use in the field. In addition to the use of 95% LI as a criteria to initiate rotational grazing, the residual height is also of crucial matter.

Residual height is directly related to forage consumption, nutrient intake (Carvalho et al., 2009), and plant regrowth (Silva et al., 2009). Recently, Fonseca, Mezzalira, Bremm, Gonda, and Carvalho (2012) suggested that intake could be maintained at high levels, as far as residual height is kept at 40 to 50% of forage height. Below that threshold, there could be considerable decrease on intake rate, due mainly to difficulty to access lower strata of the sward, resulting in decreased bite mass. If grazing is allowed to post-grazing heights lower than 60%, there could be considerable decrease in intake, negatively affecting animal performance and sward persistence because of the consequent reduction in LAI (Silveira et al., 2013).

In this context, the hypothesis of this study was that, forage peanut cv. Belmont under rotational grazing has growth pattern and leaf area renovation similar to those observed for grass species. Therefore, the use of the LI criteria during regrowth to determine grazing strategies is adequate, and the 95% LI by the sward is the target to determine grazing events. The objective of this study was to assess sward structure, forage accumulation, and forage botanical and morphological composition of forage peanut under rotational grazing.

Material and methods

The study was conducted at the University of São Paulo, College of Agriculture "Luiz de Queiroz", in Piracicaba, São Paulo State. The geographical coordinates of the experimental site are 22º42' South latitude, 47º38' West longitude and 546 m altitude.

Forage peanut cv. Belmonte is from the *Fabaceae* Lindl. Family (i.e. *Leguminosae* or *Papilionaceae*), subfamily *Faboideae* (i.e. *Papilionoideae*), tribe *Aeschynomeneae* and subtribe *Stylosanthinae* (Valls & Simpson, 2005). Forage peanut (*Arachis pintoi* cv. Belmonte) is a perennial tropical legume, herbaceous, stoloniferous from Brazil. It has been commercially used since 1999, after agronomical evaluation performed by CEPLAC (Executive Committee of Cocoa Farming Plan, in Portuguese).

The soil type of the experimental area is Kandiudalfic Euthrudox (EMBRAPA, 2006). Soil analysis at 20 cm depth prior to the experiment showed the following soil characteristics: pH $CaCl_2$: 5.85; organic matter = 41.0 g dm^{-3}; P (ion exchange resin extraction method) = 77.0 mg dm^{-3}; Ca = 87.5 mmolc dm^{-3}; Mg = 50.0 mmolc dm^{-3}; K = 16.3 mmolc dm^{-3}; H + Al = 26.5 mmolc dm^{-3}; sum of bases = 146.3 mmolc.dm^{-3}; cation exchange capacity = 172.8 mmolc.dm^{-3}; base saturation= 84%. The pH and nutrient contents were considered adequate to forage peanut needs, and therefore there was no fertilization (CEPLAC, 2013). Climate at the experimental site was described as sub-tropical with

dry winters, and 1328 mm average annual rainfall (Kottek, Grieser, Beck, Rudolf, & Rubel, 2006). The average daily temperature during the experimental period was considered typical for the study site, based on historical data from 1917 to 2012. Average daily temperatures during the experiment varied from 23°C in April to 27°C in January 2015. Rainfall during the experiment varied from 73 mm in April to 207 mm in February 2015. Rainfall during the last three months of the experiment was similar to expected, based on historical data. However, there was a drought in January, and accumulative rainfall was 90 mm.

In order to avoid stress due to drought, irrigation was applied. The amount of water used was determined based on rainfall, average daily temperature and evapotranspiration. Rainfall was monitored weekly, and in case of rain, the amount of water applied was recalculated to avoid stress related to excess irrigation. Despite irrigation, experimental areas were under drought stress in January, due to technical problems in the irrigation equipment.

