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Research Article

Effect of cattle manure and inorganic fertilizer on the growth and yield of hybrid maize (*Zea mays* L.)

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The high cost of inorganic fertilizer and continuous decline in soil fertility results to low crop yield hence, the need to supplement mineral fertilizer with organic manure. Field experiments were conducted in 2013 and 2014 cropping seasons at the Teaching and Research Farm, Abubakar Tafawa Balewa University, Gubi, Bauchi State, Nigeria, to investigate the effects of different levels of cattle manure, CM, (0, 5 and 10 t/ha) and NPK (0, 200 and 400kg/ha) on the growth, yield and yield components of hybrid maize (*Zea mays* L.). These treatment combinations were replicated three times in a randomized complete block design. CM levels had significant effect (P≤0.05) on number of leaves per plant and plant height. However, NPK levels also had significant effect on many characters in both 2013 and 2014 but lower mean values were recorded in 2013. In 2014, significant interactions were observed in mean number of leaves, plant height, husk weight and yield (t/ha). The highest seed yield (5.65t/ha) was obtained when 5t/ha CM was used, which was statistically similar (5.60t/ha) to 400kg/ha inorganic fertilizer used. The application of 5t/ha CM or 400kg/ha NPK is recommended for improved production of hybrid maize in the study area.

Key words: Cattle manure, hybrid, inorganic fertilizer, maize, NPK, *Zea mays*.

INTRODUCTION

In Africa, maize is used as both human food and animal feeds. More than 70% of maize is produced by resource poor small-scale farmers in Africa with a very low yield of less than 1.5t/ha due to low soil fertility among other factors (Salasya *et al*., 1998). Maize is an important cereal crop in Nigeria and a versatile crop which ranks third following wheat and rice in world production (Food and Agriculture Organization [FAO], 2007, FAO, 2002). It is produced extensively in Nigeria, where it is consumed roasted, baked, fried, pounded or fermented (Agbato, 2003). All parts of maize: the stalks, leaves, grain and immature ears are used as livestock feeds (Dutt, 2005). Organic manures have been reported by Delate, and Camberdella, (2004) as a good source of plant nutrient because it contains both macro and micronutrients. The application of animal manures to agricultural fields is a widely used method of increasing soil organic matter and fertility.

In a study by Enujeke (2013) using organic manure and inorganic fertilizer in Asaba, Delta State, results indicated that maize plants treated with inorganic fertilizer NPK 20:10:10 at the rate of 450kg/ha gave the highest number of grains/cob (506.0) followed by plants that received poultry manure at the rate of 30 t/ha (468.0). Plants that received cattle dung had the lowest number of grains/cob.

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Similarly, Oluwafemi and Funsho (2015) conducted a study on "Response of hybrid maize, (Zea mays L.) to organic and inorganic fertilizers in soils of South-West and North-Central Nigeria". Poultry manure applied at planting + foliar NPK at 6 weeks after sowing produced the highest plant height, stem girth, leaf area, kernel yield and weight per 100 kernels which suggest that maize can be organically fertilized to produce high yield in these locations without Chemical fertilizer which could be harmful to our soils and humans.

A field trial was also carried out by Afe et al (2015) at the Teaching and Research Farm of Kwara State University, Malete, Nigeria to "Assess the response of early maturing maize variety (TZEE-Y) using organic poultry manure (pm) alone or in combination with inorganic (NPK) and foliar fertilizer (boost xtra). The highest grain yield was obtained when poultry manure was applied alone at 10 t/ha which was also similar to the combined application of poultry manure at 2.5t/ha mixed with NPK 30 kg N/ha and foliar fertilizer. This integrated application was found to be a good soil management practice for tropical soils. Therefore, combination of pm at 2.5 t/ha with NPK 30 kg N/ha and foliar fertilizer was recommended for early maturing maize production in the study area.

Amujoyegbe *et al.* (2007) carried out a study on the "Effects of amending soil with organic (poultry manure) and inorganic fertilizer on yield and chlorophyll content of maize (*Zea mays* L.) and sorghum (*Sorghum bicolour* (L.) Moench)" at the Teaching and Research Farm of the Obafemi Awolowo University, Ile - Ife, Nigeria. The highest leaf area and total chlorophyl content of both maize and sorghum was obtained using the 2.76t/ha + 25kg/ha combination of organic and inorganic fertilizer respectively. Similar study on the effect of organic manure, cow dung and NPK on the growth rate of maize at the University of Abuja revealed that the NPK treatment gave significantly high number of leaves, tallest plants and thicker stems girth while the control had the least values (Solomon *et al*., 2012).

