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EFFECT OF PLANT DENSITY AND LAND RACE ON THE GROWTH AND YIELD OF SWEETPOTATO IN NORTHERN GUINEA SAVANNA OF NIGERIA

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ABSTRACT
Field study was conducted at National Root Crops Research Institute out station Nyanya Research farm located at Zhewun Jidna Nasarawa State during 2007 and 2008 cropping seasons. The aim was to determine the effect of optimum plant population Density of sweet potato land races under improved management condition. Three Land races or Local varieties known locally as Katsina, Kunkudu, Dunku and TIS 87/0087 an elite variety that served as a check were used for the trial. The populations evaluated were 50, 000, 40,000, 33, 333, and 28,570, Plants ha$^{-1.}$ In both years result showed that Katsina gave the highest root yield of 42.0 and 26.8 t/ha, followed by the check variety TIS 87/0087 34.98 and 24.03 t/ha. This was not different statistically (p< 0.05) in both years. Also 50,000 plants ha^{-1} gave the highest root yield across board. But in 2007,TIS 87/0087 gave the highest top yield at 50,000 plants ha^{-1} followed by 40,000 plants ha$^{-1.}$ In almost all other parameters evaluated the land race or Local variety Katsina out yielded the check variety and the other land races. It can be concluded that land races or Local varieties under improved management have capacity of out yielding some elite verities. The population of 50,000 plants ha $^{-1}$ is recommended for higher root yield, while either 40,000 or 28750 plants ha^{-1} is recommended for any other farmers need other than root yield especially when there is scarcity of planting materials.

Key words: optimum plant density sweet potato landraces and yield.

INTRODUCTION
Sweet potato (*1pomoea balatas* (L) Lam) is one of the most widely grown root crops in the world. It has the ability to produce high yields in marginal soils with little investment (Horten et al, 1989). It is a short duration crop and can be eaten in various food forms. In Nigeria sweet potato is produced virtually in every part of the country but predominantly in the Northern Guinea Savanna where many land races or Local varieties are abound. Many factors militate against the production of this crop that recently assumed the front burner. About 63% of agricultural soils in Nigeria are low in productivity and over 90% are alfisols and ultisols which are low in organic matter and have low activity clays. Enwezor et al (1989).In North central Nigeria, large quantities of sweet potato is produced by small scale farmers. In this zone farm yield is low due to poor agronomic practices and their fervent adherence to local varieties or Land races. Increased productivity can be achieved using high yielding verities (De Silva, 1995, cross man 1998, Gichuki et al,1998). Adequate plant population has been reported by several scientists to be of advantage in crop production Namo et al (2006). Omoshere et al (2006), Kalu and Adeyemi (1988) all reported that plant population density is a major factor that influenced growth and yield of sesame. verital responses vary in sweet potato. (Onunka and Nwokocha 2003). Tabo et al (2002) observed that the performance of crops can improve through plant populations densities and use of early maturing varieties. Improved management includes proper land preparation, optimum plant population, recommended fertilize application rate and timely harvesting. Therefore the objective of this

research work was to determine the optimum population density of these land races or Local varieties using TIS 87/0087 as a check, when planted under improved management.

MATERIALS AND METHODS

The field experiment was carried out in 2007 and 2008 at the Nyanya substation of National Root Crops Research Institute. It is located at lat 09^0 40^{11} and long. $07^0 37^1$ East with an altitude of 426m above sea level. The soil is classified sandy loam with other physical and chemical characteristic as indicated in table 1. The land was ploughed harrowed and ridged. The treatments composed three land races or Local varieties from the area namely Kunkudu, Katsina, Dunku with an elite variety TIS87/0087 and four population densities of 50,000, 40,000 33,333 and 28570 plants ha^{-1}. The sixteen treatments were laid in a factorial fashion of randomized complete block design (RCBD) and replicated three times. Plot size was 6m x 3m with an inter row of 1m spacing. Fertilizer rate of 600kg NPK h a^{-1} was applied at 4WAP, weeding was manually done. The trials were harvested after five months each year. From the middle row in each plot, data were recorded on total root yield, top yield, and average number of roots per stand saleable root weight. The Sweetpotato enlarged underground roots were harvested after five months each year using digging fork according to treatments. The corresponding yields in tons ha^{-1} were determined and analyzed using Gen stat (2007) edition