Experimental paddocks were established in November 2011, when forage peanut was planted. From September 2012 to March 2014, a series of experiments were conducted in the area, mainly with continuous stocking. From March to October 2014, rotational grazing was introduced, and in November experimental treatments were designed to paddocks. Treatments consisted of different combinations between LI targets (95% and maximum LI during regrowth; $LI_{95\%}$ and LI_{Max}, respectively) and post-grazing heights (40 and 60%). Therefore, the experimental design was a 2 x 2 factorial, with randomized block design established in 4 replicates. The experimental period was from January to April, 2015, which corresponds to an entire summer season, in the study site. There were 2 adaptation periods, prior to the experimental period. From March to October 2014, rotational grazing was introduced for grazing strategy adaptation, and from November to December 2014, paddocks were adapted to experimental treatments. Therefore, there was a total of 9 months of adaptation, which ensured that differences observed during the experimental period were a result of treatments.

Canopy LI was monitored with LAI 2000 canopy analyzer (LI-COR, Lincoln, NE). Initially, LI measurements were taken once weekly until 90% LI was achieved. Once canopy had reached 90% LI, measurements were taken in a daily basis to allow precise determination of LI pre-grazing targets ($LI_{95\%}$ and LI_{Max}). Canopy LI measurements were taken from 10 randomly selected points per paddock. In each point, 5 readings were made at ground level and 1 reading was taken above the canopy (total of 50 readings at ground level). The same equipment was used to determine foliage angle. Sward height was monitored, pre and post-grazing, with a stick graduated in centimeters (sward stick – Murphy) (50 readings per paddock), to ensure precision on post-grazing heights targets (40 and 60%). Grazing was conducted with 200 kg dairy heifers by mob grazing method according Gildersleeve, Ocumpaugh, Quesenberry, and Moore (1987).

The forage mass, forage accumulation, and forage botanical and morphological composition were evaluated during two consecutive grazing events in order to characterize the changes in which experimental areas were submitted (i.e. treatments). Forage mass and forage accumulation were determined based on pre and post-grazing samples. Forage botanical and morphological composition were evaluated with 0.33 m^2 (0.90 x 0.37 m) metallic frames, per paddock. Metallic frames were allocated to spots that represented the average sward condition at the time of sampling (based on visual assessment of herbage height). The forage mass within the frames was cut aboveground, stored in plastic bags and sub-sampled to manual subdivision of the following components: weed, dead material, stolon, leaflets, and petiole. Each component was stored separately in paper bags, identified accordingly and oven dried at 65°C until constant weight. Based on the dry weight determined of each component, botanical and morphological composition of forage mass was calculated (kg ha^{-1}). The relationship between leaflet and stolon was calculated through division of leaflets weight by stolon weight. Leaf area index was determined based on the same sample used to determine botanical and morphological composition, on a LI-COR equipment (model LAI-3100). Using leaf dry mass and leaf area from the subsamples the ratio between leaf area and leaf dry mass was calculated. This relationship was used to determine the leaf area of the sample from which the subsample was originated. Leaf area index was calculated based on sample leaf area and sample area. Forage accumulation was calculated as the difference between pre-grazing forage mass, and post-grazing forage mass of the previous grazing cycle, divided by the number of days between grazing cycles, generating the rate of forage accumulation (kg MS $ha^{-1}day^{-1}$). Since just one grazing cycle was used to

calculate forage accumulation, total forage accumulation was obtained by adding the pre-grazing forage mass from the previous grazing to the forage accumulated during the controlled grazing cycle, and the value was presented in kg MS ha^{-1}. The same procedure was done to leaf mass (leaflet + petiole) and to *Arachis pintoi* (leaflet + petiole + stolon) to determine leaf mass and *Arachis* accumulation.

