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Recuperação de pastagem de *Urochloa decumbens* com sistemas de manejo e adubação fosfatada

Urochloa decumbens pasture recovery with management systems and phosphate fertilization

Recuperación de pasto de *Urochloa decumbens* con sistemas de manejo y fertilización de fosfato

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Resumo

O manejo adequado das pastagens é importante para garantir a produção animal. O objetivo deste estudo foi avaliar a produção massa seca da parte aérea (SDWY) e na composição mineral na recuperação de pastagens degradadas (*Urochloa decumbens*) em um Latossolo Típico com introdução de *Stylosanthes* e fertilização com fósforo (P). O delineamento experimental foi em blocos casualizados, em arranjo de parcelas subdivididas, com quatro repetições. As parcelas foram constituídas de sete sistemas de manejo: T1 - Controle *Urochloa decumbens* sem *Stylosanthes*; T2 - *U. decumbens* + *Stylosanthes* com plantio direto; T3 - *U. decumbens* com dessecação parcial + *Stylosanthes*; T4 - *U. decumbens* com dessecação total + *Stylosanthes*; T5 - *U. decumbens* + *Stylosanthes* com escarificação do solo; T6 - *U. decumbens* + *Stylosanthes* com aração; T7 - *U. decumbens* + *Stylosanthes* com lavoura + grade e as subparcelas foram as adubações com P (presença e ausência). A adubação com P (60 kg ha^{-1} de P_2O_5) aumentou a concentração de P e SDWY de *U. decumbens*, enquanto a introdução de Stylosanthes nos diferentes sistemas de manejo utilizados não alterou o produção de forragem.

Palavras-chave: Pastagem degradada; *Stylosanthes* spp.; *Urochloa decumbens*; solo tropical.

Abstract

Adequate pasture management is important to ensure animal production. The objective of this study was to evaluate the effect on shoot dry weight yield (SDWY) and mineral composition in degraded pasture (*Urochloa decumbens*) recovery in a Typic Oxisol with introduction of *Stylosanthes* and phosphorus (P) fertilization. The experiment was set up as completely randomized block design in a split-plot arrangement with four replicates. The plots were seven management system: T_1 - Control *Urochloa decumbens* without *Stylosanthes*; T_2 - *U. decumbens* + *Stylosanthes* with no-till; T_3 - *U. decumbens* with partial desiccation + *Stylosanthes*; T_4 - *U. decumbens* with total desiccation + *Stylosanthes*; T_5 - *U. decumbens* + *Stylosanthes* with soil scarification; T_6 - *U. decumbens* + *Stylosanthes* with plowing; T_7 - *U. decumbens* + *Stylosanthes* with plowing + harrowing and the subplots was the P fertilization (presence and absence). P fertilization (60 kg ha^{-1} of P_2O_5) increased the P concentration and SDWY of *U. decumbens*, while the introduction of *Stylosanthes* in the different management systems used did not change the forage yield.

Index terms: Pasture degradation; *Stylosanthes* spp.; *Urochloa* decumbens; tropical soil.

Resumen

El manejo adecuado de los pastos es importante para asegurar la producción animal. El objetivo del estudio fue evaluar la producción en masa seca de la parte aérea (SDWY) y la composición mineral en la recuperación de pasturas degradadas (Urochloa decumbens) en un Latosol típico con la introducción de Stylosanthes y la fertilización con fósforo (P). El diseño experimental fue en bloques aleatorizados, en una disposición de parcelas subdivididas, con cuatro repeticiones. Las parcelas consistieron en siete sistemas de gestión: T1 - *Urochloa decumbens* control sin *Stylosanthes*; T2 - *U. decumbens* + *Stylosanthes* sin labranza; T3 - *U. decumbens* con desecación parcial + *Stylosanthes*; T4 - *U. decumbens* con desecación total + *Stylosanthes*; T5 - *U. decumbens* + *Stylosanthes* con cincelado del suelo; T6 - *U. decumbens* + *Stylosanthes* con arado; T7 - *U. decumbens* + *Stylosanthes* con cultivo + grada y las subparcelas fueron fertilización con P (presencia y ausencia). La fertilización con P (60 kg ha-1 de P2O5) aumentó la concentración de P y SDWY de *U. decumbens*, mientras que la introducción de *Stylosanthes* en los diferentes sistemas de manejo utilizados no alteró la producción de forraje.

