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MAIZE GROWTH AND YIELD COMPONENTS AS INFLUENCED BY DIFFERENT SOURCES OF ORGANIC FERTILIZERS

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ABSTRACT

A trial was conducted on field between May – September, 2010 in two agroecologies of South West, Nigeria to determine the effect of different organic based fertilizer source on growth and yield components of different maize varieties. The experiment was laid out in Randomized Complete Block Design in split plots arrangement replicated four times. The maize varieties served as the main plot (Obatampa, DMR-L-SR-Y, SUWAN SR -1 and ART-98-SW1)) and the organic fertilizer as the sub plot. The organic fertilizer used were poultry manure at 5t ha^{-1} + urea (100 kg ha^{-1}), Oyo organic (5t ha^{-1}) + urea (100 kg ha^{-1}), cow dung (5t ha^{-1}) + urea (100 kg ha^{-1}) and no fertilizer application served as the control. Result showed that growth and yield components were significantly affected by treatments. ART-98-SW1maize variety performed better in terms of growth and yield parameters which made it the most desirable variety among the varieties used across the two locations. Yield obtained revealed that poultry manure + urea produced the highest grain yield of 4.91 and 5.04 tha^{-1}, followed by cow dung +urea and Oyo organic + urea while the unfertilized control plant had the lowest average yield of 2.67 and 2.98 tha^{-1} at Ilora and Ibadan location respectively. Higher maize yield was obtained from Ibadan compared to Ilora, this may probably due to difference in climatic conditions at these locations.

Key words: Maize varieties, yield components, Oyo organic, cow dung, poultry manure.

INTRODUCTION

Reduction in food production in Africa is as a result of low soil nutrient status and organic matter depletion, soil erosion and erratic weather condition. Low soil nutrient status maybe due to loss of nutrient during harvesting and soil erosion combined with low inputs (Henao and Baanante, 2006). One of the best ways of addressing the low soil fertility is use of inorganic fertilizers which is most effective and convenient. However, the high cost of inorganic fertilizer, detrimental effects on soil properties (Ojeniyi 2000) and negative imbalance in nutrient status (Chukwu *et al.,* 2012) are major constraints to sustainable soil management for increasing crop growth and yield with inorganic fertilizer.

The use of organic inputs such as crop residues, farm yard manure, compost and compost tea have great potential for improving soil fertility conditions and crop yield through improvement of the physical, chemical and microbiological properties of the soil as well as nutrient supply. Research carried out by Asadu and Unagwu (2002), stated that organic materials such as cow dung, poultry dropping and farm yard manure as soil amendments were suitable for increasing crop production in West Africa. However, such organic manure cannot meet crop nutrient demand over large area because of limited availability, low nutrient composition and high labour requirement (Tolera *et al.*, 2005). Hence,

practices that would address the problem of nutrient deficiency are needed.

The integrated use of organic and inorganic plant nutrient sources not only recycles organic waste which causes environmental pollution but also improve soil nutrients resources, which in turn reduce the sole dependence on chemical fertilizers. Furthermore, incorporation of organic manure and chemical (inorganic) fertilizers is the best alternative to improve low nutrient composition, provide balanced, and efficient use of plant nutrients and increase productivity of soil (Gruhn *et al.,* 2000; Rizwan *et al.*, 2007) and also increase the potential of organic fertilizer (Heluf, 2002) especially for a crop like maize which does not stay long on field to utilize nutrient supplied by organic fertilizer which usually release nutrient slowly.

MATERIALS AND METHODS

A field experiment was carried out during rainy season of 2010 at the Institute of Agricultural Research and Training farm at Ibadan (latitude at 07^0 22''N, 3^0 50''E) in the rainforest agro-ecology and Ilora (Latitude 08^0 02''N, 04^0 02 E) in the derived savanna agro-ecology of South west Nigeria. The zones are characterized by a bimodal rainfall pattern with a rainy season using starting from March till September. The soil of the two locations is dominantly alfisol.

