EFFECT OF POULTRY MANURE AND PALM BUNCH ASH ON GROWTH AND YIELD OF GINGER (*Zingiber officinale*) ON A TROPICAL ULTISOL AT UMUDIKE, NIGERIA

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ABSTRACT
A trial was conducted in 2010 and 2011 cropping seasons at the National Root Crops Research Institute's Experimental farm at Umudike to determine the effect of poultry manure and palm bunch ash on the growth and yield of ginger (Zingiber officinale). The treatments comprised four rates of poultry manure (0, 3, 6, 7, 9t/ha) combined factorially with four rates of palm bunch ash (0, 3, 6, 9t/ha).the ginger variety used was UGI. Mean number of tillers/plant measured at 4 months after planting (MAP) was significantly ($P<0.05$) increased by poultry manure over the control. Palm bunch ash did not have effect on mean number of tillers/plant. Poultry manure applied at 6/ha gave mean number of tillers/plant of 6.70 which was significantly higher than 5.5 obtained with the control. Plant height measured at the same period was significantly increased by both poultry manure and palm bunch ash application. Poultry manure and palm bunch ash each applied at 3t/ha resulted to significantly higher ginger rhizome yield at 6MAP over the control. It was therefore recommended that for ginger production on the soil studied 3t/ha of poultry manure and 3t/ha of palm bunch ash should be applied.

Keywords: Ginger, poultry manure, palm bunch ash, growth and yield

INTRODUCTION
Ginger (*Zingiber officinale*) is a tropical herb which belongs to the family *Zingiberaceae*. It is erect and propagated by means of rhizomes which are underground stems. Among the spices (pepper, ginger, onions and chilies) ginger is the only one that is grown on a commercial scale for export in Nigeria (Emehute, 2003). It is grown as a cash crop for domestic and export purposes. Ginger is commonly used as a cooking spice throughout the world and as medicine and ornamental in so many parts of the world (Crawford and Odle, 2005).

The soils of southeastern Nigeria suffer multiple nutrient deficiencies (Enwezor, 1988) arising from low soil organic matter, excessive leaching of basic cations (especially K) and improper soil fertility management practices. Reports of farming systems survey have shown that in this region fallow period has decreased from 10 to between 2 and 3 years (Unamma *et al*., 1985). In some areas, continuous cropping is already practiced and this has led to a declined soil fertility which is one of the production constraints in the area (Udealor *et al.*, 1991). The soils are also characterized by low organic matter content, low nutrient status, low pH, low cation exchange capacity, and low activity clay (Lal and Kang, 1986). Low pH soils have problems associated with aluminum toxicity Liming reduces the solubility and toxic concentration of aluminum and results to availability of nutrients with consequent increase in crop yield (Oguatoyinbo, 1990). Organic farming is a means of using organic waste to create wealth. Lim (2000) reported that palm bunch ash contains about 30% of potassium oxide and is used as fertilizer. Palm bunch ash originates from organic material. It is an eco-friendly product, 40% cheaper than inorganic potassium fertilizer and is used commercially in neutralizing acidic soil effectively (Agriscape, 2007). It can be used as liming material and is useful in ameliorating low soil pH. Palm bunch ash is also significant source of P, K, Mg, and Ca (Ahaiwe, 2008). Agro-waste has been found to be a cheap source of manure for root and tuber crops on a sustainable basis. Farmers produce these wastes at no extra cost in mixed farming. It improves the physical structure of the soil as well as supplies the nutrient requirement of the crops (Onunka, 2005). Poultry manure has been reported to be rich in N (Onunka, 2005) which is of importance for vegetative growth and yields of

crops. Potassium is vital to many plant processes such basic biochemical and physiological reactions in plants. Adequate supply of K to crops increases their ability to resist pest and diseases attack thereby ensuring good quality (FPDD, 1989). It is envisaged that ginger production package that is based on inputs such as poultry and palm bunch ash that are generated in the farming systems will easily be adopted by the farmers. The objective of this study was therefore to determine the optimum rates of palm bunch ash in combination with poultry manure for sustainable ginger production in southeastern Nigeria.

