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Effect of planting space on plant population at harvest and tuber yield in taro (*Colocasia esculenta* L).

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A two year study was carried out in two locations in south eastern Nigeria in the years 2008 and 2009, to determine the effect of planting space on plant population at harvest, and corm yield in cocoyam cultivars. This was aimed to identify optimum planting space for optimum cocoyam production. Five taro cultivars; Nkpong, Ugwuta, Nworoko, Odogolo and Nadu were used. Three planting space; 50 x 100 cm, 40 x 100 cm and 30 x 100 cm were tested. The result showed that decreasing planting space from 50 x 100 cm to 40 x 100 cm resulted to increase in plant population at harvest. There was a decline in plant population as planting space was further decreased to 30 x 100 cm. The closest planting space of 30 x 100 cm produced the highest tuber yield ha^{-1} among the three planting space in the two locations. The result also showed that the Ugwuta cultivar produced the highest tuber yield among the five cultivars in the Nsukka location while the Odogolo cultivar recorded highest tuber yield in the Umudike location. It was therefore recommended that planting at the spacing of 30 x 100 cm should be adopted as a production practice in these areas for high tuber yield in cocoyam.

Key words: Cocoyam, cultivars, planting space, population, tuber yield.

INTRODUCTION

Cocoyam is the common name for two tuber crops *Colocasia esculenta* and *Xanthosomona sagitifolum*. Cocoyam is an important crop grown for its starchy corms and is a staple food throughout the rural subtropical and tropical regions of the world especially in the Pacific and Caribbean islands and West Africa (Hancock, 2004). Together with yam and cassava, cocoyam forms the major source of carbohydrates in Nigeria. Cocoyam cultivation in Nigeria is concentrated in southwestern and southeastern parts of the country due to favourable ecological conditions in these areas (Shiyam et al., 2007). Cocoyam production, like production of other crops, is still carried out by poor rural farmers with low production technologies. These resource poor farmers account for over 90% of Nigeria's agricultural output through the use of the indigenous farming practices.

Nigeria is presently the world highest producer of cocoyam producing about 1800000 tons per annum, accounting for about 30% of world total and 48% of Africa total production (Onwueme and Sinha, 1991; Eze and Okorji, 2003). Yield is still low in Nigeria as a result of poor production practices. There is therefore the need to

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enhance the production of cocoyam as this will help to reduce food shortage and also help in alleviating poverty among rural people.

Plant response to spacing varies from species to species and is highly dependent on such environmental conditions as soil characteristics, biotic elements and climatic conditions of the site. Planting with space according to Hailu and Sue (2011) involves the growing of plants on a plot of land with sufficient space between each of the plants so that they can develop their roots and shoots more fully. Cocoyam is a rhizomatous plant and when planted produces a number of suckers which develop into full plants/plantlets. Hence the expected plant population at planting will always be less than the plant population at maturity due to the emergence of these plantlets. Squire (1990) reported that production increases as population increases until a point is reached when further increase only lead to slight increase in production. He attributed the high production to high leaf area index. To maximize production therefore interception of light by chloroplast must be maximized to enhance photosynthesis upon which yield of crops is totally and directly dependent (Barden et al., 1989). Such increases in yield with decrease in plant spacing have been reported in other crops (Ogbonna and Obi, 2000; Ofori and Stern, 1987; Pardales and Belmontes, 1984; Bolton, 1971). Osundare, (2006) however, noted that average cormel weight decreases with increase in plant population. The objectives of this study are to determine the effect planting space on plant population at harvest and tuber yield in cultivars of cocoyam. This was aimed at identify high yielding and stable cocoyam cultivar and optimum planting space for maximum cocoyam production.

MATERIALS AND METHODS

To address the objectives of the study, field practical experiments were conducted in two locations in southeastern Nigeria namely; University of Nigeria, Nsukka in Enugu state (latitude 06°52'N longitude 07°24'E and at altitude 442 m above sea level), National Root Crop Research Institute (NRCRI), Umudike in Abia State (latitude 05°29'N, longitude 07 33'E and at altitude 122 m above sea level. The experiments were carried out in the growing season of two years, Nsukka location (2008) and Umudike (2009).

