# Evaluation of some farming practices on soil physicochemical properties and performance of maize *Zea mays* (L.) in Southeastern Nigeria.

Omovbude, S. and Benwari, A.O

Department of Crop and Soil Science, Faculty of Agriculture, University of Port Harcourt, P. M. B. 5323, Choba, Port Harcourt, Rivers State, Nigeria.
sundayomovbude@yahoo.com

**Abstract:** The study was carried out at Teaching and Research Farm of University of Port Harcourt between May and August, 2016 to evaluate the effect some farming practices on soil physicochemical properties and performance of maize *Zea mays* (L.) in Southeastern Nigeria. The experiment consisted of six treatments namely: control, pumpkin cover, 10t/ha dry guinea grass mulch, 10t/ha poultry manure, 250kg/ha N:P:K 20:10:10 and 10t/ha dry guinea grass (bush burning). These treatments were laid out in a Randomized Complete Block Design with four replicates. Results showed that farming practices did not significantly (P >0.05) increased in soil physical properties such as sand and clay particles except silt. Soil chemical properties (N, P and K) were significantly (P<0.05) increased by the various farming practices when compared with the control. However, soil pH, Ca, and organic matter did not followed any particular trend as others soil chemical properties. Organic matter was significantly higher in plots treated with cover crop (40.60 g/kg) and lower in N:P:K 20:10:10 (15.25 g/kg). Soil pH was significantly higher in burnt plot (5.5) and lower in N:P:K 20:10:10 (4.0). Ca content (12.65mg/kg) was higher (P< 0.05) in burnt plot and lower in poultry manure (4.35 mg/kg). At 12WAP plants height were superior with plots treated with 250kg/ha N:P:K 20:10:10 producing the tallest plants (2.91m) which was statistically the same with that of bush burning (2.81m) and poultry manure (2.71m) while the shortest (2.11m) were produced in plots with pumpkin cover which were statistically the same with plots mulched with dry guinea grass (2.42m). In the same vein, leaf areas at 12WAP were superior with plots treated with N:P:K 20:10:10 producing the largest leaf area (9.37m$^2$) which was statistically the same with that of bush burning (9.16m$^2$), poultry manure (8.78m$^2$) and dry guinea grass mulch (8.62m$^2$) while the smallest were produced in plots with pumpkin cover (6.97m$^2$) which was statistically the same with the control (7.00m$^2$). N:P:K 20:10:10 plot produced the highest yield (0.17t/ha) which was not significantly different from that of bush burning (0.15t/ha) and poultry manure (0.12t/ha). In conclusion, the choice of which farming practice to use is sometime difficult to make but comparative analysis will put N:P:K 20:10:10, followed by bushing burning and poultry manure above all others practices. However, more studies are needed to evaluate the cost implications of these practices before a recommendation can be made.
[Omovbude, S. and Benwari, A.O. **Evaluation of some farming practices on soil physicochemical properties and performance of maize *Zea mays* (L.) in Southeastern Nigeria.** *J Am Sci* 2017;13(2):69-76]. ISSN 1545-1003 (print); ISSN 2375-7264 (online). http://www.jofamericanscience.org. 10. doi:10.7537/marsjas130217.10.

**Keywords**: Evaluation, farming practices; maize, soil properties, Southeastern Nigeria

## 1. Introduction

Maize (*Zea mays* L.*)*popularly called corn of the family poaceae is one of the most populous cereal crop in south eastern Nigeria. It serves as a multipurpose crop because of its numerous uses such as: food for man, feed for animals, and industrial crop. Despite the usefulness, its production is hampered by inappropriate farming practices such as bush burning, overgrazing, cleaning clearing, inorganic fertilizer application, organic manuring, continuous cropping, intercropping, flooding, and tillage. When burning of excess plant residues in a newly cleared land is thorough, maize planted within a week after the burning can stay weed-free for about 4-6weeks after planting Akobundu (1987). Ayeni (1992) reported that burning could also, after land –clearing, lead to reduced weed seed population and hence, reduced number of viable seeds. Anonymous (2016) reported that during the process of burning some nutrients such as phosphorous, nitrogen and sulphur that are required by the plants are lost in form of gasses to the atmosphere which invariably pollutes the atmosphere; the ash which is the principle products of burnt material although rich in phosphorous, nitrogen and potassium can be easily washed away by rain and the heat produced during burning creates an unfavorable condition for activities of the soil organism such as earthworms, bacteria etc. Organic manuring involves the application of manure such as poultry manure, farm yard manure, compost Olayinka, (2009) recommended the application of organic manures to tropical soils as sources of nutrients because of the inherently low organic matter content, and low activity clays predominant in the clay mineralogy (Okusami et al., 1997). Cheng et al., (1988) reported that application of organic materials influence the degree of aggregation and aggregate stability and can reduce bulk density, increase porosities, water holding capacity, moisture retention and transmission, and drought resistance in plant and its use is hampered by low quality and slow release of nutrients (Abdulraheem et al, 2015**)** The process of manure application may lead to the introduction of pathogens to the soil ant it may have adverse effect on crops, if not properly applied. Fertilizers are essential to agriculture, their acquisition and distribution in Nigeria remain a challenge to government and farmers (Odeyemi et al 2013). Inorganic fertilizer supplements nutrient content of the soil through fast release of nutrients and enhances the productive capacity of the soil. Excessive of inorganic fertilizer application can have adverse effects on the environment by polluting underground or surface water, causing nutrient imbalance and increasing soil acidity (Remison,1998). Sanchez and Salinas (1981) noted the depletion of soil nutrients due to continuous cropping reduces the soil organic matter (SOM) and leads to significant acidification and reduction of yield. Tillage is the agricultural preparation of soil by mechanical agitation of various types, such as digging, stirring, and overturning. Proper operations improve soil physical properties while inappropriate, excessive, and unnecessary tillage operations may not provide the desirable results hence yield can significantly decrease (Iqbal, *et al.,* 2005).

