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CROP PRODUCTION

Corte sequencial de *Urochloa brizantha* cv. MG 5 altera época de florescimento e componentes de produção de sementes

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ABSTRACT: *In tropical grass seed production fields, reducing plant size can increase the solar radiation to the base of the plant canopy and improve the quantity and quality of the seeds produced. This research studied the responses of the production components, the productivity, and the seed quality of U. brizantha cv. MG-5 to different canopy sequential cuttings under cultivation conditions in rain fed systems. Two experiments were carried out (agricultural year 2015/16 (s1) and 2016/17 (s2)) in a randomized block experimental design with four repetitions. The treatments consisted of sequential cut-off, indicating the month of the last cut and the agricultural year: for the 2015/16 agricultural year: Aug - s1, Sep - s1, Oct - s1, Nov - s1, Dec - s1, Jan - s1, and Feb - s1; for the 2016/17 agricultural year: Aug – s2; Set - s2; Nov - s2; Dec - s2; Jan - s2, and Feb - s2. Plant growth biometrics, seed quality variables, and productivity were evaluated. The sequential cut strategy increased the productivity and quality of pure seeds when the final cuts were done between November and December. Cuts performed after December increased the reproductive components. However, in the region in question, rainfall levels compromised seed filling; and therefore productivity and quality since the flowering of these cuttings (January and February) occurs in May.*
Key words: *plant management, vegetative growth, seed yield, seed quality.*

Sequential cutting of *Urochloa brizantha* cv. MG 5 changes flowering season and seed production components

RESUMO: *Em campos de produção de sementes de forrageiras tropicais, a redução do porte das plantas pode ser uma estratégia de melhorar os índices de radiação solar no dossel inferior da lavoura, com possíveis consequências positivas para a produtividade e qualidade das sementes produzidas. Neste contexto, foi desenvolvido um trabalho com propósito de estudar as respostas dos componentes de produção, produtividade e qualidade de sementes de U. brizantha cv. MG-5 em razão de cortes sequenciais da parte aérea, em condições de cultivo em sistema de sequeiro. Para tanto foram implantados dois experimentos (ano agrícola 2015/16 – s1 e ano agrícola 2016/17 – s2), em que se adotou o delineamento experimental em blocos casualizados, com quatro repetições. Os tratamentos foram constituídos por cortes sequenciais da parte aérea, sendo que os cortes mensais e a nomenclatura dos respectivos tratamentos indicam o mês do último corte e ano agrícola: Ago – s1; Set – s1; Out – s1; Nov – s1; Dez – s1; Jan – s1 e Fev – s1 para o ano agrícola 2015/16 (s1) e Ago – s2; Set – s2; Nov – s2; Dez – s2; Jan – s2 e, Fev – s2 para o ano agrícola 2016/17 (s2). Foram avaliadas variáveis biométricas de crescimento da planta, e variáveis de qualidade e produtividade de sementes. O manejo de cortes sequenciais incrementa a produtividade e qualidade de sementes puras para cortes finais realizados entre novembro e dezembro. Cortes realizados posteriormente a dezembro aumentam os componentes reprodutivos, entretanto, na região em questão, os índices pluviométricos comprometem o enchimento das sementes e consequentemente a produtividade e qualidade, visto que o florescimento destas épocas de cortes (janeiro e fevereiro) ocorrem em maio.*
Palavras-chave: *manejo de plantas, crescimento vegetativo, rendimento de sementes, qualidade de sementes.*

INTRODUCTION

Brazil is the largest producer of tropical fodder plant seeds, especially *Urochloa brizantha* (syn. *Brachiaria*), which features cespitose growth, high size and high capacity forage (EMBRAPA, 2003). The demand for tropical forage seeds will grow in the coming years, driven by exports to Africa, Australia, and Latin America, mainly for seeds used in crop–livestock integration systems and in pasture reform areas that are in the process of degradation (GARCIA et al., 2013; CECATO et al., 2014; BATELLO et al., 2017; CATUCHI et al., 2019).

The management programs of tropical forage grasses in Brazil aimed to increase the development of vegetative structures (vegetative

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tillers and leaves), with a particular focus on pasture (BARCELOS et al., 2011; CECATO et al., 2014). However, for the production of seeds, the development of reproductive structures (reproductive tillers, flowers, and seeds) should be prioritized, which has led to questions about the proper management of forage plants (NERY et al., 2012; CATUCHI et al., 2013; 2017; 2019).

