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Effect of Different Doses of Swine Biofertilizer in the Development and Production of Cultivars of *Brachiaria brizantha*

[1]Rafael Silva Ferreira, [2]Carlos Antonio da Silva Junior, [1]Paulo Eduardo Teodoro, [1]Patrícia Paiva da Silva, [1]Gilcelene Medeiros Arima, [1]Nanci Cappi and [1]Francisco Eduardo Torres
[1]State University of Mato Grosso do Sul, Aquidauana, Mato Grosso do Sul, Brazil
[2]State University of Maringá, Department of Agronomy, Av. Colombo, 5790-Bloco J45, Postal Code 87020-900, Maringá, Paraná, Brazil

Abstract: Several studies have shown satisfactory results of swine manure with biofertilizer on the increased production of grasses such as maize and millet. However, there is little information on the response of grassland to this practice. Thus, the objective of this research was to evaluate four concentrations (0, 50, 100 and 150 m^3 ha^{-1}) of swine biofertilizer production of two cultivars of forage *Brachiaria brizantha* (Marandu and Piatã). The experiment was carried out at the State University of Mato Grosso do Sul, where the soil of the area was classified as dystrophic Ultisol. We used a completely randomized design with four replications in a split plots to measure the following morphogenetic characters: plant height leaf length, leaf width at 15, 30, 45 and 60 Days after Seeding (DAS) and quantity of green matter fresh and dry weight of shoots and roots only at 60 DAS. There was an increasing in parameters as a function of plant age, no differences among cultivars. The swine manure with biofertilizer promoted significant increases in these parameters. Doses of 150, 100 and 50 m^3 ha^{-1} swine biofertilizer did not differ for the variables, fresh and dry matter of green shoots and roots which allows us to infer that the use of biofertilizer adequately supplied the nutritional requirements of this forage conditions this research.

Key words: Organic fertilization, marandu, Piatã, forage production, agricultural waste

INTRODUCTION

The Brazilian swine production is increasing annually, either to meet domestic demand, is also to meet the foreign market. The increase in production has caused the accumulation of waste in the properties, often beyond the capacity of the surrounding areas to receive such waste (Seidel *et al*., 2010).

This fact has generated concern from environmental agencies, for once exhausted the soil adsorption capacity, such wastes can cause serious environmental damage, particularly to water resources. This concern with pollution from animal waste has stimulated the search for alternatives that enable the most efficient use of waste (Queiroz *et al*., 2004).

Why be waste containing high levels of organic matter and other nutrients, primarily nitrogen and phosphorus (Scherer *et al*., 2007), swine manure can improve the physical properties and chemical and biological soil properties (Galvao *et al*., 1999), allowing its use in agriculture as immediate supplier of nutrients and beneficial elements to the development and production of plants, minimizing losses through volatilization (Basso *et al*., 2004; Costa *et al*., 2004).

For Seidel *et al*. (2010), agricultural production is focused on the sustainability of agroecosystems and, therefore, it is essential the need for treatment and proper management of swine manure, returning them to production systems.

Thus, the high cost of agricultural production, mainly by the use of chemical fertilizers (about 40% of costs), the use of biofertilizers swine-origin becomes feasible, since nowadays the searching agriculture increased productivity and reduced costs (Seidel *et al*., 2010). The economy is characterized not only by being a resource available on the property, since it is also possible to treat these wastes with low cost and after mineralization, using them as an organic fertilizer (Mondardo *et al*., 2009).

Several studies have demonstrated the effect of swine manure with biofertilizer on the increased production of various grasses like oats (Ceretta *et al*., 2005), millet (Moreira *et al*., 2011) and maize (Giacomini and Aita, 2008; Leis *et al*., 2009; Seidel *et al*., 2010), yet there is little information on the response of grassland to this practice, justifying this research.

Corresponding Author: Carlos Antonio da Silva Junior, State University of Maringá, Department of Agronomy, Av. Colombo, 5790-Bloco J45, Postal Code 87020-900, Maringá, Paraná, Brazil

The forage plants have high potential to respond to application of agricultural residues, mainly because of its presence in large areas in stages of increasing degradation (Benett *et al*., 2008). Grazing areas in Brazil have evolved significantly with the introduction of *Brachiaria* spp. and their cultivars which have adapted their hardiness various soil and climatic conditions of our country, being predominant in existing pastures and training (Assis, 2007).

Among the pastures of better adaptation to the Cerrado (Brazilian Savanna) are Marandu and Piatã (Brites *et al*., 2011), both of *Brachiaria* spp., whose morphology and physiological aspects can bring to the economy of a large benchmark against gain animal weight (Magalhaes, 2010).

