Direct RESEARCH JOURNALS
Vol.4 (9), pp. 239-247, September 2016
ISSN 2354-4147
Article Number: DRJA12182081

Direct Research Journal of Agriculture and Food Science
http://directresearchpublisher.org/aboutjournal/drjafs

Research Paper

Comparative Yield of Planting on Heap and Ridge of Four Yam (*Dioscorea rotundata* Poir) mini setts Landraces

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Received 14 June 2016; Accepted 8 July, 2016

Nigeria is the world largest yam producer with 68 percent of global production. A multi-location field experiment was conducted from May to November 2013 and 2014 rainy seasons at the Teaching and Research Farm of Federal University of Technology, Gidan Kwano, Minna and at Kuta, Shiroro Local Government Area in Niger State Nigeria, to assess the influence of seed bed type and yam landraces on mini sett growth and yield. The experiments were carried out in a 2x4x3 factorial combination in a randomized complete block design planted to 4 yam landraces – Kwasi, Laushi, Sule and Lagos. The results obtained showed that heap method of planting significantly produced superior number of sprouts than the ridge at both locations in 2013 but was not in 2014. Laushi was significantly the least the landraces in the number of sprouts at Gidan Kwano in 2013 while others were not. Heap method significantly resulted to the highest vine length Gidan Kwano and Kuta in 2013 and 2014 respectively though it was reversal at Kuta in 2013. Heap method had a significant of number of leaves, than others at both locations. While Laushi had the best number of leaves at Kuta in 2013, Kwasi topped the list at Gidan Kwano significantly in 2014. The ridge method significantly produced superior number of seed yam at Gidan Kwano in 2013 and Kwasi significantly had the least number of seed yam. Heap method significantly produced the highest number of ware yam at both locations in 2013 and so too at Gidan Kwano in 2014. Heap method of planting resulted to the highest total tuber number. Heap method significantly produced the highest total number of tubers at Gidan Kwano in 2013 and 2014 compared to the ridge method. The study points to heaps as an important option for tuber sprouting and the use of ridges for seed yam production in 2013 and so too for the combined data in 2014 while the use of heap is a strong tool in the production of ware yam.

Key words: Mini sett; *Dioscorea rotundata;* Global production, landraces.

INTRODUCTION

Yam is one of the root crops produced in Nigeria. It belongs to the genus Dioscorea Family *Dioscoreaceae* (Riley *et al*., 2006). It is the second most important tropical root crop in West Africa after cassava (Osunde, 2008). These include: guinea white yam (*Dioscorea rotundata* Poir*),* yellow yam (*D. cayenenses),* water yam (*D. alata*), trifoliate yam *(D. dumetorum)* aerial yam (*D. Bulbifera*) and Chinese yam (*D. esculenta*) Yams (*Dioscorea* species) are annual root tuber bearing plants with more than 600 species out of which six are socially and economically important in terms of food, cash and medicine (IITA, 2009). Some of the yam species are water yam (*Dioscorea alata*), white yam (*Dioscorea rotundata*), yellow yam (*Dioscorea cayanensis*), Chinese yam (*Dioscorea esculant*) and three-leaf yams (Ike and Inoni

, 2006; Olubukola and Bolarin, 2006; Zaknayiba and Tanko, 2013). International Istitute of Tropical Agriculture (2010), reported that 4.6 million hectares were planted world wide with 4.3 million of that being in Central and West Africa.

Yam production is constrained by several factors. Bolarinwa and Oladeji, (2009) established that the cost of planting material is rated to be about one third of the total cost of yam production. Nweke *et al*. (1991) also found that limited plantig material, high cost of labour for operations such as land preparation, staking, weeding and harvesting were major constraints but that planting material accounted for about 50% of the total cost of yam production, while labour accounted for over 40%. Oguntade *et al.* (2010) also 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. The authors further stressed that yam farmers in Nigeria, usually obtained planting material from harvest of previous years through milking or cuting good ware yam into sections for planting. Lawrence, (2006) stated that scarcity and expensive nature of clean seed yam is the major constraint to increasing yam production and productivity in West Africa because traditional methods of seed yam production was inadequate for farmers for large producion. The mini sett techinque (as descibed by National Root Crop Research Institute, Nmudike in collaboration with International lnstitute of Tropical Agriculture - IITA Ibadan), Nigeria in the 1970s tried to addresse this problem of non- availabilty of seed yam (Oguntade *et al.,* 2010).

Yam responds to various agroecological factors. Thomas *et al.* (2007) declared that yam grows and develops well between altitute of 0-1500 metres above sea level with temperature ranges of 23–25°C and rainfall above 1500 mm requiring at least five months during the rainy season and transition zone between the tropical rainforest and savannah as the most sui Table for its production. The authors also recommended deep soils that are permeable rich in humus and application of well decomposed manure to ridges or mounds if necessary. These researchers established that yams can yield 5 - 12 tons/ha which can go up to 20 t/ha with the use of chemical fertilizers or organic manuring.