The spatial distribution of each botanical and morphological component along the vertical profile of the sward was evaluated using the inclined point quadrat (Wilson, 1960), pre and post-grazing during the second grazing cycle. The equipment was allocated to spots that represented the average sward condition at the time of sampling (based on visual assessment of herbage height) allowing the description of the vertical positioning of the botanical and morphological components of the forage mass as the metallic rod was being introduced into the sward and its pin touched different structures and vegetal tissues. The components identified were: leaflets, petioles, stolons, dead material (material completely necrosed or separated from the plant), and weed (every plant different from forage peanut). Each component was identified and its height recorded using the rod of the quadrat (graduated in centimeters). The data was written down in a spreadsheet specially prepared for this type of evaluation. After each touch, the touched component was carefully taken out of the pin to continue the procedure of evaluation introducing the graduated rod into the sward until new touch occurred. This procedure was repeated until the pin touched the soil generating the last height reading, utilized as reference for the calculations of the effective heights of touches realized in relationship to the soil. A total of 100 readings was done and results were presented as the percentage of total reading in each sward height stratum.

Statistical analysis was performed using the MIXED procedure of SAS® (*Statistical Analysis System* 8.2 for Windows®). Light interception, post-grazing height, grazing cycle and their interactions were considered fixed effects, and blocks were considered the random term (Piepho, Büchse, & Emrich, 2003). Data were tested for normality of residuals and variance homogeneity. Different structures of the variance-covariance matrix were tested and Bayesian Information Criterion (BIC) was used to select the best one (Yang, 2010). The ANOVA considered the following effects: light interception, post-grazing height, grazing cycle and their interactions. Treatment means were determined using the LSMEANS procedure, and means separation was based on the Student test. All tests were performed with 95% confidence ($\alpha = 0.05$). Only significant effects are shown in the Results section.

Results

Light interception (LI) pre-grazing was used as a covariate, and therefore was not submitted to ANOVA. During both grazing cycles monitored, LI values observed were 94.9 and 99.2%, for $LI_{95\%}$ and LI_{Max}, respectively (Table 1). Post-grazing LI was considered response variable, and therefore was submitted to ANOVA. Post-grazing LI varied with post-grazing height, with greater values observed for 60% post-grazing heights, as compared to 40% post-grazing height (65.0 and 70.7 ± 0.07% for 40 and 60% post-grazing heights, respectively).

Pre-grazing, sward height did not differ between post-grazing heights, when paddocks were managed with $LI_{95\%}$. However, when paddocks were managed with $LI_{Max,}$ greater values were observed for 60% post-grazing height, as compared to 40% post-grazing height (Table 2), which resulted in significant LI x post-grazing height interaction.

Similarly to pre-grazing LI, post-grazing height was used as a covariate and therefore was not submitted to ANOVA. In general, for all treatments the observed sward height was close to expected, mainly for paddocks managed with $LI_{95\%}$ as compared to LI_{Max} (62.0, 41.0, 58.4 and 42.0% of pre-grazing height for $LI_{95\%}/60$, $LI_{95\%}/40$, $LI_{Max}/60$ and $LI_{Max}/40$, respectively; Table 1).

Paddocks managed with $LI_{95\%}$ allowed a maximum of six grazing cycles, and paddocks managed with LI_{Max} allowed a maximum of four grazing cycles. Grazing interval in days did not differ between treatments and was on average 27.7 ± 1.10 days (Table1).

In general, pre-grazing pastures had increased proportion of leaves in the upper half sward stratum, and increased proportion of stolon and dead material in the lower half stratum of the swards, across treatments. Weeds were observed in the medium/high stratum of the sward (Figure 1; mainly *Sphagneticola trilobata* (L.) Pruski). Post-grazing, a greater proportion of leaves were observed in pastures managed with 60% post-grazing height, as compared to 40% post-grazing height, which had greater proportion of stolon and dead material in the upper stratum (Figure 1).

Table 1. Pasture and experimental characteristics.