Palabras clave: Degradación de pasturas; *Stylosanthes* spp.; *Urochloa decumbens*; suelos tropicales.

1. Introduction

Soil inadequate management with fertilization absence and the exhaustion of natural soil fertility have been identified as one of causes of the degradation of cultivated pastures (Costa et al. 2009). In these conditions occur mainly due to soil organic matter (SOM) reduction, in addition to nutrients losses such as P, potassium (K), calcium (Ca) and magnesium (Mg) (Schaefer et al. 2002). To recovery degraded areas can be adapted various strategies. Including management systems that reduce or null mechanical soil stirring, perennial crop system with high biomass yield and well developed root system, favoring the SOM accumulation, improving the biological activity and availability of nutrients in the soil (Tan et al. 2007).

The adoption of practices such as grass and legume intercropping can be an alternative for restoring or increasing soil fertility (Silva and Saliba 2007), as the legumes present great environmental and economic potential for their ability to nitrogen (N) fixation in the soil, maintaining pasture more productivity and providing the yield systems sustainability at reduced cost (Werner et al. 2001; Moreira, Malavolta, and Moraes 2002).

Another problem is the low available P content in weathered soils as it is found in Brazil's edaphoclimatic conditions. P fertilization plays an essential role in root development and grasses tillering (Fageria et al. 2013a), being related to the plant energy metabolism in all metabolic cycles related to energy expenditure (Fageria et al. 2013b). The P absence limits yield capacity, establishment and pastures persistence, as well as impairs the other nutrients uptake (Werner et al. 2001; Heinrichs and Soares Filho 2014).

The structural and productive characteristics of forage plants are benefited by phosphate fertilization (Melo, 2016; Pietramale, et al., 2020). Based on these responses, it is possible to establish management strategies associated with the phosphorus application in pasture recovery.

The objective of this study was to evaluate the degraded pasture recovery of *Urochloa decumbens* with introduction of *Stylosanthes* and P fertilization on the shoot dry weight (SDW) yield, macronutrient (N, P, K, Ca, Mg, and S) concentration and soil chemical properties.

2. Methodology

A field experiment was carried out in an *Urochloa decumbens* area with 10 years of grazing, which had low forage yield, with little invasive plants infestation, without soil compaction. The experimental area was located in Dracena County, São Paulo State, Brazil at 379 m altitude, latitude 20°55' S and longitude 51°23' W. According to the Koppen classification, the climate is type Aw, characterized by hot and humid summer seasons, warm, and dry winter, with a higher rainfall index between November and March. The annual

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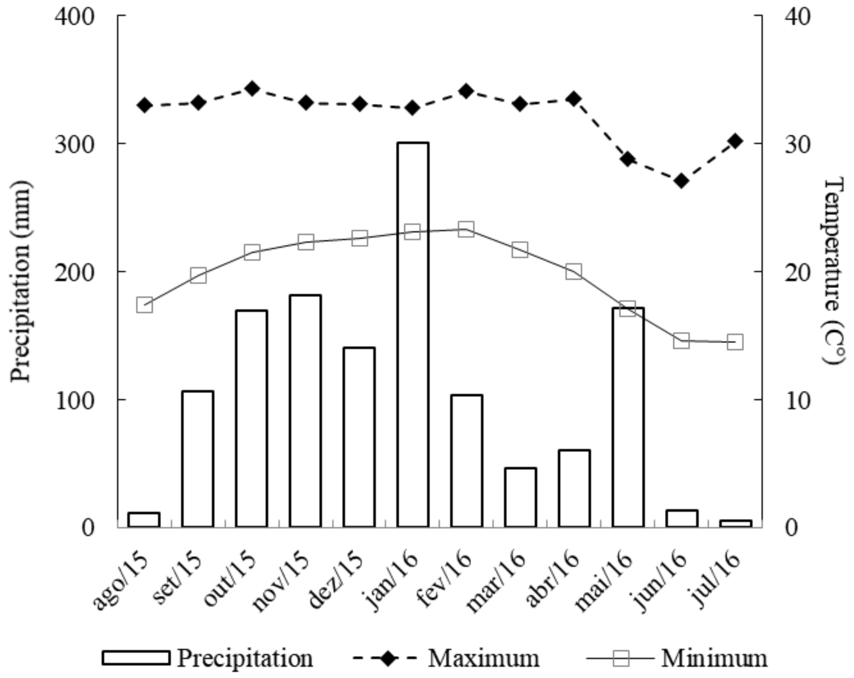
temperature and precipitation are respectively 23°C and 1,300 mm, and the climatic data for precipitation (mm), minimum average temperatures and maximum averages for the experimental period are presented in Figure 1.

