International Journal of Life Science and Agriculture Research

ISSN (Print): 2833-2091, ISSN (Online): 2833-2105

Volume 03 Issue 12 December 2024

DOI: https://doi.org/10.55677/ijlsar/V03I12Y2024-07

Impact Factor: 6.774 , Page No : 961-967

Effect of Mini-Doses of Compost on Maize Development and Yield at the Refugee Site in Maro in the Greater Sido Region of Chad

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ABSTRACT: Chemical fertilizers are polluting for the environment, they are expensive and sometimes inaccessible to producers. With the arrival of refugees from the Central African Republic in Maro in southern Chad, arable land is reduced and soils have become impoverished. An alternative use of locally available organic fertilizers is possible to improve agricultural productivity. The Refugees do not have enough livestock to produce the 5 to 10 t/ha of manure that is recommended for maize cultivation. The objective of the study is to determine the minimum dose of compost that can increase corn productivity. The plant material is composed of 2009 TZEE-W-STR corn variety, with a 90-day cycle. The trial is conducted according to an experimental Fisher block design with 5 treatments (T1, T2, T3, T4 and T0) with 4 replicates. The mini-compost doses (20 g, 40 g, 60 g, 80 g and NPK dose equivalent to 100 kg/ha) correspond respectively to the T1, T2, T3, T4 and T0 control treatments. The results revealed that T0 (16.80 cm ± 0.106) had the longest cob, T1 (14.52 cm ± 0.29) had the lowest cob length. The best biomasses were obtained on T0 (5.14 kgm-2 ± 0.098) and T4 (5.13 kgm-2 ± 0.12), while T2 and T1 recorded the low biomasses. T4 (3.02 tha-1 ± 0.035) and T3 (3.02 tha-1 ± 0.087) obtained better yields, the low yield was observed on T1 (2.33 tha-1 ± 0.055). The T0 (0.253 kg ± 0.005) recorded the best grain weight. T3 and T1 obtained the low grain weights. T2 gave the same results as T4 and T3, which are the high rates of compost and the T0 control. The T2 treatment corresponding to 40 g compost/pocket would be recommended to refugees to increase maize production.

Published Online: December 05, 2024

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KEYWORDS: Zea mays L, organic manure, mini dose, yield, Chad

INTRODUCTION

The agricultural policy in Chad is to ensure food security for the population with quality and low-cost agricultural products on a sustainable basis and to promote the increase in the productivity of small producers (Goalbaye et al, 2018). However, for several decades, Chadian agriculture has been affected by poor agricultural practices based on the system of Agriculture of High Consumption of External Inputs AFCIE (the misuse of synthetic chemical inputs), which has proven to be potentially polluting for the environment (Tran et al, 1996) and slash-and-burn cultivation. These different practices have ended up acidifying and impoverishing the soil, destroying plant cover, polluting waterways or causing the disappearance of biodiversity (CORPEN, 2006). Also, producers find it difficult to make adequate use of chemical inputs due to their high cost and low accessibility (Goalbaye et al, 2016). All these factors and their corollaries have led to lower yields which, in turn, have created food insecurity. Also because of the low fertility of the soil, and with the arrival of refugees and returnees from the Central African Republic in the Department of Grande Sido, the arable land is decreasing from year to year. As a result, an alternative use of non-polluting and locally available organic inputs is possible to improve agricultural productivity (Goalbaye et al, 2016). One of the promising ways to increase agricultural production in peasant areas is to add different types of organic matter to the soil in order to increase the availability of nutrients (Nyembo et al, 2013; Mulji, 2011). However, producers in the Grande Sido Department, in particular the refugees from the Bélom camp, do not have enough livestock to produce the sufficient quantity of 5 to 10 t/ha of manure that is recommended for maize cultivation. Several studies have shown the importance of the use of organic fertilizers in improving crop yields (Goalbaye et al, 2016; Kasango et al, 2013; Useni et al, 2012; Kaho et al, 2011; Mulaji, 2011; N'dienor 2006; Ndayegamiye et al, 2005).