Grazing cycle	Treatment			
	Pre-grazing LI (%):			
	$LI_{95\%}$		LI_{Max}	
First	94.9	(0.22)	99.0	(0.22)
Second	95.0	(0.22)	99.4	(0.22)
Mean	94.9	(0.15)	99.2	(0.15)
	Post-grazing height (cm):			
	$LI_{95\%}$/60	$LI_{95\%}$/40	LI_{Max}/60	LI_{Max}/40
First	8.0 8.2' (0.11)'	3 5.3' (0.03)'	11.1 10.9' ((0.33)'	6.9 7.3' ((0.15)'
Second	8.0 8.3' (0.10)'	5.4 5.6' (0.24)'	11.0 10.6' (0.21)'	7.2 7.5'((0.18)'
	Grazing interval (days):			
	$LI_{95\%}$/60	$LI_{95\%}$/40	LI_{Max}/60	LI_{Max}/40
First and second grazing cycles means	26.0 a (2.03)	26.9 a (2.03)	29.6 a (2.03)	28.3 a (2.03)
Overall mean	27.7 (1.10)			
	Maximum of grazing cycles:			
	$LI_{95\%}$/60	$LI_{95\%}$/40	LI_{Max}/60	LI_{Max}/40
Maximum of grazing cycles during the experimental period	6	6	4	4

Values in parenthesis are standard error means. Values followed by ' are actual post-grazing heights, values without the symbol are planned post-grazing heights. Values followed by similar letters do not differ ($p > 0.05$).

Table 2. *Arachis pintoi* cv. Belmonte sward pre-grazing height, subjected to rotational grazing from January to April 2015.

Post-grazing heights target	$LI_{95\%}$	LI_{Max}	Mean
		(cm)	
40%	13.3Ab (0.18)	17.6 Ba (0.18)	15.5 (0.13)
60%	13.3 Ab (0.18)	18.4 Aa (0.18)	15.9 (0.13)
Mean	13.3 (0.13)	18.0 (0.13)	

Values in parenthesis are standard error means. Values followed by similar capital letters in columns, and lower case letters in rows do not differ ($p > 0.05$).

The pre-grazing LAI values remained stable across LI targets, regardless of post-grazing height. However, the post-grazing height was greater for paddocks managed with 40% post-grazing height combined with LI_{Max}. The same pattern was not observed for paddocks managed with 60% post-grazing height, and therefore the LI x post-grazing height interaction was significant (Table 3). The post-grazing LAI values did not vary across treatments and post-grazing heights, and was on average 1.59 ± 0.338. Greater values of foliage angle were observed pre-grazing for $LI_{95\%}$ paddocks as compared to LI_{Max} (49.2 and 42.5 ± 0.77° for $LI_{95\%}$ and LI_{Max}, respectively). The post-grazing foliage angle did not vary across treatments and was on average 57.4 ± 0.13°.

Pre and post-grazing forage mass varied with LI ($p < 0.05$), with greater values observed for LI_{Max} as compared to $LI_{95\%}$ (13440 and 9490 ± 380 kg MS ha^{-1} pre-grazing, and 8140 and 6500 ± 360 kg MS ha^{-1} post-grazing for LI_{Max} and $LI_{95\%}$, respectively). The dead material proportion varied with LI, both pre- and post-grazing ($p < 0.05$), with greater values observed on paddocks managed with $LI_{95\%}$, as compared to LI_{Max} paddocks. Pre-grazing observed values were 9.3 and 4.9 ± 0.86%, and post-grazing values were 13.3 and 7.6 ± 0.93%, for $LI_{95\%}$ and LI_{Max}, respectively. Weed proportion pre-grazing varied with LI x post-grazing height interaction ($p < 0.05$). For LI_{Max} paddocks, there were no differences observed for post-grazing heights. However, for $LI_{95\%}$ paddocks greater values were observed for 40% post-grazing height as compared to 60% post-grazing height (Table 4).

The post-grazing proportion of weeds varied with post-grazing height and with the LI x grazing cycle interaction ($p < 0.05$). Greater values were observed in paddocks managed with 60% post-grazing height as compared to paddocks managed with 40% post-grazing height (18.3 and 30.3 ± 3.01%, for 40 and 60% post-grazing heights, respectively). During the first grazing cycle, there was no difference between paddocks managed with $LI_{95\%}$ or LI_{Max}. However, during the second grazing cycle, greater values were observed on paddocks managed with $LI_{95\%}$, as compared to those managed with LI_{Max} (Table5).

