Journal of Agriculture and Veterinary Sciences *Volume 4, September 2012*

www.cenresinpub.org
ISSN 2277-0062

EFFECT OF INORGANIC FERTILIZER (N-P-K) ON THE GROWTH OF A NAMED CEREAL (MAIZE)

Ikelle Issie Ikelle[1], Anyigor Chukwuma[1] and Ndukwe Cornelius Chukwe[2]
Department of Industrial Chemistry
Department of Fisheries & Aquaculture
Ebonyi State University Abakaliki, Ebonyi State, Nigeria

ABSTRACT
This work examines the effects of inorganic fertilizer (N-P-K) on maize. The preliminary soil analysis tests were carried out and the results include temperature of 28^{o}C, pH value of 7.4, moisture content of 14.7%, soil texture values are: sand 17.05%, silt 4.55%, clay 18.8%, while water constitutes 60.23%. The results of the soil analysis after the harvesting of the plant shows temperature of 29^{o}C, pH value of 8.0, moisture content of 17.5%, soil texture values are: sand 15%, silt 3.80%, clay 16.1%, while water constitutes 65.1%. The control sample was analyzed for micronutrients with Ca – 0.0242, Mg – 0.4179, Fe – 2.4946, Zn – 3.2846, while the test sample has Ca – 0.0189, Mg – 0.0892, Fe – 1.8914, Zn – 1.4858. The proper and daily observation of the plants' growth were observed and recorded. The results suggest that the preliminary soil analysis are acceptable, hence, the soil supports plant growth. From the observation and plant analysis, the applied inorganic fertilizer made great impact in the plants in bed-B as they had faster growth rate, broad leaves and larger stems than the plants in bed-A.
Keywords: *Fertilizer, Macronutrients, Micronutrients, Germination*

INTRODUCTION
Fertilizer is a substance that is added to the soil so as to increase its fertility or productivity.(1) The substance could be of natural origin such as peat, mineral, plant deposits, animal or human deposits and synthetic. It could be organic or inorganic and in liquid or granular forms.(2)For a plant to grow it needs different elements classified as macronutrients which includes nitrogen, phosphorus and potassium found in most packed fertilizer, and micronutrients that include calcium, sulphur, magnesium, boron, zinc, iron.(3) The unavailability of any of the macronutrients will limit the growth rate and subsequently reduce plant yield. In nature, nitrogen, phosphorus and potassium are obtained from decay of dead plants. The recycling of nitrogen from dead to living plants is the source of nitrogen to the soil.(3) Most of the nitrogenous/inorganic fertilizers just supply nitrogen, phosphorus and potassium because the other nutrients are needed in much lower quantities and are generally available in most soils.(5) The study is aimed as a matter of urgency to boost food production and supply. Inorganic fertilizer is derived from non-living source that can occur naturally as diatomaceous earth and limestone or synthesized chemically as ammonium nitrate, potassium sulphate, super-phosphate or triple super-phosphate.(4) Artificial fertilizer is the synthesized form and regarded as a complete fertilizer if it contains the primary ingredients of nitrogen (N), phosphorus (P) and potassium (K). They are branded/labeled according to

Corresponding Author: Ikelle Issie Ikelle

the content of the macro elements, thus, N-P-K 20:10:10 fertilizer would contain 20% nitrate, 10% phosphate and 10% potash in its ingredients. Indeed, if Nitrogen is the main element, it is regarded as nitrogenous fertilizer.(3) The nitrogenous fertilizer is blended into brands from these four raw materials urea, diammonium phosphate, muriate of potash and limestone (filler).(5)