Yam is important in the diet of man. Osunde, (2008) reported that yam is an excellent source of carbohydrate, mineral and vitamin (especially C). Pursegolve, (1985) stated that some wild species of yam can contain toxic alkaloid that could be used in hunting (as arrow poison) and as insecticide. Oguntade *et al.* (2010) also reported the importance of yam to include source of starch (carbohydrate) with its main function being the provision of calories to the body which can be prepared and consumed in form of boiled yam, fried, baked, dried flour-amala, pounded yam or pottage yam. These authors further stated other uses of yam to include integral part of social and religious festivals stressing that it plays strong roles in many traditional marriages as well as sacrificial ceremonies of traditional religions. Linus, (2003) reported that mashed yam is offered as meals to gods in South–East Nigeria. Bolarinwa and Oladeji (2009) established that yam is an indispensable part of "bride price" and it contributes about 32% of farmers gross income derived from crops in many parts of Nigeria.

Mini setts 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. Oguntade *et al.* (2010) reported that the seed yam production potential is best from three yam species - (*D. Rotundata, D. alata,* and *D. cayenenses).* For the traditional method, 100 – 200 g setts can be used while mini sett technique could be achieved using 25, 20, 15 and 10 g cut from other tubers. Thus, the mini sett technique remains the only on-farm practicable alternative to the use of ware yam as seed yam, (Oguntade *et al.* 2010). This explains, why the need to determine the best planting method of mini sett for better yield.

The study was conducted to assess the effect of seed bed preparation methods on agronomic performance of yam verieties and to determine the effect of seed bed preparation methods on the yield of yam mini sett.

MATERIALS AND METHODS

The study consisted of multi location field experiment conducted at the Teaching and Research farm at Gidan Kwano and Kuta village, Shiroro Local Government, Niger State, Nigeria during 2013 and 2014 rainy seasons. Minna is located in South Guinea Savannah of Nigeria (latitude 09° 40` N and longitude 60° 30'E) with mean annual rainfall of 1,200 mm and mean annual temperature of 29°C (Tsado, 2012) while the field is located on latitude 09° 33' N and longitude 006° 27' E with 782 m above the sea level on global positioning system (GPS). Kuta is situated 56 km North-North West of Minna located within latitude 09° 30`N and longitude 60°45`E with mean annual rainfall between 1,100 mm and 1,600 mm and a mean temperature of 29°C (Shiroro Local Government Diary, 2000) The experimental field at Kuta was located on latitude 09^0 49'N and longitude 006^0 41'E on GPS.

Pre-planting soil samples were collected from the soil surface randomly across the experimental sites at 0-15 cm and 15 - 30 cm depth along a transect using soil auger and then bulked together to form the composite sample. The samples were subjected to physico-chemical analysis using standard laboratory procedures. The preparation of heaps and ridges was manually done using big traditional hoes at on season. Heaps and ridges were made as per the treatments in which were all planted same number of mini sett seed. Experimental design was laid out as a 2 × 4 factorial combination in a randomized complete block design

(RCBD). Four yam landraces (Kwasi, Laushi, Sule (Army) and Lagos) and two seed bed preparation methods were the treatment combinations which were replicated three times (2×4×3=24 treatment combinations).

Five heaps were prepared in a row spaced at 1 m × 1 m in which 5 rows were contained in a plot to give 25 heaps per plot (5 m ×5 m = 25 m^2). The space between the heap in each row was filled with soil for planting mini sett while 5 ridges measuring 5m long at 1m apart were prepared per plot (5m × 5m = 25 m^2). This resulted to 25 m^2 × 8 = 200 m^2 per block which fitted to the 8 treatment combination. An alley of 1 m was left between the replicates and as well 0.5m between the treatments. Total heaps prepared = 25 × 4 = 100 ×3 = 300 while the total ridges prepared = 5 × 4 = 20 × 3 = 60. Sixteen mini sett seed size of 50 g were planted on each row of the heaps at 30 cm × 30 cm using traditional hoes at 15 cm deep as established by Onwueme and Hamon, (2002). The planting was done when rains were fully established with cut surface facing upward (Mkpado and Onuoha, 2008). Total mini setts planted on heaps were:
16 × 5 = 80 mini sett seeds/plot; 80 × 4 treatments = 320/block × 3 = 960 mini setts.
Similarly, the total mini sett seeds planted on ridges were same as heaps.
Sixteen mini sett seeds were planted on a ridge where; 16 × 4 = 80 mini setts seed/plot
80 × 4 treatments = 320/block × 3 = 960 mini sett seeds.
Therefore, 960 + 960 =1920 mini sett seeds for the combined treatments.

Agronomic practices

Mother tubers (ware yams) selected for mini sett were cut into several pieces like dices about 5 cm long (Mkpado and Onuoha 2008) using knife. Each of these pieces was further cut into several units of 50 g each with skin attached. The mini setts cuts were treated with solution of chemicals (seed plus 30 WS), which is an insecticide/fungicide; 10 g Containing active ingredients (Imidacloprid 10 % + Metalaxyl 10 % + Carbendazim 10 % WS) where imidacloprid is an insecticide while metalaxyl and carbendazim are fungicides. 100 g of these chemical was diluted in 10 litres of water and the mini sett cuts were dipped into the solution for about 5 - 10 min which were moved out and allowed to drain and dry for 2 h before planting (Stephen, 2009).