Pre-Cropping Soil Analysis

Soil sampling for chemical analysis was taken at a depth of 0 - 20 cm with the use of soil auger before the application of the treatments to each plot. The samples were air dried, crushed and sieved to pass through 2 mm sieve before being analysed for nutrient content. Soil pH was determined with distil water at 1:1 soil to water ratio. Organic carbon was determined by Walkey-black method (Walkey and Black, 1934). Total nitrogen by regular micro- kjeldahl method, Potassium was determined by extraction with neutral normal NH_4OAc at a soil; solution ratio 0f 1:10. Phosphorus was determined by Bray 1 testing using 0.03N NH_4F in 0.025N HCl as the extractant (Bray and Kurtz, 1945).

Experimental Procedures and Treatments

The experimental site was previously planted with cassava and melon with little or no mineral fertilizer. The experiment was a split plot in Randomized Complete Block Design (RCBD) replicated four times. Plot size was 4x5 m^2 at both locations. The main plot consisted of the maize varieties and the sub plot was the organic-based fertilizer sources. Treatments included; F1: Poultry manure + urea (5t ha^{-1} + 100 kg ha^{-1}), F2: cow dung + urea (5t ha^{-1} +100 kg ha^{-1}), F3: Oyo organic + urea (5t ha^{-1} + 100 kg ha^{-1}) and no fertilizer as the control. Obatampa, DMR-L-SR-Y, SUWAN- 1-SR, and ART-98-SW1 (popularly known as oloyin), maize varieties were used which were obtained from the Institute of Agricultural Research and Training. After viability test was carried out, maize seeds were treated with Apron star at the rate of 10 g/3kg of seed before planting to protect seeds against pathogens and pests. Experimental sites were mechanically ploughed and harrowed before the treatments were applied. Organic fertilizer was applied 2 weeks before planting, randomly spread on the plots according to treatments with the use of hoe. Inorganic fertilizer (urea) was applied three weeks after planting using side dressing method. Planting was done at a spacing of 75 x 25cm. Missing stands were supplied at 7days to meet the target plant population which was later thinned down to two at three weeks after planting.

Weeding was done manually as necessary throughout the experimental period. Maize was harvested at 12 weeks after planting; it was sun dried to 13% moisture content to get the dry grain weight.

Data Collection

Ten plants/plots were randomly selected and tagged for data collection. Growth parameters such as Number of days to 50 % flowering, Plant height, leaf area and number of leaves were taken two weeks after planting and yield parameters (100 seed weight, cob length, cob weight, ear length, number of seeds/cob and grain t ha-1) were collected at harvest.

Data Analysis

Data collected were subjected to statistical analysis of variance (ANOVA) using SAS (2003) package. The treatment means were sep-

Table 1: Pre cropping soil chemical and physical properties at the two stations

Parameters	Ibadan	Ilora
Ph (H_2o)	6.7	6.1
N%	0.15	0.11
P (ppm)	4.23	3.87
Org. C	0.26	0.3
Exchangeable Potassium(cmol/kg)	0.57	0.34
Exchangeable ca (cmol/kg)	4.43	3.21
Exchangeable Na(cmol/kg)	0.17	0.15
Exchangeable Mg(cmol/kg)	0.73	0.84
Sand (%)	77.5	81.2
Silt (%)	14.7	11.4
Clay (%)	10.7	9.8

Table 2: Chemical composition of Poultry manure, Cow dung and Oyo organic used for the experiment

Parameters	Poultry manure	Cow dung	Oyo organic
Ph (H_2o)	5.1	7.5	6.9
N (%)	4.1	2.3	0.61
Available P (%)	2.4	1.8	0.62
Org. C (%)	13.76	10.78	6.08
K (%)	2.67	2.13	1.98
Ca (%)	3.17	1.89	2.05
Na (%)	1.67	1.98	0.78
Mg (%)	3.23	2.12	0.54
Fe (%)	1.97	1.56	0.47

Table 3: **Effect of Varieties and treatments on Growth and yield Components of Different maize varieties**

