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

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ABSTRACT

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 tomato. The experiment comprised 5 treatments with 3 replicates each. The treatment consisted of 3 organic nutrient sources (poultry droppings, burnt groundnut shell, and raw groundnut shell) and 1 inorganic source of nutrient (NPK 10:10:10). They were applied at different rates depending on what quantity of the nutrient sources can supply the recommended kilogram (100) of Nitrogen per hectare. Groundnut shell was applied at the rate of 94.34 g 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 47.17g+49.50g 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. 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.

Keywords: Groundnut shell, Growth, Nutrients, Organic, Yield

**INTRODUCTION**

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. The crop is rich in vitamin C and contains lycopene, a very vital antioxidant which prevents cancers (Beckles, 2012). Tomato quality and yield are greatly reduced by nutrient shortage in the soil (Sainju *et al.,* 2003). Organic manure provides essential nutrients to crops when decomposed and also act as soil conditioners (Makinde *et al.*, 2007). Soil organic amendments such as cow dung, goat manure and poultry manure are valuable sources of plant nutrients (Takahashi *et al*., 2010). 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. Organic farming restricts the use of agrochemicals and offers a way to reduce the adverse effects of chemical fertilization (Aguilera *et al., 2013;* Aires *et al., 2013*). Although the most significant disadvantage of organic crop production has been low yields compared to intensive farming (Seufert *et al*., 2012) thus farmers choose to use industrial synthetic chemical fertilizers to grow vegetables (Matsumoto and Yamano, 2009). However, 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). The need to examine the effect of different fertilizer sources on the growth and productivity of tomato is quite important as it helps farmers to make better choices that will reduce cost and improve yield while also considering ecological sustainability. Groundnut hulls make up around 25% of the several million tons of mass-produced hulls generated each year but are not used. Most groundnut hulls are currently burned, discarded in forests. As a result, its collection and commercialization as an organic source of nutrients holds great promise as a potential substitute for chemical fertilizers and controlling environmental pollution. Thus, this research was conducted to evaluate the growth and yield of tomato crop in response to groundnut shell and other sources of nutrient.

**METHODOLOGY**

# Study Location, Treatment Sources and Experimental Designs

The study was carried out at the screenhouse of the Department of Crop Production, School of Agriculture and Agricultural Technology, Federal University of Technology Minna, Niger State. Monarch Tomato seed was used in the research. It was sown in the seed tray and tinned to 30 seedlings per tray two weeks after sowing. The experiment was arranged in Completely Randomized Design (CRD) with five treatments (granulated groundnut shell, burnt groundnut shell, poultry dropping, mixture of granulated groundnut shell and poultry dropping, and NPK 10:10:10) replicated three times. Recommended Nitrogen rate of 100Kg/ha was used in calculating the needed quantity per pot for the tomatoes. Treatment 1 (Granulated groundnut shell at 94.34g per pot. Treatment 2 (Burnt groundnut shell at 161.29g per pot. Treatment 3 Poultry dropping at 99.01g per pot. Treatment 4 (Mixture of poultry manure and groundnut shell = 47.17+49.50=96.67g. Treatment 5 (N. P. K 10:10:10 at 10g per pot. A total amount of 15 pots were filled with soil weighing 20kg per pot. The pots were arranged properly on a sturdy support. The organic treatments were applied a week before transplanting while the inorganic was applied two weeks after transplanting.

**Pre-Planting Soil Analysis**

The soil was slightly acidic. The result of the physicochemical pre-planting analysis used to assess the soil fertility status is shown in Table 1. From the result, it was evident that the soil needs amendment before being used for tomato production and thus it was fit to be used for fertilizer experiment.

**Table 1: Physicochemical Pre-Planting Analysis of the Sample of Experimental Soil**

|  |  |
| --- | --- |
| **Properties**  | **Values**  |
| **Physical** Sand (g kg-1)  | 800  |
| Silt (g kg-1)  | 80  |
| Clay (g kg-1)  | 120  |
| Textural class  | Loamy Sandy  |
| **Chemical** PH (H2O)  |  6.33  |
| PH (CaCl2)  | 5.6  |
| Organic carbon (g kg-1)  | 2.3  |
| Total nitrogen (g kg-1)  | 1.2  |
| Available phosphorus (mg kg-1)  | 10.06  |
| **Exchangeable bases (cmol kg-1)** Na+  |  0.16  |
| K+  | 0.06  |
| Mg2+  | 1.0  |
| Ca2+  | 2.0  |
| **Exchangeable acid (cmol kg-1)**  | 0.11  |

**Transplanting and Management Practices**

Disease-free, vigorous and uniform size seedlings were transplanted using naked root method. The nursery bed was properly watered to help in removing the seedlings without damages. Manual weeding was carried out by hand picking when weed was noticed. Staking was done to keep the plant erect and for proper fruit development.

 **Data Collection**

Plant height was taken from each replicate from the respective treatment, this was done once a week. The measurement was taken from the base to the apex of the plants using a tape rule.  Leaves from each replicate from the respective treatment was counted at two weeks interval from two weeks after sowing.

