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Scientific paper

Development of sorghum culture in a Latossolo Amarelo submitted to organic fertilization

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Abstract

The use of organic fertilizers in Brazilian agriculture has been increased recently. With the objective of evaluating the production of the culture of sorghum, in function of the organic fertilization application, it was installed an experiment in the experimental area of the Campus of the Unidade Acadêmica de Garanhuns UAG/UFRPE. The experiment was installed in vases of 16 liters, called experimental parcels. Sorghum cultivar IPA (464) Colmo Candy was used as indicating plant, where the following treatments had been tested (three organic fertilization): cattle manure (CM), sheep manure (SM) and hen manure (HM), at the rates of 50, 25 e 25 t ha^{-1} and a control (without organic fertilization). The experimental design was randomized blocks with four treatments and four replications. To evaluate the growth and production it was made a weekly measure of the next variables: plant height (PH), stem diameter (SD), at 22, 50, 85 and 106 days after sowing (DAS). Green mass (GM) and dry mass (DM) were determined at the laboratory. It was observed that the three different types of organic fertilization had promoted significant statistic differences in the two variables of production. In a general way, HM given its wealth in nutrients presented the best results of the variable height of the plant and diameter of the steam when compared organic fertilizers CM and SM. Amongst the organic composts, the HM was what induced higher increase in the production of green mass and an increase in dry weight of 49.77 and 98% compared to control (soil without fertilization) and bovine manure (EB), respectively.

Key words: manure, nutrients, fodder plant, sorghum.

Introduction

The city of Guaranhuns is an important center of milk production and distribution for North/Northeast, maintained by approximately 400 milk producers of the region. For a good quality and yield of the animal livestock of the region it is indispensible the good nutritional management, which is directly linked to the quality and nutritive value of sorghum as forage in the animal fed. Besides the use in the human fed, the crop is considered a great alternative to substitute maize, for the use in the composition of bird and swine rations, in the form of grains, and in the use as raw material for the production of anhydrous alcohol, alcoholic beverages, paints and brooms (BARBOSA e SILVA 2002).

Sorghum (*Sorghum bicolor* L. Moench) belongs to the family Poaceae, and it is an important compound of the animal fed in the United Stated, Australia and South America. Sorghum has been seen as a good substitutive to maize, mainly in the regions with semi-arid climates. In these regions, this forage has been explored the most, due to the largest resistance to veranicos[1], higher production per area and lower demand concerning soil fertility in relation to maize.

Sorghum is characterized as one crop

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[1] 'Veranico' is a Brazilian word to define dry periods during the wet season.

which responds to liming and fertilization with macro nutrients (FREITAS at al., 2009). The appropriate soil management system favors the root development and the nutrient absorption and, as a consequence, the plant development (ARF et al., 2002). Among these systems, the organic management has presented many advantages.

The use of organic fertilization has increased gradually in Brazil in the last years. The agricultural and farming systems originate several types of organic residues, which, correctly managed and used, can be providers of nutrients for the production of food and improvers of the physical, chemical and biological conditions of the soil. The use of animal organic residues as source of nutrients for different production chains of vegetables represents efficient alternatives which aim at the reduction or elimination of the dependence of the chemical fertilizers and increase in the environmental security. According to KONZEN and ALVARENGA (2005), in work performed with maize, it was verified that the organic fertilization using swine, bird and cattle manure are efficient fertilizers in the production of maize, either for grains or for forage.

According to MALAVOLTA et al. (2002) chemically, the organic fertilization is an important source of nutrients, specially N, P, K and micronutrients, and it is the only way of storage of N which does not volatilize and, still, it is responsible for 80% of the total phosphorus found in soil. According to DURIGON et al. (2002), the contribution of the organic matter is lower than 5% of the total mass, in most of the agricultural soils. Components of the manure, converted in humus, will have influence in soils in a persistent and lasting way (BRADY, 1989).

According to NORONHA (2000), the use of organic matter in soil as source of nutrients to plants has positive effects in the quality of the harvested product, and of the soil, since in its incorporation, especially as manure, has showed to be a viable practice in the increase of productivity. In this context, the objective of the work was to evaluate the growth and production of the sorghum crop submitted to different organic fertilization: cattle, sheep and hen manure.

