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Article

Weeds Interference in Pequi Plants

Interferência de Plantas Daninhas em Plantas de Pequi

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ABSTRACT - Pequi plants are native fruit species of the Cerrado and is at risk of extinction due to the destruction of native vegetation and the extraction of their fruits. Because this species has a long juvenile period, it becomes susceptible to the interference of weeds, mainly forage grass. This research aimed to evaluate the effects of forage grass species coexisting with small seedlings. The treatments, arranged in a factorial scheme, consisted of three weed species *(Melinis minutiflora*, *Paspalum notatum* and *Urochloa decumbens)* coexisting in four densities (1, 2, 3, and 4 plants per pot) with pequi plants. As an additional treatment a pequi plant was cultivated free of coexistence. The physiological variables photosynthetic rate *(A),* stomatal conductance (g_s), transpiration rate *(E) Ci/Ca relation,* the effective quantum yield of PS II, transport rate of electrons and non-photochemical quenching, and growth variables: height (PH), Leaf area (LA) and dry matter (DM) were affected by weed coexistence. *U. decumbens* promoted greater intensity interference with pequi plants. The degree of interference was greater with increasing density of weeds, with linear decreasing behavior for the variables *A*, g_s, *E*, PH, LA, MD, stem diameter and number of leaves of pequi plants.

Keywords: *Caryocar brasiliense*, *Urochloa decumbens*, *Melinis minutiflora*, *Paspalum notatum*.

*RESUMO - O pequizeiro, espécie frutífera nativa do cerrado, encontra-se em risco de extinção devido à destruição de vegetações nativas e pelo extrativismo de seus frutos. Por ser uma espécie de período juvenil longo, torna-se sensível à interferência imposta por plantas daninhas, principalmente gramíneas forrageiras. Nesta pesquisa, objetivou-se avaliar os efeitos da interferência causada por gramíneas forrageiras convivendo com plantas de pequi. Os tratamentos, arranjados em esquema fatorial, constituíram-se de três espécies de plantas daninhas (**Melinis minutiflora, Paspalum notatum** e **Urochloa decumbens**) convivendo em quatro densidades (1, 2, 3 e 4 plantas por vaso) com as mudas de pequizeiro. Como tratamento adicional, foi cultivada uma planta de pequi livre de convivência. As variáveis fisiológicas taxa fotossintética (A), condutância estomática (g_s), taxa transpiratória (E), relação Ci/Ca, rendimento quântico efetivo do FS II, taxa de transporte de elétrons e quenching não fotoquímico e as variáveis de crescimento altura (AP), área foliar (AF) e massa seca (MS) foram afetadas pela convivência das plantas daninhas, após 75 dias de convivência. **U. decumbens** promoveu maior intensidade de interferência com plantas de pequi. O grau de interferência foi maior com o aumento da densidade das plantas daninhas, com comportamento linear decrescente para as variáveis A, g_s, E, AP, AF, MS, diâmetro do caule e número de folhas do pequizeiro.*

Palavras-chave: *Caryocar brasiliense*, *Urochloa decumbens*, *Melinis minutiflora*, *Paspalum notatum*.

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INTRODUCTION

The cerrado, according to the Brazilian biome in extension, occupies approximately 23% of the national territory and it is distributed in the states of Goiás, Tocantins, Mato Grosso, Mato Grosso do Sul, Bahia, Minas Gerais, São Paulo and Maranhão (Queiroz, 2009). Biodiversity of this biome has been gradually reduced by the establishment of extensive areas of agricultural activities. Thus, several fruit species native to the cerrado are threatened with extinction (Cunha et al., 2008; Naves et al., 2010). Among them, the pequi plants *(Caryocar brasiliense* Camb.) a semi-deciduous plant, heliophytic selective xerófita considered a typical native fruit from the Brazilian cerrado (Lorenzi, 2014). The importance of this species is acknowledged by Brazilian legislation, which prohibits the cutting and commercialization of its wood. This is due, besides the importance of human diet, to the fact that pequi can be used to rebuild native vegetation, favoring the control of erosion and biodiversity by the presence of endangered animals in their natural habitat (Alves Júnior et al., 2015).

