



Effect of Poultry Droppings and Inorganic Fertilizer on the Growth and Yield of Maize (*Zea mays*) in Ikwo, Ebonyi State – Nigeria

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Abstract: Maize (*Zea mays* L.) a staple food for over 1.3 billion people in SSA, is limited by poor soil fertility that characterize soils in the region and as such increases production cost in rural areas. Therefore this experiment was carried out at the Students' Research and Demonstration Farm, Faculty of Agriculture at Alex Ekwueme Federal University Ndufu-Alike, Ebonyi State, Nigeria to compare the effect of poultry droppings with inorganic fertilizers (NPK 15:15:15) on the growth and yield of Maize during the 2021 cropping system. The study site was 16 m x 48 m (768 m²) and the treatments used were 10t/ha, 20t/ha, 200kg/ha, 400kg/ha with their combinations as well as control (check). The experiment was laid out in a randomized complete block design, and replicated three times. Data was taken on growth and yield components. All data were subjected to analysis of variance (ANOVA) with Genstat Statistical Package and means separated using Duncan Multiple Range Test (DMRT) at 5% level of probability. From the results, treatment of 20t/ha gave the highest percentage LAI (3.89), PH (192.7) and biomass (24.78) at 12WAS amongst the organic fertilizer for all parameters measured, while control recorded the lowest. For inorganic fertilizer (NPK), 400kg/ha gave the highest percentage for LAI (3.65), PH (163.8) and biomass (23.76) amongst all the parameters measured. The treatment combination (20 t/ha + 400 kg/ha) gave the highest total yield (266.66) amongst all the treatments while control gave the lowest total yield (12.79). From the result, it was observed that control had the least percent effect amongst all parameters measured while treatment combination showed positive impact. Further studies are ongoing to collaborate and authenticate findings.

Keywords: Maize, NPK, Poultry Droppings, Yield

1. Introduction

Maize (*Zea mays* L.) is of the Poaceae family and the most important principal cereal in the world after wheat and rice especially in developing countries where it is eaten as a staple food for over 1.3 billion people in sub-Saharan Africa (SSA) [4], as well as a major component of the traditional mixed cropping system in Southern Nigeria [1]. It is grown in several regions of the world and referred to as the world best adapted crop [7]. Over 5 million hectares of Nigerian

land were planted with maize, which constitutes about 61% of total cultivable land in Nigeria [3]. Maize is been used primarily as human food (with more energy yield higher than rice and wheat), feed for animals and a source of raw materials for many industries [9]. It is also consumed as a vegetable and it is rich in dietary fiber and other nutrients [7]. In Nigeria, the demand for maize is increasing at a faster rate daily [13]. It is also important being a hunger breaker since it the first crop available for consumption after the dry season [2]. One of the major problems is the low harvest of maize in

Nigeria which is inherent due to poor soil. One of the ways of increasing the yield per unit area of soil is by the addition of external input including organic and chemical fertilizers [10]. Maize is a nutrient demanding crop and therefore adequate and balanced nutrient supply is important in its growth and production. Unfortunately, majority of ultisols available for crop production in the South-Eastern Nigeria have low organic matter and nutrient status [1]. The use of chemical fertilizer has been reported to increase crop yields [4]. The application of N. P. K fertilizer to the soil actually boosts the performance of maize. However, its persistent use destroys soil reaction and impedes the activities of soil microorganisms thereby making the soil acidic and toxic to maize [11]. In Nigeria, its use is limited by high cost, scarcity during the time of planting (season), soil acidity and nutrient imbalance [10]. In order to sustain soil fertility over a long period of time, the use of soil organic amendment is being advocated. Organic manure could be a good source of macro and micro nutrients in available forms as well as improving the physical and biological properties of the soil [12]. Because of these, the use of organic manures like poultry manure (PM) was found useful in increasing crop production. PM is cheap, readily available at all times, environmentally friendly, and also has no residual effect and ability to improve soil structure compared with chemical fertilizers [14]. There is the need to use organic amendments which are readily available, cheap and environmental friendly. This study aims to determine effect of poultry manure and inorganic fertilizer on the growth and yield of Maize (*Zea mays*) in Ikwo, Ebonyi State – Nigeria for sustainable productivity and profitable grain yield.

2. Materials and Methods

The study area is located at the Faculty of Agriculture Students' Research and Demonstration Farm beside meteorological station in Alex Ekwueme Federal University Ndufu-Alike, Ebonyi State, Nigeria. It lies on latitude 06°19' 407'' N and longitude 08° 7' 831'' E at an altitude of about 447m above sea level with a mean annual rainfall of about 1700 mm to 2060 mm spread between April and October. The maximum mean daily temperature is between 27°C to 31°C with abundant sunshine and a high humidity all through the year [15].