Mulching is the process or practice of covering the soil/ground to make more favorable condition for plant growths development and efficient crop production (Dalorima et al, 2014). Mulches can be derived from organic or inorganic materials (Rumpel et al, 2003). Incorporation of mulches to the soil has a number of agronomical benefits such as: suppressing weed growth, increasing organic matter contents, increasing nutrient availability to crops, reducing the surface run-off and improving the moisture retaining capacity of the soil that improves nutrient availability of the plants and maintaining soil fertility in agricultural lands, particularly in areas where application of fertilizer is expensive (Weerakon and Senewirantne, 1984) Crop cover is the planting of a thick vegetative crop which covers the soil surface completely, reducing evaporation of water from the soil surface and improving soil structure through roots and leaf fall. Cover crops are also good for clearing weeds as little light penetrates the soil surface to induce germination. Useful cover crops are beans, groundnut, and sweet potato. The disadvantages of cover crop include: competition with the crops for available moisture, light, nutrients and increasing the rate of water loss from the soil through transpiration. Farmers in South eastern are in dilemma about the appropriate farming practice to adopt in maize cultivation. Hence the objective of this study was to find out the most appropriate farming practice on soil physico chemical properties and maize performance.

## 2.0 Materials and Methods

### 2.1 Description of study area

The study was conducted at the Faculty of Agriculture Teaching and Research Farm, University of Port Harcourt (04°15′N and 7°15′E) between the month of May and August. The mean annual rainfall ranges from about 2000mm – 4500mm (FAO, 1984) with a bimodal pattern starting from March and ending in November, with peaks in June and September, and a short dry spell in August. The annual temperature ranges from a minimum of 22°C to a maximum of 31°C (FDRD, 1981). The experimental site before cropping was mostly dominated by guinea grass (*Panicum maximum*). The site has been under continuous cultivation with arable crops such as maize (*Zea mays*), fluted pumpkin (*Telfairia occidentalis*) cucumber (*Cucumis sativus*.) and “egusi” melon (*Citrullus vulgaris*) for eight years.

### 2.2 Sources of materials used and preparation

Local maize variety and pumpkin pods were purchased from the local farmers at Choba village in Obio/Akpor Local Government Area **o**f Rivers State. The Seed extracted from the pumpkin pods were sun – dried for two days to reduce moisture and prevent decay. The poultry manure used was collected from the Livestock unit of the Faculty of Agriculture Teaching and Research Farm, University of Port Harcourt.. The poultry manure was cured under shade for one month and sun dried later before crushing into granules. The inorganic fertilizer, N:P:K (20:10:10) was purchased from Rivers State Agricultural Development Program (R.A.D.P), The guinea grass was obtained from the experimental area during clearing and it was sun dried for 1 week to a constant weight before application.

