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Yield response of cocoyam (*Colocasia esculenta* and *Xanthosoma sagittifolia)* cultivars to different planting dates in the rainforest zone of Anambra State, Nigeria.

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Abstract
The experiment, yield response of cocoyam (Colocasia esculenta and Xanthosoma sagittifolia) cultivars to different planting dates in the rainforest zone of Anambra State, Nigeria was conducted in 2019 at the Teaching and Research Farm of Department of Crop Science and Horticulture, Chukwuemeka Odumegwu Ojukwu University, Igbariam Anambra State. The research was a 3x3 factorial experiment which was laid out in Randomized Complete Block Design (RCBD) in three replicates. Three cultivars of cocoyam and 3 planting dates constitute nine (9) treatment combinations (cultivars x varying date of planting). The aim was to find out the best period during the rainy season for planting each variety of the cocoyam cultivars. The planting was done at three different planting dates, 28th June, 28th July and 28th August, 2019. Data was collected on total corm yield (t/ha), number of corms, total weight of main corms (g), and total weight of secondary corms (g). Data collected were subjected to analysis of variance (ANOVA) and the mean where significant was separated using Fisher's Least Significant Difference. The highest yields were recorded in June planting date 3351g and 2452g for corms and secondary corms weight while Colocasia spp (0.057t/ha) gave best performance in yield attributes. June is most suitable planting date for cocoyam while July/August and beyond would be considered delayed planting dates for optimal cocoyam production. Among cocoyam cultivars, Ede Nkiti showed more prospects in terms of yield and performed optimally in the month of June and significantly differs from the other two cultivars.

Keywords: *Cocoyam, planting dates, yield responses, Colocasia esculenta, Xanthosoma sagittifolia*

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I. Introduction

Cocoyam is a staple food in many developing countries. It is cultivated in the tropical and sub-tropical regions of the world (Lyonga and Nzietchueng, 1986). Among the tuber crops of economic importance, cocoyam ranks third after yam and cassava (National Root Crops Research Institutes, 2008). Cocoyam is grown for its edible corms, cormels and leaves as well as other traditional uses (Pinto and Onwueme, 2000). Its corms and cormels are eaten in the same way as yams and sweet potatoes, although it is not as highly valued (Olayiwola *et al.*, 2012).

Fresh cocoyam contains about 70-80 percent water, 20-75 percent carbohydrate and 1.5-3.0 percent protein; it also contains significant amounts of vitamin C, thiamine, riboflavin, niacin and carotene (Udo *et al.*, 2005).

Despite the nutritional advantages of cocoyam and its potential for poverty alleviation, relatively little research has been devoted to it; thus, its potentials as an important staple food crop and associated nutritional and health benefits has remained under exploited (Onyeka, 2014). In recent times however, there has been significant increases in the production of cocoyam in West and Central Africa due to increased area under cultivation rather than increase in crop yield per land area; thus, the average yield per land area is relatively low (Onyeka, 2014).

In Nigeria Cocoyam is the common name for two tuber crops such as: *Colocasia esculanta and Xanthosoma sagitifolum*, which has ten high yielding cultivars from both: *Colocasia esculenta* has seven cultivars namely via (Coco India, Nworoko, Odogolo, Nadu, Nkong, Edenkiti and Akili Nsukka). These are used for soup thickening. While *Xanthosoma sagittifolia* has three cultivars such as Ede Ugwu, Ede oyibo, and Okoriko, these are non- irritation cultivars in the throat when eaten boiled or roasted this clearly distinguished them from *Colocasia esculenta* cultivars. Cocoyam is a well adapted food crop across many agro-ecological zones of Sub-Sahara Africa. They rank third in importance, after cassava and yam, among the root and tuber crops cultivated and consumed in many West and Central Africa countries. Cocoyam is nutritionally superior to

both cassava and yam in the possession of higher protein, mineral and vitamin contents as well as easily digestible starch. Africa in the last three decades has consistently accounted for an increasing percentage of global cocoyam production, which currently stands at about 10 million tonnes per annum (FAO, 2012). The continent accounted for 74% of global cocoyam production (approximately 50% of global output) occurring in the West and Central African sub-region. Cocoyam is an important food crop in Sub-Saharan Africa, (SSA), particularly in Nigeria, Ghana and Cameroon. However, the increasing production in the region has depended largely on peasant farming rather than increasing crop yields per unit area of land (Manner and Taylor, 2010).

