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No. 1 - April, 2022

Evaluation of On-Farm Oil Palm Yield Parameters in the Niger Delta Region of Nigeria

Oil palm is a significant crop in Nigeria, occupying over 2.5 million (M) ha and production stands at 1.0 M t yr^{-1}. However, the yield of oil palm in smallholder farmers' fields is very low due to poor nutrient management.

The stem, fronds, and leaf area are proper agronomic parameters that determine plant vigor and if these parameters are not properly developed due to nutrient imbalance, fresh fruit bunch (FFB) yield will be affected.

Therefore, assessment of these critical oil palm parameters will help in identifying soil-specific and regional fertilizer formulations that match the needs of oil palm in Nigeria. A survey study was conducted in small and medium-scale farmers' fields in three Niger Delta states in Nigeria where oil palm is predominantly grown to determine the variability in oil palm FFB yield, leaf area, and petiole cross section for precise nutritional management.

The results showed that all measured parameters were significantly different among the states and local governments (Table 1), demonstrating a need for site-specific management. There was positive correlation among FFB yield, leaf area, and petioles cross section in all the local government areas (data not reported), which indicates that any response in vegetative growth due to precision management will likely increase FFB yield in these areas. AAPA

Table 1. Oil palm fresh fruit bunch yield, leaf area, and petiole cross section.

Local government (state)	Bunch weight (tons ha^{-1} $year^{-1}$)	Leaf area (m^2)	Petiole cross section (cm^2)
Biase (Cross River)	7.92 ab	4.27 bc	4.27 bc
Akpabuyo (Cross River)	8.43 a	6.98 a	6.98 a
Akamkpa (Cross River)	4.18 c	5.31 ab	5.31 ab
Abak (Akwa Ibom)	6.10 b	5.23 ab	17.13 b
Itu (Akwa Ibom)	6.67 a	5.48 ab	20.05 ab
Oruk Anam (Akwa Ibom)	7.76 ab	5.86 ab	21.41 ab
Ahoada (Rivers)	5.81 bc	6.43 b	21.13 ab
Emohua (Rivers)	9.55 a	6.68 ab	25.71 a
Tai (Rivers)	5.16 b	3.45 c	11.74 c

For more information about this research conducted by Dr. Donald N. Madukwe, and Dr. Frank Ekhator, please see the AfCPA 2020 Proceedings at https://paafrica.org/Proceedings.

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Spatial Distribution of Soil Micronutrients in a Nigerian Citrus Orchard

Of primary importance in increasing citrus yield in Nigeria is the need for more precise micronutrient fertility management. Proper micronutrient nutrition is essential for citrus production including improved crop quality and yield, improved disease resistance, and prevention of physiological disorders. Nigerian citrus producers currently use blanket fertilizer applications of compound NPK fertilizers, which has led to low, imbalanced, and variable soil fertility, widespread micronutrient deficiency, and crop failure in many regions of the country.

Precision agriculture is a viable tool for nutrient management, helping to reduce low and poor utilization of fertilizers due to spatial variation in soil fertility. Studies on micronutrients in Nigerian soil are limited; thus, this study was carried out to map the micronutrient status of a citrus orchard to determine the potential for precision nutrient management.

Soil samples (0 to 15 cm) were collected from a multi-varietal citrus block at the National Horticultural Research Institute (NIHORT) in Ibadan, Nigeria. The block consisted of 12 sweet orange varieties planted at a 7.0 by 7.0-m spacing. The soil samples were analyzed for micronutrient content using standard laboratory procedures. Data were subjected to descriptive statistics and spatial analysis using standard GIS software.

Table 1 shows the descriptive statistics for the micronutrient concentrations of the study area. The mean values of Mn, Fe, and Zn were adequate for citrus production while the mean concentration of Cu was low (*Chen et al., 2007*). Coefficient of variation (CV) is an indicator of the level of variability in the data, with 0 to 15 representing low variability, 15 to 35 moderate variability and >35 high variability. Thus, in this study, Mn, Fe, and Cu were moderately variable, while Zn was highly variable.

Table 1. Descriptive statistics of micronutrients in a Nigerian citrus orchard.

Micronutrient	Mean ± SD (mg/kg)	CV	Kurtosis	Skewness
Mn	330.08 ± 88.84	29.91	0.44	0.28
Fe	115.70 ± 30.74	26.56	-0.53	0.43
Cu	3.14 ± 0.72	22.85	-0.01	-0.31
Zn	8.81 ± 3.65	36.83	0.94	-0.06

Figures 1 and 2 illustrate why precision agriculture data should always be considered in the proper context. Although Zn was the “most highly variable” micronutrient in the study, when mapped according to fertility category, the entire field was high to optimum in Zn content (Fig. 1). A stronger candidate for precision management was Cu, which was only “moderately” variable (Fig. 2). The mean value of Cu (3.14 mg/kg) across the orchard indicated low nutrient status and a need for fertilization, but the spatial distribution indicated low of Cu showed a portion of the field having high Cu fertility.