Both in areas of native vegetation restoration and areas of natural occurrence of pequi, note the presence of weeds, especially forage grasses, which may compromise their establishment due to the long juvenile period. Grasses, especially from *Urochloa*, *Melinis* and *Hyparrhenia* are aggressive weeds, with C4 metabolism, have low forage value and are perennial unwieldy, considered the most important group of weeds because of the damage they can cause (Pereira et al., 2006).

Most of the pastures of Brazil predominate the species of the genus *Urochloa* (syn *Brachiaria)* due to low nutritional requirements of the species, tolerance to acidity and high dry matter yield (Silva et al., 2011). As an example, *U. decumbens* (signal grass) is an aggressive African grass difficult to control, especially in areas where it was introduced as a forage and later became tillage (Bianco et al., 2005). This species is also considered a difficult-to-control weed in conservation units, especially in cerrado and pantanal biomes (Alho et al., 2011). The African grass *Melinis minutiflora* P. Beauv. (molasses grass) shows aggressive characteristics similar to those of *U. decumbens* and has invaded large areas in protected areas in these biomes (Pivello et al., 1999; Alho et al, 2011.).

The species *Paspalum notatum* (grama-batatais) originates in South America and is a kind used in the formation of lawns with different purposes in residential areas, industrial, urban and highway (Gates et al. , 2004; Cidade et al, 2008). This species is considered native pasture in several regions of the country (Townsend, 2008). It is also found in areas of agricultural exploitation, mainly in the cerrado (Guglieri-Caporal et al., 2010).

Although few species of exotic plants become invasive of natural communities and limiting the maintenance of biodiversity (Nachtigal, 2009), it is noticeable that African grasses used as fodder have invasive potential in different ecosystems and provide economic and ecological impacts. Since weeping is widely used for reforestation, in addition to planting for consumption, weed competition is necessary in order to know whether the pequi tree establishes or excels after periods of coexistence. Given the above, the aim of this study was to evaluate the effects of interference of forage grasses *Melinis minutiflora*, *Paspalum notatum* and *Urochloa decumbens* in coexistence with pequi plants.

MATERIAL AND METHODS

This research has been carried out from April to August of 2015 in a temperature conditioned greenhouse. During the whole experimental period, the temperature inside the greenhouse varied between 22 and 29 °C, and the relative humidity, between 65 and 75%.

The soil used as substrate was from the arable layer of a Red Latosssolo dystrophic (Embrapa, 1999), which presented the following physicochemical characteristics: pH in $CaCl_2$ 5.6; 22.84 mg dm^{-3} of P; 190 mg dm^{-3} of K; 5.98 $cmol_c$ dm^3 Ca; 1.80 $cmol_c$ dm^{-3} of Mg; 2.80 $cmol_c$ dm^{-3} H + Al; 2.45 dag kg^{-1} of organic matter; And 74.7% base saturation. After being collected, the soil was sifted and fertilized in pots with a capacity of 18 liters (30 cm in diameter and 30 cm in height). Each vessel was fertilized with 100 g of single superphosphate and 20 g of potassium chloride.

Pequi seedlings, with an average height of 20 cm, were purchased in a nursery located in the city of Guapó, GO. After the transplanting of the seedlings, 1 g per pot of fertilizer containing N: 13 was used every 30 days; $P_2O_{5:}$ 5; K_2O: 13; B: 0.04; Ca: 1; Cu: 0.05; S: 5; Fe: 0.2; Mg: 1; Mn: 0.08; Mo: 0.005; and Zn: 0.15%. The vessels were irrigated whenever necessary, aiming at maintaining the humidity close to the field capacity.

Thirty days after transplanting the seedlings pequi, the coexistence of these treatments were started with the forage species *Melinis minutiflora Paspalum notatum* and *Urochloa decumbens.* Seeds of forage species were sown in plastic trays containing sieved soil plus fertilizer. The used mixture of substrate in the trays was similar to that used in the vessels. On the fifteenth day after the emergence of the weeds, the seedlings were transplanted to the pots with the pequi trees.

The experimental design was a completely randomized block design with four replications. The treatments were arranged in a 3 x 4 + 1 factorial scheme, being: three forage species and four cohabitation densities (1, 2, 3 and 4 plants per pot) with the pequi tree, plus an additional treatment, represented by the pequi free Coexistence with forage species. Each vessel constituted an experimental unit. The evaluated experimental period was considered after the beginning of the coexistence until the cut of the plants, totaling 75 days.

