THE RESPONSES OF TOMATO (*Solanum lycopersicon L.)* GROWTH AND YIELD TO GROUNDNUT SHELL AND OTHER SOURCES OF NUTRIENT

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ABSTRACT

The agronomic response of tomato (*Solanum lycopersicon L.)* to fertilizer application was examined at the screen house of the crop production department, Federal University of Technology Minna. The study was carried out to evaluate the effect of granulated groundnut shells and other sources of nutrients (poultry droppings, burnt groundnut shell, NPK 10:10:10,) on the growth and yield of the tomato plant. The experiment was divided into 5 treatments with 3 replicates each. The treatment consisted of 3 organic nutrient sources (poultry droppings, burnt groundnut shell, and groundnut shell) and 1 inorganic (NPK 10:10:10) source of the nutrient. They were applied at different rates; groundnut shell was applied at the rate of 94.34g per 20kg of soil, burnt groundnut shell was applied at the rate of 161.29g per 20kg of soil, poultry dropping was applied at the rate of 99.01g per 20kg of soil, a mixture of groundnut shell and poultry dropping was also applied (groundnut shell was 47.17+49.50 poultry droppings) = 96.67g per 20kg of soil and NPK 10:10:10 was applied at the rate of 10g per 20kg of soil. The experiment was laid out in a completely randomized design. Data were collected on morphological parameters including the number of leaves, plant height, stem girth, number of branches, days to first flowering, days to 50% flowering, days to first fruiting, number of fruits, and weight of fruits. These data were collected over a period of 2-10 weeks after transplanting. Data collected were subjected to analysis of variance (ANOVA) using a statistical analysis system (SAS) package, Means were separated using Duncan's Multiple Range Test (DMRT), and statistical means were tested at a 5% level of significance. The result of the study showed that a mixture of groundnut shells and poultry droppings enhanced the growth and yield of tomatoes more than any other treatment used. Therefore, the application of a mixture of poultry manure and groundnut shell at 96.67g per 20kg of soil is ideal for optimum growth and yield of Tomato plant.

INTRODUCTION

Tomato (*Solanum lycopersicum L.)* is an annual crop which belongs to the family Solanaceae. Tomato species originated from the South American Andes and the use of tomato as a food originated in Mexico, and spread from there throughout the world following the Spanish colonization of the Americas (Encyclopedia of Life, 2014). Tomato is a very important vegetable cultivated and consumed in most parts of the world, from home gardens and greenhouses to large commercial farms due to its wider adaptability to various agro-climatic conditions. Several different varieties of tomato are cultivated to serve various culinary and processing needs of consumers (Agyeman, 2014). There has been a gradual increase in the area of land cropped by tomato and this led to marginal increases in tomato production (FAOSTAT, 2013), nevertheless many countries in Africa have low tomato yield. It has been observed that low soil fertility and use of improper varieties adaptable to the agro zones-ecological are among the factors that contribute to low tomato yield. Soil organic amendments such as cow dung, goat manure and poultry manure are valuable sources of plant nutrients (Takahashi *et al*., 2010). Organic manure provides essential nutrients to crops when decomposed and also act as soil conditioners (Makinde *et al.,* 2007). Most developing countries are trying to get rid of expensive chemical fertilizers by supplementing them with some organic-based sources. Mixture of organic and inorganic fertilizers is a good method of soil fertility management strategy. Apart from enhancing crop yields, it has a greater beneficial effect that can be derived from the use of organic and inorganic fertilizers. Large-scale use of inorganic fertilizers can contribute to environmental pollution such as groundwater contamination, eutrophication of waterways, soil acidification and increased denitrification, resulting in higher emission of nitrous oxide, which contributes to global warming (Molla *et al*., 2012). Agriculture must consider priorities such as food quality, production costs, the environmental impact of crops in addition to yield and productivity, in this perspective, a promising sustainable approach could be the use of organic and inorganic amendments for vegetable production. In Nigeria, there are several varieties of Tomato with varying response to environmental condition, agronomic practices and nutritional management adopted for their growth and yield. Thus, it is imperative to evaluate the response of tomato varieties to different nutritional management. Integrated nutrient sources increase nutrient use efficiently and soil fertility thus enhancing the productivity of tomato.

This study was conducted to evaluate the growth and yield of tomato crop in response to groundnut shell and other sources of nutrient and rates of application on the yield of tomato crop to determine their efficacy on tomato crop.

