PROXIMATE ANALYSIS OF MAIZE TREATED WITH ORGANIC AND INORGANIC FERTILIZER

Okparavero, O. O., Coker, T. & Okusanya P. O.
Department of Agricultural Technology, The Federal Polytechnic, Ilaro
Corresponding Author's email:
oluwaseun.okparavero@federalpolyilaro.edu.ng:temitope.coker@federalpolyilaro.edu.ng

Abstract

A study was carried out to determine the proximate composition of maize treated with organic and inorganic fertilizer. The factors considered were organic manure (5t, 10t) and inorganic (200 kg, 400 kg) and control, the experiment was replicated four times. The data collected were analysed using Analysis of Variance. Plant height, number of leaves, leaf area and yield components were similar all through the period of the experiment but the plant treated with organic manure (10t) had the tallest plant while the unfertilized plant had the shortest plant. Inorganic fertilizer (200 kg) had the highest number of leaves and leaf area while unfertilized plants had the lowest number of leaves, and organic (5t) had the lowest leaf area. Inorganic (400 kg) had the highest yield/ha and grain/cob while organic (5t) and the unfertilized plan had the lowest yield/ha and grain/cob, respectively. There was significant difference in the proximate composition of maize, the moisture content, crude protein and carbohydrate were significant while crude ash and crude fat were similar. Application of inorganic fertilizer (400 kg) gave an optimum yield in maize production and adequate composition content.

Keywords: Proximate, Organic fertilizer, Inorganic fertilizer

Introduction

Maize is a member of the Poaceae family and it originated from Central America (Okoroafor et al., 2013; Am &Morsy, 2017). It is also referred to as the "queen of cereals" since it is one of the most genetically versatile growing crops with a wide range of uses. (Maize Biology, 2012). It is a significant staple food cultivated in different countries of the world aside from rice and wheat, it is also rated the third among the cereal crops (A. E. G., &Morsy, A. S. M. 2017;Mulyati, Baharuddin, A. B., &Tejowulan, R. S 2021). Maize grain is made up of 13, 10, and 70.3% moisture, crude protein and carbohydrates, respectively (Martin et al., 2006; A. E. G., &Morsy 2017). Maize cultivation has increased immensely over the years due to different uses, as food, feed processing and it has a lot of industrial applications (Mulyati et al., 2021). Several factors including soil fertility, soil quality and nutritional imbalance are responsible for the constraint in maize production. Hence, in order to get an optimum yield, fertilization is done, which may be organic or inorganic to improve the fertility of the soil (Mahmood et al., 2017; Hija, Junus&Kamaliyah, 2021). Inorganic fertilizer are synthetic fertilizers which helps in increasing crop productivity, stimulates the development of vegetative parts of plants, they are as well efficient and quick required to improve soil properties including ensuring adequate supply of macro and micro nutrients to satiate crop needs Purbajanti, E. D., Slamet, W., &Fuskhah, E. 2019;Hija, Junus&Kamaliyah, 2021). Excessive application of fertilizer causes reduction in soil organic matter content and toxicity storage of heavy metals (Cooke 1982; Illahi et al., 2021). Trace elements like cadmium and arsenic, found in fertilizer like triple superphosphate can accumulate in plants, travel up the food chain, getting to people which eventually poses health risk (Sonmez&Sonmez 2007; Laird et al., 2010; Ilahi et al., 2021). Organic fertilizers are natural, enables fertility of soil, affordable, improve soil structure, increases water holding capacity, hydraulic conductivity and infiltration rate (Mahmoobadi et al., 2010; Purbajanti, E. D., Slamet, W., &Fuskhah, E. 2019). It however, decomposes gradually and low in nutrient (Han, S. H., An, J. Y., Hwang, J., Kim, S. B., & Park, B. B. (2016). Thus, farmers make use of chemical fertilizers due to the fact that they are quick, and releases nutrient readily (Ilahi et al., 2021). This study was, therefore, conducted to evaluate the nutritional content and proximate composition of maize treated with organic and inorganic fertilizers.