In a comparative study of hybrid and open-pollinated varieties in different ecological zones of Nigeria, the results confirmed that hybrid has yield advantage over open-pollinated varieties especially with respect to grain yield. Hybrid seeds are also more vigorous and have higher rate of survival, have reduced plant and ear height and are more uniform for height, flowering and maturity than open-pollinated varieties among other characteristics (Kim *et al.,* 1993). Abayomi and Badiru (2007) reported that maize morphological growth parameters such as number of leaves per plant, plant height, leaf area per plant and leaf area index were higher in hybrid than in the open pollinated variety, consequently, grain yield in hybrid maize variety was also higher than in the open pollinated variety.

The use of inorganic fertilizers alone under intensive agriculture was found to aggravate soil degradation (Sharma and Mittra, 1991). Consequently, this degradation is as a result of loss of organic matter which causes soil acidity, nutrient imbalance and low crop yields (Ayoola and Makinde, 2007). Application of organic manures has also been found to improve the soil physical and microbial properties (Belay *et al*., 2001). Due to continuous decline in soil fertility as a result of using mineral fertilizers alone and the high cost of the inorganic which has put the commodity out of reach of most poor resource farmers resulted to low maize yield, there is the need to supplement mineral fertilizer with cattle manure to tackle this issue. Therefore this research was conducted to determine the effect of cattle manure and inorganic fertilizer on the growth and yield of hybrid maize with a view to help boost commercial maize production in the study area.

MATERIALS AND METHODS

Experimental Site and Materials

The experiments were carried out during the 2013 and 2014 cropping seasons at Gubi (latitude $10^{o}28^{1}$north and longitude $09^{0}49^{1}$east at 600metre above sea level), experimental site of the Abubakar Tafawa Balewa University Research and Teaching Farm Ganjuwa Local Government Area of Bauchi State, Nigeria. Bauchi is found in the northern guinea savanna zone of Nigeria. Cattle manure (CM) and inorganic fertilizer (NPK 20:10:10) were used in this study. Both treatments had three levels. CM had 0, 5 and 10 t/ha and NPK had 0, 200 and 400kg/ha of application. The cattle manure (CM) was obtained from the Abubakar Tafawa Balewa University farm while NPK was bought from Bauchi market. Seeds of hybrid maize known as "Oba Super 2" obtained from Premier Seed Company of Nigeria, was used as planting materials.

Physical and Chemical Properties of Soil at the Experimental Site

Soil samples were collected from the experimental sites at a depth of 0–15cm and 15–30 cm using a soil auger after ploughing the land. The soil samples were analyzed for Particle size distribution which was determined by hydrometer method as described by Gee and Bauder, (1996). Sand, silt and clay fractions were determined by dispersing the soil sample in 5% sodium hexametaphosphate (Calgon) solution. The dispersed samples were shaken on a reciprocating shaker after which particle size distribution was determined with the aid of Bouyoucous hydrometer at progressive time intervals. The soil pH was determined in both water and 0.01M $CaCl_2$ at ratios 1:1 and 1:2 respectively of soil water suspension, using pH meter model Cyber Scan pH^{20}. Organic carbon content was determined by the wet

oxidation method of Walkley and Black as described by Nelson and Sommers (1982), available phosphorus was extracted using Bray –1 method (Bray and Kurtz, 1945) while total nitrogen was determined using the micro–Kjeldahl technique as described by Bremner (1982).

Meteorological data covering the experimental period in 2013 and 2014.

Meteorological data covering the experimental period in 2013 and 2014 was obtained from the Nigerian Meteorological Agency in order to determine variation in weather and its effect on maize production.

Experimental design and agronomic practices

The experimental design used was randomized complete block design (RCBD) with three replications. The land was ploughed using a disc plough and harrowed manually to give a fine tilth before the seeds were sown. The spacing from row to row was 75cm while spacing from plant to plant within a row was 25cm. Thus, each plot had a size of 2.5m by 1.5m or 3.75m^2. The seeds were sown on a flat area and each plot had 20 maize plants or 53,333 plants per hectare based on the recommendation of Iken and Anusa (2004). Weeding was done manually at 3 and 6 weeks after sowing (WAS). 0ther agronomic practices were carried out according to standard practices for maize production. Harvesting was carried out when the crops have reached physiological maturity. This was noticed when the cobs and shoots were fully dried.