Material

Three local cultivars of cocoyam (*Colocasia esculenta)*; Odogolo, Nworoko and Nadu were sourced from the study area. Two cocoyam varieties; Ugwuta and Nkpong were also obtained from NRCRI Umudike, bringing the number of cultivars to five. The experiment was a factorial experiment in Randomized Complete Block Design (RCBD). The treatments consist of five cocoyam cultivars and three planting space of 50 x 100 cm, 40 x 100 cm and 30 x 100 cm, respectively. This resulted to 15 treatments combinations and was replicated into four.

The land was ploughed, harrowed and ridged before marking out into blocks and plots according to the experimental design. Planting was done immediately after land preparation at the depth of 10 cm. Two weeding were carried out manually with hoe before maturity. NPK 15:15:15 fertilizer was applied at the rate of 200 kgha^{-1} at eight weeks after planting. At maturity, expert women harvesters were engaged to harvest the cocoyam.

Data collection and analysis

Records were taken on number of plants per plot, number of cormels per stand, weight of cormels per stand, average cormel weight, weight of corm per stand, total tuber yield per stand, cormel yield ha^{-1} and total tuber yield ha^{-1}. These data were subjected to analysis of variance (ANOVA). This was carried out using the method outlined by Steel and Torrie (1980) for factorial experiments. Separation of means for statistical significance was by the F-LSD procedure described by Obi (2001). The F-LSD was calculated at 5% significant level. Meteorological records were obtained from meteorological stations at both institutions.

Soil data

At the time of planting soil samples were taken at different representative locations in each experimental site at the depth of 0 to 20 cm. The samples were thoroughly mixed to obtain a composite sample for each location from which a sub sample was used for laboratory analysis to determine the physical and chemical properties of the soil.

RESULTS

The result of soil analysis for the two locations is shown in Table 1.The result indicated that the soils of Nsukka and Umudike were texturally clay soil and loam soil, respectively. Their acidity levels were not too far apart however, Umudike appeared to be more fertile having higher quantities of organic matter and minerals than Nsukka soil. The weather data from the two location presented in Table 2 also revealed that rainfall started earlier in the year in Umudike. Also, high amount of rainfall and better distributed was recorded in Umudike. Temperature and relative humidity were also higher at Umudike.

The result of the effect of planting space on plant population at harvest shown in Figure 1 indicated significant effect (P=0.05). Decrease in planting space from 50 x 100 cm to 40 x 100 cm caused a significant increase in plant population at harvest. Further decrease in planting space to 30 x 100 cm resulted to a decline in plant population at harvest. The decline was however non significant. This trend was the same in both locations. Similarly, at Nsukka location, yield components such as number of cormels per stand, weight of cormels per stand, weight of corm per stand, average cormel weight and total tuber yield per stand also decreased significantly in capacity with decreased planting space (Table 3). On the contrary cormel yieldha^{-1} and total tuber yield ha^{-1} increased with decrease in planting space, hence planting at 30 x 100 cm planting space produced the highest cormel yieldha^{-1} and tuber yieldha^{-1} and were significantly higher than values obtained at 50 x 100 cm

Table 1. Physical and Chemical Properties of the Soil of the Experimental Sites before Planting.

Physical properties (%)	Nsukka	Umudike
Course sand (%)	10.00	44.00
Fine sand (%)	60.00	40.00
Silt (%)	20.00	9.00
Clay (%)	64.00	7.00
Textural Class	Clay soil	Loam soil
Chemical properties		
pH in Water	5.00	5.20
pH in KCL	4.60	4.10
Organic matter (%)	1.03	1.38
Total Nitrogen (%)	0.05	0.11
Total Carbon (%)	0.60	0.79
Available P (ppm)	2.60	10.30
Exchangeable Na (Meq/100 g)	0.10	1.73
Exchangeable K (Meq/100 g)	0.09	2.72
Exchangeable Ca (Meq/100 g)	1.00	3.80
Exchangeable Mg (Meq/100 g)	0.80	1.80
Exchangeable Al (Meq/100 g)	1.00	Nil
Exchangeable H (Meq/100 g)	0.40	1.40
Cation exchange capacity (Meq/100 g)	6.00	6.00

planting space but statistically the same with planting at 40 x 100 cm planting space. A similar trend was observed at Umudike location (Table 4).

