Soil Characteristics and Growth Performance of *Arachis hypogea* L. in Soil Treated with Decomposed Fluted Pumpkin Pods

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ABSTRACT

***Background**:* The benefits of organic manure in sustainable agriculture cannot be overemphasized in view of the balanced supply of nutrients. *Arachis hypogea is* a lipid producing food nutrient supplement that provides more than 30 essential nutrients and phytonutrients. This study was carried out to assess the potency of decomposed fluted pumpkin pods as organic manure in soil cultivated with the test crop.

***Methods**:* Soil samples (0-15cm depth) collected from the study site, CRUTECH, Calabar, Cross River State, were analysed using standard methods for physico-chemical properties. Pods of fluted pumpkin were macerated into small pieces, weighed and mixed with 2.0kg of sandy loam soil. These were allowed to condition for 3 weeks. The levels of 0.5, 1.0, 1.5 and 2.0kg of fluted pumpkin pods were used alongside a control (0kg-Soil only) treatment. Each treatment containing 2.0 kg sandy loam soil + appropriate level of fluted pumpkin pods was placed in poly bags and four (4) seeds of *A. hypogea* were sown directly in each poly bag. Each level of treatment was replicated three times using randomized complete block design. The experimental set up was maintained under light condition for 60 days for examination of growth parameters of the test crop.

***Results**:* The contents of available phosphorus, calcium, organic carbon, total nitrogen, sodium, magnesium and potassium significantly ($P < 0.05$) increased with increase in the level of decomposed fluted pumpkin pods. In addition, the values recorded in all soils treated with decomposed fluted pumpkin pods were significantly ($P < 0.05$) higher than that of the control treatment (0kg). The shoot length, root length, fresh weight and dry weight of *Zea mays* grown in soil treated with decomposed fruited pumpkin pods significantly ($P < 0.05$) increased with increase in the level of decomposed fluted pumpkin pods.

***Conclusion**:* Decomposed fluted pumpkin pods has the potentials as a valuable source of organic manure for improvement of growth performance of *A. hypogea*.

Key words**—** Soil, Growth, *Arachis hypogea,* Decomposed, Fluted pumpkin pods.

1. INTRODUCTION

Arachis hypogea L. commonly called groundnut or peanut belongs to the legume or "bean" family (Fabaceae). It provides more than 30 essential nutrients and phytonutrients and a good source of niacin, foliate, fiber, magnesium, vitamin E, manganese and phosphorus [1]. Peanut is used to produce a valuable oil by cold pressing, and often utilized for medical treatments and the basis for many therapeutic preparations. Groundnut oil possesses skin softening properties and used as edible oil in kitchen preparations. Peanut oil has been reported to have potency in curing Catarrh of the Bladder or Cystitis [1,2]. Peanut is used to produce cake or peanut oil meal, a rich source of crude proteins, which are used as cattle feed or as raw material for the preparation of protein isolate. Peanuts are naturally trans-fat and cholesterol-free with 12 grams of unsaturated fat, which has been proven to have heart protective benefits [2]. Peanuts have been used to enrich the soil and are able to fix nitrogen in their roots [1]. Organic manure has been reported to have a number of limitations such as low nutrient content, slow decomposition, and different nutrient compositions depending on its organic materials, compared to chemical fertilizers. However, the importance of organic manure in sustainable agriculture cannot be overemphasized in view of the balanced supply of nutrients, including micronutrients, increased soil nutrient availability due to increased soil microbial activity, the decomposition of harmful elements, soil structure improvements and root development, and increased soil water availability [3, 4]. Organic manure has been shown to improve the organic matter contents of soil by increasing the soil concentrations of organic carbon, nitrogen, phosphorus, and, potassium relative to chemical fertilizer [4]. Organic manure has been reported to enhance crop productivity

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nitrogen utilization efficiency, and soil health in acid soil compared to chemical fertilizer [5]. Excessive utilization of synthetic fertilizers containing chemical nitrogen and phosphorous can result in soil degradation and environmental instability [6, 7]. In addition, sustainable soil productivity is hampered by gradual deterioration of soil natural nutrient reserves [8, 9], leading to low nutrient and water use efficiency [10, 11]. The efficient use of natural resources with sustainable increase in yield of crops is gaining acceptability in view of its less environmental contamination. Thus, this evokes the search for efficient and sustainable natural resources for use as organic fertilizers [11, 12]. Therefore, this research was conducted to assess the growth indices of *Arachis hypogea* in soil treated with decomposed fluted pumpkin pods.