Okoli and Okoronkwo (2020) reported that the development of highly nutritious crops will improve the nutritional status of the region and generally the standard of living of farmers in South-eastern Nigeria. Indigenous knowledge of rural farmers in the South-east of Nigeria indicates that the crop is best planted in June. Reasons for that planting period are not clear. Reasons being offered include that being a less important crop, yam is always given preference. Others indicate that the crop prefers reduced isolation commonly obtainable between May and July each year. Some indicate it is just a matter of convenience. There is therefore need to determine the best period for planting cocoyam in the rainforest agro ecosystem. Hence the essence of the study, yield response of cocoyam (*Colocasia esculenta* and *Xanthosoma sagittifolia)* cultivars to different planting dates in the rainforest zone of Anambra State, Nigeria.

II. Materials And Methods

This experiment was carried out at the Teaching and Research Farm of the Department of Crop Science and Horticulture, Chukwuemeka Odumegwu Ojukwu University, Igbariam, Anambra State which lies between latitude 06° 14°E and longitude 06° 45° E.

The research was a 3x3 factorial experiment laid out in a Randomized Complete Block Design (RCBD) in five replicates (cultivar x varying date of planting).

Three cultivars of cocoyam were planted, two cultivars were from the genera *Colocasia esculenta* (L) known as Akili Nsukka and Ede nkiti in Igbo Language, both are used for soup thickening. Another was from Xanthosoma *sagithifolia* known as Ede Oyibo in Igbo Language. The planting was done at three different planting dates viz; 28th June, 28th July and 28th August 2019 at the planting spacing of 1.5m inter-row and 0.5m intra-row.

The land used for this experiment was cleared manually and tilled very well and prepared into fine tilt. The planting was done in ridges. The plot was kept weed free throughout the experimental period, using hoe.

Data Collection and Statistical Analysis

Data were collected on the following attributes:

i. **Total corm yield (t/ha):** Harvesting was done on the first crop planted on 28th May, and second on 28th June the last was planted on 28th July all planting was harvested at the end of the planting season.
ii. **Number of corms:** This was done by counting all harvested corms and cormels.
iii. **Total weight of main corms (g):** Total weight of main corms per treatment combination was measured at harvest.
iv. **Total weight of secondary corms (g):** Total weight of cormels or secondary corms per treatment combination was also weighed at harvest.

The data collected were then be subjected to analysis of variance (ANOVA) using GENSTAT release 10.3 statistical software. The means were separated using Fisher's Least significant difference (F-LSD) as described by Obi, 2002.

III. Results

Table 1: Effect of different cultivars of cocoyam and months on total corm yield (t/ha) of cocoyam.

	Total Corm Yield (t/ha)			
	Month			
Cultivar	June	July	August	Mean
Ede Nkiti (Colocosia spp)	0.057	0.037	0.038	0.107
Akili Nsukka (Colocosia spp)	0.01	0.012	0.009	0.025
Ede Oyibo (Xanthosoma spp)	0.01	0.007	0.006	0.019
Mean	0.071	0.051	0.049	

NOTE: TCY= Total Corm Yield**, N.S=** Not significant

LSD (0.05) for Cocoyam variety means	0.018
LSD (0.05) for Months means	N.S
LSD (0.05) for Cocoyam variety x Months mean	N.S

The total corm yield (t/ha) presented in table 1 indicated that there were no significant differences amongst the planting dates, however, there were significant different amongst the cultivars of cocoyam planted. The highest yield was observed in Ede Nkiti (0.057t/ha) and it differs significantly from other cultivars. The analysis of variance showed that the interaction between cocoyam varieties and months of planting dates was not significant.

Table 2: Effect of different cultivars of cocoyam and months on the number of corms of cocoyam.

	MONTH			
	NUMBER OF CORMS			
CULTIVAR	**JUNE**	**JULY**	**AUGUST**	**Mean**
Ede Nkiti (Colocosia spp)	26.2	17.8	18.0	**20.67**
Akili Nsukka (Colocosia spp)	20.6	17.2	13.6	**17.07**
Ede Oyibo (Xanthosoma spp)	19.8	13.8	12.4	**15.33**
Mean	**22.2**	**16.2**	**14.67**	

NOTE: NOC= Number of Corms**, N.S=** Not significant

LSD (0.05) for Cocoyam variety means	3.45
LSD (0.05) for Months means	3.45
LSD (0.05) for Cocoyam variety x Months mean	N.S

Table 2 above revealed that the number of cocoyam corms produced in the month of June was significantly different from that of July and August. The highest number of corms was recorded in the month of June as 26.2 followed by August then July, 18.0 and 17.8 respectively. The lowest number of corms was recorded in the month of August as 12.4.

The number of corms produced by Ede Nkiti cultivar was significantly different when compared to the other two cultivars. The analysis of variance showed that the interaction between cocoyam varieties and months of planting dates was not significant.

Table 3: Effect of different cultivar of cocoyam and months on total weight of main cocoyam corms (g).