### 2.3 Experimental design, treatment and cultural details

Experimental area of 28m x24m (672m$^2$ which is approximately equal to 0.07 ha$^)$ was manually cleared of vegetation with machete and stumped. The debris was packed out of the area and the soil surface was leveled with spade. The experiment was carried out using Randomized Complete Block Design (RCBD) consisting of six (6) treatments in four (4) replications. The area was divided into four blocks. Each block was further divided into 6smaller experimental units, measuring 3mx4.5m with an area of 13.5 m$^2$. A part way of 2m was created between experiment unit and between block in order to prevent vine spread from one plot to another and to ease cultural operations. The following treatments were applied: control (no application), pumpkin cover, 10t/ha dry guinea grass mulch, 10t/poultry manure, 250kg/ha N:P:K 20:10:10 and 10t/ha dry guinea grass as bush burning material. Poultry manure, dry guinea grass mulch and burnt dry guinea grass were applied at the rate of 10t/ha to their designated plots respectively. Ten tonnes per hectare (10t /ha) equivalent to 13.5kg /plot of poultry manure, dry guinea grass mulch and burnt dry guinea grass respectively were applied to the designated plots at two weeks before planting. N:P:K 20 -10-10 was applied at the recommended rate of 250 kg/ha by using ring method at 2WAP. Pumpkin seeds were planted in between two maize rows at spacing of 50cm x50cm at cropping pattern of 1:2. The control plot had no treatment application. Planting of maize was done on the 14$^{th}$ May 2016 at a spacing of 60cm between rows and 90 cm within rows at the rate of three seeds per hill, and the seedlings were thinned to one per stand at 2WAP to give 25 plants per plot which is equivalent to 18,518.52 plants per hectare. Hand pulling and hoeing was done twice at 3 and 7 WAP.

**2.4 Soil sampling**

Soil samples were randomly collected from 10 spots (0-20 cm depth) over the entire experimental area using auger before the commencement of the experiment. The samples were bulked and mixed thoroughly for analysis and subsequent sample collection was from corresponding points on each experimental unit after planting (harvest).

**2.5 Data collection**

Data were collected by randomly selection and tagging of 4 plants from each treatment plot from middle row to eliminate the effect of cross feeding, they were tagged by placing labeled pegs beside them to facilitate the identification. Data collected were: plant height, leaf area, and grain yield. Plant height of maize was measured from the base of the soil to flag leaf at 3 and 6 WAP, while at 9 and 12 WAP it was measured from the base to the apex of the vegetative axis (point of emergence of the tassel). The mean height was taken as the score for each plot. Leaf area was taken 3, 6 and 9 WAP. This was done by measuring the length and width (at the widest point) of each leaf. The product of this was multiply by correction factor of 0.75 to cater for leaf shape (Remison and Lucas, 1982). The average was taken as leaf area per leaf. The 4 plants that were used for both plant height and leaf area were also used for yield determination. They were harvested at 12 weeks after planting. The harvested maize ear was dehusked and the cobs were sun dried to constant weight with moisture content of 12.5%. The grain were shelled and weighed. The average of the four plants were taken as yield per plant and extrapolated per hectare by multiplying by the plant population per hectare.

**2.6 Laboratory studies**

The soil and poultry manure samples were analyzed in the laboratory. The soil sample was air-dried at room temperature for 48hours and passed through a 2mm sieve to remove small roots and coarse materials. The parameters analyzed for were particle size analysis, organic matter, available phosphorus, total nitrogen, exchangeable bases (K and Ca) and pH. Particle size analysis was determined using the hydrometer method as described by Boyoucous (1962). Total nitrogen was determined by the modified micro-kjeldahl digestion method as described by Bremner and Mulvaney, (1982). Total organic carbon was determined by the Walkley and Black wet dichromate oxidation method (Nelson and Sommers, 1996) and was converted to organic matter by multiplying the total organic carbon value by the Van Bemmelen factor of 1.724 (Vander Ploey *et al.,* 1999). available phosphorus was determined using the Bray II soil extracting procedure (Mclean, 1982). Soil pH was measured with a glass electrode in a 1:2:5 soil-water and KCl solution (McLean, 1982). Exchangeable Ca was determined using the EDTA complexometric titration and exchangeable K was determined by flame photometry (McLean. 1982). The dry guinea grass mulch materials were analyzed by AOAC (1990) method before application.

**2.7 Statistical analyses**

Data generated from the study was subjected to statistical analysis of variance (ANOVA), using the mixed model procedure in SAS (SAS, 1999). Means separated using the least significant difference (LSD) at 5% level of probability.

## 3.0 Results

### 3.1 Chemical properties of the poultry manure and dry guinea grass

Some chemical properties of the poultry manure and dry guinea grass before planting are presented in Table 1. The the pH was neutral in poultry manure (7.6). Organic carbon (340.10g/kg) and organic matter (592.45g/kg) content were higher in dry guinea grass and lower in poultry manure (112.5g/kg and 195.98g/kg) respectively. However, N, P and K contents were in higher poultry manure (18.95g/kg and 15.62 mg/kg,1453cmol/kg.) and lowest in guinea grass (10.40g/kg, 0.87mg/kg and 0.13cmol/kg). C/N (Carbon/nitrogen ratio) was higher in dry guinea grass((32.70) and lower in poultry manure (5.94).