Among the cultivars of *Urochloa brizantha*, MG-5 is characterized by high forage production, with approximately 18 t of dry matter ha^{-1} $year^{-1}$, and an average height of 1.6 m (PIRES, 2006). These characteristics of high forage yield potential result in low seed productivity because, due to the plant size (1.6 m), the tillers emitted at the bottom of the plant canopy received limited solar radiation for photosynthesis. This shortfall is reflected in the early senescence of the leaves and the low activity of the growth point, but the activity of the growth point is responsible for making the vegetative tiller reproductive (GARCEZ NETO et al., 2002; TAIZ et al., 2017). The high rate of development of vegetative tillers, at the same time as reproductive tillers, represents a competitive drain on photoassimilates that would go to the seeds. Thus, management aiming seed production should prioritize the emission of reproductive tillers (HOPKINSON et al., 1998; ANTONY et al., 2017). Plant defoliation to increase the light that hits the base of the canopy (LOCH et al., 1999; GARCEZ NETO et al., 2002; PAULA et al., 2012) may favour the development of basal buds while simultaneously leading to synchronous growth and flowering of tillers, with greater production of reproductive tillers than vegetative tillers. In perennial forage plants, the buds that differ in reproductive tillers are located at the base of the plant, so the lowering of the plants by mechanized cutting can enhance the productivity and quality of seeds, as it reduces apical dominance and increases the solar irradiation to the lower canopy, producing tillers of similar age and basal leaves with a higher photosynthetic rate (HOPKINSON et al., 1998; GARCEZ NETO et al., 2002; HARE, et al., 2007).

The time of plant lowering is fundamental to the success of such a cutting management. After floral differentiation, leaf development declines due to the modification of the source/drain ratio of the plants, where the photoassimilates that were previously destined for the growth of the aerial part (tillers + leaves) become destined for the emission of reproductive structures (TAIZ et al., 2017). In tropical environments, it is important to study the correct cutting time of plant shoots. The earliest harvest, between August and December, can result in vigorous vegetative regrowth and a consequent imbalance between the vegetative and reproductive structures, since the new tillers will develop under conditions of high water availability and an average temperature close to 26 °C, as occurs in the western region of São Paulo state between October and January. A late cutting of the aerial part, close to the flowering induction period, can provide a greater source/sink balance, i.e., greater tillering and smaller size, favouring a light environment that will enable a higher photosynthetic rate in the lower canopy; and consequently, increase seed yield.

In this context, the present study characterized the responses of the production components, productivity, and seed quality of *U. brizantha* cv. MG-5 due to sequential cutting of the shoots under a rain fed cultivation system.

MATERIALS AND METHODS

The experiment was done in *U. brizantha* cv. MG-5 during the agricultural years of 2015/16 and 2016/17 at the Experimental Farm of the University of West Paulista, located in Presidente Bernardes, São Paulo, Brazil (latitude 22°17′05.04″ S, longitude 51°40′40.22″ W, altitude 396 m). The climate of the region, according to the Köppen classification, is Aw, which is a rainfall regime characterized by two distinct periods, one rainy from October to March and one dry from April to September. The climatic conditions during the experiments are shown in figure 1.

The soil of the experimental area was classified as a dystrophic red Argisol (SANTOS et al., 2013), with 730, 110, and 160 g kg^{-1} sand, silt, and clay in the 0-20-cm depth layer, respectively. At this same depth, the chemical characteristics of the soil were as follows: pH ($CaCl_2$) 5.5; organic matter 12.3 g dm^{-3}; P_{resin} 6.4 mg dm^{-3}; K, Ca, Mg, and H + Al, 0.6; 17.9; 5.7, and 13.6 mmolc dm^{-3}, respectively; and base saturation 64%.

In both experiments (agricultural year 2015/16 - s1) and agricultural year 2016/17 - s2), a randomized block experimental design with four replicates was used. The treatments consisted of sequential cuts of the aerial part, once a month. The names of the treatments had the month of the last cut and the agricultural year: for the 2015/16 agricultural year (s1): Aug - s1: cut on August 10 (cut a total of one time); Sep - s1: cut again on September 10, for two total cuts; Oct - s1: October 9, three cuts; Nov - s1: November 6, four cuts; Dec - s1: December 8, five cuts; Jan - s1: January 15, six cuts; and Feb -

s1: February 12, seven cuts; and for the 2016/17 agricultural year (s2), on the dates of August 8, September 10, November 12, December 14, January 12, and February 10. In the 2016/17 crop year, the October cut was not performed because the plants did not develop due to the climatic conditions that occurred between the September cut and the cut that should have been made in October. Each plot was 6.3 m wide by 7 m long, with a total area of 44 m^2.

