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Meat and Bone Meals in Agronomy Performance of Tifton Grass

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Abstract A major problem is tropical pasture conditions in acid soils of low fertility. In this context the condition of nutrition of forage plants has low availability of phosphorus (P). The present study aimed to evaluate the effect of two phosphate sources (meat and bone meals and superphosphate) in dry matter production of Tifton (*Cynodon dactylon L.*). The experiment was conducted from March to July 2011, in the experimental farm of UNIR, Rolim de Moura, RO. The experiment was carried out in buckets of 10 kg of soil. Treatments were the addition of increasing doses of P_2O_5 (0, 100, 200 and 300 kg ha^{-1}) plots with nitrogen fertilization (20 kg ha^{-1}) in each section (30 days), there is still a witness (only N) and absolute control (no N and no P). The randomized blocks design was used with five replicates (3x2+2). Variable analysis, had different levels of production in relation to the cutting times can be attributed to the difference in solubility between the sources of P_2O_5 studied. In terms of response in four sections, the production levels of dry matter generated by the meat and bones proved effective in relation to single super phosphate, ranging from 94%, 66% and 78% compared with the doses 100, 200 and 300 kg ha^{-1}, respectively. The meat and bone meal produced satisfactory answers in relation to dry matter production of Tifton, compared to conventional fertilization.

Keywords *Cynodon dactylon,* mineral nutrition, phosphorus, P source solubility

1. Introduction

Brazil has a prominent position in the production of beef, since it has the 2nd largest commercial herd in the world, estimated at 204.7 million head[1] and its supply chain has significant participation in the Gross Domestic Product (GDP) country's foreign exchange generating only more than $ 5.5 billion with exports of meat, footwear and leather[2]. This condition can only be highlighted due to the activity be based on pasture. Yet the sector has not reached its potential for exportation, and to maintain or develop in its position should solve big challenges with regard to reduction in costs, adding value and sustainability of production systems[3].

In these systems the phase of slaughter must be considered since the 29.265 million head slaughtered in 2010, represents about 38% material not used in food[4] such as bone, fat, head, etc.[5] being used to manufacture products.

Among the byproducts of abattoirs as meat and bones is the principal[6], however it can have contamination by Clostridium, Salmonella, Coliforms, Pseudomonas and Stafilococcus[7] due to lack of care and an adequate standard of quality in its processing, which has limited its use in diets for poultry[6]. However, if its composition is observed (27% P_2O_5, 13% Ca)[8] it may represent an alternative source of nutrients and efficient[9] and that comes to the needs of fodder, a since the deficiency of phosphorus (P) is widely considered the country and the greater economic importance in conditions involving cattle grazing[10]. Allied to this is the diagnosis, for example, that 30 million hectares of cultivated pastures were degraded or degradation in the Brazilian Legal Amazon[11].

From the environmental point of view there is currently a major concern in the preservation of biomes, particularly the Amazon, as well as the use of natural resources more wisely. In this case the Brazilian government has worked to avoid the deforestation to grow crops and pasture farming being formed. Also to be considered that the phosphate mines with potential to be exploited economically may be depleted in a period of 60 to 100 years[12]. In this case the use of meat and bone represents an alternative source of nutrients for the replacement of chemical fertilization, which somehow promotes the recycling of nutrients to the pasture system.

Currently it is observed that the market is of particular interest in the use of meat and bones, and can be found buy and sell this product with different prices, for example, the purchase of charred bones for flour production has been listed $ 0.40 per ton in Goiás and the sale of flour to $ 409.35

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in Montes Claros, Minas Gerais and Fortaleza, Ceara, $ 487.83 in Vitória da Conquista, Bahia or even $ 584.79 in Itapetinga-Bahia[13], considering the value US$ for exchange of 1,71.

The use of meat and bone meal as a source of nutrients to forage further studies, so this study aimed to evaluate the potential production of dry matter of Tifton, using as an alternative source of nutrients to meat and bones .

2. Materials and Methods

2.1. Local Conditions

The experiment was conducted at the Experimental Farm of the Federal University of Rondonia state- UNIR, town Rolim de Moura, Rondonia, located 277 m above sea level, in latitude 11° 48'34 "S and longitude 61° 48'12" W. The climate is Aw of Köppen classification is therefore an equatorial climate with a variation to the tropical hot and humid, with well-defined dry season, June / September, minimum temperature of 24°C, maximum 32°C, with annual precipitation year average of 2,250 mm and relative humidity high, around 85%.

