



COMPARING THE EFFECT OF *NYPA FRUTICAN* ASH AND *COCOS NUCIFERA* SHELL ASH ON THE GROWTH AND YIELD OF *ZEA MAYS* L

***Eremrena, P.O. and Samuel, H. N.**

Department of Plant Science and Biotechnology, Faculty of Science, University of Port Harcourt, P.M.B.5323, Choba, Port Harcourt, Rivers State, Nigeria.

**Corresponding Author*

ABSTRACT-----

This research was Carried out at the center for Ecological studies, Abuja campus, University of Port Harcourt, Rivers State. The study was conducted to compare the effect of *Nypa fructican* and *Cocos nucifera* ash on the growth and yield of *Zea mays* L. Seven seeds of *Zea mays* were planted in a bucket of 7kg well drained sandy loamy soil and were thinned to two seeds after one week. Different concentrations of the extracted ash; control (0g), 25g, 50g *cocos nucifera* ash and 25g, 50g of *Nypa fructican* ash were applied in a ring form after two weeks of planting . A total of 5 treatments with 3 replicates each were laid in a completely randomized design. The following parameters; plant height, leaf length, number of leaves, stem girth, leaf width, fresh and dry weight were used in comparing the effects of *Nypa fructican* ash and *cocos nucifera* ash on the growth and yield of *Zea mays*. The results showed that the growth and yield of *Zea mays* were significantly ($p=0.05$) affected by the ash concentrations in the soil. The application of *Nypa fructican* ash, especially at 50g concentration, led to significantly taller plants, leaf length, number leaves , stem girth etc while 25g and 50g concentrations of *Nypa fructican* ash led to significantly higher fresh weight and dry weight. In contrast, *Cocos nucifera* ash did not improve *Zea mays* growth as compared to *Nypa fructican*. The superior performance of *Nypa fructican* ash could be attributed to its higher level of nitrogen, phosphorus and potassium nutrient content. Therefore, this study demonstrated the potential of *Nypa fructican* ash as a locally available biofertilizer that can sustainably enhance *Zea mays* productivity.

KEYWORDS: Growth and Yield, *Cocos nucifera* ash, *Nypa fructican* ash, *Zea mays* L., -----

1. INTRODUCTION

Zea mays (corn) is an erect annual grass with a height of 2-3 meters and it grows as tall as 7m (Liu *et al* 2005). *Zea Mays* is a cereal plant of the grass family (poaceae) and it's Known for it's edible grain. According to Essam, *et al.*, (2020), Maize is considered one of the most vital cereal crops in the world after wheat and rice. It is consumed as food and feed and also find its application in several industries.

The nutritional composition of corn varies due to various factors which are the structure of the kernel, genetics, environmental conditions, processing effect and various link in the food chain (Fubara, 2008). The nutritional composition of most cereal which are lower in essential minerals such as calcium, potassium, iron and zinc can be improved by blending with protein rich legumes (Mbata *et al.*, 2009). The nutritional components of a typical corn constitute (70-75%) starch, (8-10%) protein and oil (4-5%). The difference in the relative concentration of these nutrient components is due to the structure of a mature kernel which includes 80% of the endosperm and 10% of the germ on dry basis.

Research has reported maize to be a good source of carotenoid and polyphenols and the consumption of these are associated with lower risk of various degenerative diseases as antioxidants and regulators of human immune system in preventing cardiovascular diseases, cancer and age-related diseases (Messias *et al.*, 2013). The human retina has a major pigment of xanthophylls, lutein and zeaxanthin (Snodderly,1995). The, lutein and zeaxanthin are present in an appreciable amount in corn apart from having minor amount of Alpha and Beta cryptoxanthin and is also a considerable source of polyphenols antioxidant, especially phenolic acid such as ferulic, caffeic and p-coumaric acid (Sosulski *et al.*, 1982).



Nigeria is seen as the largest producer of maize and about 60% of maize produced in Nigeria is used for poultry feed. The maize farming sector in Nigeria accounts for 5% of the country's GDP (Anyanwale *et al*, 2011).

