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EFFECT OF PLANTING METHODS ON GROWTH AND YIELD OF FOUR VARIETIES OF YAM MINISETT (*Dioscorea rotundata* Poir)

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ABSTRACT

Field experiments were conducted in 2014 and 2015 rainy seasons at the Teaching and Research Farm of Federal University of Technology, Minna and on-farm site at Kuta in Shiroro Local Government Area, Niger State, Nigeria to assess the effects of planting methods and yam varieties on minisett growth and yield. The experiment was a 4 x 2 factorial combination arranged in a randomized complete block design and replicated three times. The treatments consisted of four yam varieties (Kwasi, Laushi, Sule and Lagos) and two planting methods (heap and ridge). Five heaps were prepared in a row spaced at 1 m x 1 m and five ridges measuring 5m each. 25 minisett of 50g each was planted on each plot. Data collected were subjected to analysis of variance (ANOVA). The results obtained shows that heap method of planting minisett was significantly `better at ($p \leq 0.05$) in number of minisett sprouts, vine length, number of leaves and number of ware yam compared to the use of ridge. Lagos variety recorded the highest number of minisett sprouts and number of seed yam. Similar high number of ware yam (yield) was achieved when Kwasi and Laushi varieties were used. It is therefore recommended that farmers should use Kwasi or Laushi yam varieties as planting materials and heap method should be used //to achieve better yield of yam.

KEYWORDS: Yam, minisett, heap, ridges, tubers

INTRODUCTION

Yam (*Dioscrea* spp.) is a root crop and it belongs to the genus *Dioscorea* in the family Dioscoreaceae (Riley *et al.,* 2006). There are several edible species of yam and they include *D. alata* (water yam), *D. rotundata* (white yam), *D. cayenensis* (yellow yam), *D. bulbifera* (aerial yam), *D. esculenta* (Chinese yam) and *D. dumetorum* (bitter yam). *D. rotundata* is grown and widely consumed in West Africa (Ilesanmi and Akinmusola, 2016). Babalola *et al*. (2020) reported that these yams\ species are cultivated in heaps or big ridges with staking as a

requirement during the vegetative phase to attain good yields (Agbede 2006; Otoo *et al.* 2008). It is the second most important tropical root crop in West Africa after cassava (Osunde, 2008).

Globally, 4.6 million hectares of yam were planted with 4.3 million of that being in Central and West Africa (IITA, 2009). FAO (2014), estimated that world production of yam was about 58.7 million tones with West Africa producing more than 92 %.

Despite the importance of yam among the populace, much attention was not made to its production. Babalola *et al*. (2020) reported that some empirical investigation were made to findout the factors that determine the level of yam production. Among several constrained experience by producers is cost of planting material which is rated to be about one third of the total cost of yam production (Bolarinwa and Oladeji, 2009). Limited planting material, high cost of labour for operations such as land preparation, staking, weeding and harvesting were reported by Nweke *et al.*(1991) as major constraints. Oguntade *et al.* (2010) reported that seed yams used for the production of ware or table yam consumed as food constitutes about 50% of the total cost of production. Scarcity and expensive nature of clean seed yam (disease free yams) is the major constraint militating agains yam production and productivity in West Africa (Lawrence, 2006). In the 1970s, minisett techinque was developed by National Root Crop Research Institute, Nmudike in collaboration with IITA Ibadan, Nigeria. These institites have the mandate for a rapid means of multiplying yam germplasm to address the frequent problems of high cost and non- availability of seed yam (Oguntade *et al.*, 2010). Osunde (2008) reported that yam is an excellent source of carbohydrate, mineral, vitamin (especially vitamin C). Yam can be prepared and consumed in form of boiled yam, fried, baked, dried flour - amala, pounded yam or pottage yam, it has been an integral part of social and religious festivals such as traditional marriages as well as sacrificial ceremonies of traditional religions (Oguntade *et al.*, 2010 and Okoro; 2008).

Minisetts are cut sections of yam tubers having the skin attached to them from carefully selected tubers used as alternative means to the production of seed yam through milking of ware yam.

