

Full Length Research Paper

A contrast of organic fertilizer (poultry Droppings) and chemical fertilizer in corn development

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Accepted 18 April, 2014

Poultry manure, applied like organic fertilizer on corn, has not been studied extensively; so, no one knows its effect on the genealogy of the soil. However, organic fertilizer does not cost much, it is easy to buy and it has less degree of environmental degradation as compared to chemical fertilizers. This study was conducted in the commercial fields of St. Helena / PR with corn, using the triple hybrid 2B688, established in 2008 with no-till farming for seven years in order to evaluate the effect of poultry manure on corn yield. The treatment used was chemical fertilizer having nitrogen in the formulation NPK with an addition of three doses of poultry manure (0, 3.5 and 7 t ha⁻¹) and a witness; whereas the experimental design was randomized blocks with split plots and five replications. It was observed that the results were not significant for the number of rows per ear and grains per spike. Nevertheless, increased yield in corn was observed with 100% of poultry manure.

Key words: Fertilization, yield, nitrogen, poultry manure.

INTRODUCTION

Although Brazil is the third largest corn producer in the world, the yield average is low (3,000 kg ha⁻¹) as compared to China (4,700 kg ha⁻¹) and the U.S. (8,670 kg ha⁻¹) (Araújo et al., 2004), due to several problems of pests, diseases and inadequate nutrition of plants.

Any compound derived from the remains of plants or animals that can be used in agriculture for soils or plants' fertilization is considered an organic fertilizer (Oliveira et al., 2006). Usage of organic fertilizer is essential for the proper development of plants, vegetables, flowers and fruits, as it offers rapid growth with superior quality to all species, because it has the nutrients necessary for better development. Organic fertilizer has many advantages,

such as: conditioning effect, raising the cation exchange capacity (sandy soil), contributes to soil aggregation (erosion), favors tillage operations (plasticity and cohesion), increases water retention, greater stability temperature, improves nutrient availability and assists in setting phosphorus (P) and organic acids (soluble minerals). However, with their high amount of organic matter, they serve as nutrients and energy source for soil microorganisms (SBRT, 2006).

Different organic wastes application resulted in significant changes in chemical properties and soil fertility. The hen manure, after a second application, resulted in significant increase in the levels of soil phosphorus (Brito et al., 2005). According to a study by Lima et al. (2007), organic fertilization with poultry litter can be considered an important nutrient source for *Brachiaria brizantha* cv. Marandu. However, organic

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fertilization resulted in increased dry matter yield, whereas the content of potassium and organic carbon showed a positive correlation with the increased rates. Organic fertilizer increases soil pH and phosphorus to 15 t ha^{-1} rate, and there was a decrease in the higher rate. Organic manure at a 5 t ha^{-1} rate was equivalent to chemical fertilization, whereas organic fertilization at a rate higher than 5 t ha^{-1} was more effective than treatment with chemical fertilizers. In other cultivation systems, the advantages of the poultry manure were confirmed (Zarate et al., 2002; Oliveira et al., 2003; Oliveira et al., 2006; Silva and Menezes, 2007). However, this residue application in the soil without a prior study of the soil characteristics, waste and plant that will be nurtured could provide environmental damage to natural resources. Thus, the provision of waste must be done with a nutrient balance and should only be applied to the nutrients of soil concentrations that will actually be retained by the plant species in question. Continuous applications of this waste, without consideration of the nutrient balance concept, can cause imbalances in the soil, whose severity will depend on: the composition of the waste, the amount applied, the plants' extraction capacity, soil type and residue use time (SBRT, 2006). Therefore, the objective of this study is to evaluate the effect of poultry manure as organic fertilizer and chemical fertilizer in the development and production of corn.

MATERIALS AND METHODS

The experiment used for this study was carried out at a farm localized in Santa Helena Municipal District on Paraná State (PR) and was conducted between the periods of September 2008 to February 2009. The experimental area was classified as Oxisol Udic Dystrophic (USA, 1998). It is a common region (Silva et al., 2011) with subtropical climate and an average temperature (high) of 260 m altitude. The hybrid triple of Dow AgroSciences was used for variety 2B688. However, the soil chemical analysis revealed that $\text{pH CaCl}_2 = 5.80$, $\text{Al}^{3+} = 0.0 \text{ cmol}_c \text{ dm}^{-3}$, $\text{Ca}^{2+} = 9.11 \text{ cmol}_c \text{ dm}^{-3}$, $\text{Mg}^{2+} = 2.68 \text{ cmol}_c \text{ dm}^{-3}$, $\text{K}^+ = 0.81 \text{ cmol}_c \text{ dm}^{-3}$, $\text{P} = 1.391 \text{ cmol}_c \text{ dm}^{-3}$, cation exchange capacity = $16.29 \text{ cmol}_c \text{ dm}^{-3}$, and organic matter = $31.97 \text{ cmol}_c \text{ dm}^{-3}$.

The experimental design was a randomized complete block with four treatments and five replications. The plots had a 25.20 m^2 total area, distributed in six rows of six meters, where the chemical fertilization treatments were different in manure rates.

The poultry litter was purchased from a producer in the region, who has already enjoyed it for about 10 months. Three days before the application, it was placed on a tarp in the sun to dry. To facilitate distribution in the search field, it was distributed by hand, covering half of the period of October 2008. Chemical as well as organic fertilizer was performed manually after the practice was performed for sowing. On September 16 2008, the fertilizer was applied manually after executing the sowing of the crop management, considering the dosage described in the pre-treatments, and in places where it was necessary, the 200 kg ha^{-1} rate formula with 1% N, 11% P_2O_5 and 12% K_2O was used. The experimental units consisted of the following treatments: control (without fertilizer), 100% chemical fertilizer, 50% chemical fertilizer,

50% poultry manure and 100% poultry manure.