The *Nypa fruticosa* also known as Nypa palm or simply Nypa or mangrove palm. It is the only palm considered adapted to the mangrove biome. *Nypa fruticosa* ash has proved effective in the bioremediation sector. (Pariatamby *et al.*, 2014). *Nypa fruticosa* is also known for its production in renewable energy. This is seen in the production of charcoal briquettes from the shell and fiber of nypa fruits which have the potential to be used as a renewable energy source through a more appropriate treatment for increasing heat (Eddy, 2022).

The coconut shell has large application in the production of activated carbon. Coconut shell charcoal contains the highest percentage of fixed carbon of all the ligneous charcoal. The average composition of a good charcoal is moisture 6.24%, volatile 5.46%, ash 0.54% and fixed carbon 87.76%. The charcoal obtained from coconut has a high absorption capacity for gases and colouring matter and can therefore be used as a refining agent both as a deodorizer and as a decolorizer. The commercial value of shell coconut lies in its use as a raw material for the production of activated carbon. It also finds good demand as an industrial fuel to substitute furnace oil. The shell charcoal is also used by Goldsmith in melting gold and silver and for other metal work. The coconut shell in the form of ash, is a material that can be substituted for cement. Research indicates that the materials are rich in amorphous silica and can be used as a partial replacement of cement. The use of this material, which is rich in pozzolania can lead to increase in compressive and flexural strength. The raw material used in the manufacturing of cement consist mainly of lime, silica, alumina and iron oxide. Generally, the chemical analysis of coconut shell ash reveals that it contains some quantities of these elements (Kumar, 2017). Coconut shell ash can be substituted for lime to increase the soil pH in agricultural activities and it's much more environmentally safe and friendly than any other method of waste disposal being commonly adopted nowadays (Wan Noni, 2022).

2.0 MATERIALS AND METHODS

2.1 THE STUDY SITE

The research work was carried out at the ecological research centre of the University of Port-Harcourt, Abuja Park, Port-Harcourt, Rivers State.

2.2 SOURCES OF MATERIALS

The soil used for this project work were sourced from the University of Port-Harcourt, faculty of agricultural science. The seeds were sourced from ADP farm, school to land, Rumuodomaya Port-Harcourt. The *Nypa fruticosa* were obtained from Eagle Island in Rivers State Nigeria and the *Cocos nucifera* were obtained from Choba in Rivers State Nigeria.

2.3 MATERIALS USED

Oba 98 maize seeds
15pieces of 7kg litre bucket
7kg of loam soil per bucket
Cocos nucifera shell ash and *Nypa fruticosa* wurmb ash

2.4 METHOD OF ASH EXTRACTION

2.4.1 CARBONIZATION OF *Nypa Fruticosa* and *Cocos nucifera*

The biomass were placed in a 20liters metal bucket. The biomass were carbonized for 3 hours and it was done under high temperature and pressure.

2.4.2 CRUSHING OF THE BIOMASS

The crushing of the biomass were done manually using a pestle. It was thoroughly crushed into powdered form.

2.4.3 COMPACTION OF THE BIOMASS

The biomass were compacted using cassava starch as binder. The starch was prepared with hot water in a similar way as pap. A little amount of cold water were used in mixing the starch. The hot water was poured into the starch and stirred continuously until it became thick. A bowl of 5 and half diameter and 2 and half inches deep were used in the preparation of the starch. A compacting cylindrical shaped metal and a rod were used for molding. A little quantity of starch were added to the biomass and mixed. It was placed in a cylindrical shaped metal and the rod was used in



compacting it. After compacting, it was kept to dry for 2-3 days under the sun. The drying process can also be facilitated using an oven.

2.5 ASH PRODUCTION

The dried, briquettes biomass were used in the preparation of food like bole, roasted corn, or in drying meat or fish and at the end of the day the ash is obtained.

2.5.1 CLEARING OF STUDY SITE

The study site, which was an open field were cleared using the following farm implement: shovel, hoe, broom, bucket and gloves.

2.5.2 CULTURAL PRACTICES

The weeding was done by handpicking weed from the buckets. Shovel was used to weed the field and around the nursery bag. Thinning were carried out to reduce the number of plants growing in each plot and to give space for efficient growth.

