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Introdução de Coastcross-1 sob doses de fósforo e densidades de mudas em área com leguminosas

Introduction of Coastcross-1 under phosphorus doses and densities of seedlings in area with legumes

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RESUMO

Objetivou-se com este trabalho, avaliar estratégias de estabelecimento de consórcio em áreas de pastagens com predominância de leguminosas da espécie *Arachis pintoi*, utilizando doses de adubo fosfatado e densidades de mudas de Coastcross-1. O delineamento experimental foi de blocos ao acaso, com quatro repetições em esquema fatorial 4x4, utilizando quatro doses de fósforo (50; 80; 110 e 140kg ha^{-1}) e quatro densidades de mudas (3,1; 4,2; 6,3 e 12,5 mudas/m²). Os efeitos das densidades de mudas e doses de fósforo foram analisados por meio de teste de regressão a 10% de probabilidade. As variáveis avaliadas foram: produção de massa de forragem total, composição botânica e morfológica. Houve efeito significativo das doses de fósforo na relação folha/colmo da gramínea; das densidades de mudas na produção de massa de forragem total, na composição botânica e morfológica das forrageiras e das datas de colheita para a produção de massa de forragem e composição botânica. Pôde-se inferir que o uso de maiores densidades de mudas de Coastcross-1 beneficiou o estabelecimento da gramínea em áreas em que predominam leguminosas. No entanto, não atingiu população suficiente para ser considerada ideal para a recuperação da pastagem da gramínea.

Palavras-chave: *Arachis pintoi*, adubações fosfatadas, consórcio, *Cynodon dactylon*

SUMMARY

The aim of this study was to evaluate strategies for establishing consortium pastures with the predominance of the legume species *Arachis pintoi* using doses of phosphorus and density of seedlings Coastcross-1. The experimental design was a randomized block with four replications in a factorial 4x4, using four doses of phosphorus (50; 80; 110 and 140kg ha^{-1}) and four densities of seedlings (3.1, 4.2, 6.3 and 12.5 seedlings/m²). The effects of seedlings densities and phosphorus doses were analyzed through regression testing at 10% probability. The variables evaluated were: production of total forage mass, botanical and morphology composition. There was significant effect of phosphorus doses in leaf/stem ratio of grass; of the densities of seedlings in the production of total forage mass, in botanical and morphological composition of forage and harvest dates for the production of forage mass and botanical composition. It might be inferred that the use of higher densities of seedlings Coastcross-1 benefited the establishment of grass in areas which there is the predominance of legumes. However, it has not achieved sufficient population to be considered ideal for the recovery of the grass pasture.

Keywords: *Arachis pintoi*, consortium, *Cynodon dactylon*, phosphate fertilizations

INTRODUCTION

Phosphorus, after nitrogen, is the most limiting factor for biomass productivity in tropical and subtropical soils, and this high demand by plants, associated with the small amount of available phosphorus, results in a drop in productivity of these areas. The use of fertilizers increases the dry matter production of plants as well as improves the nutritional value of the forage. However, it also raises the cost of production, making investments for maintenance of pastures inadequate, hampering sustainability in livestock systems.

The use of leguminous plants in association with the grasses is a practical of low cost, which can improve the quality of the animal's diet, as well as the supply of nitrogen to the soil and plants by biological fixation of nitrogen, with decomposition of roots and nodules of plants, of wasted leaves and stems (litter) and of feces and urine of animals, reducing the need for chemical fertilizers, resulting in lower spending on fertilizers. However, it is still not widely used in tropical conditions, because of the limited information on their management, most suitable species to consort with each grass and each climatic environment or ecosystem.

The proportion of forage in a mixed pasture depends on a few factors, such as competition for area, nutrients and water (BARBERO et al., 2009), the frequency, intensity grazing and stocking rates (NASCIMENTO, 2006), the acceptability and selectivity of grazing animals and the distribution of species in the canopy forage (BAUER et al., 2008).