Herbicides (Premextra 500SC) formulation of 170 gl atrazine and 330 gl metolachlor, a pre-emergence herbicide was applied 1-7 days after planting (5 L/ha) using CP 15 Knapsack sprayer as recommended by Stephen, (2009) while the hand weeding using traditional hoes was carried out 3 times as reported by (Onwueme and Hamon, 2002). A basal dose application of N-P-K 15:15:15 fertilizer as source at 25 g/plant stand (250 kg/ha) as recommended by (Thomas *et al.,* 2007) was implored two months after emergence by side placement (5 cm away from the plant stand). Staking was done where two plants were trained to one stick as recommended by (Onwueme and Hamon, 2002). Tubers were harvested when vines were fully dried using traditional hoes.

Statistical analysis

Data collected include; number of sprouts, main vine length and number of leaves all at every 3 weeks after planting. The data on yield attributes were; number of seed yam, number of ware yam, total tuber number and total tuber weight. The data collected were subjected to analysis of variance at 5% significant level using Statistical Analysis Software (SAS) package version (1993) and means were compared using Duncan's Multiple Range Test.

RESULTS

The effect of seed bed preparation method on sprouting (heap/ridge) in four yam landraces in 2013 and 2014 is presented in (Table 1) showed that planting method differed significantly on sprouting such that the use of heaps method of planting had better sprouts than the ridge method at both locations during (2013) while this difference was not observed statistically at both locations during (2014). Sprouting ability indicated significant difference between the yam landraces except at Kuta in (2013). The use of Laushi, Sule and Lagos at Gidan Kwano had better sprouts than Kwasi in (2013). In 2014, the use of Kwasi, and Lagos produced superior sprouts compared to Sule and Laushi at Kuta, while Lagos had better sprouts than the others at Gidan Kwano.

Table 1. Seed bed preparation method on sprouting in four yam landraces during 2013 and 2014.

	2013		2014	
Treatment	**Kuta**	**G/Kwano**	**Kuta**	**G/Kwano**
Planting (p)				
Heap	66.92a	71.00a	63.00a	3.35
Ridge	60.08b	66.33b	64.67a	55.00a
S.E ± .	1.38	1.36	3.35	3.04
Variety (v)				
Kwasi	62.00a	53.83b	69.67a	55.67ab
Laushi	57.83a	75.67a	56.83b	54.33ab
Sule (Army)	66.50a	73.18a	59.67ab	47.83b
Lagos	67.00a	72.00a	69.17a	63.67a
S.E ±	1.95	1.92	3.35	4.43
Interaction				
P × V	*	NS	NS	NS

Means followed by the same letters are not significantly different at P ≥ 0.05 by Duncan Multiple Range Test (DMRT).

Effect of seed bed preparation method on vine length on the four yam landraces at Kuta and Gidan Kwano in is recorded

Table 2. Effect of seed bed preparation method on vine length in four yam landraces during 2013 and 2014.

	2013		2014	
Treatment	**Kuta**	**G/Kwano**	**Kuta**	**G/Kwano**
Plant (p)				
Heap	117.92b	131.67a	130.92a	131.58a
Ridge	129.58a	129.50b	122.75b	129.83a
S.E ± .	0.51	0.60	0.79	0.63
Variety (v)				
Kwasi	112.83d	138.00a	142.50a	139.17a
Laushi	131.33b	124.33b	129.00b	124.67b
Sule (Army)	134.50a	139.00a	120.17c	138.67a
Lagos	116.33c	120.50c	115.67d	120.83c
S.E ±	0.82	0.84	1.12	0.90
Interaction				
P × V	**	**	**	**

Means followed by the same letters are not significantly different at P ≥ 0.05 by Duncan Multiple Range Test (DMRT).

Table 3. Effect of seed bed preparation method on the number of leaves in four yam landraces during 2013 and 2014.

	2013		2014	
Treatment	**Kuta**	**G/Kwano**	**Kuta**	**G/Kwano**
Planting (p)				
Heap	242.50a	260.42a	236.50a	255.00a
Ridge	209.67b	248.17b	196.58b	221.50b
S.E ± .	1.09	1.10	1.08	4.16
Variety (v)				
Kwasi	252.67b	293.33a	233.67b	287.33a
Laushi	275.33a	294.00a	268.83a	239.50b
Sule (Army)	203.83c	178.17c	199.67c	175.67c
Lagos	172.50d	251.67b	166.00d	250.50b
S.E ±	1.54	1.55	1.52	5.90
Interaction				
P × V	**	**	**	**

Means followed by the same letters are not significantly different at P ≥ 0.05 by Duncan Multiple Range Test (DMRT).

in (2013) and 2014 (Table 2), showed that the use of the heap method statistically differed on the vine length such that, the heap method of planting had the highest vine length at Gidan Kwano in 2013 than the ridge method, while this was reversed at Kuta location during this year of study. In 2014, at Kuta, the heap method maintained the highest vine length during this sampling period, while both factors were not significantly different in vine length at Gidan Kwano during this year.