2.5.3 APPLICATION OF TREATMENT AND PLANTING

Soil of 7kg were used in carrying out this study, 15 buckets were filled with loamy soil and were arranged in 5 treatments, 3 replicates. The treatments are 25g and 50g of *Cocos nucifera* and 25g and 50g of *Nypa frutican* with the control. A germination test were carried out on the maize and 14 out of 20 sprouted. 7 seeds were planted in each bucket and 5 were thinned to two after one week to provide space for growth.

2.5.4 METHOD OF ASH APPLICATION

The concentration of 25g and 50g of *Cocos nucifera* and *Nypa frutican* ash were applied respectively using a ring method in the application of the ash. The ash were applied two weeks after planting.

2.6 GROWTH PARAMETERS

2.5.1 PLANT HEIGHT (cm)

The plant height were measured from the base of the plant to the Apex using a meter rule. The plant height were measured weekly in centimeters.

2.5.2 LEAF LENGTH

The leaf length were measured from the base of the leaf to the Apex. It was measured weekly in centimeters.

2.5.3 LEAF WIDTH

This were measured from one side of the leaf to the other using a meter rule. The widest part of the leaf were measured weekly in centimeters.

2.5.4 NUMBER OF LEAVES

The number of leaves were counted visually on a weekly basis.

2.5.5 STEM GIRTH

This were measured using a measuring tape or rope to tie around the trunk.

2.5.6 Fresh shoot weight

Plant from each bucket were uprooted, shoots were separated from the roots and measured using sensitive weighing scale and the mean were recorded for each treatment.

2.5.7 Dry shoot weight

The fresh shoot were kept at the screen house and weighed at intervals to get a constant weight. After one (1) month and two weeks a constant weight were gotten and the mean percentage were recorded for each treatment.

$$\% \text{Dry matter} = \frac{\text{Dry weight of Shoots}}{\text{Fresh weight of shoots}} \times 100$$



2. 6 STATISTICAL ANALYSES

The data collected from the different parameters were subjected to one way analysis of variance (one-way ANOVA) using Microsoft Excel

RESULTS AND DISCUSSION

3.0 PHYSICOCHEMICAL ANALYSIS

Table 1: SOIL PROPERTIES

PROPERTIES	DATA
pH	6
Phosphorus	19.260
Nitrogen	0.0604
Organic matter	(sand 79.4) (Silt 3.4), (Clay 7.2)
Potassium	0.130
Moisture content (%)	12.74
TOC (%)	6.32
TOM (%)	10.99
PARTICLE SIZE	
Clay (%)	0.24
Silt (%)	2.83
Sandy (%)	96.93

Table 2: FERTILIZER PROPERTIES

SAMPLE	<i>Cocos nucifera</i> Ash	<i>Nypa fructican</i> Ash
Nitrogen (%)	0.067	0.138
Phosphate (%)	0.042	0.076
Potassium (%)	0.916	1.853

The soil pH of 6 is ideal for maize production, as optimal growth occurs between pH 6-7 where availability of nutrients like nitrogen, phosphorus, and potassium is maximized (Havlin *et al.* 2005). The total nitrogen percentage of 0.0604% is considered deficient, as maize requires 0.12-0.18% N for optimum growth (Binford *et al.* 1992). Nitrogen fertilizer application is advised.

The potassium concentration of 0.130 meq/100g is below the 0.20-0.25 meq/100g range considered adequate for maize (Vitosh 1996). This indicates potassium should be supplemented.

Moisture content of 12.74% is suitable, but maize may require irrigation in drought periods to meet its high water demand (Nielsen *et al.* 2010).

The total organic matter content of 10.99% is moderate and beneficial (Eghball, 2002), but inorganic N and K fertilization is still recommended per the soil test results

3.2 MORPHOLOGICAL CHARACTERS

3.2.1 Plant height

Plants with the application of 50g of *Nypa fructican* ash led to the highest average plant height, measuring approximately 89cm at week 8. 50g *Nypa fructican* ash concentration is taller than the control plants, which is 72 cm in height. The 25g *Nypa fructican* ash also increased plant height compared to control, but to a lesser degree. In contrast, both application rates of *Cocos nucifera* ash did not improve maize plant height substantially compared to the *Nypa fructican*.

