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By

Etukudo Mbosowo M
Okereke Ifeoma J
Udo Joseph I

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***[1]Etukudo Mbosowo M, [2]Okereke Ifeoma J and [3]Udo Joseph I**

[1*]Department of Biology, Federal University Otuoke, P.M.B. 126, Yenagoa, Bayelsa State, Nigeria.
[2]Department of Environmental Management and Toxicology, Michael Okpara University of Agriculture, Umudike, Abia State, Nigeria.
[3]Department of Plant Science and Biotechnology, University of Port Harcourt, River state, Nigeria.

*Corresponding Author's Email: mbosombosowo @yahoo .com; Phone: +2347032448796

ABSTRACT

Germination and early seedling growth of *Zea mays* L were studied in the laboratory using aqueous extract from seeds of *Pennisetum glaucum*. The concentration levels of the extracts used were, 20, 40, 60, 80, and 100%, alongside a control 0% (distilled water). The phytochemical and mineral nutrients analysis of *Pennisetum glaucum* seed extracts indicated the proportion of phytochemicals in their decreasing order; alkaloids, phytate, tannin, saponin, and flavonoid while mineral elements such as K, Na, Mg, Ca, P, Fe, Zn, Mn, Cu, N and Pb were found in their decreasing order of contents. The coefficient of velocity of germination of *Zea mays* was relatively higher than that of the control at 40, 60, 80, and 100 % levels of concentration of seed extract of *P. glaucum*. The germination percentage increased with increase in concentration of seed extract of *P. glaucum* with the highest value recorded at 100% level of concentration relative to the control. The shoot length and root length of the crop recorded higher values at 80 and 100%, and 100% levels of concentration of seed extract of *P. glaucum,* respectively, comparable with the control treatment. The fresh weight and dry weight of *Z. mays* increased with increase in the concentration of seed extract of *P. glaucum* with values relatively higher than the control treatment at 80 and 100% levels of concentration for fresh weight and at 100% level of concentration for dry weight Therefore, this study suggests that the extracts from this plant can be utilized as nutrients supplements for improved growth and development of *Zea mays* L.

Key words: Germination, seedling growth, seed extract, *Pennisetum glaucum, Zea mays.*

INTRODUCTION

Plants contain a huge diversity of different chemicals which include an array of both organic and inorganic compounds found in flowers, foliage, barks, roots and specialized structures (Holopainen and Blande, 2012; Verma and Verma, 2007). These chemical compounds can stimulate or inhibit seed germination, growth and development of crops (Macias et al. 2003; Chandra, 2005). Macro and micro nutrients composition of plants play a vital role in numerous biochemical processes . Organic compounds found in plants are mainly secondary metabolites and among others belong to terpenoids, phenolic compounds, organic cyanides and long chain fatty acids (Esenowo, 2004). The action of these organic compounds in target plant is diverse and affects a large number of biochemical reactions resulting in modifications of different physiological functions (Gupta and Gupta, 2005; Esenowo, 2004). Thus, the results of these organic compounds action can be detected at different levels of molecular, structural, biochemical, physiological and ecological of plant organization and interaction. Enzyme activities, cell division and ultra-structure, membrane permeability, and ion uptake in plants are modified by these organic compounds (Dutta, 2012; Chandra, 2005).

There are frequent conflicts between traditional utilization of natural resources and plant growth and development with increase in organic waste discharged into open land (Etukudo et al. 2014). Therefore, there is need to substantiate the efficacy of various organic material on plant growth and development. Although, organic materials contain micro and macro nutrients for plants growth and development, plant response during their utilization as organic materials either for nutrient conservation or restoration varies among different species (Chandra, 2005). In consequence, generalization cannot be made with respect to the effects of these substances on plants, as they may in some cases repress or enhance growth and development in different plant species depending on their physiochemical composition (Agbede, 2009; Etukudo et al., 2014).

Pennisetum glaucum belongs to the Family Poaceae. The drink called "Kunu" in Nigeria is prepared from the grains of the plant (*Pennisetum glaucum*) (Oboh and Okhai, 2012). It has been found to be rich in vitamin B-Complex, potassium, phosphorus, magnesium, iron, copper, zinc and manganese (Oboh and Okhai, 2012).