The objective of this research was to evaluate the production of two cultivars of forage species *Brachiaria brizantha* (Hochst. ex A. Rich.) Stapf, subjected to four different concentrations of swine biofertilizer.

MATERIALS AND METHODS

Site and experimental treatments: The experiment was conducted during March-May of the year 2011 in the experimental area of the State University of Mato Grosso do Sul (UEMS), located in the municipality of Aquidauana, MS, Brazil, understood in the following geographical coordinates Lat. 20°27'S and Long. 55°40'W with an average elevation of 170 m.

The soil in the pots was removed from an area of the University Unit itself, classified as Ultisol sandy texture (USDA, 2004), being collected and homogenized and then a sample was taken for chemical analysis, the result of which is described in Table 1. The climate of the region, according to the classification described by *Köppen-Geiger* is Aw (Tropical Savanna) with average annual rainfall of 1,200 mm and maximum and minimum temperatures of 33 and 19°C, respectively (Schiavo *et al*., 2010).

According to the chemical analysis of the soil used in the experiment (Table 1), the pH resulted in thus 4.87 in the soil of the State of Mato Grosso do Sul, Brazil, this pH combined with good saturation in bases (V = 58%) favors the good development of *Brachiaria brizantha*. Despite the phosphorous content present low, yet the development will be good of cultivating, however is finite, needing to be reset. The other analyzed elements (Table 1) are generally satisfactory in relation to the needs of the plant in that if you want to cultivate.

After withdrawing the sample and based on chemical analyzes of soil, the pots were filled with four liters of soil, where it was added 15 g of superphosphate (18% P_2O_5, 25% CaO and 12% S) in each pot and were then taken to an oven agricultural arc (6.40×18.00×4.00 m) with open zenith in the ridge, covered with polyethylene film of 150 μm.

Table 1: Chemical analysis of the soil used in the experiment

Chemical attributes	Value
pH ($CaCl_2$)	4.87
P (mg dm^{-3})	4.06
OM (g dm^{-3})	20.46
K ($cmol_c$ dm^{-3})	0.28
Ca^{++} ($cmol_c$ dm^{-3})	3.70
Mg^{++} ($cmol_c$ dm^{-3})	0.90
Ca^{++}+ Mg^{++} ($cmol_c$ dm^{-3})	4.60
Al^{++} ($cmol_c$ dm^{-3})	0.10
H+Al ($cmol_c$ dm^{-3})	3.51
S ($cmol_c$ dm^{-3})	4.88
T ($cmol_c$ dm^{-3})	8.39
V (%)	58.00
Sum of bases ($cmol_c$ dm^{-3})	4.88

Parameters measured and design: The experimental design used was a completely randomized design in plot scheme split plots, with four replications. The plots consisted of cultivars Marandu and Piatã (*Brachiaria brizantha*) (Hochst. ex A. Rich.) Stapf. The sub-plots consisted of four doses of swine biofertilizers (0, 1, 2 and 3 L), in plastic pots of up to 5 L, where volumes represent applied 0, 50, 100 and 150 m^3 ha^{-1} biofertilizer, respectively. The other sub-subplots comprised four evaluation times morphogenesis of the following characters: Plant Height (PH), Leaf Blade Length (LBL), Width of Leaf Blade (WLB) at 15, 30, 45 and 60 days after seeding (DAS). We also performed evaluation of the amount of fresh Green Matter (GM) and Dry Matter (DM) of shoots and roots at 60 DAS.

Source residue: The swine biofertilizer, arising from digesters product research lab animal waste Unity University Aquidauana. The digesters benchs were supplied with pig manure, with retention time of 55 days and then were stored in different gals and withdrawing a sample from each for analysis of percentages of phosphorus and nitrogen, whose values, respectively, were 3.44 and 5.35%. After the toss of the vessels, they were labeled and then irrigated with their respective strengths.

Laboratory procedure: The sowing was done after three days of the first fertigation on March 11, 2011. Fertilization was carried out with the aid of a beaker of 500 mL (0.5 L) to obtain the exact dose of the product and the witness was irrigated the same volume of water. The pots were irrigated every morning with water, according to the average evapotranspiration of the environment.

The cutting was carried out with the aid of scissors, being first removed all leaves and placed in paper bags which were weighed, numbered and brought to the oven and forced circulation at 65°C. Then the same procedure was performed with the stems. To collect the roots water was used to remove the soil which dried shade for a few hours in the bench prior to accommodate them on the package, perform the weighing and packing them in the oven and forced circulation at 65°C for 72 h, being turned once daily for a homogeneous drying. After the drying time, samples were again weighed, ground and stored in plastic bags for analysis of parameters of dry matter of shoots and roots.