# Number of Fruits per Plant

The number of fruits per plant was recorded by counting the number of ripe fruits harvested on each plant.

# Weight of Fruits per Plant

The weight of fruit per plant was recorded by weighing the number of ripe fruits harvested on each plant.

**Post Harvest Analysis**

Three post-harvest analysis were carried out. Proximate analysis on the harvested fruit was carried out at the laboratory of the Department of Water Resources, Fisheries and Aquaculture, Federal University of Technology, Minna, Niger State, Nigeria, using the methods outlined by the Association of Official Analytical Chemists (AOAC, 2000). This was to determine which of the applied nutrients produced better fruit qualities. Post planting soil analysis was also carried out to know which of the treatments used leave the soil in a better condition than at the beginning. Plant tissue analysis, to show the nutrient status of the plants and to indicate if the supplied nutrient was adequate was carried out.

#  Data Analysis

The data collected were passed through analysis of variance (ANOVA) and means were separated using Duncan Multiple Range Test (DMRT) at 5% level of significance.

**RESULTS AND DISCUSSION**

 **Effect of Granulated Groundnut Shell and Other Nutrient Sources on The Number of Leaves of Tomato**

The effect of nutrient sources on number of leaves of tomato at 2, 4, 6 and 8WAT are shown in Table 2. T5 (NPK 10:10:10) was consistently low in value in all the treatment, and differed significantly (p≤0.05) from the other treatments all through the weeks. The result obtained with T5 is not consistent with what is known with inorganic fertilizers especially that it raises root development (Scholl and Nieuwenhuis, (2004), which could aid in proper plant development.

**Table 2: Effect of Granulated Groundnut Shell and other Nutrient Sources on the Number of Leaves of Tomato**

|  |  |  |  |
| --- | --- | --- | --- |
|   |   | Number of Leaves  |  |
| Treatments  | 2WAT  | 4WAT  | 6WAT  | 8WAT  |
|  T1  | 23.00a  | 56.00b  | 100.00a  | 155.00b  |
| T2  | 35.00a  | 71.00a  | 116.00a  | 171.00ab  |
| T3  | 36.00a  | 84.00a  | 129.00a  | 172.00ab  |
| T4  | 48.00a  | 89.00a  | 140.00a  | 202.00a  |
| T5  | 16.00b  | 39.00b  | 65.00b  | 73.00c  |
| SE\_+  | 4.18  | 7.12  | 8.74  | 12.28  |

a, b means on the same column with different superscripts are significantly different at P<0.05

T1 = groundnut shell , T2 = burnt groundnut shell, T3 = poultry droppings, T4 = groundnut shell and poultry droppings, T5 = NPK 10:10:10

**Effect of Granulated Groundnut Shell and other Nutrient Sources on Plant Height**

The effect of nutrient sources on plant height on tomato at 2, 4, 6 and 8 Weeks After Transplanting (WAT) are shown in Table 3. There was no significant difference (p>0.05) for the plant height at 2WAT across all the treatments. However, a different trend was observed for the remaining weeks as there were significant differences (p<0.05) across all the treatments. T4 (groundnut shell and poultry droppings) was consistently high in value in all the treatment, and differed significantly (p≤0.05) from the other treatments all through the weeks.

 **Table 3: Effect of Granulated Groundnut Shell and other Nutrient Sources on Plant Height**

|  |  |  |  |
| --- | --- | --- | --- |
|   |   |  Plant height (cm)  |  |
| Treatments  | 2WAT  | 4WAT  | 6WAT  | 8WAT  |
| T1  | 23.33a  | 39.00ab  | 69.33b  | 106.33c  |
| T2  | 27.33a  | 46.67ab  | 86.00ab  | 123.00b  |
| T3  | 27.67a  | 54.67a  | 92.00a  | 130.33ab  |
| T4  | 33.67a  | 63.33a  | 105.00a  | 138.00a  |
| T5  | 15.67a  | 25.00b  | 53.00c  | 59.67d  |
| SE\_+  | 2.28  | 4.64  | 5.36  | 7.55  |

Means on the same column with different superscript are significantly different (p<0.05)

T1 = groundnut shell , T2 = burnt groundnut shell, T3 = poultry droppings, T4 = groundnut shell and poultry droppings, T5 = NPK 10:10:10

**Effect of Granulated Groundnut Shell and other Nutrient Sources on Number and Weight of Fruits of Tomato**

The effect of nutrient sources on number of fruit and weight of fruit are shown in Table 4. There was no significant difference (p>0.05) among the treatments means. However, the Table shows that T4 (groundnut shell and poultry droppings) influenced higher number of fruits compared to the other treatments which produced plants with lesser number of fruits.

Similarly, T4 (groundnut shell and poultry droppings) produced fruit with higher weight when compared to the other treatments which have lesser weight.