2. MATERIALS AND METHODS

2.1 Materials

2.1.1 Equipment

The following equipment and apparatus were used; soxhlet apparatus, heating mantle, blender, autoclave, incubator, automatic weighing balance, refrigerator and spectrophotometer. glasswares used include; test tubes, beaker, conical flask, reagents used include; distilled water, petroleum ether, sulphuric acid , sodium hydroxide, anhydrous sodium sulphate, ethyl acetate, ferrous sulphate, ferrous chloride, aluminum chloride, ammonia solution,. Other materials include; aluminum foil, spatula and spectrophotometer.

2.1.2 Biological Materials

The biological materials used for this research were mainly the seeds of *Arachis hypogea* and fluted pumpkin pods obtained from the study area.

2.2 Methods

2.2.1 Study Area

This study was conducted in Cross River University of Technology (CRUTECH), Calabar, Nigeria. It is almost surrounded by swampy wet lands and rivers. Average precipitation of 3000mm occurs annually along the coastal areas of Cross River State with an ambient minimum and maximum temperature of 22.4^oC and 33.2^oC, respectively, and Altitude of 32m (105ft) [13, 14].

2.2.2 Analysis of soil samples

Soil samples (0-15cm depth) collected from the study site, CRUTECH, Calabar, Cross River State, were analysed using standard methods for physico-chemical properties [15].

2.2.3 Preparation of Decomposed Pods of Fluted Pumpkin

Pods of fluted pumpkin were macerated into small pieces, weighed and mixed with 2.0kg of sandy loam soil. These were allowed to condition for 3 weeks. The levels of 0.5, 1.0, 1.5 and 2.0kg of fluted pumpkin pods were used alongside a control (0kg-Soil only) treatment.

2.2.4 Germination and Growth Studies

Each treatment containing 2.0 kg sandy loam soil + appropriate level of fluted pumpkin pods was placed in poly bags and four (4) seeds of *Arachis hypogea* were sown directly in each poly bag. Each level of treatment was replicated three times using randomized complete block design. The experimental set up was maintained under light condition for 60 days for examination of growth parameters of the test crop.

2.3 Statistical Analysis

Standard errors of the mean values were calculated and data were subjected to analysis of variance (ANOVA) test to compare the means [16] at the probability level of ($P < 0.05$).

3. RESULTS

The physico-chemical properties of the experimental soils are presented in Table 1. The pH of the experimental soil ranged from 5.20 in the control treatment (0kg) to 5.50 at 2.0kg level of decomposed fluted pumpkin pods. The contents of available phosphorus, calcium, organic carbon, total nitrogen, sodium, magnesium and potassium significantly ($P < 0.05$) increased with increase in the level of decomposed fluted pumpkin pods. In addition, the values recorded in all soils treated with decomposed fluted pumpkin pods were significantly ($P < 0.05$) higher than that of the control treatment (0kg) (Table 1). The shoot length, root length, fresh weight and dry weight of *Zea mays* grown in soil treated with decomposed fluted pumpkin pods significantly ($P < 0.05$) increased with increase in the level of decomposed fluted pumpkin pods. The values of the above stated growth parameters were significantly ($P < 0.05$) higher than that of the control treatment (0kg). The moisture content of *Zea mays* grown in soil of the control treatment was higher than that of decomposed fluted pumpkin pods treated soils (Table 2).

Table 1: Physiochemical properties of Experimental soil

Soil parameters	Levels of decomposed fluted pumpkin pods (kg)				
	0	0.5	1.0	1.5	2.0
pH	5.20±0.23	5.30±0.35	5.40±0.46	5.40±0.31	5.50±0.45
Available P (mg/100g)	6.72±0.40	6.73±0.16	6.73±0.38	6.74±0.57	6.82±0.46
Ca (mg/100g)	2.30±0.14	2.37±0.68	2.41±0.55	2.43±0.18	2.44±0.29
Organic carbon (%)	2.10±0.33	2.15±0.19	2.18±0.24	2.26±0.20	2.29±0.11
Total N (%)	2.03±0.21	2.07±0.33	2.11±0.73	2.17±0.39	2.20±0.37
Na (mg/100g)	3.20±0.46	3.31±0.58	3.32±0.46	3.36±0.57	3.38±0.19
Mg (mg/100g)	1.20±0.24	1.24±0.10	1.26±0.50	1.27±0.38	1.33±0.49
K (mg/100g)	1.52±0.43	1.53±0.48	1.54±0.35	1.57±0.32	1.60±0.18

Mean ± standard error from 3 replicates.

Table 2: Growth parameters of *Arachis hypogea* in soil treated with decomposed fluted pumpkin pods

Growth parameters	Levels of decomposed fluted pumpkin pods (kg)				
	0	0.5	1.0	1.5	2.0
Shoot length (cm)	41.30±0.31	42.40±0.50	43.53±0.60	45.20±0.19	47.56±0.52
Root length (cm)	14.35±0.39	15.37±0.68	15.23±0.81	18.15±0.73	20.28±0.64
Fresh weight (g)	2.92±0.40	2.98±0.15	3.02±0.25	3.11±0.86	3.20±0.30
Dry weight (g)	0.72±0.03	0.80±0.06	0.84±0.04	0.86±0.03	0.90±0.10
Moisture content (%)	75.34±0.14	73.15±0.21	72.19±0.30	72.35±0.92	71.88±0.73

Mean ± standard error from 3 replicates.