However, research should be more focused on the development of appropriate cultivation techniques to increase crop yields (Taffoua et al; 2008).
The objective of the study is to contribute to the reduction of poverty in rural areas by improving the incomes of agricultural producers.
Specifically, the study aims to determine the best mini dose of compost to increase corn productivity.

MATERIALS AND METHODS

Site of the experiment

The experiment is carried out in July 2024 in a peasant environment in the village of Dagoulou near the Refugee site in the Grande Sido Department in the Sudanian zone of Chad, (latitude N: 8.29'16.416" longitude E; 18. 43'56.016, altitude of m). The climate is Sudanian, characterized by a dry and hot season from November to April and a wet and hot rainy season from May to October. Average temperatures range from 24 to 38°C. The soils are ferruginous with red leaching, uniformly sandy clay to clay texture with a slightly acidic pH on the surface and very acidic at depth (Naitormbidae, 2012). Vegetation is characterized by open forests and wooded savannahs in the Sudanian part (DREM 1998).

Plant material

The plant material studied is composed of improved 2009 TZEE-W-STR variety of maize, with a 90-day cycle. The average yield obtained in improved cultivation is 3 t ha-1. The level of intensification is improved (ploughing, weeding, phytosanitary products, fertilisers).

Méthods

The trial is conducted according to an experimental Fisher block design with five treatments (T1, T2, T3, T4 and T0) with four replicates. The mini-doses of compost (contents of one can (20 g), 2 cans (40 g), 3 cans (60 g), 4 cans of tomato (80 g) and NPK dose equivalent to 100 kg/ha) correspond respectively to the T1, T2, T3, T4 and T0 control treatments. Only one factor is studied: the optimal level of mini dose of compost.

Cultivation management

The experimental plots are ploughed to a depth of 15-20 cm. Then these plots underwent harrowing in order to prepare the seedbed. Sowing is carried out after a useful rainfall of at least 20 mm. To avoid any limiting factors, the seeds are treated with a mixture of insecticide and the fungicide thioral (thiram and heptachlor). The seedling is grown to three seeds, placed at a depth of about 5 cm. The 80 cm x 40 cm spacing is retained. The first application of organic or mineral fertiliser (T0) is applied at sowing as a base fertiliser around the pockets. The second application at the 6-8 leaf stage and the third at the male flowering stage around the plants as a cover fertilizer. A first weeding is carried out on the 12th day after emergence and a second weeding on the 21st day after emergence. The unmarriage with two seedlings per pocket will be carried out on the 15th day after emergence. The surface area of the elementary plot is: 6 m x 5 m = 30 m2, i.e. a surface area of 30 m2 x 20 = 600 m2 for all the experimental plots. A 50 cm border is retained for the passage and a space of 50 cm between the blocks. The cultural precedent is fallow.

Phenological observations

Phenological observations have focused on: 50% of emergence, 50% of male and female flowering, crop cycle.

Calculated or measured or recorded parameters

The agronomic parameters related to the measurement or recording of:
Number of leaves, above-ground biomass, weight of 1000 grains, grain yield.

Statistical data analysis

Statistical data were analyzed with the Statistical Package for Social Sciences version 20.0 (SPSS) software. The means of the different parameters will be separated by the Student-Newman-Keuls (SNK) multiple comparison test.

RESULTS

1. RESULTS OF PHENOLOGICAL OBSERVATIONS

The dates of the main phenological stages of maize cultivation have been noted when 50% of the plants reach these stages (Doorenbos and Kassam, 1980; Karam et al. 2002; Goalbaye, 2014), which allows us to construct the following phenological schema:
Sowing (July 6, 2022, day T), emergence (T+4), beginning of vegetative period (T+14), 6-leaf stages (T+18), 8-leaf stage (T+23), full vegetative development (T+43), male flowering (T+50), female flowering (T+54), beginning of grain formation (T+62), complete grain formation (T+72) and harvest (T+90) for the T0 treatment. Sowing (6 July 2022, day t), emergence (t+4), early vegetative period (t + 16), 6-leaf stages (t + 20), 8-leaf stage (t + 25), full vegetative development (t + 45), male flowering (t + 52),

female flowering (t + 55), beginning of grain formation (t + 64), complete grain formation (t + 74) and harvest (t + 90) for T1 treatments, T2, T3 and T4.

