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Growth, Nutrient Uptake and Dry Matter Yields of Maize (*Zea mays* L. var) Grown With Different Levels of Organic and Inorganic Fertilizers in Morogoro, Tanzania

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Authors' contributions

This work was carried out in collaboration between all authors. Author UKA designed the study, wrote the protocol, and wrote the first draft of the manuscript. Author JPM managed the literature searches, analyses of the study performed the spectroscopy analysis and author JJM managed the experimental process and edited the first draft of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

A screen house study was conducted at the Department of Soil Science Screen house SUA, Morogoro to determine the effects of different levels of N, P and FYM on the growth, nutrient uptake and dry matter yield of maize. The experimental design used in the study was factorial design in RCBD (Randomized Complete Block Design) The results obtained indicated that application of different rates of N, P and FYM had significant influenced on the growth, nutrients uptake and dry matter yield of maize. Plot with Farm yard manure (FYM) was combined N and P fertilizers. Results on plant height ranged from 8.50 to 40.25 cm in control and from 9.38 to 67.00 cm in plants treated with 150 40 kg NP ha^{-1} with FYM 10 ton ha^{-1} of FYM. Plant growth, nutrient uptake and DMY were significantly ($P < 0.05$) influenced by treatments. Plot treated with 150 kg N ha^{-1}, 80 kg P ha^{-1} and 5 t FYM ha^{-1} significantly had higher N (2.94%) content, while plot treated with 75 kg N ha^{-1}, 80 kg P ha^{-1} and 5 t FYM ha^{-1} had higher P (0.39%) content. It is therefore concluded that,

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different levels of FYM with N and P were equally effective in enhancing nitrogen and phosphorus uptake by maize.

Keywords: Nitrogen; phosphorus; FYM; nutrient uptake; dry mater yield.

1. INTRODUCTION

In Tanzania, continual cropping without concurrent use of manure and organic/inorganic fertilizer has reduced soil fertility, leading to low crop yields. A study of assessing the extent of nutrient mining conducted by [1] reported negative balances of 27, 4 and 18 kg ha^{-1}, for NPK, respectively and this was attributed to nutrients uptake by crops, and other losses like erosion and run-off, consequently, amount of maize yields ranging between 0.5 to 1.5t ha^{-1} have been recorded, compared and 5t ha^{-1} attainable with adequate nutrient supply [2,3], whereas nutrient replacement through application of mineral or organic amendments is possible, small scale farmers are constrained by several socio-economic factors. The use of inorganic fertilizer by poor farmers is limited by the high prices, frequently unavailable, and low benefit cost rations [4,5], of the amendment. Other constraints include inadequate use of inputs such as fertilizer, improved maize seed, inadequate access to information and extension services and erratic rainfall and the high susceptibility of maize to drought.

Integrated use of organic matter and chemical fertilizers is beneficial in improving crop yield, organic carbon and available N, P and K in sandy loam soil. Organic fertilizers are materials such as green and animal manures, crop residues, cover crop, farmyard manure, composite manure and mulch. These sources of nutrients (e.g. N, P, K etc) are added in the soil following mineralization during decomposition [6-8]. Cattle manure is also an integral component of agro forestry for soil fertility management in many regions of SSA.

Nitrogen (N) is the fourth plant nutrient taken up by plants in greatest quantity next to carbon, oxygen and hydrogen, but it is one of the most deficient elements in the tropics for crop production [6,9,10]. Phosphorus in the second most limiting nutrient, since phosphorus availability to plants is affected by soil pH. Generally adequate soil nitrogen, potassium and phosphorous are essential nutrients which can be supplied by organic or inorganic fertilizer sources [11].

The objective of this study was to determine the response of maize to different levels of organic and inorganic fertilizers.

2. MATERIALS AND METHODS

2.1 Description of the Study Area

Pot experiment was conducted in the glass house of the Department of Soil Science at Faculty of Agriculture of the Sokoine University of Agriculture, Morogoro, Tanzania. The area lies between latitude 5^0 58” and 10^0 0” of the south of the Equator and longitude 35^0 25” and 35^0 30” to the East.

2.2 Soil and FYM Sampling and Preparations

The bulked surface soils samples (0.30 cm) were collected from the study area. The FYM Samples was collected from the diary house of the farm. The bulk soil samples were air-dried, ground and sieved through a 6 mm sieved mesh. Sub samples of the processed soils were passed through a 2 mm sieved and analyzed for selected physical and chemical properties. The FYM used for the study was air-dried, sieved and also analyzed for some chemical properties.