**Table 4: Effect of granulated groundnut shell and other nutrient sources on number and weight of Tomato**

|  |  |  |
| --- | --- | --- |
| Treatments  | Number of fruits | Weight of fruits (g)  |
| T1  | 2.0a  | 29.0a  |
| T2  | 1.0a  | 32.0a  |
| T3  | 3.0a  | 45.6a  |
| T4  | 4.0a  | 107.0a  |
| T5  | 2.0a  | 76.6a  |
| SE±  | 1.11  | 26.39  |

T1 = groundnut shell, T2 = burnt groundnut shell, T3 = poultry droppings, T4 = groundnut shell and poultry droppings, T5 = NPK 10:10:10

 **Proximate Analysis of Fresh Tomato Fruit**

The result of the proximate composition of fresh tomato fruit is shown in Table 5. There were no significant differences (P>0.05) in the moisture content of the treatments. The ash content was observed to be significantly different (P≤0.05). T3 and T4 showed significant levels followed by T2. There was significant difference(P≤0.05) in the crude protein content of the treatments. The significance level was observed in T4 followed by T3 and T2. For the fat content, T4 varied significantly when compared to the rest treatments and had the highest value while T1 had the lowest value. No significant difference (P>0.05) was observed in the crude fibre content among the treatments. There were significant differences (P≤0.05) in the NFE of the samples, T2 had the highest value and lowest value was obtained in T3.

**Table 5: Proximate Analysis of Fresh Tomato Fruit**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Treatments  | MC (%)  | CF (%)  | CP (%)  | Ash (%)  | Fat (%)  | NFE  |
| T1  | 30.40a  | 0.68a  | 0.70b  | 0.04b  | 0.24b  | 1.27b  |
| T2  | 30.07a  | 0.70a  | 0.87a  | 0.05ab  | 0.28b  | 1.33a  |
| T3  | 30.47a  | 0.79a  | 0.87a  | 0.07a  | 0.41a  | 0.73d  |
| T4  | 30.21a  | 0.70a  | 0.98a  | 0.07a  | 0.49a  | 0.88c  |
| SE±  | 0.41  | 0.02  | 0.03  | 0.00  | 0.03  | 0.08  |

a,b Mean on the same column with different superscript are significantly different at p<0.05

T1 = groundnut shell, T2 = burnt groundnut shell, T3 = poultry droppings, T4 = groundnut shell and poultry droppings.

**Tissue Analysis of Tomato Shoot**

The result of the tissue analysis of tomato stalk is shown in Table 6 below. There was no significant difference (p≥0.05) in the Nitrogen content of the treatments, T2 (burnt groundnut shell) had the highest value of (0.43%), while the lowest value was recorded for T1 (groundnut shell) and T3 (poultry droppings) (0.37%). The Potassium content of the treatments varied significantly (p≤0.05), with T1 having the highest value (143.67mg/100g), while the lowest value (126.33mg/100g) was recorded for T4 (groundnut shell and poultry droppings). The phosphorus content of the treatments was highest in T4, there was no significant difference (p≥0.05) observed among the 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).

**Table 6: Tissue Analysis of Tomato Stalk**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments**  | **N (%)**  | **K (mg/100g)**  | **P (mg/100g)**  |
| Groundnut shell  | 0.37a  | 143.67a  | 135.33a  |
| Burnt groundnut shell  | 0.43a  | 134.00b  | 137.33a  |
| Poultry Droppings  | 0.37a  | 131.33b  | 134.00a  |
| Groundnut shell + Poultry droppings  | 0.41a  | 126.33b  | 139.33a  |
| SE±  | 0.13  | 1.10  | 2.19  |

a,b Means on the same column with different superscripts are significantly different at p<0.05

**Post Soil Analysis**

The post soil analysis of tomato is shown in Table 7 below. The result shows that the various treatment had no significant differences (p>0.05) on the post soil parameters (O/C%, O/M% and N%). However, it was discovered that Groundnut shell treatment had higher organic carbon content and organic matter contents than the rest. This shows that the treatment had the potential of leaving soil better after a cropping season.

**Table 7: Post Soil Analysis of Experimental Soil**

|  |  |  |  |
| --- | --- | --- | --- |
| **Treatments**  | **O/C (%)**  | **O/M (%)**  | **Nitrogen (%)**  |
| Groundnut shell  | 0.75  | 1.30  | 1.20  |
| Burnt groundnut shell  | 0.53  | 0.91  | 1.60  |
| Poultry Droppings  | 0.62  | 1.06  | 1.30  |
| Groundnut shell + Poultry droppings  | 0.56  | 0.91  | 1.40  |

**CONCLUSION AND RECOMMENDATIONS**

In all the parameters, treatments with groundnut shell, either as a whole or in other form had highest value and were significant in some of the analysis. The mixture of poultry droppings and groundnut shell produced plants with higher number of leaves. 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 levels of organic matter, organic carbon, and Nitrogen remnant in the soil in the post-harvest soil analysis.

Based on the findings from this study, groundnut shell should be considered as alternative source of nutrient either as a whole, being ploughed into the soil or in combination with other nutrient sources like poultry manure. Researchers can focus more research on the potential of groundnut shell to bring a change to world of vegetable production so that the full benefits can be discovered.

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