The soil was classified as a Typic Oxisol (Santos 2013). Before of experiment, soil samples were collected at 0 – 0.2 m depth, presenting the following chemical and physical attributes: pH ($CaCl_2$ 0.1 mol L^{-1}) = 4.5, soil organic matter (SOM) = 21.5 g kg^{-1}, available P (resin) = 3.5 mg kg^{-1}, sulfur ($S\text{-}SO_4^{2-}$) = 11.0 mg kg^{-1}; K^+ = 4.6 $mmol_c$ kg^{-1}; calcium (Ca^{2+}) = 18 $mmol_c$ kg^{-1}, magnesium (Mg^{2+}) = 7.5 $mmol_c$ kg^{-1}; cation exchange capacity (CEC) = 53.6 $mmol_c$ kg^{-1}, base saturation (V) = 56%, boron (B, hot water) = 0.9 mg kg^{-1}, copper (Cu, DTPA-TEA) = 0.8 mg kg^{-1}, iron (Fe, DTPA-TEA) – 53.0 mg kg^{-1}, manganese (Mn, DTPA-TEA) = 13.3 mg kg^{-1}, zinc (Zn, DTPA-TEA) = 1.2 mg kg^{-1}, sodium (Na) = 10,35 mg kg^{-1}, clay = 170 g kg^{-1} and sand = 770 g kg^{-1}.

Figure 1. Precipitation and minimum and maximum temperatures during the experimental period. Source: CIIAGRO (2016).



The experiment was set up as completely randomized block design in a split-plot arrangement with four replicates. The plots were composed of seven management system: T_1

- Control (*Urochloa decumbens* without *Stylosanthes*), T_2 - *U. decumbens* + *Stylosanthes* with no-till, T_3 - *U. decumbens* with partial desiccation applying 1.5 L ha^{-1} of the glyphosate active ingredient + *Stylosanthes*, T_4 - *U. decumbens* with total desiccation applying 3.0 L ha^{-1} of the active ingredient + *Stylosanthes*, T_5 - *U. decumbens* + *Stylosanthes* with soil scarification, T_6 - *U. decumbens* + *Stylosanthes* with plowing, and T_7 - *U. decumbens* + *Stylosanthes* with plowing + harrowing. In the subplots was the P fertilization (60 kg ha^{-1} of P_2O_5) and without P application.

The P source used was the simple superphosphate (20% P_2O_5), applied annually at the beginning of the rainy season. The plots were sized at 10 m × 10 m and the subplots 5 m × 10 m. The legume seeds sowing density was 5 kg ha^{-1}, with 92% cultural value. The distribution was the haul in the treatments T_6 and T_7, and the other treatments were in rows spaced 0.22 m. Due to the low *Stylosanthes* spp. availability in area, in November of 2015 a haul with density 3.0 kg ha^{-1} of seed was carried out in all parcels except in the control. The soil samples for chemical properties were collected in 0.0-0.1 m and 0.1-0.2 m depth of in each subplot and the available P, K^+, Ca^{2+}, and Mg^{2+} were evaluated by the ion exchange resin method (Raij et al. 2001).