2.3 Chemical Analysis of FYM and Soil Samples

The sample of FYM was analyzed for N and P content. Total N was determined by the regular macro-Kjeldahl procedure. Available P was determined by Bray P – I method. Soil pH was determined potentiometrically in water and in 1M KCl at the ratio of 1:2.5 soil-water and soil-KCl [12]. Organic carbon was determined by the Walkley and Black wet oxidation method as outlined by [13]. Total nitrogen was determined by Kjeldahl method [14]. Available phosphorus was extracted by Bray and Kurtz-1 method [15] for soils with pH_{water} less than 7 and Olsen method for soils with pH_{water} above 7 and determined spectrophotometrically [16,17].

Cation Exchange Capacity (CEC) and exchangeable bases were determined by saturating soil with neutral 1M NH4OAc and the adsorbed $NH4^{+}$ were displaced using 1M KCl and then determined by Kjeldahl distillation method for the estimation of CEC of the soil. The bases (Ca^{2+}, Mg^{2+}, Na^{+} and K^{+}) were determined by atomic absorption spectrophotometer [18]. Extractable micro nutrients including Cu, Fe, Mn and Zn were determined using DTPA extracting solution. The suspensions were filtered through What man No. 1 filter paper and the micro nutrients in the extract determined by Flame Emission - Atomic Absorption Spectrophotometer (FE-AAS). Soil texture was determined by hydrometer method after dispersing soil with calgon 5% [18]. Bulk density was determined according to core sample method [19]. Soil moisture retention characteristics were studied using sand kaolin box for low suction values and pressure membrane apparatus for higher suction values [18].

2.4 Screen House Experiment

A pot experiment was carried out using the bulk composite soil samples that were taken from the site. The experiments were conducted in the screen house, Department of Soil Science of the Sokoine University of Agriculture, Morogoro, Tanzania.

2.5 Experimental Layout and Treatments

The pot experiment was a 3^3 factorial design laid out in RCBD (Randomized Complete Block Design) with three replications. The three factors were N, P and FYM (kraal manure), the levels were, 0, 75 and 150 kgN/ha; 0, 40 and 80 kgP/ha and 0, 5 ad 10 t FYM/ha, respectively.

2.6 Planting and Agronomic Practices

Before sowing 4 kg of the processed soil were thoroughly mixed with the N, P, and FYM weighed portions, and put inside each of the plastic pots (according to treatments) perforated at the bottom for drainage outlets. A total of 54 green house plastic pots were used. Water was then applied to the soil until it reached field capacity moisture status followed by incubation for one week at FC and this was repeated at three days interval. Fertilizer application of P and N was done at planting followed by a split dosage of N at 2 WAP. Weeding was carried out regularly by hand picking.

Tanzanian maize variety (TMV – I) maize variety was the test crop, raised in the screen house pots. Four maize seeds were sown per pot and later thinned to two plants per pot, one week after germination. The pots were maintained close to field capacity throughout the experiment.

2.7 Harvesting, Processing and Plant Tissue Analysis

The maize plant was grown in the screen house for 35 days (5 weeks) after which the whole maize plants above the soil level, i.e. two plants in each pot were harvested dried and weighed for dry matter determinations. The samples were thereafter processed and analyzed for N and P contents based on the procedures described by Okalebo et al. [20].

2.8 Statistical Analysis

Data collected on growth parameters (plant height and girth), DM yield and plant uptake were subjected to analysis of variance (ANOVA) and treatment means were compared using the least significant difference (LSD) at P = 0.05).

3. RESULTS AND DISCUSSION

3.1 Soil Characteristics

The physicochemical properties of soils (0-30 cm soil depth) of site are presented in Table 1. The soils are slightly acid to mildly alkaline in reaction with the pH in water and KCL values (7.08 and 5.68). The pH values in water suspension were higher than corresponding values in IM KCL Solution, indicating that the soils in their natural state were negatively charged [21].