The study area measuring 16 m x 48 m was cleared and ploughed with tractor then leveled manually with hoe; gross plot size was 4 m x 3 m with 1 m given between blocks and plots, respectively. The Maize seeds (Oba Super 6/ hybrid) were sourced from Premier Seed Company Abakaliki, Ebonyi State – Nigeria. Two seeds were planted at a planting distance of 75 cm X 25 cm, which was later thinned to one plant per hole. The fertilizer NPK 15:15:15 was sourced from Premier Seed Company while the poultry droppings (PD) were sourced from a deep-litter system farm within the study area. The treatments consisted of 10 tons and 20 tons of poultry droppings per hectare (which were air-dried for two weeks under shade), and 200 kg and 400 kg of NPK 15:15:15

per hectare, as well as the combination of PD and NPK. The poultry droppings were incorporated into the soil at 2 weeks before planting while NPK was applied 2 weeks after planting (WAP). Control was assigned to the plots that did not receive any treatment. The treatments were weighed on a scale before application. The factorial experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Data on growth and yield parameters were collected at 3, 5, 7, 9 and 12 WAP. All statistical data were subjected to analysis of variance (ANOVA) and means separated using Duncan multiple range test at 5% probability level with Genstat 2007 statistical package.

3. Result

Physico-chemical properties of soils from the experimental study:

Table 1 shows the nutrient status of the study site. From the result obtained, the soil was low in organic matter and other elements needed for the production of quality maize. At the end of the planting, result will be obtained to show the improvement of soil properties after the application of the treatments to which encouraged the growth and development of maize.

Table 1. Physico-chemical properties of soils from the experimental study site during the 2021 cropping season at AE-FUNAI Research farm.

S/NO.	Soil Properties	Sample readings
1	Sand%	59.60
2	Silt%	24.80
3	Clay%	15.60
4	Txc (H ₂ O)	1.25
5	Ph	6.30
6	Pmg/kg	06.50
7	N%	0.112
8	OC%	1.01
9	OM%	1.74
10	CA (cmol.kg ⁻¹)	1.65
11	Mg (cmol.kg ⁻¹)	0.98
12	K (cmol.kg ⁻¹)	0.612
13	NA (cmol.kg ⁻¹)	0.251
14	EA (cmol.kg ⁻¹)	0.24
15	ECEC (cmol.kg ⁻¹)	3.733
16	BS	94

Source: Field work (2021)

Fertilizers effect on Leaf area index (LAI) and Plant height (PH) of maize:

Table 2 shows the leaf area index and plant height of maize after application of treatments. The highest LAI (3.89) was recorded at 12 WAP under the 20 t/ha of PD, while the lowest (0.71) was recorded at 3 WAP under the control. For NPK fertilizers, the highest LAI (3.65) was also recorded at 12 WAP under the 400 kg/ha treatment and the lowest LAI (1.05) were recorded at 3 WAP under 200 kg/ha and 400 kg/ha treatments respectively. The result showed a significant difference ($P \leq 0.05$) between the treatments and control. However, there was no significant difference among the treatment combinations.

Table 2. Effect of Fertilizers on Leaf area index and Plant height of maize plant during the 2021 cropping season at AE-FUNAI Research farm.

Treatment	LAI WAP					PH WAP				
	3	5	7	9	12	3	5	7	9	12
PD										
0	0.71a	1.50a	2.11a	3.12a	2.91	6.44a	17.7a	29.1a	54.4a	108.0
10	1.19b	2.62b	3.24b	3.51a	3.56	11.60b	36.0b	66.1b	134.1b	172.8
20	1.30b	2.85b	3.52b	3.36a	3.89	12.51b	42.4b	79.1b	162.0c	192.7
NPK										
0	1.09a	2.18a	2.74a	3.10a	3.17	10.03a	27.2a	47.7a	98.7a	141.4
200	1.05b	2.45b	3.12b	3.43a	3.55	10.03b	35.8b	65.5b	128.3b	168.4
400	1.05b	2.34b	3.02b	3.47a	3.65	9.66b	33.1b	61.0b	123.5c	163.8
Interaction										
PD × NPK	NS	NS	NS	NS	**	NS	NS	NS	**	NS
LSD	0.15	0.47	0.41	0.75	0.27	1.45	6.51	12.23	25.52	29.29
SE±	0.07	0.22	0.19	0.36	0.13	0.68	3.07	5.77	12.0	13.82
CV %	14.3	20.4	13.8	22.7	7.7	14.3	20.3	18.6	21.1	21.9

