

Pepper yield according to different types of organic fertilization

Abstract

Bell pepper (*Capsicum annum* L.) is one of the most economically important vegetables in the world market, being very demanding in terms of soil fertility and, as the soils in Mozambique have, in general, low fertility, organic fertilization is used. To make them compatible with the demands of the culture. The objective of this work was to evaluate and compare the efficiency of fertilization with bovine and swine manure in terms of plant height, plant architecture, number of fruits per plant and fruit production. They were evaluated in an experiment, in the “dry” crop of 2016, at the agricultural research center of the Zambeze University in Tete-Mozambique province. The experiment was carried out in a randomized block design with three replications and plots of three rows of four meters. From each plot, fifteen plants were measured regarding plant height, number of fruits per plant and fruit production. The data were submitted to statistical processing using Sisvar software, through which normal distribution of data was confirmed, in each variable analysis of variance was performed in the Turkey multiple category test at 5% significance in consideration of the phenological indicators of the culture. The analysis of variance of all parameters evaluated, in the comparison of the averages, there were no significant differences in plant height, number of fruits per plant, and fruit production in both fertilizations, there was a significant difference in the architecture of the plant showing a higher average size when swine manure was applied. From the results shown above, we can infer that fertilization (swine manure) can be one of the alternatives when it is intended to obtain plants with erect architecture, although fruit production for both fertilization is not significant.

Keywords: organic fertilization, *capsicum annum* L., production

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Introduction

The pepper crop (*Capsicum annum* L.) is one of the most economically important vegetables in the world market, being quite demanding in terms of soil fertility and, as the soils in Mozambique have, in general, low fertility, use is made of organic fertilization to make them compatible with the requirements of the crop. Research results have shown the importance of using high doses of organic and mineral fertilizers to meet the demand for nutrients in the pepper crop (MELO, 2002). FILGUEIRA³ states that vegetables are well suited to this type of fertilization, both in terms of productivity and quality of the products obtained. The chemical and physical characteristics of swine manure are directly related to the management system adopted and animal nutrition, suffering concentration variations according to the dilution to which they are submitted and the storage system used (ALMEIDA, 2006). The average amount of swine manure produced is 10 to 12 times greater than that produced by man, the high levels of nitrogen and phosphorus found in swine manure attribute to these characteristics of agricultural fertilizers, although the use for this purpose requires certain precautions.² The production and consumption of organic peppers has been growing every year, as they are food free from contamination of chemical residues.³ However, the correct amount of organic fertilizers that can replace inorganic fertilizers in the pepper crop is not yet well defined.⁴ According to Bissani et al. (2008), organic fertilizers have low concentrations of nitrogen, phosphorus and potassium leading to low productivity, however, if supplementation with mineral fertilization occurs, in order to favor the synchronism of nutrient release during plant growth, it can thus achieve greater development and productivity of plants.

Bovine manure and its effect on pepper crop yield

In the production of vegetables, a beneficial effect of organic fertilization has been observed. According to FILGUEIRA¹ states that

vegetables react well to this type of fertilization, both in productivity and in the quality of the products obtained, with cattle manure being the most used source by horticulturists, and should be used especially in soils poor in organic matter. In vegetables, the use of organic fertilization is of great importance, especially in tropical soils, where mineralization takes place intensively.⁵ In this sense RAHMAN et al. (1997) emphasize its beneficial effect on vegetables, mainly in providing better growth and increased production. It can also improve the quality of harvested products.⁶ Several researchers studied the effect of the incorporation of organic material, associated or not with mineral fertilization, on the pepper crop⁷ and verified, in Croatia, that the highest average fruit mass was achieved from plants supplied with organic compost associated with mineral fertilizers. Vegetables benefit from the use of organic fertilizers, both in productivity and in the quality of the products obtained, with cattle manure being the most used source, especially in soils poor in organic matter.¹

Swine manure and its effect on pepper crop yield

The chemical composition of the fertilizer formed by the macronutrients: Nitrogen, Phosphorus, Potassium, Calcium and Magnesium, directly influenced the development of plants. According to MATOS⁴ nutrients perform numerous functions in plants, therefore, their omission can compromise several metabolic processes of the same, causing a decrease in the growth and development of plants. The use of swine manure as fertilizer has been widespread because it contains nutrients and organic matter and has the potential to increase soil productivity and fertility. However, manure applications often go beyond the recommendation of nutrients for agricultural crops, which, combined with inadequate soil management and the existence of clived areas, contribute to the degradation of natural resources in producing regions.⁸ Fermentation of organic matter present in manure is carried out to reduce or inactivate pathogenic microorganisms and the toxicity of these residues, before being applied to the soil. Fresh

or unstabilized manure can heat up and inhibit seed germination and root elongation, as well as contaminate the operator, soil and vegetables. On the other hand, the use of mature manure can have a stimulating effect on plant growth due to the presence of mineral nutrients, beneficial microorganisms, moist substances and the physical characteristics of a stabilized organic fertilizer. Stability or maturity is an important quality characteristic for an organic fertilizer.^{9,10} In view of the diversity of macro-nutrients and macro-nutrients contained in swine manure and the wide availability of this raw material, it is of great importance to carry out studies on its quality and health for the production of organic fertilizers; thus, the use of fresh swine manure can cause, in addition to heating due to increased microbial respiration, temporary acidification of the soil, harming plant development (JAHNEL et al., 1999); on the other hand, the use of fresh manure can be a source of contamination of people during handling, due to different pathogens, thus evidencing the need for fermentation of swine manure for agronomic use.

