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ORIGINAL RESEARCH

Influence of compost supplemented with jatropha cake on soil fertility, growth, and yield of maize (*zea mays* L.) in a degraded soil of Ilorin, Nigeria

Adebayo Abayomi Olowoake[1] · Oluremi Solomon Osunlola[1] · James Adebayo Ojo[1]

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Abstract

Purpose This study was conducted to determine the effect of compost supplemented with jatropha cake on maize (*Zea mays* L) yield in a degraded soil and their residual effects on soil fertility in Ilorin, Nigeria.

Methods Field trials were conducted at Kwara State University Teaching and Research Farm, Malete, in 2016/2017 cropping season. The treatments consisted of control, un-amended compost Grade B supplemented with Jatropha cake AJ (30% Grade B + 70% JC) at 1.5 t/ha, BJ (30% Grade B + 70% JC) at 2.0 t/ha, CJ (50% Grade B + 50% JC) at 2.5 t/ha including NPK at 60 kg N/ha. The treatments were arranged in a randomized complete block design (RCBD) and replicated three times.

Results Maize grain yield (3.1 t/ha) was obtained from CJ at 2.5 t/ha this was significantly ($p < 0.05$) greater than that of NPK treatment (2.2 t/ha) after the first cropping. At second trials, maize grain yield values gotten from CJ at 2.5 t/ha were also significantly ($p < 0.05$) greater than that of NPK values. Treatments CJ at 2.5 t/ha significantly ($p < 0.05$) improved soil pH, available P and exchangeable K.

Conclusion Fertilizer 50% Grade B + 50% Jatropha cake at 2.5 t/ha had a significant and positive effect on soil fertility after harvesting of maize when compared with NPK in both cropping.

Keywords Degraded soil · Fertilizer · Jatropha cake · Maize yield · Un-amended compost

Introduction

Reduction in tropical soil fertility and crop productivity has become a major concern, and indeed a great hindrance to achieving food sufficiency in the tropics. However, continuous and exhaustive use of highly priced mineral fertilizer materials, for improving crop productivity in the past 10 years, had been obviously connected to this problem as earlier reported to influence nutrient imbalances, leaching of nitrates and phosphates, marine eutrophication and groundwater contamination, microbial activities, soil acidity, and serious threats to man (Babajide and Olla 2014; Afe and Oluleye 2017; Crews and Peoples 2004). Unnecessary use of chemical fertilizers and pesticides adversely affects the soil environment, leading to decrease in crop productivity and production of possibly harmful food, unsafe for human feeding (Chaturvedi et al. 2013). Our traditional approach of use of synthetic fertilizer as a common fertilizer in most developing countries for crop productions can no longer be depended on especially as its use is being threatened with cost economics and absence when needed by farmers (Adeoluwa and Suleiman 2012). Thus, there is a need to consider another source of fertilizer.

Sivaprakashan (1991) reported that compost enhanced crop yield by improving nutrient status as well as growing of microbial activity in the soil. Similarly, nutrient supply by oil-based cakes which is a form of organic manure will not only decrease the reliance on chemical fertilizers, but also develop the soil structure, boost the growth and activity of useful organisms in the soil, ease the deficiency of secondary and micronutrients, and sustain higher yield due to better soil health (Tiwari 2002; Singh et al. 2006).

Jatropha cake produced during oil extraction in biodiesel production can be used as manure (Cano-Asseleih et al. 1989; Jayasingh 2003). Jatropha cake is opulent in nitrogen, phosphorous, and potassium and can be used as organic

✉ Adebayo Abayomi Olowoake
aolowoake@yahoo.com

1 Department of Crop Production, Kwara State University, Malete, Nigeria

fertilizer. The percentages of nitrogen (N), phosphorous (P), and potassium (K) in jatropha cake were 3.2–4.5, 1.4–2.1, and 1.2–1.7%, respectively (Kumar and Sharma 2008). The occurrences of these elements in the cake were known as the organic nutrients sources that are even greater than that of chicken or cow farm yard manure (Olowoake 2017).