Urea: this consists mostly of nitrogen with a chemical formula of NH_2CONH_2. It is manufactured as granules with large, hard and resistant to moisture property that makes it a suitable material for fertilizer blending, contributing 46% a total of nitrogen in N-P-K fertilizers.(4) It is produced by passing liquid carbon dioxide (CO_2) and liquid ammonia (NH_3) in a silver lined special autoclave. When ammonia is formed, the latter is heated at 130 – 135^oC under 35 atm. pressure to obtain urea. The aqueous solution is transferred into another vessel where steam is passed into it resulting in the formation of granules.(5)

$$NH_3 + CO_2 \xrightarrow[130 - 135^oC]{} NH_2COONH_4$$

$$NH_2COONH_4 \longrightarrow \underset{\text{Urea}}{NH_2CONH_2} + H_2O$$

Muriate of Potash: It is reddish in colour and can produced from ores such as carnalities $KCl.MgCl_2.6H_2O$ by crystallization and flotation method.[5] Potassium chloride in fertilizer contains 60% of potash, the whole of which are readily available to the plant. It is readily soluble in water and hence, it is rated as readily available.(2)

Diammonium Phosphate: It is a major component for N-P-K fertilizer blending. The chemical formula is $(NH_4)_2HPO_3$ and therefore a major source of phosphorus and nitrogen, contributing 46% and 18% respectively. It is soluble in water and is stable under ordinary condition of use and storage. Other sources of phosphorus for N-P-K fertilizer production are listed below in table 1.(7)

Source material	**Chemical formula**	**Percentage phosphorus**	**Solubility**
Super phosphate	$Ca(H_2PO_4)$	18-20	Not completely soluble in H2O.
Double super phosphate	$Ca(H_2PO_4)_2$	32-40	Not completely soluble in H2O.
Triple super phosphate	$Ca(H_2PO_4)_3$	44-51	Major portion soluble in water.
Monoammonium phosphate	$NH_4H_2PO_4$	48	Completely soluble in water.

Limestone: it is chemically known as calcium carbonate (CaCO3). It acts as filler and liming material thereby checking the acidity of the soil and introduces calcium to the soil.[5]

MATERIALS

Compass, thermometer, pH probe (model: pH C175), electronic weighing balance (model: MP 300), drying oven (model DHG), beakers, garden soil, sterilized plastic (PVC) pipe, deionized water, measuring cylinder, stirring rod, petri dish, autoclave, N-P-K (27:13:13) fertilizer, maize seeds, meter rule, rotary shaker (RS-12-Remi equipment).

METHODS

A total of 12 soil samples were collected using a nitric acid sterilized PVC pipe to a depth of 30cm. The soil samples were analyzed for such properties as temperature, texture, pH, moisture content and elements in the soil.

The soil texture was determined before and after the duration of the experiment using mechanical method or sedimentation method.[15] The soil sample was poured into a measuring cylinder, deionized water made up 70cm^3, NaOH was added to speed up sedimentation and the solution was shaken and allowed to stand. The values are given in table 2.

Total height of sediment, THS (before) =88cm^3; THS (after) =83cm^3

Samples height (cm^3). Before	Soil texture (%). Before	Samples height (cm^3). After	Soil texture (%). After
HSA =15	17.05	HSA = 13	15.66
HST = 4	4.55	HST = 3	3.62
HCL = 16	18.18	HCL = 18	21.69
HWA = 53	60.23	HWA = 56	67.47

Keys: HSA = Height of sand, HST = Height of silt, HCL = Height of clay, HWA = Height of water

The percentage moisture content of the soil sample was determined by the difference between the weight of the soil sample before and after heating as 14.70%. The soil temperature was determined using LCD portable digital multi-stem thermometer Model ST-9269, the value is 28^{o}C. The pH of the soil was determined using pH probe model: pH C175, the value before planting was 7.4 and after the duration of the experiment the value is 8.0. The elemental analysis of the soil sample to determine trace metals was done using modified strong acids extractable method by Angelin-Brown.[10] The soil sample was dried to 105^{o}C for 35 minutes in an oven. The dried sample was sieved, homogenized and resieved. To soil samples of 1g was added 10ml of 1:3 HNO_3:HCl, the solutions were filtered and filtrate diluted to 40ml with deionized water. The concentrations of Ca, Mg, Mn, Zn, Fe and K, were determined by atomic absorption spectrometer. The nutrient analysis involves the preparation of deoxidizing solution by dissolving 2.64g of NaOH in 100ml of deionized water.