	Plant Height (At maturity		**Leaf Area(cm^{2}at maturity)**		**Ear height**		**Cob length(cm)**	
Treatments	Ilora	Ibadan	Ilora	Ibadan	Ilora	Ibadan	Ilora	Ibadan
Maize varieties								
Obatampa	115.06^{b}	113.50^{c}	281.23^{c}	290.72^{d}	60.66^{c}	63.37^{d}	10.98^{c}	14.13^{c}
DMR-L-SR-Y	116.68^{b}	117.10^{b}	305.00^{b}	315.06^{c}	68.99^{b}	72.58^{c}	15.78^{b}	14.40^{bc}
SUWAN-SR 1	117.66^{b}	117.12^{b}	348.00^{a}	354.43^{b}	70.52^{b}	83.15^{b}	18.73^{b}	14.86^{a}
ART-98-SW 1	126.43^{a}	127.00^{a}	359.78^{a}	379.43^{a}	99.15^{a}	99.90^{a}	24.47^{a}	15.05^{a}
Organic manure								
Oyo organic + urea	128.12^{b}	130.45^{a}	312.81^{c}	321.78^{c}	71.70^{b}	75.30^{b}	14.80^{b}	15.06^{b}
CW+ urea	130.12^{b}	139.73^{b}	378.11^{b}	386.13^{b}	81.96^{b}	86.03^{b}	18.10^{b}	18.53^{b}
PM+ urea	141.03^{a}	150.83^{b}	423.81^{a}	435.16^{a}	87.76^{a}	99.71^{a}	21.10^{a}	25.93^{a}
No fertilizer	98.90^{c}	102.93^{c}	257.1^{d}	268.00^{d}	62.68^{c}	68.17^{c}	10.30^{c}	11.85^{c}

Means followed by the same letter in a column are not significantly different from each other at $P \leq 0.05$ by DMRT

CW: Cow dung
PM: Poultry manure

arated for significant difference using Duncan multiple range test (DMRT) at 5% level of probability (Duncan, 1955).

RESULTS

Soil Analysis

The result of the physical and chemical analyses of the soil before cropping are presented in table 1. The soil was sandy loam in texture for Ibadan and Ilora station with a pH of 6.7 and 6.1 respectively. Total Nitrogen content was 0.15 and 0.11 for both stations. Exchangeable potassium, calcium, sodium and magnesium for Ibadan station was 0.57, 4.43, 0.17 and 0.73cmol/kg while for Ilora was 0.34, 3.21, 0.15 and 0.84 cmol/kg respectively

Organic Manure Analysis

The nutrient analyses for different organic manure used were shown in table 2. The nutrient analysis revealed that poultry manure was richer in all nutrients analyzed except for the sodium and calcium content. Meanwhile, cow dung had the highest mean value for Sodium content (1.98 %) while the highest calcium content was recorded for Oyo organic (2.17 %) (Table 2).

Effect of Different Organic Manure Sources on Maize Varieties.

Maize variety (ART-98-SW1) performed better in terms of plant height, leaf area, as well as the yield components and it was significantly different from all the varieties used at both locations. This is followed by SUWAN SW-1, DMRT-SRY and Obampta maize

Table 4: **Effect of Varieties and treatments on Growth and yield Components of Different maize varieties**