The objective of this research was to compare the effect of planting methods on the growth and yield of yam minisett of different varieties of yam.

MATERIALS AND METHODS

The experiment was conducted at two locations during the 2014 and 2015 cropping seasons at the Teaching and Research farm of the Federal University of Technology, Gidan kwano, (G/kwano), Minna, Niger State. The other location was farmers field at kuta, Niger State. Minna is located on latitude 09° 40` N and longitude 60° 30'E with annual rainfall of 1,200mm and annual temperature of 29 °C in the Southern Guinea Savanna of Nigeria (Tsado, 2012), while Kuta is situated 56 km North- West of Minna located within latitude 09° 30`N and longitude 60° 45`E with annual range of rainfall between 1,100 mm and 1,600 mm and a mean temperature of 29 °C (Ananymous, 2000). Sorghum and groundnut were previously cropped in 2013 prior to field establishment in 2014 at Minna and Kuta respectively. The same field was used for the same research during the 2015 raining season. The yam varieties were obtained from yam farmers in Kuta.

The selected yam tubers with the skin attached were cut into several pieces like dices at 5cm long following the procedures of Mkpado and Onuoha (2008), using knife. Each of the pieces was further cut into smaller units of 50g. The minisetts cuts were treated with seed dressing chemical (seed plus 30 WS) at the rate of 100g in 10 liters of water. The minisett cuts were dipped into the solution for about 5-10 minutes and then removed and allowed to drain and dry for 2 hours before planting (Stephen, 2009).

Treatments and Experimental Design

The experiment was a factorial experiment consisting of four yam varieties (Kwasi, Laushi, Sule (Army) and Lagos) and two seed bed preparation methods (Heaps and Ridges). The experiment was laid out in a randomized complete block design and replicated three times. The size of the plot was 5 x 5 ($25m^2$) with an alley of 1m between replicates and as well as 0.5 m between the

treatments. Each plot contain 5 rows of heaps carrying 1 minisett each and five ridges carrying 5 minisett at a spacing of 1m x 1m giving 25 heaps per plot of 25 m^2.

Cultural Practices

The land used for the experiment was cleared using cutlasses and hoes. The preparation of heaps and ridges were manually done using big hoes and the planting was conducted based on the treatment design. The plots were kept free of weeds using herbicide. Premextra 500SC (formulation of 170gl atrazine) and 330gl metolachlor) were used as pre-emergence herbicide at 2 days after planting (DAP) and supplemented by hoe weeding at 3, 6 and 9 weeks after planting (WAP). Basal application of N-P-K 15:15:15 fertilizer was applied at the rate of 250 kg/ha as recommended by Thomas *et al.* (2007) at two months after emergence. Staking of yam stem was done after emergence such that two plants were trained to one stick following the recommendation of Onwueme and Hamon (2002).

Harvesting and Storage

Harvesting of yam tubers was done when the vines were fully dried using hoes. This was achieved by careful digging round the tuber to avoid injury. The tubers were stored in yam barn which were used as planting material in the subsequent cropping seasons.

Data Collection and analysis

The parameters for which data were collected include growth parameters such as number of sprouts ,main vine length, number of leaves, leaf length, number of branches, inflorescence number at three weeks after planting (WAP), while the yield parameters include number of mini-tubers, number of seed yam, number of ware yam, total tuber number, biggest tuber weight and total tuber weight bulked per plot. Data collected were subjected to analysis of variance (ANOVA) using the Statistical Analysis Software package (SAS, 1993). Duncan Multiple Range Test (DMRT) was used to separate the means at $P<0.05$.

RESULTS

Number of Leaves

The effect of planting methods on number of leaves of four varieties of yam at Kuta and Gidan Kwano in 2014 and 2015 rainy seasons is presented in table 1. The result revealed that the use of heap method produced the highest number of leaves per plant in both locations and years. However, the use of Laushi at Kuta and Kwasi at G/Kwano in 2014 rainy season significantly produced similar greatest number of leaves per plant than the other varieties used in this study, while Lagos variety at Kuta and Kwasi at G/Kwano were least. In 2014, Laushi recorded the highest number of leaves per plant in both locations, while Sule statistically produced the least number of leaves per plant at Gidan Kwano.