II. RESULTS OF MEASURED PARAMETERS

The number of leaves at 30 DAS is shown in Figure 1. Treatment T0 (9.45±0.575) obtained the highest number of leaves at 30 DAS followed by treatments T2 (7.7±0.7) and T4 (7.15±0.15). The lowest number of leaves is observed on treatment T3 (7.05±0.85). The statistical analysis of the results showed that there are highly significant differences between the treatments from the point of view of number of leaves at the threshold of 1% ($F = 7.16$, $P < 0.01$).

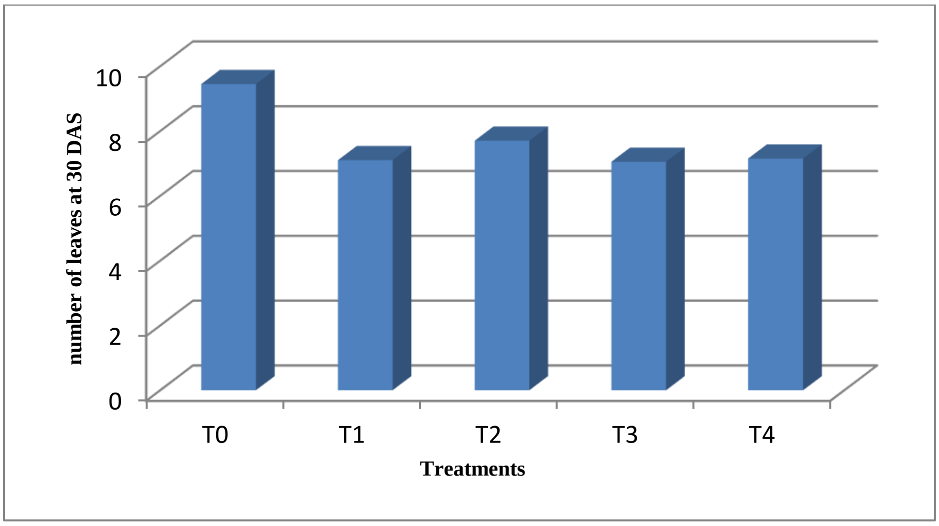

Figure 1: Number of leaves at 30 DAS

The number of corn leaves at 45 DAS (days after sowing) (is shown in Figure 2 above. Treatment T0 has the highest number of leaves T0 (11.55±0.85) followed by treatments T2 (10.1±0.65) and T1 (10±0.4). The lowest number of leaves is noted on T3 (9.7±0.7) and on T4 (9.9±0.55). Statistical analysis of the results revealed that there are significant differences between treatments regarding the number of leaves at 45DAS at the 5% threshold ($F=3.28$, $P=0.027$).