Treatments	No of Seed/cob		Cob weight (Kg)		100 seed/weight (g)		Grains tha^{-1}	
	Ilora	Ibadan	Ilora	Ibadan	Ilora	Ibadan	Ilora	Ibadan
Maize varieties								
Obatampa	352.56^{c}	373.94^{b}	22.97^{b}	23.56^{c}	24.64^{b}	21.01c	3.88^{c}	3.98^{c}
DMR-L-SR-Y	431.50^{b}	434.63^{b}	25.70^{b}	26.13^{bc}	26.99^{b}	25.55^{bc}	4.06^{bc}	4.17^{b}
SUWAN-SR 1	432.69^{b}	448.00b	25.70^{b}	26.51^{b}	30.15^{a}	28.61^{b}	4.25^{ab}	4.44^{b}
ART-98-SW 1	463.88^{a}	483.06a	31.45^{a}	38.13^{a}	35.26^{a}	45.83^{a}	4.64^{a}	5.48^{a}
Organic manure								
Oyo organic + urea	402.13^{c}	420.50^{c}	26.3^{c}	22.76^{b}	27.20^{c}	27.34^{c}	4.28^{b}	4.34^{c}
CW+ urea	443.31^{b}	469.58^{b}	38.40^{b}	33.46^{a}	36.91^{a}	43.65^{b}	4.31^{b}	4.83^{b}
PM+urea	485.31^{a}	490.88^{a}	48.30^{a}	43.53^{a}	30.93^{b}	31.18^{b}	4.91^{a}	5.04^{a}
No fertilizer	321.56^{d}	338.6^{d}	17.11^{c}	17.78^{c}	19.63^{d}	19.95^{d}	2.67^{c}	2.98^{c}

Means followed by the same letter in a column are not significantly different from each other at P≤0.05 by DMRT

CW: Cow dung
PM: Poultry manure

varieties (Table 3).

All parameters considered were significantly influenced by the treatments applied. Availability of nutrient in form of poultry manure + urea fertilizer had significant effect on maize plant height at both locations. No significant differences were recorded at both locations for maize height with cow dung + urea and Oyo organic fertilizer + urea, although plant amended with cow dung + urea had taller plants than plants amended with Oyo organic + urea (Table 3).

There was an increase in leaf area production with the addition of treatments at both Ilora and Ibadan locations. A significant increase in leaf area was observed in plants treated with poultry manure + urea (423.81 and 435.16 cm), followed by cow dung + urea (378.11 and 1386.13 cm)and Oyo organic with urea (312.13 and 321.00 cm) respectively.

Similar to what was observed for plant height and leaf area at both location were poultry manure + urea produced the highest mean value, it was also observed that maize plants treated with poultry manure + urea produced the highest ear height plants and it differs significantly from other treatments applied even to the control which recorded the lowest ear height plants at Ibadan and Ilora location (62.68 and 68.17cm) respectively. The number of seeds/cob and cob length were also influenced by fertilizer application with poultry manure + urea producing the highest mean values at both locations and it is significantly higher than every other treatment applied while the control plants produced the lowest mean values at both

Table 5: **Interaction Effect of Varieties and treatments on Growth and yield Components of Different maize varieties**

	PH at maturity(cm)		LA at maturity(cm^2)		Ear length (cm)		Cob length (cm)		No Seed/Cob	
Treatments (Var x fertilizer)	Ilora	Ibadan	Ilora	Ibadan	Ilora	Ibadan	Ilora	Ibadan	Ilora	Ibadan
CTLx Obatampa	96.25	101.25	218.17	222.17	33.50	52.20	11.17	11.32	216.80	303.58
CTL x DMR-L-SR-Y	95.40	98.75	239.45	239.80	43.37	60.47	11.37	12.05	220.00	337.04
CTL x SUWAN -SR 1	104.35	101.25	213.95	232.47	46.33	60.00	12.12	12.25	237.50	372.75
CTL x ART-98-SW1	104.30	110.5	295.17	323.12	49.20	60.00	12.17	11.80	252.00	341.25
Oyo org + urea x Obatampa	114.50	119.25	305.56	308.15	70.25	54.90	13.30	14.62	347.50	403.50
Oyo org + urea x DMR-L-SR-Y	118.30	120.42	311.40	311.00	73.67	63.70	13.77	14.87	340.50	424.25
Oyo org + urea x SUWAN SR- 1	124.90	114.50	317.48	304.60	77.32	63.00	15.77	15.52	377.90	415.33
Oyo org + urea x ART-98-SW1	129.60	128.50	323.56	350.80	80.50	63.62	16.25	15.22	383.50	439.57
CW+ urea x obatampa	128.90	126.75	356.82	310.70	63.57	62.80	16.70	15.25	390.00	402.50
CW+ urea x DMR-L-SR-Y	127.20	128.12	337.27	323.32	67.27	68.30	16.40	15.45	448.60	490.75
CW+ urea x SUWAN SR-1	130.60	120.75	388.67	352.35	66.30	67.75	18.47	16.70	425.50	500.75
CW+ urea x ART-98-SW1	139.60	133.25	405.42	420.77	69.00	70.21	19.52	16.57	426.70	506.50
PM+ urea x Obatampa	121.63	121.25	328.00	322.27	50.72	60.37	15.77	15.32	396.00	386.25
PM+ urea x DMR-L-SR-Y	129.50	121.10	334.65	383.50	53.45	70.87	16.10	15.22	467.50	482.50
PM+urea x SUWAN-SR -1	129.70	117.5	356.70	387.47	50.92	70.22	19.57	15.75	480.30	503.50
PM+ urea x ART-98-SW1	141.20	135.5	417.52	427.05	63.76	77.78	25.62	16.85	542.50	526.60
S.E	11.06	1.43	11.16	7.68	3.23	2.24	1.64	0.22	10.77	10.3

