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POTENTIALS OF SELECTED WEED DRY MATTER IN COMPARISON TO NPK FERTILIZER: A MITIGATION APPROACH TO CLIMATE CHANGE AND SUSTAINABLE ENVIRONMENT

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ABSTRACT

Utilization of inorganic fertilizer to increase productivity of tree and food crops has been on the increase with impacts on environmental degradation and climate change. This study therefore investigated the potentials of aquatic weeds (*Eichhomia crassipes* (Mart) Solms (Water hyacinth) and *Pistia stratiotes* L (water lettuce) and *Chromolaena odorata* (L) R.M King and H. Rob weeds dry matter as substitute for inorganic fertilizer (NPK 15:15:15) as a mitigation approach to climate change. Weeds dry matter produced were used to raise *Tectona grandis* seedlings at the nursery stage. There were five treatments (T1, T2, T3, T4 and T5) replicated five times, where T1 is the control (2kg of top soil alone), T2 is top soil + N.P.K. 15:15:15, T3 is top soil + 5grammes of air dried *Chromolaena odorata*, T4 is top soil + 5grammes of air dried Water lettuce and T5 is top soil + 5grammes of air dried Water hyacinth. The experimental design adopted was a Completely Randomized Designed (CRD). Data were collected on shoot height, stem diameter and leaf production and were analysed using descriptive statistics and analysis of variance (ANOVA) at $a_{0.05}$ level of probability. Results showed that *Tectona grandis* responded positively to all the weed dry matter used. The T4 had the highest shoot height of 17.68cm followed by T3 (15.68cm), T2 had 14.20cm while the T1 had 7.50cm. The mean stem diameter was also highest in T4 with7.05mm followed by T2, T3 and T5 with equal values of 6.90mm each, while T1 had the least (5.88mm). The ANOVA revealed that there were no significant differences among treatments for all the parameters assessed. Selected weeds (Water lettuce, Water hyacinth, and *Chromolaena odorata*) positively influenced growth and development of *Tectonagrandis* seedlings. The selected weeds can be used as alternatives to (N.P.K 15:15:15) in raising *Tectonagrandis* seedlings at the nursery stage.

Keywords: Organic matter, environmental degradation, climate change, inorganic fertilizer

Introduction

Agriculture and forestry constitute the backbone of most technological and scientific breakthrough and its development in Africa is a victim of climate change. However, it is also a major contributor to environmental degradation and climate change. More than in any other sector, the utilization of inorganic fertilizer to increase its productivity has the potentials to increase the effect of climate change (Brady *et al*., 2002). Hence, the impact of climate change on social, economic and ecological aspect of human life is likely to increase drastically as a result of modern agricultural practices like using agrochemicals and utilization of inorganic fertilizers. The outlook of various governments for the coming decades is that agricultural and forestry productivity needs to increase to reduce poverty and hunger threat, enhance food production and availability, promote food supplies and adequately increase food accessibility and utilization.

This will require the utilization of more fertilizers to increase soil fertility and boost agricultural and forestry production. Though, soil nutrients and its availability to crop is essential for the maximum production of food and trees, in the development of any nation, its decline which is almost universal in Africa has led to the introduction and addition of inorganic fertilizer to enhance plant growth and development. According to Iwena (2002), inorganic fertilizer which has been confirmed as effective silvicultural tool for raising healthy planting stock, hastening the growth of tree/shrub in forest plantation lack ability to hold soil structure together, less accessible to farmer, costly and usually create environmental hazard when used in excess and can easily be washed away from the reach of plant when there is excessive rainfall. Besides, its contribution to climate change has made the climatologist, silviculturist and environmentalist to be seeking for alternative tools that is ecologically friendly, economically viable and culturally acceptable for its replacement. Hence, the following materials that are high in nitrogen and carbon have been identified as good organic materials; vegetable scraps, garden weeds, farm manure dry leaves, paper, dry grass and wood ash. They are within our reach and could be conveniently used as a good substitute for inorganic fertilizer. Weed is an herbaceous plant not valued for use or beauty, growing wild and rank, and regarded as cumbering the ground or in hindering the growth of superior vegetation. It is also defined as the plant that interferes with human activity or in some way intrudes upon human welfare (Akinmoladun *et al*., 2007; Agbenin and Igbokwe, 2006). Though, many weeds are harmful, some like *Chromolaena odorata*, water lettuce, and water hyacinth are useful and have positive value (Okezie, 1987*)*. *Chromolaena odorata* is a perennial shrub in the family of Asteraceae forming dense tangles bushed up 3m in height, although it burns readily, it re-sprouts from its stump immediately after rain (Akinmoladun *et al*.,2007). This ability couple with its fast growth rate enables it to compete well with other plants. It provides a vegetative cover that protects the soil surface against erosive action of rain and wind. It plays an important part in nutrient recycling, its root tap nutrient from the lower soil depth and return these to the soil surface as litter when it sheds leaves or when the entire plant dies and decay. It adds organic matter to the soil both from the root and from the above ground plants. It can be used as pot herbs, source of pesticides, food and cover for animal. (Akinmutimi and Akufo, 2006).

