GROWTH STIMULATION AND VEGETATIVE DEVELOPMENT OF SOLANUM LYCOPERSICUM L. TREATED WITH ORGANIC WASTES

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ABSTRACT

Soil infertility has been an overriding threat in tomato production, and this has brought to spotlight less expensive ways of increasing soil fertility for crop propagation. This study investigated the influence of organic wastes like poultry manure, eggshells and plantain peels on the establishment and growth of tomato. Garden soil, poultry manure, eggshells and plantain peels were mixed in the ratio of 1000 g : 100g : 25 g : 15g, respectively. Tomato seedlings sown in garden soil and poultry manure (T1) had the highest number of leaves, leaf area, leaf width and leaf length (20.20±2.67 cm, 6.50±1.70 cm, 2.28±0.39 cm and 3.66±0.48 cm, respectively) when compared with the other treatments. The seedlings sown in garden soil and egg shell (T2) had the highest influence on shoot length (11.00 ± 0.70 cm) when compared with the other treatments. Soil amendment with poultry manure in the ratio of 1000 g: 100 g showed the highest influence in all growth parameters of the plant. Thus, poultry manure could be an alternative to inorganic fertilizers which are of high cost or be amended with inorganic fertilizers as a source of nutrient for the seedling establishment and growth of tomato.

Keywords: *Solanum lycopersicum,* growth, organic wastes, inorganic manure, soil amendment

INTRODUCTION

Tomato (*Solanum lycopersicum*) is one of the most important and widely consumed Solanaceae fruit vegetables or fruit crops in the world (Tsado, 2014). Tomatoes are grown in most home gardens, and commercially as an important food component. Globally, it is rated the second largest vegetable both in terms of production and consumption (FAO, 2016). This fruit vegetable is an important source of micro-nutrients such as vitamins and pro-vitamins, minerals (notably potassium) and carboxylic acids, including ascorbic, malic, citric, fumaric and oxalic acid (Caputo *et al.*, 2004; Hernandez *et al*., 2007). Tomato fruit can be processed into different products such as soup, paste, concentrate, juice and ketchup (Akanbi *et al.*, 2005; Bergougnoux, 2014) and it contributes positively to human health, due to the aforementioned compounds in the products. Furthermore, tomato and tomato products are natural sources of antioxidants, and are considered to be a rich source of carotenoids, particularly lycopene and phenolic compounds (George *et al.*, 2004; Ilahy *et al*., 2011; Pinela *et al.*, 2012).

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Inherent low soil fertility is one of the major drawbacks in tomato production in Nigeria, as reported by Adekiya and Ojeniyi (2002) and Dube *et al.* (2020). In recent times, many technologies have been adopted to maximise yield and quality of crops (Tüzel and Öztekin, 2017). Hence, efforts to increase tomato production by farmers in Africa have shown positive results. For instance, one of such efforts led to the release of the novel leaf curl disease-resistant tomato seeds in West Africa (Perez *et al.,* 2017). Furthermore, the need for reduced cost of crop fertilization has caused revival in the use of organic manure worldwide (Ayoola and Adeniyan, 2006). Organic manure provides essential nutrients to crops when decomposed and also acts as soil conditioners (Makinde, *et al*., 2007). In line with the report of Makinde *et al.* (2007), Adediran *et al.* (2003) also reported that organic wastes like poultry manure have proved to be effective as a nutrient source for vegetables such as tomato. This can be attributed to its macro- and micro-nutrient composition such as Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Copper, Zinc, Sulphur, Manganese and Boron (Drozdz *et al.,* 2020). Mercy *et al*. (2014) reported that fruit peels of banana or plantain, pomegranate, sweet lime and orange are highly rich in potash, iron, zinc etc. Hence, they have great potentials for soil amendment to improve soil fertility. Amu *et al*. (2005) also reported the use of chicken eggshells to improve the soil properties, especially its calcium content.

Coupled with being scarce and expensive, the use of inorganic fertilizer has not been helpful in intensive agriculture because it is sometimes associated with reduced crop yield, soil acidity and crop imbalance (Ojeniyi, 2000; Ano and Agwu, 2005; Agbede *et al*., 2008). Therefore, there is the need for an alternative and cheaper source of soil amendment for tomato propagation. This study evaluated the influence of different organic wastes on soil fertility for improved productivity of tomato plant.