Data analysis: Through statistical software Sisvar (Ferreira, 2011), analysis was made of the two trials and the averages of the results of each variable subjected to analysis of variance (F-test) and later made studies of polynomial regression.

RESULTS AND DISCUSSION

The Table 2 presents the results of analysis of variance analyzes morphogenetic cultivars of *Brachiaria* spp. (C) with different doses of biofertilizers (D) and plant age (A) and their interactions, where no significant differences were observed for the mean values of these variables only for cultivars and their interactions (D×C×A).

There was significant difference the 1 and 5% by the F-test between the characters of morphogenesis and age in different doses of biofertilizer. There was little variation as to the coefficient of variation (CV), in which the highest value was 16.31, considered stable (Table 2). Thus, suggesting a different behavior between age and response time or the characteristics of the plant depending on the doses of biofertilizer.

The interaction between the applied doses of biofertilizer was decomposed on the causal effects of doses×cultivar, cultivar×age, doses×age and doses×cultivar×age which have all been quantified. With this, you can check how much each influences to the interaction of doses. The results indicated no significant effect ($p<0.05$; 0.01), however detailed analysis was performed between these components.

The Fig. 1a shows the parameters PH and LBL, where there was a linear increase ($p<0.05$) depending on the age of the plants, providing the highest values of these variables at 60 DAS which are 77.95 and 59.58 cm, respectively.

The LLF parameter (Fig. 1b) showed quadratic behavior ($p<0.01$) and the highest value obtained (1.60 cm), also at 60 DAS. This allows us to infer that the use of swine biofertilizer adequately supplied the nutritional requirements of both cultivars of *Brachiaria* spp.

The variables PH and LBL (Fig. 2a), were described by linear functions ($p<0.05$), respectively where there was statistically more efficient dose of 150 m^3 ha^{-1} compared to the other treatments. In both variables, the values were adjusted for this dose of 56.86 cm for plant height and 47.97 cm for the length of the leaf.

With respect to the parameter WBL (Fig. 2b), increases linearly ($p<0.01$) ranging from 1.22 to 1.50 cm, as

Table 2: Summary of analysis of variance of biometrics cultivars of *Brachiaria brizantha* (C) at different doses of swine biofertilizers (D), age of the plant (A) and their interactions

Source of variation[1]	PH	LBL	WLB	GMS	GMR	DMS	DMR
	--------------cm--------------		--g $plant^{-1}$ --				
Doses (D)	3, 186.81**	1, 793.10**	13.01**	431.08**	290.61*	321.54*	191.96*
Linear reg.	231.48*	194.22*	19.21**	411.57^{ns}	225.02^{ns}	276.73^{ns}	113.88^{ns}
Quadratic reg.	98.16^{ns}	71.62*	22.88*	238.94**	142.19*	211.98**	90.16*
Cubic reg.	69.81**	56.40**	30.39^{ns}	251.27*	130.08**	200.11**	82.51**
Residue a	311.24	289.77	2.45	268.90	219.01	197.46	144.33
CV a (%)	15.15	14.98	11.99	16.14	15.81	15.22	16.03
Cultivar (C)	511.44^{ns}	12.91^{ns}	0.21^{ns}	78.77^{ns}	30.66^{ns}	44.09^{ns}	18.91^{ns}
Residue b	198.13	145.88	4.22	299.67	208.11	201.08	88.67
CV b (%)	16.31	13.24	14.56	14.11	13.78	14.06	15.88
Age (A)	1, 301.79**	804.98**	23.12**	---	---	---	---
Linear reg.	149.41**	94.92**	17.27^{ns}	---	---	---	---
Quadratic reg.	108.16*	81.62*	12.88**	---	---	---	---
Cubic reg.	77.01^{ns}	64.44^{ns}	28.91^{ns}	---	---	---	---
Residue c	529.12	305.13	0.24	801.44	370.99	421.01	207.49
CV c (%)	12.33	8.41	9.04	13.75	14.82	13.91	14.76
D×C	169.46^{ns}	15.75^{ns}	0.13^{ns}	67.00^{ns}	23.91^{ns}	32.04^{ns}	12.29^{ns}
C×A	555.41^{ns}	86.44^{ns}	0.14^{ns}	---	---	---	---
D×A	354.84^{ns}	193.78^{ns}	0.68^{ns}	---	---	---	---
D×C×A	194.51^{ns}	38.12^{ns}	0.09^{ns}	---	---	---	---