The large amount of de-oiled seed cakes produced by oil-extraction process is valuable as organic manure due to its high nitrogen content (up to 6.48%) and can be used to maintain fertility of soil. Supplementing compost with jatropha cake is not much familiar, but use of these two is of higher nutrient content as alternate of inorganic fertilizer. An organic fertilizer does more than supplying organic nutrients: it improves the water and nutrient holding capacity of soil. The organic matter over time combines the tiny clay particles into aggregates forming large opening space. This improves air infiltration, water infiltration, drainage and allows for deeper rooting depths. Build-up of toxic material in the soil is also unlikely. This work was carried out to know the possibility of using compost supplemented with jatropha cake on the yield of maize and its remaining effects on some soil physico-chemical properties on a degraded soil of Guinea savannah zone.

Materials and methods

Depiction of study area

The experimental site situated at the experimental plot of Kwara State University, Malete (08°42′48.5″N and 004°26′17.9″E), Ilorin, Nigeria, which lies in the southern guinea savanna zone of Nigeria. The yearly rainfall in the region is about 1200 mm and temperature varies among 33 and 34 °C during the period, with a dry spell from December to March. The Kwara State University land area forms part of the South-western region of Nigerian basement complex, a region of basement recurrence and plutonism during the Pan-African orogeny (Olowoake and Ojo 2014).

Soil analysis

Soil samples were randomly taken from 0 to 15 cm depth using soil auger before the study. The samples were bulked and air-dried and were taken to Laboratory for analysis. The particle size analysis was determined by hydrometer method (Bouycocous 1951). Organic carbon was determined by Walkley–Black dichromate digestion method as described by Nelson and Sommers (1982) and total nitrogen by Bremner and Mulvancy (1982). P was determined by Brays P1 method (Bray and Kurtz 1945). Exchangeable K, Na, Ca, and Mg were extracted by leaching the soil with neutral ammonium acetate (NH4OAC). K and Na concentrations were determined by flame photometer, while Mg and Ca were determined by atomic absorption spectrophotometer. Soil pH determination was carried out using a 1:2 (soil: water) ratio with a glass electrode pH meter and electrical conductivity in deionized water suspension of 1:5 (w/v).

Experimental layout

This experiment was set up under field condition with the objective of assessing the most effective compost supplemented with Jatropha de-oiled cake emanating from screen house. The field was cleared and ploughed. The experimental design used in this study was randomized complete block design (RCBD) replicated three times. The size of each plot was 3.0 × 3.0 (9 m^2), with a spacing of 0.5 m. The fertilizers were applied to the maize and the field trials had five major treatment combinations comprising the following: control, NPK 15–15–15 at 60 kg N/ha, AJ (30% Grade B + 70% JC) at 1.5 t/ha, BJ (30% Grade B + 70% JC) at 2.0 t/ha, and CJ (50% Grade B + 50% JC) at 2.5 t/ha. The chemical composition of Jatropha cake (JC) and Aleshinloye Grade B used in the study is given in Table 1. Aleshinloye Grade B (un-amended compost) is a commercial fertilizer from Aleshinloye fertilizer company, Ibadan, Oyo State Nigeria.