The evaluation of the forage yield was divided into two productive cycles: i) October to March - without hydric deficit), in which four cuts were made, and ii) April to June – with hydric deficit, corresponding to the dry period, one cut was made. The shoot dry weight (SDW) yield was measured from the forage harvest in 0.5 m^2 (1.0 m × 0.5 m), in each plot, when the plants of the best plots reached on average approximately 30 cm in height. The forage cut was at 10 cm of soil height to obtain the shoot fresh weight (SFW) in the following dates: 10/19/2015, 11/30/2015, 01/20/2016, 03/15/2016, and 06/22/2016. The samples were oven dried with forced air circulation at 65ºC until constant weight (Silva and Queiroz 2002). The rearing of grass in experimental area was performed after sampling in a grazing system with heifers until reaching the residue around 10 cm in height. Forage of the third and fifth cuttings was used for macronutrients analysis (N, P, K, Ca, Mg, and S), the two cuttings being representative, respectively. The forage after drying was ground in a Willey mill, and then the acid digestions [sulfuric acid (N) or nitric-perchloric acid (P, K, Ca, Mg, and S)] were performed as described by Malavolta, Vitti, and Oliveira 1997).

The results were tested for errors normality, variance homogeneity and statistical analyzes (Shapiro and Wilk 1965). The results were submitted to ANOVA, F test and Scott-Knott's test for multiple means comparison at 5% significance.

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3. Results and Discussion

The P, K^+, Ca^{2+} and Mg^{2+} levels in the soil, in the 0.0-0.1 m and 0.1-0.2 m depth showed a significant interaction between soil management strategies × P fertilization (Table 1). The P fertilization performed annually for four years, since 2011, provided P accumulation, mainly in the 0.0-0.1 m depth, presenting higher values to the treatments without fertilization. These results showed that soil fertility can be constructed under pasture conditions and corroborate Sansonowicz, Lobato, and Goedert (1987) on the positive effect of P application on the increase of soil fertility. Due to the pasture fertilization being superficial, the available P concentration was higher in the 0.0-0.1 m compared to 0.1-0.2 m depth. However, it is possible to observe that in the deeper layer there was also an increase in the P concentration, which shows that, although slow, there is the nutrient movement the in the soil profile. Another factor that should be highlighted in pasture conditions is that there is no soil rotation, which reduces P fixation, as well as soil erosion rate is also lower relative to annual crop systems (Santos et al. 2008). Regarding the soil management strategies, the lowest P levels were in scarification and plowing + harrowing, which may be involved with greater soil movement with these agricultural operations and promote nutrient fixation (Cubilla et al. 2007).

Even in the management systems without P fertilization, there was an increase in P levels in relation to the initial soil chemical analysis (3.5 mg $kg^{-1)}$, value inside the same interpretation range indicated as low in the soil (Raij et al. 1996). These results can be attributed to the increase of SOM mineralization during the experimental period (Ferreira et al. 2014). The exchangeable K in 0.0-0.1 m and 0.1-0.2 m depth, although showing statistical variation, the results are very close to the effects of soil availability (Table 1). All values of this study are in the range of critical level from low to medium availability (Raij et al. 1996). It was possible to verify that the K concentration was lower than those found at time of experiment installation, even with annual nutrient application, according to recommendation described by Werner et al. (1997). Possibly, it attributed to the fact the large amount required by the forage plants, as well as being a nutrient that is readily available in the soil to absorb the plant and be quite mobile in the soil, facilitating leaching, especially in soils with medium texture (Heinrichs and Soares Filho 2014).

Table 1. Soil organic matter (SOM), phosphorus (P), potassium (K^+), calcium (Ca^{2+}), and magnesium (Mg^{2+}) concentrations of different soil depths in *Urochloa decumbens* in different soil management system and with or without of P fertilization.