Observing the different responses of forage in a consortium system and considering that phosphate fertilizers positively affects root growth and tillering of the grass, it was proposed this paper, in order to evaluate the effect of phosphorus and density of seedlings in the introduction of Coastcross-1 in grassland areas with leguminous species *Arachis pintoi*.

MATERIAL AND METHODS

The experiment was conducted at Itutinga, Minas Gerais, Brazil (21°17'52"S, 44º39'28"W, at 1,136m altitude) and the experimental period was from November 2011 to June 2012. The climate of the region, according to the Köppen classification, is the transition type Cwb and Cwa, being temperate humid, with dry winter and hot summer.

The data from the analysis of soil, depth 0-20cm were: pH in water = 5.3, P (Mehlich-1) = 1.03mg dm^{-3}, K (Mehlich-1) = 28.3mg dm^{-3}, Ca^{2+} = 0.5$cmol_c$ dm^{-3}, Mg^{2+} = 0.17$cmol_c$ dm^{-3}, Al^{3+} = 0.3$cmol_c$ dm^{-3}, $H+Al^{3+}$ = 3.7 $cmol_c$ dm^{-3}, MO = 2.8 dag^{-1} and Prem = 13.6 mg L^{-1}. According to these results, it was performed correction and fertilizer of soil, based on the recommendations for the use of correctives and fertilizers in Minas Gerais: 5th approach, whereas the grasses *Cynodon* are classified as being at high technological level (CANTARUTTI et al., 1999).

The experimental area of 512m^2 was divided into small plots of 8m^2 and received, in total area, 1.5t ha^{-1} of limestone in early November 2011 to correct soil acidity and raise the base saturation to 60%. In December 2011, were open furrows spaced approximately 0.8m applied 60kg ha^{-1} of K_2O in the form of potassium chloride, 20 kg ha^{-1} of N as ammonium sulfate and the doses of

50; 80; 110 and 140kg ha^{-1} of phosphorus (P_2O_5) as superphosphate form located in the groove. Then, the seedlings Coastcross-1, comprising stolons with an average length of 50cm, were placed perpendicularly in furrow and spaced of 10; 20; 30, and 40cm to obtain the densities of 12.5, 6.3, 4.2 and 3.1 seedlings/m², respectively. Each plot contained four grooves and, to avoid residual effects of treatments, was used the area of influence of the two central lines of the plot (approximately 3.3m^2) for data taking, considering, for this, 0.5m surround. During the experimental period, two potassic fertilizer topdressings were done, using 80 and 60kg ha^{-1}, respectively.

The cuts were made at 105 and 168 days after planting, and these dates were determined once detected seedling growth Coastcross-1 to obtain sufficient forage mass. Forage samples were taken from each plot and encompassed grass and legume, cut close to the ground, removing the remaining forage. The samples were weighed in the field with scale type dynamometer and taken to the laboratory Animal Research of the Department of Animal Science, Federal University of Lavras, Minas Gerais, for processing.

A sub sample of approximately 250g was used to determine the morphological composition of the pasture and leaf/stem ratio (L/S) of grass, which is separated into leaf and stem of grass (LG and SG), leaf and stalks of legumes (LL and SL) and dead material (DM) forages. From the remaining dough, samples were taken to determine the production of total forage mass (PFM in t ha^{-1} dry matter), herbage mass of grass (MG) and herbage mass of legumes (ML).

All samples were placed in paper bags and taken to greenhouse forced circulation at a temperature of 60ºC until constant weight and, after this process, were ground in a mill type Willey, with the sieve of steel with sieves of 1mm for the determination of dry matter at 105ºC.

The experimental design was a randomized block with four replications in a factorial design (4x4) with four doses of phosphorus and four densities of seedlings of the grass, totaling 64 plots. The results were statistically analyzed using a mixed model by MIXED procedure of SAS version 9.1. (STATISTICAL ANALYSIS SYSTEM, 1999). The effects of seedling densities and doses of phosphorus were analyzed using regression test at 10% probability.