Planting of maize

Maize variety EVDT-W99 STR (*Zea mays* L.) was obtained from the International Institute of Tropical Agriculture (IITA), Ibadan, and Nigeria was used as a test crop. Maize was sown with a planting distance of 0.75 m × 0.25 mm at two plants per stand. However, maize plant was later thinned to one after seedling emergence. Compost supplemented with jatropha cake was applied using ring method 2 weeks

Table 1 Chemical composition of Aleshinloye Grade B and jatropha cake

Nutrient element (g/kg)	Concentration of Grade B fertilizer	Jatropha cake
Total N	11.7	34.1
Ca	23.4	0.3
Mg	2.4	8.39
K	20.9	2.2
Mn	106.67	0.01
Na	29.61	0.08
Fe	8195.39	2.1
Cu	16.98	0.02
P	7.6	0.7
Zn	19.9	0.08
EC (ds/m)	16.0	13.8
pH	9.3	8.5

before planting to improve mineralization, while NPK fertilizer was applied 2 weeks after planting. The plots weeds were cleared manually and free of weed throughout thee study. Maize was harvested at 12 weeks after planting. The second experiment was carried out to investigate the residual effects of fertilizer application.

Data collection

Five maize plants were randomly sampled and tagged per plot to determine growth parameters. The growth parameters collected include plant height, leaf area, stem girth, and number of leaves per plant while yield parameters; 100 seeds weight and grain yield were collected at 12 WAP.

Statistical analysis

Data collected from the study were analysed using statistical analysis system (SAS) for analysis of variance (ANOVA) and the treatments were compared using the Duncan's multiple range test (DMRT) ($p < 0.05$). Moreover, coefficient correlation was calculated to determine the relationship between maize yield and soil properties.

Table 2 Physico-chemical properties of experimental soil

Parameters	Soil test value
pH (H_2O)	5.7
EC (ds/m)	0.3
Org.C (gk/g)	6.84
Total N (g/kg)	3.1
P (mg/kg)	9.3
Exchangeable bases cmol/kg	
Mg	4.54
Ca	19.8
Na	0.78
K	1.52
Extractable micronutrients	
Cu	3.69
Fe	229.0
Mn	124.0
Zn	1.24
Textural class %	
Sand	75.8
Silt	13.4
Clay	10.8
Textural class	Sandy loam

Results

Table 1 shows the chemical analysis of fertilizer treatment used in the study. The total N in Aleshinloye Grade B is 11.7 g/kg and Jatropha cake is 43.1 g/kg. K in Aleshinloye Grade B is 2.09 g/kg and Jatropha cake is 2.2 g/kg. Ca in Aleshinloye Grade B is 23.4 g/kg and Jatropha cake is 0.3 g/kg. Mg in Aleshinloye Grade B is 2.4 g/kg and Jatropha cake is 8.39 g/kg. K in Grade B is 20.9 g/kg and Jatropha cake is 2.2 g/kg. P in Aleshinloye Grade B is 7.6 g/kg, while Jatropha cake is 0.7 g/kg. EC in Grade B is 16.0 ds/m and Jatropha cake is 13.8 ds/m. The physico–chemical properties of soil use are shown in Table 2. The soil textural class was sandy loam and slightly acidic with pH of 5.7.

Effects of fertilizers on growth and yield of maize at the first cropping

Table 3 shows the influence of fertilizers on growth and yield components of maize at the first and second cropping. Application of CJ at 2.5 t/ha performed better than the NPK fertilizer and control. Mean plant height of 152.6 cm was recorded for maize treated with 50% Grade B + 50% JC at 2.5 t/ha. The values obtained for this height was 13 and 33% higher than NPK and control, respectively. The highest stem girth (27.99 mm) recorded in maize was from treatment CJ (50% Grade B + 50% JC) at 2.5 t/ha. The lowest (13.71 mm) girth was recorded in the control and it was significantly ($p < 0.05$) lower than all other treatments. However, no significant difference ($p < 0.05$) among the values obtained for the stem girth of AJ and BJ at 1.5 and 2.0 t/ha, respectively. Maize under the CJ at 2.5 t/ha treatment performed best with 14.6 number of leaves. At 5% probability, there was no significantly difference between 2.0 t/ha BJ and 2.5 t/ha CJ at that gave 14.6 numbers of leaves. However, the treatment 2.0 t/ha BJ and 2.5 t/ha CJ were significantly ($p < 0.05$) higher than all other treatments as well as control. Application of CJ (50% Grade B + 50% JC) at 2.5 t/ha produced the highest leaves area with 501.6 cm^2. This values was not significantly different ($p < 0.05$) from BJ (30% Grade B + 70% JC) at 2.0 t/ha that had 493.9 cm^2, but was significantly ($p < 0.05$) different from control, NPK, and AJ (30% Aleshinloye Grade B + 70% Jatropha cake) at 1.5 t/ha. Maize grown with CJ at 2.5 t/ha consistently showed significantly ($p < 0.05$) higher grain yield (3.1 t/ha), and 100-seed weight (43.7 g) during the first planting. The grain yield from CJ at 2.5 t/ha was 58 and 29% higher than from control and NPK plot, respectively.