MATERIALS AND METHODS

The research was conducted at the Botanic Garden of the Department of Plant Science and Biotechnology, University of Nigeria, Nsukka. Tomato (De Rica) seeds were bought from Ogige market in Nsukka, Enugu state. The organic wastes and garden soil used were collected from within the environment of University of Nigeria, Nsukka campus. Organic wastes were sun-dried for eight (8) days, ground with grinding mill and weighed using Camry weighing scale. The treatment plan comprised six mixtures of garden soil, poultry manure, eggshells and plantain peels as follows:

T1 = 1000 g garden soil : 100 g poultry manure(GS + PM)
T2 = 1000 g garden soil : 25 g eggshells (GS + ES)
T3 = 1000 g garden soil : 15 g plantain peels (GS + PP)
T4 = 1000 g garden soil (GS); this is considered as the control treatment.
T5 = 1000 g garden soil : 100 g poultry manure : 25 g eggshells (GS + PM + ES)
T6 = 1000 g garden soil : 100 g poultry manure : 15 g plantain peels (GS + PM + PP)
T7 = 1000 g garden soil : 100 g poultry manure : 25 g eggshells : 15 g plantain peels (GS + PM + ES + PP)

The mixtures were bagged with a nylon bag, and the experiment was laid out in a Completely Randomised Design (CRD) of seven treatments with ten replications. Irrigation was carried out on days with no rainfall; and weeding was carried out when necessary to avoid nutrient competition with the propagated seedlings.

Data collection

Growth parameters such as shoot length (SL), leaf length (LL), leaf width (LW), number of leaves (NL) and leaf area (LA) were determined.

Statistical analysis

Data collected were subjected to analysis of variance (ANOVA) test and the means were tested for significance at $p \leq 0.05$ using Duncan's New Multiple-Range Test (DNMRT).

RESULTS

The establishment and growth of tomato seedlings were monitored for a period of thirty-five (35) days. Pictures were taken on the 10th day (DAP) (Plate I) and 20th day (DAP) (Plate II). The data analysed were recorded at 20 days after planting (DAP) and 35 days after planting (DAP).

Table 1: The influence of poultry manure, eggshells and plantain peels on the growth parameters of tomato 20 DAP

Treatment	SL (cm)	NL (cm)	LA (cm^2)	LW (cm)	LL (cm)
TI	10.30 ± 0.33^{a}	20.20 ± 2.67^{a}	6.50 ±1.70^{a}	2.28 ± 0.39^{a}	3.66 ± 0.48^{a}
T2	11.00 ± 0.70^{a}	20.00 ± 0.70^{a}	4.87± 0.53^{ab}	1.88 ± 0.08^{abc}	3.42 ± 0.27^{a}
T3	4.02 ± 0.37^{e}	3.80 ± 0.58^{a}	0.39 ± 0.04^{c}	0.34 ± 0.02^{d}	1.54 ± 0.50^{b}
T4(control)	6.22 ± 0.46^{cd}	13.40 ± 0.92^{bc}	1.86 ± 0.05^{c}	1.30 ± 0.05^{c}	1.92 ± 0.04^{b}
T5	8.00 ± 1.10^{bc}	18.40 ± 2.40^{ab}	5.02± 0.94^{ab}	2.04 ± 0.45^{ab}	3.16 ± 0.32^{a}
T6	9.30 ± 0.91^{ab}	18.20 ± 1.49^{ab}	5.28 ± 0.79^{a}	2.14 ± 0.16^{a}	3.22 ± 0.26^{a}
T7	5.50 ± 0.60^{e}	10.40 ± 1.77^{c}	2.42±0.71^{bc}	1.46±0.22^{bc}	2.06±0.29^{b}

In each column, mean values with different letters differ significantly at $P \leq 0.05$

From Table I, there were significant differences in shoot length of all the treatments. The shoot length of T1, T2 and T6 showed differences, but they were not significant. Also, there was a difference between T7 and T3, but the difference was not significant. In the number of leaves, there were differences between T1, T2, T3, T5 and T6 but these differences were not significant. In the leaf area, T1 differed significantly from T3, T4 and T7 but there were no significant differences between T1, T2, T5 and T6. In leaf width, T1 differed significantly from T3, T4 and T7 but it did not differ significantly from T2, T5 and T6. In the leaf length, T1 differed significantly from T3, T4 and T7 but the differences between T1, T2, T5 and T6 were not significant.

Table 2: The influence of poultry manure, eggshells and plantain peels on the growth parameters of tomato 35 DAP.