11.8g of $K_2S_2O_8$ was added to the solution and made up to 295ml. The combined stock solution of NO_3 and PO_4 was prepared when 0.9022g of KNO_3 and 0,1098g of anhydrous KH_2PO_4 are dissolved in deionized water and diluted to 500ml. 20ml of the solution was pipette and made up to 200ml. 1g of oven dried sample suspended in 25ml was placed in a rotary shaker for 48hrs. The homogenous suspension obtained was filtered. 13ml of the sample filtrate and 7ml of the deoxidizing solution were placed in polypropylene tubes and autoclaved for 45mins at 15 pounds and 121^{o}C. After digestion, the samples were cooled and analyzed for nitrogen and phosphorus spectrochemically.[12]

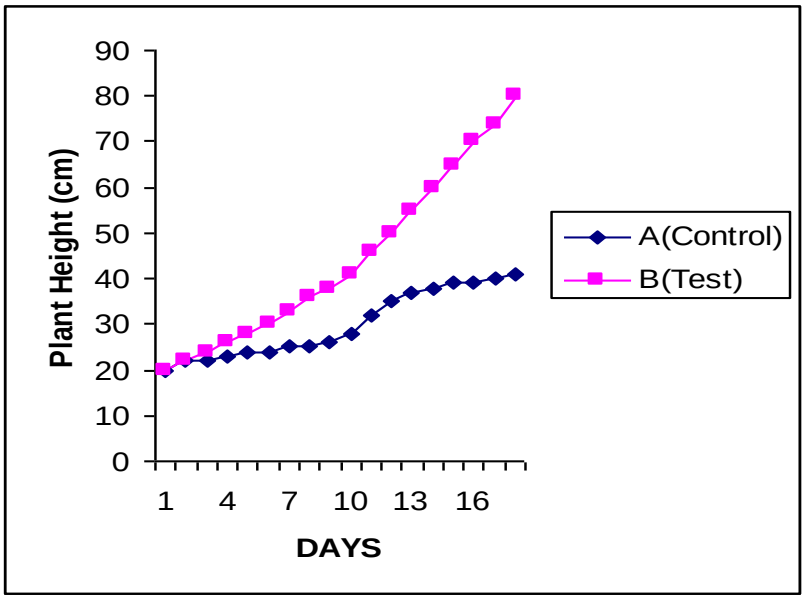
The same procure was carried out on the soil samples before and after monitoring the plant's growth. The values for soil samples are listed in table 3.

Elements	Ca	Mg	Zn	Fe	Mn	K	N(mg/l)	P(mg/l)
soil sample before planting	0.0242	0.1479	3.2846	2.4946	6.2247	1.130	3.100	0.027
Soil sample after planting	0.0189	0.0892	1.4958	1.8914	4.2427	2.210	3.300	0.053

A bed (top soil) of 6 × 4 feet was made and divided into two parts; A and B, for control and test experiments respectively. Two seeds were planted in holes of about 2cm deep and 30cm apart from each other for each bed. The plant started germinating after 5 days. The growth rate was monitored and after 18 days, 7g of fertilizer grade of N-P-K 27:13:13 was applied by ring style. The fertilizer was carefully introduced into the round holes of the test plants, covered to prevent evaporation and water sprinkled to quicken dissolution. Table 4 contains readings that were obtained for both the plant and stem heights for the control and test.