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Mapping spatial variability in soil nutrients aids visibility and presentation of fertilizer needs to enhance farm and soil management. Application of fertilizer without recourse to site specific needs of the soil and/or the crop leads to waste of inputs and poor crop yield. Precision nutrient management according to spatial variability helps direct resources to areas of need, reduces overapplication, and improves farm efficiency. AAPA

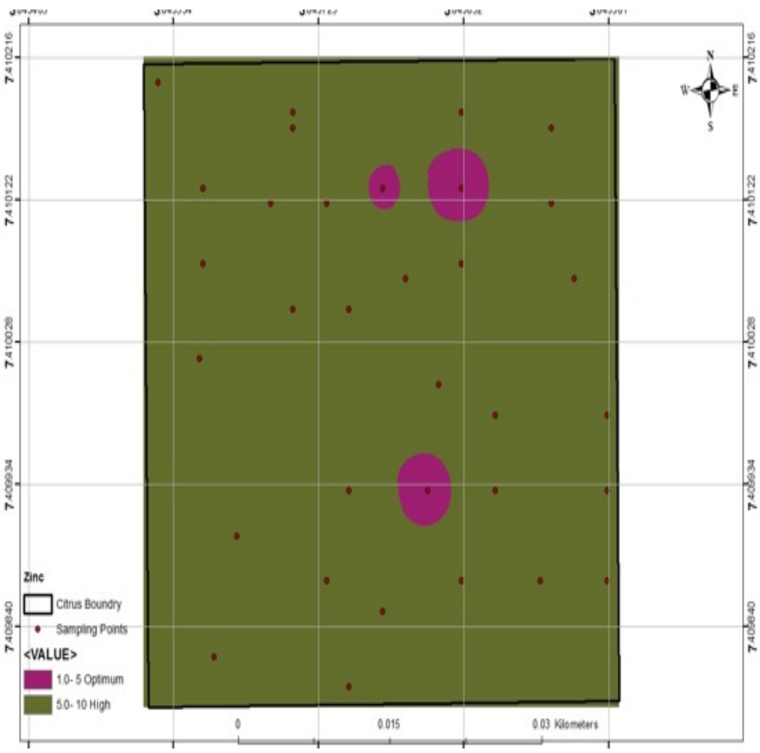

Fig 1: Spatial distribution of Zn within a Nigerian citrus orchard.

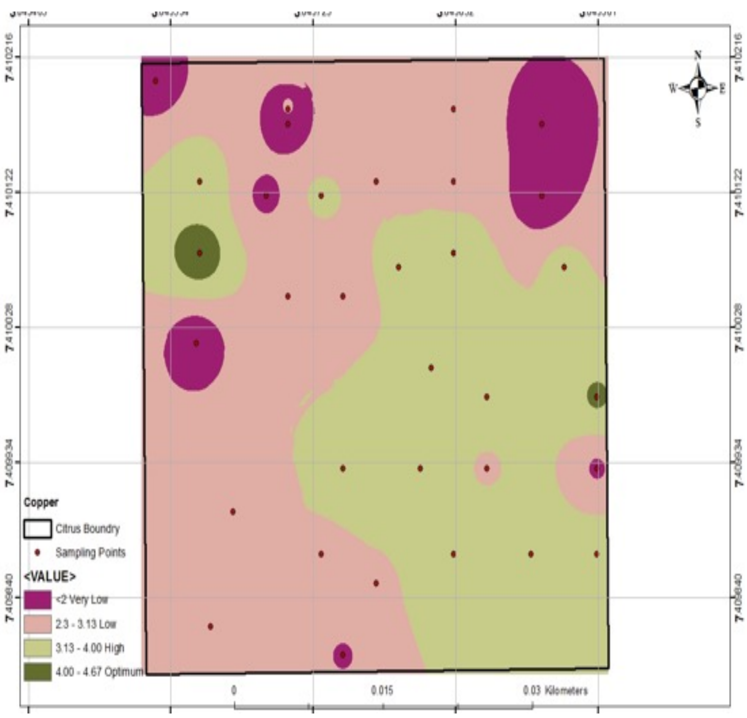

Fig 2: Spatial distribution of Cu within a Nigerian citrus orchard.

References

Chen, F., et al. 2007. Investigation of soil fertility in citrus orchards of Southern China. Better Crops 91(3): 24 -27.

For more information about this research conducted by Dr. Bernard Okafor, please see the AfCPA 2020 Proceedings at https://paafrica.org/Proceedings.

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Scaling Precision Irrigation for West African Smallholder Systems

The advent of precision agriculture (PA) is changing farming productivity around the world. The practice of PA offers benefits across large scale, and smallholder production systems, especially in the water management and irrigation sector. Smallholder irrigated crop production across West Africa accounts for significantly more area in Ghana, Nigeria, Mali, Burkina Faso, and Senegal than conventional, large-scale irrigation schemes. Scaling the practice of precision irrigation (PI) for smallholder systems faces several challenges, chief of which are farmers' technical and financial capacity.