Data Collection and Analysis

The numbers of leaves of each plant in a plot were counted and at two weekly intervals. Plant height was measured from the ground level up to the growing tip using a meter rule at two weekly intervals (2, ,…10WAS). Mean number of days to tasseling was recorded from the time of sowing to the time when the first plant in each plot tasseled and when 50% of the plants tasseled. The number of first node on which the cobs emerged was recorded by counting the nodes from the ground level and recorded as first node with cobs. The number of cobs produced on each plant was counted and recorded to obtain the mean number of cobs/plant. The husk of each cob was weighed (g). The numbers of seed on each cob of a plant were counted. The shelled seeds on each cob were weighed and the mean recorded as seed yield in tons per hectare (t/ha). All seeds of a plot were first mixed well and 100 seeds randomly picked and weighed to obtain 100 grain weight (g).

Data Analysis: The data collected was subjected to analysis of variance using Minitab software. Means that were found to be statistically significant (P≤0.05) were separated using the least significant difference (LSD) as described by Steel and Torrie (1987).

RESULTS AND DISCUSSION

Physico-Chemical Properties of Soil at the Experimental Sites

Particle size distribution of the soil at the experimental site at 0-15 and 15-30cm depth is presented in Table 1. The percentage of sand appears to be higher at 0- 15 (64.2 to 64.4%) when compare with the depth of 15-30 (60.4 to 62.4%) in 2013 and 2014 cropping seasons. Percentage of silt was higher in 2013 at both depths when compare with 2014. Seasonal differences in soil characteristics and mineral constituents are likely due to differences in climatic factors such as rainfall and temperature as experience during the years (2013 and 2014) under study. The percentage of clay ranges from 28.3 to 31.3; therefore, the experimental sites for both years appear to be sandy clay.

The chemical properties of the experimental site are also presented in Table 1. The *pH* at 15-30cm depths appears to be lower than the pH at 0-15cm depth. The same pattern was also observed in pHc. Organic carbon, total nitrogen, calcium, magnesium, potassium, cation exchange capacity and copper had lower value at 15-30cm depths than at 0-15cm depths irrespective of the year. The mean value for available phosphorus (5.35-7.20mgkg^{-1}) obtained in this study is similar to the values reported by Mamzing *et al*. (2014). The Authors reported available phosphorus ranged from 5.43 to 7.64mgkg^{-1} at soil depths of 0-15 and 15.30cm at two fadama locations in Bauchi state of Nigeria.

Meteorological data covering the experimental period in 2013 and 2014.

Table 2 shows the average rainfall, temperature and relative humidity of the two cropping seasons. The results showed that there was high rainfall in 2013 than 2014 with similar mean temperature and relative humidity. The total amount of rainfall in 2013 during the growing period of the maize plants from July to October was 1516.7mm; while during the period in 2014 was 936.4mm (Table 2). Furthermore, the rainfall in 2013 was not well spread because it rained from May to October but well spread in 2014 with rainfall from February to October. This observed trend in weather change may affect the nutrient statue of the soil and subsequently may affect the development of crops. Hence, the heavy rainfall in 2013 may have caused leaching of nutrients which reduced maize growth. Olatunji *et tal.* (2007) similarly reported that the low level of total nitrogen in the Niger Delta area of Nigeria could be due to high temperature and leaching

Table 1. Physico-chemical properties of soil at the experimental sites in 2013 and 2014 cropping seasons

Parameters	2013		2014	
	0 – 15	15 -30	0 - 15	15- 30
Particle size distribution				
Sand %	62.40	60.40	64.40	62.40
Silt %	9.28	9.28	5.28	6.28
Clay %	28.32	30.32	30.32	31.33
Textural class	sandy	clay	sandy	Clay
Chemical properties				
pHw (1:1)	6.45	5.92	6.23	5.66
pHc (1:2)	5.25	5.06	5.17	4.59
Organic carbon (gkg^{-1})	0.83	0.42	0.81	0.52
Total nitrogen (gkg^{-1})	0.07	0.05	0.10	0.07
Available phosphorus ($mgkg^{-1}$)	6.25	5.35	4.54	7.20
Calcium [cmol (+) kg^{-1}]	2.98	2.16	2.59	2.03
Magnesium [cmol (+) kg^{-1}]	0.75	0.55	0.83	0.53
Potassium [cmol (+) kg^{-1}]	0.21	0.18	0.26	0.17
Sodium [cmol (+) kg^{-1}]	0.19	0.20	0.16	0.20
Cation exchange capacity [cmol (+) kg^{-1}]	4.63	4.06	4.06	3.64
Zinc ($mgkg^{-1}$)	0.21	0.23	0.18	0.09
Copper ($mgkg^{-1}$)	0.17	0.16	0.13	0.06
Iron ($mgkg^{-1}$)	9.26	7.88	7.68	9.68
Manganese ($mgkg^{-1}$)	13.84	17.25	18.11	21.06