Means with the same alphabet within the column are not significantly different at 5% level of significance using DMRT

Source: Field work (2021)

For plant height, the highest PH (192.7) was recorded at 12 WAP under the 20 t/ha of PD, while the lowest (6.44) was recorded at 3 WAP under the control. The result showed a significant difference ($P < 0.05$) between the treatments and control. Among NPK fertilizers, the highest PH (163.8) was also recorded at 12 WAP under the 400 kg/ha treatment while the lowest PH (10.03) was recorded at 3 WAP for 200 kg/ha and control respectively. The result showed a significant difference ($P < 0.05$) between the treatments and control. However, the treatment combinations were not significantly difference ($P \geq 0.05$).

Effect of fertilizers on fresh Cob weight (FCW), Biomass and yield of maize:

From table 3; the 10 t/ha and 20 t/ha PD gave the highest fresh cob weight (2.17) which was significantly different ($p < 0.05$) than that of control (0.72). Also, 400 kg/ha gave the highest FCW (2.14) which was significantly higher than that of control (1.38). For plant biomass, 20 t/ha of PD gave the highest (24.78) which was significantly higher than control (11.62). Treatment with 400 kg/ha of NPK gave the highest biomass (23.76) which was also significantly different ($P < 0.05$) than the control (15.48). There was no significant difference among the treatment combination. For the total yield (t/ha), 10 t/ha of PD gave the highest (162.67) amongst the treatments while control had the lowest (12.79). Treatment combination of 20 t/ha PD and 400 kg/ha NPK performed better in terms of having the highest yield (266.67).

Table 3. Effect of fertilizers on Cob fresh weight, Biomass and yield of maize plant during the 2021 cropping season at AE-FUNAI Research farm.

Treatment	Cob FW	Biomass
PD		
0	0.72a	11.62a
10	2.17b	22.2b
20	2.17b	24.78b
NPK		
0	1.38a	15.48a
200	1.5b	19.44b
400	2.14b	23.76b
PD × NPK	NS	NS

Treatment	Cob FW	Biomass
LSD	0.78	3.35
SE±	0.37	1.58
CV %	46.4	17.1

Treatment	Yield
Manure	
0	12.79
10	162.67
20	149.33
NPK	
0	12.79
200	29.86
400	79.99
Interaction	
10 × 200	191.99
10 × 400	242.67
20 × 200	194.67
20 × 400	266.67

Means with the same alphabet within the column are not significantly different at 5% level of significance using DMRT

Source: Field work (2021)

4. Discussion

The result for the leave area index, plant height, cob fresh weigh, biomass and yield shows that treatment 10 t/ha and 20 t/ha of organic fertilizer performed comparably better than treatment from inorganic fertilizer despite the increase in rate used in the experiment, which may be as a result of some climate change affecting rainfall and other environmental factors [8]. From the observation, it was observed that there was a positive interaction between the organic and inorganic fertilizers when combined together in farming. Therefore, an integrated use of inorganic fertilizers with organic manures is a sustainable approach for efficient nutrient usage, which enhances efficiency of the chemical fertilizers while reducing nutrient losses. This submission tallies with the work of Gabriel [5]. Also the synergistic effects of organic manures with inorganic fertilizers help accumulate more total nitrogen in soils, as stated by the research of Huang *et al.* [6]. It was also observed that the combined use of organic and mineral

fertilizers increased maize yields more than those used alone.

5. Conclusion

There has been a great desire to increase agricultural production especially maize to meet the global demand but some of the challenges faced at the production level includes poor soil fertility that have led to the decrease in the yield of maize over the years. Some of the other challenges faced mainly include low soil nutrients, edaphic factors, climate change etc. which has hampered realization of requirement for maize proper growth and development. In this study, organic and inorganic fertilizers were evaluated to compare their performances on maize growth and development at different levels of treatments. It was observed that among the treatments under consideration, poultry droppings at 20 t/ha and NPK at 400 kg/ha gave the highest output among all the parameters measured. It is therefore advisable for farmers to use poultry dropping as alternative to inorganic fertilizers, or in places where inorganic fertilizers are used, it should be incorporated with the organic fertilizer as this will increase production as well as improve the soil properties for sustainable agriculture. More studies should be taken up to collaborate and authenticate these findings.

Conflict of Interest Statement

All the authors do not have any possible conflicts of interest.

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