Vine length differed significantly between the yam landraces. The use of Sule at Kuta in 2013 significantly produced superior vine length than the others, while Laushi, Lagos and Kwasi differed significantly in the vine length respectively. In 2013, at Gidan Kwano, Kwasi and Sule did not differ statistically in the vine length but were significantly superior to either Laushi or Lagos respectively. At Gidan Kwano in 2014 also, this trend of vine length produced was retained where Kwasi and Sule significantly had superior vine length than either Laushi or Lagos.

Effect of seed bed preparation methods on the number of leaves at Kuta and Gidan Kwano in 2013 and 2014 is recorded in (Table 3) revealed that, planting method differed significantly on number of leaves such that the use of heaps method of planting produced the highest number of leaves than the ridge method at both locations in each year. Leaf numbers differed significantly between the yam landraces in this trend. The use of Kwasi, Laushi and Sule at Kuta in 2013 and 2014 and at Gidan Kwano in 2013 significantly produced superior number of leaves than others, while Lagos variety at Gidan Kwano in 2014 statistically resulted to the best leave number than the others.

Effect of seed bed preparation method on the number of seed yam in four yam landraces at Kuta, Gidan Kwano and combined in 2013 and 2014 (Table 4) indicated that in 2013 at Kuta and combined data in 2014, the use of ridge significantly produced superior number of seed yam than the heap method. In 2013 at Gidan Kwano and combined data and as well at Kuta and Gidan Kwano in 2014, there was no significant difference in the number of seed yam.
At Kuta and its combined data of 2013, the number of seed yam did not differ significantly between the landraces, except in the case of Kwasi that was the least. At Gidan Kwano, Laushi significantly resulted to higher number of seed yam than Kwasi in which the latter was not statistically different from either Sule or Lagos landraces.

At Kuta in 2014, the number of seed yam produced was not significantly different between the landraces used. Also at Gidan Kwano in 2014, the use of Kwasi, Laushi and Lagos did not differ significantly in the number of seed yam produced except between Sule and Lagos while the use of Kwasi, Laushi and Lagos significantly produced superior number of seed yam than Sule variety. For the combined data in 2014, Sule significantly had the least number of seed yam while other landraces were not statistically different.

Effect of seed bed preparation method on the number of ware yam in four yam landraces at Kuta, Gidan Kwano and combined in 2013 and 2014 (Table 5) showed that planting method differed significantly in the number of ware yam such that the use of heap method of planting had the highest number of ware yam than the ridge method in both locations and combined data in each year of study except at Kuta in 2014 which were not significantly different.

The number of ware yam differed significantly between the yam landraces in this study. The use of Laushi at Kuta in 2013 produced better number of ware yam than either Kwasi or Lagos. At Gidan Kwano and combined data during this year, Laushi significantly had highest number of ware yam compared to others. However, the use of Lagos at Kuta and Sule at Gidan Kwano in 2013 resulted to lowest number of ware yam compared to other landraces while there was no significant difference between Kwasi, Sule and Lagos landraces in the number of ware yam produced for the combined data in 2013.

Table 4. Effect of seed bed preparation method on the number of seed yam in four yam landraces during 2013 and 2014.

	No. Seed yam			No. Seed yam		
			2013	2014		
Treatment	**Kuta**	**G/Kwano**	**Combined**	**Kuta**	**G/Kwano**	**Combined**
Planting (P)						
Heap	35.92b	39.08a	37.50a	41.50a	29.50a	31.17b
Ridge	43.75a	34.17a	38.96a	32.83a	34.00a	37.75a
S.E ±	2.32	2.41	1.53	3.21	2.82	1.67
Variety (v)						
Kwasi	31.83b	31.33b	31.58b	40.83a	33.50ab	37.17a
Laushi	39.83a	44.50a	42.17a	39.83a	32.00ab	35.92a
Sule (Army)	47.67a	36.50ab	42.08a	31.00a	24.67b	27.83b
Lagos	40.00a	34.17ab	37.08a	37.00a	36.83a	36.92a
S.E ±	3.20	3.41	2.17	NS	3.99	2.36
Interaction						
P × V	NS	NS	NS	NS	NS	*

Means followed by the same letters are not significantly different at P > 0.05 by Duncan Multiple Range Test (DMRT).

Table 5. Effect of seed bed preparation method on the number of ware yam in four yam_landraces during 2013 and 2014.

