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Research Article

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Influence of poultry manure and NPK (15:15:15) fertilizer on the growth and yield of ginger (*Zingiber officinale* Rosc)

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Abstract A field experiment was conducted in the research farm of the federal College of Education Pankshin (9^0 10" N and 9^0 26" E) in the Northern Guinea Savannah Ecological zone of Nigeria the experiment was conducted in 2008 and 2009 wet seasons to investigate the response of poultry manure and NPK fertilization on the growth and yield of ginger. The treatments consisted of four levels of poultry manure (0, 2, 4 and 6t/ha) and four levels of NPK 15:15:15 fertilizer (0, 50,100 and 150kg/ha) which were factorially combined and laid out in a randomized complete block design in three replications. The results revealed that plant height, number of leaves; stem girth, fresh and dry weights of ginger in both years increased significantly. It could therefore, be suggested that for maximum production of ginger, 2t/ha of poultry manure and 100kg /ha of NPK fertilizer be use.

Keywords Ginger, Poultry manure, NPK fertilizer, Yield

Introduction

Ginger (*Zingiber officinale* Rosc.) is an underground rhizome of a grass like plant that grows in the tropics. The importance of ginger cannot be over emphasized. The crop can be consumed as a delicacy, as a spice and for medicinal properties [1]. The production of ginger has increased due to its high demand in chemical, food processing and agro-allied industries [2]. The cultivation of ginger in Nigeria started in 1972 [3] and the area of production by then was restricted especially to kwai in Kaduna state. Ginger production has also spread to areas such as Nasarawa and Plateau State [4].

Poultry manure had been reported to influenced growth and development of ginger [5-7]. It was also reported that poultry manure contains all the essential nutrients that can be required by crops for growth and development [8]. Arunah and Ibrahim reported that poultry manure applied to ginger at the rate of 4t/ha produced ginger plants. Similarly, Ayuba et al. [9] also reported increased yield in ginger with up to 2t/ha of poultry manure.

NPK fertilizer application to crops increased up- growth and also help in the formation of chlorophyll. Nitrogen application promotes vegetative growth, plant height, crude protein and yield [10]. The low fertility of agricultural soil in Africa is one of the main causes of food insecurity.

The production of ginger has remained very low and this could be attributed to lack of definite recommendations on fertilizer rates for soil management and high yield of ginger in the guinea savannah of Nigeria. This study was therefore undertaken to determine the appropriate NPK fertilizer rates and poultry manure that could give higher yield in ginger in the guinea savannah of Nigeria.

Materials and Methods

A field experiment was conducted at the Research farm of the Federal College of Education Pankshin (09 ^{o} 10 N and latitude 9 ^{0} and 26 E) in the Northern Guinea Savannah Ecological Zone of Nigeria during the 2008and 2009 raining seasons. They had an average rainfall of 1020mm and 1420mm in 2008 and 2009 respectively with a mean monthly temperature of 42 ^{o}C. The Physio-chemical analysis of soil of the experimental site revealed that the soil was a tropical sandy loam with a pH of 6.34 (Field survey, 2008).

The treatment consisted of four poultry manure levels (0,2,4 and 6t/ha) and four levels of NPK fertilizer (0, 5^{0},100 and 150k^{0}/ha) which were factorially combined and laid out in a randomized complete block design in three applications. The crop was planted on the 10th of day of each year at a spacing of 30cm ×30cm, one meter was allowed between replications and 0.5m between plots. The depth of planting was 4.0cm as described by various researchers [11]. The poultry manure was applied during the land preparations, the NPK fertilizer was applied during planting, at six weeks after planting according to the treatments. The experimental site was weeded manually using hand pulling and hoeing to maintain a weed free plot.

The parameters assessed were plant height, number of leaves, leaf length, stem girth, fresh and dry weight per hectare during each year. All the data collected were statistically analyzer using F test as described by Steel and Torrie [12] and least significance difference (LSD) was used to separate the means.

Table 1: Effect of poultry manure and NPK fertilizer on plant height of ginger at various growth stages during the 2008 and 2009 wet seasons

Treatment	2008		2009	
	15	18	15	18
Poultry manure (t/ha)				
0	29.89	37.55a	36.01a	42.20b
2	29.15	38.29a	35.21a	44.52a
4	27.12	33.46b	35.04a	42.31b
6	29.21	34.30b	35.34b	39.80c
LS	NS	**	**	**
LSD (0.05)	-	1.87	1.43	0.84
NPK (kg/ha)				
0	30.4	37.70a	33.70b	42.53b
50	30.79	34.88b	36.96a	44.09a
100	27.5	34.88b	34.15b	42.64b
150	26.66	32.14c	31.72c	39.63c
LS	NS	**	*	*
LSD (0.05)	-	1.89	1.43	0.84

*and** =significant at 5% and 1% level of probability, respectively. NS = Not significant.