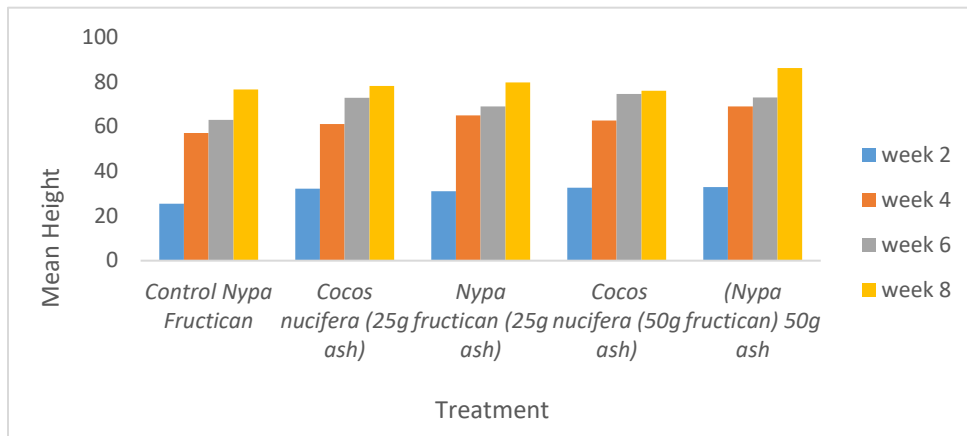


Fig 1: Effects of *Nya fructican* and *Cocos nucifera* on plant height.

3.2.2 Leaf Length

The plants with the application of 50g of *Nya fructicans* ash led to the longest leaf length in maize plants, measuring approximately 69 cm at week 8. 50g *Nya fructican* ash was longer than the average leaf length in the control treatment, which was only 54cm. The 25g *Nya fructican* ash also increased leaf length compared to control, but the effect was less prominent at this higher application rate. In contrast, both the 25g and 50g concentration of *Cocos nucifera* ash did not increase leaf length substantially compared to *Nya fructican*.

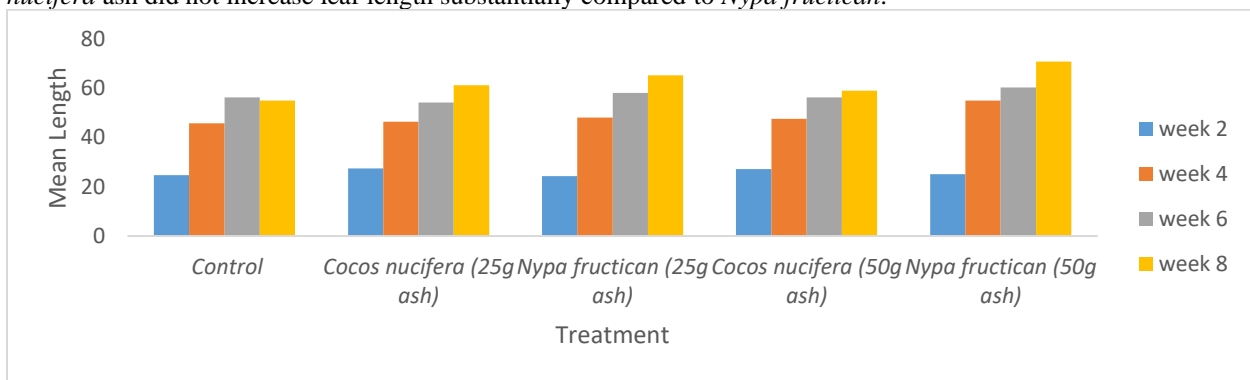


Fig 2: Effects of *Nya fructican* ash and *cocos nucifera* on leaf length.

3.2.3 Leaf Width

The results showed that applying 50g of *Nya fructican* ash led to the highest leaf width, measuring approximately 6.9cm. This were followed by the 25g *Nya fructican* ash treatment. Both rates of *Cocos nucifera* ash (25g and 50g) led to moderately higher yields compared to the control but lesser than both 25g and 50g *Nya fructican* ash.