RESULTS AND DISCUSSION

The data relating to the production of forage mass (PFM), proportion of grass and legume can be seen in Table 1. The phosphorus levels did not influence (P> 0.1) in total PFM consortium and the proportion of grass and legume. For the PFM, it was observed an increasing trend of 1.22 to 1.36t ha^{-1} when doses were 50 to 140kg ha^{-1} P_2O_5, probably due to greater tillering and leaf production, a result of the increasing availability of P_2O_5 in the soil.

The low phosphorus content in soil is one of the most serious problems to maintain pasture productivity. However, the amount of fertilizer applied is extremely important in the cultivation of forage, both in agronomic and economic terms, since the application of large doses may cause deficiency of other nutrients, such as iron (Fe) and aluminum (Al), damaging forage production (VILAR et al., 2010) as observed when the dose was increased up to 140 to 110kg ha^{-1} P_2O_5.

Table 1. Production of forage mass (PFM) and proportion (%) of grass and legume mixed under different doses of phosphorus (P_2O_5) at two harvest dates (HD)

Item	Doses of P_2O_5 (kg ha^{-1})				Mean	P value
	50	80	110	140		
PFM (t ha^{-1})	1.22	1.43	1.43	1.36	1.36	0.17
Grass (%)	42.0	57.9	54.2	57.9	53.0	0.35
Legume (%)	58.0	42.1	45.9	42.1	47.0	0.35
	HD[1]					
	105		168			
PFM (t ha^{-1})	1.71		1.01		1.36	<0.0001*
Grass (%)	57.5		48.6		53.1	<0.0001*
Legume (%)	42.6		51.4		47.0	<0.0001*

[1]In days after planting, *P <0.1, PFM = Production of Forage Mass.

The harvest dates influenced (P<0.1) in the PFM observed is reduced according to harvest dates. The second cut was made 63 days after the first and, thus, lower forage mass was produced, probably at the beginning of the experimental period the grass was still in the establishment phase, and after the first cut, regrowth of the grass was more effective in a shorter period of time. Another factor that may have influenced the lower PFM in the second cut, the environmental conditions were unfavorable to the development of Coastcross-1, which was not fully established, but favorable to the growth of peanuts, a legume which is already resistant to cold, and rose with greater coverage area of the consortium, but not enough to maintain pasture productivity.

Paciullo et al. (2003) evaluated the productivity and quality characteristics of *Brachiaria* pasture in monoculture and associated with *Stylosanthes* during the months of the year and found an average of 1.48kg ha^{-1} for the production of forage mass during the year. For the months of March and May, respectively (similar to the present study), the averages were 1.54 and 1.65kg ha^{-1} of dry matter, concluding that, besides influencing the growth of grass, *Stylosanthes guianensis* contributed to the increase in total forage mass of mixed pasture.

The harvest dates also influenced (P<0.1) in the botanical composition, and at the second cut, the lower participation of the grass in the consortium was due to the low efficiency in regrowth after the first cut, tied to differences in environmental conditions unfavorable to the grassy and less effect on the legume, and the competition for nutrients between the area and forage.

Aroeira et al. (2005) evaluated the botanical composition of pastures consortium of *Brachiaria decumbens* cv. Basilisk with *Stylosanthes guianensis* var. vulgaris cv. Mineirão and legume trees for two years and found out that the percentage of legume in the pasture remained constant during the rainy months (26% to 29%), reached the highest value (56%) during the late dry season (October) and decreased with the beginning of the rainy season (December), concluding that the variation in the percentage of legumes throughout the experimental period was

affected mainly by the dry matter of *Brachiaria decumbens* in different months of the year.

The densities of seedlings Coastcross-1 influenced (P<0.1) in the PFM and the botanical composition of the pasture. The data can be seen in Figures 1 and 2. The PFM was higher when the density of seedlings Coastcross-1 was 12.5 seedlings/m² it being possible to conclude that as one increases the density of seedlings at planting Coastcross-1, the PFM will be higher due to higher contribution of the grass. To this fact, it can also assign the lowest proportion of grass and a higher proportion of legumes.