Influence of soil amendment on growth and yield of maize at second cropping

Among the fertilizer in the second cropping (residual) CJ at 2.5 t/ha produced the tallest plant of 112.6 cm, this values was significantly ($p < 0.05$) higher than values of 71.0, 76.6, 91.7, and 81.5 cm obtained from control, NPK, AJ at

Table 3 Effects of fertilizer types on growth and yield of maize at the first and second field cropping

Treatment	Rate (t/ha)	Plant height (cm)	Stem girth (mm)	Number of leaves	Leaves area cm^2	100 seed weight (g)	Grain yield (t/ha)
First cropping							
Control	0	102.8d	13.71d	11.3c	243.0d	18.0d	1.3c
NPK	0.06 kg N	123.1c	18.84c	12.0c	418.1c	31.9b	2.2b
AJ	1.5	141.5b	19.51b	13.1b	476.9b	24.7c	2.0b
BJ	2.0	149.9a	22.27b	14.3a	493.9a	22.3c	2.5b
CJ	2.5	152.6a	27.99a	14.6a	501.6a	43.7a	3.1a
Residual effect							
Control	0	71.0e	11.58c	11.9c	220.1d	10.0c	0.6c
NPK	0.06 kg N	76.6d	14.68b	12.2b	255.5c	11.9b	1.9b
AJ	1.5	91.7b	14.13b	12.9b	296.3b	13.7b	1.5b
BJ	2.0	81.5c	12.34c	12.9b	245.9c	11.0b	1.6b
CJ	2.5	112.6a	26.13a	13.6a	408.0a	18.7a	2.4a

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

AJ—30% Aleshinloye Grade B + 70% Jatropha cake

BJ—30% Aleshinloye Grade B + 70% Jatropha cake

CJ—50% Aleshinloye Grade B + 50% Jatropha cake

1.5, and BJ at 2.0 t/ha, respectively. However, the plant height from CJ at 2.5 t/ha was 37 and 32% higher than from control and NPK plot, respectively. The stem girth ranged from 11.58 mm in control to 26.13 mm in CJ at 2.5 t/ha. Stem girth of maize plant with CJ at 2.5 t/ha was 56% greater than the value obtained from the control plants. The lowest stem girth recorded from control was 11.58 mm. The highest number of leaves of 13.6 was obtained from CJ at 2.5 t/ha which was significantly higher at 5% probability than other fertilizer treatments. The lowest mean number of leaves 11.9 was produced from control. The value of number of leaves obtained from CJ at 2.5 t/ha was 13% greater than the values produced from the control plant. The highest value of leaf area 408.0 cm^2 was produced with application of 2.5 t/ha of CJ. The least leaf area produced from the control plant has a value of 220.1 cm^2. The fertilizer 2.5 t/ha CJ at 5% probability level significantly influenced leaf area development in the residual experiment. The residual effects of application of compost resulted to higher yield components of maize than NPK and control. In maize, 100-seeds and grain yield obtained with the residual CJ at 2.5 t/ha compared favourable and significantly ($p < 0.05$) different from what was obtained with plants fertilized with NPK fertilizer. This rate gave about 8 and 75% more grain yield than NPK treatment and control, respectively.