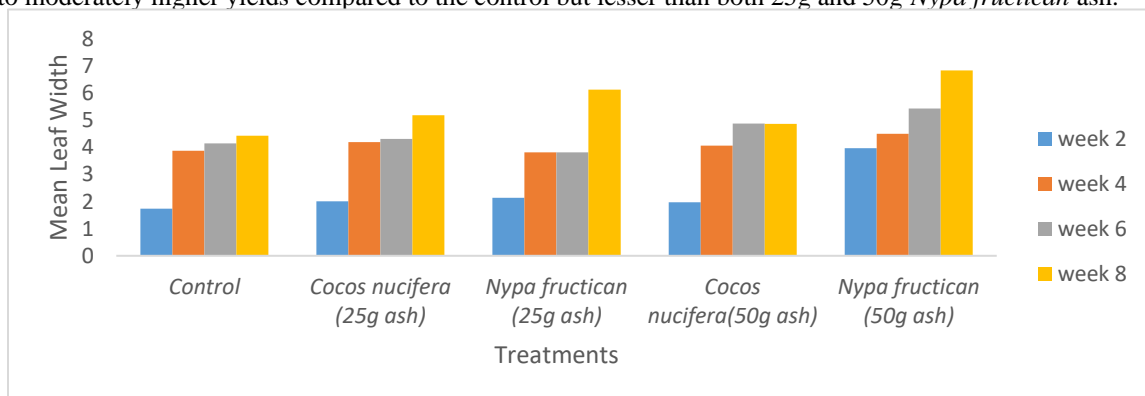


Fig. 3: Effects of *Nya fructican* ash and *cocos nucifera* on leaf width

3.2.4 Number of leaves

The results showed that applying 50g of *Nypa fructicans* ash led to the highest number of leaves in *Zea mays*, measuring approximately 9 leaves. This were followed closely by the 25g *Nypa* ash treatment, which resulted in 8 leaves. Both rates of *Cocos nucifera* ash (25g and 50g) led to moderately higher yields compared to the control, but lesser than both 25g and 50g of *Nypa fructican* ash.

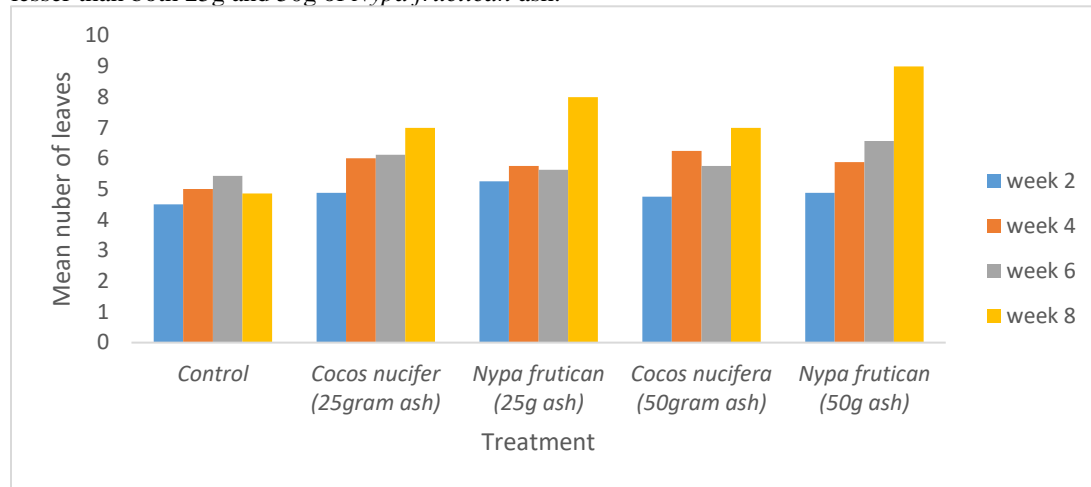


Fig.4: Effects of *Nypa fructican* and *cocos nucifera* on mean number of leaves.

3.2.5 Stem Girth

Plants with the application of 50g of *Nypa fructican* ash led to the highest stem girth, measuring approximately 4.5cm at week 8. 50g *Nypa fructican* ash concentration is taller than the control plants, which is 2.4 cm in height. This were followed by 25g *Nypa fructican* ash. In contrast, both application rates of *Cocos nucifera* ash did not improve maize plant height substantially compared to *Nypa fructican*.