Material and methods

Location and characterization of the study area

The experiment was carried out at the Faculdade de Ciências Agrária, 3 km from the national road (EN34), in the district of Angónia

in the village Ulónguè located in the province of Tete, being limited to the north, northeast and east by the territory of neighboring Malawi, and south by the district from Macanga. The district has the following coordinates: 14°42'57" South latitude 34° 22' 23" East longitude, and 1650 m altitude in the municipality of Angónia.¹¹ In terms of climate, the district is covered by a humid temperate climate strongly influenced by altitude, with a wide variation in precipitation from 725 mm to 1149 mm, with most of the pluviometric fall (90%) occurring between the end of November and the beginning of April, the pattern of temperature and conditioned by the altitude which varies from 700 to 1655m, with an average temperature for Ulónguè 20.9°C.¹¹ The topography considered very undulating and dissected in this region of high altitudes that occurs frequently being geographically located in the complex zone of marvel-Angonia, the main mountain forms are Mount Domué-2095m Macumgua-1797m and Chirobwe-2021m. The district's soils are feralitic, red to reddish-brown, heavy in texture, deep and moderately well drained, slightly to slightly leached, but with good water retention capacity.¹¹ The experimental design applied was in randomized blocks. With three (3) Treatments, three (3) Repetitions, with a total field area of 120 m². The plots consisted of three (3) rows spaced 0.60 between plants, and 1m between rows. Each plot consisted of 3 lines, each line corresponding to a total of 8 plants, totaling a universe of 24 plants per plot Figure 1.



Figure 1 Map of the district of Angónia.

Source: Angónia District Secretariat.

In conducting the experiment, all the cultural treatments required by the crop were carried out, in a logical sense of all activities such as identification of the area, demarcation of the area, cleaning of the area, soil preparation, fertilization, sowing, weed control, pest control and disease, ending with the harvest. Soil preparation was carried out in January, according to the recommendation, soil preparation consists of leveling the soil so that the root system can have a good development in addition to allowing good crop management such as irrigation (TIVELLI, 2000). Fertilization was made with bovine and swine manure, being applied 3 weeks before transplanting to the

definitive field in an amount of 28.8 kg of bovine and swine manure in each plot, totaling 88.9 (kg) in all treatments.

The useful area for each plot was 9.6 m², according to the calculations, the amount applied will be 28.8 kg, following the basic guidance of (LOPES and GUIMARÃES, 1989) for Horticulture Bovine manure an amount of 30 to 50 ton/ha is required. Sowing was carried out in the nursery on February 2, 2016, and after 40 days the transplant was carried out, which consisted of removing the seedlings from the nursery to the definitive field, the transplant was usually

done when the seedlings had six to eight definitive leaves, about 10 to 15 cm in height, which happens approximately in a period of 50 days. The variables measured were, respectively, Plant height (AP), Height of insertion of the first fruit (AIPF) referring to the vegetative variable. As for the reproductive variables, the following variables were evaluated: Total number of fruits per plant (NFP), Average fruit weight (PMF), Fruit yield (RF). The data were submitted to statistical processing, through which normal distribution of data was confirmed, in each variable analyzes of variance were performed to observe the existence or not of differences between the means of the analyzed variables. The Turkey multiple category test was also performed at 5% of insignificance considering the phonological indicators of the culture.

Results and discussion

The treatment effect was significant ($P < 0.01$) for all characters evaluated (Table 1). Thus, it was found that there was at least one mean different from the others in each treatment. What was already expected since three treatments were evaluated in which the control was not applied. The coefficients of variation of the characteristics evaluated in the experiment conducted were between 8.98 and 24.89 (Table 1), while the coefficients of variation of productivity were 11.39, which indicates great experimental precision. After data processing, analysis of variance of all parameters evaluated, in the comparison of means there were no significant differences in plant height, number of fruits per plant, and height of insertion of the first fruit, there were significant differences in the average weight of the fruits, and in income. Allowing to reach the following results and discussions in the tables illustrated below:

Table 1 Mean values of the height of insertion of the first fruit (AIPFR), Height of the plant (AP), number of fruits per plant (NFP), Weight of fruits per plant, fruit productivity

FV	Average				
	PROD (kg. ha ¹)	AL (cm)	PMFP (kg)	NFP	ALPFR
Cattle manure	11.53 ^a	25.72 ^a	1.45 ^a	5.76 ^a	16.63 ^a
Swine manure	13.06 ^a	28.39 ^a	1.65 ^a	5.49 ^a	17.27 ^a
Witness	4.96 ^b	24.04 ^a	0.63 ^b	3.09 ^a	13.03 ^a
CV (%)	11.39	8.95	17.79	24.89	13.05

Source: from the author

Means followed by the same letter in the same column do not show significant differences by Tukey's test, at 5% probability. In Table 1, it can be seen that there were no significant differences between bovine and swine manure, but there was a significant difference in the control treatment with the others, corresponding to the superior average the swine manure with a value of 13,063 ton/ha, with the control lowest value of 11.3ton/ha. It was observed for plant height for all treatments that there were no significant differences regarding the application of bovine and swine manure, as well as for the variable number of fruits per plant and height of insertion of the first fruit.¹²⁻¹⁶

Conclusion

Regarding the different types of fertilization studied in the soil and climate conditions of Angónia, the analysis of the data obtained allowed us to conclude that: The culture was implanted in agro-climatic conditions favorable to the morpho-physiological performance of the plants, where the analyzed variables presented the highest performance in fertilization with swine manure, with the treatment having a positive influence on plant height, yield, fruit

weight, and number of fruit surpassing the other variables analyzed in the present work. The highest yield in the pepper crop was observed in the treatment with swine manure, having presented an average value of 13.1 ton/ha and 1.6508 kg of average fruit weight.

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None.

Conflicts of interest

The author declares there is no conflict of interest.

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