The pre-grazing proportion of leaflets varied with LI and grazing cycle ($p < 0.05$). Greater values were observed on paddocks managed with $LI_{95\%}$, as compared to paddocks managed with LI_{Max} (26.4 e 23.4 ± 0.97% for $LI_{95\%}$ and LI_{Max}, respectively). Regarding grazing cycle, the second cycle had greater values than the first cycle (22.4 and 27.3 ± 0.97% for first and second cycles, respectively). Post-grazing, no effects were observed, and the proportion of leaflets was on average 10.1 ± 0.15%. The petioles proportion had similar pattern as leaflets both pre and post-grazing, with values ranging only from 5.0 to 7.3% of the forage mass.

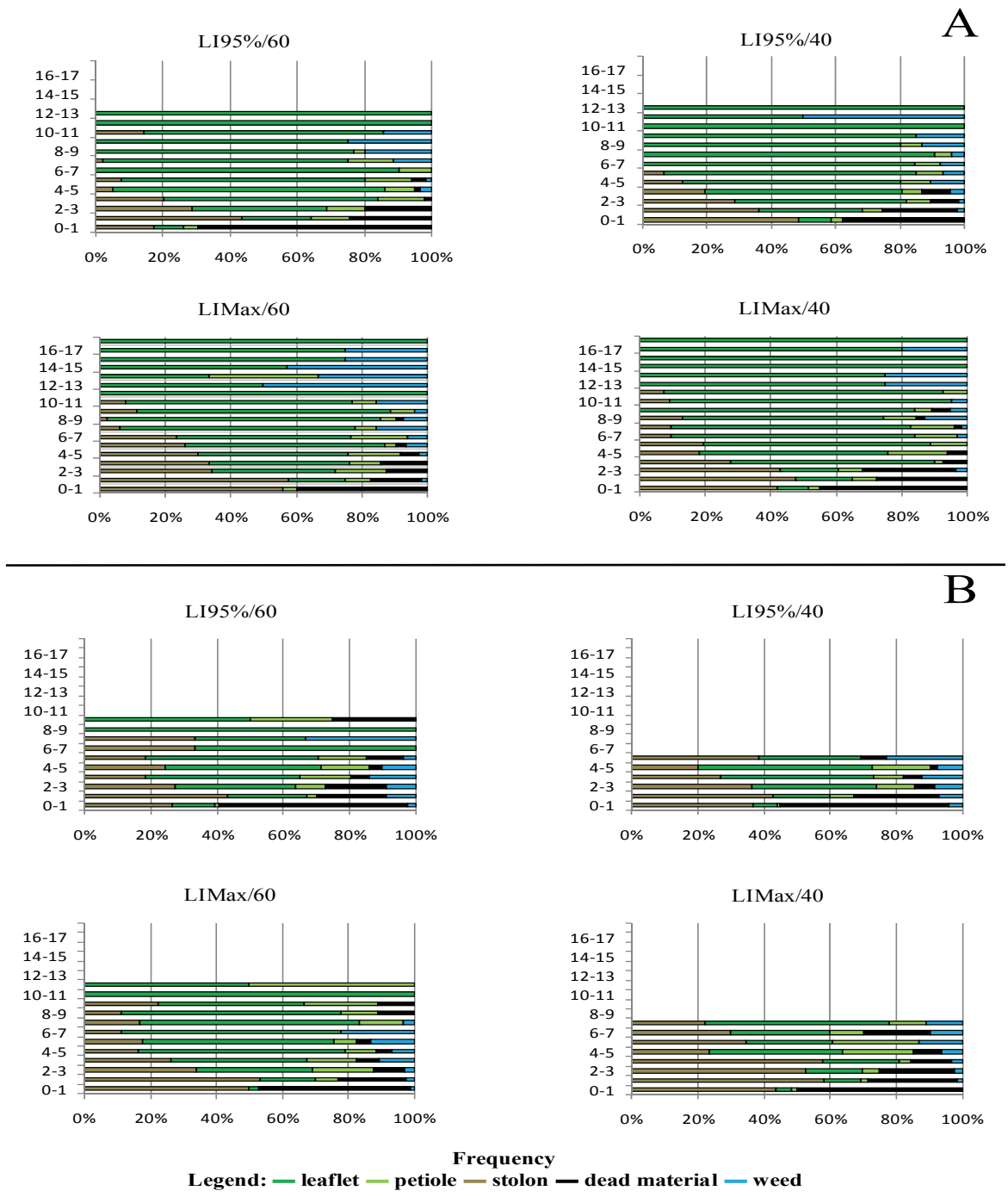

Figure 1. Vertical distribution of morphological components in the pre-grazing (A) and post-grazing (B) forage mass of forage peanut subjected to rotational grazing from January to April, 2015.

Table 3. Leaf area index pre-grazing of *Arachis pintoi* cv. Belmonte paddocks subjected to rotational grazing from January to April 2015.

	LI – Targets		
Post-grazing heights targets	$LI_{95\%}$	LI_{Max}	Mean
40%	5.94 Ab (0.465)	8.64 Aa (0.465)	7.29 (0.373)
60%	6.81 Aa (0.465)	7.77 Aa (0.465)	7.29 (0.373)
Mean	6.38 (0.373)	8.21 (0.373)	

Values in parenthesis are standard error means. Values followed by similar capital letters in columns, and lower case letters in rows do not differ ($p > 0.05$).

Table 4. Weed proportion in pre-grazing forage mass of *Arachis pintoi* cv. Belmonte paddocks subjected to rotational grazing from January to April 2015.

Post-grazing heights target	$LI_{95\%}$	LI_{Max}	Mean
40%	17.7 Aa (2.79)	9.4 Ab (2.79)	13.6 (2.27)
60%	10.8 Ba (2.79)	12.0 Aa (2.79)	11.4 (2.27)
Mean	14.2 (2.27)	10.7 (2.27)	

Values in parenthesis are standard error means. Values followed by similar capital letters in columns, and lower case letters in rows do not differ ($p > 0.05$).