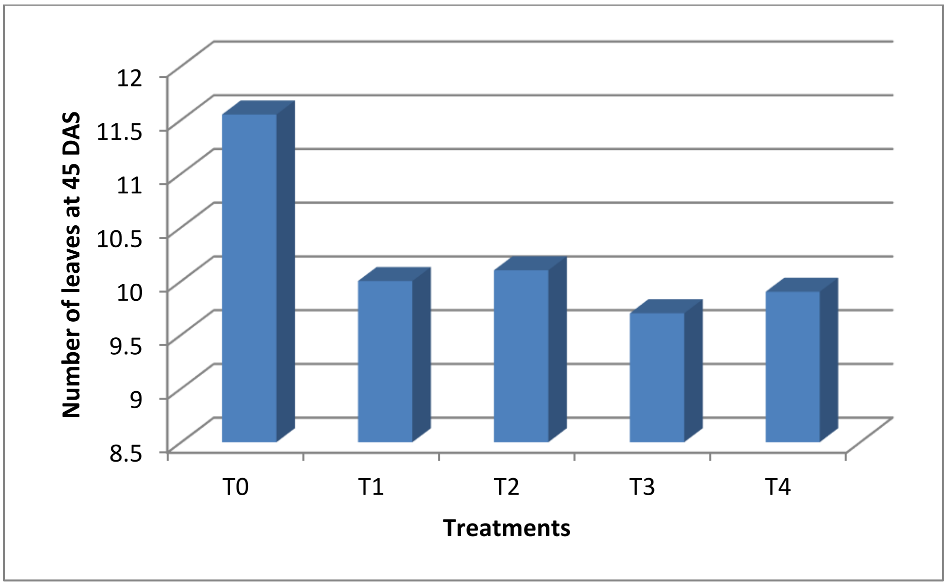

Figure 2: Number of sheets 45 days before sowing (JAS)

The length of the spikes is shown in Figure 3. Treatment T0 (16.802 cm ± 0.106) recorded the longest spike followed by T2 (16.347 cm ± 0.184), T4 (16.245 cm ± 0.405), T1 (14.525 cm ± 0 ,29) obtained the low spike length. Analysis of variance revealed that there is a highly significant difference between treatments with regard to cob length at the 1% threshold ($F=17.225$; $P=0.094$).

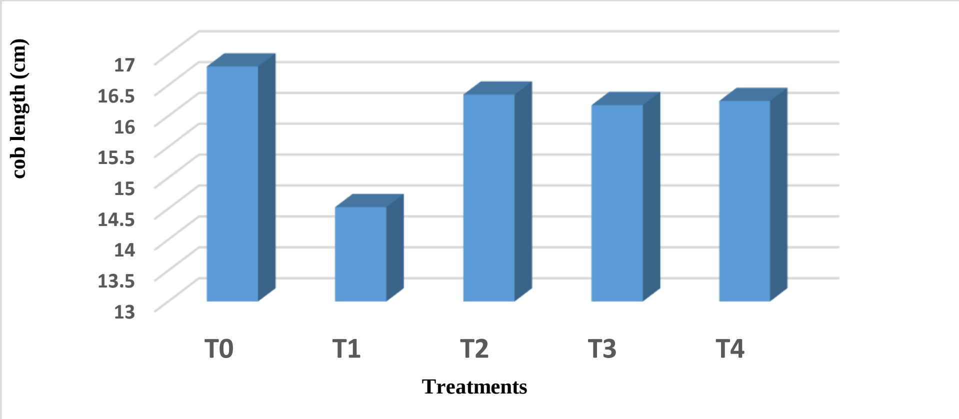

Figure 3: Length of corn cobs

The aboveground biomasses are reported in Figure 4. The best biomass was observed on treatment T0 (5.147 kgm-2 ± 0.098) followed by T4 (5.135 kgm-2 ± 0.12) and T2 (5.0525 kgm- 2 ± 0.138). Treatment T1 (4.24 kgm-2 ± 0.63) recorded the low biomass. The statistical analysis showed that there is a significant difference between the treatments at the biomass point at the 5% threshold (F= 4.7355; P= 0.046).