Significant cultivar differences were also identified among the cultivars in plant population at harvest (Figure 2). Nworoko had the highest plant population among the cultivars in the Nsukka location while Nadu was at the top in the Umudike location. However both cultivars did not differed significantly in this attribute at both locations. The lowest plant population at harvest was recorded from Nkpong at both locations. The result presented in Table 5 indicated significant differences among the cultivars grown in the Nsukka location in all the yield components. Odogolo produced the highest number of cormels per stand while Nadu produced the lowest. Ugwuta had the highest weight of cormels per stand and was followed by Odogolo while Nkpong registered the least value. Records on weight of corms per stand showed that Nworoko topped the list followed by Odogolo while Nadu was the last. The highest average cormel weight was recorded in Nadu while Nkpong had the lowest value of average cormel weight. The highest total tuber yield per stand, cormel yieldha^{-1} and total tuber yieldha^{-1} were recorded in Ugwuta and was followed by Odogolo. Nkpong ranked the least in all the yield components except in weight of corm per stand. It was noted that Ugwuta, Odogolo and Nworoko produced statistically the same effect in all the yield components measured.

In the Umudike location, significant effects of cultivars were observed in all the yield components. Odogolo recorded the highest performance in all the yield components measured with the exception of average cormel weight in which Nworoko was the best. Ugwuta however ranked second in all the components with the exception of number of cormels per stand. Nkpong was lowest in weight of corms per stand, average cormel weight and corm yieldha^{-1}, while Nadu was lowest in number of cormels per stand, weight of cormels per stand, total tuber yield per stand and total tuber yieldha^{-1}. It was also observed that Odogolo, Ugwuta and Nworoko registered statistically the same effect in all the yield components with the exception of cormel yieldha^{-1} and total tuber yieldha^{-1} where they differed significantly (Table 6).

The cultivar x planting space interaction effect was significant on plant population at harvest. The result shown in Figure 3 revealed a trend of increase in plant population at harvest in all the cultivars as planting space decreased from 50 x 100 m to 40 x 100 m and declined as planting space was further decreased to 30 x 100 m in the Nsukka location. The same trend was observed in the Umudike location (Figure 4). The highest plant population at harvest was recorded in Nworoko in Nsukka location while at the Umudike location both Nworoko and Nadu produced the highest number.

Cultivar x planting space interaction effect was also significant in all the yield components measured (Table 7). There was a trend of decrease in number of cormels per stand as planting space was decreased in all the cultivars. Odogolo planted at 50 x 100 m spacing produced the highest number of cormels per stand, weight of cormel per stand, weight of corm/stand,

Table 2. Weather records of the areas during the periods of the Experiment.

Location	**NSUKKA**											
Year	**2008**											
Months	**Jan**	**Feb**	**Mar**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec.**
Rainfall amount (mm)	0	0	61	143	254	186	246	203	326	199	8	
Number of Rain days	0	0	4	11	12	15	14	19	22	11	2	
Maximum Temp (^{0}C)	31.4	34.1	33.8	31.7	31.2	29.8	28.9	27.8	27.6	29.5	31.1	
Minimum Temp (^{o}C)	20.3	22.0	22.9	22.0	20.8	21.4	20.8	20.7	20.8	20.9	22.0	
Relative Humidity (0900)	72.0	73.2	74.1	74.8	75.0	76.9	78.2	79.6	78.7	76.4	74.8	
Relative Humidity (1500)	56.0	56.2	57.0	66.20	70.30	72.7	74.60	75.00	74.50	74.70	61.70	

Location	**UMUDIKE**											
Year	**2009**											
Months	**Jan**	**Feb**	**Mar**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Rainfall amount (mm)	63	63	48	101	416	237	306	287	204	311	24	0
Number of Rain days	2	4	4	12	15	14	18	19	18	14	7	0
Maximum Temp (^{0}C)	33.0	35.0	34.0	33.0	33.0	31.0	30.0	29.0	30.0	31.0	32.0	34.0
Minimum Temp (^{o}C)	23.0	24.0	24.0	23.0	23.0	23.0	22.0	23.0	22.0	23.0	22.0	23.0
Relative Humidity (0900)	75.0	79.0	78.0	78.0	81.0	83.0	87.0	88.0	86.0	82.0	74.0	78.0
Relative Humidity (1500)	50.0	56.0	57.0	63.0	70.0	72.0	78.0	78.0	72.0	72.0	58.0	43.0