Organic Carbon, Total N and CEC values were generally low with values of 0.21, 0.04 gKg^{-1} and 10.20 Cmol/Kg respectively. The low level of organic carbon (below 1%) could be attributed to high range of organic matter decomposition and burning of organic residues and these indicate impossibility of obtaining potential crop yield in the area. The total N level was directly proportional to the organic carbon content in the soils of the study area. [22] also reported that, the higher the organic carbon the higher the total N in the soil. The low CEC value may have been caused by the soils lower organic matter content occasioned by the burning and grazing in the area. Available P values were generally medium (mean value = 6.68 mg/Kg).

Table 1. Some selected physical and chemical properties of the surface soil (0-30 cm) used for pot experiment

Soil properties	Measured value
Clay (%)	12.12
Silt (%)	3.64
Sand (%)	84.24
Text. Class	LS
pH (H_20)	7.08
pH (KCL)	5.68
Org.C (%)	0.21
Total N (%)	0.04
Avail. P.mg kg^{-1}	6.68
CEC cmol kg^{-1}	10.20
Ex.Ca cmo kg^{-1}	0.37
Ex. Mg cmol kg^{-1}	0.80
Ex. K cmol kg^{-1}	0.33
Ex. Na cmol kg^{-1}	0.20
BS (%)	16.68
Ex. Cu mg kg^{-1}	0.28
Ex. Zn mg kg^{-1}	0.19
Ex. Fe mg kg^{-1}	21.20
Ex. Mn mg kg^{-1}	31.50
EC dS/m	0.02

Exchangeable calcium and magnesium were 0.37 and 0.80 cmol/Kg. While exchangeable potassium and sodium content were 0.33 and 0.20 cmol respectively. The low content for these exchangeable bases Vis - a - Vis the rating scale of the critical values limit of soils parameters in Tables 2 and 3 (especially Ca and Mg) was due to low in CEC of the soil resulting in the low content of clay and organic matter [23].

The BS percent (16.68%) was low as per the rating scale given in Table 3 and this may be due to low content of organic matter in the surface soils, hence organic matter is the natural store of the base elements and other soil nutrient elements from where they are slowly released into the soil solution [24].

Total copper and Zinc content have values of 0.28 and 0.19 mg/Kg^{-1}, while the values of Iron (Fe) and manganese were 21.20 Kg^{-1} and 31.50 mg/Kg respectively. The values of Fe and Mn in these soils are ratio medium to high which indicate a presence of volcanic parent rock [25,26] reported that high concentration of zinc in basic igneous rocks, such as basalts due to zinc occurring in ferromagnesian minerals. The low levels of other micronutrients may be due to continuous residues removal, grazing and bush burning. The EC value was 0.02 dSm. This indicates that the soil is naturally non-saline.

3.2 Screen House Experiment

3.2.1 Effect of organic and inorganic fertilizers on plant height and stem girt of maize

Application of different rates of organic and inorganic fertilizers had no significant effects ($P<0.05$) on height of maize throughout first week after planting (WAP) (Table 4). Plot that had treatments T_5 ($N_{150}P_{80}$ FYM_o) produced statistically the tallest plants of 68.50 cm and closely followed by T_{24} ($N_{150}P_{40}$ FYM_{10}) and T_{27} ($N_{150}P_{80}$ FYM_{10}), while the control produced the shortest plant.

In term of stem girth T_{27} ($N_{150}P_{80}$ FYM_{10}) had the thickest stems of 4.90 cm while 4.80 cm and 4.73 cm were recorded from the pot received T_{25} and T_{21} respectively, while control had the lowest stem girth of 2.10 cm (Table 5). The result of the applied treatments on stem girth at the end of screen house study revealed that the treatments had significantly increased stem girth ($P<0.05$) (Table 5).

Table 2. Rating for soil fertility classes

Parameter	Low	Medium	High
Total Ngkg^{-1}	<1.5	1.5 – 2.0	>2.0
Bray 1p mg kg^{-1}	<8.0	8 – 20.0	>20.0
Exch K cmol kg^{-1}	<0.20.0	0.20 – 0.40	>0.40
Exch Ca cmol kg^{-1}	<5.0	5.0 – 10.0	>10.0
Exch Mg cmol kg^{-1}	<1.5	1.5 – 3.0	>3.0
Exch Na cmol kg^{-1}	<0.3	0.3 – 0.7	>0.7
Org. mtter gkg^{-1}	<20.0	20.0 – 30.0	>30.0

Sources: [27]