Table 5. Post-grazing weed proportion in *Arachis pintoi* cv. Belmonte forage mass subjected to rotational grazing strategies determined based on 95% and maximum light interception during regrowth from January to April, 2015.

Grazing cycle	$LI_{95\%}$	LI_{Max}	Mean
First(Jan-Feb)	22.7 Aa(3.74)	26.2 Aa(3.74)	24.5 (3.01)
Second (Mar-Apr)	29.2 Aa (3.74)	19.1 Ab (3.74)	24.2 (3.01)
Mean	25.9 (3.01)	22.6 (3.01)	

Values in parenthesis are standard error means. Values followed by similar capital letters in columns, and lower case letters in rows do not differ ($p > 0.05$).

The proportion of stolon pre-grazing varied with LI ($p < 0.05$), and greater values were observed on paddocks managed with LI_{Max}, as compared to paddocks managed with $LI_{95\%}$ (43.4 and 55.0 ± 1.78% for $LI_{95\%}$ and LI_{Max}, respectively). Post-grazing, there were effects of LI and post-grazing height ($p < 0.05$), with greater values observed on paddocks managed with LI_{Max} (47.5 and 56.7 ± 2.87% for $LI_{95\%}$ and LI_{Max}, respectively), and on paddocks managed with 40% post-grazing height as compared to paddocks managed with 60% post-grazing height (59.6 and 44.5 ± 2.87 for 40 and 60% post-grazing height, respectively).

The relationship between leaflet and stolon pre-grazing, varied with LI and grazing cycle ($p < 0.05$), with greater values observed on paddocks managed with $LI_{95\%}$ (0.63 and 0.43 ± 0.032 for $LI_{95\%}$ and LI_{Max}, respectively), and during the second grazing cycle as compared to the first grazing cycle (0.46 and 0.60 ± 0.032 for the first and second grazing cycles, respectively). Post-grazing, the only effect observed was for post-grazing height, and greater values were observed on paddocks managed with 60% post-grazing height (0.17 and 0.25 ± 0.024 for 40 and 60% post-grazing height, respectively).