RESULTS AND DISCUSSION

The physical and chemical properties of the experimental area

There was no significant difference in both physical and chemical properties of the soil in the experimental area during the two cropping season, Table 1. The areas were both of high base saturation, available phosphorus, and the pH in water was slightly acidic. The effective cation exchange capacity and organic matter were low. All the exchangeable cations were as well, low indicating the soil to be of low activity and prone to positive response to fertilization. The soil was classified as sandy clay loam

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Root Yield

In 2007 results showed that the local variety Katsina gave the highest mean root yield of 42t/ha followed by the check variety TIS 87/0087, these yields were significantly different $P \leq 0.01$. The next were Kunkudu and Dunku. The mean root yield from the different population densities were statistically significant. Population density by local variety interaction was very highly statistically significant. $P \leq 0.001$. In 2008 also the local variety Katsina gave the highest mean root yield of 26.8t/ha closely followed by the check variety TIS 87/0087 table 2. The yield difference between Katsina and TIS 87/0087 was not statistically significant $P \leq 0.05$. The population density of 50, 000 plants ha^{-1} gave the highest mean root yield (20.47) t/ha) followed by 40,000 plants ha^{-1} (18.2 t/ha), the least was 28,570 plants ha^{-1} but they were not statistically different from each other. Similar trend was observed in 2007. In both years the local varieties out yielded the check variety, this implies that with efficient management practices the full genetic potential of the local varieties can be obtained. In 2007 and 2008, 50.000 plants ha^{-1}gave the highest mean root yield, this result is in line with findings of Ojikpong et al 2007Funnah and Matsebullar (1984) where maximum yields are obtained at a closer spacing.This according to the authors have been attributed to better water utilization, less evaporation , better weed control through canopy shading, better radiant energy utilization, increased photosynthesis and increased leaf production. The result differs from the work of Ikeorgu (2003) where neither size nor spacing (density) affected seed yam yield. A similar scenario was recorded by Nwokocha at al (2000) where spacing (population density) of elite Sweetpotato varieties did not affect root yield.

Top yield

In 2007 the population density of 50,000 plants ha $^{-1}$produced the highest top yield of 43.2 t/ha, followed by 33,333 plants ha $^{-1}$(41.8/ha) the next was 40.000 plants ha $^{-1}$(36.2 /ha) while the least was 28,570 plants ha $^{-1}$ with a yield of 34.0 t/ha, Table 3. The result also showed that TIS 87/0087 gave the higher top yield followed by the local variety Kunkudu while the least was Katsina. The highest yield of TIS87/0087 was produced by the population density of 50, 000 plants ha $^{-1}$ while the lowest (katsina) was at the population density of 28, 570 plants ha $^{-1.}$ The mean yield of Kunkudu and Katsina were significantly different ($p<0.05$) from the yield of TIS 87/0087. In 2008 a different trend was observed

The top yield was generally low amongst all the population densities and the varieties. 40, 000 plants ha $^{-1}$gave the highest top yield of 25.1t/ha followed by 50,000 plants ha $^{-1}$which yielded 23. 5t/ha. The variety Katsina also produced the highest top yield of 24.7 t/ha followed by both Kunkudu and Dunku (22. 2t/ha) each. The highest top yield of 28.6t/ha by the variety Katsina was produced at the population density of 40,000 plants ha $^{-1.}$Though the yield trend was at variance with each other in the two cropping seasons, it is worthy of note that differences between the yield of the check variety and the mean yield of some of the local varieties did not differ significantly, (46t/ha for TIS 870087 and 45.9t/ha for Dunku in 2007) while the local variety Katsina out yielded the check variety in 2008.The top yield is an essential part of the crop as it serves as fodder in areas of dorminant livestock production. The livestock farmers sustain their herds during the food scarcity period with the top yield. The local varieties have the capacity of large top yield production which can be of added advantage as they can be used to control both erosion and weed.