The drought for weed control was performed in two applications. The first application was done on 10 August 2008, and the second one was done on 2 September 2008. Desiccation was performed with a tractor boom sprayer, using a herbicide whose active ingredients were glyphosate at 4 L ha^{-1} , 2-4-D at a rate of 0.62 L ha^{-1} and Paraquat + Diuron at a rate of 1 L ha^{-1} . The seeds were sown in the management system of the tillage without irrigation (with spacing of 0.70 m) and were distributed to an approximate depth of 5 cm and a depth of 12 cm for better development, with less resistance to the growth of the root.

Weed control was accomplished by mechanical weeding with a hoe. For pest management, an insecticide with active ingredient (Lefenuron) was used, where three applications were necessary due to heavy infestation of caterpillars. The crop was harvested manually on February 26, 2009. It was evaluated for the following characteristics: the rows number per ear, grains number per spike and the final yield; although the weight of 1,000 seeds was used in cases where an analytical balance was used to achieve higher measurement accuracy, and was also used to measure the grain moisture during the harvesting activity.

Yield was obtained from the floor area of the plants of each plot, and the two central lines (four meters in length) which were discounted by 1 m from each end and from the two rows of each edge were used to eliminate the "border effect". In a bid to reduce the alleged errors that could occur by chance because the plants on the headboard of each plot can be influenced by the treatment of a nearby field, the floor area of 16.80 m^2 harvest was totaled. Consequently, the corn was harvested manually and threshed with Lanyard manual. The total grain volume was weighed separately and the specified humidity was used to calculate the final yield, after which it was adjusted to 13%.

The results of the variables that were determined were subjected to analysis of variance, while their significance level was analyzed by F test and their means were compared by Tukey test at 5% probability using the statistical program SISVAR.

RESULTS AND DISCUSSION

There was no significant difference at 5% variance between the variables and interaction of the increasing manure rates with the number of grains per spike, number of rows per ear and number of kernels per row in corn (Table 1). Significant effect was noted at 5% probability in maize yield due to management of organic manure in the soil (Table 2). It can be seen in Table 1 that the average results for each treatment are very similar, where the number of rows per ear ranged from 17.6 to 18.2 with a coefficient of variation of 4.8%, the number of grains per spike ranged from 431 to 462 obtaining a coefficient of variation of 14.3% and the number of kernels per row ranged from 24.4 to 25.3 resulting in a variation coefficient (V.C.) of 11.2%. However, when analyzed in the F test, the results were not significant in any treatment of the analyzed variables.

Yield variable was influential to the rates or fertilizer management used for corn (Table 2). In this study, it was noticed that the result had a lower yield of $3,000 \text{ kg ha}^{-1}$ and an increased yield of $3,928 \text{ kg ha}^{-1}$ with 11.1% coefficient of variation, and when it was analyzed in F

Table 1. Number of rows per ear, grains per spike and grains per ear of corn rows, depending on fertilizer management.

Treatment	Rows per ear	Grains per spike	Grains per ear
Control	17.6 ^a	431 ^a	24.4 ^a
100% chemical	17.8 ^a	410 ^a	22.9 ^a
50% chemical/manure	18.2 ^a	465 ^a	25.5 ^a
100% manure	18.2 ^a	462 ^a	25.3 ^a
Variation coefficient (%)	4.8	14.3	11.2
F test	n.s.	n.s.	n.s.

Means followed by same letter within each parameter analyzed do not differ by Tukey test at 5% probability. n.s. = not significant.

Table 2. Corn yield depending on fertilizer management.

Treatment	Yield (kg ha ⁻¹)
Control	3,000 ^b
100% chemical	3,035 ^b
50% chemical/manure	3,230 ^b
100% manure	3,928 ^a
Variation coefficient (%)	11.1
F test	*

Means followed by same letter within each parameter analyzed do not differ by Tukey test at 5% probability. * = Significant at 5% probability.

test, it was significant at 5% level of probability. The treatment showed that the best result was obtained from the fourth treatment, where we used the full dosage of poultry manure and from 7 t ha⁻¹, which resulted to a 3,928 kg ha⁻¹ yield.

Supplemental fertilization coverage with poultry manure promoted significant increases which are directly proportional to the rates employed, with reference to the total dry weight and shoot fresh weight of the "head". Moreover, the yield and N, P, K, Ca and Mg leaves of cabbage, taken from the crop cycle, were influenced by the supplementation levels (Oliveira et al., 2003). Poultry litter addition does not affect the distribution of forms of copper in soils, except the exchangeable fraction (Nachtigall et al., 2007).

Although manure incorporation in the planting period of potato which increased the P and K soil levels throughout the growing season caused N soil immobilization in the first weeks after the merger, the planting and incorporation combination of crotalaria and manure application was more effective to provide nutrients for plants, because it was able to prevent the immobilization of soil N in the short term and increase the contents of available P and K soil over the period of culture (Silva and Menezes, 2007).

According to Castro et al. (2005), the eggplant crop responded to about 391 kg ha⁻¹ of nitrogen in the form of supplemental fertilization covered with litter, and it reached a yield of 50.6 t ha⁻¹. Oliveira et al. (2006) demonstrated that organic fertilization with poultry litter applied piecemeal gave rise to the levels of nitrogen, phosphorus and potassium and also for diameter, fresh weight, dry weight and yield of lettuce, regardless of the planting system. The results were also confirmed in the studies of Zarate et al. (2002), Oliveira et al. (2007) and Vieira et al. (2009) in others crops.

Conclusion

After the experiment was concluded in this study, yield increase was observed with 100% poultry manure application at 7 t ha⁻¹ rate.

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