PAT December, 2023; 19(2): **120-123** *ISSN: 0794-5213*
Online copy available at www.patnsukjournal.net/currentissue
Publication of Nasarawa State University, Keffi

EVALUATION OF ON–FARM OIL PALM GROWTH AND YIELD IN NIGER DELTA REGION OF NIGERIA

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Abstract
The potential yield of oil palm in smallholder farmers' field is low due to poor nutrient and agronomic management. Yield of over 40 tons of fresh fruit bunch (FFB) hectare^{-1} is achievable with NIFOR tenera material (actual yield is between 22 to 25 tons ha^{-1}). An agronomic yield survey was conducted in farmers' fields in three Niger Delta States of Nigeria to determine actual yield of palms. In each state, three local governments, five communities per local government and three palms were collected per community. Data collected were subjected to analysis of variance and means separated using Duncan Multiple Range Test. The results showed that bunch weight palm^{-1} at harvest, bunch weight palm^{-1} year^{-1}, bunch weight tons hectare^{-1}, leaf and petiole cross sectional areas were significantly different in all the states. Bunch weight palm^{-1} at harvest, bunch weight palm^{-1} year^{-1}, bunch weight tons hectare^{-1}, and petiole cross sectional were significantly highest in Emohua local government area of Rivers State with values of 8.99 kg palm^{-1}, 65.7 kg palm^{-1} year^{-1}, and 9.55 tons hectare^{-1}year^{-1} respectively. This result suggests that oil palm yield in the sampled areas are far lower than the average yield of well managed NIFOR tenera material in Nigeria.
Keywords: Oil palm, growth and yield parameters, tenera, NIFOR

Introduction

Oil palm is a unique tropical crop cultivated mainly for its mesocarp and kernel oil (Woittiez et al., 2017). Crude palm oil is the preferred oil for the diet of Sub-Saharan African people (Corley and Tinker, 2003). A growing demand for palm oil for food and soap industries is due to an increase in population in Africa, which is estimated as 770 million; while the use of palm oil for biodiesel has added greatly to the continent's demand for the commodity (Bakoume *et al*., 2017). There is a growing global demand for palm oil because of its universal applicability and increasing population (Murphy, 2014). Oil palm is a uniquely productive tropical crop with a potential fresh fruit bunch (FFB) and palm oil yield capacity well over 40 tons FFB ha^{-1}yr^{-1} and 10 Mt of palm oil ha^{-1}yr^{-1} (Murphy, 2014). Actual yields are between 18 to 30 tons FFB ha^{-1}yr^{-1} and 3-6 Mt of palm oil ha^{-1}yr^{-1} and for NIFOR tenera hybrid it is 19 to 25 tons in Nigeria (Okwagwu *et al.* 2005; Okomu, 2018). Oil palm is a significant crop in Nigeria, occupying over 2.53 million hectares and production stands at 1million ton yr^{-1} (Bassey, 2016). Nigeria's current palm oil production falls far short of the national local consumption and industrial uses (Proshare, 2019). The national production deficit estimated at nearly 2 million metric tonnes is met by importation into the country (Asemota, 2013; Bassey, 2016 and Proshare, 2019). This deficit could be due to the fact that of the 2.53 million hectares purportedly cultivated to oil palm in Nigeria, 2.1millions hectares are in the wild and poorly managed (Bassey, 2016). There is every need for planned and co-ordinated best management practices that will impact on oil palm farmers' yield and income (Corley and Tinker, 2003).

In order to bridge the palm oil deficit/production gap and considering the population of Nigeria which currently stands at about 200 million and consumption of palm oil which is estimated at about 3 million metric tons; the need to increase the farm size and adopt best management practices

which promote proper palm nutritional enhancement becomes very pertinent for the development of oil palm industries in Nigeria and also satisfying the palm oil need of the Nigeria populace. The stem, fronds and leaf are proper agronomic parameters that determine plant vigour (Fairhurst and Hardter, 2005). If these parameters are not properly developed due to nutrient imbalance (Aduramigba-Modupe, 2017), the FFB yield will be affected. Therefore, assessment of agronomic parameters that will help in specialty fertilizer formulations for oil palm becomes very necessary if the aim of meeting the palm oil need of Nigeria is to be achieved. This study evaluated oil palm FFB yield, leaf area and petiole cross sectional area in Niger Delta regions of Nigeria.