Effects of fertilizer types on some soil chemical and physical properties at harvest during the first and second planting

Table 4 shows the soil analysis after maize harvest at the first and second planting. At the first harvesting stage of maize, pH value ranged from 5.5 in control plots to 6.1 in 2.5 t/ha CJ. Application of CJ at 2.5 t/ha increased soil pH value than other treatment including control and NPK. Furthermore, control soil had EC of 1.2 ds/m, while plot treated with compost supplemented with jatropha ranges from 4.8 to 7.3 ds/m. However, at residual harvest, soil treated with AJ at 1.5, BJ at 2.0 t/ha and CJ at 2.5 t/ha increased soil electrical conductivity content in the soil over control and NPK fertilizer plot. Soil available P content in soil ranged between 2.65 mg/kg from control plots and 44.29 mg/kg from NPK plots, which was higher than the plot treated with compost supplemented with Jatropha cake. However, there was a general increase in soil available P after comparing with the pre-cropping results (Table 2). The control soil had available K content of 2.14 cmol/kg, while that in plot treated with compost supplemented with Jatropha cake increased from 2.30 to 2.32 cmol/kg. Soil treated with AJ at 1.5, BJ at 2.0 t/ha,

Table 4 Effects of fertilizer types on some soil chemical and physical properties at harvest during the first and second planting

Treatment	Rate (t/ha)	EC (ds/m)	pH (H_2O)	Available P mg/kg	K cmol/kg	OC	N	Clay	Silt	Sand
First Harvest										
Control	0	1.2d	5.5e	2.65e	2.14e	15.2e	2.84b	80.0b	90.4c	820.6a
NPK	0.06 kg N	3.2c	6.0b	44.29a	2.28d	24.7b	2.19b	80.0b	130.4a	780.6c
AJ	1.5	4.8c	5.7d	6.32c	2.30c	17.9c	3.62a	80.0b	90.4c	820.6a
BJ	2.0	5.7b	5.9c	3.30d	2.31b	16.0d	2.24d	80.0b	110.4b	800.6b
CJ	2.5	7.3a	6.1a	6.75b	2.32a	31.2a	2.59c	120.0a	130.4a	740.6d
Second Harvest										
Control	0	0.7d	7.0d	7.7e	0.33e	7.5e	0.77e	18.2e	114.0d	867.8a
NPK	0.06 kg N	1.3c	7.2c	11.05c	0.41b	7.8d	0.81d	34.0a	126.0b	840.0e
AJ	1.5	6.1b	7.5b	13.93b	0.39c	14.6b	1.51b	24.6d	114.0d	861.4b
BJ	2.0	6.5b	7.2c	10.66d	0.36d	8.9c	0.92c	28.4b	116.2c	855.4c
CJ	2.5	7.5a	7.6a	20.44a	0.52a	15.9a	1.65a	27.0c	132.0a	841.0d

Means having the same letter along the columns indicate no significant difference using Duncan's multiple range test at 5% probability level

AJ—30% Aleshinloye Grade B + 70% Jatropha cake

BJ—30% Aleshinloye Grade B + 70% Jatropha cake

CJ—50% Aleshinloye Grade B + 50% Jatropha cake

and CJ at 2.5 t/ha increased soil available K content in the soil over NPK fertilizer plot.