Table 2. Meteorological data covering the experimental period in 2013 and 2014

	2013			2014		
Month	Total Rainfall (mm)	Mean Monthly Temperature (^{O}C)	Mean Monthly Relative Humidity (%)	Total Rainfall (mm)	Mean Monthly Temperature (^{O}C)	Mean Monthly Relative Humidity (%)
January	0.0	25.1	21	0.0	25.6	33
February	0.0	28.0	18	16.8	26.6	18
March	0.0	33.7	20	1.6	31.4	26
April	41.7	32.4	42	17.4	32.6	41
May	61.9	30.3	53	170.5	29.7	57
June	171.0	27.8	62	253.0	28.5	61
July	569.0	25.9	71	347.0	26.9	69
August	707.0	24.7	77	376.6	26.0	72
September	126.0	26.8	69	197.6	26.6	71
October	114.7	28.5	49	15.2	28.8	54
November	0.0	30.1	23	0.0	28.6	33
December	0.0	26.3	33	0.0	24.4	20

Source: Nigerian Meteorological Agency

of' nitrate by torrential rainfall prevalent in the environment.

Mean Number of Leaves per Plant: Mean number of leaves for each level of CM and NPK at two week intervals are presented in Table 3. There was no significant difference (P≥0.05) in mean number of leaves per plant among the CM treatments in 2013. In 2014 however, there was a significant differences (P≤0.05) in mean number of leaves among CM levels at 4, 6 and 8WAS. Mean number of leaves increased as CM level increased from 0 – 5t/ha. The non significant effect of cattle manure on leaf number per plant in 2013 might be attributed heavy rainfall experience in that year which might have caused leaching of nutrients and hence reduced maize growth while in 2014, the uniform distribution of rainfall from February to October might have increase maize growth. Olatunji *et al.* (2007) reported that the low level of total nitrogen in the Niger Delta area of Nigeria could be due to high temperature and leaching of' nitrate by torrential rainfall prevalent in the environment. The mean number of leaves differed significantly (P≤0.05) for the different levels of NPK, except at 4 and 6WAS. Mean number of leaves increased as inorganic fertilizer level increased in 2013, while there was significant difference (P≤0.05) among the means of NPK levels throughout the sampling period in 2014. Mean number of leaves increased as NPK levels

Table 3. Number of leaves per plant at 2 weeks interval

Cattle manure (t/ha)	Weeks after sowing (WAS)				
2013	2	4	6	8	10
0	4.30	6.60	9.07	12.12	12.52
5	4.30	6.75	9.21	12.32	12.53
10	4.32	6.76	9.28	12.22	12.71
SE±	0.034	0.099	0.148	0.203	0.157
2014					
0	4.66	8.78	11.74	13.76	12.55
5	4.68	9.39	12.36	14.77	12.83
10	4.72	9.15	12.00	14.24	12.65
LSD (P≤ 0.05)	-	0.320	0.452	0.481	-
SE±	0.040	-	-	-	0.181
Inorganic fertilizer kg/ha)					
2013					
0	4.19	6.60	9.10	11.94	12.11
200	4.26	6.65	9.14	12.07	12.46
400	4.47	6.68	9.34	12.65	13.20
LSD (P≤ 0.05)	0.118	-	-	0.501	0.363
SE±	-	0.099	0.148	-	-
2014					
0	4.57	8.37	10.91	13.16	12.10
200	4.74	9.55	12.53	14.74	12.55
400	4.75	9.41	12.67	14.86	13.38
LSD (P≤ 0.05)	0.152	0.320	0.452	0.481	0.345
Interactions: 2013	NS	NS	NS	NS	NS
Interactions: 2014	NS	**	***	NS	**

increased except at 4WAS (Table 3). This is in agreement with the finding of Solomon *et al.* (2010) who reported that number of leaves of maize plant treated with NPK was highest followed by cowdung while the lowest was observed in the control in Abuja, Nigeria.