Material and Methods

The experiment was conducted in experimental area inside the Campus da Unidade Acadêmica de Garanhuns (UAG – Academic Unit of Garanhuns), the externsion of the Universidade Federal Rural de Pernambuco (UFRPE – Rural Federal University of Pernambuco), in the period from April to July 2008, with the aim at evaluating the effect of different organic fertilizers ver the development of sorghum plants. The experiment was installed in vases, with the sorghum cultivar IPA (464) with sweet stem as indicating plant.

The design used was the randomized blocks, with four treatments and four replications. Each experimental plot was constituted of vases with 16 liters of capacity, containing one plant/vase, in which it was applied different organic fertilizers. The treatments correspond to four organic fertilizers: cattle manure (CM), sheep manure (SM) and hen manure (HM), in the dosages of 50, 25 and 25 t ha^{-1} and one control (without organic fertilization). For the statistic analysis, it was used the software Sisvar (FERREIRA, 2000), and the data was submitted to the analysis of variance and of regression, trough the F test at the level of 1 and 5% of significance. In the mean comparison, it was used the Tukey test at 1 and 5% of probability. The variance homogeneity was tested by Leyene test and the normality of errors was tested by the Cramer Von-Misses test, both at 1 and 5% of significance (PIMENTEL GOMES, 2002).

For the evaluation of the growth and production of the forage sorghum crop they were measured at the 22, 50, 85 and 106 days after seeding in the following variables: plant height (PH) and stem diameter (SD). The determination of green matter (GM) and dry matter (DM) was performed in laboratory after drying the material in oven with forced circulation, during 72 hours at 65 °C. The crop was irrigated by dripping, using a lateral line by row and drippers spaced from 1m along the lateral according to the distances between vases. The drippers presented an average flow of 2.0 L/h for a pressure of operation of 60 kPa.

The management of the irrigation water was based in the daily evapotranspiration

of the Tank Class A, installed over one wooden plataform with 15 cm of height, painted white, placed in the interior of the oven. The water volume to be applied, in the frequency of two days, was calculated considering the percentage of the evaporation measured in the period expected between to irrigation, according to the level of irrigation (correspondent to the fraction of 75% of the evaporation of the Tank Class A), the efficiency of application of water of the irrigation system, the average flow to the drippers and the spacing between them (along and between the irrigation rows.

The cattle (CM), sheep (SM) and the hen (HM) manure used in this study were acquired in the Sítio Morada Nova. This material was matured in cover environment, dried and totally tanned for 40 days. It was used plastic vases containing 16 kg of LATOSSOLO Amarelo, which received doses of dolomitic limestone, in order to raise the base saturation, according to the chemical analysis of soil, and to the organic fertilization (CM, SM and HM) according to the respective treatments.

The soil samples used in the experiment were collected in the layer form 0 to 20 cm of depth, dried in the air, and accordingly sieved in order to obtain a higher uniformity of granulometry using the sieve with 4 mm and conditioned in vases, submitted to the chemical analysis of the soil.

The chemical analysis of the soil with the fertilizers, determined according to the methods described by MALAVOLTA et al. (2002), resulted in P = 5.76 mg dm^{-3}; OM = 1.36%; pH in water = 5.9; K^+ = 0.23 cmol cdm^{-3}; $Ca2^+$ = 2 cmol cdm^{-3}; $Mg2^+$ = 0.89 cmol cdm^{-3}; $Al3^+$ = 0.16 cmol cdm^{-3}; $H+ + Al3^+$ = 2.18 cmol cdm^{-3}; CEC pH 7 = 5.34 cmol cdm^{-3}; and base saturation (V) = 59.18%.

Results and discussion

In Table 1, it is presented the results of the analysis of variance referent to plant height (PH) and stem diameter (SD) measured at 22, 50, 85 and 106 days after the crop sowing.

Table 1. Summary of the variance of the data of variable growth: plant height (PH) and stem diameter (SD), obtained in the experiment of evaluation of the sorghum crop submitted to different treatments, in the year 2008 (Garanhuns-PE).