Before the experiment, the soil of the areas of both experiments was conventionally prepared with the use of disc plows, grading harrows, and compactor rollers adapted for soil uniformity, practices used in seed production fields in the first year of cultivation. Before preparing the area, 1 t ha^{-1} dolomitic limestone and 1 t ha^{-1} gypsum were applied. After soil preparation, *U. brizantha* cv. MG-5 (December 8, 2014 for agricultural year 2015/16 and November 12, 2015 for agricultural year 2016/17), at a spacing of 0.90 m, using 4 kg ha^{-1} of certified seeds of category C2. Simultaneously, sowing fertilization was performed with 300 kg ha^{-1} of the formulated fertilizer N-P_2O_5-K_2O 04-30-10. After the implantation of each area, the plants spontaneously vegetated until the standardization cut for the beginning of the experiment, which was performed on July 27, 2015 (agricultural year 2015/16) and August 2, 2016 (agricultural year 2016/17) at 10 cm height, with the removal of all the cut plant material.

After the standardization cut, the cuts were made to implement the treatments as described in the experimental design. That is, at the September cutting, the plants of all treatments (Sep, Oct, Nov, Dec, Jan, and Feb) were cut; at the October cutting, all plants were cut except the Sep group; and so forth.

The topdressing fertilizers were divided into three applications, on the dates of 06/11/2015; 08/08/2015 and 01/29/2016 (agricultural year 2015/16), and 12/15/2016; 13/01/2016 and 14/02/2016 (agricultural year 2016/17), with application of 70 kg ha^{-1} of N, 40 kg ha^{-1} of P_2O_5 and 70 kg ha^{-1} of K_2O in each application, using ammonium nitrate, triple superphosphate, and potassium chloride, respectively, for NPK.

The application of imazethapyr (84.8 g ha^{-1} of ai ha^{-1}) was necessary to control monocotyledonous weeds in the forage rows. The herbicide 2,4-D (1.4 g ha -1 of ai ha^{-1}) was applied to control dicotyledonous plants in the forage rows. Until the interrows were closed, four manual weeding operations were performed for total elimination of weeds in the area.

At the time of full flowering, in each treatment group, 1 linear meter of tillers samplings per plot was sampled, which was used to measure the number of tillers per hectare (NTH). Subsequently, five tillers containing panicles were separated and used to measure the following variables: percentage of tillers with no lateral branches (PTNLB), percentage of tillers with lateral branches (PTWLB), tiller length (TL), number of nodes per tiller (NNT), number of leaves per tiller (NLT), number of green leaves per tiller (NGT), number of dry leaves per tiller (NDT), number of panicles per tiller (NPT), panicle length (PL), number of racemes per panicle (NRP), raceme length (RL), number of seeds per raceme (NSR), and number of seeds per panicle (NSP).

The dry matter of the shoot (DM) was evaluated at the time of degraining of the seeds of the respective treatments, with collection of 1.5 m of row per plot, which were then dried in an oven at 65 °C for 72 hours and weighed to determine the DM per hectare.

To determine the productivity of pure seeds, in each degraining period under the treatments applied, seeds were collected from two subsamples of 10.8 m^2 per plot. In the harvest areas, the straw was removed, and then the seeds from this area were swept with a brush. The seeds were transferred to a set of sieves to remove soil and impurities. The two subsamples of each plot were mixed to form one sample per plot, which was taken to the seed laboratory to quantify the mass of one thousand seeds (MTS), pure seeds and apparent seeds (units with caryopsis and empty), percentage of germination (G), first germination count (FGC), and percentage of seeds that were viable by the tetrazolium test (TZ) (BRASIL, 2009). The number of pure seeds was used to calculate the productivity of pure seeds (PPS - pure), and the raw seed yield (RSY - pure + apparent) was calculated based on the sum of pure and apparent seeds, with the water content corrected to 130 g kg^{-1}.

The data obtained in each experiment were subjected separately to analysis of variance. The means of the treatments were ordered by the Scott-Knott test at 5% probability. The statistical program SISVAR (FERREIRA, 2011) was used. The variables of the two years of the experiment (agricultural years 2015/16 and 2016/17) were subjected to multivariate principal component analysis (PCA) according to Bray-Curtis ordination using R software.

RESULTS AND DISCUSSION

In the two years studied, the early cuts, those in August and September, led flowering to begin in February. The sequential cuts until January and February induced late flowering, starting in mid-May.

The plants that remained lower for longer responded with a shorter vegetative period and flowering in a period with low water availability (Figure 1).