MATERIALS AND METHODS

The study was conducted at the National Root Crops Research Institute, Umudike experimental farm (07^{o} $33^{'}$E, 05^{o} $29^{'}$ N, 122 meters above sea level) in 2010 and 2011 cropping seasons, on a soil having sandy clay loam texture, pH of 4.88, org. matter of 1.36% exchangeable bases Ca, Mg, K, Na of 2.4 meq/kg, 1.60 meq/100g 0.01/100g and 0.07 meq/100g respectively. Total N and available P of the soil were 0.12% and 60.7 mg/kg respectively .Palm bunch ash was obtained from incineration of empty palm bunch while poultry manure was obtained from deep liter system. Palm bunch ash (PBA) sample was collected and physic-chemical properties of the sample were determined by the method described by (Udo and Ogunwele, 1978). The experiment was 4x4 factorial laid out in randomized complete block design (RCBD) with three replications. The treatment comprised four levels of palm bunch ash, 0, 3, 6 and 9t/ha and 4 levels of poultry manure (0 ,3, 6, 9t/ha) factorially combined. Each plot measured 2mx2m with 100 plants per plot which gave plant population of 250,000\ha. The rhizome setts weighing 10-20g with at least 2 viable buds, was planted at the depth of 5cm and mulched with elephant grass (*Panicum maxium*) to a thickness of 5-10cm. Data was collected on number of tillers and plant height at 4 months after planting (MAP) and rhizome yield at harvest 6MAP.Data was subjected to analysis of variance using Gen stat 2003 discovering edition.

RESULTS AND DISCUSSION

The chemical properties of palm bunch ash and poultry manure are shown Table 1. The pH of aqueous solution (1:2.5) of palm bunch ash was 12.45 indicating that it was alkaline while poultry manure contains all the essential plant nutrient elements in different quantities. The total annual rainfall obtained from National Root Crops Research Institute,(NRCRI), Umudike Metrological Station was 1916mm for 2010 and 2135.9mm for 2011(Table2).The mean maximum temperature for 2010 and 2011 were 31.8°C and 31.50°C respectively while the mean minimum temperature were 23.33°C and 22.6°C respectively (Table 2).

The effect of poultry manure and palm bunch ash on the mean number of tillers/plant combined for the two cropping seasons (2010 and 2011) studied is shown in Table 3. Palm bunch ash did not affect the number of tillers/plant while poultry manure led to significant increase in mean number of tillers/plant over the control. Poultry manure applied at 6t/ha gave mean number of tillers/plant of 6.70 which was significantly higher than 5.5 obtained with the control. However mean number of tillers/plant obtained with 9t/ha poultry manure did not significantly ($P>0.05$) differ what was obtained with 6t/ha of poultry manure.

The plant height measured at 4 months after planting (MAP) was significantly increased by both poultry manure and palm bunch ash application (Table 4). Palm bunch ash and poultry manure each applied at 9t/ha significantly increased plant height over the control.

The effect of poultry manure and palm bunch as on mean ginger rhizome yield combined over the two seasons studied is shown in Table 5. Highest mean ginger rhizome yield of 33.06t/ha was obtained with the application of 9t/ha of palm bunch ash, this however did not differ significant ($P>0.05$) with 31.06t/ha obtained with 3t/ha of palm bunch ash. The mean ginger rhizome yield of 26.6t/ha obtained with the control was significantly ($P<0.05$) smaller than the yields obtained with each of the palm bunch ash rates studied. Significant palm bunch ash x poultry manure interaction on the ginger rhizome yield was obtained. Optimum rhizome yield was obtained with 3t/ha bunch ash mixed with poultry manure.

Application of poultry manure significantly improved all the ginger growth indices (mean number of tillers/plant, plant height and rhizome yield), poultry manure and palm bunch ash improved the yield of ginger, over the control that had neither poultry manure nor palm bunch ash. The result obtained in this study was in agreement with the result obtained by Ano and Emehute (2004) on the complementary effect of poultry manure and inorganic fertilizer on ginger rhizome yield. Soils of the experimental site and indeed most Nigeria soils are highly weathered and have low activity clays (Ano, 1991). Consequently sufficient native nutrients are not available in the soil for good crop growth. This explains why application of poultry manure and palm bunch ash resulted to significant improvement in ginger growth indices. The poultry manure had total N,P, and K levels of 3.00%, 0.85% and 0.85% respectively. In addition to having high level of K, the palm bunch ash had appreciable levels of P, Ca and Mg (Table 1), when the poultry manure and palm bunch ash were applied to the soil, the nutrients they contained were released into the soil system thereby making more nutrients to be available to the ginger plant. Application of palm bunch ash also increases soil pH (Ojeniyi *et al*, 2009). The pH of palm bunch ash in water was found to be 12.5 (Table 1).Application of palm bunch ash would therefore raise the soil pH to a level that will optimize absorption of nutrients by ginger plant, however when the pH of the soil is increased beyond 10 by high levels of palm bunch ash, immobilization of plant nutrients occur. This explains the observed palm bunch ash X poultry manure interaction on ginger plant yield. It can therefore be concluded that for optimum ginger yield on the soil studied 3t/ha each poultry manure and palm bunch ash are required.