[1]CV: Coefficient of variation; PH: Plant height; LBL: Leaf blade length; WLB: Width of leaf blade; GMS: Green matter of the shoot; GMR: Green matter roots; DMS: Dry matter shoot; DMR: Dry matter root. *Significant ($P<0.05$), **highly significant ($P<0.01$) and ^{ns}not significant by the F-test

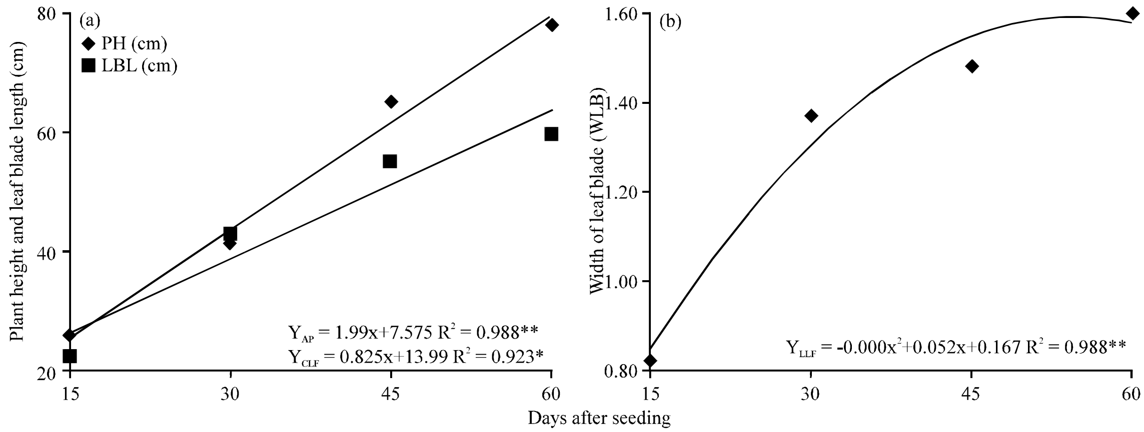

Fig. 1(a-b): (a) Plant height and leaf blade length and (b) Width of leaf blade in function evaluation times in two cultivars of *Brachiaria* spp.

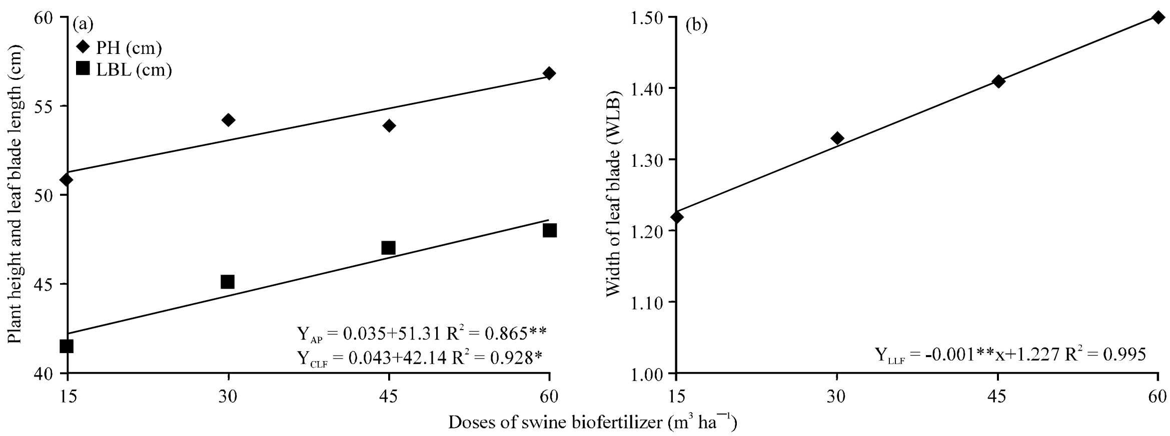

Fig. 2(a-b): (a) Plant height and leaf blade length and (b) Width of leaf blade as a function of doses of swine biofertilizer in two cultivars of *Brachiaria* spp.

doses increased, yielding the largest value in the treatment of 150 m^3 ha^{-1} of swine biofertilizer.

Moreira *et al*. (2011), to compare the morphological characteristics of millet fertilized with swine biofertilizer and chemical fertilizer, observed that there was a significant increase for the variables height, diameter and number of leaves for plants fertilized with biofertilizer. These results are similar to those obtained in this study which allows us to infer the efficiency of biofertilizer in nutrient supply grasses which provided better development of the same.