Water hyacinth (*Eichhomia crassipes*) belongs to the family of Pontederiacea. It is a larger-flower aquatic weed and the worst weed in the world of aquatic and terrestrial. (Westerdahl and Getsinger, 1989), hence, it is believed to be the most invasive aquatic weed that interferes with environmental sustainability (FME, 2008). It is a free floating plant which grows fast and absorbs water abundant nutrients which are readily released in the soil when used as organic manure. It has been known to be useful in the production of livestock feeds, organic manure for soil amendment, mulch, basket, pharmaceuticals and drugs, vitamin, hydrogen, ethanol and distilled water and for pulp and paper making. It has also been found to be effective in removing trace elements and polluctants from industrial effluents (Westerdahl and Getsinger, 1989). These benefits are greatly overshadowed by its environmental invasion on the water bodies.

Water lettuce (*Pistia stratrioties*) belongs to the family of Araceae. It is an aquatic plant native to tropical and sub-tropical. It affects water bodies in many negatives ways. There are economic impacts when the weed blocks boat access and interferes with the fishing activities (Westerdahl and Getsinger, 1989). Wind movement and water current helps contribute to its wide distribution thereby making breeding and reproduction condition of the aquatic animals to be difficult, hence reducing their economic values. It has got a number of advantages as green manure and as compost (Cooke, 1982). This study therefore investigated potentials of selected weed dry matter in comparison to NPK fertilizer with a view to mitigating climate change influenced by the use of inorganic fertilizers.

Materials and Methods

The experiment was carried out at Federal College of Forestry premises, Jericho, Ibadan. The College is located on latitude 07º23' 18"N to 07º 23' 40"N and longitude 03º 36' 20"E to 03º32' 41"E. The climate of the study area is the West African monsoon with dry and wet seasons. The dry season is usually from November through March and is characterized by dry cold wind of harmattan. The wet season usually starts from April to October with occasional strong winds and thunderstorms. Mean annual rainfall is about 1548.9 mm, falling within approximately 90 days. The mean maximum temperature is 31.9^{o}C, minimum 24.2^{o}C while the mean daily relative humidity is about 71.9% (FRIN, 2015).

Experimental Procedure

River sand was collected from the College stream situated at the back of the College students' practical field. It was sterilized, air dried, sieved and then filled into germination box. Seeds of *Tectonagrandis* were collected from Forestry Research Institute of Nigeria (FRIN) and sown intothe germination box under humid propagator. Watering was carried out every morning to hasten seed germination.

Chromolaena odorata, water lettuce, Water hyacinth were collected along Eleyele dam and air dried for a week after which it was grinded into powdery form and weighed at the soil laboratory of Forestry Research Institute of Nigeria (FRIN). N.P.K. 15:15:15 fertilizer was also weighed with beam analytical balance into desired weight of 5grammes. Polythene pots (20) of size

3cm x 9cm were filled with 2kg of top soil thoroughly mixed with air dried *Chromolaena odorata*, water lettuce, water hyacinth dry matter of 5grammes each while the N.P.K 15:15:15 was applied in a ring form to reaming 5 polythene pots filled with 2kg of top soil and watered immediately.