P**lant Height (cm):** There was no significant differences (P≥0.05) in mean plant height among CM levels in both years except at 10WAS in 2014 (Table 4). This could be probably due to slow release of nutrients in cattle manure. However, significant differences (P≤0.05) among the means of NPK levels were observed at 2 and 4WAS in 2013. In 2014, there was significant difference (P≤0.05) among the means of NPK levels except at 2 WAS (Table 4). Plant height increased as inorganic fertilizer level increased. The significant effect of Inorganic fertilizer was probably because its nutrients are readily available for plant uptake. This agreed with the findings reported by Achieng *et al.* (2010) who observed significantly taller maize plants in plots treated with inorganic fertilizer.

Days to First Tasseling, Days to 50% Tasseling and First Cob with Node**:** Mean values for number of days to first tasseling, days to 50% tasseling and first node number with cob per plant for each of the CM and NPK levels are presented in Table 5. There was no significant difference among CM means for all the three characters in both 2013 and 2014. There were significant differences (P≤0.05) in mean days to first and 50% tasseling among the NPK levels in 2013 but significant difference (P≤0.05) among NPK levels means was observed throughout the sampling period in 2014 for all the characters studied. The early tasseling observed in NPK treatment could be attributed to nutrients which are readily available to the crop and thus, induce early tasseling while cattle manure due the slow release of its nutrient for uptake by plants probably delays the tasseling period. Afe *et al.* (2015) similarly discovered that maize plots treated with combined application of pm at 2.5 t/ha mixed with NPK 30 kg N/ha and foliar fertilizer commenced tasseling earlier while late tasseling was recorded at the control treatments. However, the delayed in tasseling period observed in 2013 when the highest level of inorganic fertilizer was used could be as a result of the heavy rainfall experience in that year which might have caused leaching of nutrients. Maize plants fertilized with cattle manure and NPK treatment had their first node with cobs on the 7th and 8th nodes in 2013 and 2014 respectively

Cobs and Seed Parameters: The mean values for number of cobs, husk weight, number of seeds, seed yield and 100 seed weight are presented in Table 6. There were no significant differences (P≥0.05) among the

Table 4. Mean plant height (cm) at 2 weeks interval

Cattle manure (t/ha)	Weeks after sowing (WAS)				
2013	2	4	6	8	10
0	8.26	19.84	47.51	104.67	169.29
5	8.61	20.97	50.82	111.99	174.50
10	8.61	20.71	50.56	117.83	173.43
SE±	0.187	0.694	1.615	3.847	5.469
2014					
0	8.25	29.17	65.63	151.22	199.09
5	8.45	30.77	72.02	171.61	213.34
10	8.31	30.21	70.66	165.74	208.09
LSD (P≤ 0.05)	-	-	-	-	10.068
SE±	0.152	1.101	2.573	5.392	-
Inorganic fertilizer kg/ha)					
2013					
0	7.95	20.15	48.65	108.41	166.85
200	8.54	20.18	48.84	110.25	173.08
400	9.52	20.20	51.41	115.84	177.28
LSD (P≤ 0.05)	0.595	1.824	-	-	-
SE±	-	-	1.615	3.847	5.469
2014					
0	7.95	24.90	58.47	146.61	190.16
200	8.54	32.36	72.83	165.89	211.09
400	8.52	32.90	77.01	176.05	219.27
LSD (P≤ 0.05)	-	2.844	6.009	14.548	10.068
SE±	0.152	-	-	-	-
Interactions 2013	NS	NS	NS	NS	NS
Interactions 2014	NS	NS	NS	NS	***

Table 5. Mean values for number of days to first tasseling, 50% tasseling and first cob node as affected by different levels of cattle manure and inorganic fertilizer in 2013 and 2014

Cattle manure (t/ha)	DFT	D50%T	FCN
2013			
0	58.89	66.41	6.62
5	58.33	65.52	6.85
10	57.74	65.00	6.87
SE±	0.455	0.417	0.112
2014			
0	53.59	59.33	7.68
5	51.93	57.93	7.92
10	51.74	57.82	7.97
SE±	0.610	0.640	0.190
Inorganic fertilizer (kg/ha)			
2013			
0	58.11	65.04	6.53
200	58.56	65.48	6.80
400	58.30	66.41	7.00
LSD (P≤ 0.05)	-	-	0.225
SE±	0.455	0.417	-
2014			
0	54.15	60.30	7.07
200	51.78	57.41	8.17
400	51.34	57.33	8.33
LSD (P≤ 0.05)	1.889	1.468	0.461
Interactions: 2013	NS	NS	NS
Interactions: 2014	NS	NS	NS

