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**Research Communication**

# EFFECT OF CROPPING SYSTEM ON SOIL PROFILE NUTRIENT CONTENTS

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## ABSTRACT
Four soil profile pits were dug under differing cropping systems at Nigerian Institute For Oil Palm Research (NIFOR) experimental plantations in Benin City and chemically analysed. Cropping systems were sole oil palm, oil palm with cassava, oil palm with plantain, and oil palm with coconut. Samples were collected at 0 – 20, 20 – 40, 40 – 60, 60 – 80 and 80 – 100cm depth and analyzed for K, P, Ca, Mg, C and N. Sole oil palm gave the highest soil P, Ca, OC and pH within 100cm. The N and K were generally inadequate. Intercropping reduced nutrients up to 100cm depth. Nutrients reduced with soil depth

## INTRODUCTION
The type of cropping systems and crops determine soil fertility and nutrients content because crop derives nutrients from soil for its growth. The crops have different root systems, hence they exploit nutrients in different intensity and depth. The knowledge of the impact of crops combination will enable understanding of suitable fertility management approach for the different crop combinations. This work investigated soil nutrients concentrations in soil profile located under sole and intercropped oil palm plantations in the Nigerian Institute for Oil Palm Research, Benin City.

## MATERIALS AND METHOD
Profile pit was dug under different cropping systems at the Nigerian Institute for Oil Palm Research (NIFOR) near Benin City, Edo State. The pit was dug to 100cm in (a) oil palm with cassava plantation, (b) oil palm with plantain, (c) sole oil palm, and (d) oil palm with coconut. Soil samples were collected in triplicate at 0 – 20, 20 – 40, 40 – 60, 60 – 80 and 80 – 100 cm layers for laboratory analysis.

Soil samples were air-dried and 2mm sieved. Total N was determined using micro-kjeldahl method, organic carbon by oxidation method, through chromic acid digestion, P was extracted by Bray 1 extraction and determined using spectrophotometric method, exchangeable K, Ca and Mg were extracted with ammonium acetate, K was determined using flame photometer and Ca and Mg by EDTA titration, soil pH in ratio 1:2 water suspension was read using glass electrode pH meter (Tel and Hagarty, 1984).

Analysis of variance was done and means compared using Fisher's least significant test at 5% level of probability.

## RESULT AND DISCUSSION
Soil nutrients (N, P, K, Ca, OM,) contents, OC and pH reduced with depth between O to 100cm. This is attributable to the fact that OM normally reduced with depth. Plant residues

are normally concentrated on surface soil and later decomposed to release nutrients.

Total N varied between 0.01 to 0.10%. The values are quite low compared with 0.15% determined as critical for the coastal plain sand which is dominant soil in Benin area. Available P was inadequate under oil palm/cassava, oil palm/ plantain, and oil palm/coconut systems, but adequate under sole oil palm reaching 9.6 to 14.5 ppm between 0 to 100cm depth. This implies that cassava, plantain and coconut exhausted P. Azeez et al., (2013), studied effect of land use and soil depth on P fractions at Abeokuta, Southwest Nigeria. They also found that Oil palm plantation had higher total soil P than plantain and cassava farms which also recorded negative nutrient balance.

Exchangeable K generally was quite low compared to critical 0.15 – 0.20 me/100g. This is attributable to the nature of the parent material (Orimoloye and Akinbola, 2013).

Exchangeable Ca was generally adequate reaching 2.88 cmol/kg but in instances low under oil palm/ plantain and oil palm/ cassava (0.48 to 0.64). This confirms that intercropping oil palm with plantain or cassava exhausts Ca. For example Ca is important in the supply and regulation of water in cassava production.

Exchangeable Mg is adequate up to 80cm depth varying between 0.16 – 6.08 me/100g and is high as 4.41cmol/kg between 80 – 100cm. The critical value of exchangeable K is 0.15 – 0.42 for the coastal plain sands. The highest soil Mg concentrations were recorded under oil palm / coconut irrespective of depth. This could be due to application of Mg fertilizer in oil palm production and possible little exhaustion of Mg by coconut.

Cultivation of plantain generally caused relatively low nutrients contents compared with other crops. Plantains are known to be heavy feeders on soil nutrients and hence need high fertilization to replace lost nutrients from harvested fruits (Azeez et al., 2013).