There has been prevalent situation of improper disposal of the grains of *Pennisetum glaucum* after their use in preparing kunu drink without regard to their stimulatory or inhibitory effect on surrounding crop plants. Therefore, this study attempts to exploit the biochemical composition of this plant extract in relation to its effect on *Zea mays*.

MATERIALS AND METHOD

Preparation of Aqueous Extract from seeds of *Pennisetum glaucum*

60 grams of macerated grains of *Pennisetum glaucum* were weighed into extraction flask. 2 litres of cold distilled water was poured into the ground millet powder. The flask was left overnight. The extraction was done by filtration and decantation to obtain a stock solution. The various concentrations of 20, 40, 60, 80, and 100% were prepared through series of dilutions from the stock solution, while distilled water 0% was used as control.

Analysis of Seed Extract of *Pennisetum glaucum*

The contents of mineral nutrients (calcium, magnesium, sodium, potassium, iron, manganese, copper, zinc, phosphorus, lead and nitrogen) and secondary metabolites (alkaloids, tannins, saponins, flavonoids, and phytate) were assessed using standard procedures (AOAC, 1999).

Growth Study

Seeds of *Zea mays* used for this study were obtained from local farmers in Yenagoa, Bayelsa State, Nigeria. Healthy and viable seeds were sorted out and surface-sterilized with 5% sodium hypochloride solution for 5 minutes and washed several times with sterile distilled water. 10 seeds of the test crop were air-dried and sown in sterilized Petri-dishes containing 2 sterile What-man filter paper per treatment. Each level of treatment was replicated five (5) times using a completely randomized design. Seedlings were allowed to grow for a period of 14 days for evaluation of growth parameters.

Statistical Analysis: Standard errors of the mean values were calculated for the separate readings and data were subjected to analysis of variance (ANOVA) ($P < 0.05$) to compare the means using the method of Ogbeibu (2005).

RESULT AND DISCUSSION

The mineral nutrients and secondary metabolites in seed extract of *Pennisetum glaucum* are presented (Table 1). The macro nutrient contents were in a decreasing order; potassium, sodium, magnesium, calcium, phosphorus, and nitrogen, while the micronutrient contents were in a decreasing order; iron, zinc, manganese, copper and lead (Table 1). Similarly, alkaloid recorded the highest content of secondary metabolites while flavonoid was the lowest (Table 1). This study indicated that the seed extract of *P. glaucum* is riched in basic mineral nutrients such as calcium, magnesium, sodium, potassium, iron, manganese, copper, zinc, phosphorus, lead and nitrogen. Although, the mineral nutrient composition of plants material vary with age, cultural practices, environment, the season and the varieties (Apoxi et al. 2000), mineral elements play different but important roles in plants ranging from structural, catalytic to electro-chemical function (Anoliefo, 2006; Gupta and Gupta, 2005). Many growth and developmental processes in plants have been demonstrated to be influenced by mineral nutrients (Range and Williams, 2002; Etukudo et al., 2015). In general, mineral elements play many crucial roles in the growth and development of plants ranging from catalytic function in redox reactions in the mitochondria, chloroplast, and cytoplasm of cells or as an electron carrier during plant respiration to regulation of processes such as photosynthesis, respiration and biosynthesis of enzymes (Yruela 2009; Todorovis et al. 2009; Soceanu et al. 2005).

Table 1: Mineral Nutrients and Secondary Metabolites in Seed Extract of *Pennisetum glaucum*

PARAMETERS	CONTENTS
Calcium (mg/100g)	32.25 ± 0.54
Magnesium (mg/100g)	46.73 ± 0.22
Sodium (mg/100g)	52.03 ± 0.39
Potassium (mg/100g)	66.21 ± 0.20
Phosphorus (mg/100g)	7.27 ± 0.43
Nitrogen (mg/100g)	0.71 ± 0.03
Iron (mg/100g)	4.06 ± 0.49
Manganese (mg/100g)	2.04 ± 0.94
Copper (mg/100g)	1.20 ± 0.28
Zinc (mg/100g)	3.88 ± 0.24
Lead (mg/100g)	0.023 ± 0.35
Alkaloids (%)	27.30 ± 0.22
Tannins (%)	26.76 ± 0.24
Saponins (%)	18.20 ± 0.37
Flavonoids (%)	9.09 ± 0.44
Phytate (mg/100g)	26.78 ± 0.23