Gas exchange of pequi plants to record the photosynthetic rates were evaluated *(A,* μmol m^{-2} s^{-1}) and transpiration *(E,* mmol m^{-2} $s^{-1)}$, stomatal conductance ($g_{s,}$ mol H_2O m^{-2} s^{-1}) and the relationship between CO_2 internal and external concentration *(Ci/Ca).* These assessments were made using an automated analyzer photosynthesis, LI-6400XTR model (Licor ®, Nebraska, USA) with block temperature of 24 °C, and photon flux density of 1,000 μmol m^{-2} $s^{-1.}$ The evaluations were carried out at 75 days after the beginning of the coexistence between pequi and forage species, and specifically between 8:30 a.m. and 10:30 a.m. Evaluations were made on the penultimate pair of fully expanded leaves.

Fluorescence parameters were determined in the same leaves of gas exchange, using modulated fluorometer (MINI-PAM, Walz ®) (Bilger et al., 1995; Rascher et al., 2000). After 30 minutes of adaptation leaves the dark was measured the initial fluorescence (Fo) which is stimulated by low intensity of red light (0.03 μmol m^{2} $s^{1)}$. The maximal fluorescence (Fm) was obtained by applying a saturating light pulse actinic 0.8 seconds (> 3,000 μmol m^{-2} s^{-1}) and the potential quantum yield of photosystem II (PS II) has been calculated as (Fv/Fm) = (Fm-Fo)/Fm (van Kooten and Snel, 1990). In order to determine the effective quantum yield of PS II (ΔF/Fm'), a saturation pulse was superimposed on leaves previously adapted to ambient light, calculated as ΔF/Fm' = (Fm'-F)/Fm', where F represents the pre-pulse fluorescence and Fm', the maximum fluorescence after light pulse (Genty et al., 1989). The Af/Fm*'*, along with photosynthetically active radiation was used to estimate the apparent rate of electron transport (ETR mmol m^{-2} s^{-1}) (Bilger et al., 1995; Laisk and Loreto, 1996). The non-photochemical extinction coefficient (NPQ) was calculated as NPQ = ((Fm-Fm')/Fm') (Bilger and Björkman, 1990).

Accordingly, as described for the gas exchange, the evaluations with the fluorometer were performed between 8:30 and 10:30, always in the same area of each leaf, at 75 days after the beginning of the coexistence. Also in the morning, the chlorophyll content with portable meter, ClorofiLOG1030® was evaluated (Falker®, Porto Alegre, Brazil), obtaining the chlorophyll content, chlorophyll *b* and total chlorophyll, expressed in Clorofilog index.

After the physiological evaluations, he measured plant height, stem diameter, number of leaves and leaf area of pequi plants. The height of the plants was measured with a millimeter ruler from the soil surface to the apex of the plant, and the stem diameter was measured with pachymeter near the soil surface. The leaf area was determined by the method of summing the length of the main veins of the leaflets, and the values applied to the formula AF 1.218 - 0.012S + $0.0208S^2$ (Oliveira et al., 2002), where S is the sum of the ridges Of the leaflets. The length of the ribs was obtained with a millimeter ruler.

After determining the length of the veins, the aerial part of the pequi plant (leaves and stems) was separated, placed in paper sacks and taken to the forced circulation oven at 65 °C for 72 hours until constant weight was reached Weighing. The specific leaf area (AFE) of pequi plants was determined by dividing the FA by the dry leaf mass.

For forages, only the dry mass of leaves and stems was measured, with a similar procedure adopted for pequi plants.

The results were submitted to analysis of variance (ANOVA) by the F test and, when significant ($p \leq 0.05$), the averages for the effects of the forage species were compared by the Tukey test, and against the comparative control, By the Dunnett test. Regression analysis was applied to the effects related to the densities of each forage species living with pequi seedlings. The regression models were chosen for simplicity, for biological meaning and for coefficient of determination. Statistical analyzes were performed using the Assistat statistical software (version 7.7 beta 2014), and the drawing of graphs using software Sigmaplot V.12 (SPSS Inc., USA).

RESULTS AND DISCUSSION

Significant interactions were not found for the variables measured in pequi plants in relation to their coexistence with the species *M. minutiflora*, *P. notatum* and *U. decumbens* and densities of 1, 2, 3 and 4 plants per pot, with only effects Both main factors (Tables 1 and 2).