The experiment was carried out during March-July 2011. The plots consisted of buckets with 10 kg of sieved soil, classified as Typic dystrophic, LVAdf[14], which had the following characteristics: clay 470 g kg^{-1}, MOS: 31.88 g kg^{-1} , pH 4.9, P: 0.17 mg dm^{-3}, K: 0.11 cmolc dm^{-3}, Ca + Mg: 1.51 cmolc dm^{-3}, Al: 0.20 cmolc dm^{-3}, H + al: 3.26 cmolc dm^{-3}; CTC: 4.88 cmolc dm^{-3} and V: 33.16% for the 0 - 20cm. As the Tifton is a grass that requires high soil fertility with V% over 60% in clay soils was conducted over the area where the patch is removed the soil with the addition of 0.550 Mg ha^{-1} of lime with 90% PRNT 120 days before transplanting of seedlings of Tifton.

2.2. Treataments and Plant Material

We used eight treatments in a completely randomized design with five replicates (Table. 1). The plots consisted of buckets with 10 kg of sieved soil, the fertilizer was incorporated into the soil 10 days before transplanting of stolons of Tifton. The treatments consisted of the addition of increasing doses of P_2O_5 (0, 100, 200 and 300 kg ha^{-1}) in the form of superphosphate and meat and bone, split with nitrogen fertilization (20 kg ha^{-1}) in the planting and each cut (30 days), there still remains absolute control (no N and no P).

The stolons of Tifton grass (*Cynodon dactylon* (L.)) were obtained from the collection of the Experimental Farm the University, with three gems, selected from the middle of the plants. In order to standardize the booth proceeded to cut the stolons yielding plants of different heights and mass, which were grouped into three categories, so it used a precision scale and a tape measure to classify them in the "low" (1.36g ± 0.40), "media" (2.25g ± 0.39) and "high" (3.37g ± 0.29), were then transplanted into the buckets, using one seedling in each category, a total of three plants per bucket.

At 30 days after planting the seedlings was made the first cut (04/08/2011) the height of 20 cm above the ground using a garden shears. After trimming, the plant material was measured in the mass balance accurate and dried in an oven with forced ventilation of air at 65°C to constant weight, making a total of four cuts in a period of 120 days. At 150 DAP proceeded to a destructive collection in order to verify a possible difference in the shoots and roots of plants with different treatments Tifton, so that the plants were uprooted, to remove soil from the roots held the washing roots in water, then the material was oven dried to constant weight.

Table 1. Tifton treatments with three doses of superphosphate and meat bone meal applied 10 days before the pre-planting each 30 days

Treatments	Pre-planting fertilization (kg ha^{-1})		Coverage fertilização (kg ha^{-1})	
	P_2O_5	Source	N	Fonte
T1		-	-	-
T2		-	20	Urea
T3	100	SP	20	Urea
T4	200	SP	20	Urea
T5	300	SP	20	Urea
T6	100	MBM	20	Urea
T7	200	MBM	20	Urea
T8	300	MBM	20	Urea

MBM: meat and bone meals (27%P_2O_5) e SP: Superphosphate (18%P_2O_5)

2.3. Experimental Design and Data Analysis

The effects of "doses" and "phosphorus sources" about the growth and development of cement Tifton were evaluated by analysis of variance test Dunett. For the factor "levels of phosphorus" was carried out linear regression analysis, as a quantitative factor, trying to explain, you see attraction of mathematical models, the effect of doses in each variable. Was used to perform the analysis computer program ASSISTAT at 5% probability[15].

3. Results and Discussion

The dry matter production of shoots of Tifton significant differences among treatments. For the treatment which included only with the nitrogen application, its effect was manifested at 60 DAP was maintained up to 120 DAP. Regarding the different sources of phosphate, can be seen that treatment with superphosphate at a dose equivalent to 300 kg ha^{-1} P_2O_5 significant effect 30 days after planting (30 DAP). The lack of response from the meat and bones with the same dosage can be attributed not only to conditions of particle size but also the aspect of solubility.