MATERIALS AND METHODS

The research was carried out at the screen house of the Department of Crop Production, school of agriculture and agricultural technology, Federal University of Technology Minna, Niger State. Minna is located in the southern guinea savannah Agro-ecological zone of Nigeria and lies

between longitude 9.62^{o}N and latitude 6.55^{o}E. The experiment was arranged in Complete Randomized Design (CRD) with five treatments (granulated groundnut shell, burnt groundnut shell, poultry dropping, mixture of granulated groundnut shell and poultry manure, and NPK 10:10:10) replicated three times. The seeds of tomato variety (monarch) were used and were thinned to 30 seedlings per seed tray which was done 2 weeks after sowing. The seedlings that were implanted were disease-free and of uniform size. Soil sample was collected from the experimental field and taken to soil science laboratory for physicochemical analysis. The experimental field was ploughed, harrowed and made into fine tilt. Groundnut shell applied at the rate of 94.34g/20kg of soil, burnt groundnut shell was applied at the rate of 161.2g/20kg of soil, poultry manure was applied at the rate of 99.01g/20kg of soil, mixture of poultry manure and groundnut shell was applied at the rate of 96.67g/20kg of soil and NPK 10 10 10 fertilizer was applied at the rate of 10g/20kg of soil one week before transplanting. Before the seedlings were transplanted, the nursery bed was properly watered with a sufficient amount of water to help in removing them from the ground. The acquired data was subjected to an analysis of variance (ANOVA), and the Duncan multiple range test (DMRT) was used to separate the means.

RESULTS AND DISCUSSION

Plant heights

The effect of nutrient sources on plant height of on tomato is shown in Table 1. The results show no significant difference ($p>0.05$) for the plant height at 2 weeks after transplanting across all the treatments. However, a different trend was observed for the remaining weeks as there was significant difference ($p\leq0.05$) across all the treatments. The application of groundnut shell and poultry manure produced significantly ($p\leq0.05$) taller plants all through the study period while NPK produced the least. By providing both macro and micronutrients that are crucial for tomato growth, poultry manure has a significant impact on tomato growth, as evidenced by the rise in plant height that results from its application. Oladotum (2002), who noted that poultry manure contained both macro and micronutrients such NPK, Ca, Mg, Cu, Mn, Zn, Bo, and Fe that boosted plant growth, backed up this claim. Suriya *et al*., 2020 reported that the conjunctive use of compost and inorganic fertilizers had resulted in higher plant height at all the stages of tomato plant.

Table 1. Effect of granulated groundnut shell and other nutrient sources on plant height.

	Plant height (cm)			
Treatments	**2WAT**	**4WAT**	**6WAT**	**8WAT**
T_1	23.33[a]	39.00[ab]	69.33[b]	106.33[c]
T_2	27.33[a]	46.67[ab]	86.00[ab]	123.00[b]
T_3	27.67[a]	54.67[a]	92.00[a]	130.33[ab]
T_4	33.67[a]	63.33[a]	105.00[a]	138.00[a]
T_5	15.67[a]	25.00[b]	53.00[c]	59.67[d]
SE_+	2.28	4.64	5.36	7.55

key: mean on the same column with different superscript are significantly different ($p<0.05$), SE=Standard error, WAT=week after transplanting

T_1 is groundnut shell
T_2 is burnt groundnut shell
T_3 is poultry droppings
T_4 is groundnut shell and poultry droppings
T_5 is NPK 10:10:10

Number of branches

The effect of nutrient sources on number of branches of tomato is presented in Table 2. The number of branches affects yield because they produce leaves that fix carbon dioxide. The results show that at 2 weeks after transplanting, plants on groundnut shell and plants on burnt groundnut shell were observed to be significantly different ($p\leq0.05$) from plants on NPK. A Similar trend was observed at 8 weeks after transplanting, Plants on the mixture of groundnut shell and poultry droppings was consistently high in values in all the treatments. The increased nutrient content of the soil, which in turn led to an increase in the number of branches, especially due to the nitrogen content in both groundnut shell and poultry manure, may be the cause of the improved tomato performance seen with the application of groundnut shell and poultry droppings. This is consistent with the findings of Onasaya *et al.* (2009) who stated that nitrogen plays a significant role in plant growth as a component of protein and as a major component of a variety of other chemicals that are necessary for plant growth. According to Reddy et al. (2018), onions produced more branches when integrated nutrient management using biofertilizer (Azotobacter and Azospirillum) and 50% inorganic N through organic manure (VC or FYM) and inorganic fertilizer was used.

Table 2. Effect of granulated groundnut shell and other nutrient sources on number of branches of tomato

	Number of Branches			
Treatments	2WAT	4WAT	6WAT	8WAT
T_1	5.00^{ab}	12.00^{a}	23.00^{c}	35.00^{b}
T_2	5.00^{a}	13.00^{a}	25.00^{bc}	38.00^{ab}
T_3	6.00^{a}	14.00^{a}	26.00^{ab}	39.00^{ab}
T_4	7.00^{ab}	15.00^{a}	28.00^{a}	43.00^{a}
T_5	3.00^{b}	8.00^{b}	14.00^{b}	21.00^{c}
SE_+	0.55	0.77	1.33	2.13

key: mean on the same column with different superscript are significantly different ($p<0.05$), SE=Standard error, WAT=week after transplanting

T_1 is groundnut shell
T_2 is burnt groundnut shell
T_3 is poultry droppings
T_4 is groundnut shell and poultry droppings
T_5 is NPK 10:10:10

Stem girth

The effect of nutrient sources on stem girth of tomato is shown in Table 3. The table shows that at 2,4,6 and 8WAT, T_3 (poultry dropping) and T_4 (groundnut shell and poultry droppings) produced plants with wider stem girth compared to the other treatments and differed significantly ($p<0.05$) from the other treatments. These findings lend credence to past research showing that manures and other organic sources provide adequate nutrients plants need to develop and produce. (Atiyeh *et al*., 2002; Ojeniyi, 2008; Mehdizadeh *et al.*, 2013). T_5 (NPK 10:10:10) produced plants with smaller stem.