Watering was done for a period of 7days before seedlings of *Tectona grandis* were transplanted to allow curing inside the polythene pots. There were five treatments (T1, T2, T3, T4 and T5) replicated five times, where T1 is the control (2kg of top soil alone), T2 of top soil + N.P.K. 15:15:15, T3 is top soil + 5grammes of air dried *Chromolaena odorata,* T4 is top soil + 5grammes of air dried Water lettuce and T5 is top soil + 5grammes of air dried Water hyacinth, making a total of 25 experimental units. The experimental design was a Completely Randomized Design (CRD). Initial measurements of plant height (cm) and stem diameter (mm) were taken with metre rule and digital Vernier calliper, respectively. Leaf production was assessed by direct counting the number of leaves produced. The growth parameters (plant height, stem diameter, leaf production) of each seedling in each pot were assessed fortnightly and the data recorded for 12 weeks. Descriptive statistics and Analysis of Variance (ANOVA) were used to analyze the collected data.

Results and Discussion

The result of soil analysis is presented in Table 1. The pH of the experimental soil is slightly acidic (6.69) and it is loamy sand in texture. The organic carbon content and available phosphorus of the soil were higher (17.9gkg^{-1} and 51gkg^{-1}) respectively when compared with the critical value of 15mgkg Sand >20mgkg^{1} (Adeoye, 1986), respectively. The concentration of Fe, Mn and Zn fall within the critical value range of 5-200mgkg-^{1},5,100mgkg-^{1} and 1-5mgkg-^{1} (Adeoye, 1986), respectively while Cu is lower than the critical value of 1.2-2mgkg-^{1} (Adeoye, 1986). Therefore, the soil could be said to be low in major nutrients with the exception of P which is higher than the critical value. The phosphorus is one of the main plant nutrients in the soil, which is essential for cell division and development of the growing tip of the plant. This makes it vital for seedlings and young plants. However, low main nutrients can have significant influence on plant growth and vigour (Wiedenhoeft, 2006).

Table: 1: Physico-chemical analysis of top soil used for the experiment

Soil properties	values
Organic Carbon (cmol/kg)	17.9
Organic Matter (cmol/kg)	30.6
Total Nitrogen (cmol/kg)	1.5
K(cmol/kg)	0.11
Na (cmol/kg)	1.27
Ca (cmol/kg)	5.19
Mg (cmol/kg)	2.34
Mn (mg/kg)	46.1
Cu (mg/kg)	0.8
Zn (mg/kg)	3.1
Fe (mg/kg)	36
P(mg/kg)	51.92
Sand (%)	81.5
Clay (%)	14
Silt (%)	4.5
pH	6.69

Table 2 shows the pH, percentage phosphous (P), Potassium (K) and Nitrogen composition of weed dry matter. The water lettuce dry matter had the highest pH (8.0), which made it to be slightly alkaline. *Chromolaena odorata* dry matter had 6.8 (slightly acidic) while Water hyacinth had 6.1 (moderately acidic). Busari *et al*., (2015) reported that pH plays significant roles on solubility and availability of plant nutrients and decomposition of organic matter. This ability will eventually facilitate utilization of the organic matter by the plants for optimum growth.The percentage phosphorus was highest in *Chromolaena odorata* (0.17 %). According to Wiedenhoeft, (2006) Phosphrus (P) plays the similar chemical and biochemical role in plants as it does in all other organisms. It is the main element involved in energy transfer for cellular metabolism and it is a structural component of cell membranes, nucleic acids, and other critical materials.Jalali and Ranjbar, (2010) observed that P laden manure added to the soil was rapidly converted to water-soluble phosphate for plant use. It relatively becomes less soluble compounds within a very short time due to high absorbing capacities of the soils. The percentage composition of potassium (K) and Nitrogen (N) in water hyacinth was 0.5% and 6.64% respectively. There are mainly two sources of N; the N from organic residues and N from soil organic matter or humus (Wiedenhoeft, 2006). All these materials are important in maintaining or improving soil fertility and plant nutrition through their direct and indirect effects on microbial activity and nutrient availability (Wiedenhoeft, 2006).

Table 2: The pH, Phosphorous (P), Potassium (K) and Nitrogen composition of weed dry matter

Dry matter samples	pH	% P	% K	% N
Water hyacinth	6.1	0.09	0.50	6.64
Water lettuce	8.0	0.08	0.50	1.55
Chromolaena odorata	6.8	0.17	0.43	3.98

Table 3 showed that seedlings planted with 5g of water lettuce dry matter + 2kg of top soil (T4) gave the best result of 17.68cm in term of mean plant height, followed by (T3) (15.68cm). T2 had 14.20cmwhile the control treatment (T1) had 7.50cm.