LA: Leaf Area
PH: Plant height
CW+PM: Cow dung
PM: Poultry manure, CTL: Control

Table 6: Interaction Effect of Varieties and treatments on Growth and yield Components of Different maize varieties

	Cob weight(Kg)		100seed weight		Grain t ha^{-1}	
Treatments (Var x fertilizer)	**Ilora**	**Ibadan**	**Ilora**	**Ibadan**	**Ilora**	**Ibadan**
CTLx Obatampa	17.45	20.42	19.50	16.17	2.6	3.2
CTL x DMR-L-SR-Y	20.25	17.12	14.90	20.75	2.03	2.49
CTL x SUWAN -SR 1	20.12	17.22	15.82	18.77	3.02	3.07
CTL x ART-98-SW1	20.72	16.35	18.25	21.12	3.03	3.14
Oyo org + urea x Obatampa	28.9	21.67	21.60	24.15	4.09	4.17
Oyo org + urea x DMR-L-SR-Y	24.72	19.32	19.30	24.87	4.15	4.13
Oyo org + urea x SUWAN SR- 1	23.05	22.1	20.35	23.42	4.29	4.29
Oyo org + urea x ART-98-SW1	30.15	27.95	28.32	27.45	4.40	4.28
CW+ PM Xobatampa	30.07	30.45	29.15	30.00	4.38	4.55
CW+ PM X DMR-L-SR-Y	34.32	29.00	31.17	29.12	4.44	4.38
CW+ PM X SUWAN SR-1	31.43	30.42	35.57	27.10	4.47	4.47
CW+ PM X ART-98-SW1	32.37	38.97	35.65	33.40	4.79	4.89
PMxObatampa	33.40	33.52	32.62	30.00	4.46	4.44
PMx DMR-L-SR-Y	28.40	28.80	26.52	27.47	4.51	4.32
PMx SUWAN-SR -1	25.65	38.30	31.05	36.77	4.87	4.56
PMX ART-98-SW1	38.97	40.28	35.65	33.4	5.06	5.21
S.E	2.58	1.04	1.07	1.06	0.12	0.13

LA: Leaf Area
PH: Plant height
CW+PM: Cow dung + Poultry manure
CTL: Control

locations.

In Ibadan, no significant differences were observed in cob weights with the application of poultry manure + urea and cow dung + urea. Although, plants amended with poultry manure + urea performed better with the mean value of 43.53cm compared to cow dung + urea (38.46 cm). At Ilora station, application of poultry manure + urea proved superior followed by cow dung + urea, Oyo organic + urea while the control plants had the least mean cob weight value (Table 3)

Contrary to what was observed for cob weight and number of seeds/cob, it was observed that cow dung + manure produced the highest 100 seed weight at both locations (36.91 and 43.65g) respectively. Meanwhile the unfertilized maize plants produced the lowest mean values (19.95 and 16.30g). Yield obtained with the use of poultry manure + urea was more superior to all treatments applied and it is significantly different ($p<0.05$) from all treatments applied. Yield produced with the application of cow dung + urea and poultry manure + urea were not significantly different from each other while the unfertilized plants produced the lowest maize yield (grain t/ha) at both locations (Table 4).