Soil organic carbon ranged between 15.2 g/kg from control plot and 31.2 g/kg from plot with CJ at 2.5 t/ha. NPK plot had a total carbon content of 24.7 g/kg. There is a general increase in the values of organic C compared with pre-cropping (Table 2). Total N varied between 2.84 g/kg from control plot and 3.62 g/kg from 1.5 t/ha 30% Grade B + 70% JC plot. At residual harvesting stage of maize, pH value ranged from 7.0 in control plots to 7.6 in 2.5 t/ha CJ. Plot treated with CJ at 2.5 t/ha increased in pH value than other treatment including control and NPK. Soil available P content in maize plot extended between 7.7 mg/kg from control plots to 20.44 mg/kg from CJ at 2.5 t/ha plots. CJ fertilizer at 2.5 t/ha plots had available P value of 20.44 mg/kg which was greater than NPK plot. However, there was general increase in soil available P when compared with the first cropping values (Table 2). Control plots had available K content of 0.33 cmol/kg, while soil from plot treated with compost supplemented with Jatropha cake increased soil available K from 0.36 to 0.52 cmol/kg. Soil treated with CJ at 2.5 t/ha increased soil available K content in the soil over NPK fertilizer plot. Soil organic carbon ranged between 7.5 g/kg from control plot to 15.9 g/kg from CJ (50% Grade B + 50% JC) at 2.5 t/ha. NPK plots had nitrogen content of 0.81 g/kg N and varied between 0.77 g/kg from control plot and 1.65 g/kg from 50% Grade B + 50% JC at 2.5 t/ha plot.

Relationships between maize yield and soil properties

Table 5 presents Pearson correlation coefficients (r) between the soil parameters studied and maize yield at $p < 0.05$. At the first cropping, maize yield was positively correlated with the pH content (0.9202) and EC content (0.9361). However, at residual cropping, the yield was significantly and negatively correlated with the sand content (−0.8957) and positively correlated with K content (0.8876).

Table 5 Correlation coefficients between maize yields and soil chemical properties at the first and residual cropping

Soil properties	Correlation Coefficient (r)	
	First cropping	Residual cropping
EC	0.9361*	0.6073 NS
pH	0.9202*	0.7583 NS
Available P	0.0457 NS	0.8299 NS
K	0.8567 NS	0.8876*
OC	0.7498 NS	0.5787 NS
Total N	− 0.3559 NS	0.5855 NS
Clay	0.7442 NS	0.7334 NS
Silt	0.7564 NS	0.8375 NS
Sand	− 0.8498 NS	− 0.8957*

NS not significant

*Significant at five levels of probability ($p < 0.05$)

Discussion

The result of pH was in a range of 5.0–6.8 for tropical soil (Udo and Ogunwale 1977). Organic matter content 6.84 g/kg was below the critical level for maize crop production given as 30 g/kg (Agboola and Corey 1972a, b). The available P was 9.3 mg/kg, showing that it was lower than the critical level between 10 and 15 mg/kg (Adeoye and Agboola 1985). This indicates that the soil needs the addition of nutrient for crop optimum production. The total nitrogen was 3.1 g/kg, showing that it was greater than the critical level between 0.01 and 1.20 g/kg for the soils in the tropics (Bremner and Mulvancy 1982). A calcium value of 19.8 cmol/kg was higher than the critical level of 2.6 cmol/kg (Agboola and Corey 1972a, b). Exchangeable sodium value which was 0.78 cmol/kg was higher than the critical level for tropical soils between 0.48 and 0.94 cmol/kg. Exchangeable magnesium values of 4.54 cmol/kg were higher than the critical level of 0.15 cmol/kg. Exchangeable potassium values of 1.52 cmol/kg were greater than the critical level of 0.2 cmol/kg (Adeoye 1986).This indicates that potassium amendment is not needed for the optimum of maize crop production.

Maize growth and yield parameters significantly increased by highest values obtained from CJ at 2.5 t/ha. The fertilizer 2.5 t/ha CJ gave the higher maize grain yield of 3.1 t/ha. The high maize yield obtained from CJ at 2.5 t/ha could be due to the stability of the compost with Jatropha cake when applied to soil. The highest organic carbon and K after the harvest could be attributed to the relatively higher nutrient concentration in the compost supplemented with Jatropha cake.