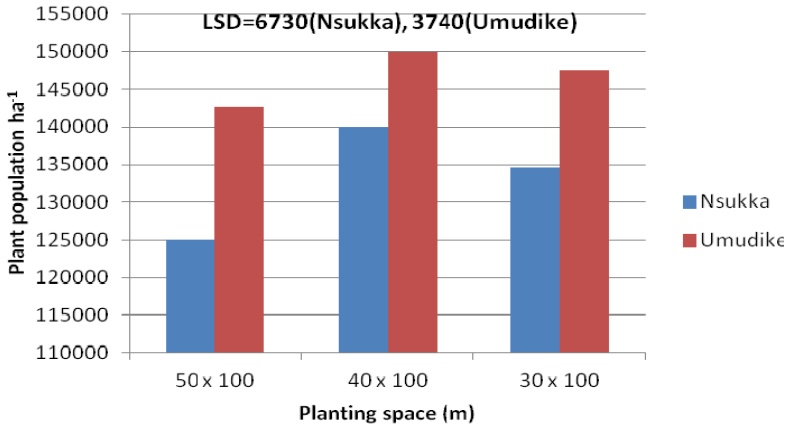

Figure 1. Effect of planting space on plant population at harvest in the Nsukka and Umudike locations.

Table 3. Mean effect of planting space on yield attributes of cocoyam in Nsukka Location in 2008.

Plant population (plants ha^{-1})	No. of cormels per stand	Weight of cormels per stand (kg)	Weight of corms per stand(kg)	Average cormel weight(kg)	Total tuber yield per stand(kg)	Cormel yield (kgha^{-1})	Total tuber yield (kgha^{-1})
20000	17.62	0.93	0.35	0.06	1.28	18560	25547
25000	13.90	0.80	0.32	0.06	1.13	20083	28117
33000	11.82	0.70	0.27	0.05	0.97	22978	32422
LSD (P<0.05)	1.88	0.11	0.06	0.01	0.14	3068	3855

Table 4. Mean effect of planting space on yield attributes of cocoyam in Umudike location in 2009 .

Plant population (plants ha^{-1})	No. of cormels per stand	Weight of cormels per stand(kg)	Weight of corms per stand(kg)	Average cormel weight(kg)	Total tuber yield per stand(kg)	Cormel yield (kgha^{-1})	Total tuber yield(kgha^{-1})
20000	10.46	0.35	0.07	0.24	0.42	9647.00	10827.0
25000	8.65	0.30	0.06	0.15	0.36	10180.00	11265.0
33000	7.32	0.26	0.04	0.13	0.31	11742.00	12926.0
LSD(P<0.05)	1.87	0.08	0.02	0.10	0.07	1678.80	1204.0

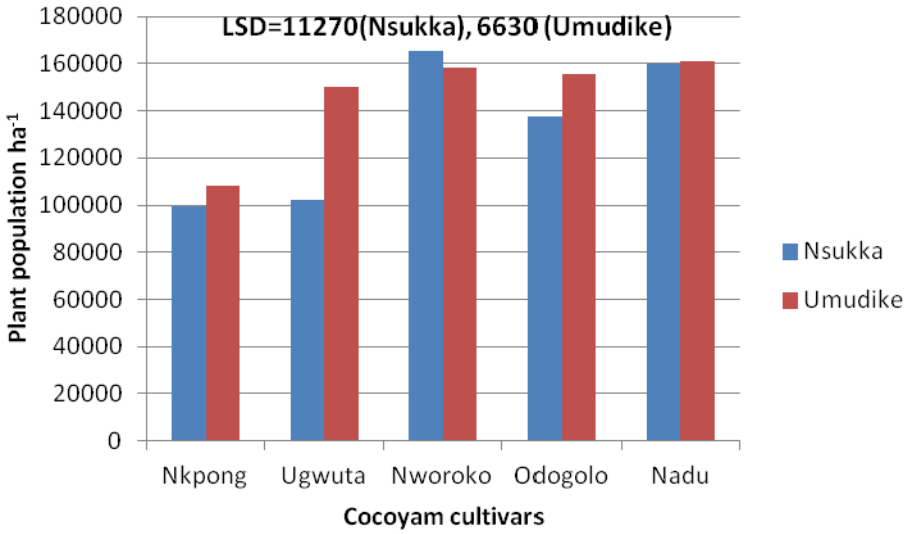

Figure 2. Effect of cultivar on plant population at harvest in the Nsukka and Umudike locations.

Table 5. Mean effect of cultivar on yield attributes of cocoyam in Nsukka location in 2008.