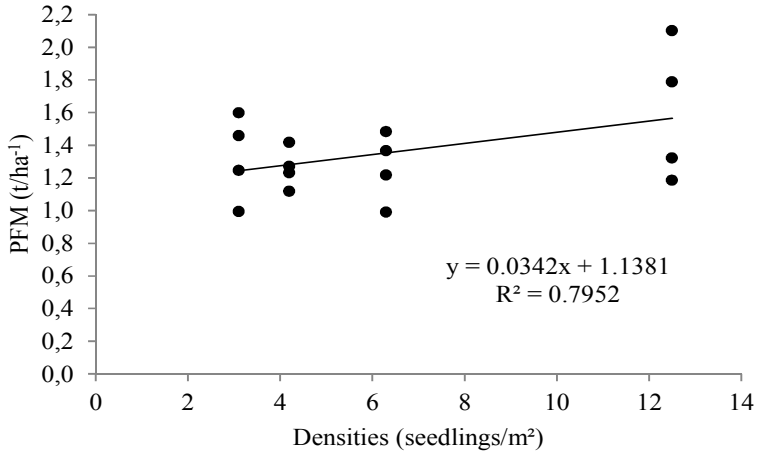

Figure 1. Production of total Forage Mass (PFM) on the different densities of seedlings Coasstcross-1 in a mixed system

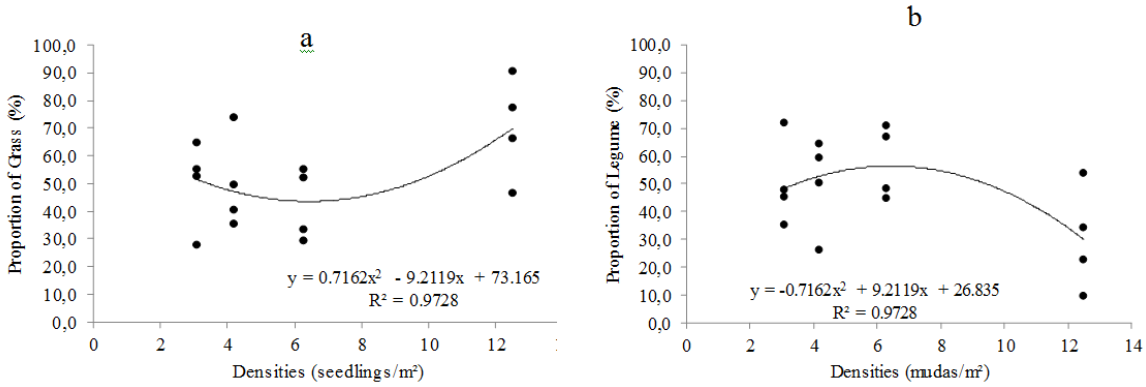

Figure 2. Proportion of grasses (a) and legumes (b) according to the density of seedlings Coastcross-1 in a mixed system

There was no significant effect (P>0.1) of the interaction between levels of phosphorus and density of seedlings Coastcross-1 in the botanical composition of the pasture. From Figure 2 a and b, it can be seen that when using higher

densities of seedlings Coastcross-1 (12.5 seedlings/m²) occurs an increased production of herbage mass (Figure 1) due to the higher number of buds for rooting and greater emission of stolons compared with lower densities (3.1 seedlings/m², for example), providing greater participation of grass and lower participation of legume in the pasture system (approximately 30%).

There was influence of phosphorus levels ($P<0.1$) in the leaf/steams ratio (L/S) of grass with reduced quadratically (Figure 3) to the estimated dose of 101kg ha^{-1} of P_2O_5, to stimulate more growth of stolons over the leaves, remembering that this nutrient is involved in essential processes to plants such as respiration, photosynthesis and protein regulation directly influencing the development mainly of the root system as well as the tillering of grasses and consequently the production of leaves and stems/stalks (SILVA & DELATORRE, 2009). For the other morphological components, there was no significant effect ($P>0.1$) of doses.