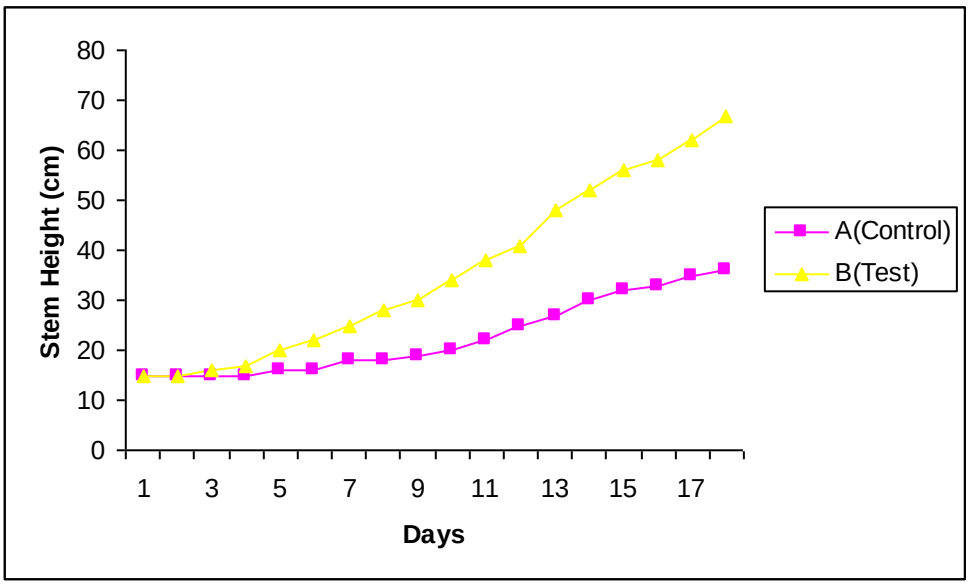
Days	**A(Control)cm**	**B(Test)cm**
1	20	20
2	22	22
3	22	24
4	23	26
5	24	28
6	24	30
7	25	33
8	25	36
9	26	38

10	28	41
11	32	46
12	35	50
13	37	55
14	38	60
15	39	65
16	39	70
17	40	74
18	41	80



Days	A(Control)cm	B(Test)cm
1	15	15
2	15	15
3	15	16
4	15	17
5	16	20
6	16	22
7	18	25
8	18	28
9	19	30

10	20	34
11	22	38
12	25	41
13	27	48
14	30	52
15	32	56
16	33	58
17	35	62
18	36	67



DISCUSSION

From the results obtained, the temperature of the soil at 28°c, pH of 7.4, soil texture values for sand-17.05%, silt - 4.55%, clay-18.18% and water-60.23% are all suitable for normal plant growth. The data in table 4 above shows a clear summary of the results obtained after application of the fertilizer. The results show remarkable increase in growth for plant and stem heights for the test sample due to the effect of the applied inorganic fertilizer. The colour of the leaves of the test sample showed a significant deep green colouration, increase in the transverse area of the stems of plants and increase in the depth of leaf colour, all are clear evidence of the contribution of nitrogen contained in inorganic fertilizer. Nitrogen, of all the nutrients absorbed from the soil, is the most important needed for growth and also promotes strong vegetative growth and dark green foliage.[13] From the moisture content analysis, the control sample gave a higher value of 81.0% as against 74% from test sample showing that the test samples contains less water and more of plant substances, which was due to the effect of fertilizer added especially potassium which facilitates plant metabolism.

Phosphorus is needed for stimulating root branching, development of root and plant maturity. This was seen in the faster rate of development of the test samples as against the control sample.

REFERENCES

Adepetu, J.A., 1986. Soil Fertilizer and Fertilizer Requirement on crop in Oyo and Ondo states. EDALR/Fed. Min. of Agric. and Rural Dev. 5: 10-15.

Aina, P.O. and Egolum, E.,1980. Effect of Feedlot Manure and Inorganic Fertilizer on the Improvement of Subsoil Productivity. Journal of Soil science, 29(1): 212-217.

http://www.Ces.State.Nc.Us/Cumberland/fertpage/inorganic.html.(2008). Retrieved on 12th January, 2008.

Lee, J.D., 2005. Concise Inorganic Chemistry. 5th ed. Blackwell Science Ltd., India. pp 489-494.

Sara, W., 1999. Gardenline/porpourri-miscellaneous/Fertilizer Application (Organic/Inorganic). Extension Division of the Saskatchewam. 21: 2-4.