Table 3. Critical limits for interpreting levels of analytical parameter

Parameter	Rating			
	Low	Medium	High	Unit
Ca	<2	2 – 5	>5	cmol (+) kg^{-1}
Mg	<0.3	0.30-1.0	>1.0	cmol (+) kg^{-1}
K	<0.15	0.15-0.30	>0.30	cmol (+) kg^{-1}
Na	<0.1	0.1-0.30	>0.30	cmol (+) kg^{-1}
ECE	<5	5.0-1.0	>10.0	cmol (+) kg^{-1}
CEC (Soil)	<6	6-12	>12	cmol (+) kg^{-1}
CEC (cky)	<15	15-25	>25	cmol (+) kg^{-1}
Exch. Acidity	<2	2-5	>5	cmol (+) kg^{-1}
Base saturation	<50	50-80	>80	Percent
Org. C	<10	10-15	>15	gkg^{-1}
Total N	<0.1	0.1-0.2	>0.2	gkg^{-1}
Avail. P	<10	10-20	>20	$mgkg^{-1}$

Source: [28,29]

Table 4. Mean effects of fertilizers on plant height (cm) of the 1st screen house potted Maize

S/No	Treatments	Weeks			
		1	2	3	4
		Plant height (cm) Pot^{-1}			
1	N_oP_o FYM_o	8.50	35.47	35.50	40.25
2	N_oP_o FYM_5	10.17	43.67	43.25	49.25*
3	N_oP_o FYM_{10}	9.35	41.57	44.50	49.75*
4	N_oP_{40} FYM_o	8.97	29.92	45.75*	45.00
5	N_oP_{40} FYM_5	7.25	41.50	40.75	44.75
6	N_oP_{40} FYM_{10}	8.40	43.60	45.50	56.25*
7	N_oP_{80} FYM_o	9.56	41.77	46.50*	47.50
8	N_oP_{80} FYM_5	10.00	45.95	47.70*	56.26*
9	N_oP_{80} FYM_{10}	9.15	44.20	44.50	56.26*
10	$N_{75}P_o$ FYM_o	8.50	43.00	38.75	45.00
11	$N_{75}P_o$ FYM_5	9.00	41.57	46.50*	66.00*
12	$N_{75}P_o$ FYM_{10}	9.62	45.55	47.25*	66.50*
13	$N_{75}P_{40}$ FYM_o	10.75	36.62	41.50	49.25*
14	$N_{75}P_{40}$ FYM_5	7.87	44.20	48.00*	61.50*
15	$N_{75}P_{40}$ FYM_{10}	8.92	41.12	39.50	61.75*
16	$N_{75}P_{80}$ FYM_o	8.10	40.67	39.50	56.75*
17	$N_{75}P_{80}$ FYM_5	11.25	44.95	47.25*	66.25
18	$N_{75}P_{80}$ FYM_{10}	12.05	46.96	47.75*	63.25*
19	$N_{150}P_o$ FYM_o	9.22	39.55	32.00	43.75
20	$N_{150}P_o$ FYM_5	10.25	43.77	44.00	62.25*
21	$N_{150}P_o$ FYM_{10}	8.82	38.80	45.25	63.75*
22	$N_{150}P_{40}$ FYM_o	10.67	46.37	46.75*	66.00*
23	$N_{150}P_{40}$ FYM_5	11.00	43.37	46.75*	62.00*
24	$N_{150}P_{40}$ FYM_{10}	9.87	41.42	48.25*	67.00*
25	$N_{150}P_{80}$ FYM_o	12.37	48.25	51.79*	68.50*
26	$N_{150}P_{80}$ FYM_5	10.62	50.12*	51.75*	66.00*
27	$N_{150}P_{80}$ FYM_{10}	11.42	46.67	51.50*	66.75*
LSD (0.05)		**4.537**	**13.516**	**9.932**	**8.391**
CV (%)		**22.80**	**15.40**	**10.70**	**7.20**

Table 5. Effects of fertilizer on stem girth (cm) of the 1st screen house potted Maize in 2014