Interaction Effect of Varieties and treatments on Growth and yield Components of Different Maize varieties

All parameters were significantly influenced by interaction effect of treatments and varieties as ART-98-SW1 with poultry manure +urea significantly produced the highest mean value for all the treatments considered across both locations except for 100 seed weight where the application of cow dung + urea had the highest mean value of 39.47 and 41.65g at Ilora and Ibadan respectively. ART-98SW1 performed very well with all the treatments applied com-

pared to other maize varieties tested (Table 6).

DISCUSSION

The result at the two locations revealed that tallest plants was recorded from poultry manure in combination with urea which was followed by integrated use of cow dung + urea then Oyo organic + urea and the shortest plant was recorded for the unfertilized plots. This finding is in agreement with Ayoola and Makinde (2009), who reported better plant height in maize yield with integrated application of organic and inorganic fertilizer. The fact that integration of organic manure with urea gave the tallest plant height is an indication of good soil management and sufficient nutrient availability. Also, higher maize plant with the application of organic manure with urea compared to unfertilized plants is a reflection that abundant nutrient supply is directly correlated with growth. Akinrinde *et al.*, (2004), also gave the same report while working on alfisol soil in Nigeria.

The high amount of nitrogen in urea together with the high amount of nitrogen content in poultry manure used could have led to plant with longer cob length, this is because nitrogen increases the photosynthetic activity of plant thereby increasing the leaf area therefore convert more photosynthate to maize cob. Since cob length is the most yielding parameter of maize contributing to the grain yield, this might have been the reason for higher grain yield obtained in plant treated with poultry manure with urea. Similar observation was observed by Rajeshwari *et al.* (2007), who reported a significant increase in cob length with the use of Nitrogen rich fertilizer in form of urea.

Grain yield is the end result of morphological and physiological processes occurring during growth and developments of a crop. An increase in grain yield with the use of poultry manure and urea is an indication that nutrients are balanced and more available throughout the growing period which might have led to better growth and development. This observation is also in accordance with the findings of Khan *et al*. (2008). This also confirms the findings of Tasneem *et al.* (2004), who reported high grain yield in maize due to balanced nutrient supply with the use of Farm yard manure in combination with inorganic fertilizer. Similarly, Shah and Ahmad (2006), recently reported that application of urea combined with organic materials in such a way that the former contributing 75 % and latter 25 % Nitrogen produced the highest crop yield of wheat in a field experiment in Peshawar Valley. Furthermore, the higher plant growth as a result of poultry manure with urea amendments maybe associated with fact that poultry manure is higher in Nitrogen content compared to cow dung and Oyo organic manure which is essential for chlorophyll and protoplasm formation thereby resulted to higher yield gotten. Also, Abunyewa *et al.* (2007), found higher maize grain yield from integrated use of smaller amounts of manure with inorganic fertilizer application than sole organic material which was due to the efficiency in terms of crop utilization and sustainable productivity.

The wide gaps between the maize yield produced in control plots and the treatments supplied with application of poultry manure + urea, Oyo organic + urea, cow dung + urea and across the locations reveals the importance of soil nutrients either alone or integrated. (Heluf, 2002). Higher response of maize varieties to poultry manure mixed with urea compared to other sources of organic manure shows that poultry manure nutrients are readily available and plants root can easily absorb it which in turn improved the morphological growth of maize

plants. This finding was initially reported by Ajari *et al.*, (2003), when working on Okra who reported that poultry manure improves plant growth when compared with other sources of organic manure.

Due to their residual value that could last for several years of cropping, organic amendments can also be intermittently applied to soil and supplemented by chemical fertilizer to rapidly supply immediate nutrients required by crop plants (Kihanda *et al.,* 2006). Slow nutrient releasing nature of organic manures can be complemented with the addition of fast nutrient supply of inorganic fertilizer which can therefore improve crop growth and development. Such response has also been reported by Chung et al. (2000) which stated that application of organic manure with an adequate supply of chemical fertilizer improves maize growth and yield components.