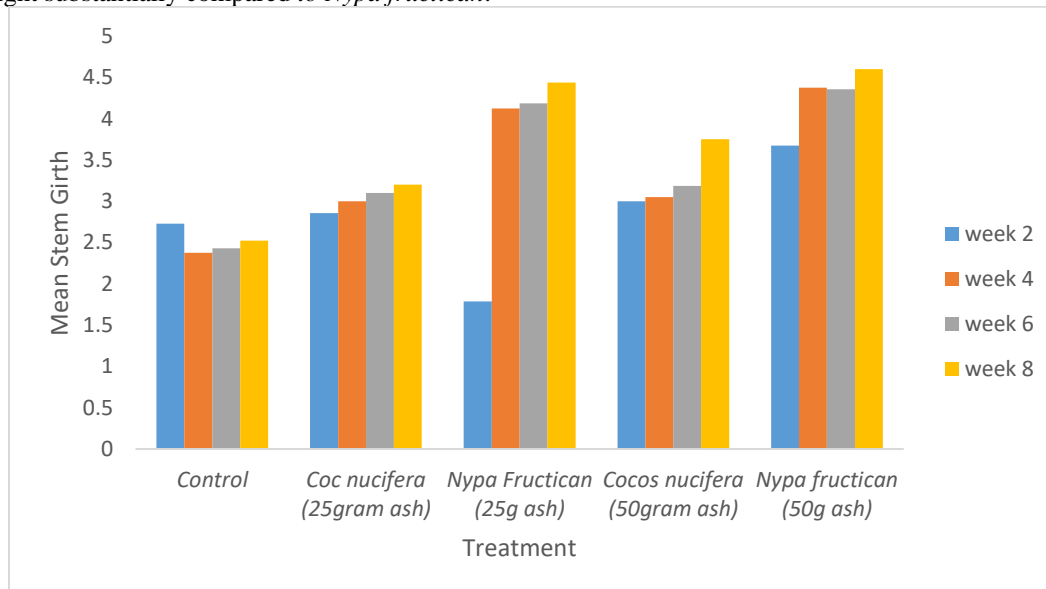


Fig. 5: Effects of *Nypa fructican* and *Cocos nucifera* on stem girth

3.3 MEAN FRESH WEIGHT OF SHOOT AND ROOT

25g of *Nypa fructicans* ash led to the highest values, measuring approximately 60g. The 50g *Nypa fructican* ash also increased shoot growth relative to control, but slightly less than the 25g rate. Both 25g and 50g Concentration of *Cocos nucifera* ash resulted in only marginally better shoot growth over the control 50g *Nypa fructican* ash root had the highest value, measuring around 30 respectively. The 25g *Nypa fructican* ash also improved root growth but to a lesser degree than the 50g compared to 25g and 50g of *Cocos nucifera*.