For gas exchange of pequi plants, effects were observed between the species of weeds to photosynthetic rate *(A)*, stomatal conductance (g_{s}), transpiration rate *(E)* and the ratio *Ci/Ca*. The pequi plants who lived with the *U. decumbens* species was most affected by the interference with the presence of *M. minutiflora* and *P. notatum*, which showed similar results (Table 1). In coexistence with *U. decumbens* plants pequi showed higher stomatal closure, by the fall of stomatal conductance, preventing water loss and mitigating the direct effects of competition for this feature. Plants with the characteristic of reducing the stomatal conductance are considered preventive regarding the loss of water; However, this closure blocks the CO_2 uptake into the leaves interfering with the CO_2 carboxylation and reducing the dry mass and plant growth (Silva et al., 2004).

Table 1 - Photosynthetic rate (A), stomatal conductance (gs), transpiratory rate (E), Ci/Ca ratio, maximum quantum yield (Fv/Fm), effective quantum yield of FS II (DF/Fm' (CLA), B (CLB) and Total (CLT), plant height (AP), diameter of the stem (DC), Leaf dry matter (DM), leaf dry matter (DMF) and specific leaf area (AFE) of pequi plants grown in association with weeds *Melinis minutiflora* (MELMI), *Paspalum notatum* (PASNO) and *Urochloa decumbens* (URODE)

Variables	Weeds			Control	VC (%)
	MELMI	PASNO	URODE		
A (µmol m^{-2} s^{-1})	6.13 a	7.19 a	3.7 b (-)	7.28	7.71
g_s(mol m^{-2} s^{-1})	0.063 a	0.070 a	0.040 b (-)	0.076	14.85
E (mmol m^{-2} s^{-1})	1.009 a	1.068 a	0.636 b (-)	1.139	17.95
Ci/Ca	0.575 b	0.550 b	0.643 a	0.551	13.16
Fv/Fm	0.807 a	0.805 a	0.792 a	0.791	4.79
ΔF/Fm'	0.397 a	0.409 a	0.304 b	0.368	25.08
NPQ	0.995b	0.936b	1.271 a	1.142	24.78
ETR	147.544ab	150.094 b	109.750 a	154.60	32.69
CLA(1)	34.00 a	33.66 a	33.76 a	33.78	4.77
CLB(1)	20.53 a	19.59 a	19.32 a	18.13	20.72
CLT(1)	54.53 a	53.25 a	53.08 a	51.80	10.71
AP (cm)	32.29 b	40.53 a	32.08 b	39.55	16.43
DC (mm)	7.92 a	8.48 a	7.71 a	8.97	16.04
AF (cm²)	158.24 ab	187.96 a	120.56 b (-)	219.8	32.26
NF	9.17 a	10.52 a	9.25 a	13.25	21.36
MSC (g)	3.90 ab (-)	4.84 a	3.42 b (-)	6.975	33.39
MSF (g)	14.68 ab	17.23 a	12.53 b (-)	17.70	26.21
AFE (cm^2 g^{-1})	10.73 a	11.00 a	10.00 a	12.67	26.31

(1) ÍndiceClorofiLog. Means followed by the same letters in the lines are statistically the same by the Tukey test ($p \leq 0.05$). Means followed by (-) are lower than the control by the Dunnett test ($p \leq 0.05$).

Table 2 - Photosynthetic rate (*A*), stomatal conductance (*gs*), transpiratory rate (*E*), *Ci/Ca* ratio, maximum quantum yield (Fv/Fm), effective quantum yield of FS II (DF/Fm' (CLA), B (CLB) and Total (CLT), plant height (AP), diameter of the stem (DC), Dry leaf mass (DMF), leaf dry matter (DMF) and specific leaf area (AFE) of pequi plants grown in different densities of weeds