Treatment	Soil management						
	T_1	T_2	T_3	T_4	T_5	T_6	T_7
				SOM (g kg^{-1})			
				0.0 - 0.1 m			
Without P	15.0	17.0	16.3	18.5	18.5	17.3	15.3
With P	16.5	16.0	16.5	17.0	15.8	15.0	13.5
CV (%)	19.6						
				0.1 - 0.2 m			
Without P	14.0	14.3	14.5	14.8	13.5	14. 0	13.5
With P	14.0	14.3	13.0	12.5	12.3	12.3	12.5
CV (%)	11.4						
				P (mg kg^{-1})			
				0.0 - 0.1 m			
Without P	5.0b	7.5b	7.0b	6.5b	5.0b	7.5b	7.0b
With P	26.5Aa	24.0Aa	24.5Aa	27.5Aa	21.0Ba	25.0Aa	18.5Ba
CV (%)	18.2						
				0.1 - 0.2 m			
Without P	2.0b	4.0b	4.0b	5.5	3.0b	6.5b	2.0b
With P	17.0a	11.0a	10.5a	9.5	9.0a	13.5a	6.5a
CV (%)	28.9						
				K (mmol$_c$ kg^{-1})			
				0.0 - 0.1 m			
Without P	1.5Ba	0.9Db	1.7Aa	1.5 B	1.2 Cb	1.3 Cb	1.7A
With P	1.3Bb	1.2Ba	1.0Bb	1.5 A	1.4 Aa	1.7 Aa	1.6A
CV (%)	9.9						
				0.1 - 0.2 m			
Without P	1.3Ba	1.2Ba	1.6Aa	1.7Aa	1.2Ba	1.3B	1.7Aa
With P	1.0Bb	0.9Bb	1.1Bb	1.4Ab	0.8Bb	1.2 A	1.3Ab
CV (%)	14.0						
				Ca (mmol$_c$ kg^{-1})			
				0.0 - 0.1 m			
Without P	10.5Cb	14.0Ab	9.5Cb	12.5Bb	11.5Bb	12.0B	9.5C
With P	17.5Aa	16.5Aa	12.5Ca	15.5Ba	15.0Ba	12.0C	8.5D
CV (%)	9.5						
				0.1 - 0.2 m			
Without P	7.0Cb	11.5A	9.0B	9.5B	8.0Cb	10.0B	7.5C
With P	12.0Aa	12.5A	7.5C	9.0C	10.5Ba	9.5C	8.0C
CV (%)	11.6						
				Mg (mmol$_c$ kg^{-1})			
				0.0 - 0.1 m			
Without P	5.5Ca	9.5Aa	6.0Ca	8.0Ba	6.5C	5.5C	4.5D
With P	3.5Cb	6.5Ab	4.0Cb	3.0Cb	5.5B	5.0B	3.5C
CV (%)	19.0						
				0.1 - 0.2 m			
Without P	5.0C	7.0Aa	4.5Ca	6.0B	4.5Ca	4.5Ca	4.0C
With P	4.5B	6.0Ab	3.5Bb	5.5A	3.5Bb	3.5Bb	4.0B
CV (%)	14.5						

T_1 = *U. decumbens* - control; T_2 = no-till without desiccation; T_3 = partial desiccation; T_4 = total desiccation; T_5 = soil scarification; T_6 = plowing; T_7 = plowing + harrowing. Without P = no phosphate fertilization; with P = with phosphate fertilization. CV (%) = coefficient of variation; P, K, Ca and Mg: extracted with ion exchange resin. Means followed by lower case letters in the columns and upper case in the lines differ from each other to 5% probability by the Scott-Knott test.

In relation to Ca^{2+}, the P fertilization contributed to increase the Ca^{2+} concentration in the 0.0-0.1 depth, and this result was attributed to the Ca presence (18 - 20%) in the phosphate source used in this study (superphosphate simple – 20% Ca). In general, the Ca^{2+} concentration were above 7.0 $mmol_c\ kg^{-1}$, considered as high availability (Raij et al. 1996). While the Mg^{2+} presented values between 3.5- to 9.5 $mmol_c\ kg^{-1}$, considered as average availability for forage plants (Raij et al. 1996).

In relation to the initial soil chemical analysis, it is observed the soil maintenance the values of P, K^+, Ca^{2+}, and Mg^{2+}. However, in relation to the values found after two years of implementation of management and fertilization systems (Rebonatti et al. 2016), there was chemical fertility recovery, since the management systems allow the cycling of nutrients that were extracted by the plants, especially those associated with no-tillage system. Although the SOM did not present a significant effect among the legume introduction systems, there was an increase in its concentration when compared with data found by Rebonatti et al. (2016) in same edaphic conditions.

