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Effects of locally available fertilizing agents on the growth and yield of Zea-mays

Nathaniel Yakubu[1] Bethrand Tabugbo Nwufo[2], and Emmanuel Usman Onche[3]*
1. Demonstration secondary school, College of Education, P.M.B 05, Akwanga, Nasarawa State, Nigeria

2. Department of Chemistry, Faculty of Natural sciences, University of Jos, P.M.B. 2084 Jos, Nigeria

3. Department of Chemistry, College of Education, P.M.B 05, Akwanga, Nasarawa State, Nigeria

* E-mail of the corresponding author: emmaonche@gmail.com

Abstract

Manure potentials of three organic fertilizers locally available in Nigeria: cow-dung, soya beans cake and ground nut cake were investigated and compared with NPK, an inorganic fertilizer. The final grain yield at 12% moisture content shows that G/nut cake has the highest yield followed by NPK, soya beans cake, cow dung and control with the least yield. It was observed that though NPK had the largest percentage of Nitrogen and potassium, it did not perform better than Ground nut cake plot. Groundnut cake and soya beans cake compete favourably with conventional NPK fertilizer. Ground nut cake has the lowest ash content (4.13%), followed by soya beans cake (5.42%), NPK (37.43%) and then cow dung (70.79%) with the highest value.

Keywords: Organic fertilizer, growth, yield, low income.

1. Introduction

One of the major problems facing the world is feeding a steadily growing population.(Von Braun, 2007) The situation is further intensified by poor agricultural and land management. On a yearly basis, less land is available for food production (Van Meijl, Van Rheenen, Tabeau, & Eickhout, 2006) The top soil is constantly being eroded by agents of denudation like wind and water. Over cultivation further depletes the nutritional value of the soil which may greatly reduce the yields and sometimes incompletely infertile land. To reverse these trends, careful agricultural management should be combined with scientific methods to improve growing conditions and maximize crop production (Bumb, 1995). For developing countries like Nigeria, where the bulk of the population depends heavily on cereals like rice, wheat, maize, sorghum and millets, scientific methods for improvement would have to be affordable. To increase crop production, four important inputs must be considered: water, fertilizer, pest control and crop variety (Godfray et al., 2010). The first three are associated with providing a better environment for the growth of the crops while the fourth is concerned with inherent ability of the plant to produce within the environment that has been provided.

NPK fertilizers have been used extensively to improve the yield of crops (Marschner, Kandeler, & Marschner, 2003; Tomaszewska & Jarosiewicz, 2002; Wu & Liu, 2008), sometimes in combination with other organic manures (Ghosh et al., 2004). Despite its safety and efficacy, NPK fertilizer suffers from several major drawbacks: utilities infrastructure, transport infrastructure, raw material infrastructure, marketing infrastructure and so on (Hignett, 1985). However, there have been no controlled studies which compare differences in efficiency of NPK with locally available and affordable fertilizers from cow-dung, soya bean cake and g/nut cake in Nigeria. This paper seeks to provide farmers with knowledge of the performance of these fertilizers. Also to check the suitability of groundnut cake and soya bean cake as good organic fertilizers compared to cow-dung and NPK. All these are to enable farmers with low-income to adopt ways of using organic fertilizers more efficiently.

2. Materials and Methods

The maize variety used was TZPBSR-YELLOW. These were obtained from Plateau Agricultural Development Programme (PADP) in Jos. The cow-dung used is dry litter gotten from Abattoir in Jos. NPK in the ratio 20:10:10 was from MANR in Jos. The groundnut cake and soya-beans cake were from Grand Cereals and Oil Mills Nigeria Limited Bukuru, Jos.

2.1 Sampling and sample preparation

The land preparation was done manually. The plot size for each of the fertilizers used: NPK, Control, Cow-dung, Soya bean- cake and groundnut cake is $2M^2$. The soil sample was sandy loam, coarse and has a P^H content of 6.8 and Nitrogen 0.685%. A total of five treatments were used and designated as follows:

Table 1: Different types of fertilizer used and their designation

Designation	Types of fertilizer in soil
A	NPK
B	Control
C	Cow-dung
D	Groundnut-cake
E	Soybeans-cake

Three seeds were sown in each hole and the interplant and intra-plant spacing were 50cm and 30cm respectively. Plants were thinned down to two plants per hole twenty eight (28) days after germination in samples A-E.