For the grain is that the meat-sources and have average geometric diameter of 605μm[16] while the superphosphate 1-2 mm[17], despite its higher specific surface, this unit is classified as a fertilizer of low solubility, with 24-30% P_2O_5 solubility for phosphates in 2% citric acid[18]. Thus, combined with its smaller amount of soluble P, it is involved in the process of fixing to the ground, which can be permanent for most tropical soils acids. This helps explain the variability of response of Tifton as the P roots absorbing solution of the soil in amounts proportional to their concentration[17]. However, being a slow release source of the gradual[19] its effects can be verified by more than five years[20.21,22]. The treatments showed significant responses from 60 DAP, lasting until the end of the period ex-learning provided (Table 2).

In productive behavior observed at 30 DAP differences in solubility of the sources used can be considered the main factor[23] since the seedlings were planted at the same time there is a similar opportunity to explore their roots in the soil volume[24] and temperatures environment were not limiting[19].

Comparing the data obtained in this work with others in the literature is that, for grass-star cv. "Florico" grown in ultisoil Eutrophic Latosol (V = 74%) and fertilized with 60 kg ha^{-1} N and 60 kg ha^{-1} K_2O, highest yields were observed ranging from 153.57 g m^{-2} at 20 days of 1,098.66 g m^{-2}, at 70 days[25]. However, values close to that been taken into account at 90 DAP for the Tifton that produced 1050.72 g m^{-2} DM when the simple superphosphate was used at a dose of 300 kg. ha^{-1} P_2O_5. In the same condition, the use of meat and bone meal resulted in 837.05 g m^{-2} DM. The production potential of Tifton may still be higher than the values obtained in this experiment. This plant can produce 1780 g m^{-2} can be obtained in the rainy season[26] or 3.540g m^{-2} when considered as the sum of production between the dry and water[27].

Regarding the adjustment of linear regression, we can observe that the first cut, there was no significant response to any of the treatments, meat and bone meal and superphosphate. But the second cut, the two treatments showed significant results, the treatments with superphosphate showed higher values in the treatments of meat and bones.

For the third cut, the 90 day trial period, only the treatments with superphosphate led to a significant extent, is not observed linear response to treatments with meat and bones. The same behavior can be observed at 120 days. Surely such behavior may be related to the ability of plant roots to take up forms of most soluble phosphate (superphosphate), when the exploitation of soil volume.

In other cultures demonstrated the same behavior, for example, lettuce (*Lactuca sativa* L.) effects the production of P in the form of simple superforfato were superior to those of meat and bone meal, while being registered in that there the need for a period of time longer than 25 days of incubation so that the meat and bone mineralization suffer appropriate nutrient[28]. In this study the application of meat and bone occurred only 10 days before planting the seedlings, therefore, longer periods of incubation should be studied to define a time most suitable for the cultivation of forage plants.

In maize (*Zea mays* L.) showed that fertilization with different doses of meat and bone meal provided income as efficient as the conventional fertilization for the culture and also promoted a greater weight of ears and a larger number of live leaves at harvest[9].

In assessing the efficiency of dry matter production between the different treatments can be observed profit or loss in relation to important sources of phosphorus used. In relation to the control treatment was a superiority in dry matter production of shoots in 437% of Tifton as 300 kg ha^{-1} of P_2O_5 in the form of meat and bone meal was used or even 562% relative to treatment with 300 kg ha^{-1} of P_2O_5 as superphosphate (Table 3).

In the comparison between treatments with different sources of phosphorus, can be observed that the differences in efficiency were close level of 100 kg ha^{-1} P_2O_5 (93%) of meat and bones in relation to superphosphate while the remaining at levels not too close, but satisfactory (66.08 and 77.73% for 200 and 300 kg ha^{-1} P_2O_5, respectively).

The variability in the regression results for dry matter production of Tifton as meat and bone meal was used is related to product characteristics and their interaction as the soil-plant system. In this respect it must be remembered that besides the characteristic initial solubility of the flour, there is an increase in this behavior as it has a greater opportunity for interaction with the soil[29], especially when acidity levels are among 6.0 and 6.5[30] and the organic matter contents are suitable to reduce the P fixing of the environment mineral soil[31,32].