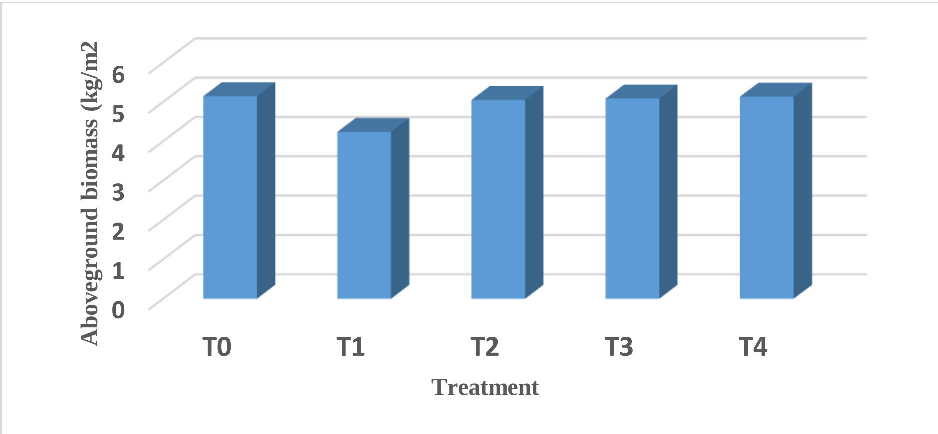

Figure 4: Dry above-ground biomass of corn plants

The grain yields are shown in Figure 5. Treatments T4 (3.025 tha-1 ± 0.035) and T3 (3.025 tha-1 ± ± 0.087) obtained the best yields followed by T2 (2.99 tha-1± 0.035) and T0 (2.975 tha-1 ± 0.100), the low yield was observed on T1 (2.33 tha-1 ± 0.055). The statistical analysis showed that there is a highly significant difference between the treatments at the yield point at the 1% threshold (F= 41.477; P= 0.0¬67).

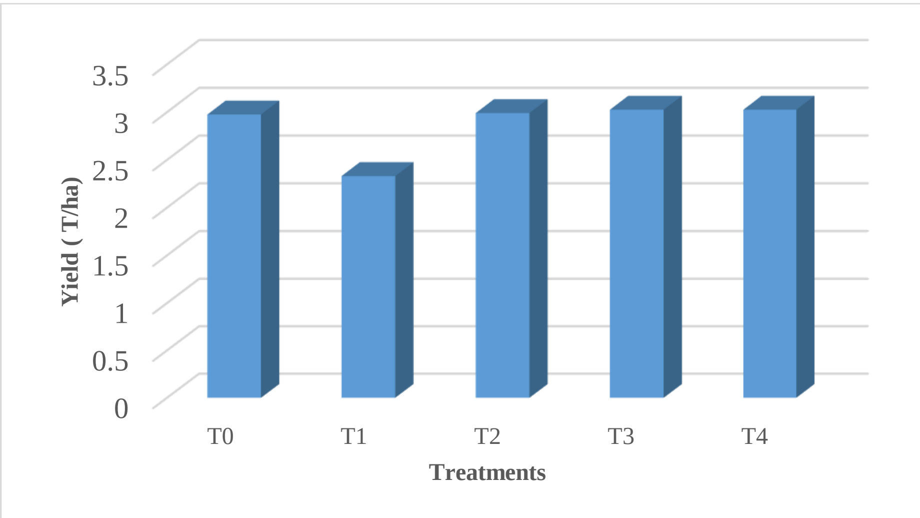

Figure 5: Grain yields

The weight of 1000 grains is shown in Figure 6. Treatment T0 (0.253 kg ± 0.005) recorded the best grain weight followed by treatments T2 (0.252 kg ± 0.005) and T4 (0.252 kg ± 0.005). 0015). Treatments T3 (0.2495 kg ± 0.0015) and T1 (0.2485 kg ± 0.005) obtained the low weights of 1000 grains. Statistical analysis of the results revealed that there is no significant difference between the treatment means with regard to grain weight at the 5% threshold (F = 0.4822; P< 0.01).