Materials and Method

The field experiment was carried out at The Federal Polytechnic Ilaro, Ogun State between April and August 2021. Cropping history investigation of the experimental sites revealed that the sites had been under cultivation for the previous cropping season in the farm location with crops like maize, cassava, and vegetables (*Amaranthus*). The experimental site was ploughed and levelled mechanically. There were five treatments in the study comprising maize treated with inorganic fertilizer (200 and 400 kg), organic fertilizer (5 and 10 t) and control were replicated four times

to give a total of 20 subplots. The estimated field size was 19 x 15 m, with each subplot size of 3 × 3 m and plant spacing of 75 x 25 cm. Cured manure was incorporated into the soil manually two weeks before planting using the detailed rate. Inorganic fertilizer application was done as well by applying NPK 15-15-15. An improved variety of maize seeds was purchased from the Ministry of Agriculture Ilaro, the planting of three seeds per hole was done, and thinning of maize to two plants per stand was done as well. Weeding was done at 3 and 5 weeks after planting (WAP). Surface soil samples (0 – 20 cm) were randomly collected from the experimental sites with the aid of a soil core sample of 15 cm in length. The collected sample was air-dried and sieved, using a 2 mm mesh sieve these were then bulked together to form a composite, from which a portion was collected and taken for laboratory analysis. Analysis of the soil sample was carried out on the physical and chemical properties of the soil. Data were collected on plant height, the number of leaves, leaf area, yield per ha, and number of grains per cob. Statistical analysis of the data was carried out by subjecting the data to Analysis of variance (ANOVA) using the GEN STAT Discovery Statistical package. Means separation was carried out using the Least Significant Difference (LSD) at a 5% probability level ($p \leq 0.05$).

Result

At pre-planting, the soil was sandy loam, slightly acidic, the organic carbon, total nitrogen and, exchangeable potassium were low, exchangeable bases ranges from low to moderate, while the micronutrients were generally low (Table 1). The poultry manure was slightly alkaline, with moderate contents of organic matter, nitrogen; available phosphorus and exchangeable K (Table 1). The proximate composition of maize treated with organic and inorganic fertilizer revealed there was a significant difference $p \leq 0.05$ in moisture content (inorganic 400 kg), protein content (inorganic 400 and 200 kg) and carbohydrate content (5 and 10 t) but there was no significant difference in ash and crude fat (Table 2). The Plant height of maize increased with time. The effect of both organic and inorganic manure was not significant ($P \leq 0.05$) on plant height all through the period of the experiment, although plants treated with organic manure (10 t) were the tallest all through the period of the experiment except at 6 WAP, while unfertilized plants had the shortest plant height except at 2 and 6 WAP (Table 3). Plants treated with inorganic manure (200 kg) had the highest number of leaves at 8 WAP while unfertilized plants at 8 WAP had the lowest number of leaves, although the fertilizer effect (organic and inorganic) was not significant ($p \leq 0.05$) all through the period of the experiment (Table 4). Plants treated with inorganic manure (200 kg) had the highest leaf area at 6 and 8 WAP while plants treated with organic manure (5 t) had the lowest leaf area, though the fertilizer effect was not significant (Table 5). Plants treated with inorganic fertilizer at the rate of 400 kg had the highest yield while those treated with organic manure (5 t) had the lowest yield, although fertilizer (organic and inorganic) was not significant on the yield (Table 6).

Table 1: Manure and pre-cropping soil chemical and physical analysis

Physiochemical properties	Soil	Poultry Manure
pH	5.42	7.80
Org.c (g/kg)	1.88	63.20
Organic matter (g/kg)		110.60
T.N (g/kg)	2.2	21.50
Avg. P (mg/kg)	42.0	126.32
Exchangeable. K	0.36 cmol/kg	11.14 mg/kg
Na	0.25 cmol/kg	6.03 mg/kg
Ca	4.32 cmol/kg	1.81 mg/kg
Mg	2.89 cmol/kg	1.81 mg/kg
Sand (g/kg)	776.8	-
Clay (g/kg)	76.0	-
Silt (g/kg)	54.2	-
H+	0.14	-
CEC	7.96	-
Cu ppm	2.5	-
Fe ppm	3.2	-
Zn ppm	1.8	-
Mn ppm	0.8	

Source of Manure: Makinde et al., (2021)

Table 2: Proximate Analysis of Maize treated with Organic and Inorganic Manure.

Fertilizer	Moisture (%)	Crude Protein (%)	Crude fat (%)	Ash (%)	Crude Fiber (%)	CHO (%)
Control	10.01^{a}±0.06	6.63^{b}±0.31	4.45±0.29	0.79±0.10	5.06^{a}±0.22	73.03^{c}±0.43
Organic (5 t)	8.91^{b}±0.08	5.02^{c}±0.06	3.93±0.11	0.78±0.02	3.28^{c}±0.09	78.06^{a}±0.09
Inorganic (200 kg)	10.06^{a}±0.14	7.59^{a}±0.26	4.06±0.51	0.86±0.05	3.87^{b}±0.11	73.54^{c}±0.93
Organic (10 t)	8.89^{a}±0.08	5.11^{c}±0.13	4.59±0.46	0.86±0.04	3.32^{c}±0.17	76.21^{b}±0.28
Inorganic (400 kg)	10.11^{a}±0.12	8.09^{a}±0.08	4.77±0.21	0.85±0.07	3.19^{c}±0.19	72.96^{c}±0.17

^{abc} means with different superscript are significantly different at $p<0.05$.