Table 1. Some chemical analysis of poultry manure and dry guinea grass before application

| Property | Unit | Poultry manure | Dry guinea grass |
|---|---|---|---|
| pH | | 7.6 | - |
| Organic matter (OM) | g/kg | 195.98 | 592.45 |
| Organic carbon(OC) | g/kg | 112.5 | 340.10 |
| Total nitrogen (TN) | g/kg | 18.95 | 10.40 |
| C/N | | 5.94 | 32.70 |
| Phosphorus(P) | mg/kg | 15.62 | 0.87 |
| Potassium (K) | Cmol/kg | 1453.00 | 0.13 |

**3.2 Physical properties of the soil**

Some of the physical properties of the soil before and after treatment application are presented in Table2. Before application of treatments, the soil was sandy loam in texture with sand, silt and clay contents of 730, 150 and 120. g/kg respectively. After the experiment, the particle size analysis result showed that the soil textural class was the same across all treatment plots, though there were slight differences in percentage sand, silt and clay. There were no significance differences (P>0.05) among the various farming practices in sand and clay particles but in silt particle significance difference exists with poultry manure plot having the highest silt content (170g/kg) and the lowest of 150g/kg in both pumpkin cover and burnt plots.

Table 2. Some physical properties of the soil before and after application of treatments

| Treatment | Sand (g/kg) | Silt (g/kg) | Clay(g/kg) |
|---|---|---|---|
| Initial soil test(before planting) | 730.00 | 150.00 | 120.00 |
| Final soil test(after planting) | 720.00 | 160.00 | 120.00 |
| Control | 720.00 | 160.00 | 120.00 |
| 10t/ha dry guinea grass mulch | 700.00 | 160.00 | 140.00 |
| Pumpkin cover | 730.00 | 150.00 | 120.00 |
| 10t/ha poultry manure | 710.00 | 170.00 | 120.00 |
| 250kg/ha N:P:K 20:10:10 | 720.00 | 160.00 | 120.00 |
| 10t/ha dry guinea grass(bush burning) | 710.00 | 150.00 | 140.00 |
| LSD(P=0.05) | NS | 11.00 | NS |

NS=Not significant

**3.3 Chemical properties of the soil**

Some of the chemical properties of the soil before and after treatment application are presented in Table3. Before application of treatments, the soil was very strongly acid in pH (4.80) with low nitrogen, N (0.99), potassium, K (0.09cmol/kg) and calcium, Ca (6.60 mg/kg). The phosphorous, P content (26.68mg/kg) of the soil was high while the Total organic matter content, TOM(20.90 g/kg) was low. The values of the chemical properties of the soil assessed differ significantly (p<0.05) after harvest among the various farming practices. Soil pH ranged from 4.0 to 5.50; N, 0.97 to 6.97g/kg; P, 26.55 to 59.81mg/kg; K, 0.08 to 0.40mg/kg; Ca, 4.35 to 12.65mg/kg and TOM 15.25 to 40.60g/kg.

Table 3. Some chemical properties of the soil before and after application of treatments

| Treatment | Soil pH($H_2O$) | TN (g/kg) | Av. P (mg/kg) | Ex. K (cmol/kg) | Ex. Ca (mg/kg) | TOM (g/kg) |
|---|---|---|---|---|---|---|
| Initial soil test (before planting) | 4.80 | 0.99 | 26.68 | 0.09 | 6.60 | 20.90 |
| Final soil test (after planting) | | | | | | |
| Control | 4.70 | 0.97 | 26.55 | 0.08 | 6.40 | 20.85 |
| 10t/ha dry guinea grass mulch | 5.10 | 10.60 | 26.70 | 0.18 | 11.50 | 24.80 |
| Pumpkin cover | 4.80 | 6.97 | 29.03 | 0.19 | 10.35 | 40.60 |
| 10t/ha poultry manure | 4.20 | 1.37 | 31.25 | 0.10 | 4.35 | 21.80 |
| 250kg/ha N:P:K 20:10:10 | 4.00 | 1.81 | 50.62 | 0.20 | 4.75 | 15.25 |
| 10t/ha dry guinea grass(bush burning) | 5.50 | 1.00 | 59.81 | 0.40 | 12.65 | 30.65 |
| LSD(P=0.05) | 0.12 | 3.29 | 1.39 | 0.12 | 0.49 | 1.57 |

TOM (total organic matter); TN (Total nitrogen); Av. P (Available Phosphorus); Ex. K Exchangeable potassium

### 3.4 Maize performance

#### 3.4.1 Plant height and leaf area

The effect of some farming practices on plant height of maize is shown in Table 2. Plant height increases (gradually from 3 to 12 WAP. At 3WAP, there were no significant differences in plant height among the various farming practices hence, identical plant height were observed subsequently, the plant height differed at the other periods of observation. Plant height ranged from 0.93 to 1.24 m, 1.64 to 2.20 m at 6WAP and 9WAP respectively. At 12WAP plants height were superior with plots treated with N:P:K 20:10:10 producing the tallest plants (2.91m) which was statistically the same with that of bush burning (2.81m) and poultry manure(2.71m) while the shortest (2.11m) were produced in plots with pumpkin cover which were statistically the same with plots mulched with dry guinea grass (2.42m).