DFT = number of days to first tasseling; D50%T = number of days to 50% tasseling and FCN = first cob node

Table 6. Mean for number of cobs, husk weight, number of seeds, seed weight and 100 seed weight at different levels of cattle manure and inorganic fertilizer in 2013 and 2014

Cattle manure (t/ha)	NC/P	HW/P (g)	NS/P	SY/P (t/ha)	100SW (g)
2013					
0	1.02	19.47	360.32	3.46	18.00
5	1.03	21.08	383.73	4.05	19.70
10	11.04	23.02	381.54	3.81	20.67
SE±	0.008	1.156	10.174	0.147	0.488
2014					
0	1.10	33.70	448.74	5.12	21.33
5	1.11	30.74	625.07	5.65	21.44
10	1.14	21.98	476.64	5.12	21.52
LSD (P≤ 0.05)	-	0.005	-	-	-
SE±	0.019	-	45.588	0.193	0.578
Inorganic fertilizer kg/ha)					
2013					
0	1.03	19.29	360.39	3.68	19.11
200	1.03	20.07	369.64	3.81	19.26
400	1.03	24.21	395.55	3.83	19.37
LSD (P≤ 0.05)	-	3.554	-	-	-
SE±	0.008	-	10.174	0.147	0.488
2014					
0	1.05	26.30	439.65	4.96	21.04
200	1.10	31.85	605.35	5.33	21.56
400	1.20	34.44	505.45	5.60	21.70
LSD (P≤ 0.05)	0.195	0.067	-	-	-
SE±	-	-	45.588	0.193	0.578
Interactions: 2013	NS	NS	NS	NS	NS
Interactions: 2014	NS	*	NS	*	NS

NC/p = number of cobs per plant, HW/p = husk weight per plant, NS/p = number of seeds per plant, SY (t/ha) = seed yield (tons/ hectare), 100SW (g) = 100 seed weight

CM treatments for all of the five characters in both 2013 and 2014, except husks weight per plant in 2014. Application of 5t/ha CM gave the highest number of seeds per plant (625.07) and seed yield (5.65t/ha) in 2014, it was however statistically similar to other treatments. This high number of seeds and seed yield suggest that cattle manure at the rate of 5t/ha have the potential to improve maize yields significantly over the control. NPK treatment in 2014 at the rate of 400kg/ha gave significantly (P≤0.05) highest number of cobs per plant (1.20) and husk weight per plant (34.44g). This NPK treatment (400kg/ha) also gave higher weight of 100 seeds in 2014, though it was statistically similar to other treatments. The significant effect of plants that received NPK fertilizer on number of cobs and husks weight could be attributed to nutrients that are in readily available form for plant uptake for better yield enhancement over other nutrient sources. Previous study by Solomon *et al.* (2012) also revealed that NPK fertilizer increased both growth and yield parameters of maize than cow dung, though statistically the same but significantly higher compared to the control. Enujeke (2013) similarly reported that maize plants treated with inorganic fertilizer NPK 20:10:10 at the rate of 450kg/ha gave the highest number of grains/cob (506.0) followed by plants that received poultry manure at the rate of 30kg/ha (468.0) while plants that received cattle dung had the lowest number of grains/cob among the treatments applied.

CONCLUSION AND RECOMMENDATIONS

From the results of this study, both cattle manure and inorganic fertilizers were found to significantly increase the growth and yield attributes of hybrid maize. Variation in weather during the period of study might be responsible for differences in the growth and yield between the two years. The results revealed that 5t/ha cattle manure gave the highest number of leaves, plant height and the yield and yield components of maize which was statistically the same as the application of 400kg/ha inorganic fertilizer. Maize plants fertilized with high level of both cattle manure and inorganic fertilizer tasseled early. Therefore cattle manure where available can serve as a good nutrient source to supplement inorganic fertilizer.

RECOMMENDATIONS

i. 5t/ha cattle manure is recommended for farmers who want to practice organic farming
ii. In the interim, 400kg/ha inorganic fertilizer may be used by farmers who prefer inorganic fertilizer
iii. More research work need to be conducted to determine the effect applying higher level of inorganic fertilizer in order to draw valid conclusion.

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