Cultivars	No. of cormels per stand	Weight of cormels per stand(kg)	Weight of corms per stand(kg)	Average cormel weight(kg)	Total tuber yield per stand(kg)	Cormel yield (kgha^{-1})	Total tuber yield(kgha^{-1})
NKPONG	13.11	0.71	0.30	0.05	1.00	17274.00	25557.00
UGWUTA	15.53	0.88	0.31	0.06	1.19	22180.00	30015.00
NWOROKO	14.08	0.79	0.35	0.06	1.15	20204.00	29468.00
ODOGOLO	15.75	0.85	0.32	0.06	1.17	21833.00	29937.00
NADU	13.75	0.83	0.29	0.06	1.12	21211.00	28498.00
LSD(P<0.05)	2.42	0.14	0.07	0.01	0.09	3960.90	4977.30

Table 6. Mean effect of cultivar on yield attributes of cocoyam in Umudike location in 2009.

Cultivars	No. of cormels per stand	Weight of cormels per stand(kg)	Weight of corms per stand(kg)	Average cormel weight(kg)	Total tuber yield per stand(kg)	Cormel yield(kgha^{-1})	Total tuber yield(kgha^{-1})
NKPONG	6.64	0.25	0.04	0.13	0.29	8066.00	9098.00
UGWUTA	9.34	0.32	0.07	0.30	0.40	11832.00	13197.00
NWOROKO	10.11	0.31	0.07	0.24	0.38	10443.00	11869.00
ODOGOLO	11.53	0.42	0.07	0.17	0.48	14080.00	15459.00
NADU	6.42	0.22	0.05	0.14	0.27	8195.00	8740.00
LSD(P<0.05)	2.42	0.10	0.02	0.13	0.08	2167.30	2541.00

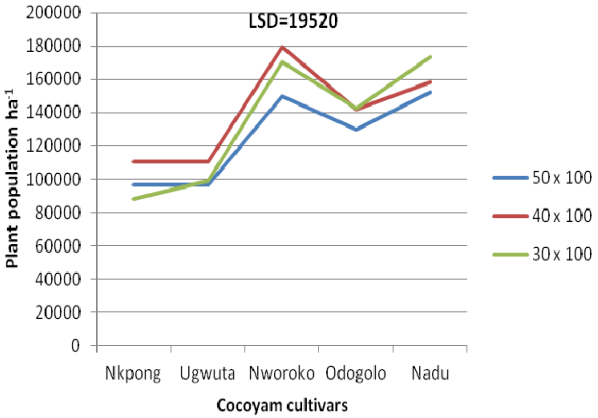

Figure 3. Effect of cultivar x planting space interaction on plant population at harvest in the Nsukka location.

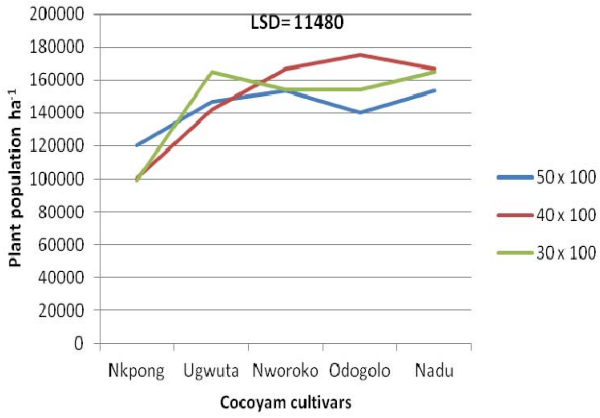

Figure 4. Effect of cultivar x planting space interaction on plant population at harvest in the Umudike location.

average cormel weight and total tuber yield per stand among the cultivar x planting space combinations. On the contrary cormel yieldha^{-1} and total tuber yield/ha increased as planting space was decreased in all the cultivars. Highest cormel yieldha^{-1} and total tuber yieldha^{-1} were recorded in Ugwuta planted at 30 x 100 m spacing. In the Umudike location the trend of the effect of cultivar x planting space interaction was the same with that of Nsukka location (Table 8). However in this location, Odogolo planted at 50 x 100 m spacing produced the highest values in number of cormels per stand, weight of cormels per stand, weight of corms per stand, average cormel weight and total tuber yield per stand among the combinations. It also recorded the

Table 7. Mean effect planting space by cultivar interaction on yield attributes of cocoyam in Nsukka location in 2008.