In either crop year, NTH was not affected by the date or cut-off number of the shoots. The mean NTH in the 2015/16 agricultural year was 2.22 million ha^{-1}, and in the 2016/17 agricultural year, the mean of NTH was 2.26 million ha^{-1} (Table 1).

PTNLB and PTWLB were influenced by the date and number of cuttings of the shoots in each crop year (2015/16 and 2016/17) (Table 1). PTNLB in the 2015/16 crop year was highest in the plants with final cuts between November and February, in which more than 50% of the tillers lacked lateral branches. In contrast, PTWLB was higher when the last cutting was between August and October, in which more than 62% of the tillers showed lateral branches. Conversely, in the agricultural year 2016/17, when the final cut was performed in February, PTNLB was highest (90%) and lower PTWLB (10%). Lateral

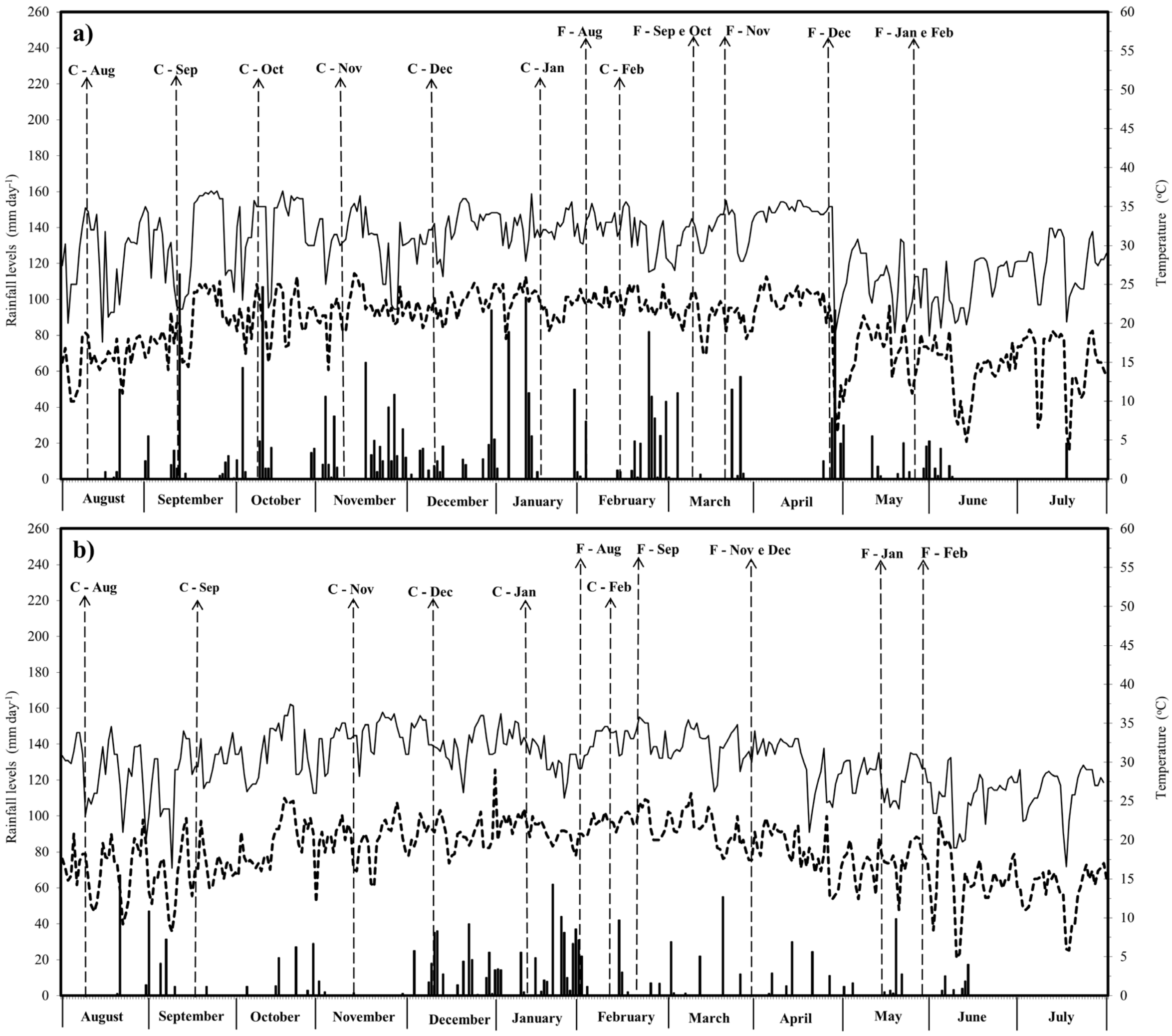

Figure 1 - Rainfall levels (▌), maximum temperature (__) and minimum temperature (- -) registered in the experimental area: (a) agricultural year 2015/16 – s1; (b) agricultural year 2016/17 – s2. C – Aug; C – Sep; C – Oct; C – Nov; C – Dez; C – Jan and C – Feb, respectively are the cuts made in August, September, October, November, December, January and February. F – Aug; F – Sep; F – Oct; F – Nov; F – Dez; F – Jan and F – Feb, respectively are the flowering periods of the plants in which cuttings were carried out in August, September, October, November, December, January and February.

Table 1 - Medium values of number of tillers per hectare (NTH), percentage of tillers with no lateral branches (PTNLB), percentage of tillers with lateral branches (PTWLB), tiller length (TL), number of nodes per tiller (NNT), number of leaves per tiller (NLT), number of green leaves per tiller (NGT) and number of dry leaves per tiller (NDT), due to the date and cut numbers of the aerial part. (Presidente Bernardes, SP. Agricultural year 2015/16 – s1 and 2016/17 – s2).

Treatment	NTH	PTNLB	PTWLB	TL	NNT	NLT	NGT	NDT
		%	%	cm				
FCM[(2)]	---Agricultural year 2015/16---							
Aug	2,105,534a[(1)]	22b	77a	213a	12.6a	11.8a	3.1b	8.8a
Sep	2,038,868a	25b	75a	184a	11.0b	9.7b	2.3b	7.5a