Average Root Number per Stand

The average root number per stand of the local varieties as influenced by different population densities is shown in Table 4. In 2007 the population density of 33, 333 plants ha $^{-1}$ gave the highest average number of roots per stand (3.93), followed by 40, 000 plants ha $^{-1}$(3.42) the least was produced by a population density of 50,000 plants ha $^{-1.}$The local variety Katsina produced the highest average number of roots per stand, (4.60) followed by Kunkudu by (4.06). The least was produced by the check variety TIS 87/0087.In 2008 the average root number per plant was low compared to 2007. The effect of population density and the variety was very highly significant $P< 0.001$. The local variety Katsina produced the highest average number of roots per plant (2.9) followed by Kunkudu (1.52) the check variety TIS 87/0087 produced the least. The number of roots per stand of the crop is an indication of yield increase. The production of higher average number of roots per stand by the local varieties than the check variety implies that roots may not be too large or bulky. This may be of advantage as bulky roots are more difficult to store or package for export than the smaller but saleable ones. Similarly too Ngeve (1991) reported that such is a desirable attribute for breeding activity. It would have been expected that lower population density would have produced fewer average number or roots per stand but this was not the case. This result is similar to the observations of Ikeorgu (2003) in his study of the effect of size and spacing (Population density) of mini tubers on the yield of selected yam tubers where neither size nor spacing significantly affected seed yam yield. Similarly too there was no significant interaction between (population density) and variety as was also observed in this work.

Saleable Root Weight

The saleable root of the local varieties as influenced by population density is shown on table 5. In 2007 the result showed that the population density of 28,570 plants ha $^{-1}$ gave the least mean saleable root weight of 90.68t/ha, this was followed by 33,333 plants ha $^{-1}$ with a yield of 29.52 t/ha, the least was 26. 77 t/ha for 50,000 plants ha $^{-1}$ while the least was obtained

from 40,000 plants ha $^{-1}$.The yield from 28,570 plants ha $^{-1}$ was significantly different from other population densities. The check variety TIS 87/0087 produced the highest mean saleable root weight(44. 95 t/ha) the next was Dunku (33. 435 t/ha) while least was Kunkudu with a yield of 23.45 t/ha. The yield was statistically significant at $P \leq 0.01$. The interaction between the population density and the varieties were also highly significant $P \leq 0.001$. Both Kunkudu and the check variety TIS 87/0087 produced the highest saleable root weight at the population density of 28,570 plants ha $^{-1}$ while the least mean saleable root weight was produced at the population of 33.33 plants ha^{-1} across all the varieties .In 2008 the yield was low, with the population density of 33.333 plants ha $^{-1}$producing the mean saleable root weight (21. 9 t/ha) followed by 50,000 plants ha $^{-1}$(19.6 t/h) 40,000 plants ha^{-1}(17. 6 t/ha), 28,570 plants ha $^{-1}$producing 15.3 t/ha. This was a complete reversal of 2007 result. The local variety Katsina produced the highest mean saleable root weight (28.8t/ha) followed by the check variety TIS 87/0087 (22.7 t/ha), the least was obtained from Kunkudu. The effect of both population density and varieties were significant at $P \leq 0.01$including their interactions. Saleable roots are those that weigh more than 100g while those that weigh less than 100g are regarded as unsalable.(levett 1993) In 2007 the difference in mean saleable root weight of check variety and the one of the local varieties was not statistically significant, and in 2008 the local variety out yield the check variety significantly. This can be attributed to the afore mentioned management practices.. The smaller plant population density producing highest mean saleable root weight is contrary to the result obtained by Funnah et al (1984) probably because they used cereal as their test crop while this was root crop. The result also differed from the result obtained by Nwokocha et al (2002) earlier quoted because of the improved management practices. The local varieties have the potential to attain the same yield level as improved varieties if improved management practices are applied. This can lead to increased food production which ensures food security.

CONCLUSION AND RECOMMENDATIONS

From this work it can be seen that improved management practices play a role in obtaining optimum yield of sweet potato local varieties where they are available. Katsina performed better in mean root number per stand, and total root yield in 2007 and 2008, than the check variety TIS 87/0087. It appears also that different population densities favour different yield parameters which implies that farmers desire should guide her choice of plant density in planting local varieties however from this work 50,000 plants ha $^{-1}$ is recommended.