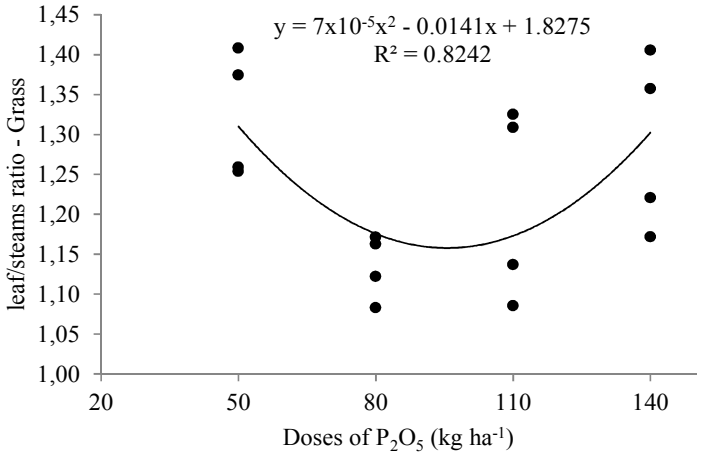

Figure 3. Leaf/Stem ratio of Grass Coastcross-1 under doses of phosphorus (P_2O_5)

According to Paris et al. (2009), the amount of morphological constituents of the grass Coastcross-1 depends on several factors such as the level of nitrogen fertilization, climatic conditions, the supply of forage, the forage species, the management type and other factors intrinsic to the medium carrying an effect on production and botanical composition of the pasture. Barbero et al. (2009) evaluated the production of forage and morphological components in Coastcross-1 intercropped with peanut and they found medium values for the ratio L/S of 0.52, lower than the values found in this work.

The densities of seedlings Coastcross-1 significantly influenced ($P<0.1$) in the percentage of leaves and stems of grass (Figure 4) and leaves and stalks of legumes (Figure 5).

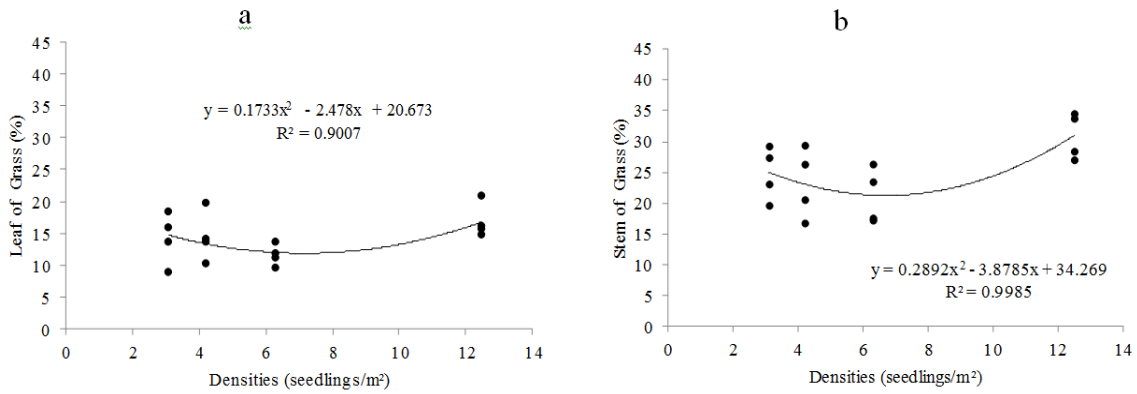

Figure 4. Proportion of Leaf (a) and Stem (b) of Grass according to the density of seedlings Coastcross-1 in a mixed system

The percentage of leaves and stems of grass were responding quadratic, with higher proportions in the highest density (12.5 seedlings/m²), which was expected, since the more Coastcross-1 seedlings were placed in the groove, the greater the proportion of grass in the consortium. Accordingly, the proportion of morphological components of legume exhibited the opposite behavior, and to the proportion of legume leaf was a quadratic response to approximate density of 6.9 seedlings/m² and the proportion of stalks, the response was linear with higher values at lower densities of seedlings Coastcross-1, as seen in Figure 5.