Table 1: Chemical properties of palm bunch ash and poultry manure

Palm bunch ash		Poultry manure	
pH	12.45	MC (%)	15.80
Mg	1.80%	DM (%)	84.00
Ca	1.18%	N (%)	3.00
K	2.10%	Ca (%)	2.75
P	1.90%	Mg (%)	0.65
N	0.85%	Na (%)	0.35
		K (%)	0.85
		P (%)	0.85

Table 2: Agro-metrological data on rainfall and temperature for 1999 and 200 cropping seasons

	2010			**2011**		
Months	**Rainfall (mm)**	**Temperature (^oC)**		**Rainfall (mm**	**Temperature (^oC)**	
	Total	**Max**	**Min**	**Total**	**Max**	**Min**
January	0.0	35	23	0.0	33	20
February	78.2	35	24	60.8	33	23
March	34.1	34	24	111.4	34	24
April	129.0	34	24	105.8	33	24
May	138.5	32	24	347.7	32	23
June	427	30	24	239.5	30	23
July	310.2	30	23	236.5	30	22
August	376.7	29	23	345.1	29	23
September	303.3	29	23	424.7	30	23
October	34.9	30	23	242.8	30	23
November	77.8	31	23	12.0	31	23
December	6.4	33	22	9.6	33	21
Total	1916.1	382	280	2135.9	378	272
Mean	159.68	31.8	23.33	177.99	31.5	22.66

Source: NRCRI met station

Table 3: Effect of palm bunch ash and poultry manure on mean number of Tillers /plant at 4MAP (2010 and 2011 cropping seasons combined)

	Mean number of tillers/plant				
	Poultry manure rates (t/ha)				
Palm bunch ash levels (t/ha)	**0**	**3**	**6**	**9**	**Mean**
0	5.5	6.10	6.05	6.80	6.11
3	6.6	6.73	6.73	7.40	6.78
6	5.77	6.23	6.97	6.40	6.34
9	5.40	5.84	7.07	5.84	6.04
Mean	5.82	6.14	6.70	6.61	
LSD (0.05) for poultry manure			0.98		
LSD (0.05) for palm bunch ash			0.98		
LSD (0.05) for poultry manure x palm bunch ash			NS		

Table 4: Effect of palm bunch ash and poultry manure on ginger height/plant (cm) at 4MAP (2010 and 2011 cropping seasons combined)

	Mean of height/plant				
	Poultry manure rates (t/ha)				
Palm bunch ash levels (t/h	**0**	**3**	**6**	**9**	**Mean**
0	48.50	54.43	51.60	56.33	52.72
3	52.60	52.14	55.45	56.54	54.18
6	50.38	57.33	57.33	57.17	55.55
9	56.30	58.63	58.63	55.47	57.26
Mean	51.95	55.63	55.75	56.38	
LSD (0.05) for poultry manure			4.25		
LSD (0.05) for palm bunch ash			4.25		
LSD (0.05) for poultry manure x palm bunch ash			NS		

Table 5: Effect of poultry manure and palm bunch ash on rhizome yield of ginger at harvest (t/ha) (mean over the 2010 and 2011 cropping seasons)

	Mean rhizome yield (t/ha)				
	Poultry manure rates (t/ha)				
Palm bunch ash levels (t/l	**0**	**3**	**6**	**9**	**Mean**
0	14.67	28.58	29.83	33.33	26.60
3	27.50	32.33	32.17	32.25	31.06
6	29.42	27.75	30.67	35.00	30.76
9	30.17	33.17	30.42	38.50	33.06
Mean	25.44	30.47	30.77	34.77	
2011					
LSD (0.05) for poultry manure			3.317		
LSD (0.05) for palm bunch ash			3.317		
LSD (0.05) for poultry manure x palm bunch ash			6.633		

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