The shoot dry weight (SDW) yield in each cut and the total did not present significant interaction between *Stylosanthess* and P fertilization. However, the P fertilization showed difference in presence or absence of application. The four initial cuts comprise the period without hydric stress (spring and summer), while the fifth cutting corresponds to period with hydric stress (autumn) (Table 2).

Table 2. Shoot dry weight (SDW) yield per cutting and SDW of *Urochloa decumbens* in different soil management system and with or without of P fertilization.

Treatments	1st Cutting	2nd Cutting	3th Cutting	4th Cutting	5th Cutting	Total
	----------	----------	---------- kg ha^{-1}	----------	----------	----------
T_1	2,777A	2,098B	2,143B	2,827A	2,448B	12,293
T_2	2,478 A	1,817B	1,713B	2,151B	2,736A	10,895
T_3	2,402	1,908	2,201	2,477	2,358	11,346
T_4	2,299	2,185	2,205	2,310	2,710	11,711
T_5	2,566A	2,101B	1,907B	2,699A	2,487A	11,760
T_6	2,686A	1,834B	2,520A	2,413A	2,564A	12,017
T_7	2,061	1,850	2,313	2,637	2,368	11,230
Without P	2,310a	1,944a	1,980b	2,353b	2,246b	10,833b
With P	2,623a	1,997a	2,307a	2,651a	2,803a	12,381a
CV (%)	26.4	25.7	21.6	25.9	25.3	

T_1 = *U. decumbens* control; T_2 = no-till without desiccation; T_3 = partial desiccation; T_4 = total desiccation; T_5 = soil scarification; T_6 = plowing; T_7 = plowing + harrowing. CV (%) = coefficient of variation. Means followed by lower case letters in the columns and upper case in the lines differ from each other to 5% probability by the Scott-Knott test.

Except for the control, the fifth cutting, which represents the cut during the rainy season, is among the highest yield averages. This result can be attributed to rainfall during the autumn period (Figure 1), that is usually characterized by long dry season. From the third to the fifth cut and the total yield in the period presented higher SDW with P presence. These results can be attributed by the beginning of the rainy season, in which the plants were not yet in full development caused by the stress during the dry season, as well as due to the pasture fertilization system, which is performed in and requires a longer period for soil incorporation, especially P that presents low soil mobility. The results corroborate Rebonatti et al. (2016), on study carried out in previous years, in same edaphic conditions.

The SDW in autumn and period without hydric stress (spring and summer) were similar and did not present significance in the partial desiccation (T_3), total desiccation (T_4) and plowing + harrow (T_7). These results occurred because the year 2016 was atypical, with regular rainfall during the period that is characterized by severe drought (Figure 1). The N, P, K, Ca, Mg and S did not present a significant interaction between *Stylosanthes* spp. × P rates. However, it presented significance for the two periods of hydric deficit and for presence and absence of P fertilization (Table 3).

The N concentration presented a significant difference between the 2 season periods with 9.9 g kg^{-1} in spring and summer and 7.9 g kg^{-1} in autumn (Table 3). Despite this difference in the two periods, in all treatments presented lower levels than those considered adequate for the *U. decumbens*, ranging from 12.0- to 20.0 g kg^{-1} (Werner et al. 1996). These effects showed that the *Stylosanthes* spp. does not contribute to increase the N concentration in total *U. decumbens* composition.

In relation to P concentration, the highest concentrations were associated to P fertilization, in both periods. In the spring and summer, the concentrations ranged from 1.4 g kg^{-1} and 2.0 g kg^{-1} and in autumn 1.4 g kg^{-1} and 2.1 g kg^{-1} (Table 3). These results with those of Ieiri et al. (2010) and Moreira and Malavolta (2001), that studying sources and P rates in pasture recovery area and alfalfa (*Medicago sativa* L.), respectively, obtained a significant response regarding the presence of P fertilization. Even with the difference in SDW, no difference was observed in relation to the periods evaluated (Table 3). Although the P values are in the range considered adequate for *U. decumbens* ranging from 0.8- to 3.0 g kg^{-1} (Werner et al. 1996), it is important to emphasize the contribution of phosphate fertilization on forage quality in relation to the P presence in the animal diet.