Variables	Density (plants per pot)				Regression
	1	2	3	4	
A (µmol m^{-2} s^{-1})	6.55	6.46	4.64	5.12	$\hat{Y} = 7{,}2742 - 0{,}6402x^{*}$ $r^2 = 0{,}7045^{*}$
g_s (mol m^{-2} s^{-1})	0.067	0.068	0.049	0.049	$\hat{Y} = 0{,}074 - 0{,}0064x^{*}$ $r^2 = 0{,}7745^{*}$
E (mmol m^{-2} s^{-1})	1.050	1.020	0.771	0.794	$\hat{Y} = 1{,}1554 - 0{,}1051x^{*}$ $r^2 = 0{,}8238^{*}$
Ci/Ca	0.563	0.584	0.623	0.586	$\hat{Y} = \bar{Y} = 33{,}81$
Fv/Fm	0.803	0.809	0.797	0.796	$\hat{Y} = \bar{Y} = 0{,}801$
ΔF/Fm'	0.388	0.372	0.321	0.397	$\hat{Y} = \bar{Y} = 0{,}370$
NPQ	142.33	137.79	120.50	142.56	$\hat{Y} = \bar{Y} = 135{,}79$
ETR	0.927	1.09	1.22	1.03	$\hat{Y} = \bar{Y} = 1{,}067$
CLA[(1)]	34.58	34.08	33.11	33.46	$\hat{Y} = \bar{Y} = 33{,}81$
CLB[(1)]	21.04	20.58	18.10	19.53	$\hat{Y} = \bar{Y} = 19{,}82$
CLT[(1)]	55.62	54.66	51.21	52.99	$\hat{Y} = \bar{Y} = 53{,}62$
AP (cm)	39.28	35.39	31.72	33.48	$\hat{Y} = 40{,}2337 - 2{,}1085x^{*}$ $r^2 = 0{,}7035^{*}$
DC (mm)	8.79	8.45	7.48	7.44	$\hat{Y} = 9{,}3 - 0{,}505x^{*}$ $r^2 = 0{,}8977^{*}$
AF (cm²)	201.76	175.11	143.42	102.05	$\hat{Y} = 238{,}279 - 33{,}077x^{*}$ $r^2 = 0{,}9900^{*}$
NF	10.89	9.58	9.25	8.86	$\hat{Y} = 11{,}25 - 0{,}1408x^{*}$ $r^2 = 0{,}8851^{*}$
MSC (g)	4.91	4.25	3.48	3.58	$\hat{Y} = 5{,}2458 - 0{,}4767x^{*}$ $r^2 = 0{,}8584^{*}$
MSF (g)	18.27	16.50	12.03	12.46	$\hat{Y} = 20{,}8312 - 2{,}4021x^{*}$ $r^2 = 0{,}9826^{*}$
AFE (cm^2 g^{-1})	11.37	10.54	10.99	9.39	$\hat{Y} = \bar{Y} = 10{,}57$

(1) ÍndiceClorofiLog. * Significant ($p \leq 0{,}05$) by t test (regressor) and F (r^2), respectively.

Among the variables related to chlorophyll *a* fluorescence, Af/Fm', NPQ and ETR differed among species of weeds, without, however, control differ (Table 1). Similarly, the gas exchange was verified greater interference in the analyzed variables when pequi plants coexisted with *U. decumbens* (Table 1), because there was reduction in the ratio Af/Fm'. According to Lu et al. (2003), the reduction in these values reflects the reduction of the excitation energy capture efficiency of PS II reactions open centers, corroborating the observations of smaller ETR found to *U. decumbens*. The decrease in the Fv/Fm ratio and the increase in NPQ also indicate the dissipation of the energy in the form of heat. However, the observed reduction was not sufficient to promote photoinhibition, due to the maintenance of potential quantum yield values (Fv/Fm), around 0.800, which is normal for the variable, without causing damage (Chaves, 2015).

Thus, it is observed that the light energy was dissipated by means of non-photochemical processes, as can be evidenced by the increase of NPQ values, which symbolizes the non-photochemical dissipation in the form of heat, as a stress strategy that suffered as a result of Interference (Table 1). This increase in NPQ is a defense mechanism of the plant, which prevents energy accumulation from further damage, such as the formation of reactive oxygen species (EROs) (Maxwell and Johnson, 2000).

Regarding variable chlorophyll *a*, chlorophyll *b*, total chlorophyll, stem diameter, number of leaves and specific leaf area of pequi plants in coexistence with the weed, no differences were observed between treatments (Table 1). For chlorophyll content and specific leaf area, the results corroborate those observed by Cruz et al. (2010), which found no effects of interference colonião grass forage grass *(Panicum maximum)* on the initial growth of eucalyptus plants in 90 days of living together; However, leaf area and dry leaves of leaves and stems were affected in relation to free competition control.