Mean ± standard error from five (5) replicates

The coefficient of velocity of germination of *Zea mays* was relatively higher than that of the control at 40, 60, 80, and 100 % levels of concentration of seed extract of *P. glaucum*. The germination percentage increased with increase in concentration of seed extract of *P. glaucum* with the highest value recorded at 100% concentration relative to the control (Table 2). The shoot length and root length of the test crop recorded higher values at 80 and 100%, and 100% concentration of seed extract of *P. glaucum,* respectively, comparable with the control treatment (Table 3). The fresh weight and dry weight of *Z. mays* increased with increase in the concentration of seed extract of *P. glaucum* with values relatively higher than the control treatment at 80 and 100% levels of concentration for fresh weight and at 100% level of concentration for dry weight (Table 3). The shoot length, root length, fresh weight and dry weight of the test crop exhibited positive responses to treatment containing seed extract of *P. glaucum*. This positive growth response may be attributed to the rich mineral nutrients composition of the seed extract which supported optimum growth performances of the test crop. The overall growth performance of plants may be influenced by the availability and absorption of mineral nutrients (Baker et al. 2000; Esenowo, 2000). This also indicates the disparity in growth response among the various treatments. The availability of individual element is a function of pH and interaction between other elements in the growth medium (Agbede, 2009; Ebukanson and Bassey, 1992).

Table 2: Effect of Seed Extract of *Pennisetum glaucum* ON GERMINATION PARAMETERS OF Zea mays L

Concentration of extract	Coefficient of velocity of germination	Germination percentage (%)
0	0.28 ± 0.02	92.33 ± 0.35
20	0.27 ± 0.03	84.21 ± 0.45
40	0.30 ± 0.02	88.62 ± 0.32
60	0.29 ± 0.05	90.43 ± 0.47
80	0.32 ± 0.04	90.82 ± 0.31
100	0.32 ± 0.03	93.56 ± 0.42

Mean ± standard error from five (5) replicates

Table 3: Effect of Seed Extract of *Pennisetum glaucum* ON GROWTH PARAMETERS OF Zea mays L

Concentration of extract	Shoot length (cm)	Root length (cm)	Fresh weight (g)	Dry weight (g)
0	13.20 ± 0.32	6.51 ± 0.51	2.30 ± 0.21	0.46 ± 0.34
20	9.30 ± 0.36	4.98 ± 0.32	1.72 ± 0.32	0.30 ± 0.26
40	11.32 ± 0.29	5.21 ± 0.27	1.76 ± 0.43	0.36 ± 0.37
60	12.65 ± 0.55	5.42 ± 0.73	1.82 ± 0.36	0.38 ± 0.54
80	13.40 ± 0.41	6.30 ± 0.12	2.36 ± 0.65	0.44 ± 0.43
100	14.20 ± 0.33	6.82 ± 0.22	2.44 ± 0.56	0.48 ± 0.41

Mean ± standard error from five (5) replicates

In consequence, interactions among individual element may induce deficiency of other elements (Esenowo, 2004), while, a pH value outside the physiological range may result in damage to plant tissue and inhibition of salt absorbtion (Agbede, 2009, Anoliefo, 2006). Therefore, the availability of needed plant nutrients enhances rapid growth rate, increase the concentration of cytoplasm and the rate of cell division (Esenowo, 2004, Verma and verma, 2007). This also shows that the rate of accumulation of an ion in plant is influenced by the external concentration of such ions, which in turn affect the rate of synthesis of metabolites and physiological processes in plants (Etukudo et al., 2011; Anoliefo, 2006).

CONCLUSION

This study showed *that* aqueous seed extract of *Pennisetum glaucum* contains valuable proportions of mineral nutrients such as calcium, magnesium, sodium, potassium, iron, manganese, copper, zinc, phosphorus, lead and nitrogen. Therefore, this suggests that the seed extract could be utilized as nutrient supplement for plant growth and development of *Zea mays.*

COMPETING INTEREST

There was no conflict of interest among the three authors.

AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between all authors. Author MME designed the study, wrote the protocol and wrote the first draft of the manuscript. Author IJO supervised the work and revised the final manuscript. Author JIU managed the literature searches. All authors read and approved the final manuscript.

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REFERENCES

Agbede OO (2009). Understanding soil and plant nutrition. Nigeria, Salmon Press and Co. Ltd. 20-60.