Also, in terms of mean stem diameter, seedlings planted with 5g water lettuce dry matter + 2kg of top soil (T4) gave the best result of 7.05mm followed by T2, T3 and T5 with equal values of 6.90mm each, while the control treatment (T1) had the least mean stem diameter of 5.88mm. The variation recorded in each treatment with respect to plant height, stem diameter and leaf production can be attributed to variation in the percentage of Nitrogen, Phosphorus, Potassium and pH as indicated by the result of the chemical analysis of the weed dry matter. According to Cicek *et al*, (2010), the joint influence of NPK in soil on plant growth and development cannot be overemphasized. They enhance photosynthesis process, retention and absorption of water in soil stock growth, root growth and fruit production. This finding is in conformity with (Nwoboshi, 2000) who found that the quality of the weed dry matter in terms of elemental composition varies with species. It also supports Otogunwa (2009) findings which stipulated that growth and seedlings response is directly proportional to the availability of nutrients in the growth media. The relatively least values in shoot height (7.50cm) and stem diameter (5.88mm) as recorded for control treatment depicts that the presence of additional soil nutrients to the soil at appropriate quantity augment nutrient status of the soil and in turn increase plant's growth. According to IPCC, (2006) and Thompson *et al*., (2016) plants with good vigour beget healthy forests that will possess high biomass accumulation and carbon sequestration potential. This implies that optimum plant growth under the auspices of fertile soil has the potential to mitigate climate change through sequestration of carbon dioxide.

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Table 3: **Effect of different weed dry matter on mean plant height, stem diameter and leaf production of *Tectonagrandis* seedlings within 12 weeks of growth**.

Treatments	Plant Height (cm)	Stem Diameter (mm)	Number of leaves
T1	7.50	5.88	12
T2	14.20	6.90	12
T3	15.68	6.90	12
T4	17.68	7.05	14
T5	11.64	6.90	12

The result in Tables 4, 5 and 6 showed that there was no significant difference in the mean height of *Tectonagrandis* seedlings in response to selected weeds as substitute for NPK 15:15:15. at 5% probability level. Hence, any of the dry matter from water hyacinth, water lettuce and *Chromolaena odorata* could be used to raise *Tectona grandis* seedlings at the nursery stage. This shows that presence of key mineral elements from sustainable sources is pertinent to plant growth. Adelani *et al*, (2014) posited that leaf litters that were converted to green manure play important roles on the growth of plant. Basically, as a result of essential nutrients that are locked in them.

Table 4: Analysis of Variance (ANOVA) for plant height (cm)

SV	df	SS	MS	F-cal	F-tab
Treatments	4	734.52	183.63	1.3704ns	2.8660
Error	20	2680.05	134.00		
Total	24	3414.57			

ns = Not significant at $p < 0.05$

Table 5: Analysis of Variance (ANOVA) for stem diameter (mm)

SV	df	SS	MS	F-cal	F-tab
Treatments	4	4.857	1.214	0.866ns	2.8660
Error	20	28.013	1.401		
Total	24	32.87			

ns = Not significant at $p < 0.05$

Table 6: Analysis of Variance (ANOVA) for leaf production

SV	df	SS	MS	F-cal	F-tab
Treatments	4	587.63	146.91	1.79144ns	2.8660
Error	20	1640.13	82.01		
Total	24	2227.76			

ns = Not significant at $p < 0.05$

Conclusion and Recommendation

Based on the observation and the result of the analysis of the data collected, it is clearly shown that *Tectonagrandis* seedlings responded positively to all the selected weeds (Water lettuce, Water hyacinth, and *Chromolaena odorata*) dry matter. This means that any of the selected weeds can be used as organic manure. In addition, the fact that there was no significant difference among the treatment established that any of the selected weeds can be used as alternatives to (N.P.K 15:15:15) in raising *Tectonagrandis* seedlings at the nursery stage. The collection and use of water lettuce, and water hyacinth will definitely lessen the negative environmental impact of aquatic weeds on other aquatic lives.