	No. Seed yam			No. Seed yam		
			2013	2014		
Treatment	**Kuta**	**G/Kwano**	**Combined**	**Kuta**	**G/Kwano**	**Combined**
Planting (P)						
Heap	8.83a	23.67a	16.25a	8.17a	14.33a	11.25a
Ridge	4.67b	7.92b	6.29b	5.33a	7.42b	6.38b
S.E ±	0.77	0.10	0.90	1.29	1.36	0.94
Variety (v)						
Kwasi	6.67b	13.00bc	9.83b	11.00a	11.83a	11.42a
Laushi	10.17a	23.67a	16.91a	10.33a	12.33a	11.33a
Sule (Army)	7.33ab	10.67c	9.00b	2.83b	8.33a	5.83b
Lagos	2.83c	15.83b	9.33b	2.83b	11.00a	6.92b
S.E ±	1.10	1.26	1.28	1.82	1.92	1.33
Interaction						
P × V	NS	**	*	NS	NS	NS

Means followed by the same letters are not significantly different at P > 0.05 by Duncan Multiple Range Test (DMRT).

At Gidan Kwano in 2014, there was no significant difference in the number of ware yam produced between the landraces. At Kuta and combined data in 2014, Kwasi and Laushi similarly produced significant number of ware yam than Sule and Lagos.

Effect of seed bed preparation method on the total number of tubers in four yam landraces at Kuta, Gidan Kwano and combined data of 2013 and 2014 (Table 6) revealed that, planting method differed significantly such that, the use of heap method significantly produced the highest number of tubers than the use of ridge method at Gidan Kwano while the factors were not significantly different at Kuta in this regard. In 2014, there was no significant difference between the factors in the total number of yam produced at both locations and combined data.

The total number of tubers differed significantly between the yam landraces. The use of Sule at Kuta in 2013 significantly had the highest total number of tubers than others while Laushi and Lagos landraces were the case at Gidan Kwano. In the combined data, Lagos and Sule significantly had superior total number of tubers than Kwasi.

At Kuta in 2014, Kwasi significantly resulted to superior total number of tubers than Sule in which the latter did not differ statistically between Laushi and Lagos but Lagos significantly produced total number of tubers than Sule at Gidan Kwano. In the combined data, Kwasi and Lagos significantly had higher total number of tubers than Laushi and Sule landraces.

Effect of seed bed preparation method on total tuber weight in four yam landraces at Kuta, Gidan Kwano and

Table 6. Effect of seed bed preparation method on the total number of tuber in four yam_landraces during 2013 and 2014.

Treatment	Total Number of tuber 2013			Total Number of tuber 2014		
	Kuta	G/Kwano	Combined	Kuta	G/Kwano	Combin
Planting (P)						
Heap	71.42a	71.33a	71.38a	58.25a	56.33a	57.29a
Ridge	71.17a	53.08b	62.23b	68.08a	51.17a	59.63a
S.E ±	3.80	2.02	2.13	3.58	3.90	2.74
Variety (v)						
Kwasi	66.00b	52.67b	59.33b	75.00a	58.17ab	66.58a
Laushi	67.83b	68.33a	68.0ab	62.83ab	52.67ab	57.75b
Sule (Army)	89.17a	57.83b	73.50a	52.00b	43.50b	47.75c
Lagos	62.17b	70.00a	66.08a	62.83ab	60.67a	61.75ab
S.E ±	5.37	2.85	3.01	5.07	5.52	2.74
Interaction						
P × V	NS	NS	NS	NS	*	

Means followed by the same letters are not significantly different at P > 0.05 by Duncan Multiple Range Test (DMRT).

Table 7. Effect of seed bed preparation method on the total tuber weight in four yam landraces during 2013 and 2014.

Treatment	Total Number of tuber 2013			Total Number of tuber 2014		
	Kuta	G/Kwano	Combined	Kuta	G/Kwano	Combined
Planting (P)						
Heap	16.05a	38.73a	27.39a	15.64a	24.80a	20.22a
Ridge	17.90a	17.41b	17.66b	17.68a	17.48b	17.58a
S.E ±	2.53	1.05	1.16	2.12	2.03	1.86
Variety (v)						
Kwasi	12.02b	24.78bc	18.40b	22.53a	21.20ab	21.87ab
Laushi	20.98ab	38.33a	29.66a	21.23ab	26.88a	20.06a
Sule (Army)	24.37a	22.08c	23.23ab	9.85c	13.40b	11.63c
Lagos	10.55b	27.08b	18.82b	13.06bc	23.07a	18.05b
S.E ±	3.58	1.49	2.28	2.99	2.87	1.86
Interaction						
P × V	NS	*	NS	NS	NS	NS

Means followed by the same letters are not significantly different at P > 0.05 by Duncan Multiple Range Test (DMRT).

Combined data in 2013 and 2014 (Table 7) depicts that, the heap method of planting did not differ significantly in the total tuber weight produced at Kuta in 2013 and also at Kuta and combined data in 2014. Also, the use of heap method significantly resulted to the highest total tuber weight than the ridge at Gidan Kwano and combined data in 2013 and this was similarly observed at Gidan Kwano again in 2014.