S/No	Treatments	Stem girth (cm) Pot^{-1}
1	N_oP_o FYM_o	2.10
2	N_oP_o FYM_5	3.30
3	N_oP_o FYM_{10}	3.23
4	N_oP_{40} FYM_o	2.55
5	N_oP_{40} FYM_5	2.96
6	N_oP_{40} FYM_{10}	3.23
7	N_oP_{80} FYM_o	2.85
8	N_oP_{80} FYM_5	2.77
9	N_oP_{80} FYM_{10}	3.10
10	$N_{75}P_o$ FYM_o	2.18
11	$N_{75}P_o$ FYM_5	3.93*
12	$N_{75}P_o$ FYM_{10}	4.23*
13	$N_{75}P_{40}$ FYM_o	3.15
14	$N_{75}P_{40}$ FYM_5	3.75
15	$N_{75}P_{40}$ FYM_{10}	3.90*
16	$N_{75}P_{80}$ FYM_o	3.85
17	$N_{75}P_{80}$ FYM_5	4.13*
18	$N_{75}P_{80}$ FYM_{10}	4.58*
19	$N_{150}P_o$ FYM_o	2.20
20	$N_{150}P_o$ FYM_5	4.53*
21	$N_{150}P_o$ FYM_{10}	4.73*
22	$N_{150}P_{40}$ FYM_o	4.43*
23	$N_{150}P_{40}$ FYM_5	4.40*
24	$N_{150}P_{40}$ FYM_{10}	4.45*
25	$N_{150}P_{80}$ FYM_o	4.80*
26	$N_{150}P_{80}$ FYM_5	4.60*
27	$N_{150}P_{80}$ FYM_{10}	4.90*
LSD (0.05)		**0.804**
CV (%)		**10.70**

3.2.2 Effect of organic (FYM) manure and inorganic fertilizer on root, shoot and total dry matter yield of maize

Table 6 and 7 shows the effect of the different rates of organic and inorganic fertilizers on on root, shoot and total dry matter yield of maize. With shoot biomass, the highest of 5.447 g/plant was obtained by plants treated with $N_{150}P_{80}$ FYM_{10} and the smallest of 0.70 g/plant produced by control plants. Shoot biomass ranged from 0.70 g/plant to 5.45 g/plant.

Root and total dry matter yields followed the same trend as shoot dry matter yield. It could be observed that, there was significant increase in total dry matter yields as the rate of FYM application increased. Total dry matter yields in plants treated with 1500 g N ha^{-1} was doubled that of plants treated with 0 kg N ha^{-1}, P and FYM and four times that of the control plots. This could be due the fact that nutrient are readily released from inorganic fertilizer than from organic fertilizer because organic fertilizer has to undergo mineralization before the nutrients are made available for maize plant to use. A similar result was obtained by [30] when he reported that, maize as a shoot duration crop, being and aggressive feeder was able to utilize the readily available nutrient from mineral fertilizer for its growth and development.

The total dry matter yields were in this order: $T_{27} > T_{24} > T_{26} > T_{25} > T_{18} > T_{17} > T_{21} > - - T_1$. This shows that increased and sustained crop yield could be obtained with judicious and balanced inorganic fertilizer combined with organic fertilizer amendment.

3.2.3 Effect of FYM, N and P fertilizers on nutrient uptake of maize

Table 8 shows the N and P uptake in maize at green-house study under different levels of organic and inorganic fertilizers. Application of FYM, N and P fertilizers significantly increased nutrient uptake of maize plant. The highest N uptake occurred in T_{26} followed by plant in T_{20} then T_{22}. The lowest N uptake was obtained from pot with T_{7}.. In order of ranking T_{17} gave the highest P uptake value of 0.39 mg/plot followed by T_{27}, T_9, T_{15}, and T3.

All other treatments have similar P uptake except control which recorded the least value of P uptake. Concentration of phosphorus in maize plant grown with different treatments in the pot experiment ranged from 0.08% to 0.4% (Table 7).

Table 6. Effects of fertilizers on dry matter yield of the 1st screen house potted Maize in 2014