Significant effects of weeds on plant height were observed, leaf area, biomass accumulation of dry matter of the stem and leaves of pequi plants being observed, in general, that *U. decumbens* and *M. minutiflora* promoted greater interference the pequi plants, compared to *P. notatum* (Table 1). However, for leaf area and dry mass of leaves, the effects promoted by *U. decumbens* differed from control; for the dry matter stem, the presence of this much as *M. minutiflora* were lower than the control (Table 1).

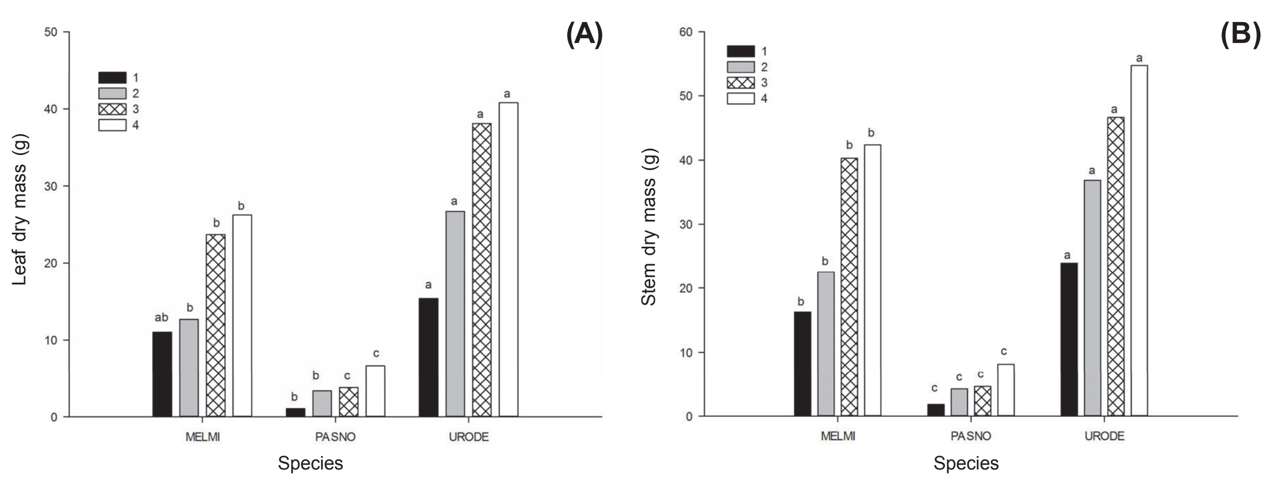
Weeds compete for available resources and are generally more efficient at obtaining them. Specifically, in coexistence with *U. decumbens*, the pequi plants was more susceptible to interference due to *U. decumbens* be more competitive, because it adapts to low soil fertility, has rapid onset, C4 photosynthetic metabolism, being very aggressive and tough conditions in (Bianco et al., 2005). It is considered an important species of weeds found infesting most of the cultivated species (Kuva et al., 2003; Souza et al., 2006).

The variables A, g_s and E were affected with increasing weed density per pot coexisting with pequi plants, with decreasing linear behavior, regardless of weed species (Table 2). The reductions were 0.6402 μmol m^{-2} s^{-1} for photosynthetic rate of 0.0064 mol m^{-2} s^{-1} for stomatal conductance and 0.1051 mmol m^{-2} s^{-1} for the transpiration rate, with The addition of one plant per pot of weed species (Table 2). Although the ratio *Ci/Ca* pequi plants in coexistence with *U. decumbens* has submitted value greater than living with *M. minutiflora* and *P. notatum*, there was no difference of values *Ci/Ca* in the control, regardless of the species (Table 2).

With respect to the densities of the three individual weed species, no effects were observed for fluorescence parameters Chlorophyll *a:* Fv/Fm Af/Fm', NPQ and ETR pequi plants (Table 2). There were also no differences between treatments evidenced chlorophyll levels *a*, *b*, total and specific leaf area pequi plants. For the variables plant height, stem diameter, leaf area, number of leaves, leaf and stem dry matter mass, linear reductions were observed when plant density of forage species increased in coexistence with the pequi plant (Table 2).