Table 3. Macronutrient concentrations in shoot dry of the *Urochloa decumbens* in different soil management conditions and with or without of P fertilization: a) without hydric deficit, WTDH [spring and summer (third cutting)] and b) with hydric deficit, WDH [autumn (fifth cutting)].

	N		P		K		Ca		Mg		S	
Treatments	WTDH	WDH	WTDH	WDH	WTDH	WDH	WTDH	WDH	WTDH	WDH	WTDH	WDH
	---------- g kg $^{-1}$ ----------											
T_1	9.5	9.0	1.6	1.8	18.0A	13.8B	1.9B	2.3A	1. 7	1.6	1.2	1.4
T_2	9.6	8.4	1.7	1.8	17.5A	13.0B	2.0B	2.4A	1.9A	1.7B	1.3	1.4
T_3	9.0	8.7	1.6	1.8	17.5	15.0	2.0	2.6	1.7	1.7	1.2	1.4
T_4	9.9A	7.9B	1.8	1.8	18.1A	13.4B	1.8B	2.4A	1.7	1.5	1.2	1.3
T_5	8.7	8.6	1.8	1.7	16.4	13.2	2.3	2.4	1.8	1.5	1.3	1.4
T_6	9.7	8.2	1.8	1.7	18.0A	13.0B	1.9B	2.4A	1.7	1.6	1.4	1.4
T_7	9.8	8.5	1.7	1.7	17.9	13.1	2.2	2.4	1.9A	1.5B	1.3	1.4
Without P	9.2	8.4	1.5 b	1.4 b	17.4	13.2	2.0	2.5	1.8	1.6	1.2	1.4
With P	9.2	8.6	1.9 a	2.1 a	17.8	13.8	2.0	2.3	1.7	1.5	1.3	1.4
CV (%)	19.1	16.6	32.1	18.8	28.2	16.9	17.5	25.5	15.1	13.4	22.5	10.9

T_1 = *U. decumbens* - control; T_2 = no-till without desiccation; T_3 = partial desiccation; T_4 = total desiccation; T_5 = soil scarification; T_6 = plowing; T_7 = plowing + harrowing. CV (%) = coefficient of variation. Means followed by lower case letters in the columns and upper case in the lines differ from each other to a 5% probability by the Scott-Knott test.

In the period without hydric stress, the K concentration was higher in relation to the period with hydric stress, except in the partial desiccation, soil scarification and plowing + harrowing systems. This result can be associated to nutrient dynamics in the soil, which in the presence of moisture occurs greater availability and diffusion in the soil, increasing its uptake (Havlin et al. 2005). However, due to hydric restriction, the total ions concentration in solution increases, but the Ca^{2+} and Mg^{2+} concentrations increase faster than K, because the cation ratio activity in solution is constant (Gapon Equation), which explains the lower K uptake in autumn and higher Ca uptake (Table 3). Therefore, it is necessary to provide all nutrients in a balanced manner to reduce the conditions limiting the growth and plants development (Fernandes 2006). In general, the K concentrations are within the range considered adequate for grazing (Werner et al. 1996). Despite the presence of sulphate (12%

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S) in simple superphosphate, the Mg and S concentrations, the values are within the range considered adequate and can be considered random within the experimental study. The reference values for plant nutrition suitable for Mg and S are, respectively, 1.5- to 4.0 g kg^{-1} e 0.8- to 2.5 g kg^{-1} (Werner et al. 1996).

4. Conclusion

After four years of experiments, the soil management strategies for the introduction of *Stylosanthes* spp. in *U. decumbens* grazing did not affect the soil chemical properties and the SDW yield was not significant. The P fertilization in the soil increase in relation to the find values in the implantation of the experiment, especially in the treatments with nutrient application, and the soil fertility construction took place. Phosphorus fertilization provide higher P concentration in forage and increase SDW yield. No significant differences were observed in the N, K, Ca, and Mg concentration in SDW of *U. decumbens* with introduction of *Stylosanthes* spp. and P fertilization. At 0.00-0.10 and 0.10-0.20 m depths, regardless of the management system, the P application of altered the K, Ca and Mg contents of the soil.

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