Table 2. Dry Matter production (g m^{-2}) Tifton (*Cynodon dactilon* L.) subjected to two sources of phosphate (Superphosphate – SP and meat bones meals – MBM), cut every 30 days with coverage 20 kg ha^{-1} N (urea) by cutting

	Dry Matter (g.m^{-2})									
	Cuts – days after planting									
Treatments	30		60		90		120		Total	
Control	58,73		79,10		47,55		70,00		255,38	
N (only)	50,12		256,28	*	197,14	*	204,97	*	708,51	*
SP 100	84,97		344,65	*	298,63	*	260,69	*	988,94	*
SP 200	78,32		493,18	*	359,87	*	389,91	*	1321,28	*
SP 300	97,34	*	483,38	*	470,00	*	385,63	*	1436,35	*
MBM 100	90,81		390,81	*	225,34	*	222,44	*	929,40	*
MBM 200	75,22		377,38	*	200,36	*	214,24	*	867,20	*
MBM 300	84,00		470,28	*	282,77	*	279,51	*	1116,56	*
CV(%)	24,45		15,32		18, 39		16,74		9,12	

Values with (*) are significantly by Dunett test at 5% de probability

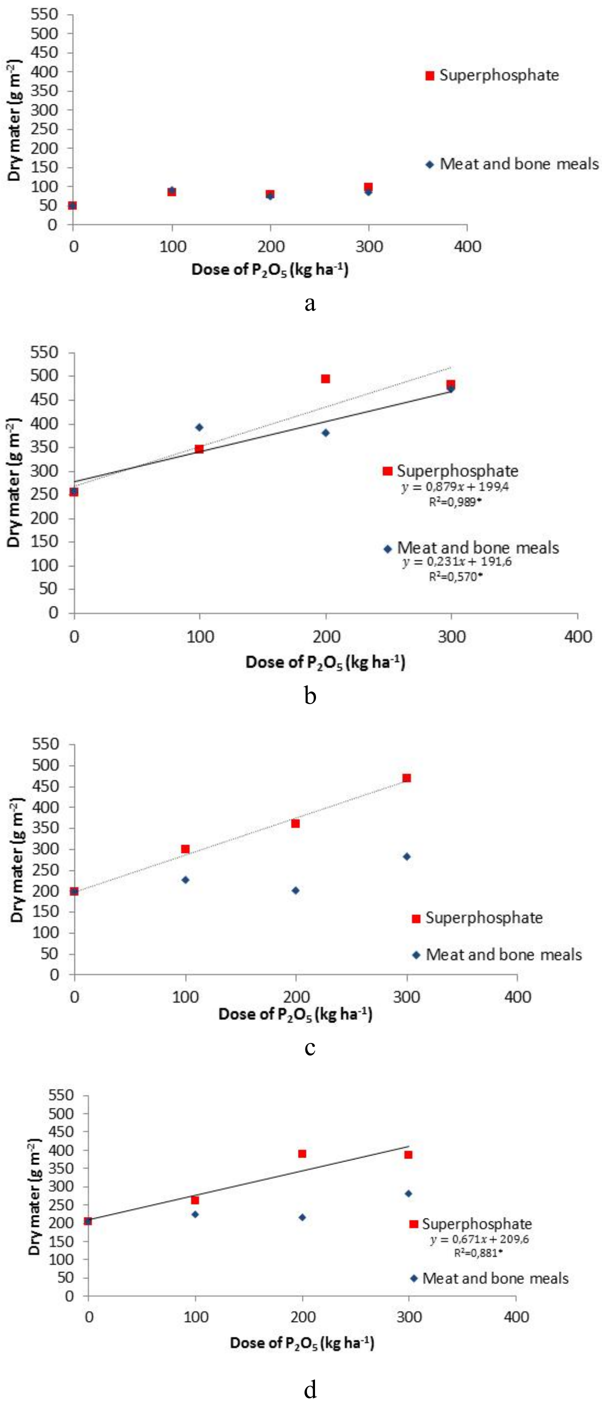

Figure 1. Adjustment regression for treatment phosphorous (100, 200 and 300 kg ha^{-1} P_2O_5) in the form of superphosphate and meat bones meals to Tifton grass (*Cynodon dactilon*): (a) First cut – 30 days after planting/DAP, (b) Second cut – 60 DAP, (C) Third cut – 90 DAP e (d) fourth cut – 120 DAP

At 150 DAP proceeded to a destructive collection in order to verify a possible difference in the shoots and roots of plants with different treatments Tifton. It can be seen that at the time the treatments control, SS100, SS200, SS300 and FCO100 had a higher proportion of shoots in relation to its roots. The greater the value obtained was SS100 (27% larger PA) being close to treatment SS200 (25%) and FCO (23%). This situation was reversed (roots showing a higher proportion) in the treatments with "N only", FCO FCO 300 and 200, although the differences are not as large (Table 4).