With the increase of weed per pot, regardless of species, reduction of 2.10 cm for plant height were observed, 0.50 mm for stem diameter, 33.07 cm^2 for leaf area, 0.14 for number of leaves per plant and 2.40 and 0.47 g for leaf and stem dry matter mass, respectively. This behavior agrees with the observations found by Fialho et al. (2011), which studied the interference of *Urochloa decumbens* in different densities of infestation on the growth characteristics of young plants of Arabica coffee, found 0.17 mm reduction in stem diameter, 72.13 cm^2 leaf area, 1.17 and 1.54 g in the dry matter mass of leaves and stems, respectively, with each addition of a forage plant in coexistence with the coffee tree.

In relation to weeds, significant interactions were observed for the accumulation of dry mass of leaves and stem of them in coexistence with the pequi tree (Figure 1A, B). For the



Histograms with distinct letters are different from each other by the Tukey test (p≤0.05).

Figure 1 - Leaf dry mass (A) and stem dry mass (B) of the species *Melinis minutiflora* (MELMI), *Paspalum notatum* (PASNO) and *Urochloa decumbens* (URODE) grown at different densities (1, 2, 3 and 4 plants by pot), in coexistence with the pequi.

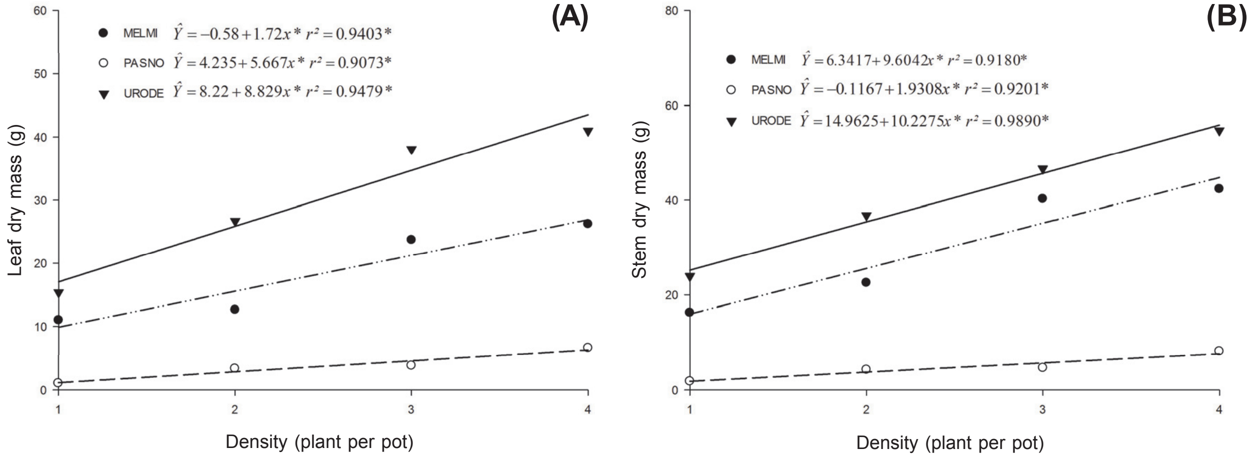


Figure 2 - Leaf dry mass (A) and stem dry mass (B) of the species *Melinis minutiflora* (MELMI), *Paspalum notatum* (PASNO) and *Urochloa decumbens* (URODE) grown in different densities, coexisting with pequi tree.

accumulation of dry matter of leaves of weeds, except for the density of one plant per pot, note that *U. decumbens* was the species with the largest accumulation of dry matter, followed by *M. minutiflora* and *P. notatum*, thus justifying the deleterious effects of interference on most variables measured in plant pequi (Table 1). Mainly due to its size and less dangerous low dry mass, *P. notatum* was the kind that less interfered in the variables evaluated in pequi plants.

As for weed densities per pot living with pequi, linear increases were observed in the accumulation of dry mass of leaves and stems (Figure 2A, B). For each weed added, linear increases were recorded for the dry matter mass of leaves, with increments of 8.82, 5.67 and 1.72 g (Figure 2A), and for the dry matter mass of 10.22, 9.60, and 1.93 g (Figure 2B) to *U. decumbens*, *M. minutiflora* and *P. notatum*, respectively.

Thus, the increased density of weeds directly contributed to reducing physiological and pequi plant growth (Table 2), in *U. decumbens*, which had a higher total dry matter and consequently has the species but interfered with the pequi.

In summary, it is clear that during phase changes, pequi should avoid the presence of these forage species, mainly *U. decumbens* and *M. minutiflora.*

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