S/No	Treatments	Root biomass	Shoot biomass	Total biomass
1	N_oP_o FYM_o	0.267	0.797	1.065
2	N_oP_o FYM_5	0.439	2.147	2.586*
3	N_oP_o FYM_{10}	0.455	2.396*	2.851*
4	N_oP_{40} FYM_o	0.261	1.349	1.631
5	N_oP_{40} FYM_5	0.407	1.792	2.199
6	N_oP_{40} FYM_{10}	0.504	2.075	2.578*
7	N_oP_{80} FYM_o	0.374	2.793*	3.167*
8	N_oP_{80} FYM_5	0.396	2.044	2.440
9	N_oP_{80} FYM_{10}	0.488	1.995	2.483
10	$N_{75}P_o$ FYM_o	0.162	0.888	1.050
11	$N_{75}P_o$ FYM_5	0.497	3.662*	4.159*
12	$N_{75}P_o$ FYM_{10}	0.758*	4.068*	4.827*
13	$N_{75}P_{40}$ FYM_o	0.307	1.652	1.960
14	$N_{75}P_{40}$ FYM_5	0.623	3.952*	4.575*
15	$N_{75}P_{40}$ FYM_{10}	0.623	3.929*	4.553*
16	$N_{75}P_{80}$ FYM_o	0.607	3.299*	3.905*
17	$N_{75}P_{80}$ FYM_5	0.945*	4.291*	5.236*
18	$N_{75}P_{80}$ FYM_{10}	0.775*	4.467*	5.242*
19	$N_{150}P_o$ FYM_o	0.168	0.737	0.905
20	$N_{150}P_o$ FYM_5	0.651	3.770*	4.421*
21	$N_{150}P_o$ FYM_{10}	0.714	4.113*	4.827*
22	$N_{150}P_{40}$ FYM_o	0.604	4.011*	4.616*
23	$N_{150}P_{40}$ FYM_5	0.709	3.969*	4.678*
24	$N_{150}P_{40}$ FYM_{10}	0.823*	4.800*	5.624*
25	$N_{150}P_{80}$ FYM_o	0.797*	4.731*	5.528*
26	$N_{150}P_{80}$ FYM_5	0.833*	4.743*	5.576*
27	$N_{150}P_{80}$ FYM_{10}	1.164*	5.447*	6.611*
LSD (0.05)		**0.4613**	**1.4135**	**1.4136**
CV (%)		**39.40**	**22.10**	**22.10**

Table 7. Effects of fertilizers on dry matter yield (g pot^{-1}) of the 1st screen house potted Maize in 2014

S/No	Treatments	dry matter yield (g Pot^{-1})	
		Root	**Shoot**
1	N_oP_o FYM_o	0.536	1.59
2	N_oP_o FYM_5	0.878	4.29
3	N_oP_o FYM_{10}	0.909	4.79*
4	N_oP_{40} FYM_o	0.502	2.70
5	N_oP_{40} FYM_5	0.813	3.58
6	N_oP_{40} FYM_{10}	1.007	4.15
7	N_oP_{80} FYM_o	0.798	5.59*
8	N_oP_{80} FYM_5	0.792	4.09
9	N_oP_{80} FYM_{10}	0.976	3.99
10	$N_{75}P_o$ FYM_o	0.234	1.78
11	$N_{75}P_o$ FYM_5	0.994	7.32*
12	$N_{75}P_o$ FYM_{10}	1.517	8.14*

Table 7 continued….

13	$N_{75}P_{40}$ FYM_o	0.615	3.30
14	$N_{75}P_{40}$ FYM_5	1.246	7.30*
15	$N_{75}P_{40}$ FYM_{10}	1.246	7.86*
16	$N_{75}P_{80}$ FYM_o	1.214	6.60*
17	$N_{75}P_{80}$ FYM_5	1.889	8.58*
18	$N_{75}P_{80}$ FYM_{10}	1.549	8.93*
19	$N_{150}P_o$ FYM_o	0.336	1.47
20	$N_{150}P_o$ FYM_5	1.301	7.54*
21	$N_{150}P_o$ FYM_{10}	1.428	8.23*
22	$N_{150}P_{40}$ FYM_o	1.209	8.02*
23	$N_{150}P_{40}$ FYM_5	1.418	7.94*
24	$N_{150}P_{40}$ FYM_{10}	1.647	9.60*
25	$N_{150}P_{80}$ FYM_o	1.594	9.46*
26	$N_{150}P_{80}$ FYM_5	1.667	9.49*
27	$N_{150}P_{80}$ FYM_{10}	2.328	10.89*
LSD (0.05)		**0.9227**	**2.827**
CV (%)		**39.40**	**22.10**

Table 8. Effects of fertilizers on N and P uptake of the 1st screen house potted Maize in 2014