The accumulation rate of *Arachis pintoi* (leaflets + petioles + stolons) varied only with LI ($p < 0.05$), and greater values were observed on paddocks managed with LI_{Max} (110 e 230 ± 20 kg MS ha^{-1} day^{-1} for $LI_{95\%}$ and LI_{Max}, respectively). Similarly, total accumulation of *Arachis pintoi* mass (accumulation rate of *Arachis pintoi* + pre-grazing mass of *Arachis pintoi*) varied only with LI ($p < 0.05$). Greater values were observed on paddocks managed with LI_{Max} (10140 and 17708 ± 730 kg MS ha^{-1} for $LI_{95\%}$ and LI_{Max}, respectively).

Leaf accumulation rate (leaflets + petioles) varied only with LI ($p < 0.05$), with greater values observed on paddocks managed with LI_{Max} (90 and 120 ± 10 kg MS ha^{-1} day-1 for $LI_{95\%}$ and LI_{Max}, respectively). Similarly, total leaf accumulation rate of *Arachis* (leaf accumulation + pre-grazing leaf mass) varied only with LI ($p < 0.05$), with greater values observed on paddocks managed with LI_{Max} (5170 and 6800 $\pm$ 330 kg MS ha^{-1} for $LI_{95\%}$ and LI_{Max}, respectively).

Discussion

The pre- and post-grazing targets planned were obtained and maintained successfully, which demonstrated that the experimental control was adequate (i.e. nine months of adaptation to experimental conditions and control of grazing and plant regrowth).

Despite the fact that grazing interval was not different among treatments, paddocks managed with $LI_{95\%}$ had 6 grazing cycles, whilst paddocks managed with LI_{Max} had 4 grazing cycles (Table 1). Likely, the difference in grazing severity resulting from the grazing treatments was not strong enough to result in significant difference in the number of grazing cycles. Grazing interval is also determined by regrowth rate. The rate of plant regrowth is dependent on two plant characteristics: size and efficiency of reminiscent leaf area. In this study, no differences on post-grazing LAI was observed, however, the distribution of plant components along the sward vertical profile was different (Figure 1). Paddocks managed with $LI_{95\%}$ and 40% post-grazing height had lower leaflets proportion on upper stratum of the sward, as compared to paddocks managed with 60% post-grazing height. This difference was not observed on paddocks managed with LI_{Max}, which indicated that post-grazing height resulted in different grazing severities depending on the LI target used, offsetting the larger grazing interval implemented on LI_{Max} paddocks. In this study, regrowth was controlled based on paddock LI. Light interception represents not only pasture leaf area, but also several other plant components that intercept light within the sward profile. Therefore, the greater proportion of stolons on LI_{Max} paddocks could have contributed to decrease grazing interval on these paddocks, resulting in lack of difference of grazing interval between LI targets. Greater LI values during regrowth were obtained with greater forage height values (13.0 and 18.0 cm for $IL_{95\%}$ e IL_{Max}, respectively; Table 2). The difference between heights associated to LI targets was of 5 cm, which is much lower than previously observed for tropical grasses, such as mombaça grass (25 cm; Carnevalli et al. (2006), tanzânia grass (15 cm; Barbosa et al. (2007), xaraés grass (10 cm; Pedreira, Pedreira, and Silva (2007)), marandu grass (10 cm; Trindade et al. (2007), mulato grass (10 cm; Silveira et al. (2013) and napier grass (40 cm; Pereira, Paiva, Geremia, and Silva (2014). This difference was likely due to the more horizontal leaf structure of legumes as compared to grasses.

The proportion of leaves pre-grazing (petioles + leaflets) in the upper half stratum of the sward was

greater than post-grazing, regardless of LI target implemented. However, weeds were also present (Figure 1). The greater proportion of leaflets in the upper half stratum of the sward reiterates the importance of an adequate post-grazing height definition. The reason is that, removing more than 50% of the starter forage implicates small amount of reminiscent leaf area (lower quality leaves), which results in restrictions to grazing (Fonseca et al., 2012), lower nutritional value of the forage (Trindade et al., 2007) due to increased proportion of stolon and dead material in the lower stratum of the sward (Figure 1).