Oct	2,466,642a	37b	62a	172a	10.0b	9.9b	2.9b	7.0a
Nov	1,974,980a	55a	45b	172a	10.1b	9.2b	3.3b	5.9a
Dez	2,686,084a	55a	45b	155b	9.6c	9.3b	3.2b	6.1a
Jan	2,088,868a	60a	40b	144b	8.8c	7.5c	4.0a	3.6b
Feb	2,213,867a	75a	25b	99c	7.1d	6.8c	4.5[a]	2.3b
Mean	2,224,978	47	52	161	9.9	9.2	3.3	5.9
CV%	26.7	45.4	40.4	16.1	8.9	13.6	16.3	24.1
F value	0.06[ns]	0.02[*]	0.02[*]	0.01[**]	0.01[**]	0.01[*]	0.01[*]	0.01[**]
FCM[(2)]	---Agricultural year 2016/17---							
Aug	2,516,641a	15b	85a	185a	19.5a	9.8a	4.3b	5.4a
Sep	2,727,750a	5b	95a	179a	15.8b	10.4a	4.6b	5.8a
Nov	2,177,756a	5b	95a	164a	8.9c	7.9a	4.7b	3.2b
Dez	1,958,314a	20b	80a	164a	9.3c	9.1a	6.0a	3.0b
Jan	2,080,535a	20b	80a	146a	8.0c	8.1a	5.8[a]	2.2b
Fev	2,119,423a	90a	10b	85b	5.6d	5.8b	3.9b	1.8b
Mean	2,263,403	25	74	154	153.9	8.3	5.1	3.2
CV%	22.1	25.1	26.1	12.8	12.8	13.3	13.3	28.3
F value	0.28[ns]	0.01[*]	0.01[*]	0.01[**]	0.01[**]	0.01[**]	0.01[*]	0.01[**]

[(1)] Means followed by distinct letters in the column differ from each other by the Scott-Knott test at 5% probability. [(2)] FCM: Final cut month. ns – not significant; [*] significant P < 0,05; [**] significant P < 0,01. CV: coefficient of variation.

branching is related to a greater TL, which also showed higher values with the final cut performed between August and November for the 2015/16 agricultural year and higher values for the final cut performed between August and January for the agricultural year 2016/17. The reduction in tiller length with seven cuts compared to only one cut was 53.6% and 54.3% in 2015/16 and 2016/17, respectively.

Thus, greater growth in height may increase lateral branching but not result in a greater number of panicles per unit area because lateral branching may be a drain of photoassimilates that would go to reproductive structures. According to HOPKINSON et al. (1998) and ANTONY et al. (2017), the high rate of development of vegetative tillers, at the same time as reproductive tillers, can be a physiological drain of photoassimilates that would go to the seeds; thus, management aiming seed production should prioritize synchronization in the emission of reproductive tillers.