Table 1: Effects of planting method on number of leaves per plant in four yam varieties in 2014 and 2015 seasons

	2014		2015	
Treatment	Kuta	G/Kwano	Kuta	G/Kwano
Planting (p)				
Heap	237.00a	255.00a	222.00a	244.00a
Ridge	197.00b	222.00b	200.00b	241.00b
S.E±	1.08	4.16	2.00	1.06
Variety (v)				
Kwasi	234.00b	287.00a	234.00b	261.00b
Laushi	269.00a	240.00b	271.00a	292.00a
Sule (Army)	110.00c	176.00c	165.00d	175.00d
Lagos	166.00d	251.00b	174.00c	242.00c
S.E±	1.52	5.90	2.83	1.50
Interaction				
P x V	**	*	**	**

Means followed by the same letter(s) are not significantly different at $P > 0.05$ by Duncan Multiple Range Test (DMRT); S.E = Standard error; WAP= Weeks after planting; ** highly significant

Minisett Sprout

The effect of planting methods on sprouts of four yam varieties at Kuta and Gidan Kwano in 2014 and 2015 rainy seasons is shown in table 2. Number of minisset sprout was not significantly affected by planting method at both location in 2014 and G/kwano in 2015, but significant effect on minisett sprout was observed at Kuta in 2015 such that the use of heap method of planting recorded the highest number of minisett sprouts. Number of sprouts significantly differed between the yam varieties. Kwasi and Lagos produced similar highest number of sprouts compared to the use of Laushi at Kuta in 2014, while only Lagos had higher number of sprouts compared to other yam varieties at G/Kwano in 2014. At Kuta in 2015, Kwasi significantly had better number of sprouts than other varieties. This trend was similarly observed with Lagos variety at Gidan Kwano in 2015 with Kwasi been the least.

Table 2: Effects of planting methods on number of minisett sprout in four yam varieties in 2014 and 2015 seasons

	2014		2015	
Treatment	Kuta	G/Kwano	Kuta	G/Kwano
Planting (P)				
Heap	63.00a	56.00a	74.00a	66.00a
Ridge	65.00a	55.00a	65.00b	64.00a
S.E±	3.35	3.04	0.59	0.66
Variety (V)				
Kwasi	70.00a	56.00ab	72.00a	57.00c
Laushi	57.00b	54.00ab	68.00b	66.00b
Sule (Army)	60.00ab	48.00b	69.00b	67.00b
Lagos	69.00a	64.00a	68.00b	70.00a
S.E±	3.35	4.43	0.84	0.93
Interaction				
P x V	NS	NS	*	*

Means followed by the same letter(s) under each factor are not significantly different at $P > 0.05$ by
Duncan Multiple Range Test (DMRT); S.E = Standard error; WAP= Weeks after Planting; NS = Not significant; * = Significant

Vine Length

The effect of planting methods on vine length of four yam varieties at Kuta and Gidan Kwano in 2014 and 2015 rainy seasons is presented in table 3. The result showed that vine length was significantly affected by planting methods such that, the use of heap method recorded the highest vine length at Kuta in 2014 and 2015 rainy seasons compared to the use of ridge method while ridge methods recorded the highest vine length at Gidan Kwano in 2015. However, there was no significant difference in vine length at Gidan Kwano in 2014 rainy season. Furthermore, vine length differed significantly between yam varieties in this study. Kwasi consistently recorded the longest vine length in both location and in both years. Similar longest vine length was observed at G/kwano in 2014, while Lagos yam variety consistently recoded the shortest vine length in both locations in both years.

