

# Evaluation of Macro-Element and Chlorophyll Content of Okra as Influenced by Oil Palm Bunch Ash Application

OGBUEHI H.C.<sup>1\*</sup>, EMERIBE, E.O.<sup>1</sup> AND UKAOMA, A. A<sup>2</sup>

<sup>1</sup>Department of Crop Science & Biotechnology, Faculty of Agriculture and Veterinary Medicine  
Imo State University, Owerri P.M.B 2000 Owerri, Imo State.

<sup>2</sup>Department of Biological Science, Federal University of Technology Owerri.

\*Corresponding author email id: ogbu\_h@yahoo.com; hcogbuehi@imsu.edu.ng

**Abstract** — An experiment to investigate the effect of Palm Bunch (PBA) Ash on the nutrient content of okra was conducted at the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, Imo State University, Owerri, during the cropping season of 2014. The experiment was laid out in a Randomized Complete Block Design with three replications 100g, 200g and 300g of PBA concentrations were used for the experiment while the no PBA (0g) represented the control. The various rates of PBA were incorporated into the soil two weeks prior to sowing, as one dose application. Data were collected on various parameters and recorded for analysis. Results showed that Chlorophyll content (17.31mg/g) which was obtained from PBA plots and 2.40mg/g of Nitrogen from the PBA plots were significant. Potassium content (0.060mg/g) and Phosphorous content (0.064mg/g) were found to be significant ( $p < 0.05$ ) at 200g of PBA application rate. It was concluded that PBA application increases nutrient content of okra except protein content which was not affected significantly by application of Palm bunch Ash. It was recommended that small holder farmers should adopt PBA application as a soil amendment tool for increased productivity.

**Keywords** — Palm Bunch Ash, Nutrient, Okra, Macro-Element and Yield.

## I. INTRODUCTION

Okra (*Abelmoschus esculentus* (L.)) is the only vegetable crop of significance in the *Malvaceae* family and is very popular in the Southeastern Nigeria (Schippers, 2000). In India, it ranks number one in its consumption but its original home is Ethiopia and Sudan, the north-eastern African countries (Torkpo *et al.*, 2008). It is one of the oldest cultivated crops and presently grown in many countries and is widely distributed from Africa to Asia, southern Europe and America. It is a tropical to subtropical crop and is sensitive to frost; low temperature, water logging and drought conditions, and the cultivation from different countries have certain adapted distinguishing characteristics specific to the country to which they belong (Kumar *et al.*, 2013). It is an oligo purpose crop, but it is usually consumed for its green tender fruits as a vegetable in a variety of ways. These fruits are rich in vitamins, calcium, potassium and other mineral matters. The mature okra seed is a good source of oil and protein has been known to have superior nutritional quality. Okra seed oil is rich in unsaturated fatty acids such as linoleic acid, which is essential for human nutrition (Kumar *et al.*, 2013). Its mature fruit and stems contain crude fibre, which is used in the paper industry.

Studies carried out in parts of Africa shows that plant

derived ash including those of wood and cocoa pod increased P, K, Mg, Ca status and pH of the soil and yield of *amaranthus*, tomato and pepper (Ojeniyi and Adejobi, 2002). Odedina *et al.* (2003) also reported of reduced acidity Awodun *et al.* (2007). Also found that PBA improved soil chemical properties by supplying organic matter. Palm bunch ash was also found to increase nutrient supply to cassava and increased the yield of cassava significantly (Ezekiel *et al.*, 2003). In Ghana, Adjei-Nsiah (2012), reported of increase in maize grain and dry matter yields when PBA was applied at 2t ha<sup>-1</sup>. In spite of the positive effects of PBA on growth and yield of food crops including maize and cassava, published works on effect of oil palm bunch ash on yield and nutrient content of okro is limited. Also information on the comparative response of different okra species to oil palm bunch ash is very scanty.

The objective of this study was to investigate the potentials of oil palm bunch ash to increase macro element and biochemical content of Okra.