The effect of some farming practices on leaf area of maize is shown in Table 5. The leaf area increases steadily throughout the sampling intervals and also differed significantly. It ranged from 1.02 to 1.94m$^2$, 3.65 to 6.94m$^2$, 6.01 to 8.18m$^2$ at 3WAP, 6WAP and 9WAP respectively. Leaf areas at 12WAP were superior with plots treated with N:P:K 20:10:10 producing the largest leaf area of 9.37m$^2$ which was statistically the same with that of bush burning (9.16m$^2$), poultry manure (8.78m$^2$) and dry guinea grass mulch (8.62m$^2$) while the smallest was produced in plot with pumpkin cover(6.97m$^2$) which was statistically the same with the control plots (7.00m$^2$).

Table 4. Effect of some farming practices on plant height (m) of maize

| Treatment | 3 WAP | 6 WAP | 9 WAP | 12 WAP |
|---|---|---|---|---|
| Control | 0.41 | 1.06 | 1.95 | 2.55 |
| Dry guinea grass mulch 10t/ha | 0.46 | 1.11 | 2.06 | 2.42 |
| Pumpkin cover | 0.38 | 0.93 | 1.64 | 2.11 |
| 10t/ha poultry manure | 0.43 | 1.12 | 2.10 | 2.71 |
| 250kg/ha N:P:K 20:10:10 | 0.50 | 1.24 | 2.20 | 2.91 |
| 10t/ha dry guinea grass(bush burning) | 0.50 | 1.22 | 2.10 | 2.81 |
| LSD(P=0.05) | NS | 0.25 | 0.41 | 0.319 |

NS=Not significant

Table 5. Effect of some farming practices on leaf area (m$^2$) of maize

| Treatment | 3 WAP | 6 WAP | 9 WAP | 12 WAP |
|---|---|---|---|---|
| Control | 1.43 | 5.20 | 6.02 | 7.00 |
| 10 t/ha dry guinea grass mulch | 1.45 | 5.48 | 7.52 | 8.62 |
| Pumpkin cover | 1.02 | 3.65 | 6.01 | 6.97 |
| 10t/ha poultry manure | 1.30 | 6.00 | 7.83 | 8.78 |
| 250kg/ha N:P:K 20:10:10 | 1.94 | 6.94 | 8.18 | 9.37 |
| 10t/ha dry guinea grass(bush burning) | 1.48 | 6.44 | 7.85 | 9.16 |
| LSD(P=0.05) | 0.88 | 2.03 | 1.77 | 1.45 |

#### 3.4.2 Maize grain yield

Table 6. Effect of some farming practices on grain yield (t/ha)) of maize

| Treatment | Grain yield |
|---|---|
| Control | 0.06 |
| 10t/ha dry guinea grass mulch | 0.08 |
| Pumpkin cover | 0.05 |
| 10t/ha poultry manure | 0.12 |
| 250kg/ha N:P:K 20:10:10 | 0.17 |
| 10t/ha dry guinea grass(bush burning) | 0.15 |
| LSD(P=0.05) | 0.051 |

The effect of some farming practices on maize grain yield is shown in Table 6. The yield differed significantly among the various farming practices. The yield ranged from 0.05t/ha to 0.17t/ha. Plots that received N:P:K 20:10:10 produced the highest yield (0.17 t/ha) which was not significantly different from that of bush burning (0.15t/ha) and poultry manure (0.12t/ha) while the lowest grain yield (0.05t/ha) was produced in plot with pumpkin cover which was statistically at *par* with the control (0.06t/ha) and dry guinea grass mulch (0.08t/ha).

### 4.0 Discussions

The low C/ N ratio for poultry manure might be attributed to the curing process of the manure under the shade and subsequently sun drying which might had resulted to leaching and volatilization of nitrogen. The low C/ N ratio implied that the it had a faster rate of decomposition than dry guinea grass mulch which had a higher C/N. The soil samples collected were dominated by sand, followed by silt, then clay. The soils were classified as sandy loam. Climatic (high rainfall, sunlight, high temperature and low relative humidity) and parent material factors might be responsible for the sandy loam texture of the experimental site. Brady and Weils, (1999) reported that high sand content of the soil could be attributed to high content of quartz in the parent material. The soil pH before cropping fell approximately within pH value required for arable crops production. This finding is in conformity of that of Enwezor *et al.,* (1990) who reported that the optimum soil pH ranged from 5 to 7 is most suitable for arable crops production in Nigeria. The organic carbon, nitrogen, and calcium and potassium content of the soil were quite inadequate while organic matter was moderate and phosphorus was adequate when compared to their various critical levels of soil in southern eastern Nigeria outlined by Ibedu *et al.* (1988). The moderate organic matter status of the experimental site could be attributed to history of land use and cultural practices associated with the land use (that is, cropping of crops that had not too much uptake of organic matter) from the soil. The low level of total nitrogen could be attributed to leaching of nitrate by rainfall prevalent in the environment (Olatunyi, *et al.* 2005). The high level of phosphorus noticed in the experimental area before the experimentation may be due to two reasons. Firstly, the history of land use and cultural practices associated with the land use (that is, cropping of crops that do not take much of phosphorus nutrient from the soil and the application of P organic or inorganic fertilizers (Nnaji, 2002 and 2008). Secondly, The parent material from which the soil was formed may be rich in phosphorus minerals (Nnaji, 2002). The low values of exchangeable Ca and K may be attributed to the leaching due to intensive rainfall features of the area, mineralization of nutrients as result of high temperature and rapid nutrient uptake. FMANR (1990) reported that most soils of the Southern Nigeria are poor in nutrients due to intensive rainfall, soil erosion, and nutrient depletion through leaching and continuous cultivation of land without adequate application of fertilizer or other amendments.