Means followed by the same letter(s) within a treatment group are not statistically significant using LSD0.05

Table 2: Effect of poultry manure and NPK fertilizer on the number of leave per plant of ginger at various growth stage during the 2008 and 2009 wet seasons.

Treatment	2008		2009	
	15	18	15	18
Poultry manure (t/ha)				
0	7.75a	9.33a	9.33	11.91c
2	7.58b	9.39a	9.66	12.91b
4	7.00c	8.59b	9.25	15.50a
6	7.08c	9.16a	9.16	11.33a
LS	*	**	NS	**
LSD (0.05)	0.14	0.54	-	0.53
NPK (kg/ha)				
0	7.08	9	9.50a	12.25bc
50	7.66	9.5	9.41a	12.00c
100	7.15	9.08	9.75	12.58b
150	7.5	9.41	8.75a	16.83a
LS	NS	NS	**	**
LSD (0.05)	-	-	-	0.53

*and ** = significant at 5% and 1% level of probability, respectively. NS =Not significant.
Means followed by the same letter (s) within a treatment group are not statistically significant using LSD0.05

Table 3: Effect of poultry manure and NPK fertilizer on the stem girth of ginger at Various growth stages during 2008 and 2009 wet seasons

Treatment	2008		2009	
	15	18	15	18
Poultry manure (t/ha)				
0	4.41	5.32a	4.75b	5.15c
2	4.5	5.20b	5.08a	5.79a
4	4.55	5.17bc	4.77b	5.40ab
6	4.38	5.09c	4.70b	5.22bc
LS	NS	**	**	**
LSD (0.05)	-	0.11	0.11	0.21
NPK (kg/ha)				
0	4.6	5.49b	4.6	5,05c
50	4.5	5.29c	5.00a	5.75a
100	4.34	5.04d	4.53c	5.20bc
150	4.39	5.96a	4.88b	5.36b
LS	NS	**	**	**
LSD (0.05)	-	0.11	-	0.21

*and** = significant at 5% and 1% level of probability, NS = not significant
Means followed by the same letter(s) within a treatment are not statistically significant using LSD0.05

Table 4: Effect of poultry manure and NPK fertilizer on fresh weight (kg) of ginger per hectare in 2008 and 2009 wet seasons

Treatment	2008	2009
Poultry manure (t/h)		
0	1712.50c	1910.33b
2	2458.33a	2208.33a
4	1770.83b	1520.83a
6	1812.50b	1583.33c
LS	*	*
LSD (0.05)	62.4	43.5
NPK (kg/ha)		
0	1875.00b	1800.00c
50	2000.00a	1854.16b
100	2000.0a	1937.50a
150	1979.16a	1479.16d
LS	*	*
LSD (0.05)	62.4	43.5

*and** =significant at 5% and 1% level of probability, respectively NS =Not significant
Means followed by the same letter(s) within a treatment group are not statistically significant using LSD 0.05

Table 5: Effect of poultry manure and NPK fertilizer on dry weight (kg) of ginger per hectare in 2008 and 2009 wet seasons

Treatment	2008	2009
Poultry manure (t/he)		
0	1495.83c	1708.33c
2	2208.33a	1895.83b
4	1500.00b	2183.33a
6	1516.66b	1708.33c
LS	*	*
LSD (0.05)	64.7	48.7
NPK (kg/ha)		
0	1579.16c	1937.50b

50	1662.50b	1558.33d
100	1958.33a	1750.00c
150	1520.83c	2250.00a
LS	*	*
LSD (0.05)	64.7	48.7

*and **=significant at 5% and 1% level of probability, respectively. NS= not significant
Means followed by the same letter(s) within a treatment group are not statistically significant using LSD0.05

Results

Result in Table 1: shows the effect poultry manure and NPK fertilizer on plant height of ginger during 2008 and 2009 wet seasons. The differences in the means of plant height were found to be significantly affected by poultry manure levels in both years of the study. At 18 WAS in 2008, 2t/ha of poultry manure produced a similar height of ginger plants with the control which were significantly taller than the other poultry manure rates. However at 15 WAS in 2009, all the poultry manure rates produced similar plant height with control except 6t/ha which produced shorter plants.

At 18 WAS in 2009 wet seasons, 2/ha of poultry manure produced the tallest plants. It was followed by 4t/ha and the control were similar but significantly taller than the plant height obtain when 6t/ha was applied. The effect of NPK was found to be significant on the plant height of ginger at 18 WAS in 2008 and 2009. At 18 WAS in 2008, the control produced the tallest plants. It was followed by 50kg/ha and 100kg/ha which were similar but significantly taller than 150kg/ha. The result followed similar trend in 2009 for both 15 and 18 WAS, where 50 kg/ha NPK Produced tallest plants.it was followed by 0kg/ha and 100k/ha which were similar but significantly taller than 150g/ha.