Apoxi SO, Long RJ, Castro FB and Orakor ER (2000). Chemical composition and nutritive value of leaves and stems of tropical weeds. Grass and Forage Sci., 55(1), 77-81.

Anoliefo CO (2006). Introductory tropical plant Biology. Nigeria, Uniben Press. 257-362.

AOAC (1999). Association of Official Analytical Chemist. Methods of analysis (16h Edition), Washington DC., U.S.A.

Baker AJM, McGrath SP and Reeves RD (2000). Metal Hyper accumulator Plants. A Review of the Ecology and Physiology of a Biological Resource for Phytoremediation of metal- polluted soils. In: Terry N, Banuelos G, Editors. Phytoremediation of Contaminated Soil and Water. Boca Raton: Lewis Publishers. 85-108.

Chandra K (2005). Production and quality control of organic inputs; A 10 day training programme on production and quality control of organic inputs of Kottayam, Kerala Regional Centre of organic farming- Herbbal, Banglaore, 24, 1-46.

Dutta AC (2012). Botany for Degree students, 6th Ed. Oxford University Press. New Delhi, India. 317-627.

Ebukanson G J and Bassey ME (1992). About seed plants. Baraka Press and Publisher, Nigeria. 20-60.

Esenowo GJ (2000). Elements of biotechnology. Bonie Print Publishing Company, Uyo.

Esenowo GJ (2004). Developmental Biology and plant physiology. Abeam Publishing Co. Nigeria. 23-168.

Etukudo MM, Nwaukwu I A and Habila S (2011). The Effect of Sawdust and Goat Dung Supplements on Growth and Yield of Okro (*Abelmoschus esculentus*) (L. Moench) in Diesel Oil Contaminated Soil. Journ.al of Research in Forestry, Wildlife and Environment; 3(2): 92- 98.

Etukudo MM, Udo, Joseph I and Okereke IJ (2014). Germination and Growth Studies of *Abelmoschus esculentus* L. Moench in Palm Bunch Extract of *Elaeis guineensis* Jacq. Supplemented Medium. IOSR:Journal of Environmental Science, Toxicology and Food Technology, 8(12 Ver.III): 45- 48.

Etukudo MM, Hamilton-Amachree A and Roberts EMI (2015). Eco-physiological Studies of Elemental and Proximate Contents of Gnetum africanum Welw and Telfairia occidentalis Hook seeds from two Ecological Zones of Akwa Ibom State. European International Journal of Science and Technology, 4(6):47-53.

Gupta NK and Gupta S (2005). Plant Physiology. New Delhi. Oxford IBA Publishing Co. Pvt Ltd.

Holopainen Jarmo K and Blande James D. (2012). Molecular plant volatile communication: Sensing in nature in nature. Journal of The British Ecological Society, 26(5), 18-20.

Macias FA, Marian D, Oliveros-Bastidas A, Varela RM, Simonet AM and Carrera C (2003). Allelopathy as a new strategy for sustainable ecosystem development. Biol. Sci. Space. 17(1), 18-23.

Oboh HA and Okhai EO (2012). Antioxidant and some free radical scavenging abilities of some indigenous Nigerian drinks. Nigerian Journal of Basic and Applied Science, 20(1), 21-26.

Ogbeibu AE (2005). Biostatistics: A practical approach to research and data handling. Mindex Publishing Company Limited, Benin.

Range CM and Williams RK (2002). Mineral nutrition and plant morphogenesis. In Vitro Cellular and Developmental Biology, Gaithersborg, 38, 115-124.

Soceanu A, Magearu V, Popescu V, Matei N (2005). Accumulation of manganese and iron in citrus fruits. Analele Universitatii Bucuresti, Chimie. 14(1-2), 173–177.

Todorovis S, Giba Z, Simonovic A, Bozic D, Banjanac T, and Grubišić D (2009). Manganese effects on in vitro development of lesser centaury *[Centaurium pulchellum* (Sw.) Druce] Archives of Biological Sciences. 61(2), 279–283.

Verma S K and Verma M C (2007). A textbook of plant physiology, biochemistry and biotechnology. 6th Edition. S. Chad & Company Ltd. New Delhi.

Yruela I (2009). Copper in plants: acquisition, transport and interactions. Functional Plant Biology. 36(5): 409–430.

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