Table 3. Effect of granulated groundnut shell, and other nutrient sources on tomato stem girth

	Stem girth (cm)			
Treatments	2WAT	4WAT	6WAT	8WAT
T_1	1.56^{bc}	1.83^{bc}	2.33^{b}	2.87^{c}
T_2	1.90^{ab}	2.16^{b}	2.77^{b}	3.40^{b}
T_3	2.26^{a}	2.56^{a}	3.33^{a}	3.93^{a}
T_4	2.50^{a}	2.80^{a}	3.33^{a}	3.97^{a}
T_5	1.20^{c}	1.43^{c}	1.70^{c}	1.93^{d}
SE_+	0.14	0.15	0.17	0.21

key: mean on the same column with different superscript are significantly different ($p<0.05$), SE=Standard error, WAT=week after transplanting

T_1 is groundnut shell
T_2 is burnt groundnut shell
T_3 is poultry droppings
T_4 is groundnut shell and poultry droppings
T_5 is NPK 10:10:10

Days to first flowering, days to 50% flowering and days to first fruiting

The effect of different nutrient sources on tomato fruit, days to first flowering, days to 50% flowering and days to first fruiting is shown in Table 4. T_3 (Poultry droppings) influenced flowering of plants as it produced plants that flowered early compared to the T_4 (groundnut shell and poultry dropping) which flowered late. It evident that T_2 (burnt groundnut shell) also had effect on flowering of plants as it produced plants that flowered early. There was significant ($p<0.05$) among the treatments. Similarly, in T_1, T_2 and T_3, 50% of the plants flowered earlier compared to the rest treatments which flowered late. There was no significant difference ($p>0.05$) observed among the treatments in the days to first fruiting.

Table 4. Effect of granulated groundnut shell and other nutrient sources on tomato fruit, days to first flowering, days to 50% flowering and days to first fruiting.

Treatments	Days to first flowering	Days to 50% flowering	Days to first fruiting
T_1	40.0^c	39.0^b	47.0^a
T_2	39.0^c	35.0^b	54.0^a
T_3	38.0^c	35.0^b	47.0^a
T_4	64.0^a	67.0^a	54.0^a
T_5	53.0^b	63.0^a	66.0^a
SE±	2.67	2.89	10.39

key: mean on the same column with different superscript are significantly different ($p<0.05$), SE=Standard error, WAT=week after transplanting

T_1 is groundnut shell
T_2 is burnt groundnut shell
T_3 is poultry droppings
T_4 is groundnut shell and poultry droppings
T_5 is NPK 10:10:10

Number and weight of fruits

The effect of nutrient sources on number of fruit and weight of fruit are shown in Table 5. The table shows that T_4 (groundnut shell and poultry droppings) influenced higher number of fruits compared to the other treatments which produced plants with lesser number of fruits.

Similarly, T_4 (groundnut shell and poultry droppings) produced fruit with higher weight when compared to the other treatments which have lesser weight. There was no significant difference ($p \leq 0.05$) observed among the treatments. This is consistent with Adenawola and Adejoro's (2005) research, which stated that poultry manure increase growth and yield of tomato.

Table 5. Effect of granulated groundnut shell and other nutrient sources on number and weight of fruits of Tomato

Treatments	Number of fruits	Weight of fruits (g)
T_1	2.0^a	29.0^a
T_2	1.0^a	32.0^a
T_3	3.0^a	45.6^a
T_4	4.0^a	107.0^a
T_5	2.0^a	76.6^a
SE±	1.11	26.39

key: mean on the same column with different superscript are significantly different ($p<0.05$), SE=Standard error, WAT=week after transplanting

T_1 is groundnut shell
T_2 is burnt groundnut shell
T_3 is poultry droppings
T_4 is groundnut shell and poultry droppings
T_5 is NPK 10:10:10

CONCLUSION

Poultry droppings produced early flowering plants and plants that produced fruits early. However, the mixture of poultry droppings and groundnut shell produced plants with higher number of branches and leaves and plants with wider stem girth. It also produced taller plants, and plants with higher number of fruits and fruits that weigh higher. Also, Groundnut shell treatment showed the potential to leave soil in a better condition after a cropping season judging from post crop soil analysis. Poultry manure and groundnut shell should be used by farmers as a nutrient source as it has been proven effective. More research should however be carried out on the potential uses of groundnut shell and other organic nutrient sources in enriching the soil and enhancing plant growth so that the full benefits can be discovered.

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