In Fig. 3a GMS variables are shown ($p<0.01$) and DMR ($p<0.05$) and these are represented by quadratic functions where, again, a dose of 150 m^3 ha^{-1} swine biofertilizer higher values in both. Mean values adjusted for doses of 0, 50, 100 and 150 m^3 ha^{-1} swine biofertilizer to produce GMS were, respectively, 38.34, 135.99, 175.33 and 202.08 g $plant^{-1}$. For DMR parameter, values for the same dosages were 22.50, 54.20, 60.69 and 76.70 g $plant^{-1}$, respectively.

The Fig. 3b shows the parameters DMS ($p<0.01$) and DMR ($p<0.05$), described by quadratic functions, where the mean values for treatment with 150 m^3 ha^{-1} swine biofertilizer (48.59 and 26.73 g $plant^{-1}$, respectively) were higher compared to other dosages.

According to Costa *et al*. (2006), show that the dry matter production was in proportion to the increase in the interval between cuts but the nutritional value (N, P, K and Mg) of forage decreased. Therefore, in this study were conducted strictly cuts to 15, 30, 45 and 60 days after sowing.

Research conducted by Ceretta *et al*. (2005), evaluating different concentrations of swine biofertilizer (0, 20, 40 and 80 m^3 ha^{-1}), found that the highest dosage

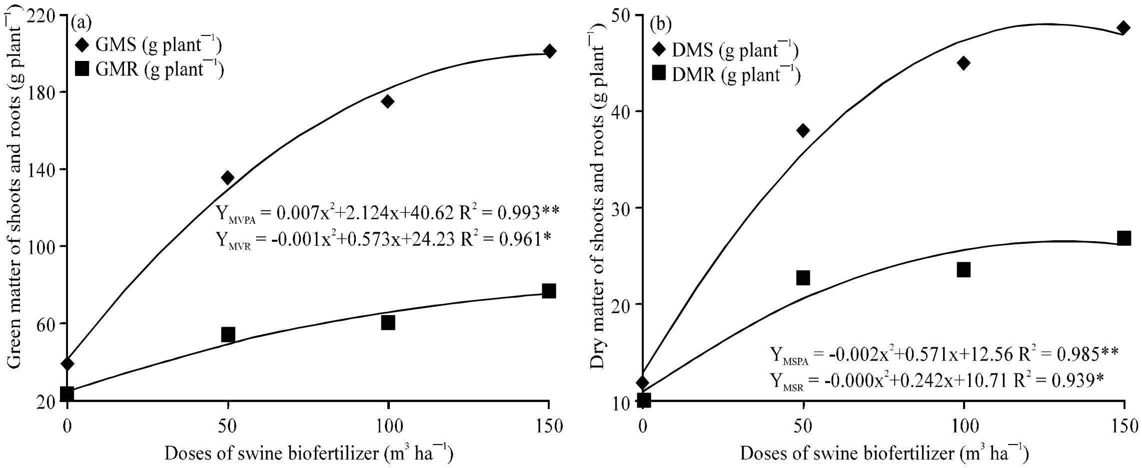

Fig. 3(a-b): (a) Green matter and (b) Dry of shoots and roots as a function of doses of swine biofertilizer in two cultivars of *Brachiaria* spp.

promoted increase in dry matter production of oat, corn and turnip, agreeing with this study. However, these data disagree with Mondardo *et al.* (2009) which to evaluate the dry matter production of *Brachiaria brizantha* with seven doses of swine biofertilizer (0, 13, 26, 39, 52, 65 and 78 m^3 ha^{-1}), found no significant increases in the doses used compared to the control.

The results of green fresh and dry corroborate those of Assis (2007), that by studying the fertilization of *Brachiaria decumbens* with liquid swine manure doses (0, 60, 121, 181 and 241 m^3 ha^{-1}), observed that treatments promoted an increase in productivity compared to the control.

Consistent with this research, Pereira (2006) to test the application of swine biofertilizer on grass (*Brachiaria decumbens*), obtained green and dry matter increases in the order of 200 and 300%, respectively. The increase in forage production is a major reason for convincing the farmers to use organic fertilizers liquids, by virtue of its proper nourishment and vigor apparent that they provide the fertilized plants.

CONCLUSION

The manure with swine biofertilizer interfere promoted significant increases in parameters, the recommended dosage is 150 m^3 ha^{-1}.

An increment of the parameters analyzed in the course of plant age and the highest values obtained with 60 DAS.

There were no differences among cultivars of *Brachiaria Brizantha* used, where these do not differ from each other, showing the same performance for the evaluated variables.

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