Therefore, in a bid by foresters and nursery managers to mitigate the effect of climate change through enhancement of plant optimum growth, weed dry matter from water lettuce, water hyacinth and *Chromolaenaodorata* can be used as substitute and adequate replacement for inorganic fertilizer (N.P.K 15:15:15). Besides, government should encourage the use of organic manure and weed dry matter by nursery managers, farmers and scientists to reduce the contribution of inorganic fertilizers (via environmental contamination) to climate change

Referrences

Adelani, D.O., Suleiman, R.A., Aduradola, M. A and Akesode, H. A. (2014). Assessment of leaf litters of some tree species on growth of *Zeamays* (L) in Northern Guinea Savanna ecology. *Journal of Organic Agriculture and Environment* 2:117-130.

Adeoye, G. O (1986): Comparative Studies of ammonium bifluoridechelateextractant and some conventional extractants for sedimentary soils of South Western Nigeria. Ph.D. Thesis. Department ofAgronomy. Uniiversity of Ibadan. Pg 48

Agbenin, J. O and Igbokwe, S.O. (2006): Effect of soil-dung manure incubation on the solubility and retention of applied phosphate by a weathered tropical semi-arid soil. Geoderma. 133, 191-203.

Akinmoladun, A. C, Ibukun, E.C and DanOloge, I. A (2007): Phytochemical constituents and antioxidant properties of extracts from the leaves of *Chromolaenaodorata*. Sci Res Essays. 2:191–194.

Akinmutimi AH and Akufo A (2006): The effect of graded levels of dietary inclusion of siam weed (*Chromolinaodorata*) leaf meal in grower rabbits diet in a tropical environment. J Ani Vet Adv. 5:707–711.

Brady, Nyle C., and Weil, Ray R. (2002): The Nature and Properties of Soils , 13th edition. Upper Saddle River, NJ: Prentice Hall. pp740

Busari, A.B., Kukal, S. S., Kaur, A.. Bhatt, R and Dulazi. A. A. (2015): Conservation tillage impacts on soil, crop and the environment.International Soil and Water Conservation Research. 3:119-129. doi:10.1016/j.iswcr.2015.05.002

Cicek, E., Yilmaz, F. and Yilmaz M. (2010):. Effect of N and NPK fertilizers on early field performance of narrow-leaved ash, *Fraxinus angustifolia*. J. Environ. Biol. 31 (1): 109

Cooke, G.W (1982): Fertilizing for maximum yield, English language books, society, London, (pp 30)

Federal Ministry of Environment (2008): Managing the Nigeria Environment for Sustainable Development: Challenges and Opportunities.Pg. 112

Forestry Research Institute of Nigeria (2015): Annual Report of Forestry Research

Institute of Nigeria.

FRIN, (2015): Forestry Research Institute of Nigeria, Department of Meteorological Station Report

Intergovernmental Panel on Climate Change (2006): *IPCC Guidelines for National Greenhouse Gas Inventories, Prepared by the National Greenhouse Gas Inventories Programme*. Tokyo: Inst. Glob. Environ. Strateg.

Iwena, O.A (2002): Essential agricultural science for secondary school. Tonad publishers limited 219 – 222

Jalali, M. and Ranjbar, F. (2010): Aging effects on phosphorus transformation rate and fractionation in some calcareous soils. Geoderma. 155, 101-106.

Nwoboshi, L.C (2000): The nutrient factor in sustainable forestry, Ibadan University Press, pp 75

Okezie, A. (1987): Weed Science in the Tropics edited by Adeleke, A.O Federal College of Forestry, Ibadan. Pg 10-39

Otogunwa, S. (2009): Effect of different agricultural wastes on the early growth of *J. Curcas* (Linn) seedlings. An unpublished Higher National Diploma project, Department of Forestry Technology, Federal College of Forestry Ibadan. Pp 26

Thompson, W. H., McFarland., C. and Brown, T.(2016): Agricultural Lime and Liming Part 2: Laboratory Testing to Determine Lime Requirements. Washington State University Fact Sheet http://pubs.wpdev.cahnrs.wsu.edu/pubs/fs217e

Westerdahl, H.E and H.D Getsinger, eds (1989): Aquatic plant identification and herbicide use guide, volume ii: Aquatic plants and susceptibility to herbicides. Technical report A -88-9. Department of the Army Waterways experiment station, corps of engineers, Vicksburg, Ms.

Wiedenhoeft, A. C. (2006): Plant Nutrition, Chelsea House Press, USA. 144 p.