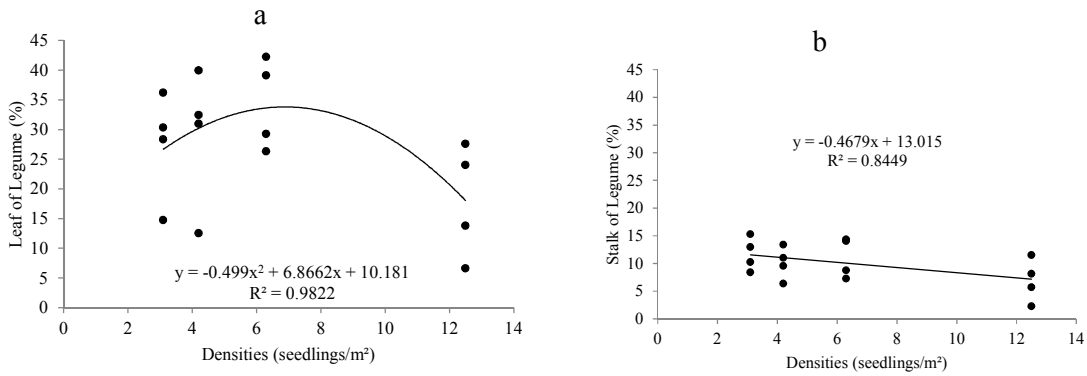

Figure 5. Proportion of Leaf (a) and Stalk (b) of Legume *Arachis pintoi* sp. according to the density of seedlings Coastcross-1 in a mixed system

For the leaf/stem ratio of grass and proportion of dead material of forage, there was no significant effect (P>0.1) of densities of seedlings Coastcross-1. The mean of these parameters was 1.24 and 23.6%, respectively.

The harvest dates did not affect (P>0.1) on morphology, except for the proportion of stalks of legumes (P<0.1) which was higher in the second harvest, probably due to the better condition of establishment where peanuts were and stood by the increasing competition for

the area between the forages. The data are shown in Table 3.

According to Nascimento (2006), in shaded conditions or at a certain stage of growth, the peanut has more vertical growth with greater stem elongation and reduced leaf density. In this case, it shows reductions in the size of leaves and internodes spacing for greater protection of growth points, ensuring greater persistence explaining also the reduction in the percentage of leaves of legumes.

Table 3. Morphological characteristics of Coastcross-1 and peanut mixed according to the harvest dates (HD)

Item	HD[1]		Mean	P value
	105	168		
L/S ratio	1.22 ± 0.04[2]	1.26 ± 0.04	1.24	0.53
LG (%)	13.7 ± 1.1	14.7 ± 0.7	14.2	0.36
SG (%)	25.8 ± 1.6	24.4 ± 1.2	25.1	0.32
LL (%)	27.9 ± 2.2	26.4 ± 2.2	27.1	0.41
SL (%)	9.2 ± 1.0	10.8 ± 0.7	10.0	0.08*
DM (%)	23.5 ± 1.4	23.8 ± 1.4	23.6	0.84

[1]In days after planting; [2]Standard Error of the Mean, *P <0.1, L/S ratio = leaf/stem of grass, LG and CS = proportion of leaves and stems of grass, LL and SL = proportion of leaves and stalks of the legume, DM = dead material of forage.

Gobbi et al. (2009), evaluating levels of shading in areas of *Brachiaria* and peanut planted in monoculture, noted that in sunny conditions, similar to the present study, the mean percentage of leaves and stalks of the legume in two harvest periods was 67% and 33%, respectively. For grass, the average percentage of leaves, stems and L/S ratio in the three harvest periods was 54.2%, 36.5% and 1.5, respectively. The percentage of dead material was measured only in the third cut and presented values around 21.4%, similar to the values found in this experiment. Despite presenting differences in nutritional value, *Cynodon* and *Brachiaria* grasses are from the same family (Poaceae) and have the same C4 photosynthetic pathway.

Therefore, although insufficient, the use of higher densities of seedlings Coastcross-1 and levels of phosphorus within the recommended contributed to greater participation of the grass in the implementation phase of the consortium.

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