## II. MATERIALS AND METHODS

### *Location and Weather Condition*

The field trial was conducted in 2014 cropping season at the Teaching and Research Farm of the Faculty of Agriculture and Veterinary Medicine, Imo State, Owerri. Owerri lies between the latitudes 5°10'N and 6°0'N and longitudes 6°35'E and 7°0'E within the south East rain forest agricultural zone of Nigeria. The rainfall distribution of the area is bimodal, with peaks in July and September with a two week break in August. The rainy season begins in March and lasts till October or early November. However, variations occur in rainfall amount from year to year. The area as reported by NIMET (2010) maintains an average annual rainfall of 2,500 mm, 27°C temperature and relative humidity of 85%.

### *Experimental Materials*

An experimental plot of 19m x 17m was used for the study. Soil samples were collected randomly on site at depths ranging from 0-15cm, air dried and packaged for analysis to ascertain the physico-chemical status of the experimental site prior to the experiment. This was also done at the end of the experiment. Empty palm bunch (EPB) was collected from palm oil processing center at Ohaji Egbema. Okra seeds were collected from Imo ADP Owerri. Simple farm tools such as cutlass, hoe, rake, hand trowel were used. An electronic weighing balance (LT 502) and sieve mesh size of 0.3mm were used.

### Preparation of Palm Bunch Ash (PBA)

The empty palm bunch collected from Ohaji/Egbema were gathered in an open space and set to burn in full supply of oxygen. It was allowed to burn completely to ash. The ash was collected in a wide metal tray and allowed to cool for 48 hours. The ash collected was sieved after 48 hours to get a fine particle of the PBA. Samples of the PBA was collected for analysis and the chemical composition was determined.

### Treatment Application and Procedure

Various rates (control 0.00g, 100g, 200g, and 300g) of the PBA will form the treatments while the 0.00kg will serve as a control. The treatment will be incorporated into the soil two weeks prior to sowing as one full dose application.

### Experimental Design and Layout

The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. Each plot measured 5m X 3m each, giving a total of 15 plots.

### Planting and Agronomic Practices

The okra seeds were sown two weeks after treatment application at a depth of 2-3cm with four seeds per hole.

The inter and intra row spacing was 50cm X 30cm. Thinning was done 7days after emergence to reduce the plants to two seedlings per stand. Weeding was done regularly to keep the field weed free. The plant was monitored for possible emergence.

### Fruit and Leaf Analysis

Chlorophyll content was analyzed from the leaf using spectrophotometer method. Nitrogen was determined from using micro-kjeldal method, Phosphorous by molybdenum blue calorimeter. Potassium by flame photometer, Protein was obtained from total Nitrogen multiplied by 6.25 factor. Viscosity of okra was measured using the Ostwald viscometer as described by AOAC(2000)

### Data Analysis

Data collected were analyzed using analysis of variance (ANOVA) and means compared using Duncan Multiple Range Test (DMRT) and the probability significantly different was set at  $P < 0.05$  according to Gomez (1984)

## III. RESULTS

### Chlorophyll Content (mg/g)

At 2WAP, the highest (5.54mg/g) mean chlorophyll content was recorded from the 300g PBA treated plots while the lowest (4.78mg/g) mean chlorophyll was recorded from the 100g PBA treated plots. At 4WAP, the 100g PBA treated plots recorded the highest (5.17mg/g) mean chlorophyll content while the 200g PBA treated plots recorded the lowest (3.57mg/g) mean chlorophyll content. At 6WAP, plots that received 200g PBA treatment recorded the highest (5.16mg/g) mean chlorophyll content while the 300g PBA treated plots recorded the lowest (4.25mg/g) mean chlorophyll content (Table 13). The 200g PBA treated plots recorded the highest (17.13mg/g) mean chlorophyll content at 8WAP, while the control plots recorded the lowest (15.04mg/g)

mean chlorophyll content. At 10WAP, the highest (17.31mg/g) mean chlorophyll content was recorded was recorded from the 300g PBA treated plots while the lowest (14.88mg/g) mean chlorophyll content was recorded from the 100g PBA treated plot (Table 13). There was no significant difference ( $P < 0.05$ ) observed among the means recorded for chlorophyll content (Table 13).

