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Influence of Compost Supplemented with Jatropha Cake on Growth, Dry Matter Accumulation and Nutrient Uptake of Maize (*Zeamays* L.)

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Abstract

The potentials of compost supplemented with jatropha cake as soil amendments were evaluated under screenhouse at Kwara State University. Maize (variety EVDT-W99 STR) was used as test crop. The experiment consisted of two consecutive experiments in which residual effect was observed in the second experiment. The treatments were: control (Zero addition), NPK 15 –15-15 at 60 kg N/ha, 30% Grade B + 70% Jatropha cake at 1.5, 2.0 and 2.5 t /ha, 40% Grade B + 60% Jatropha cake at 1.5, 2.0 and 2.5 t /ha, 50% Grade B + 50% Jatropha cake at 1.5, 2.0 and 2.5 t /ha, 60% Grade B + 40% Jatropha cake at 1.5, 2.0 and 2.5 t /ha . The design was completely randomized design replicated three times. Results obtained showed that 50% Grade B + 50% Jatropha cake greatly influenced growth parameters of maize at first and second cropping. The 50% Grade B + 50% Jatropha cake treatment resulted in the highest nitrogen, phosphorus and potassium uptake value; 13.28, 0.32and 14.60 mg/pot respectively at second planting which differed significantly from all other treatments. The study showed that jatropha cake supplemented with compost at 2.5 t/ha resulted in higher growth parameters and nutrient uptake when compared with NPK at second planting.

Introduction

Declining soil fertility is a serious limitation to crop production in Nigeria. The primary causes are loss of organic matter, acidity, low nutrient contents, nutrients imbalance and soil erosion (Ojo *et al*., 2014). The low nutrient status of most tropical soils necessitates the use of fertilizers (Ogundare *et al*., 2016).The majority of the small holder peasant farmers in Nigeria lacked the financial resources to purchase sufficient fertilizers to replace soil nutrients exported with harvested crop products. As a result, soil fertility has declined and yields of staple food crops are typically low (Olowoake and Adeoye, 2013). One of the ways of increasing the nutrient status is by boosting the soil nutrient content either with the use of organic materials such as poultry manure, animal waste or compost (Dauda *et al*., 2005). Several sources of organic materials and residues abound in Nigeria which can be processed, packaged and made available as branded organic fertilizer at a cheap rate for home gardening, horticulture and farming as a whole (Olowoake *et al*., 2015). There is paucity of information on the use of compost augmented with jatropha cake for the production of maize in Ilorin, Nigeria. This study was carried out to evaluate the influence of compost supplemented with jatropha cake on growth, dry matter yield and nutrient uptake of maize.

Materials and Methods

Pot experiment was conducted in 2016 at Kwara State University Malete, Nigeria (Latitude 80 71'N and Longitude 40 44'E). The university lies in the southern guinea savanna belt of Nigeria. Forty two pots were filled with 5.5 kg of soil. The treatments used were; Control (No fertilizer), NPK 15 –15-15 at 60 kg

N/ha, 30% Grade B + 70% Jatropha cake at 1.5, 2.0 and 2.5 t /ha, 40% Grade B + 60% Jatropha cake at 1.5, 2.0 and 2.5 t /ha, 50% Grade B + 50% Jatropha cake at 1.5, 2.0 and 2.5t /ha, 60% Grade B + 40% Jatropha cake at 1.5, 2.0 and 2.5 t /ha .Grade B is a commercial fertilizer product of Aleshinloye Fertilizer Plant, Ibadan, Oyo State, Nigeria. The results of the laboratory analyses of Grade B fertilizers and jatropha cake is summarized in Table 1.The treatments were arranged in a completely randomized design (CRD) with three replicates. The soils and compost supplemented with jatropha cake were left to mineralize for two weeks before planting while the mineral fertilizer was applied two weeks after planting. Four maize seeds (variety EVDT-W99 STR) were planted in each pot, but later thinned to two after germination. Pre-cropping chemical analysis of the experimental soil used in the screen-house was carried out before the experiment. Plants were watered daily and weeding was also carried out as required. The plants were observed for six weeks after which they were harvested and analyzed for N, P and K contents based on the procedures described by Okalebo *et al*. (2002).The experiment was repeated without any fertilizer application at the second planting.