Equally, total tuber weight differed significantly between the yam landraces. The use of Sule at Kuta in 2013 statistically had superior total tuber weight than Lagos and Kwasi landraces while Laushi and Sule were not significantly different. Furthermore at Gidan Kwano in 2013, Kwasi significantly produced the highest total tuber weight than the other landraces used but Lagos and Kwasi were not significantly different. Consequently, the use of Lagos landrace significantly resulted in better total tuber weight compared to Sule. For the combined data in 2013, this similar trend of result was recorded in which Laushi had the highest total tuber weight than either Lagos or Kwasi landraces but there was no significant difference between Laushi and Sule.

In 2014 at Kuta, Kwasi had the highest total tuber weight than landraces Lagos and Sule but there was no significant difference between Kwasi and Laushi as well as between Lagos and Sule landraces too. Also at Gidan Kwano in 2014, the use of Laushi and Lagos significantly had superior total tuber weight than Sule variety but Kwasi was not statistically different between the landraces. In the case of combined data in 2014, the use of Laushi had the best total tuber weight than landraces of Lagos and Sule while Laushi and Kwasi did not differ significantly. However, the use of Sule produced the least total number weight compared to other landraces.

DISCUSSION

Yams like many other crops in Nigeria are labour intensive. The high cost of labour has been among the major constraints to yam production. It has constrained smallholder yam farmers from enhancing productivity (Ayanwuyi *et al.,* 2011; Migap and Audu, 2012). The labour cost of yam production from mounding to staking, especially in the forest areas account for approximately 40% of cultivation costs. In addition, about 50% of the expenditure goes to the planting process (IITA, 2009). In order to cut labour cost, most family members practically do all the production and marketing activities themselves (Ike and Inoni, 2006). Okeoghene *et al.* (2013) confirmed that over 65% of smallholder farmers used family labour in Delta State, Nigeria.

Some studies (Ayanwuyi *et al.,* 2011; Kleih *et al.,* 2012), stressed that low soil fertility, lack of improved yam varieties, poor road networks, high cost of labour and lack of finance to carry out necessary farming activities were the constraints to productivity.

The result obtained showed a superior number of mini sett sprouts in the use of heaps of planting than the ridge at Kuta location in 2013. This can be suggested to be due to the fact that, the heap method had higher raised and bulky seed bed than the ridge which could probably retained more moisture and better heat protection and hence, better sprouts. This agreed with the findings of Ijayah *et al.* (2006) who found significant variation on better mini sett sprouts on raised bed system than the use of ridge method.

The significant least number of sprouts observed in Kwasi at Gidan Kwano in 2013 and so too, in Laushi at Kuta and Sule at Gidan Kwano in 2014 might be attributed to inherent genetic difference in response to environment and the difference observed from the landraces in the study years could be due to seasonal effect. This is in consonant with Okezie and Nzekwe, (2009) who observed that sprouting depends on hormonal control and the recovery from dormancy would imply existence of sprout promoting hormone at the level that is optimal for bud break and hence sprout emergence.

The significant superiority of heap method of planting over the ridge in the vine length at Gidan Kwano in 2013 and at Kuta and Gidan Kwano in 2014 could be attributed to the better secured nutrients in the heap for plant growth. This agreed with the view of Ijoyah *et al. (*2006) who reported that the main problem encountered in ridge planting method of yam is the gradual wash down of the top tip ridge by rains which decreases the height of ridges. However, the superiority of ridge method in the vine length produced at Kuta in 2013 suggests better utilization of growth factors such as nutrient availability by the plant in this location of the year. This is in line with the findings of Ennin *et al.* (2009) who found ridging as a potential option to mounding for cassava and yam production.

In general, the significant superiority of Sule and Kwasi landraces in vine length in this study could probably be due to their potential genetic characteristics. This confirmed the work of Kambaka *et al.* (2009), who found that plant height (yam) significantly varied between landraces due to their genetic differences.

The significant highest number of leaves observed in the use of heap at Gidan Kwano in 2013 and 2014 though reversal at Kuta in 2013 could probably be due to the response to the specific location. In general, however, the use of heaps method produced superior number of leaves significantly can be suggested to be attributed to the cultivation type where heap provided a better suitable environment with plant needs such as minerals, moisture regime for growth and development. This finding is in line with that to Ijoyah *et al.* (2006), who observed that the use of raised seed bed provided more favorable growth conditions associated with the moisture retention and nutrients without any wash.The ability of landrace Laushi to produce superior number of leaves in 2013 and 2014 at Kuta location but Kwasi at Gidan Kwano in 2014 suggests varietal response to different environment. This result is similar to the findings of Linus, (2003), who found that the yield of yam depends on location, variety and cultivation practices.

The highest significant number of seed yam recorded in the ridge method at Kuta in 2013 and combined in 2014 might be attributed to the differences in seed bed structure. This finding is similar what Ijoyah *et al.* (2006), reported that higher percentage of seed yam was recorded on the use of ridge system than the raised bed.