Burning increased the content of soil organic carbon which influenced the value of the total organic matter in the soil. The finding is in agreement with that of (Kara and Bolat, 2009; Pardini *et al.,* 2004; Anonymous 2016). Burning also increased the amount of available P, exchangeable K and Ca in the soil when compared with the control values. This could be as a result of the rapid release of nutrients when compared to natural decomposition processes that could take years, as fire acts as a rapid mineralizing agent (St. John and. Rundel, 1976) and besides the amount of rainfall in the study area might not be sufficient enough to wash away the ash which is one of the principle products of burnt material that is rich in phosphorous, nitrogen and potassium.

The quality of the dry guinea grass mulch material had remarkable effects on soil chemical properties (organic matter, total N, pH, available P, and exchangeable K and Ca). The soil fertility enhancement by dry guinea grass mulch obtained in this study might be attributed to the promotion of microbial activity and consequent decomposition of organic materials. Mulch materials can change the biological properties of the soil with consequences on soil fertility (Marinari *et al*., 2006).

Application of poultry manure increased all the chemical properties of the soil assessed except $P^H$ when compared to the control plot. This could be attributed to the impact of poultry manure on soil as it mineralized, resulting to an improvement in the soil condition. Wild (1988) noted that application of farm yard manure increased the availability of phosphorous in soil solution and reduced phosphorous adsorption in an experiment conducted on an Ultisol in Nigeria. The reduced pH value in poultry manure plot could be attributed to the formation of organic acids as a result of the presence of organic matter, since organic acids are produced as a result of organic matter decomposition (Bot and Benites 2005), or as a result of $H^+$ released from $NH_4^+$ breakdown, which contributes to soil acidification.

The application of NPK compound fertilizer was observed to have increased the soil available P, total N and exchangeable K when compared with the control plot. This could be as result of the release of the primary nutrient elements by the activities of microorganisms. This result is in accordance with Parham *et al* (2002) who noted that the inorganic manure treated plot had higher nutrient availability than organic manure treated soil. The non-significant increase in the soil organic matter content in the NPK treated plots recorded in this study is in line with Kang *et al*., (2005) who reported that the application of poultry manure increased the soil organic matter, whereas the NPK does not. The high amount of organic matter noticed in plot covered with pumpkin might be attributed to leaf fall from the pumpkin plant which formed litters. The litters decomposed to add more organic matter to soil. The high amount of organic matter might also be responsible for the increase of the other soil chemical properties in plots covered with pumpkin.

The variation in maize performance is attributed to treatment effect of various farming practices that were applied to each plot. The non-significant effect observed in plant height at 3WAP could be attributed to no treatment effect of various farming practices. The significance differences noticed in plant in the other sampling intervals could be attributed to treatment effect of various farming practices. Plant height was superior at 12WAP and became more pronounced on NPK, bush burning and poultry manure plots. However, NPK tend to be more responsive probable due to higher and faster release of nutrient elements into the soil which facilitated the increase in maize height. Leaf area was also superior at 12WAP and became more pronounced on NPK, bush burning, poultry manure. bush burning, and dry guinea grass with broader leaf areas with the NPK plot having highest leaf area probable as result much uptake of nutrients by the plant for photosynthesis. Remarkable maize grain yield was obtained in plot treated with NPK, bush burning and poultry manure when compared with other farming practices However, NPK plot was the most remarkable probable as a faster rate of mineralization and release of nutrients for maize uptake. Abiola and Aiyelaagbe (2005) also noted that inorganic fertilizer performed better than organic manure because inorganic fertilizer made their minerals easily available for plants.