Table 3. Relationship between the average yields of dry matter (g m^{-2}) submitted to treatments of two sources of phosphate (Superphosphate – SP and meat bones meals – MBM) for the Tifton grass (*Cynodon dactilon*)

Treatments	Relationship	Result
N/c	=708,51/255,38	= 2,77
SP100/c	=988,94/255,38	= 3,87
SP200/c	=1321,28/255,38	= 5,17
SP300/c	=1436,35/255,38	= 5,62
MBM100/c	=929,40/255,38	= 3,63
MBM200/c	=867,20/255,38	= 3,39
MBM300/c	=1116,56/255,38	= 4,37
MBM100/SP100	= 929,40/988,94	= 0,93
MBM200/SP200	= 867,20/1321,28	= 0,65
MBM300/SP300	= 1116,56/1436,35	= 0,77

Control (c), Nitrogen (coverage 20 kg ha^{-1} N–urea), superphosphate (SP) and meat bones meals (MBM) doses de 100, 200 e 300 kg ha^{-1} de P_2O_5

Can be considered that a good root development creates the opportunity for a greater volume of soil explored by roots. It is also interesting to be observed that the treatments had a higher value in the relation R: PA were those who, in general, always produced higher amounts of DM (g m^{-2}), possibly because these highest yields were generated according to the source phosphorus with increased solubility. However, it is important to remember that the roots of plants present a high dynamic compartment and indicating use of the phosphorus sources used in this experiment cannot reflect the relationship P of the plant tissue, as in coastcross (*Cynodon dactylon* cv. Coastcross), in general, it is observed that increased levels of macro and micro-macronutrients in the shoots with increasing doses of N applied to soil, with the exception of P and Fe[33].

Table 4. Dry Matter production (g m^{-2}) Tifton (*Cynodon dactilon* L) subjected to two sources of phosphate (Superphosphate – SP and Meat bones meals – MBM), cut every 30 days with coverage of 20 kg ha^{-1} N-urea by cutting

Treatments	Dry Matter (g)		Relationship R: PA
	Roots (R)	Aerial Part (PA)	
Control	14,06 ± 1,73	15,5 ± 0,77	0,90
N (only)	15,13 ± 1,12	11,46 ± 3,77	1,32
SP 100	17,75 ± 0,85	22,56 ± 2,12	0,78
SP 200	17,74 ± 0,76	22,18 ± 0,63	0,79
SP 300	24,75± 1,52	29,36 ± 1,90	0,84
MBM 100	19,13 ± 3,27	23,54 ± 1,08	0,81
MBM 200	12,76 ± 0,36	11,77 ± 0,57	1,08
MBM 300	22,71 ± 3,04	19,75 ± 0,84	1,14

In Brazil, the potential dry matter production of *Cynodon sp.* has not yet been fully determined by the survey despite being found that many dairy farmers already grow this plant on their properties. As this plant and its hybrids require fertile soils[24] other variables such as C: N ratio, pH changes during the crop cycle and the residual power of alternative sources of P must be studied in order to reduce costs and be better spent waste from slaughterhouses[34,35,36].

These results are preliminary and other information must be generated for better understanding of the subject, however, these data are of great importance to the region where the study developed once indicates another way of use of meat and bone meal[34] when its acidity makes it prohibitive to make poultry feed[37]. His concern is inappropriate disposal of health authorities[38] and its use in fertilization of pastures avoids problems such as odor, attraction of insects and disease transmission[9].

4. Conclusions

The highest yield of dry matter was obtained as Tifton phosphorus has been added in the form of superphosphate.

The meat and bone meal produced satisfactory answers in relation to dry matter production of shoots Tifton, with efficiencies ranging from 65-93% when compared to fertilization with superphosphate.

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