Obi, A.O.,1996. Management of Nigerian Acid Soils for Optimum Productivity. Journal of Soil Science,45(1): 31-35.

Nomeh, M.C., 2006. Proceedings of a workshop. Ebonyi State Fertilizer and Chemical Company and its Production Measure. pp 13-20.

Dlouhy, J.,1981. Alternative forms of Agriculture – Quality of Products from Conventional and Biodynamic Growing. Sweedish University of Agricultural Sciences. Dept. of Plants Husbandry. Report 91. 112-119.

Lynch, S.J., Seymour, G. and Clarence, E.R.,1953. Some Effects of Nitrogen, Phosphorus and Potassium Fertilizer on the Constituents of Persian lime. La. State Hort. Soc. Proc. 45: 224-227.

Anglin-Brown, B., Armour-Brown, A. and Lalor, G.C., 1995. Heavy metal pollution in Jamaica. Survey of Cadmium, Lead and Zinc concentrations in the Kintyre and Hope flat District. Environmental Geochemistry and Health, 17(1). 51-56.

Yongming, H., Peixuan, D., Junji, C. and Posmentier, E.S., 2006. Analysis of Heavy Metal in Urban Dusts of Xian, Central China. Science of the Total Environment, 355(1): 76-186.

Omaka, N.O., Keith-Roach, M.J. and Worsfold, P.J., 2007. Flow Injection Spectrophotometric Method for the Determination of Filterable Reactive Phosphorus in Natural Waters in the Presence of High Concentrations of Arsenates and Silicate. J. Chem. Soc. Nigeria, 32(1): 143-149.

Varley, J.A.,1966. Automatic Methods for the Determination of Nitrogen, Phosphorus and Potassium in plant material. Journal of Agric. Chem., 33(2): 119-126.

Okeke G.O. and Ewelukwa G.O.,1979. Handbook of Practical Agriculture for Senior Secondary School. Win. Publishers Ltd, Ibadan. pp 16-23.

Yambao, J., 1984. Physiologia Plantarum. Journal of Agric. Chem., 51(4). 507.

Barer, D.E. and Amacher, M.C., 1982. Methods of Soil Analysis. Madison W.I. USA. American Society of Agronomy. 67(3): 323-336.

Hsoonri, M. and Sudo, R.1986. Simultaneous Determination of Total Nitrogen and Total Phosphorus in Freshwater Samples Using Persulphate Digestion. International Journal of Environmental Studies. 27(2): 267-275.

http://www.Elsevier.com/locate/scitot env. Science of the Total Environment. Retrieved on 13th April 2007.

Grystyuk, N., Arapis, G. and Perepelyatnikoval C., 2006. Heavy Metals Effects on Forage Crops Yields and Estimation of Elements Accumulation in Plant. J. of Soil Science. 354(8): 224-231.

Lieth, H. and Markert, B., 1990. Elements Cadasters in Ecosystems. Methods of Assessment and Evaluation. VCH Publishers. pp 354-362.

Benton Jones, J.J., and Case, W.V.,1990. Sampling, Handling and Analysing Plant Tissue Samples. 3rd ed. SSSA Book Series No. 3.p 56

Hunter, R.C., Halverson, T.L., and Anderson, R.D.,1984. Quality Assurance for Plant Tissue Analysis by ICP-AES. Commun. in Soil Sci. Plant Anal., 15(11). pp 1285-1322.

Arinushkina, Y.,1970. Guide in Chemical Analysis of Soils. Moscow State University Press. p 168.

Gernitse, R.G., Van, D.W., Snrilde, K.W. and Van, L.B.,1983. Uptake of heavy metals by crops in relation to their concentration in the soil solution. Journal of Agric .Chem. .50(4): 393-404.

Adetunji, M.T. and Adepetu, J.A.,1993. Potassium Supplying Capacity of Representative Soils of Southwestern Nigeria as Measured by Intensity, Quantity and Capacity Factors. Lpertanika J. of Tropical Agric. Sci. 16(1) : 71-74.