The response of variety on the number of seed yam indicated the superiority of landraces Laushi, Sule and Lagos at Kuta in 2013 while Kwasi landrace which was the least compared to landrace Laushi at Gidan Kwano suggests the varietal genetic potentials to produce seed yam. The consistent superiority of landrace Lagos at Gidan Kwano in 2014 as well as Kwasi, Laushi and Lagos landraces for the combined data is an indication of their ability to consistently produce seed yam. The result is in line with Adeniyan and Owolade, (2012) who observed that some genotypes of yam that consistently produced seed tuber and the genotypes differed significantly in the yield of seed tubers.

The ability of heap method of planting to produce superior number of ware yam at both locations and the combined data could be attributed to the difference in seed bed structure in which heap provided deep loose soil that enhanced better initiation and easy penetration of tubers than the ridge method. This result disagrees with what Ennin *et al*. (2009), found that yam yields on mounds and ridges were statistically not different with respect to tuber weight and fresh tuber yield.

The superiority of landrace Laushi in the number of ware yam at both locations and combined data in 2013 and as well consistently landrace Laushi and Kwasi at Kuta and combined data in 2014 can be attributed to the inherent

genetic characteristic of the landraces to produce heavy tubers (ware tubers). The result is in agreement with that by Adeniyan and Owolade, (2012) who found 3 landraces of yam that consistently produced highest ware tubers suggesting relatively stable yield performance.

The ability of the heap method of planting and combined data to produce superior total number of tubers at Kuta in 2013 could be due to the cultivation method and the location. This result agrees with the reported of Ijoyah *et al.* (2006) who said that raised bed system improved total tuber number by 24% compared to ridge and that it could also be due to the bed structure that had simple depth of loose fertile soil for tuber and root penetration and not readily washed during the course of season compared to ridges.

The superiority of the Sule at Kuta and Laushi cum Lagos landraces at Gidan Kwano in the total number of tubers in 2013; Kwasi at Kuta and Lagos at Gidan Kwano in 2014 suggests varietal response to location while the Sule and Lagos landraces superiority in combined data in 2013 and Kwasi 2014 depicts their general ability to produce high number of tubers genetically. The result is similar to the findings of Ajayi *et al.* (2006) who stated that the highest mean yields of yam differ with location and that, the critical nutrient requirement for the crop is location specific.

The ability of heap method of planting to produce the highest total tuber weight at Gidan Kwano and combined data in 2013 and as well heap at Gidan Kwano in 2014 could also be attributed to the use of heap method that has ability to keep nutrient intact for plant use which could have influenced tuber formation. This is also similar with that by Ijoyah *et al.* (2006) who reported that raised bed produced improved total tuber number significantly than the use of ridge.

The varietal response to total tuber weight indicated the superiority of landraces Sule at Kuta, Laushi at Gidan Kwano as well as Laushi in combined data in 2013 with Kwasi at Kuta, Laushi at Gidan Kwano and again Laushi in combined data maintaining the superiority in 2014 could be attributed to genetic differences in the landraces particularly Laushi variety with the ability to produce heavy tubers. This result is in agreement with Angus *et al.* (2012) found that the yield and yield components of different yam genotypes differed significantly in number of seed tubers; ware tubers and total tuber yield due to genetic differences.

Conclusion

The use of the heap method of planting significantly produced higher number of sprouts. The number of sprouts was more in 2013 than in 2014. In the ridge method of planting, a higher vine length was found (a little more than the heap method at Kuta), this may not be attributed to the types of planting method but rather the weather type. Heap method significantly produced superior number of leaves than the ridge at both locations in 2013 and 2014. The numbers of seed yam produced were not statistically different between the planting methods except at Kuta in 2013 and in the combined data of 2014. The use of the heap method resulted in superior number of ware yam at both locations and in the combined data. The planting methods did not differ significantly in the total number of tubers produced except at Kuta and in the combined data of 2013, (the use of heap method had higher total number of tubers than the ridge method). The use of heaps significantly produced superior total tuber weight at Gidan Kwano and combined data than the ridge in 2013 and in 2014.

Authors` declaration

We declare that this study is an original research by our research team and we agree to publish it in the Journal.

REFERENECES

Adeniyan ON, Owolade OF (2012). Comparative performance of improved white yam (*Dioscorea rotundata*) genotypes in the rainforest belt of South-west Nigeria**.** Int. Res. J. of Agric. Sc. and Soil Sci .2(4), pp. 127-132.

Ajayi SA, Beriak P, Kioko JI, Dulloo ME, Vodouhe RS (2006). Response of fluted pumpkin (Telfeiria occidentalia Hook f.; Curcubitaceae) seeds to dessication, chilling and hydrated storage. South African Journal of Botany 72: 544-550.

Angus N, George E, Lawrence K (2012). Evaluation of yield productivity and economic returns of some yam (*Dioscorea esculenta* (Poir) Genotypes grown in a Kaolinite utisol. *J of Biol, Agric and Health care*.2(6):provide page number

Ayanwuyi E, Akinboye AO, Oyetoro JO (2011). Yam production in Orire local government area of Oyo State, Nigeria: farmers perceived constraints. World Journal of Young Researchers, 1(2):16–19.