**Table 1:** Chlorophyll Content as Influenced by PBA

| Treatments | Mean Chlorophyll Content (mg/g) |                   |                   |                    |                    |
|------------|---------------------------------|-------------------|-------------------|--------------------|--------------------|
|            | 2WAP                            | 4WAP              | 6WAP              | 8WAP               | 10WAP              |
| Control    | 5.45 <sup>a</sup>               | 4.02 <sup>a</sup> | 4.26 <sup>a</sup> | 15.04 <sup>a</sup> | 15.86 <sup>a</sup> |
| 100g PBA   | 4.78 <sup>a</sup>               | 5.17 <sup>a</sup> | 4.46 <sup>a</sup> | 15.53 <sup>a</sup> | 14.88 <sup>a</sup> |
| 200g PBA   | 4.59 <sup>a</sup>               | 3.59 <sup>a</sup> | 5.16 <sup>a</sup> | 17.13 <sup>a</sup> | 16.16 <sup>a</sup> |
| 300g PBA   | 5.54 <sup>a</sup>               | 3.93 <sup>a</sup> | 4.25 <sup>a</sup> | 15.67 <sup>a</sup> | 17.31 <sup>a</sup> |
| LSD        | 1.87                            | 2.07              | 1.00              | 4.76               | 5.09               |

Means with the same letter(s) superscript are not significantly different at  $P < 0.05$ .

### Nitrogen Content (mg/g)

At 2WAP, 4WAP and 8WAP, no significant difference was recorded from the mean nitrogen content of okra plant, whereas, at 6WAP, the highest (1.00mg/g) mean nitrogen content was recorded from the 200g PBA treated plots which showed significant difference ( $P < 0.05$ ) from the lowest (0.79mg/g) mean nitrogen content recorded from the control (Table 14). Also at 10WAP, the highest (2.40mg/g) mean nitrogen content recorded from the 300g PBA treated plots showed significant difference ( $P < 0.05$ ) from the lowest (1.75mg/g) mean Nitrogen content observed in the control plots (Table 14).

**Table 2:** Nitrogen Content of Okra as Influenced by PBA

| Treatments | Mean Nitrogen Content (mg/g) |                   |                    |                   |                    |
|------------|------------------------------|-------------------|--------------------|-------------------|--------------------|
|            | 2WAP                         | 4WAP              | 6WAP               | 8WAP              | 10WAP              |
| Control    | 0.78 <sup>a</sup>            | 1.16 <sup>a</sup> | 0.79 <sup>b</sup>  | 1.71 <sup>a</sup> | 1.75 <sup>b</sup>  |
| 100g PBA   | 0.83 <sup>a</sup>            | 1.33 <sup>a</sup> | 0.95 <sup>ab</sup> | 1.37 <sup>a</sup> | 2.13 <sup>ab</sup> |
| 200g PBA   | 0.94 <sup>a</sup>            | 1.10 <sup>a</sup> | 1.00 <sup>a</sup>  | 1.73 <sup>a</sup> | 2.18 <sup>ab</sup> |
| 300g PBA   | 0.94 <sup>a</sup>            | 1.27 <sup>a</sup> | 0.94 <sup>ab</sup> | 1.49 <sup>a</sup> | 2.40 <sup>a</sup>  |
| LSD        | 0.44                         | 0.52              | 0.19               | 0.43              | 0.56               |

Means with the same letter(s) superscript are not significantly different at  $P < 0.05$ .

### Potassium Content

Potassium content of okra plant did not show significant difference ( $P < 0.05$ ) until 10WAP, when the 200g PBA treated plots recorded the highest (0.64mg/g) mean potassium content which showed significant difference ( $P < 0.05$ ) from other plots except the 300g PBA treated plots. However, the lowest (0.40mg/g) mean Nitrogen content was recorded from the control plots (Table 15).