Materials and Methods

An agronomic yield survey was conducted (as a component of the soil fertility mapping for oil palm specialty fertilizer development) in small and medium scale farmers' fields in three Niger Delta states (Akwa Ibom, Cross River and Rivers) of Nigeria, where oil palm is predominantly grown to determine the actual yield of oil palm for precise nutrient management. The 3 states were marked out for agronomic data collection. In each state, three local government areas (LGAs) and five communities per LGA were selected for the agronomic data collection. Three palms were randomly selected geospatially per farm in 15 farmers' field per community, and the following data (FFB weight, leaf area, petiole cross sectional area and varietal identification by NIFOR experts in the team) were collected per palm in each community. The area sampled were three LGAs of Cross River (Biase, Akamkpa and Akpabuyo); Akwa Ibom (Abak, Itu and Oruk Anam) and Rivers (Ahoada, Emohua and Tai). The samples were collected in three selected farmers' field in each community; the samples were properly labeled and placed in sample bags for further processing. Processed agronomic data were subjected to analysis of variance and means separated using Duncan Multiple Range Test.

Results and Discussion

The results of this study showed that bunch weight palm^{-1} at harvest, bunch weight palm^{-1} year^{-1}, bunch weight tons hectare^{-1}, leaf area and petiole cross sectional area were significantly different in all the LGAs and states (Table 1). Bunch weight palm^{-1} at harvest, bunch weight palm^{-1} year^{-1}, bunch weight tons hectare^{-1}, and petiole cross sectional area were significantly highest in Emohua LGA with values of 8.99 kg palm^{-1}, 65.7 kg palm^{-1} year^{-1}, and 9.55 tons hectare^{-1}year^{-1} respectively (Table 1). Conversely, bunch weight palm^{-1} at harvest, bunch weight palm^{-1} year^{-1}, bunch weight tons hectare^{-1} were lowest in Akamkpa LGA with values of 2.07 kg palm^{-1}, 30.5 kg palm^{-1} year^{-1}, 4.18 tons hectare^{-1}year^{-1} respectively; but leaf area and petiole cross sectional area were lowest in Tai LGA with values of 3.45 m^2 and 11.74 cm^2 respectively (Table 1). In addition, Cross River state had the highest bunch weight palm^{-1} at harvest, bunch weight palm^{-1} year^{-1}, bunch weight tons hectare^{-1}, leaf area and petiole cross sectional area of 8.93 kg palm^{-1}, 8.03 tons hectare^{-1} year^{-1}, 56.2 kg palm^{-1} year^{-1}, 5.68 m^2,and 19.9 cm^2 respectively. However, bunch weight palm^{-1} at harvest, bunch weight palm^{-1} year^{-1}, bunch weight tons hectare^{-1} and leaf area was lowest in Akwa Ibom state with values of 3.371 kg palm^{-1}, 5.61 kg palm^{-1} year^{-1} 39.2 tons hectare^{-1} year^{-1} and 5.38 m^2 respectively (Table 1). Nigrescens was the predominant fruit type in all the LGAs with 100% recorded in Itu, Oruk-Anam and Ahoada LGAs. Virescens was recorded in Biase, Akpabuyo, Akamkpa, Emohua and Tai LGAs with values of 15.38 %, 6.67 %, 13.35% and 14.29% respectively (Table 1). There was positive correlation between bunch weight, leaf area and petioles cross sectional area in all the LGAs. Tenera fruit form had the highest percentage of 93.33 in Emohua LGA (Table 2). Fresh fruit bunch weight kg palm^{-1} year^{-1} and fresh fruit bunch weight ton ha^{-1} were lower than the FFB yield of NIFOR hybrid tenera probably because most of the palms were left without adequate care and fertilization (data not shown). During the period of sampling, most of the farms were overgrown with weeds, hardly pruned, inaccessible and no records of fertilizer application. If oil palm is left unkempt and unfertilized, large amount of nutrients are