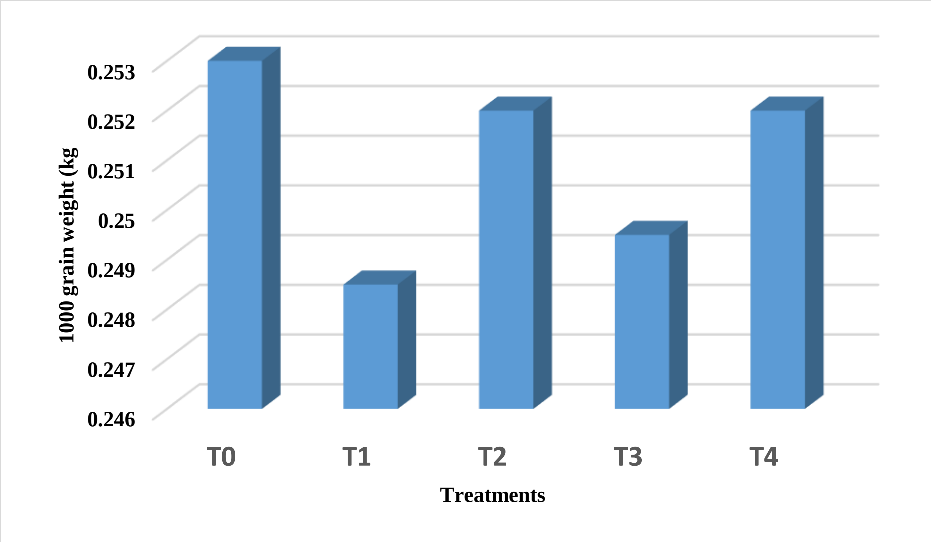

Figure 6: Weight of 1000 grains of corn

DISCUSSION

The use of mini doses of compost made it possible to increase the yield of corn on the refugee site in Maro. Indeed, mineralized organic matter, like chemical fertilizer, makes soils favorable for growth and constitutes a source of nutrients for crops (Mulaji, 2011). Compared to the vegetative development of corn at 30 DAS and 45 DAS, the statistical analysis revealed that there are significant differences between the treatment averages from the point of view of number of leaves. Indeed, a significant increase in the number of leaves per plant was observed in the control treatment having received chemical fertilizer. On the other hand, on the treatments which received organic fertilizer, a non-significant increase in the number of leaves was recorded. These results match those obtained by Diallo et al (2019) who observed a non-significant increase in the number of millet leaves with the addition of organic fertilizer. Regarding dry aboveground biomass, the results revealed that there are significant differences between the treatment averages at the 5% threshold. Likewise, a significant increase in aboveground biomass was obtained in the control treatment having received chemical fertilizer. On the other hand, in the treatments having received organic fertilizer, a non-significant increase in dry aboveground biomass was observed. Our results are in agreement with those of Diallo et al (2019) who noted a non-significant increase in the dry aerial biomass of millet with the addition of organic fertilizers. The non-significant effect of organic fertilizers would be linked to the low availability of nutrients due to the decomposition time which was not sufficient during the vegetative phase of the crop (Diallo et al, 2019). Indeed, these authors observed the high number of millet leaves per plant with the addition of organic fertilizer. The results relating to corn grain yield showed that there are no significant differences between the averages of the different treatments which received chemical or organic fertilizers. The improvement in performance from the grain yield point of view of the treatments which received the organic fertilizer would be due to the total decomposition of it during the reproduction phase. Several authors such as N'Dienor (2006), N'Dayegamiye and Drapeau (2005, 2009), Diallo et al (2008), Kotchi et al (2010), Kaboré et al (2011), Nyembo et al (2014) and Goalbaye et al (2016) managed to increase the yield of cultivated plants by using organic fertilizers. Furthermore, the analysis of variance revealed that there is no significant difference between the means of the treatments from the point of view of weight of 1000 grains. These results do not agree with those of Goalbaye et al (2016). Indeed, these authors noted the increase in the weight of peanut seeds with the use of organic fertilizers.

CONCLUSION

he objective of the study is to determine the best mini dose of compost to increase corn productivity. Compared to the number of leaves, treatment T0 obtained the greatest number of leaves at 30 DAS followed by treatments T2 and T4. The lowest number of leaves is observed on treatment T3. In JAS, treatment T0 has the highest number of leaves T0 followed by treatments T2 and T1. The lowest number of leaves is noted on T3 and T4. As for the 1000 grain weight, treatment T0 has the highest 1000 grain weight followed by treatments T3 and T4. The lowest weight of 1000 grains is observed on treatments T2 and T1. Regarding the yield, treatment T1 has the highest yield followed by T0 followed by T3 and T4 are equal and the lowest yield is observed on treatment T2.

Treatment T2 gave the same results as T3 and T4 which are the high doses of compost and the control T0. The T2 treatment corresponding to 40 g of compost per pocket would be recommended to producers in the study area to increase corn production. However, subsequent studies on the same topic are necessary to confirm the results obtained.

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