**Table 3:** Potassium Content of Okra as Influenced by PBA

| Treatments | Mean Potassium Content (mg/g) |                   |                   |                   |                    |
|------------|-------------------------------|-------------------|-------------------|-------------------|--------------------|
|            | 2WAP                          | 4WAP              | 6WAP              | 8WAP              | 10WAP              |
| Control    | 0.32 <sup>a</sup>             | 0.44 <sup>a</sup> | 0.54 <sup>a</sup> | 0.42 <sup>a</sup> | 0.55 <sup>ab</sup> |
| 100g PBA   | 0.26 <sup>a</sup>             | 0.35 <sup>a</sup> | 0.49 <sup>a</sup> | 0.42 <sup>a</sup> | 0.42 <sup>b</sup>  |
| 200g PBA   | 0.27 <sup>a</sup>             | 0.45 <sup>a</sup> | 0.69 <sup>a</sup> | 0.39 <sup>a</sup> | 0.60 <sup>a</sup>  |
| 300g PBA   | 0.32 <sup>a</sup>             | 0.39 <sup>a</sup> | 0.56 <sup>a</sup> | 0.38 <sup>a</sup> | 0.57 <sup>a</sup>  |
| LSD        | 0.21                          | 0.18              | 0.24              | 0.15              | 0.14               |

Means with the same letter(s) superscript are not significantly different at  $P < 0.05$ .

### Phosphorus Contents (mg/g)

Significant difference ( $P < 0.05$ ) in the mean phosphorus content as influenced by PBA was observed only at 10WAP with 200g PBA treated plots recording the highest (0.64mg/g) mean phosphorus content while the 100g PBA treated plots recorded the lowest (0.37mg/g) mean phosphorus content (Table 16).

**Table 4:** Phosphorus Content of Okra as influenced by PBA

| Mean Phosphorus Content (mg/g) |                   |                   |                   |                   |                    |
|--------------------------------|-------------------|-------------------|-------------------|-------------------|--------------------|
| Treatments                     | 2WAP              | 4WAP              | 6WAP              | 8WAP              | 10WAP              |
| Control                        | 0.20 <sup>a</sup> | 0.43 <sup>a</sup> | 0.29 <sup>a</sup> | 0.28 <sup>a</sup> | 0.40 <sup>bc</sup> |
| 100g PBA                       | 0.31 <sup>a</sup> | 0.30 <sup>a</sup> | 0.39 <sup>a</sup> | 0.37 <sup>a</sup> | 0.37 <sup>c</sup>  |
| 200g PBA                       | 0.19 <sup>a</sup> | 0.35 <sup>a</sup> | 0.40 <sup>a</sup> | 0.72 <sup>a</sup> | 0.64 <sup>a</sup>  |
| 300g PBA                       | 0.31 <sup>a</sup> | 0.43 <sup>a</sup> | 0.49 <sup>a</sup> | 0.42 <sup>a</sup> | 0.61 <sup>ab</sup> |
| LSD                            | 0.19              | 0.30              | 0.26              | 0.95              | 0.22               |

Means with the same letter(s) superscript are not significantly different at  $P < 0.05$ .

### Protein Content (mg/g)

The highest (5.92mg/g) mean protein content of okra at 2WAP, was recorded from the 300g PBA treated plots which did not differ ( $P < 0.05$ ) significantly from the lowest (4.92mg/g) mean protein content recorded from the control plot. At 4WAP, the 100g PBA recorded the highest (8.32mg/g) mean protein while the 200g PBA treated plots recorded the lowest (6.91mg/g) mean protein with no significant difference ( $P < 0.05$ ). At 6WAP, the 200g PBA treated plots recorded the highest (6.26mg/g) mean protein which showed significant difference from the lowest (4.97mg/g) mean protein which was recorded from the control plots (Table 17). At 8WAP, the 300g PBA treated plots recorded the highest (11.65mg/g) mean protein content which was significantly different ( $P < 0.05$ ) from the means recorded in other plots while the lowest (8.80mg/g) mean protein was recorded from treated plots recorded the highest (Table 4). At 10WAP, the 200g PBA treated plots recorded the highest (15.53mg/g) mean protein content which did not show significant difference ( $P < 0.05$ ) from the other treated plots while the lowest (13.22mg/g) mean protein content was recorded from the 300g PBA treated plots (Table 4).