4. DISCUSSION

In this study, mineral nutrient contents of soil from decomposed fluted pumpkin pods were comparatively higher than those of control treatment. This result may be attributed to favourable conditions for biodegradation usually associated with pre-treated organic manure [17, 18, 19] as was evident in soil containing the decomposed fluted pumpkin pods than in untreated soil. Similarly, microbial activity has been shown to increase in the presence of dead plant materials relative to fresh plant tissues [20]. The presence of high carbonaceous compounds in dead plant materials provides energy and food for microbial metabolism [21]. This shows that dead tissues added to soil continue to undergo gradual decomposition and are transformed into microbial cells and various carbonaceous compounds [21, 22]. The plant height, root length, fresh weight and dry weight of the test crop in soil containing decomposed fluted pumpkin pods were comparatively higher than those of control treatment. This results show that the high chemical nutrients composition of associated with organic manure supported optimum growth performance of the test crop [23, 24]. Therefore, the decomposed fluted pumpkin pods used as organic supplement in this study might have replenished plant nutrients, maintained soil organic matter content and improved the physical, chemical and biological conditions of the experimental soil better than the control treatment [25, 26]. Higher yield response of crops due to organic manure application has been reported and could be attributed to improved physical and biological properties of the soil resulting in better supply of nutrients to the plants [27, 28].The choice of decomposed fluted pumpkin pods is further buttressed by the fact that the use renewable forms of energy can reduce costs of fertilizing crops, hence, has revived the use of organic fertilizers worldwide. Again, improvement of environmental conditions and public health are important reasons for supporting increased use of organic materials [29, 30].

5. CONCLUSION

This study revealed that decomposed fluted pumpkin pods could enhance the growth performance of *Arachis hypogea* as well improve the physical and chemical properties of the soil. Therefore, organic manure resulting from this plant based sources could be utilized in crop improvement and soil fertility.

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Conflict of Interest

Conflict of interest was not applicable.

Contribution of the Authors

The author conducted a single authored paper with collaborative assistance from senior colleagues in the field.

REFERENCES

[1] Geetha K, Ramarao N, Kiran RS, Srilatha K, Mamatha P, Rao VU. An overview on *Arachis hypogaea* plant. Int. J. Pharm. Sci. Res. 2013; 4(12): 4508-18.

[2] Kylenorton: The World Most Healthy Foods – Nuts & Seeds – Peanuts (*Arachis hypogaea*) Health Benefits and Side Effects.://kylenorton.healthblogs.org/2011/12/29/the-world-most-healthy-foods-nuts-seeds -peanuts-arachis-hypogaea-health-benefits-and-side-=87ffects/ last accessed on 11 October 2013.

[3] Han SH, An JY, Hwang J, Kim SB, Park BB. The effects of organic manure and chemical fertilizer on the growth and nutrient concentrations of yellow poplar (Liriodendrontulipifera Lin.) nursery system, Forest Science and Technology. 2016;12(3):137-143.

[4] Kaur K, Kapoor KK, Gupta AP. Impact of organic manure with without mineral fertilizers on soil chemical biological properties under tropical conditions. J. Plant Nutr.Soil Sci.2005;168(1):117–122..

[5] Murmu K, Swain DK, Ghosh BC. Comparative assessment of conventional and organic nutrient management on crop growth and yield and soil fertility in tomato-sweet corn production system Aust. . Crop Sci; 2013; 7(11):1617–1626.

[6] Chen D, Wang Y, Liu S, Wei X. Response of relative sap flow to meteorological factors under different Soil moisture conditions in rainfed jujube(*Ziziphus jujuba* Mill.) plantations in semiarid North West China. Agr. Water Manage. 2014; 136: 23–33.

[7] Zhao YC, Yan ZB, Qin JH, Xiao ZW. Effects of long-term cattle manure application on soil properties And soil heavy metals in corn seed production in Northwest China. Environ. Sci. Pollut. Res. Int. 2014; 21; : 7586–7595.

[8] Wang YJ, Xie ZK, Malhi SS, Vera CL, Zhang YB, Wang JN. Effects of rainfall harvesting and mulching technologies on water use efficiency and crop yield in the semi-arid Loess Plateau, China. Agr Water Manage. 2009; 96: 374–382.