Table 1: Physical and chemical properties of the experimental area

Particle size distribution	2007	2008
Sand	55.8	59.5
Silt	10.00	11.2
Clay	35.2	29.3
Exchangeable cations (cmol/kg)		
Ca	2	2.3
Mg	2.8	2.6
K	0.10	0.9
Na	0.17	0.18
Ea	2.4	2.1
EcEc	7.47	7.40
Available P(cmg/kg)	42.0	40.0
Organic carbon (%)	0.89	0.57
Organic matter (%)	1.53	1.54
Base saturation (%)	67	69
PH (H_20)	6.46	6.53
Textural class	sandy clay loam	sandy clay loam

Table 2: Effect of plant density and Local Varieties on root yield (t/ha) of Sweet potato in 2008and 2009 cropping seasons.

Variety

	2007					2008				
Plant Density (t/ha)	**Kunkudu**	**Katsina**	**87/0087**	**Dunku**	**Means**	**Kunkudu**	**Katsina**	**87/0087**	**Dunku**	**Means**
50,000	11.1	39.9	39.1	21.7	27.95	13.5	35.3	24.6	8.5	2047
49000	15.4	47.8	32.2	8.8	26.1	10.8	29.6	25.0	7.2	18.2
33,333	11.6	40.4	37.8	8.2	24.5	11.2	17.9	18.8	23.6	0.9
28570	12.24	40.0	30.8	8.9	23.0	6.6	24.5	27.7	5.5	16.08
Mean	12.6	42	37.7	11.9		10.5	26.8	24.03	112	
SED D	4.38					3.95				
SEO V	438					3.95				
SED DXV	8.75					7.90				

Table 3: Effect of plant density and local varieties on top yield (t/ha) of Sweet potato in 2007 and 2008 cropping seasons.

Variety

	2007					**2008**				
Plants Density t/ha	Kunkudu	Katsina	87/0087	Dunku	Means	Kunkudu	Katsina	87/0087	Dunku	Means
Grow t/ha	33.2	26.1		55.5	58.1	43.2	23.2	20.3	31.3	19
40,000	33.2	31.8	45.1	34.7	36.2	24.5	28.6	21.2	25.9	25.1
33,333	25.7	40.6	41.3	57.6	41.8	18.1	26.8	17.0	23.2	21.3
28750	37.4	25.5	42.1	31.0	34.0	22.9	23.2	15.9	20.2	20.6
Means	32.4	31.0	46.0	45.9		22.2	24.7	21.4	22.2	
SED D	5.23					6.15				
SED V	5.23					6.15				
SED D xV	10.46					12.30				

Table 4: Effect of plant density and local varieties on Average root number per stand of sweet potato in 2007 and 2008 cropping seasons.

	VARIETY									
	2007					**2008**				
Plant density tlha	**Kunkudu**	**Katsina**	**87/0087**	**Dunku**	**Means**	**Kunkudu**	**Katsina**	**87/0087**	**Dunku**	**Means**
50.000	4.10	4.07	2.17	3.00	3.33	1.817	2.78	0.85	1.11	1.47
401000	4.00	4.67	23.33	2.67	3.42	1.39	2.43	1.07	1.03	1.46
33,333	4.47	5.33	2.53	3.37	3.93	1.99	3.01	0.91	1.36	1.82
28570	3.67	4.33	2.10	2,93	3,26	1.52	1.39	1.35	1.17	1.86
Means	4.06	4.60	2.28	2.99		1.52	289	1.03	1.17	
SED D	0.31					0.17				
SED V	0.31					0.17				
SED D xV	0.62					0.34				

Table 5: Effect of plant density and local variety on saleable root weight (t/ha) of Sweet potato in 2008 and 2009 cropping seasons

	VARIETY									
	2007					**2008**				
Plant density (t/ha)	**Kurudu**	**Katsina**	**87/0087**	**Dunku**	**Means**	**Kurudu**	**Katsina**	**87/0087**	**Dunku**	**Means**
50.000	10.8	48.9	28.7	18.7	26.77	12.7	34.1	24.4	7.2	19.6
40.000	10.2	47.3	28.8	5.5	22.95	10.0	28.7	25.0	6.5	17.6
33.333	6.8	18.0	35.3	58.0	29.52	10.5	26.2	18.7	32.0	21.9
28,570	66	58.0	87.05		90.68	8.2	25.4	22.7	5.0	15.3
Means	23.45	43.05	44.95	33.48	65.67	10.3	28.6	22.7	12.7	
SED D	5.46					3.11				
SED V	5.46					3.11				
SED DxV	10.92					6.22				

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