The increased in maize yield in burnt plots may be due to the increase in the soil pH value from 4.7 (control) to 5.5 which is optimal for maize cultivation, as well as the mineralizing capability burning had on soils which led to the availability of plant essential nutrients such as phosphorous, nitrogen, potassium and calcium. The low yield recorded in plot mulched with dry guinea grass might be attributed to immobilization of soil nitrogen by the soil microbes due to high C: N ratio and also to its ability to produce some toxins substances which might have interferes with maize growth. The control plot had poor yield because of its poor inherent soil fertility status. Nnaji *et al*. (2005) noted that poor inherent soil fertility could be caused by high intensity of rainfall, leaching of basic cations and nature of parent materials from quartz and sesqui-oxides. It was observed that the pumpkin cover plots had lowest growth and yield responses throughout the course of this study; this could be as a result of the competition of pumpkin plant with the maize plant for nutrients, water, light etc. which are fundamental for plant growth.

## Conclusion

In conclusion, the choice of which farming practice to use is sometime difficult to make but comparative analysis will put N:P:K 20:10:10, followed by bushing burning, poultry manure above all others practices. However, more studies are needed to evaluate the cost implications of these practices before a recommendation can be made.

**Corresponding Author:**
Dr. Omovbude, Sunday
Department of Crop and Soil Science, Faculty of Agriculture, University of Harcourt P.M.B. 5323 Port Harcourt, Rivers State, Nigeria
Telephone: 08053186814
E-mail: sundayomovbude@yahoo.com

## References

1. Abdulraheem MI, Ojeniyi, SO. Combined application of urea and sawdust ash in okra production effects on yield and nutrients availability. Nigerian Journal of Soil Science 2015; 25: 146-154.
2. Abiola IO, Aiyelaagbe IO. (2005). Comparative investigation on the influence of organic and inorganic fertilizers on the growth *of Passifola edulis var (flavicarpa).* In Horstson Abstracts 2005 23rd Annual conference on September at Port Harcourt, River State, 2005: 16-22.
3. Akobundu IO. Weed Science in the Tropics. Principles and Practices. John Wiley and Sons. N.Y.1987: 522.
4. Anonymous. The effect of bush burning on agricultural land: case study of Okada in Ovia North East Local Government Area of Edo www.grossarchive.com/project/1458036161.htm 21st, December, 2016.
5. AOAC (Association of official Analytical Chemist). Official Method of Analysis. 15th edition. Washington, D.C., USA,1990.
6. Ayeni AO. Weed management in crop production in Nigeria. In: Aiyelari, E.A., Lucas, E.O; Obatan, M.O and Akinboade, A.O (eds.). Fundamental of Agriculture 1992; 256-63.
7. Bot A, Benites J. The Importance of Soil Organic Matter: Key to Drought-Resistant Soil and Sustained Food Production. FAO, UN, Rome, 2005.
8. Bouyoucous GH. Hydrometer method improved for making particle size analysis of soils. Agronomy Journal 1962; 54: 464-465.
9. Brady C, Weils RR Nature and properties of Soil Twelfth Edition, Prentice Hall, New Delhi, 1999: 74 – 114.
10. Bremmer JM, Mulvaney C S. Nutrient Total In: Methods of 2nd ed. AL. Page al., (Eds). 1982: 595-624.
11. Cheng FJ, Yang DQ, Wu, QS. Physiological effects of humic acid on drought resistance of wheat. Chinese Journal of Applied Ecology 1998;6:363 – 367.
12. Dalorima LT, Bunu A, Kyari Z, Mohammed T. Effects of Different Materials on the Growth Performance of Okra in Maiduguri. International Research Journal of Agricultural Science and Soil Science 2014; 4(8): 145-149.
13. Enwezor WO, Udo EJ, Ayotade KA, Adepetu JA, Chude VO. A review of Soil and Fertilizer use research in Southwestern Nigeria, In: Literature Review of Soil Fertility Investigations in Nigeria, FMANR, Lagos, Nigeria 1990; (3): 100- 200.
14. FAO (Food and Agricultural Organization). Agro climatological Data in Africa, FAO publications, Rome.