[9] Liu CA, Zhou LM, Jia JJ, Wang LJ, Si JT, Li X, et al. Maize yield and water balance is affected by Nitrogen application in a film-mulching ridge–furrow system in a semiarid region of China. Eur J Agr. 2014;52: 103–111.

[10] Dai XQ, Ouyang Z, Li YS, Wang HM. Variation in yield gap induced by nitrogen, phosphorus and potassium fertilizer in North China Plain. PLoS One. 2013;8: e82147. pmid:24349204

[11] Fan YB, Wang CG, Nan ZB. Determining water use efficiency of wheat and cotton: a meta-regression Analysis. Agr Water Manage. 2018;199: 48–60.

[12] Meng QF, Hou P, Wu LQ, Chen XP, Cui ZL, Zhang FS. Understanding production potential and yield gaps in intensive maize production in China. Field Crop Res. 2013;143: 91–97.

[13] Ewona IO, Udo SO. Characteristic pattern of rainfall in Calabar, a tropical coastal location. Nigerian Journal of physics. 2008, 20:1.

[14] Adie HA, Okon OE, Arong GA, Ekpo UF, Braide EI. Environmental factors and distribution of urinary Schistosomiasis in Cross River State, Nigeria. International Journal of Zoological Research. 2014;10: 42-58.

[15] A.O.A.C., Association of Official Analytical Chemist. Methods of analysis (16h Edition), Washington DC., U.S.A.1999.

[16] Obi 1U. Statistical Methods of Detecting Differences Between Treatment Means and Methodology Issues in Laboratory and Field Experiments. Nigeria, AP Express publishers limited, 2002.

[17] Etukudo MM, Nwaukwu IA, Habila S. The Effect of Sawdust and Goat Dung Supplements on the growth and yield of Okra (*Abelmoschus esculentus*) (L. Moench) in Diesel Oil Contaminated Soil. Journal of Research in Forestry, Wildlife and Environment. 2011; 3(2): 2011, 92- 98.

[18] Odokuma LO, Ibor, MN. Nitrogen fixing bacteria enhanced bioremediation of crude oil polluted soil. *Global Journal of Pure and Applied Sciences*. 2002; 8(4): 455- 468.

[19] Belay A, Classens AS, Wehner FC, De-Beer JM. Influence of residual manure on selected nutrient elements and microbial composition of soil under long term crop rotation. South African Journal of Plant and Soil. 2001; 18: 1-6.

[20] Chandra K. Production and quality control of organic inputs; A 10 day training program on production and Quality control of organic inputs of Kottayam, Kerala Regional Centre of organic farming- Herbbal, Banglaore, 24, 2005; pp 1-46.

[21] Agbede OO. Understanding soil and plant nutrition. Nigeria: Salmon Press and Co. Ltd, 2009, pp. 20-60.

[22] Moeller J, Gaarn H, Steckel T, Wedebye EB, Westermann P. Environmental sciences, biodegradation, argumentation, diesel fuels, soils contamination. *Bull. Environ. Contam. Toxicology*, 2008; 96 (6): 913-918.

[23] Akinyele BJ, Adetuyi FC. Effect of agrowastes,pH and temperature variation on the growth of *Volvarieella volvacea*. African Journal of Biotechnology. 2005; 4(6):1390-1395.

[24] Hubbe MA, Nazhad M, Sanchhez C. Composting as a way to convert cellulosic biomass and organic waste into high value soil amendment, a review: Bioresources, 2010; 5(4): 2808-2854.

[25] Etukudo MM, Roberts EMI, Omeje F. Early Seedling Growth and Development Response of *Zea mays* L. To Extract from Palm Bunch Ash (PBAE) of *Elaeis guineensis* Jacq. *International Journal of recent Scientific Research, 2014; 5(7): 1307 -1310.*

[26] Kapanen A, Itavaara M. Ecotoxicity tests for compost application. Ecotoxicology and Environmental *Safety*, 2001; 49: 1-16.

[27] Sanwal SK, Lakminarayana K, Yadav RK, Rai N, Yaldav DS, Mousumi B. Effect of organic manures on Soil fertility, growth, physiology, yield and quality of turmeric. Indian Journal of Horticulture 2007. 64(4)**:** 444-449.

[28] Premsekhar M, Rajashree V. Influence of organic manure on growth, yield and quality of okra. American Eurasian Journal of Sustainable Agriculture. 2009;3(1): 6 – 8.

[29] Seifritz W. *Alternative and Renewable Sources of Energy in Optimizing Yields.* The Role of Fertilizers. In: Proceedings of 12th IPI Congress. 1992, Pp. 155 – 163.

[30] Maritus CHT, Vlelc PLG.. The Management of Organic Matter in Tropical Soils: What are the priorities?

[31] Nutrients Cycling in Agro Ecosystems.1992; 61**:** 1-16.