	MONTH			
	TOTAL WEIGHT OF MAIN CORM (g)			
CULTIVAR	**JUNE**	**JULY**	**AUGUST**	**Mean**
Ede Nkiti (Colocosia spp)	3351	2512	1990	**2618**
Akili Nsukka (Colocosia spp)	680	559	487	**575**
Ede Oyibo (Xanthosoma spp)	497	326	296	**373**
Mean	**1509**	**1132**	**924**	

NOTE: TWOMC= Total Weight f Main Corm**, N.S=** Not significant

LSD (0.05) for Cocoyam variety means	950.09
LSD (0.05) for Months means	N.S
LSD (0.05) for Cocoyam variety x Months mean	N.S

The result of total weight of cocoyam main corm recorded for the three planting dates was not significantly different (Table 3). The highest weight of main corm was recorded in the month of June as 3551g followed by July and August, 2512g and 1990g respectively. The lowest total weight of cocoyam corm was recorded in the month of August as 296g.

The result of total weight of cocoyam main corm recorded for Ede Nkiti (3351g) cultivar was significantly different when compared to the other two cultivars. The analysis of variance showed that the interaction between cocoyam varieties and months of planting dates was not significant.

Table 4: Effect of different cultivar of cocoyam and months on total weight of secondary corms.

	MONTH			
	TOTAL WEIGHT OF SECONDARY CORMS (g)			
CULTIVAR	**JUNE**	**JULY**	**AUGUST**	**Mean**
Ede Nkiti (Colocosia spp)	2452	2592	1155	**2066**
Akili Nsukka (Colocosia spp)	623	584	451	**553**
Ede Oyibo (Xanthosoma spp)	509	381	343	**411**
Mean	**1195**	**1186**	**650**	

NOTE: TWOSC= Total Weight of Secondary Corms**, N.S=** Not significant
LSD (0.05) for Cocoyam variety means 883.40
LSD (0.05) for Months means N.S
LSD (0.05) for Cocoyam variety x Months mean N.S

Table 4 revealed that the total weight of cocoyam secondary corm recorded for the three planting dates was not significantly different. The highest weight of secondary corm was recorded in the month of June as 2452g followed by July and August, 2592g and 1155g respectively. The lowest was recorded in the month of August as 343g.

The result of total weight of cocoyam secondary corm recorded for Ede Nkiti cultivar was significantly different when compared to the other two cultivars. The analysis of variance showed that the interaction between cocoyam varieties and months of planting dates was not significant.

IV. Discussion

Findings of this experiment indicate that corm weight and cormel total yield decreased in delayed planting, though the differences were not significant, however, similar studies was carried out by Lu *et al.,* (2001) on taro, Khan *et al.,* (2003) on some potato for yield increase. Further observations by Pandey *et al.,* (2009) and Paul and Bari, (2011) on cocoyam, along the vein of aim and objective of this present study, showed that selection of planting dates can increase yield and it's attributes in most improved cultivars. Planting date significantly affects growth, yield and yield components of most roots and tubers crops which include yam, potato, cocoyam, cassava etc. Hence, each crop has its best time of planting that suits it physiological requirements.

June planting seems to be best in the farming system of cocoyam, presently in the hot humid tropical lowlands of south-east Nigeria. The interaction between planting date and cultivar was not significant in the experiment for the yield attributes studied, which reflects an indication that cultivars exhibited differential responses to different planting date in the agro-ecological region. Studies have tended to show differential response of crop to some environmental factors and determine to some extent the efficacy of crop growth and overall yield (IITA, 1995). The highest cocoyam yields were recorded in June planting date according to table 3 and 4 records as 3351g and 2452g for corms and secondary corms weight while Ede Nkiti (0.057t/ha) gave best performance in yield attributes, closely followed by Akili Nsukka (0.012t/ha) both showed superior in yield characteristics than Ede Oyibo (0.007t/ha).

Among the three cultivars, (Ede Nkiti, Akili Nsukka and Ede Oyibo), Ede Nkiti and Akili Nsukka which belongs to the colocasia esculenta generic showed more prospect in yields and performed optimally in the month of June in the studied region. Based on the result obtained from this research on yield response of three cultivars on varying planting dates, we can conclusively say that month of June is most suitable planting date for cocoyam while July/August and beyond will be delayed planting dates in the region. Also those *colocasia spp* cultivars perform well with the June planting date. Nevertheless, more works and investigations can be done on genetic selection programme for early maturing and pest resistivity.

Figure 1: *Colocasia esculanta* (EDE NKITI)

Figure 2: *Colocasia esculanta* (AKILI NSUKKA)

Figure 3: *Xanthosoma sagittifolia* (Ede oyibo)

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