15. Federal Department of Rural Development Area (FDRDA). FDRDA Programme Preparation Report, November, 1981.
16. FMANR (Federal Ministry of Agriculture, Water Resources and Rural Development). Literature on Soil Fertility Investigations in Nigeria Bobma Publishers, U.I. Ibadan, 1990.
17. Ibedu MA, Unamba RPA, Udealor A. Soil management strategies in relation to farming systems development in South East agricultural zone of Nigeria. Paper presented at the Natural farming system research workshop Jos, State, Nigeria, 1988: 26-29.
18. Iqbal MAU, Hassan AA, Rizwanullah M. Residual effect of tillage and farm manure on some soil physical properties and growth of wheat (*Triticum aestivum* L.). Int. J. Agri. Biol. 2005; 7: 54-57.
19. Kang GS., Beri V, Rupela O.P, Sidhu BS. A new index to assess soil quality and sustainability of wheat based cropping systems. Biol. Fertil. Soils 2005;41: 389-398.
20. Kara O, Bolat I. Short-term effects of wildfire on microbial biomass and abundance in black pine plantation soils in Turkey. Ecological Indicators 2009; (9):1151–1155.
21. Marinari SG, Masciandaro B C, Grego S. Evolution of soil organic matter changes using pyrolysis and indices: A comparison between organic and mineral fertilization. Bio-Resource Technology 2006;25: 61-67.
22. McLean EO. Soil pH and lime requirement. In: Methods of soil analysis. Part 2, 2nd edition. Page, A.L. (ed.), Agronomy monograph: No 9, ASA and SSSA, Madison, WF, 1982: 539-579.
23. Nelson OW, Sommers LE. Total carbon, organic carbon and organic matter. In: Methods of Soil Analysis. Part 2, 2nd edition. Page, A.L.(ed.) Agronomy Monograph, no 9, ASA and SSSA, Madison W.I. 1982: 539-579.
24. Nnaji GU, Asadu CLA, Mbagwu JSC. Morphology and physical characteristics of soil profile under cultivation and Natural forest. Proceedings of the 19th Annual conference of Farm Management Association of Nigeria. 2005: 395-399.
25. Nnaji GU, Mbagwu, JSC, Asadu CLA. Influence of organic manures on cassava yield and some chemical properties of an ultisol Nsukka area of Southeastern Nigeria. Proceedings of the 29th annual conference of the soil science society of Nigeria, Makurdi, 5th-9th December, 2005.
26. Nnaji, GU, Asadu CLA, Mbagwu JSC. Evaluation of the physico-chemical properties of soils under selected agricultural land utilization types. Journal of Tropical Agriculture, Food, Environment and Extension 2002; 3:27-33.
27. Nnaji, GU. Fertility status of some soils in Isoko South Local Government Area of Delta State. Proceedings of the Annual Conference of the Agricultural Society of Nigeria held in Ebonyi State University, Abakiliki 2008: 515-519.
28. Odeyemi RT, Awodun MA, Ojeniyi SO. Combine Effect of Poultry Manure and NPK Fertilizer on Soil Plant Nutrient Composition and Growth of Rubber. Nigerian Journal of Soil Science 2013**:** 23(2):136-141.
29. Okusami RA., Rust RH, Alao AO. Red soils of different origins from southwest Nigeria characteristics, classification and management considerations. Canadian Journal Soil Science. 1997;77:295-307.
30. Olatunji USA, Ayuba A, Oboh VU. Growth and yield of Okra and Tomato as Affected by pig dung and other organic manures. Proceedings of the 30th Annual Conference of the soil science society of Nigeria 5-9th December, Makurdi, Nigeria, 2005.
31. Olayinka A. Soil microorganisms, wastes and national food security. Inaugural 222 Obafemi Awolowo University, Ile-Ife, 2009.
32. Pardini G, Gispert M, Dunjó, G. Relative influence of wildfire on soil properties and erosion processes in different environments in NE Spain. Science of the Total Environment 2004; 328: 237–246.
33. Parham JA Deng SP, Raun, WR, Johnson, GV. Long-term application in soil I. Effect on soil phosphorus levels, microbial biomass C, and dehydrogenase and phosphatase activities. Biology and Fertility of Soils 2002;35: 328–337.
34. Remison SU. Agriculture As the Way. Ambik Press, Benin City,1998.
35. Remison SU, Lucas, EO. Effects of planting density on leaf area and productivity of two maize cultivars in Nigeria. Experimental Agriculture 1982; 18: 93 – 100.
36. Rumpel J, Kaniszewski S, Dyś ko J. Effect of drip irrigation and fertilization timing and rate on yield of onion. J. Veg. Crop Prod.2003; 9(2).
37. Sanchez, P.A., Salinas JG. Low input technology for managing Oxisols and Ultisols in tropical America. Adv. Agron. 1981; 34: 279-406.
38. SAS (Statistical Analysis System). SAS user's guide: Basic Statistics, Cary N. C: Statistical Analysis Systems Institute Inc. 1999.
39. St. John TV, Rondcl PH. The role of fire as a mineralizing agent in a Sierran coniferous forest. Oecologia1976; 25:35-45.
40. Van der Ploeg RR, Bohm W, Kirkham MB. On the origin of the theory of mineral nutrition of plants and the law of the minimum. Soil Sci. Soc. Am. J., 1999; 66: 1055-106.
41. Weerakoon WL, Seneviratne AM. Managing a sustainable farming system in the dry zone of Sri Lanka. Tropical. Agriculturist. (1984): 140:41-50.
42. Wild A. Soils condition and plant growth. Longman group, London. 1988;116.


1/29/2017