removed from the soil which must be replaced either by recycling of palm waste or by addition of inorganic mineral fertilizers (Aduramigba-Modupe, 2017). This is to avoid yield reduction or else assimilates will be partitioned to vegetative growth during stress instead of reproductive growth (Hartley, 1988; Woittiez *et al*. 2017). Harvesting frequency of once per month may also be attributed to the low bunch yield observed in all locations, which has been validated by (Donough *et al*., 2013). Leaf area was lower than the standard recommended for field palm in all the locations because of the fact that the palms in the area were not properly managed or fertilized. The correlation observed in leaf area, petiole cross sectional area with oil palm FFB yield in all the LGAs sampled indicated that any response in vegetative growth due to the partitioning of assimilates will probably increase FFB yield in these areas. The observed low rate of adoption of NIFOR elite tenera hybrid materials in almost the LGAs except Emohua indicated lack of awareness on the benefits of using NIFOR hybrid materials. Virescens has previously been found to occur at very low frequency in Africa usually 50 in 10, 000 bunches in grove in Nigeria (Hartley, 1988).

Table 1. Oil Palm Fresh Bunch Yield, Leaf Area Petiole Cross Sectional Area, Percentage Fruit Types and Forms per Local Government in Three Niger Delta States, Nigeria

Local government (state-1)	Bunch weight (kg) palm^{-1} at harvest	Bunch weight (kg) palm^{-1} year^{-1}	Bunch weight (tons) ha^{-1} year^{-1}	Leaf area (m^2)	Petiole cross sectional area (cm^2)	Tenera (%)	Dura (%)	Nigrescens (%)	Virescens (%)
Biase (Cross River)	6.77b	53.8ab	7.92ab	4.27bc	15.72b	38.50	61.50	84.62	15.38
Akpabuyo (Cross River)	8.74a	60.9ab	8.43a	6.98a	23.22a	53.33	46.67	93.33	6.67
Akamkpa (Cross River)	2.07b	30.5c	4.18c	5.31ab	19.65ab	33.33	66.67	86.67	13.33
Abak (Akwa Ibom)	5.31b	43.1c	6.10b	5.23ab	17.13b	60.00	40.00	100.00	0
Itu (Akwa Ibom)	5.69b	47.3bc	6.67b	5.48ab	20.05ab	26.67	73.33	100.00	0
Oruk Anam (Akwa Ibom)	6.57b	54.8ab	7.76ab	5.86ab	21.41ab	6.67	93.33	100.00	0
Ahoada (Rivers)	3.94b	39.0c	5.81bc	6.43b	21.13ab	58.33	41.67	100.00	0
Emohua (Rivers)	8.99a	65.7a	9.55a	6.68ab	25.71a	93.33	6.67	86.67	13.33
Tai (Rivers)	4.65b	40.1c	5.16b	3.45c	11.74c	85.71	14.29	85.71	14.29
SE	1.551	6.92	0.995	0.598	2.489				

Table 2. Pearson Correlation Matrix of Some Selected Growth and Yield Parameters of Oil Palm in Niger Delta Region, Nigeria

	Bunch weight tons ha-1	Petiole Cross Section (cm^2)	Leaf area (m^2)	Bunch weight at harvest (kg)	Bunch weight (kg) palm^{-1} year^{-1}
Bunch Weight tons/ha					
Petiole Cross Section (cm^2)	0.627**				
Leaf area (m^2)	0.599**	0.864**			
Bunch weight at harvest (kg)	0.819**	0.503**	0.472**		
Bunch weight (kg) palm^{-1} year^{-1}	0.928**	0.646**	0.612**	0.841**	

****Significant at 0.01 probability; N=135**

Conclusion

The survey result concluded that bunch yield, leaf area and petiole cross sectional area were lower than the standard recommended for oil palm. This study recommends oil palm best and good agronomic management practices and development of oil palm specialty fertilizer for the Niger Delta region.

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