Cultivar x population	No. of cormels per stand	Weight of cormels per stand(kg)	Weight of corms per stand(kg)	Average cormel weight(kg)	Total tuber yield per stand(kg)	Cormel yield ($kgha^{-1}$)	Total tuber yield ($kgha^{-1}$)
Nkpong x 20000plts ha^{-1}	15.92	0.83	0.33	0.05	1.14	16600.00	22867.00
Nkpong x 25000plts ha^{-1}	13.00	0.69	0.33	0.05	1.02	17333.00	25583.00
Nkpong x 33000plts ha^{-1}	10.42	0.59	0.25	0.05	0.85	17889.00	28222.00
Cocoindia x 20000plts ha^{-1}	18.67	0.93	0.34	0.06	1.28	18667.00	25533.00
Cocoindia x 25000plts ha^{-1}	14.83	0.86	0.33	0.06	1.19	21500.00	29833.00
Cocoindia x 33000plts ha^{-1}	13.75	0.76	0.27	0.05	1.03	25333.00	34444.00
Nworoko x 20000plts ha^{-1}	17.17	0.90	0.36	0.06	1.26	18000.00	25267.00
Nworoko x 25000plts ha^{-1}	13.42	0.79	0.34	0.06	1.17	19833.00	29250.00
Nworoko x 33000plts ha^{-1}	11.67	0.68	0.33	0.05	1.02	22777.00	33888.00
Odogolo x 20000plts ha^{-1}	20.00	1.04	0.38	0.06	1.41	20733.00	28267.00
Odogolo x 25000plts ha^{-1}	15.08	0.86	0.30	0.06	1.16	21583.00	29000.00
Odogolo x 33000plts ha^{-1}	11.50	0.73	0.26	0.05	0.99	24222.00	32778.00
Nadu x 20000plts ha^{-1}	16.33	0.94	0.35	0.06	1.29	18800.00	25800.00
Nadu x 25000plts ha^{-1}	13.17	0.81	0.27	0.06	1.08	20167.00	26917.00
Nadu x 33000plts ha^{-1}	11.75	0.74	0.24	0.06	0.98	24666.00	32777.00
LSD(P<0.05)	4.20	0.24	0.12	0.01	0.22	6860.50	8629.90

highest cormel yieldha-1 and total tuber yield/ha at the closest planting space of 30 x 100 m.

Table 9 shows the result of the effect of locations on the yield components. The result indicates significant location effects on all the yield attributes. Planting at the Nsukka location produced significantly higher values in all the yield components than planting in Umudike location.

DISCUSSION AND CONCLUSSION

The study has shown that planting space affects plant population at harvest in cocoyam. Plant population at harvest increased with decrease in planting space and peaked at a particular planting space after which further decrease in planting space caused a decline in plant population at harvest. It was also observed that the cocoyam cultivars differed in plant population at harvest irrespective of the planting space. It will be important to note that it may be wrong to make estimate of plant population for some plant species that produce suckers, based on plant spacing at planting as that may entail stating plant populations that are far below the actual plant populations obtained in the field.

The observed decrease in corm and cormel yield per stand at closer planting space was in agreement with the findings of Tumuhimbise et al. (2009), Pardales and Belmonte (1984), Igbokwe and Ogbonnaya (1981) and De la Pena (1977). It has however, been reported that corm yield is a positive function of the number of corms and weight of corms per planting hill (Khan et al., 2003; Kader and Rolle, 2004). Calculated on hectare basis these yield components were found to increase as planting space decreased. In this study highest corm and cormel $yieldha^{-1}$ were realized from the closest planting space of 30 x 100 cm. This has also been reported by Pardales et al. (1982), Villanueva et al (1983) and Talwana et al. (2010). In south eastern Nigeria, like in many other parts of West Africa, sole cropping is a rare practice, so cocoyam is not normally planted sole but in mixture with other crops. In such combination individual plant population is always low and low yields are recorded (Onwueme and Sinha, 1991; Shiyam et al., 2010). This work has shown that growing cocoyam at closer planting space of 30 x 100 cm produced the highest corm and cormel $yieldsha^{-1}$ compared to yields recorded at wider planting spaces of 50 x 100 cm and 40 x 100 cm.

Table 8. Mean effect of planting space by cultivar interaction on yield attributes of cocoyam grown in Umudike location in 2009.