S/No	Treatments	Shoot N (%)	Shoot P (%)
1	N_oP_o FYM_o	1.400	0.077
2	N_oP_o FYM_5	1.155	0.249
3	N_oP_o FYM_{10}	1.260	0.336
4	N_oP_{40} FYM_o	1.260	0.250
5	N_oP_{40} FYM_5	1.032	0.201
6	N_oP_{40} FYM_{10}	1.155	0.308
7	N_oP_{80} FYM_o	1.068	0.206
8	N_oP_{80} FYM_5	1.260	0.242
9	N_oP_{80} FYM_{10}	1.225	0.369
10	$N_{75}P_o$ FYM_o	2.292	0.155
11	$N_{75}P_o$ FYM_5	1.802	0.164
12	$N_{75}P_o$ FYM_{10}	1.802	0.312
13	$N_{75}P_{40}$ FYM_o	2.450	0.158
14	$N_{75}P_{40}$ FYM_5	1.750	0.302
15	$N_{75}P_{40}$ FYM_{10}	1.907	0.337
16	$N_{75}P_{80}$ FYM_o	2.188	0.290
17	$N_{75}P_{80}$ FYM_5	1.660	0.386
18	$N_{75}P_{80}$ FYM_{10}	1.575	0.316
19	$N_{150}P_o$ FYM_o	2.188	0.164
20	$N_{150}P_o$ FYM_5	2.555	0.200
21	$N_{150}P_o$ FYM_{10}	2.345	0.306
22	$N_{150}P_{40}$ FYM_o	2.485	0.156
23	$N_{150}P_{40}$ FYM_5	2.363	0.309
24	$N_{150}P_{40}$ FYM_{10}	2.205	0.296
25	$N_{150}P_{80}$ FYM_o	2.083	0.220
26	$N_{150}P_{80}$ FYM_5	2.940	0.325
27	$N_{150}P_{80}$ FYM_{10}	1.943	0.370
LSD (0.05)		**0.4906**	**0.2001**
CV (%)		**13.100**	**37.500**

4. CONCLUSSION

The study showed that the use of inorganic and organic (FYM) fertilizer resulted to significantly higher maize growth, dry matter yield and nutrient uptake compared to the control plot. Yield from application of 150 kg N^{-1}, 80 kg P^{-1} plus FYM 10 t/ha and was the best compared with 75 kgN^{-1}, 40 kg P^{-1} plus FYM 5 t/ha and control. Thus, for enhance performance of maize in the test soil; application of a combination of inorganic and organic fertilizer is essential and recommended.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Smaling EMA, Janssen BH. Calibration of QUEFTS, a model predicting nutrient uptake and yields from chemical soil fertility indices. Geoderma. 1993;59:21–44.
2. Ikerra ST, Kalumuna MC. Phosphorus adsorption characteristics of soils and their influence on maize yield responses to phosphorus application along the Mlingano Catena, Tanga, Tanzania paper resulted at the 11th Annual General Meeting of the Soil Science Society of East Africa, Kampala, Uganda; 1991.
3. Ndaki SMM. Agronomic evaluation of some industrial wastes as alternative sources of plant nutrients in Morogoro, District Tanzania. Unpublished dissertation for award of M.Sc. Degree of Sokoine University of Agriculture, Morogoro, Tanzania. 2001;98.
4. Palm CA, Mycis RJK, Nandwa SM. Organic – inorganic nutrient interaction in soil fertility replenishment. In: Buresh RJ. Sanchez PA. and Calhoun F. (eds). Replenishing soil fertility in Africa. Soil Science Society of America, Madison Wisconsin. 1997;193–218.
5. Palm CA, Gachengo CN, Delive RJ, Cadisch G, Giller KE. Organic inputs for soil fertility management in tropical agro ecosystems. Agriculture Ecosystems and Environments. 2001;83:27–42.
6. Sharma AR, Miltra BW. Direct and residual effect of organic materials and phosphorus fertilizer in rice (*Oryza Sativa*). Based on cropping systems. Indian journal of Agronomy 1991;36:299–303.
7. Goh KM, Peason DR, Daily JM. Effects of apple orchard production system on some important soil physical, chemical and biological quality parameters. Biological Agriculture and Horticulture Journal. 2001; 18:269–292.
8. Niang AI, Amadalo BA, de Wolf J, Gathumbi SM. Species screening for short-term planted fallows in the highlands of Western Kenya. Agroforestry Systems. 2002;56:15–154.
9. Mengel K, Kirkby EA. Principles of plant nutrition. Panima Publ. Corporation, New Delhi, Bangalore, India. 1987;687.
10. Mesfin Abebe. Nature and management of Ethiopian soils. Alemaya University of Agriculture, Ethiopia. 1998;272.
11. Morifsuka N, Yancii J, Koski T. Effect of application of inorganic and organic fertilizer on the dynamics of soil nutrients in the rhizosphere. Soil Science and Plant Nutrition. 2001;47(1):139-148.
12. McLean N. Aluminium. In: Black, C. A. (Ed:), Methods of Soil, Part 2, ASA, Madiroson, Wisconsin. 1965;78-998.
13. Nelson DW, Sommers LS. Total carbon. Organic carbon and organic matter. In: page, E.L. et al (eds). Methods of Soil Analysis. Part 2. Agion. Monogr. 9 (2nd edition). 1982;539-579. ASA and SSSA. Madison wise.
14. Bremner JM, Mulvaney CS. Total nitrogen. In (L.A. Page, R.H. Miller & D.R. Keeney, eds.) Methods of Soil Analysis, Part 2, 2nd Edition, Agronomy Monograph. 1982;9: 595-624. American Society of Agronomy, Madison, Wisconsin.
15. Bray RH, Kurtz LT. Determination of total, organic and available forms of phosphorus in soils. Soil Science. 1945;59: 39-45.
16. Murphy HF. A report on the fertility status and other data on some soils of Ethiopia, Experiment Station Bulletin No. 44, College of Agriculture Haile Sellassie I University, Dire Dawa, Ethiopia. 1968;551.
17. Watanabe FS, Olsen SR. Test of an ascorbic acid method for determining phosphorusin water and NaHCO3 extracts from Soil. Soil Science Society of America Proceedings. 1965;29:677-678.
18. NSS. Laboratory Procedures for routine soil analysis, 3rd ed. Ministry of Agriculture and Livestock, Development, National soil service (NSS). ARI. Mlingano; 1990.
19. Blake GR, Hartge KH. Bulk density In: A Klute (ed) methods of soil analysis. Agronomy 9; Part 1, second edition, ASA Madison WI. 1986;363-375.
20. Okalebo JR, Gathna KW, Woonor PL. Laboratory Method of Soil and Plant Analaysis, A working manual. Tsts, Soil