**Table 1: Nutrient Content of Soil profile in Oil Palm / Cassava mixture**

| Depth | K | P | pH | Ca | Mg | C | N |
|---|---|---|---|---|---|---|---|
| | cmol/kg | ppm | | cmol/kg | cmol/kg | % | % |
| 0-20cm | 0.06 | 5.08 | 5.71 | 1.60 | 0.42 | 1.28 | 0.10 |
| 20-40cm | 0.05 | 4.53 | 5.01 | 1.52 | 0.34 | 0.96 | 0.07 |
| 40-60cm | 0.05 | 4.40 | 4.73 | 1.28 | 0.24 | 0.64 | 0.06 |
| 60-80cm | 0.04 | 4.37 | 4.43 | 1.12 | 0.20 | 1.45 | 0.05 |
| 80-100cm | 0.02 | 3.07 | 4.40 | 0.80 | 0.18 | 0.16 | 0.02 |
| LSD (0.05) | 0.02 | 1.02 | 0.79 | 0.47 | 0.12 | 0.61 | 0.04 |

**Table 2: Nutrient Content of soil profile in Oil Palm / Plantain mixture**

| Depth | K | P | pH | Ca | Mg | C | N |
|---|---|---|---|---|---|---|---|
| | cmol/kg | ppm | | cmol/kg | cmol/kg | % | % |
| 0-20cm | 0.09 | 5.99 | 5.12 | 1.28 | 0.96 | 1.13 | 0.06 |
| 20-40cm | 0.08 | 5.10 | 4.81 | 1.04 | 0.80 | 1.09 | 0.06 |
| 40-60cm | 0.05 | 5.02 | 4.50 | 0.80 | 0.64 | 1.06 | 0.05 |
| 60-80cm | 0.05 | 4.41 | 4.42 | 0.64 | 0.19 | 0.96 | 0.04 |
| 80-100cm | 0.04 | 4.11 | 4.40 | 0.48 | 0.13 | 0.70 | 0.01 |
| LSD (0.05) | 0.03 | 1.00 | 0.43 | 0.44 | 0.51 | 0.24 | 0.03 |

**Table 3: Nutrient Content of Soil profile in Oil Palm sole plot**

| Depth | K | P | pH | Ca | Mg | C | N |
|---|---|---|---|---|---|---|---|
| | cmol/kg | ppm | | cmol/kg | cmol/kg | % | % |
| 0-20cm | 0.10 | 14.52 | 5.64 | 2.88 | 1.52 | 1.66 | 0.07 |
| 20-40cm | 0.06 | 14.46 | 5.62 | 2.24 | 0.64 | 0.93 | 0.05 |
| 40-60cm | 0.05 | 12.60 | 5.52 | 2.00 | 0.32 | 0.70 | 0.05 |
| 60-80cm | 0.05 | 11.73 | 5.31 | 1.92 | 0.16 | 0.64 | 0.04 |
| 80-100cm | 0.04 | 9.57 | 5.10 | 1.68 | 0.08 | 0.32 | 0.02 |
| LSD (0.05) | 0.03 | 2.04 | 0.33 | 0.63 | 0.82 | 0.69 | 0.03 |

**Table 4: Nutrient Content of Soil profile in Oil Palm / Coconut mixture**

| Depth | K | P | pH | Ca | Mg | C | N |
|---|---|---|---|---|---|---|---|
| | cmol/kg | ppm | | cmol/kg | cmol/kg | % | % |
| 0-20cm | 0.06 | 6.08 | 4.97 | 1.62 | 6.088 | 1.03 | 0.07 |
| 20-40cm | 0.05 | 5.70 | 4.83 | 1.58 | 5.70 | 0.83 | 0.06 |
| 40-60cm | 0.04 | 4.85 | 4.76 | 1.52 | 4.85 | 0.80 | 0.05 |
| 60-80cm | 0.03 | 4.55 | 4.72 | 0.88 | 4.55 | 0.70 | 0.04 |
| 80-100cm | 0.03 | 4.41 | 4.70 | 0.80 | 4.41 | 0.64 | 0.03 |
| LSD (0.05) | 0.01 | 1.01 | 0.15 | 0.56 | 1.01 | 0.21 | 0.02 |

**CONCLUSION AND RECOMMENDATION**

Fertilization to increase N and K is required irrespective of cropping system in the ultisols of the coastal plain sand in Benin area. Intercropping of oil palm requires application of P source. Because soil pH, N and K are low and Ca is exhausted in the intercropping system, application of organic sources of nutrients is recommended, which could be in form of wood or oil palm bunch ash (Awanlemhen and Ojeniyi 2012, Ojeniyi et al, 2010), rather than scarce and acidity producing fertilizers. Ash has fertilizing and liming effects (Okigbo, 1989). The organic nutrient source will also enhance physical characteristics and stabilization of soil as opposed to NPK Mg fertilizer which increases soil bulk density, reduces porosity, infiltration rate, aggregate stability and soil mean weight diameter (Ovie et al, 2013).

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