Regarding the number of nodes per tiller (NNP), in both agricultural years (2015/16 and 2016/17), the highest values were observed for the month of final cut in August, i.e., only one cut (Table 1). This response pattern is attributed to the greater length of the tiller (TL), which was also higher in the treatment with the final harvest month performed in August. Morphologically, forage plants with longer tiller growth times; consequently, have a higher rate of emission and elongation of internodes (COSTA et al. 2004).

In the 2015/16 agricultural year, NLT responded similarly as the NNP variable, with a higher value with the final cut performed in August, whereas in the 2016/17 agricultural year, the highest NLT values were observed when the final cut was performed between August and January. Regardless of the significant responses, the values of NNP and NLT were similar in both crop years (2015/16 and 2016/17). BRITO & RODELLA (2002), in a morphology study with *U. brizantha,* also observed similar values of NNP and NLT, since the insertion point of the leaves is in the nodes. These responses support the hypothesis that plants with a longer growth period have high TL, which results in more nodes and leaves per tiller. However, this pattern of plant growth may not be good for reproduction, since the excess of leaves causes high shading of the leaves in the lower third of the plant canopy, resulting in early senescence of the leaves, reduction of the photosynthetic rate, in addition to the low activity of the growth point, which is responsible for making the vegetative tiller reproductive (GARCEZ NETO et al., 2002; PAULA et al., 2012; TAIZ et al. 2017). This was observed in the present study, with the highest number of dry leaves per tiller being present when the final cutting month was between August and December for the 2015/16 agricultural year and between August and September for the 2016/17 agricultural year, to the detriment of NGT in these periods in both agricultural years (Table 1).

The shoot DM production in the 2015/16 crop year showed higher values when the final harvest month was August, September, or October, with an averages of 21.4, 19.5, or 21.2 t ha^{-1} DM, respectively (Table 2). Conversely, in the 2016/17 agricultural year, the highest dry matter yields were observed in the August and September groups, with dry matter yields of 15.9 and 15.4 t ha^{-1}, respectively. These responses are related to the longer vegetation periods between cutting and dry matter evaluation, which were approximately 180 to 210 days, respectively, for the cuts performed in August and September. NPT in both crop years was highest in the August group of both years, with means of 3.6 and 3.8, respectively (Table 2).

For both crop years, the PL and NRP were higher when the final cut was performed in February; consequently, there was an increase in NSP when the final cut was performed in February (Table 2), which may be a response to the shorter tiller length, which favours the incidence of radiation in the lower canopy of the plant.

Raceme length was not influenced by the cut time. NSR was higher when the final cut was done in September, November, January, or February

Table 2 - Dry matter of the shoot (DM), number of panicles per tiller (NPT), panicle length (PL), number of racemes per panicle (NRP), raceme length (RL), number of seeds per raceme (NSR) and number of seeds per panicle (NSP), due to the date and cut numbers of the aerial part. (Presidente Bernardes, SP. Agricultural year 2015/16 – s1 and 2016/17 – s2).

Treatment	DM	NPT	PL	NRP	RL	NSR	NSP
	kg ha^{-1}		cm	Cm			
FCM [2]	---Agricultural year 2015/16---						
Aug	21,466a[1]	3.6a	5.1b	2.3b	7.9a	22.7b	50.8b
Sep	19,454a	2.1b	4.9b	2.2b	8.3a	29.5a	62.8b
Oct	21,218a	2.0b	5.6b	2.6b	8.8a	24.8b	64.3b
Nov	15,615b	2.3b	5.2b	2.2b	8.4a	29.8a	64.4b
Dez	14,353b	2.1b	5.4b	2.3b	7.7a	26.6b	60.4b
Jan	12,547b	2.1b	5.4b	2.2b	7.3a	32.6a	69.4b
Feb	8,320b	1.5b	7.6a	3.4a	8.2a	29.9a	100.1a
Mean	16,139	2.2	5.6	2.4	8.1	28.0	74.3
CV%	26.2	26.5	19.8	20.4	12.3	12.3	24.4
F value	0.02*	0.04*	0.05*	0.03*	0.44	0.04*	0.02*
FCM [2]	---Agricultural year 2016/17---						
Aug	15,910a	3.8a	8.8b	3.1b	8.8a	24.4a	93.6b
Sep	15,492a	3.0b	8.7b	3.4b	8.5a	25.4a	85.8b
Nov	8,829b	2.9b	7.3b	2.9b	7.6a	29.6a	82.1b
Dez	8,331b	2.7b	7.6b	3.1b	7.7a	25.5a	77.8b
Jan	6,984b	2.6b	7.7b	3.3b	7.9a	25.3a	82.5b
Feb	6,849b	0.6c	10.1a	4.5a	8.0a	25.3a	111.0a
Mean	10,399	2.6	8.5	3.5	8.1	25.9	88.8
CV%	20.3	19.9	9.3	15.6	8.0	15.6	12.7
F value	0.01**	0.01**	0.01*	0.01*	0.09	0.54	0.01*