Bolarinwa KK, Oladeji JO (2009). "Adoption and Relevance of Yam Minisett Technology Practices to Farmers Indigenous Practices in Rain Forest and Derived Savannah Zones of Nigeria" *J. App. Sci. Res.*, 5(12): 2461-2465.

Ennin SA, Otoo E, Tetteh FM (2009). Ridging, a mechanized alternative to moulding for yam and cassava production. West African Journal of Applied Ecology, 15:1-8.

Ike PC, Inoni OE (2006). Determinants of yam production and economic efficiency among small-holder farmers in South-eastern Nigeria. *J. Cent. Euro. Agric.* 7(2): 337–342.

IITA (International lnstitute of Tropical Agriculture) (2009). Research to Nourish Africa news and Events. Global initiative underway to preserve yam Biodiversity.

pp.1-6. Retrieved from IITA Website http:// www.iita.org/publications.

Ijoyah MO, Aba J, Ugannyan S (2006). Effects of seedbed types on yam-mini setts yield: A Case study of Ushongu Local Government area of Benue State of Nigeria. Afr. J.Biotechnol.5 (22): 2091 .

Kleih U, Phillips D, Mignouna D, Ogbonna M Siwoku B (2012). Yam improvement for income and food security in West Africa, Nigeria: scoping yam value chain analysis. Ibadan: IITA. Retrieved from http://bit.ly/1mrhbrr.

Lawrence K (2006). Up-scaling sustainable"*clean"* seed yam production systems for small scale growers in Nigeria. United kingdom Department for International Development, R8416(2a06 48) crop protection programme. *Final Technical Report*. pp.1-2.

Linus UO (2003). Yams: Post – harvest operation Edited by AGST/FAO: FAO(Technical) .Pp 5-7.

Migap JP, Audu F (2012). Empirical study on yam cultivation and economic development of Taraba State: Case study of Wukari local government area. Journal of Business and Organizational Development, 4: 32–52.

Mkpado M, Onuoha C (2008). Indigenous Knowledge as Sources of Low Input Agricultural Technologies in Sub Sahara Africa: Nigerian Experience. Inter. J. Rur. Stud. 15 (2): 2-8.

Nweke FI, Ugwu BO, Asiedu R (1991). Production costs in yam - Based cropping system of southern Nigeria. Resource of Crop Management Programme (RCMP) Research Monogram No.6 IITA, Ibadan, Nigeria. Pp. 29.

Oguntade AE, Thompson OA, Ige T. (2010): Economics of Seed. Yam Production using mini sett techniques in Oyo State, Nigeria. *The Journal of field Actions* Vol.4/2010.

Okeoghene ES, Egbodion J, Ose OO (2013). Profitability Analysis of Yam Production in Ika south local government area of Delta State, Nigeria. Journal of Biology, Agriculture and Healthcare, 3(2): 118–130.

Olubukola AA, Bolarin TO (2006). Production efficiency in yam based enterprises in Ekiti State, Nigeria. Journal of Central European Agriculture, 7(4): 627–636.

Okezie CEA, Nzekwe U (2009). The synergistic effect of gibberellic Acid and indolebutyric acid on multiple sprout formation and early seedling establishment from *Dioscorea rotundata* Poir mini setts, *Nigeria Journal of Botamy,* 22 (1):129 -146.

Onwueme IC, Hamon P (2002). *Dioscorea cayenensis* Lam. (Internet) Record from Protabase. Oyen, L.P.A and Lemmens, R.H. M..J (Editors) PROTA (Plant Resources of Tropical Africa) Wageningen Netherlands

http.//data base prota.org/search.htm. Accessed ,9th April,2012.

Osunde ZD (2008). Minimizing Post harvest losses in yam (Dioscorea spp): Treatments and Techniques. Chapter 12 from using Food Science and Technology to Improve Nutrition and Promote National Development, Robertson, G.C and Lupien, J.R (Eds). *International Union of Food Science and Technology* (2008).

Pursegolve JN (1985). Monocotelydon: Vol.1 and 2 combined. ELSB Edition, Produced by Longman, Singapore Publishers. pp 97-108.

Riley CK, Wheatley AO, Asemota HN (2006). Isolation and characterization of starches from eight *Dioscorea alata* cultivars grown in Jamaica. Afr. J. Biotechnol. 5 (17):1528-1536.

Stephen M (2009). Potential for clean seed yam production by resource poor farmers in the middle belt of Nigeria. Partly funded by the Department for International Development (DFID) of the UK (ZA0566). pp.3-9.

Thomas NB, Andre M, Domini N (2007). Technology guide for the production and conservation of yams (Dioscorea spp) Cameroon, Ministry of Agriculture and Rural Development, National Programme for Roots and Tubers Development. Pp.10-17.

Tsado EK (2012). Substituting Wooden sticks with plastic stakes in yam production in Niger State Nigeria. J. Nat. Sci. Res. 2 (9) pp.88-89.

Zaknayiba DB, Tanko L (2013). Costs and returns analysis of yam production among small scale farmers in Karu local government area, Nasarawa State, Nigeria. PAT, 9(1), 73-80.