Table 3: Plant Height (cm) of Maize as Affected by Organic and Inorganic Fertilizer

Fertilizer	PH2WAP	PH4WAP	PH6WAP	PH8WAP
Control	7.56	13.83	69.1	156.8
Inorganic(200 kg)	7.63	14.97	67.9	171.2
Inorganic(400 kg)	7.25	15.44	70.2	185.8
Organic (5 t)	7.69	16.01	63.8	168.0
Organic (10 t)	8.08	16.78	65.4	187.9
LSD	2.525 (ns)	2.954 (ns)	22.26 (ns)	5.99 (ns)

Table 4: Number of Leaves of Maize as Affected by Organic and Inorganic Fertilizer

Fertilizer	2WAP	4WAP	6WAP	8WAP
Control	4.562	5.125	5.25	5.17
Inorganic(200 kg)	4.375	4.812	5.42	5.69
Inorganic(400 kg)	4.188	4.938	5.45	5.58
Organic (5 t)	4.562	5.000	5.17	5.50
Organic (10 t)	4.938	5.000	5.31	5.29
LSD	0.6387 (ns)	0.4205 (ns)	0.693 (ns)	0.700 (ns)

Table 5: Leaf Area (cm^2) Of Maize as Affected by Organic and Inorganic Fertilizer

Fertilizer	2WAP	4WAP	6WAP	8WAP
Control	62.65	77.78	216.18	528.58
Inorganic(200 kg)	30.16	62.38	300.03	537.84
Inorganic(400 kg)	27.49	58.62	299.05	525.85
Organic (5 t)	35.05	65.04	119.78	521.92
Organic (10 t)	55.50	64.76	215.55	524.89
LSD	57.080 (ns)	17.606 (ns)	115.349 (ns)	59.767 (ns)

Table 6: Yield and Yield Components of Maize as Affected by Organic and Inorganic Fertilizer

Fertilizer	Yield/Ha	Number of Grain/Cob
Control	1472.50	2000556
Inorganic(200 kg)	1890.00	2055833
Inorganic(400 kg)	2390.00	2352500
Organic (5 t)	1417.50	2275556
Organic (10 t)	2110.00	2046111
LSD	1343.651 (ns)	515639.0 (ns)

Discussion

The soil was slightly acidic, and therefore, will be favourable for the availability of most nutrients needed by plant growth (Ojo-Atere et al., 2011). Organic carbon was observed to be low and this may be as a result of erosion

(Amacher et al., 2007). Total nitrogen follows the same trend with organic carbon with low values, there is a strong relationship between total nitrogen and organic carbon. According to Meysner et al., (2006), low level of total nitrogen in soils could be as a result of minimal vegetation cover and discarding of debris/crop residue on soil surfaces (Haruna et al., 2014) and this may result in low yield. Low level of P in the soil is attributable to poor soil compaction, herbicide injury, insect pressure and poor soil health. The exchangeable bases ranged from low to moderate which implies that they are adequate for most plant, micronutrient was observed to be low this could be as a result of over fertilization with phosphate. There were differences observed in moisture, protein and carbohydrate contents of maize (organic and inorganic) although there was no differences in ash and crude fat, this corroborate with the findings of Iken, Amusa&Obatolu (2002) that both crude fat and crude protein had no significance difference in newly developed maize varieties. Although there was no significance difference in the plant height of maize treated with both organic and inorganic fertilizer, but plants treated with inorganic fertilizer had the tallest height at 8WAP, this was attributed to the fact that inorganic fertilizer releases its nutrient quickly when compared with organic manure which must first decompose and mineralize before being available to plant, these findings agrees with the study of Hazra (2016) that inorganic fertilizers are readily available to plants. The similarities observed in number of leaves and leaf area of plants treated with organic and inorganic fertilizer, also agreed with the findings of Wajid et al. (2012) that there were similarities in LAI between two maize hybrids. The observed similarities in the yield of maize treated with inorganic fertilizer corroborates with the findings of Yahaya, M. S., Bello, I., &Unguwanrimi, A. Y. (2021) while the observed similarities observed in the yield of maize treated with organic manure corroborates with the findings of Jjagwe, J., Chelimo, K., Karungi, J., Komakech, A. J., &Lederer, J. (2020).