Source of variation	GL	Mean square (MS)	
		AP (m)	DC (cm)
		22 (Days after seeding - DAS)	
Treatments (organic fertilization)	3	0.00830 **	0.03148 *
Block	3	0.00014 ns	0.00078 ns
Residues	9	0.00011	0.00024
Coefficient of variation – CV(%)		10.54	9.20
		50 (Days after seeding - DAS)	
Treatments (organic fertilization)	3	0.12980 **	1.65840 *
Block	3	0.00232 ns	0.02190 ns
Residues	9	0.00374	0.02622
Coefficient of variation – CV(%)		20.44	11.66
		85 (Days after seeding - DAS)	
Treatments (organic fertilization)	3	1.63524 *	2.13575 *
Block	3	0.02034 ns	0.01192 ns
Residues	9	0.03991	0.03169
Coefficient of variation – CV(%)		20.62	10.36
		106 (Days after seeding - DAS)	
Treatments (organic fertilization)	3	2.62570 *	1.02467 *
Block	3	0.02429 ns	0.03114 ns
Residues	9	0.03913	0.2038
Coefficient of variation – CV(%)		14.71	9.75

By Table 1, it is verified that there were significant differences when submitted to the different treatments (cattle manure, sheep manure, hen manure and one control, absence of organic fertilization), in the variables plant height and stem diameter.

It is verified in Figure 1 that in all the treatments in which it was applied organic fertilization, the mean values of the variables; plant height (PH) and stem diameter (SD) were superior to those observed in the control treatment. However, the application of hen manure presented the best results for the growth and development of sorghum crop. These results are in accordance concerning PH and SD with those observed by FREITAS at al. (2009), who verified the best treatment for the sorghum crop development in function of the addition of organic fertilizer.

It is also observed by Figure 1 that in the initial stage of growth of sorghum plants, that the treatment with organic fertilization CM, SM and HM obtained best performed for the characteristics plant height and stem diameter, and they were not statistically different from each other. However, during the period of evaluation, it was observed that the responses of the sorghum plants submitted to the treatment with the three organic fertilizers were not maintained with the same growth speed.

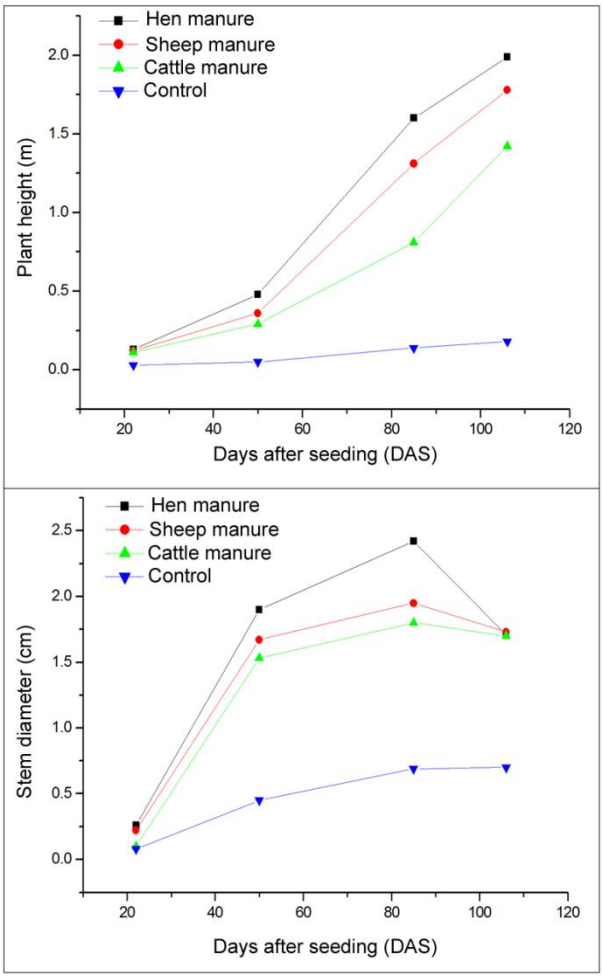

Figure 1. Summary of the variance of the data of variable growth: plant height (PH) and stem diameter (SD), obtained in the evaluation of the sorghum crop submitted to different treatments, in year 2008 (Garanhuns-PE)

The results of the analysis of variance referent to the characteristics of production; green matter (GM) and dry matter (DM) evaluated in the end of the 106 days after seeding are presented in Table 2. It can be verified, by the F test, significant differences at 1 and 5% of significance for both characteristics of production of sorghum with application of the treatments of organic fertilization. It can be also observed that the coefficients of variation were considered appropriated for the characteristics of production GM and DM, indicating thus, a good experimental accuracy (PIMENTEL GOMES, 2002).

Table 2. Analysis of variance of the variables: green matter (GM) and dry matter (DM) 106 days after the seeding of the sorghum crop submitted to different treatments, in the year 2008 (Garanhuns-PE).