Cultivar x population	No. of cormels per stand	Weight of cormels per stand (kg)	Weight of corms per stand (kg)	Average cormel weight (kg)	Total Tuber yield per stand (kg)	Cormel yield ($kgha^{-1}$)	Total tuber yield ($kgha^{-1}$)
Nkpong x 20000plts ha^{-1}	7.87	0.31	0.05	0.15	0.36	8233.00	9033.00
Nkpong x 25000plts ha^{-1}	6.88	0.22	0.04	0.12	0.26	7675.00	8383.00
Nkpong x 33000plts ha^{-1}	5.18	0.21	0.03	0.10	0.23	8289.00	9878.00
Ugwuta x 20000plts ha^{-1}	11.41	0.37	0.08	0.23	0.45	10733.00	12173.00
Ugwuta x 25000plts ha^{-1}	9.28	0.33	0.06	0.20	0.39	11750.00	13083.00
Ugwuta x 33000plts ha^{-1}	7.34	0.27	0.05	0.16	0.32	13011.00	14333.00
Nworoko x 20000plts ha^{-1}	11.81	0.36	0.08	0.14	0.44	9533.00	10867.00
Nworoko x 25000plts ha^{-1}	9.82	0.32	0.07	0.14	0.38	9983.00	11150.00
Nworoko x 33000plts ha^{-1}	8.71	0.26	0.05	0.13	0.31	11811.00	13589.00
Odogolo x 20000plts ha^{-1}	13.66	0.47	0.08	0.20	0.55	12480.00	13880.00
Odogolo x 25000plts ha^{-1}	11.07	0.41	0.06	0.17	0.47	13383.00	14642.00
Odogolo x 33000plts ha^{-1}	9.85	0.37	0.07	0.17	0.43	16378.00	17856.00
Nadu x 20000plts ha^{-1}	7.55	0.25	0.06	0.16	0.31	7253.00	8180.00
Nadu x 25000plts ha^{-1}	6.20	0.22	0.05	0.14	0.27	8108.00	9067.00
Nadu x 33000plts ha^{-1}	5.52	0.20	0.03	0.11	0.23	9222.00	8972.00
LSD(P<0.05)	4.18	0.13	0.03	0.02	0.12	3753.90	4401.20

Table 9. Mean effect of location on growth and yield of cocoyam.

Locations	No. of cormels per stand	Weight of cormels per stand(kg)	Weight of corms per stand(kg)	Average cormel weight(kg)	Total tuber yield per stand(kg)	Cormel yield($kgha^{-1}$)	Total tuber yield($kgha^{-1}$)
Nsukka	14.35	0.84	0.26	0.06	1.10	20657.00	27533.00
Umudike	13.35	0.49	0.14	0.04	0.59	12307.00	15149.00
F-LSD(P<0.05)	1.135	0.07	0.03	0.01	0.07	1644.00	1916.9.00

The variation in yield among the cultivars collaborate with the findings of Khan et al. (2003). The Cocoindia and Odogolo cultivars were observed to produce highest yield at both locations and at the three planting space, among the cultivars. This is an indication that these cultivars possessed inherent genetic qualities that enhanced growth and development than the other cultivars. Such attributes brings about more efficient use of production factors. Breeding genotypes that are adapted to wide geographical areas and that show some degree of stability from year to year is one of the major challenges facing plant breeders. Such stable genotypes will be capable of utilizing the resources available in higher yielding environments and maintain a mean performance that is above average in all environments (Moll and Stuber, 1974). The Nsukka location appeared to have provided conditions most suitable for cocoyam growth and development; hence all the cultivars performed

best at that location. It has been reported by other researchers that yield of root crops are affected by changes in environmental conditions between sites and planting dates (Lu et al., 2001; Scheffer et al., 2005; Kumar et al., 2007; Mare and Mode, 2009).

Planting at the closest spacing of 30 x 100 cm which produced the highest tuber yield in all cultivars will be recommended to farmers. It will also be suggested that further studies will be conducted to determine the effect of planting at spacing that are closer than the ones tested in the present study. This will help to determine the optimum planting space. The Ugwuta and Odogolo cultivars which produced high tuber yield ha^{-1} will also be recommended to farmers in these areas. It will however be noted that other parameters may also be considered in making a choice. However, the funding for this research could not cover such other areas.

Conflict of Interest

The authors have not declared any conflict of interest.

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