[1] Means followed by distinct letters in the column differ from each other by the Scott-Knott test at 5% probability. [2] FCM: Final cut month. ns – not significant; * significant P < 0,05; ** significant P < 0,01. CV: coefficient of variation.

in the 2015/16 crop year, but it showed no response to treatment in the 2016/17 crop year. However, NSP was superior when the final cut was performed in February in either year. These findings, taken together, reinforce that lower length and fewer branched tillers end up producing more seeds.

As shown in table 3, MTS responded to the treatments applied in the 2015/16 agricultural year, being higher when the final cut was performed between August and November. In the 2016/17 crop year, there was no effect of the cutting season on MTS. Percentage of germination (G) was higher in the final harvest months of October and November for the agricultural years 2015/16 and 2016/17, respectively. The percentage of germinated seeds in the first count of the germination test (FGC) was influenced by treatment only in the second agricultural year (2016/17), with higher values observed for the final cut months between August and November. Viable seeds by TZ in the 2015/16 agricultural year was highest when the final harvest was in August, September, November, or December. In 2016/17, the highest percentage of TZ occurred when the final cutting was performed in November (Table 3).

PSP was highest when the final cut was performed in December in the first agricultural year, and the highest yields were observed when the final cut was performed in August, September, or November of the 2016/17 agricultural year (Table 3). Regarding RSY, there was interference by the treatments applied only for the agricultural year 2016/17, with higher productivity when the final cut was performed in September or November.

In general, the variables TL, NLT and shoot dry matter (DM) were lower in the final cut months between January and February, a fact that reinforces the hypothesis of consecutive cuts could favour the smaller size of the plant and less branched tillers, improving the light environment in the lower canopy, which would result in increased seed productivity. In fact, a higher NSP was reported in the treatment whose final cut was performed in February in the two crop years, but this was not in agreement with the higher PPP that occurred in the December group of

Table 3 - Mass of one thousand seeds (MTS), percentage of germination (G), first germination count (FGC), percentage of seeds that were viable by the tetrazolium test (TZ), productivity of pure seeds (PPS) and raw seed yield (RSY), due to the date and cut numbers of the aerial part. (Presidente Bernardes, SP. Agricultural year 2015/16 – s1 and 2016/17 – s2).

Treatment	MTS	G	FGC	TZ	PPS	RSY
	g	%	%	%	kg ha^{-1}	kg ha^{-1}
FCM [2]	-----------Agricultural year 2015/16-----------					
Aug	9.6a[1]	84b	16a	90a	16.4c	409.8a
Sep	9.7a	84b	45a	92a	22.6c	434.2a
Oct	9.6a	91a	31a	84b	23.8c	431.0a
Nov	9.7a	86b	34a	92a	29.7b	507.1a
Dez	9.3b	74c	26a	91a	41.9a	451.9a
Jan	9.2b	78c	27a	84b	13.7c	469.5a
Feb	9.4b	79c	30a	82b	16.8c	457.0a
Mean	9.5	82	30	88	23.6	451.5
CV%	4.3	4.4	38.4	4.5	29.4	17.8
F value	0.02*	0.01**	0.08^{ns}	0.02*	0.01**	0.72^{ns}
FCM [2]	-----------Agricultural year 2016/17-----------					
Aug	9.4a	72b	31a	87b	52.0a	214.5b
Sep	9.0a	74b	31a	82b	57.6a	277.0a
Nov	9.1a	85a	33a	93a	64.7a	289.5a
Dez	9.2a	71b	18b	77c	29.2b	207.7b
Jan	9.2a	75b	15b	84b	37.3b	222.0b
Feb	9.0a	67b	6b	73c	39.7b	198.3b
Mean	9.1	74	22	83	46.8	234.9
CV%	2.0	6.3	34.0	4.9	25.8	19.6
F value	0.01*	0.01**	0.01*	0.01*	0.01*	0.05*

[1] Means followed by distinct letters in the column differ from each other by the Scott-Knott test at 5% probability. [2] FCM: Final cut month. ns – not significant; * significant P < 0,05; ** significant P < 0,01. CV: coefficient of variation.

the first crop year and the August–November groups of the second year. These responses can be explained by the climatic conditions (Figure 1) observed for the cuts performed in January and February in both crop years, when flowering occurred between the first and second half of May, and conditions of reduced water availability contributed to the translocation of photoassimilates to the plants. CANTO et al. (2016), in a study with *Megathyrsus maximus* (Jacq.) (Syn. *Panicum maximum* Jacq.), which evaluated the production rates of seeds due to different closing cut dates and nitrogen rates, the authors observed that later cuts, such as in February, decreased the seed yield.