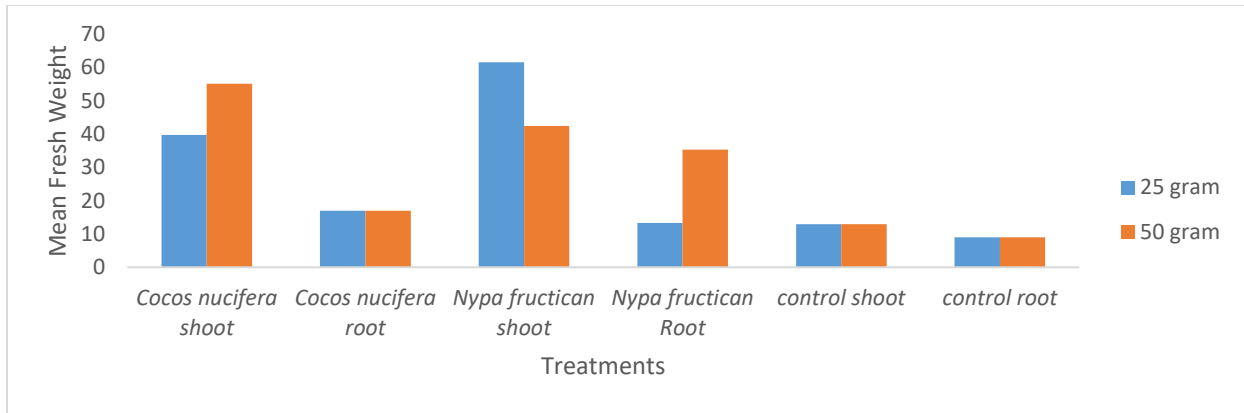


Fig 6: Effect of *Cocos nucifera* and *Nypa fructican* on Mean fresh weight

3.4 MEAN DRY WEIGHT OF SHOOT AND ROOT

25g of *Nypa fructican* ash led to the highest values, measuring approximately 14g. The 50g *Nypa* ash also increased shoot growth relative to control, but slightly less than the 25g rate. Both 25g and 50g Concentration of *Cocos nucifera* ash resulted in only marginally better shoot growth over the control 50g *Nypa* ash root had the highest value, measuring around 4g respectively. The 25g *Nypa* ash also improved root growth but to a lesser degree than the 50g compared to 25g and 50g of *Cocos nucifera*.

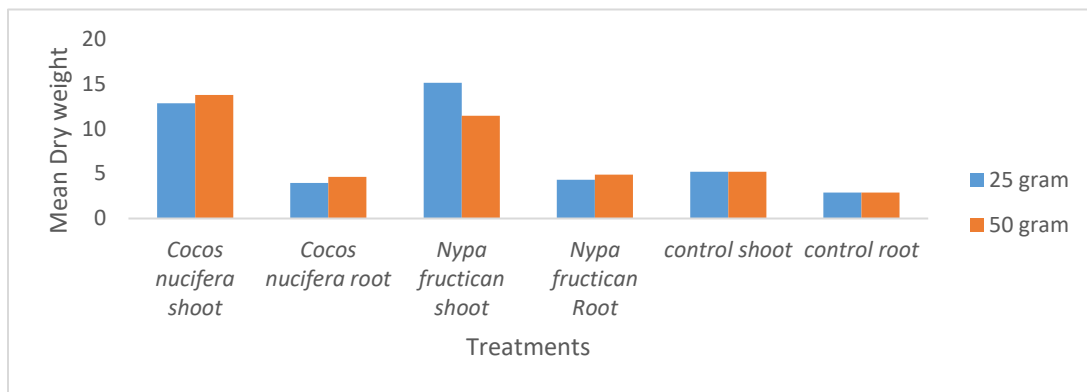


Fig 7: Effect of *Cocos nucifera* and *Nypa fructican* on Mean dry weight

The growth and development stages of the *Zea mays* plant improved greatly with the application of *Cocos nucifera* and *Nypa fructican* ash. The results from the study showed that the parameters studied varied significantly at $p=0.05$ by the application of the fertilizers. Growth parameters such as plant height, leaf area, number of leaves, stem girth, fresh weight etc. were used to observe the treatments at various weekly intervals.

The results indicated that amending soil with *Nypa fructicans* ash led to significantly better growth and higher yields in maize compared to *Cocos nucifera* ash. The higher growth and yield observed with *Nypa fructican* ash application is likely due to its higher nutrient composition. Analysis of the ash showed *Nypa fructican* contains higher levels of nitrogen, phosphorus, and potassium compared to *Cocos nucifera*.

These macronutrients are essential for plant growth and development. The release of these nutrients from the ash allowed for improved uptake by maize plants, resulting in better vegetative growth and grain production.

Additionally, *Nypa fructican* palm ash tends to have higher K, P, Ca, Si and Mg content versus *Cocos nucifera* ash (Oliveira *et al.*, 2014). *Cocos nucifera* ash has been found useful for improving yields of certain crops, but appears less effective than palm oil biomass ash sources (Ekebafe *et al.* 2011).



These findings agreed with past studies demonstrating the fertilizer value of palm ash materials (Ekebafé *et al.*, 2011; Meena *et al.*, 2014). The results highlight the potential of *Nypa fructicans* ash as a locally available, sustainable soil amendment for boosting cereal crop productivity. The superior performance of *Nypa fructicans* ash could make it an attractive biofertilizer option for maize farmers in tropical regions.

CONCLUSION

Nypa fructicans ash significantly increased plant height, leaf length, Stem Girth, number of leaves fresh and dry weight etc. compared to *Cocos nucifera* shell ash. The agronomic superiority of *Nypa fructicans* ash can be attributed to its higher content of nutrients, that improved maize growth and development. *Nypa fructicans* ash showed potential as an alternative fertilizer for sustainably increasing maize productivity.