Table 1. **Chemical composition of Aleshinloye Grade B and jatropha cake**

Nutrient element	N	P	K	Na	Cu (g/kg)	Mn	Ca	Mg	Fe	Zn
Grade B	11.7	7.6	20.9	29.61	16.98	106.7	23.4	2.4	8195.4	19.9
Jatropha cake	34.1	0.7	2.2	0.08	0.02	0.01	0.3	8.39	2.1	0.08

The data were taken at an interval of two weeks; plant height and number of leaves. At six weeks after planting (6 WAP) maize shoots were harvested from the ground level, oven dried at 70^{o}C to a constant weight; and the weights were recorded as dry matter yield. The dried maize shoots were milled using Willey E. D. 5 milling equipment. Plant samples were analyzed for N, P and K as described by Okalebo *et al*, (2002).The data collected were subjected to analysis of variance (ANOVA) and treatment means were separated by Duncan Multiple Range Test.

Results

Table 2 showed the effect of compost supplemented with Jatropha cake and NPK on growth parameters, dry matter yield and nutrient uptake of maize during the first planting in the screenhouse at 6 WAP.NPK at 60 kgN / ha and 50% Grade B + 50% JC at 2.5 t / ha were significantly ($p< 0.05$) higher than control and other treatments. The highest plant height of 45.3 cm was obtained from plant fertilized with 50% Grade B + 50% JC at 2.5 t / ha. Maize number of leaves in 50% Grade B + 50% JC at 2 .5 t / ha was significantly ($p< 0.05$) higher than number of leaves from NPK and all other fertilizer treatments including control. The dry shoot weight in the compost supplemented with jatropha cake and NPK pots was larger than control by 39-80%. The control treatment produced the smallest dry shoot weight. Dry shoot weight was significantly ($P<0.05$) influenced by the fertilizer treatments in the first trial. Table 3 showed the mean N, P and K uptake of maize during the first planting in the screen house. For the N uptake, the highest value of 13.5 mg N / pot from NPK was significantly ($p <0.05$) higher than the values from all other fertilizer treatments. P uptake values showed that NPK had highest value (3.0 mg P / pot). K uptake had the values of 60.7 mg K / pot from the treatment NPK. However, 30% Grade B + 70% JC at 1.5 t /ha had the lowest value of 14.5 mg K / pot excluding control. Table 4 showed the residual effects of different rates of fertilizer treatments on growth parameters, dry matter yield and nutrient uptake of

maize during the second planting in the screenhouse. Height of maize plants treated with 50% Grade B + 50% JC at 2.5 t /ha on maize was significantly ($p<0.05$) different from all other fertilizer treatments including control. The highest height of 39.3 cm was observed under 50% Grade B + 50% JC at 2.5 t /ha. Control (no fertilizer) produced plant that were shorter than 50% Grade B + 50% JC at 2.5 t /ha by 57 %. Effect of fertilizer treatment on maize number of leaves.

Table 2. **Effects of compost supplemented with jatropha cake and NPK on dry matter yield and nutrient uptake of maize during first cropping**

Treatment	Rate (t/ha)	Plant height (cm)	Number of leaves	Dry matter yield (g)	N (mg / pot)	P	K
Control	0.0	33.8c	8.2d	3.5e	3.3d	0.8d	8.4d
30% Grade B + 70% JC	1.5	39.8b	9.8abc	5.7d	5.1c	1.2c	14.5c
30% Grade B + 70% JC	2.0	40.3b	9.3bcd	8.2c	8.5c	2.1b	37.1b
30% Grade B + 70% JC	2.5	37.7b	10.0ab	7.9c	8.7c	2.5b	40.2b
40% Grade B + 60% JC	1.5	39.0b	9.5bcd	7.4c	6.5c	1.2c	23.0c
40% Grade B + 60% JC	2.0	43.8b	9.5bcd	7.7c	7.2c	1.4b	27.8c
40% Grade B + 60% JC	2.5	42.4b	9.5bcd	7.4c	6.1c	1.5b	28.9 c
50% Grade B + 50% JC	1.5	37.6b	8.5d	7.7c	5.1c	1.5b	29.4c
50% Grade B + 50% JC	2.0	39.7b	8.5d	6.9c	4.9c	1.1c	30.9c
50% Grade B + 50% JC	2.5	45.3a	10.5a	10.3b	10.0b	2.9a	54.9b
60% Grade B + 40% JC	1.5	39.2b	9.1bcd	4.9d	6.4c	1.5b	17.8c
60% Grade B + 40% JC	2.0	38.8b	9.1bcd	4.7c	5.7c	1.1c	14.9c
60% Grade B + 40%	2.5	42.3b	9.2bcd	4.9c	6.2c	1.5b	16.0c
NPK	0.06 kgN	45.0a	8.5cd	17.7a	13.5a	3.0a	60.7a

Means having the same letter along the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level

Legend:
Grade B – Un-amended compost JC- Jatropha cake

The effect of 50% Grade B + 50% JC at 2.5 t/ha on shoot dry matter yield of maize was significantly ($p< 0.05$) different from all other fertilizer treatment including control. Table 3 showed the N, P and K uptake of maize during the second planting in the screenhouse. N, P and K uptake differed significantly under different treatments.