Conclusion

In the study, inorganic fertilizer at the rate of 400 kg was more effective in maize cultivation than other the treatments, It enhanced the plant height, number of leaves, leaf area, yield, protein and moisture contents. Inorganic fertilizer application in maize plant cropping will give optimum economical yield and yield component.

References

A. E. G., &Morsy, A. S. M. (2017). Integrated impact of organic and inorganic fertilizers on growth, yield of maize (Zea mays L.) and soil properties under Upper Egypt conditions. *Journal of Plant Production*, *8*(11), 1103-1112.

Cooke, G. W. (1982). Fertilizing for maximum yield. Third Edition English Language Book society/Collins. 457.

Han, S. H., An, J. Y., Hwang, J., Kim, S. B., & Park, B. B. (2016). The effects of organic manure and chemical fertilizer on the growth and nutrient concentrations of yellow poplar (Liriodendron tulipifera Lin.) in a nursery system. *Forest science and technology*, *12*(3), 137-143.

Hija, M. F., Junus, M., &Kamaliyah, S. N. (2021) Effect of Organic Fertilizers and Inorganic Fertilizers on the Growth of Maize Plant (Zea mays L.).

Hazra, G. (2016). Different types of eco-friendly fertilizers: An overview. *Sustainability in Environment*, *1*(1), 54.

Iken, J.E., Amusa, N.A., &Obatolu, V.O. (2002). Nutrient composition and weight evaluation of some newly developed maize varieties in Nigeria. *Journal of Food Technology in Africa*, 7(1), 27-29.

Ilahi, H., Hidayat, K., Adnan, M., Rehman, F. U., Tahir, R., Saeed, M. S. &Toor, M. D. (2020). Accentuating the impact of inorganic and organic fertilizers on agriculture crop production: A review. *Indian Journal of Pure Applied. Biosciences*, *9*, 36-45.

Jjagwe, J., Chelimo, K., Karungi, J., Komakech, A. J., &Lederer, J. (2020). Comparative performance of organic fertilizers in maize (Zea mays L.) growth, yield, and economic results. *Agronomy*, 10(1), 69.

Laird, David, Fleming, P., Wang, B., Horton, R., &Karlen, D. (2010). Biochar impact on nutrient leaching from a Midwestern agricultural soil. *Geoderma 158*, 436-442. DOI: 10.1016/j.geoderma.2010.05.012.

Mahmood, F., Khan, I., Ashraf, U., Shahzad, T., Hussain, S., Shahid, M &Ullah, S. (2017). Effects of organic and inorganic manures on maize and their residual impact on soil physico-chemical properties. *Journal of Soil Science and Plant Nutrition*, *17*(1), 22-32.

Marschner, H., 1995. Mineral Nutrition of Higher Plants. Academic Press, London. 889p.

Mulyati, Baharuddin, A. B., &Tejowulan, R. S. (2021). Improving maize (*Zea mays* L.) growth and yield by the application of inorganic and organic fertilizers plus. In *IOP Conference Series: Earth and Environmental Science*, 712(1), 012027. IOP Publishing.

Okoroafor, I. B., Okelola, E. O., Edeh, O., Nemehute, V. C., Onu, C. N., Nwaneri, T. C., &Chinaka, G. I. (2013). Effect of organic manure on the growth and yield performance of maize in Ishiagu, Ebonyi State, Nigeria. *IOSR Journal of Agriculture and Veterinary Science (IOSR-JAVS)*, *5*(4), 28-31.

Purbajanti, E. D., Slamet, W., &Fuskhah, E. (2019). Effects of organic and inorganic fertilizers on growth, activity of nitrate reductase and chlorophyll contents of peanuts (*Arachishypogaea* L.). In *IOP conference series: earth and environmental science*, 250(1), 012048. IOP Publishing.

Sonmez, K. M., &Sonmez, S. (2007). An investigation of seasonal changes in nitrate contents of soils and irrigation waters in greenhouses located in Antalya-Demre region. *Asian Journal of Chem*istry *19*(7), 5639.

Wajid, N. A. S. I. M., Ashfaq, A. H. M. A. D., Tasneem, K. H. A. L. I. Q., Aftab, W. A. J. I. D., Muhammad, F. H. M., Hassan, J. C., ... & Hafiz, M. H. (2012). Effect of organic and inorganic fertilizer on maize hybrids under agro-environmental conditions of Faisalabad-Pakistan. *African Journal of Agricultural Research*, *7*(17), 2713-2719.

Yahaya, M. S., Bello, I., &Unguwanrimi, A. Y. (2021). Growth and yield response of irrigated maize (Zea mays l.) to the application of different rates of inorganic fertilizer and poultry manure. *Science World Journal*, *16*(1), 1-5.