**Table 5:** Protein Content of Okra as influenced by PBA

| Mean Protein Content (mg/g) |                   |                   |                    |                     |                    |
|-----------------------------|-------------------|-------------------|--------------------|---------------------|--------------------|
| Treatments                  | 2WAP              | 4WAP              | 6WAP               | 8WAP                | 10WAP              |
| Control                     | 4.92 <sup>a</sup> | 7.26 <sup>a</sup> | 4.97 <sup>b</sup>  | 10.17 <sup>ab</sup> | 14.76 <sup>a</sup> |
| 100g PBA                    | 5.23 <sup>a</sup> | 8.32 <sup>a</sup> | 5.98 <sup>ab</sup> | 8.80 <sup>b</sup>   | 14.68 <sup>a</sup> |
| 200g PBA                    | 5.90 <sup>a</sup> | 6.91 <sup>a</sup> | 6.26 <sup>a</sup>  | 9.06 <sup>ab</sup>  | 15.53 <sup>a</sup> |
| 300g PBA                    | 5.92 <sup>a</sup> | 7.95 <sup>a</sup> | 5.87 <sup>ab</sup> | 11.65 <sup>a</sup>  | 13.22 <sup>a</sup> |
| LSD                         | 2.80              | 3.26              | 1.24               | 2.84                | 3.05               |

Means with the same letter(s) superscript are not significantly different at  $P < 0.05$ .

### Viscosity

The viscosity test did not show significant difference ( $P < 0.05$ ) however, the highest (61.15) viscosity of okra was recorded from the 300g PBA treated plot while the

lowest (56.32) was recorded from the 200g PBA treated plots (Table 6).

**Table 6:** Viscosity of Okra as influenced by PBA

| Treatment | Mean Viscosity     |
|-----------|--------------------|
| Control   | 57.28 <sup>a</sup> |
| 100g PBA  | 56.86 <sup>a</sup> |
| 200g PBA  | 56.32 <sup>a</sup> |
| 300g PBA  | 61.15 <sup>a</sup> |
| LSD       | 5.29               |

Means with the same letter(s) superscript are not significantly different at  $P < 0.05$ .

## IV. DISCUSSION

The study showed that data on leaf analysis as shown in the results indicate that compared with control, increased application of Palm Bunch Ash resulted in increase in Nitrogen, Potassium and Phosphorus content of okra.

This is in conformity with work of Adjei-Nsiah (2012) who also reported positive responses of yield and nutrient content of *amaranthus* and okra to application of wood ash treatment. This could be attributed to increase in soil nutrients and enhanced mineralization by okra plant as result of application of PBA. It could also be attributed to increased microbial activities in the soil and increased organic matter production with its concomitant increased in availability of N,P,K and Mg (Saarsalmi *et al.*, 2001)

The genetic makeup of the okra plant could also be responsible for the insignificant difference observed in the chlorophyll content of the okra leaves. Even though the chlorophyll contents increased with the age of the plant from 2 weeks till 8 weeks after planting it was observed that at 10WAP, there was only a slight increase in the chlorophyll content in the 100g and 200g PBA plots were observed to diminish drastically.

However, the 300g PBA treated plots showed increase in the chlorophyll content. This could be responsible for the greater yield recorded in the 300g PBA treated plots. Greater quantity of chlorophyll present in the leaves could help to greater photosynthesis rate which will produce more photosynthesis for storage, hence the greater yield value.