Source of variation	DL	Mean squares (MS)	
		GM (g)	DM (g)
Treatments (organic fertilization)	3	8,2396.31 **	3,592.55 **
Block	3	2.414.73 ns	224.44 *
Residues	9	1.274.58	65.74
Coefficient of variation – CV(%)		17.44	19.47

ns - non significant; * - significant at the level of 5% by F test; ** - significant at the level of 1% by the F test.

It is observed, through the comparative analysis of the averages of the Tukey test of Table 3, that in all the treatments in which it was applied the organic fertilizer, the values of the dry matter and green matter were superior to those observed in the control treatment. This result is coherent with many researches with sorghum crop, which demand high content of fertilization for the final production (SCHEFFER, 1998; FREITAS at al., 2009). However, only the application of hen manure (HM) determined significant increase in relation to the other organic fertilizers.

Table 3. Mean values of the data of green matter (GM) and dry matter (DM) 120 DAS of the sorghum crop submitted to different treatments, in the year 2008 (Garanhuns-PE).

Organic fertilization	Variables of production	
	MV (g)	MS (g)
Cattle manure (CM)	238.96 b	41.51 b
Sheep manure (SM)	224.63 b	51.53 b
Hen manure (HM)	349.14 c	72.49 c
Control	6.30 a	1.08 a

Averages followed by the same letter in column do not differ statistically at the level of 1% of probability by the Tukey test.

Figure 2 presents mean values of the GM and the DM with respective pattern errors of the mean of sorghum production at the 106 days after seeding (DAS), obtained through the application of the test of mean comparison of Dunnett at the level of 5% of probability. It is evident that the higher values of GM and DM occurred in the presence of fertilization with hen and cattle manure respectively, with statistic difference in relation to the control in the level of significance of 1% of probability.

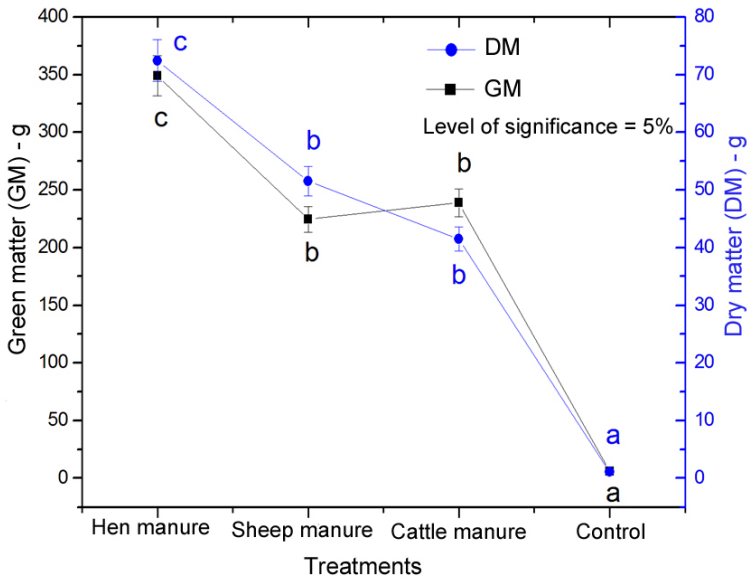

Figure 2. Mean values for green matter (GM) and dry matter (DM) per plant, with patter deviation 106 days after the crop seeding (DAS) when submitted to different organic fertilizers, in the year 2008 (Garanhuns-PE).

The Best results of the variables analyzed were obtained with the use of hen manure. The Best efficiency of the organic fertilization of hen may be related to the nutritional biological properties, i.e., it is richer in nutrients than the other animals, since birds normally are fed with concentrated rations (MARIGUELE and SILVA, 2002). According ALVES et al. (1999), the efficiency of the organic fertilization of hen is associated to the content in mineral nutrients, mainly nitrogen, phosphorus and micro nutrients and by its high content of organic matter, improving its resistance to erosion and drought, activating the microbiological life of soil and possibly increasing the plant resistance. For RAIJ (1991), the favorable effect of the organic matter in the characteristics of soils is related to the aggregation of particles and to the stabilization of the aggregates, which results in higher porosity, aeration and water retention.

Conclusions

The different kinds of organic fertilization with cattle, sheep and hen manure affected the development of the sorghum cultivar IPA (464) with sweet stem, in different degrees.

It was theoretically registered the maximum plant height and stem diameter, obtained with the application of the hen manure, when compared to cattle, sheep manure and the control.

For dry matter, it was obtained the best theoretical development with hen manure.

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