Table 3: Effects of planting methods on vine Length (cm) in four yam varieties in 2014 and 2015 seasons

	2014		2015	
Treatment	Kuta	G/Kwano	Kuta	G/Kwano
Planting (p)				
Heap	130.92a	131.58a	134.33a	119.75b
Ridge	122.75b	129.83a	127.67b	121.92a
S.E±	0.79	0.63	0.81	0.67
Variety (v)				
Kwasi	142.50a	139.17a	149.00a	132.33a
Laushi	129.00b	124.67b	133.17b	119.67c
Sule (Army)	120.17c	138.67a	126.83c	124.50b
Lagos	115.67d	120.83c	115.00d	108.83d
S.E±	1.12	0.90	1.15	0.94
Interaction				
P x V	**	**	**	**

Means followed by the same letter(s) are not significantly different at $P > 0.05$ by Duncan Multiple
Range Test (DMRT); S.E = Standard error; WAP= Weeks after Planting; ** highly significant

Number of Seed Yam

The effect of planting methods on yield attributes (number of seed yam) in four yam varieties at Kuta, Gidan Kwano and combined in 2014 and 2015 rainy seasons is presented in table 4. The

result revealed that, number of seed yam was not significantly affected by planting methods in both locations and years including the combined. Number of seed yam was statistically influenced in terms of yam varieties. At G/Kwano and in combined during the 2014 rainy season, Lagos and Sule (Army) produced significantly similar highest number of seed yam, though at par with Kwasi and Laushi at G/kwano, while the least number of seed yam was obtained from Laushi at combined. In 2015, Sule and Lagos at Kuta and at combined produced similar highest number of seed yam, similar result was observed at G/kwano in combination with Laushi variety.

Table 4: Effects of planting method on number of seed yam of four yam varieties in 2014 and 2015 seasons

	No. Seed Yam_2014			No. Seed Yam_2015		
Treatment	Kuta	G/Kwano	Combined	Kuta	G/Kwano	Combined
Planting (p)						
Heap	42.00a	30.00a	31.00a	42.00a	21.00a	32.00a
Ridge	33.00a	34.00a	33.00a	42.00a	20.00a	31.00a
S.E±	3.21	2.82	1.67	3.18	2.22	1.97
Variety (v)						
Kwasi	41.00a	34.00ab	37.00a	39.00b	16.00b	28.00bc
Laushi	40.00a	32.00ab	36.00b	38.00b	31.00a	35.00ab
Sule (Army)	37.00a	37.00a	37.00a	58.00a	20.00b	39.00a
Lagos	37.00a	37.00a	37.00a	58.00a	20.00b	39.00a
S.E±	2.36	3.99	2.36	4.50	3.14	2.79
Interaction						
P x V	NS	NS	*	NS	NS	NS

Means followed by the same letter(s) are not significantly different at P > 0.05 by Duncan Multiple Range Test (DMRT); S.E= Standard error; NS = Not significant; * = Significant.

Number of Ware Yam

The effect of planting methods on the number of ware yam in four yam varieties at Kuta, G/Kwano and in combined during the 2014 and 2015 rainy seasons is presented in table 5. The result indicated that heap method recorded the highest number of ware yam at G/kwano and in combined in 2014, while the ridge method recorded the least.

Number of ware yam differed significantly between the yam varieties. At Gidan Kwano in 2014, there was no significant difference in the number of ware yam produced among the varieties. At Kuta and when the data were combined in 2014, Kwasi and Laushi produced statistically similar quantities of ware yam which were significantly more than Sule and Lagos. In 2015 rainy season, there were no significant difference in the number of ware yam among varieties at Kuta and G/kwano, but significant difference was observed at combined data which revealed that Laushi recorded the highest number of ware yam, though at par with Kwasi and Lagos, while Sule (Army) was the least.

Table 5: Effects of planting method on number of ware yam of four yam varieties in 2014 and 2015 rainy seasons

	No. Ware Yam 2014			No. Ware Yam 2015		
Treatment	Kuta	G/Kwano	Combined	Kuta	G/Kwano	Combined
Planting (p)						
Heap	8.00a	14.00a	11.00a	23.00a	4.00a	13.00a
Ridge	5.00a	8.00b	6.00b	17.00a	2.00a	10.00a
S.E±	1.29	1.36	0.94	3.20	1.03	1.50
Variety (v)						
Kwasi	11.00a	12.00a	11.00a	21.00a	1.00a	11.00ab
Laushi	10.00a	12.00a	11.00a	25.00a	5.00a	15.00a
Sule (Army)	3.00b	8.00a	6.00b	14.00a	2.00a	8.00b
Lagos	3.00b	11.00a	7.00b	22.00a	3.00a	12.00ab
S.E±	1.82	1.92	1.33	4.53	1.45	2.13
Interaction						
P x V	NS	NS	NS	NS	NS	NS