CONCLUSION

From the result stated, it can clearly be seen that integrated use of organic manure with inorganic fertilizer is the best way of improving soil nutrient status and also increase maize production. Also, ART-98-SW maize variety performed better with all type of fertilizer used in terms of growth and yield components considered, this made it more desirable among all varieties tested. Therefore, based on this research, integrated use of poultry manure (5t ha^{-1}) with inorganic fertilizer inform of urea (100kg ha^{-1}) can be recommended.

REFRENCES

Abunyewa, A.A., Osei, C., Asiedu, E.K. and Safo, E.Y.(2007). Integrated manure and fertilizer use, maize production and sustainable soil fertility in sub humid zone of West Africa, *Journal of Agronomy* 6(2):302-309.

Asadu, C.L.A. and Unagwu, B. (2012). Effect of combined poultry manure and inorganic fertilizer in maize performance in an ultisol of Southeastern Nigeria. *Nigerian Journal of Soil Science* 22(1) 79-87.

Ayoola, O.T. and Makinde (2009). Maize growth, yield and soil nutrient changes with N- enriched organic fertilizers. *African Journal of Food Agriculture Nutrition and Development.* Volume 9(1):580-592

Bray, R.H. and Kurtz, L.T. 1945. Determination of total organic and available forms of phosphorus in soil. *Soil Science*. 599: 39 – 45.

Chukwu, L.I., Ano, A.O and Asawalan, D.O. (2012). Effect of poultry manure on soil properties and nutrient uptake of maize (*Zea mays* L.) plants growth in an utilsol. *Proceedings of the 36th Annual Conference of the soil science of Nigeria* (SSSN) on 7th-11th March, 2012, University of Nigeria Nsuka.

Chung, R.S., Wang, C.H., Wang, C.W. and Wang, Y.P. (2000). Influence of Organic matter and inorganic fertilizer on the growth and Nitrogen accumulation of corn plants. *Journal of Plant Nutrition*. 23(3):297-311.

Duncan, D.B. (1955). Multiple range and multiple F-test. *Biometrics,* 11: 1–42

Khan, H.Z., Malik, M.A. and Saleem, M.F. (2008) Effect of rate and source of organic materials in the production potential of spring maize (*Zea mays* L). *Pakistan Journal of Agriculture and Soil.* Volume 45(1):40-43.

Kihanda, F. H., Waren, G.P. and Micheni, A. N. (2006). Effect of manure application on crop yield and soil chemical properties in a long term field trial of semi and Kenya. *Nutrient cycle Agroecosystem.* 76, 341-354

Ojeniyi, S.O. (2012). S*oil Managements, Natural resources and Environment*. Oke Ado: Adediran press.

Rajeshwari, R.S, Hebsur, N.S., Pradeep, H.M and Bharamagouder, T. D. (2007). Effect of integrated nutrient management on growth and yield of maize. *Karnataka Journal Agricultural Science.* 20(2):399-400.

Rizwan, A., Shahzad, S.M., Khalid, A., Arshad, M. and Mahmood, M.H. (2007), "Growth and Yield response of (*Triticum aestivium* L.) and Maize (*Zea mays* L.) to nitrogen and L-tryptophan enriched compost. *Pakistan Journal Botany*. 39(2):541-549.

Shah, Z. and M.I. Ahmad (2006). The integrated effect of farm yard manure and urea on crop and nitrogen yields of wheat. *Journal of Agricultural Biological Science* 1(1):60-64.

Tolera, A., Tamado, T. and Pant, L.M. (2005). Grain yield and LER of maize-climbing bean intercropping as affected by inorganic, organic fertilizers and population density in Western Oromia, Ethiopia. *Asian Journal of Plant Sciences.*4 (5):458-465.

Walkley, A. and Black, I. A. (1934). An examination of the Detjareff method for determining soil organic matter and a proposed modification to the chromic acid titration method. *Soil Science* , 29- 38.