The result from applied compost supplemented with Jatropha cake after harvesting of maize on soil fertility and its effect on some chemical properties such as soil pH, EC, soil available P, organic carbon, % N, exchangeable K, and clay content was presented. The increase in pH of the studied soil with the application of fertilizers was enhanced by contents of the various compost supplemented with Jatropha cake. The direction of the change in soil pH as a result of treatment application reflected the initial pH of the amendment material. The increase in pH could be due to the higher pH value of the jatropha cake (pH of 8.5) and Grade B fertilizer (9.3) in relation with soil (pH of 5.7). The rise in the soil pH level of the experimental soil after harvesting is an indication of the buffering capacity of compost with Jatropha cake applied. This enhanced the availability of the applied nutrients released from fertilizer resulting in increased crop growth and yield. Soil available P was assessed in the soil after maize had been harvested during the first cropping. Integration of composts into soil increases the salt content as well as soil electrical conductivity, especially if high rates of compost are applied because of the high salinity of composts (Angelova et al. 2013). The addition of compost and jatropha cake to the soils led to increase in EC values compared with control soil. The soils amended with compost had higher EC than the untreated soils. The soil EC increased with an increasing application rate of compost in soil as reported by Hossen et al. 2015. The EC of compost depends on the raw materials used for composting and their ion concentration (Atiyeh et al. 2001).

Furthermore, to ascertain that organic materials are known to release soil nutrients slowly in the soil (Agboola and Omueti 1982; Eghball et al. 2004; Tejada and Gonzalez 2007), the residual effect of compost supplemented with Jatropha cake on maize yield shows that 2.5 t/ha of 50% Grade B + 50% JC resulted to the maize grain yield of 2.4 t/ha. These results indicate that organic fertilizer has a high potential for building up residual nutrients in the soil. The nutrient added from NPK fertilizer was exhausted after the first cropping, leaving behind less nutrients that could sustain a good harvest during the second cropping.

The fertility study of the residual plots shows that residual soil organic carbon decreased in all the plots. The increase in the soil pH level of the plots after harvesting is an indication of the buffering capacity of the compost with Jatropha cake treatment applied. This enhanced the availability of the applied nutrients released from composts and jatropha cake, resulting in increased growth and yield. Adequate residual N was not observed in the plot fertilized with NPK, because much of the soil nitrogen in the inorganic fertilizer plots could have been lost to plant uptake and by other pathways (e.g., denitrification, ammonia volatilization, and leaching). In contrast, the soil N contents in the plots of maize the application of 50% Grade B + 50% JC at 2.5 t/ha had a slow but steady N supply capacity. The presence of compost with Jatropha cake contributed to the soil available P. The residual P increased in the second cropping of maize. Soil available P was assessed in the soil after maize had been harvested during second cropping. The available P contents increased more than in NPK fertilizer or control plots. This reflects the high level of P available in the compost supplemented with Jatropha cake used. Increase in the availability of P after organic fertilizer applications has been recorded by Eghball (2002) and Eghball et al. (2004). The amount of residual K in the soil is closely linked to the soil organic matter. By formation of organic complexes with the help of the organic substances existing in compost added to the soil potassium mobility in the soil is reduced (Miller and Donahue 1991). The residual K decreased in plot fertilized with NPK than other compost with jatropha cake.

Positive linear correlations observed between maize yield and pH, EC, K, and sand indicate that these properties were strongly correlated with maize yield. This was in agreement with the study carried out by Rodrigues et al. 2012 who found out that a positive correlation between maize yield and K contents in soils. Moreover, Montezano et al. 2006 observed that soil property such as sand content was negatively correlated to maize yield.

Conclusion

In summary, from this study, it can be deduced that jatropha cake used supplemented with compost can serve as an alternative to mineral fertilizer. Furthermore, application of fertilizer CJ at 2.5 t/ha increased soil productivity and led to higher maize yield than using NPK 15–15–15. Therefore, 50% Grade B + 50% JC at 2.5 t/ha is recommended for growing maize crop in the studied area.

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