This was contrary to the result obtained by Adjei-Nsiah and Obeng (2013) who reported lower chlorophyll content with increased application of PBA. It was also observed that the protein content fluctuate with the stages of growth of the plant. Significant difference was observed at 6 and 8WAP with the treated plots showing greater protein contents. This could be confirming the potential of PBA to improve nutrient status of vegetables claimed by Adjei-Nsiah and Obeng (2013)

Although, the PBA treated plots did not show significant influence on the viscosity of okra fruit when compared with the control plots. The viscosity level observed where at par even though higher numerical values were recorded from the 300g treated plots. This

observation cannot be linked with either the treatment effect or soil status effect but can only be attributed to the genetic makeup of the okra species which presently is beyond the scope of his study.

## V. CONCLUSION

The study showed that application of PBA contributed to the improvement of level of macro nutrients such as Nitrogen, phosphorus, potassium and chlorophyll content of okra, which in turn improve nutritional quality of okra plant. The study suggests that peasant farmers in the oil palm growing area of south eastern agro ecological zone of Nigeria where there is abundant quantity of PBA scattered around oil palm plantations and processing mills should be encouraged to apply the use of PBA as a soil conditioner for improved food productivity.

## REFERENCES

- [1] Adjei-Nsiah, S. (2012). Response of Maize (*Zea mays L.*) to Different Rates of Palm Bunch Ash Application in the Semi-deciduous Forest Agro-ecological Zone of Ghana. *Applied and Environmental Soil Science. Volume 2012, Article ID 870948, 5 pages doi:10.1155/2012/870948*
- [2] Adjei-Nsiah, S. and Obeng, C.B. (2013). Effects of Palm Bunch Ash Application on Soil and Plant Nutrient Composition and Growth and yield of garden eggs, pepper and okra. *International Journal of Plant and Soil Science, 2(1): 1-5.*
- [3] Awodun, M.A., Ojeniyi, S.O. Adeboye, A. and Odedina, S.A. (2007) "Effect of Oil Palm Bunch Refuse Ash on Soil and Plant Nutrient Composition and Yield of Maize", *American-Eurasian Journal of Sustainable Agriculture, 1(1):50-54*
- [4] Ezekiel, P.O., Ojeniyi, S.O., Asawalam, D.O., and Awo, A.O. (2003). Root growth, dry root yield and NPK content of cassava as influenced by oil palm bunch ash on ultisols of southeast Nigeria. *Nigerian Journal of Soil Science. 19:6-10*
- [5] Kumar, D.S., Tony, D.E., Kumar, A. P., Kumar, K.A., Rao, D.B.S. and Nadendla, R (2013). A review on: *Abelmoschus esculentus* (okra). *International Research Journal of Pharmaceutical and Applied Sciences (IRJPAS) 3(4):129-132*
- [6] Odedina, S.A., Odedina, J.N., Ayeni, S.O., Arowojolu, S.A., Adeyeye, S.D., and Ojeniyi, S.O. (2003). Effect of type of ash on soil fertility, nutrient availability and yield of tomato and pepper. *Nigeria Journal of Soil Science. 13:61-67.*
- [7] Ojeniyi, S.O., and Adejobi, K.B. (2002). Effect of wood ash and goat dung manure on leaf nutrient composition, growth and yield of *amarantus*. *The Nigeria Agricultural Journal.33:46-57.*
- [8] Saarsalmi A, Malkonem E, and Pirainem S (2001). Effect of wood ash fertilization on forest soil chemical properties. *Silva Fennica.Vol.35 (3) pp.355-368.*
- [9] Schippers, R.R. (2000). *African Indigenous Vegetables: An Overview of the Species. National Resources Institute/ACP-BU Technical Centre for Agriculture and Rural Cooperation, Cathan, UK.*
- [10] Torkpo, S.K., Danquah, E.Y., Offei, S.K., and Blay, E.T. (2008). Esterase, total protein and seed storage protein diversity in okra. *West Africa Journal of Applied Ecology. 9: 8-18.*
- [11] AOAC (2000), official methods of Analysis Association of Official Analytical Chemist.16<sup>th</sup> Ed. Washington D.C.,USA.