3. Results and discussion

The need for increased food production with less land, less water and less fertilizer is being advocated recently (Balmford, Green, & Scharlemann, 2005; Hobbs, Sayre, & Gupta, 2008; Seckler, 1996).

Each sample: A-D, were analysed for Nitrogen, Phosphorus and potassium.

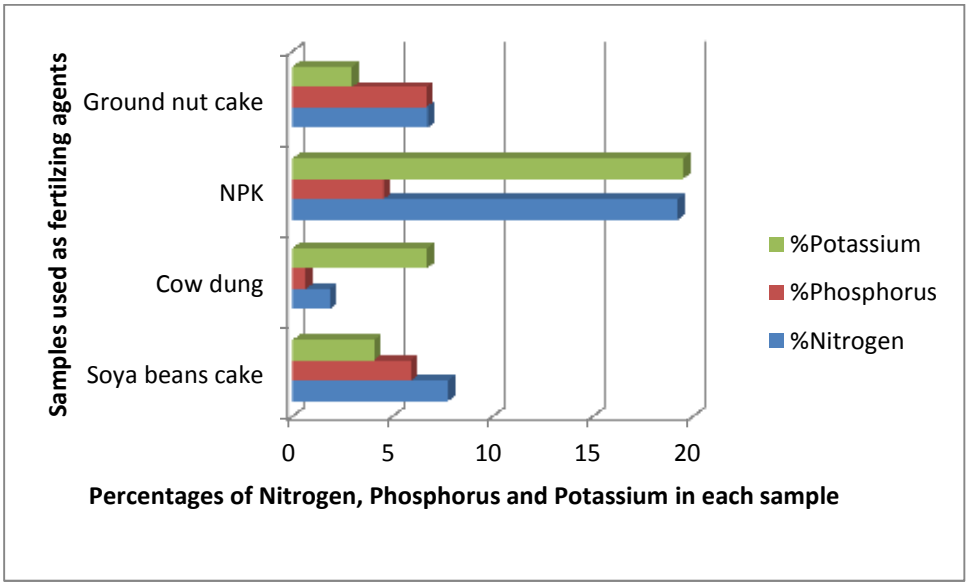

Figure 1: Analysis of Nitrogen, Phosphorus and Potassium in all the Samples A-D.

From Figure 1, the percentages of Nitrogen, Potassium and Phosphorus in the experimental samples are in the order NPK>soya beans cake>Groundnut cake>cow dung for Nitrogen, NPK>cow dung>soya beans cake> Ground nut cake for Potassium, and Ground nut cake>soya beans cake>NPK>cow dung for Phosphorus.

Table 1: Average plant height for 7 weeks (cm)

PLOT	1ST Week	2ND Week	3RD Week	4TH Week	5TH Week	6TH Week	7TH Week
A (NPK)	24±1	33±0.2	49 ± 0.1	68 ± 0.4	91 ± 0.3	117 ± 0.2	147 ± 0.3
B (Control)	22±0.5	23±0.7	35 ±0.1	43 ± 0.3	58 ± 0.5	78 ± 0.3	85 ± 0.2
C(Cow-D)	39±0.5	52±0.3	72 ± 0.3	86 ± 0.2	101 ± 0.2	132 ± 0.2	159 ± 0.2
D (G/Cake)	17±0.5	20 ±0.4	48 ± 0.3	78 ± 0.2	109 ± 0.2	143 ± 0.3	190 ± 0.1
E(S/Cake)	21±0.4	33±0.5	49 ± 0.4	76 ± 0.6	104 ± 0.3	130 ± 0.3	148 ± 0.2

The implication for the NPK values(Figure 1) manifested in the average plant height (Table 1) and stem girth (Table 2), which shows Ground nut cake plot having the highest plant height and girth followed by cow dung, soya beans cake, NPK and control has the least plant height (Table 1) and stem girth (Table 2).