Means followed by the same letter(s) are not significantly different at $P > 0.05$ by Duncan Multiple Range Test (DMRT);

S.E= Standard error; NS = Not Significant; * = Significant; ** highly significant.

DISCUSSION

It has been observed in this study that the heap method of planting was superior over the ridge method in terms of minisett sprout, vine length and number of leaves. The superiority of heap method over the use of ridge method could probably be attributed to the fact that, the heap method had higher raised and bulky seed bed than the ridge which could retain more moisture and heat protection to enhance better sprouts. This result is similar to the findings of Ijoyah *et al.* (2006), who reported a superior minisett sprouts on raised bed system than the use of ridge method. The greater vine length recorded on heap planting method could also be attributed to the secured nutrients in the heap. The highest number of leaves per plant recorded in the use of heap method at both locations during the study periods could be attributed to the cultivation type

where the heap provided a better suitable environment with plant needs such as mineral nutrients, moisture for growth and development. This result supported the report of Ijoyah *et al.* (2006), that the use of raised seed bed provided more favourable conditions for plant agronomic performance such as moisture retention and nutrients. The ability of heap method of planting to produce greater yield components such as number of ware yam could be attributed to the differences in seed bed structure in which heap method provided deep loose soil that enhanced better initiation and easy penetration of tubers than the ridge method. A contrary view was reported by Ennin *et al.* (2009), that yam yields on mounds and ridges were statistically similar with respect to tuber weight and fresh tuber yield.

Varietal response of Sule, Kwasi and Lagos in this study revealed that similar number of sprouts could be attributed to similar potential genetic sprouting ability of the varieties while the difference between the years could be due to seasonal effects. This agreed with the view of Okezie and Nzekwe (2009) who observed that sprouting generally depends on hormonal control and the recovery from dormancy would imply the existence of the sprout promoting hormone at the level that is optimal for bud break and hence sprout emergence. The significant differences in vine length among the different yam varieties in this study could probably be due to the differences in inherent varietal characteristics. This is in conformity with the report of Kambaska *et al.* (2009) who reported that plant height and other agronomic characters varied significantly among yam varieties due to their genetic differences. The ability of Laushi and Kwasi to produce highest number of leaves during the production period in the two locations may be due to varietal or environmental influence. This corroborated the report of Linus (2003) who found the yield of yam to depend on location, variety and cultivation practices.

The response of variety on the number of seed yam which indicated consistent greater performance of Sule (Army) and Lagos variety is an indication of their ability to consistently produce seed yam. The result is consistent with that of Adeniyan and Owolade (2012), who observed some genotype of yam that consistently produced seed tuber and the genotypes differed significantly in the yield of seed tubers. However, the higher number of ware yam produced from

Laushi and Kwasi varieties during the period under study can be suggested to be attributed to the inherent genetic characteristic of the varieties to produce heavy tubers (ware tubers). The result is in agreement with that of Adeniyan and Owolade (2012), who found three varieties of yam that consistently produced highest ware tubers and therefore relatively had stable yield performance.

CONCLUSION

From this study, it can be concluded that heap method of planting minisett resulted to higher number of minisett sprouts, vine length, number of leaves and number of ware yam. Performance of Lagos variety was superior to other varieties in terms of number of minisett sprouts and number of seed yam including Sule variety, while Kwasi or Laushi varieties recorded the highest number of ware yam. Based on the findings, it is recommended that farmers should be encouraged to use the heap method for planting yam minisett instead of the ridge method.for better sprouts and other agronomic performance. Farmers should use Kwasi or Laushi variety for planting if their target is centered on yield because it can produce more tubers.

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