Paddocks managed with LI_{Max} had greater pre-grazing forage mass than paddocks managed with $LI_{95\%}$. Once the difference between grazing intervals was not significant, the greater forage mass observed on LI_{Max} paddocks was likely due to greater proportion of stolons, which is the heaviest plant component. On the other hand, paddocks managed with $LI_{95\%}$ target had greater proportion of leaflets (Table 1) pre-grazing, which favors biting and nutritional value of the forage (Trindade et al., 2007). Result suggested that paddocks allowed to growth more than 95% of LI had greater accumulation of stolon as compared to leaves. This pattern is in agreement with the lower leaflet/stolon relationship, greater stolon proportion and forage mass accumulation observed on LI_{Max} paddocks. Usually, on tropical grasses pastures, the increase in stem proportion (which is equivalent to stolon proportion) is accompanied with greater dead material accumulation, however this pattern was not observed in this study. The greater proportion of dead material both pre- and post-grazing was observed on $LI_{95\%}$ paddocks, as compared to LI_{Max} paddocks. The reason is likely that paddocks managed with $LI_{95\%}$ had greater proportion of weed (on average 25%) than paddocks managed with LI_{Max}. Increased grazing frequency and severity of paddocks managed with $LI_{95\%}$ and 40% post-grazing height, resulted in increased proportion of weeds. The longer rest period (LI_{Max} versus $LI_{95\%}$ for post-grazing height 40%) or less severe grazing (post-grazing height of 60% as compared to 40%, for $LI_{95\%}$ paddocks) resulted in lower weeds proportion (Table 4). These results are likely associated to less severe or less frequent grazing that gave the forage peanut better growth conditions, relative to the observed weeds, which had similar growth habit to forage peanut and was highly aggressive. Thus, this fact, associated with weed management trough manual pull-off in post grazing during the experimental period, likely contributed to increased dead material on $LI_{95\%}$ paddocks (Tables 4 and 5).

Greater accumulation and production rated of *Arachis* during the two grazing cycles monitored were observed in paddocks managed with LI_{Max}, as compared to paddocks managed with $LI_{95\%}$. However, only part of the total forage mass is available for animal consumption, and different morphological components have different nutritional values. Consequently, each component influences animal feeding behavior and total nutrient consumption. The elevated production of *Arachis* on LI_{Max} paddocks was a result of greater presence and accumulation of stolons in the total forage mass. However, on LI_{Max} paddocks, stolons were in the lower half stratum of the sward, closer to the ground, which is outside the grazing stratum (forage sward upper half). Additionally, there was greater leaves accumulation on *Arachis* paddocks managed with LI_{Max}, suggesting that for forage peanut pastures, greater stem (or stolon) elongation related to longer regrowth allowance, may not result in such reduction of forage and nutrient intake as observed for grasses. This hypothesis needs further evaluation, but the small difference observed between pre-grazing heights (5 cm; 13 versus 18 cm for $LI_{95\%}$ and LI_{Max}, respectively) supports the hypothesis. The reason is that, greater heights non-associated to increased proportion of dead material and stems favors bite mass and forage intake (Griffiths, Hodgson, & Arnold, 2003). In the context which forage production is no longer the sole criteria to determine grazing strategies, patterns such as stolon growth implications, greater amount of nodules and nitrogen biological fixation become necessary for stipulation of the most adequate grazing strategy, for a specific condition and production objective.

Conclusion

Forage peanut has regrowth pattern similar to tropical grasses. However, due to stoloniferous growth habit, the greater accumulation of stolons on paddocks managed with $LI_{95\%}$, did not compromise leaves accumulation nor forage composition in the grazing stratum of the sward. In this scenario, increased forage height on LI_{Max} paddocks could favor animal intake and performance. However, this hypothesis needs further and more detailed investigation.

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