Application of conventional PI requires machine controls for field equipment, monitors, sensors, and GPS systems to achieve variable rate application. This is feasible in large-scale irrigation systems using center-pivot, traveling sprinkler systems, and high-tech drip systems. However, in smallholder farms, surface, bucket, and hose irrigation, conventional sprinklers, and low-tech drip systems are predominant. Scaling PI in West Africa smallholder system will need to be done largely without automation or sophisticated equipment.

Some PI practices that are immediately adaptable to smallholder system with the potential to improve productivity include:

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- Site-specific irrigation scheduling: Contrary to publicly available irrigation schemes, site-specific irrigation scheduling will allow water to be applied when crops need it.
- More efficient irrigation methods: Deployment of more efficient irrigation methods such as sprinkler and drip irrigation systems, may increase water use efficiency in smallholder systems.
- Soil moisture monitoring: Smallholder irrigators often depend on their personal judgement, experience, and observation of soil and plant stresses to determine when to irrigate. The deployment of small, field-level moisture monitoring tools such as time domain reflectometry (TDR) probes, soil water sensors (i.e., Chameleon SWS), and wetting front detectors will go a long way in monitoring moisture depletion and ensuring precise water application.

Scaling these tools for efficient deployment of PI in smallholder systems will require increased awareness of PA benefits as a driving incentive, capacity building, bringing the tools closer to the end users, and business models that make such tools affordable for smallholder farmers.

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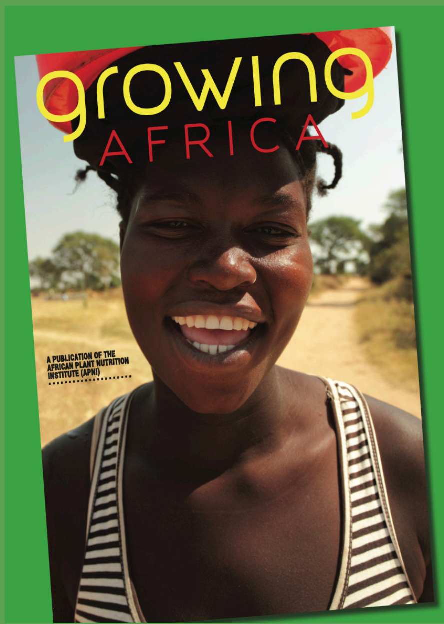
Invitation to Contribute to a New Publication: Growing Africa

Growing Africa is a new semi-annual, digital publication initiated by the African Plant Nutrition Institute to provide a forum serving stakeholders interested in Africa-centric plant nutrition science. The publication seeks to providing scientific information in an actionable manner that helps to enable Agricultural Research for Development (AR4D) in Africa. Topics of interest include:



- Site-specific nutrient management, Integrated soil fertility management, 4R Nutrient Stewardship
- Nutrient and yield gap assessment and reduction
- Best management practice development and implementation
- Best agronomic practices and their influence on nutrient use
- Nutrient-driven cropping system diversification
- Nutrients as a catalyst for value chains
- Nutrient catalyzed improvement in Soil-Plant-Animal-Human Health outcomes
- Economic, and Socioeconomic performance of nutrient management practices
- New analytics/tools for dissemination and scaling of nutrient best management practices (BMPs)
- Nutrient use efficiencies, nutrient balances, and nutrient cycling in agricultural systems

Interested in submitting an article? Lean more by downloading a copy of our guidelines at https://www.growingafrica.pub/about/

Specific enquiries about the article submission process may be sent to the editor at g.sulewski@apni.net.

Mapping Nutrient Status of Nigerian Cropland - A Pathway for Precision Agriculture

In sub-Saharan Africa, the geographical extent of soil nutrient constraints and opportunities for managing these constraints are highly uncertain. An ongoing project in Nigeria in cooperation with The Africa Soil Information Service (AfSIS) aims to provide spatially explicit measurements and predictions of nutrient levels and crop yield, and nutrient management recommendations.

Georeferenced, composite soil samples (0 to 20 and 20 to 50-cm depths) were collected from 1,590 plots (100-m^2) within the cropland areas of Ebonyi and Kebbi states, Nigeria. The plots represented varying environmental conditions and management practices.

The soil samples were analyzed with mid-infrared (MIR) and portable X-ray fluorescence (pXRF) spectroscopy. A reference subset (15%) of the samples was analyzed for essential macronutrients, micronutrients, and other beneficial nutrients.

The reference measurements are being used to develop machine learning models for predicting soil nutrient content and plant uptake in Nigerian cropland. The models will provide a key reference for evaluating changes and impact on the current distribution and cycling of nutrients in soils and crops and will establish a statistical baseline for comparing crop yields before and after nutrient interventions. AAPA

UPCOMING OPPORTUNITIES

15th International Conference on Precision Agriculture (#ICPA2022)

Minneapolis, Minnesota, USA – June 26-29

https://www.ispag.org/icpa/

African Plant Nutrition Scholar Award

Application Deadline – April 30

https://www.apni.net/scholar-apply/

African Plant Nutrition Research Fund

Application Deadline – April 30

https://www.apni.net/research-fund/

For more information about this research conducted by Dr. Vincent Aduramigba-Modupe, please see the AfCPA 2020 Proceedings at https://paafrica.org/Proceedings.

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