Table 2: Average stem girth for 7 weeks (cm)

PLOT	1ST Week	2ND Week	3RD Week	4TH Week	5TH Week	6TH Week	7TH Week
A (NPK)	4.0 ± 0.2	4.72 ± 0.3	5.3 ± 0.1	6±1.0	7.5±0.6	8 ± 0.2	8±0.5
B (Control)	2.8 ± 0.3	3.15 ± 0.2	3.6 ± 0.3	4.1 ± 0.6	4.7 ±0.6	5.05 ± 0.8	4.7 ± 0.4
C(Cow-D)	4.8 ±0.2	5.3 ± 0.4	5.96 ± 0.6	6.02 ± 0.5	6.1 ± 0.8	6.3 ± 0.6	6.3 ± 0.8
D (G/Cake)	3.9 ± 0.9	4.3 ± 1.0	5.9 ± 1.0	7.7 ± 1.5	8.9 ± 2.0	9 ± 1.7	9.1 ± 0.8
E(S/Cake)	2.2 ± 0.1	3.6 ± 0.4	5 ± 0.08	5.5 ± 0.9	6 ± 0.4	6.13 ± 0.5	6.3 ± 0.3

The result of the stem Girth showed ground nut cake with the best developed stem followed by NPK, cow dung, soya beans cake and control having the least. The cow dung plot had proper stem development despite low Nitrogen due to its immediate availability to plants and quick absorption before it was leached (Bansal & Kapoor, 2000).

Table 3: Number of days to 50% Tasselling and Silking

PLOT	No of days to 50% tasseling	No of days to 50% silking
A (NPK)	77	84
B (CONTROL)	79	90
C (C-DUNG)	73	82
D (G-CAKE)	67	71
E (S-CAKE)	72	80

Analysis of Table 3 shows that G/cake has the lowest number of days to 50% tasseling and silking while the control has the highest number of days.

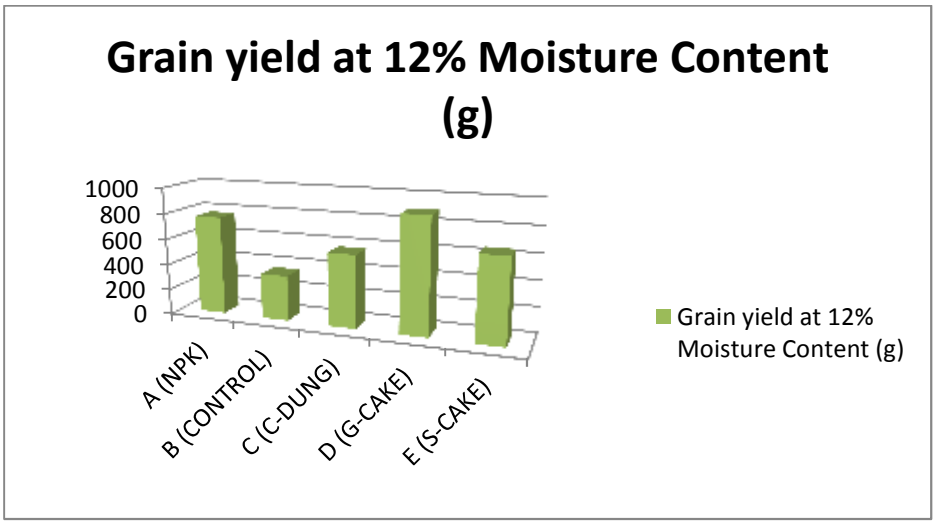

Figure 2: Grain yield at Harvest

The final yield parameter was grain yield at 12% moisture content. This result shows G/nut cake with the highest yield followed by NPK, S/beans cake, cow dung and control with the least yield. It was obviously observed that though NPK had the largest percentage of Nitrogen and potassium, it did not perform well or perform better than G/nut cake plot. This could be attributed to the fact that application of conventional fertilizer has often being associated with low level efficiency due to leaching at the peak of the rainfall, volatility and run off where the efficiency is only 50% for N, 10% for P and about 40% for K (Baligar & Bennett, 1986). It was observed that the crops in the G/nut cake and Soya beans cake plot performed well during the growing season mainly because decomposition of soil of soil organic matter is a slow release source of nutrients to plants and a source of carbon to micro-organisms (Guertal, 2000).

4. Conclusion

Groundnut cake and soya beans cake compete favourably with conventional NPK fertilizer and they have the tendency of supplying nutrients to maize plants throughout the cropping season thereby improving the yield of crops. Low-income Local farmers who don't have access to the subsidized NPK fertilizers supplied by the government due to competition and unavailability can now rely on these competing locally available fertilizers.

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