REFERENCES

1. Ayanwale, A.B, Idowu, E.O., Adeniyi, O.R and Ogunsola, G.O., (2011). *The place of maize in Nigeria food security: A review*. A journal of Agricultural Biotechnology and sustainable Development, 3(8), pp 124-135
2. Binford, G.D., Blackmer, A.M. and Meese, B.G. (1992). *Optimal concentrations of nitrate in cornstalks at maturity*. Agron. J. 84:881-887.
3. Eddy, S., Setiawan. A. A., Zaharaini. B. U. and Oktavia. M. (2022). "Nipa (*Nypa fructicans*): can it be a renewable source of energy? IOP conference series: Earth and Environmental science 1180.
4. Eghball, B. (2002). *Soil properties as influenced by phosphorus- and nitrogen-based manure and compost applications*. Agronomy Journal, 94(1), 128-135.
5. Ekebafé, L. O., Ogbefun, D. E., and Okieimen, F. E. (2011). *Polymer applications of biomass-based blended liquid fertilizer*. Biokemistri, 23(2)
6. Essam E. K., Nader R. A., and Manzer H. S., (2020). *Potentials of Organic manure and potassium forms on maize (*Zea mays* L.) growth and production*. Scientific reports 12:(33)87-52.
7. Fubara, E.P. *Effect of processing on the storage temperature of some organic properties of palm oil*. African Journal Industrial studies 2008; 8:38-40
8. Havlin, S. L. Beaton, S. D., Tisdale, S. L; Nelson W. L., (2005). *Soil Fertility and Fertilizers.. An introduction to nutrient management*. Pearson Practically uppersaddle, NJ.
9. Kumar. L., Kamal. K. P and Sabir. K. (2017). "Use of coconut shell ash as aggregate". *International journal of research engineering and social science* :7(2): 15-19
10. Liu, H., Shi, A., Navarro, J., Todeng, M., Fan, S., Qin, D. and Li, Z. (2005). *Genetic architecture of maize kernel row number and whole genome prediction*. The plant journal, 91 (3), 524-536
11. Mbata, T.I., Ikenebomeh, M.J and Ezeibe, S. (2009). *Evaluation if mineral content and functional properties of fermented maize (generic and specific) flour blended with bambara groundnut (*Vigna subterranean* L.)*. African journal of food science. 3(4):107-112.
12. Meena, S. L., Meena, R. S., Meena, V. S., Patel, K. P., and Pal, S. S. (2014). *Role of silicon in mitigation of heavy metal stresses in crop plants*. Proceedings of the National Academy of Sciences, India Section B: Biological Sciences, 84(3), 535-543.
13. Messias R. D., Vannesa G., Sergio D. D., Anjos E. S., Manoel A. S., and Ceasar V. R. (2019). *Micronutrient and functional compounds biofortification of maize grains*. Critical Revolution of food Science and Nutrition. 55(1):123-39.
14. Nielsen, D.C. (2010). *Water Use and Yield of Canola and Five Broadleaf Crops in the Central Great Plains*. Crop Science, 50(5), 2204-2215.
15. Oliveira, D.Q.L., Feitosa, R.C., and Akkari, W.S.H. (2014). *Use of coconut ash and lime on a degraded pasture in the Eastern Amazon*. Grass Forage Sci. 70, 308-320.
16. Snodderly, D.M (1995). *Evidence for protection against age related macular degeneration by carotenoids and antioxidants vitamins*. American journal of clinical nutrition 64:1448-1461.
17. Sosulski, F., Krygier, K and Hogge, L (1982). *Free esterified and insoluble bound phenolic acids. Composition of phenolic acids in cereal and potato flours*. Journal of agricultural food chemical. 30(2):337-340.
18. Vitosh, M.L. (1996). *Nitrogen Fertilizer Requirements for Michigan Crops*. Michigan State University Extension Bulletin E-896.
19. Wan Noni. A. A. M., Anis. I. G. and Fatin. N. M. Y. (2022). *Utilization of coconut (*Coco's nucifera*) shell ash to improve soil pH for agricultural purposes*". Malaysian journal of chemistry 2022, 24(2): 24-28.