The data in figure 2 show the principal component multivariate analysis (PCA) of the data for all variables and both experimental years. The data for the final cut months and variables are distributed in the graph; axis 1 corresponds to 31% of the entire variation, while axis 2 corresponds to 18.2% of the variation. Regarding axis 1, the variables PL, NRP, NSP, NGT, and PPS were the most influential, explaining 33%, 32%, 31%, 27%, and 10% of the variation, respectively. Conversely, the variation in axis 2 was more related to the PTNLB, NSR, and RSY variables, which explained 39%, 23%, and 22% variation, respectively. Based on this analysis, PPS is correlated with the variables PL, NRP, NSP, and NGT when the final cuts performed between November and January.

A management strategy to optimize the light environment at the lower canopy and favor seed productivity through shoot management

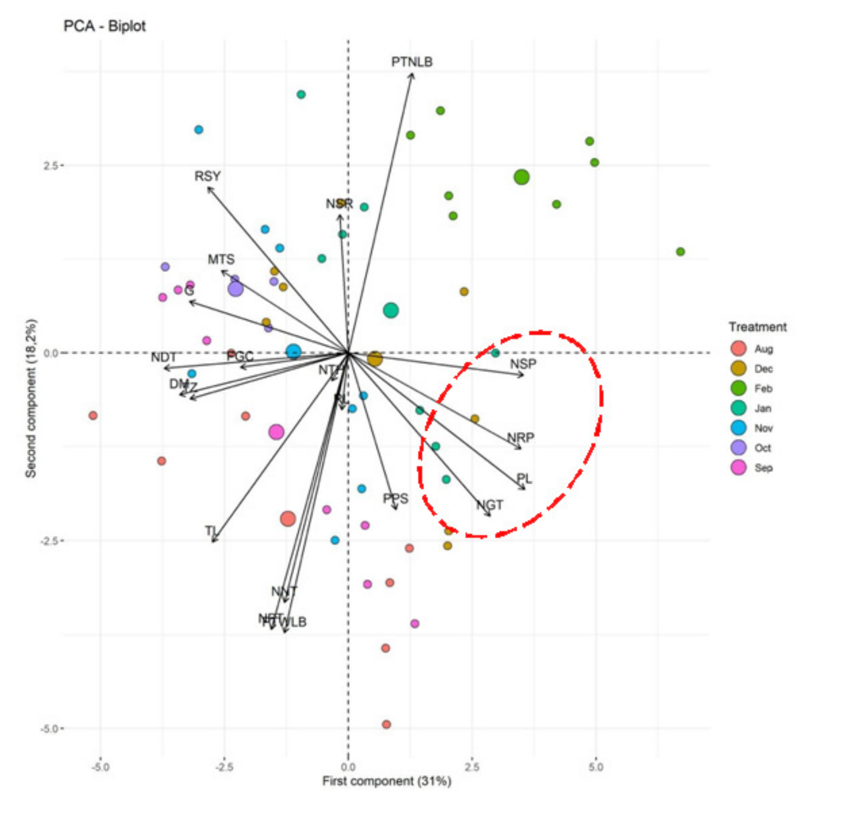

Figure 2 - Multivariate analysis of principal components by Bray-Curtis ordering, considering the two experiments (Agricultural year 2015/16 – s1 e 2016/17 – s2), the treatments and all variables. Name of the treatment: month of final cut. The circle indicates the variables that most correlated with productivity of pure seeds (PPS) and the final cuts carried out between November and January.

should be aligned with the complementary water availability for cuts that promote a later flowering period but still early enough to form seeds at the end of the rainy season.

CONCLUSION

The management of sequential cuts increases the productivity and quality of pure seeds for final cuts performed between November and December. Cuts made after December increase the reproductive components; however, in the region in question, rainfall indices compromise seed filling; and therefore, productivity and quality, since the flowering from these cutting seasons (January and February) occurs in May.

DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest. The founding sponsors had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, and in the decision to publish the results.

AUTHORS' CONTRIBUTIONS

All authors contributed equally for the conception and writing of the manuscript. All authors critically revised the manuscript and approved of the final version.

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