Treatment	SL(cm)	NL(cm)	LA(cm^2)	LW(cm)	LL(cm)
T1	25.50 ± 1.85^{a}	73.40 ± 11.92^{a}	14.15 ± 1.90^{a}	3.14 ± 0.21^{ab}	5.90 ± 0.43^{a}
T2	20.00 ± 0.79^{bc}	42.80 ± 2.43^{b}	8.82 ± 0.99^{b}	2.76 ± 0.67^{b}	4.48 ± 0.26^{b}
T3	6.30 ± 0.33^{e}	12.40 ± 1.60^{c}	2.14 ± 0.52^{c}	1.24 ± 0.20^{c}	2.16 ± 0.30^{c}
T4	11.54 ± 0.27^{d}	25.00 ± 2.00^{bc}	3.75 ± 0.13^{c}	1.70 ± 0.03^{c}	2.94 ± 0.06^{c}
T5	22.96 ± 1.43^{ab}	83.20 ± 7.43^{a}	18.04 ± 1.35^{a}	3.52 ± 0.16^{a}	6.76 ± 0.40^{a}
T6	24.70 ± 0.80^{a}	77.00 ± 6.65^{a}	14.05 ± 0.92^{a}	3.10 ± 0.10^{ab}	6.02 ± 0.20^{a}
T7	18.86 ± 1.05^{c}	70.40 ± 12.60^{a}	16.63 ± 2.48^{a}	3.48 ± 0.35^{a}	6.24 ± 0.34^{a}

In each column, mean values with different letters differ significantly at $p \leq 0.05$. Results showed that the shoot length of T1, T5 and T6 showed differences that were not significant, but they differed significantly from T2, T3, T4 and T7 (Table 2). Also, the difference between T2 and T7 was not significant. In the number of leaves, the differences between T1, T5, T6 and T7 were not significant, but they differed significantly from T2, T3 and T4. In the leaf area, the differences between T1, T5, T6 and T7 were not significant, but they differed significantly from T2, T3 and T4. In leaf width, T1, T5, T6 and T7 differed significantly from T2, T3 and T4.

In the leaf length, the differences between T1, T5, T6 and T7 were not significant, but they differed significantly from T2, T3 and T4. T3 and T4 differed, but not significantly.

DISCUSSION

The results of the experiment showed that the treatment of garden soil mixed with poultry manure in the ratio of 1000 g : 100 g had the greatest influence on the seedling establishment and growth of *Solanum lycopersicum*. This result is in agreement with the finding of Ogundare *et al.* (2015). In all the treatments containing poultry manure, it was observed that all the parameters performed better than the other treatments without poultry manure. This could be attributed to the high content of major macro-nutrients such as Nitrogen (N), Phosphorus (P) and Potassium (K) with the N component being relatively higher, as affirmed by Altunaga (2007) and Abdulmaliq *et al.* (2019). The treatment of garden soil mixed with eggshells resulted in a faster germination rate and the plants were taller than the other treatments from the beginning, but later slowed down during the growing period. The high length of the shoot in the garden soil mixed with the eggshell could be attributed to the calcium content of the eggshell, as reported by Radha and Karthikeyan (2019) and Erdogan and Karaca (2011). The slow growth of tomato seedling in T2 could also be attributed to the ratio of the eggshell added (Erdogan and Karaca, 2011). It was observed that garden soil mixed with plantain peels resulted in stunted or slow growth throughout the period of the experiment. This could be attributed to the ratio of the plantain peel used, which could have led to insufficient nutrients needed for growth.

Furthermore, the slow growth of tomato seedlings with treated poultry manure, garden soil and plantain peel amendment could be as a result of too much of nutrient, which must have inhibited growth due to some factors in the organic wastes, as seen in the amendment of garden soil with plantain peels in which the growth of the plants was related throughout the study.

CONCLUSION

The results of this study suggest that soil amendment with poultry manure is the best for tomato seedling establishment and growth, because it contains the macronutrients that enhance all the growth parameters. The use of eggshells could also be recommended, as results showed that it had maximum and fast germination effects. Everyday huge quantities of organic wastes are generated as bio-wastes; the use of these organic wastes as soil amendments could curtail the pollution caused by these wastes in our environment. They could instead be used to improve the fertility of the soil for increased crop productivity.

ILLUSTRATIONS

Plate I: Tomato seedlings 10 DAP

Plate II: Tomato seedlings 20 DAP

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