Table 3. **Effects of compost supplemented with jatropha cake and NPK on dry matter yield and nutrient uptake of maize during second cropping**

Treatment	Rate (t/ha)	Plant height (cm)	Number of leaves	Dry matter yield (g)	N (mg / pot)	P	K
Control	0.0	16.8e	8.2c	2.5d	2.84f	0.03e	2.34e
30% Grade B + 70% JC	1.5	19.0cd	9.2b	2.9d	8.78c	0.04d	10.44b
30% Grade B + 70% JC	2.0	17.9d	9.3b	2.7d	7.33c	0.05d	7.25c
30% Grade B + 70% JC	2.5	18.8cd	8.8b	4.9c	6.56d	0.08d	7.19c
40% Grade B + 60% JC	1.5	20.9cd	8.8b	2.7d	6.32d	0.14c	5.80d
40% Grade B + 60% JC	2.0	20.7cd	9.2b	2.8d	6.34d	0.14c	7.11c
40% Grade B + 60% JC	2.5	20.8cd	8.7b	2.6d	6.69d	0.22b	5.95d
50% Grade B + 50% JC	1.5	28.6b	9.0b	8.9b	4.52e	0.09d	3.34d
50% Grade B + 50% JC	2.0	32.1b	9.2b	7.9b	4.27e	0.15c	3.48d
50% Grade B + 50% JC	2.5	39.3a	10.3a	11.1a	13.28a	0.32a	14.60a
60% Grade B + 40% JC	1.5	29.3b	9.0b	3.5cd	3.70 e	0.09d	3.46d
60% Grade B + 40% JC	2.0	25.9bc	8.8b	5.4c	3.81e	0.10	3.76d
60% Grade B + 40% JC	2.5	28.7b	9.0b	3.5cd	3.85e	0.09	3.35d
NPK	0.06 kgN	27.3b	8.9b	8.6b	9.28b	0.15c	4.22

Means having the same letter along the columns indicate no significant difference using Duncan's Multiple Range Test at 5% probability level

Legend:
Grade B – Un-amended compost
JC- Jatropha cake

For Nitrogen uptake, 2.5 t / ha 50% Grade B + 50% JC had the highest (13.28 mg N / pot) which was significantly ($p< 0.05$) different from other treatments. 60% Grade B + 40% had at 1.5, 2.0 and 2.5 t/ ha the least N uptake of 3.70, 3.81 and 3.85mg N / pot respectively excluding the control. In P uptake, 2.5 t / ha 50% Grade B + 50% JC had the highest values (0.32 mg P / pot). Control had the least P uptake of 0.03 mg P / pot. For the K uptake 2.5 t / ha 50% Grade B + 50% JC had the highest (14.60mg K/ pot) which is significantly ($p< 0.05$) different from other fertilizer treatments.

Discussion

Results of this study showed that plant height, number of leaves and dry matter of maize plant differed significantly ($p < 0.05$) among the different rates of fertilizers. This might have been enhanced by the difference in the rates of the compost supplemented with Jatropha cake. Application of 50% Grade B + 50% JC at 2.5 t/ha had significantly ($P <0.05$) higher maize dry matter yield compared to NPK in the second planting of maize. This is in agreement with the findings of Kihanda, (2003), Oghoghodo and Ilegar (1995) and Titiloye (1982) they affirmed that the quantity of organic residues added to the soil might influence the rate of decomposition, which in turn affect the dry matter yield. The uptake of N, P and K by the maize reveals that 50% Grade B + 50% JC at 2.5 t/ha performed better could be as a result of nutrient release pattern of the treatment during the first planting. Observations on some plant growth parameters in second planting showed that residual effects of maize were significantly different from other treatments. The low dry matter yield produced by the control during the second planting of the maize under the screen house conditions showed that the soil where no fertilizer was applied was low in essential nutrients. Therefore, nutrient availability especially N, P and K could affect the photosynthetic activities of the plant and subsequent storage of dry matter produced. The result of residual nutrient

uptake effects on maize as a result of applied treatment showed that 50% Grade B + 50% JC at 2.5 t/ha performed better than NPK.

Conclusion

Based on the aforementioned findings, it can be deduced that jatropha cake supplemented with compost at 2.5 t/ha can serve as an alternative to mineral fertilizer.

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