The effect of poultry manure and NPK fertilizer on the number of leaves of ginger is shown in Table 2. Poultry manure application significantly affected the number of leaves of ginger ta 15 and 18 WAS in both in study years. At 15 WAS in 2008, the control produced the highest number of leaves followed by 2t/ha which produced significantly higher number of leaves of ginger than the other poultry manure levels. However, at 18 WAS, 2t/ha and 6t/ha produced similar number of leaves with the control. The lowest number of leaves was produced when 4t/ha of poultry manure was applied. However, at 18 WAS in 2009 season 4t/ha produced the highest number of leaves. It was followed by 2t/ha which had a significantly highest number of leaves than the other poultry manure rates the control produced significantly higher number of leaves than 6t/ha.

The effect of NPK rates on the number of leaves of ginger was not significant in 2008: however, NPK application significantly, affected the number of leaves in 2009 wet season. At 15 WAS 50kg NPK/ha and 100kg NPK/ha produced similar number of leaves with the control. The lowest number of leaves was obtained when 150kg NPK/ha was used among all the other NPK rates in 2009 season. It was followed by 100kg NPK/ha and the control which were similar but significantly higher than 50kg NPK/ha.

The effect of poultry manure and NPK application on the stem girth of ginger during the 2008 and 2009 raining seasons is presented in Table 3. The stem girth was significantly affected by poultry manure application 15 and 18 WAS in 2008 and 18WAS in 2009. The application at 2t/ha of poultry manure produced significantly higher stem girth at 15 WAS and 18 WAS in 2008 season. However, in 2009, the control produced the highest stem girth than all the applied poultry manure levels. It was followed by 2t/ha which produced similar stem girth with 4t/ha but significantly higher than at 6t/ha. The effect of NPK application significantly affected the stem girth at both 15 and 18 WAS in 2008 and at 18 WAS in 2009. 50kg NPK/ha. Produced the highest stem girth. It was followed by 150kgNPK/ha. However, 0kgNPK/ ha and 100kgNPK/ha had similar stem girth in 2009 season. The highest stem girth was obtained when 100kgNPK/ha was used.

The effect of poultry manure and NPK fertilizer on the fresh weight of ginger during the 2008 and 2009 wet season is presented in Table 4. Poultry manure application significantly influenced the fresh weight of ginger per hectare with 2t/ha producing the highest fresh weigh per hectare in all the years. All the rates of applied NPK produced similar fresh weights which were significantly higher than control during the 2008 seasons. However, in 2009 season, 100kgNPK/ha produced the highest fresh weight.

Table 5 shows the effect of poultry manure and NPK application on the dry weight per hectare. The poultry manure application NPK fertilization significantly influenced the dry weight of ginger in all the years of

experimentation. In 2008 season, 2t/ha of poultry manure produced the highest dry weight. It was followed dry 4 and 6t/ha which were similar but significantly higher than control. In 2009, 4t/ha produced the highest dry weight. It was followed by 2t/ha which had higher dry weight than the other poultry manure rates. The application of 100kgNPK/ha rate had the highest dry weight in 2008. It was followed by 50kgNPK/ha which had significantly higher dry weight than the other NPK rates. In 2009 season, 150kgNPK/ha produced higher dry weight per hectare and the lowest was obtained when 100kgNPK/ha was applied.

Discussion

The performance of ginger was significantly affected by poultry manure application. The parameters assessed responded to both poultry manure and NPK application rates. The plant height of ginger was significantly increased with increase in poultry manure application up to 2t/ha in both years. Taller plants were obtained when 2t/ha of poultry manure was used in both 2008 and 2009 seasons having the average height of 35.29cm and 44.52cm in 2008 and 2009 respectively and significant increase in plants height had also been observed by Sharma and Jabrin [13], Lee and Asher [14] and Aruna and Ibrahim [15].

An increase or decrease in the number of any crop has a direct bearing on the photosynthetic ability of the crop. Application of poultry manure and NPK fertilizer has significantly affected the number of leaves of ginger in 2009 season. The increase in the number of leaves might be due to available nutrient as reported by Lee and Asher [14]. The application of poultry manure significantly increased the stem girth of ginger, 2t/ha of poultry manure and 50kgNPK/ha produced the highest stem girth than the other rates.

Fresh and dry weight is a function of genetic as well as environmental factors which play a vital role in plant growth and development. The fresh and dry weight were significantly affected by both organic and inorganic fertilizers. The treatment receiving poultry manure at the rate of 2t/ha and 50kgNPK/ha produce the highest fresh weight in 2008 and 2009. However, 2t/ha of poultry manure and 100kgNPK/ha produced the highest dry weight in 2008, while in 2009 4t/ha and 150kg NPK/ha of poultry manure and NPK respectively produce the highest dry weight of ginger.

The increase in yield with increased fertilizer application was probably due to the higher number of leaves; taller plants and wider stem girth. The result agreed with the finding of Arunah and Ibrahim [15], Ayuba et al. [9] and singh [16]. Based on the result of this experiment, it could be concluded that for maximum production of ginger, 2t/ha of poultry manure and 100kgNPK/ha could be suggested for use in the Northern Guinea Savannah of Nigeria.

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