Science society of East Africa publication. 1993;1:88.
21. Villapando RR, Greatz DA. Phosphorus absorption and desorption properties of the soil. Spodic horizon from selected Florida spodosols. Soil Science Society of American Journal. 2001;63:331-339.
22. Ayolagha GA, Onuegbu BA. Soils of Rivers State in land and people of Rivers State Centrak Niger Delta. (Alagoa E.J ed.), Onyoma publication, Choba, port Harcour. 2002;19-42.
23. Adamu UK. Profile distribution of some primary macro nutrients and exchangeable bases in Kano University of Science and Technology, Research and Commercial farm, Gaya. Techno Science African Journal. 2013;8(2):14-18.
24. Sanchez PA. Properties and management of soils in the tropics. John Wiley and Sons, Inc., New York, USA. 1976;618.
25. Olowolafe EA, Owonubi A, Omueti JAI. Distribution of copper and zinc in soils derived from volcanic parent materials on the Jos plateau Nigeria. Journal of Soil Science. 2012;22(2):239-247.
26. Alloway BJ. Zinc in Soils and Crop Nutrition 2nd Edn. IZA and IFA Brussels, Begium and Paris. 2008;135.
27. FMA, NR. Literature review on soil fertility investigation in Nigeria (in five volumes). Federal Ministry of Agriculture and Natural Resources, Abuja. 1990;281.
28. Esu IE. Detailed soil survey of NIHORT farm Bunkure, Kano state, Nigeria. Institution for Agricultural research, Ahmadu Bello University Zaria. 1991;7.
29. Enwezor WO, Udo EJ, Sabulo RA. Fertility status and productivity of the "Acid Sands". In: Udo, E.J. and Sabulo., R.A. (eds) " Acid Sands of Southern; 1981.
30. Hoffman I, Gerling D, Kyiogwam UB, Mane – Bielfeldth A. Farmers management strategies to maintain soil fertility in a remote area in northwest Nigeria. Agriculture, Ecosystems and Environment. 2001;86:263–275.

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