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EFFECTS OF SETT SIZE ON THE FIELD ESTABLISHMENT, GROWTH FRESH TUBER YIELD AND YIELD RELATED ATTRIBUTES OF WHITE YAM (Dioseora rotundata)

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Abstract: The work to investigate the effect of sett sizes on the field performance of white yam (Dioseorea rotundata) was done in Delta State Polytechnic Demonstration farm, Ozoro between March, 2016 and September 2016. Sett sizes classified into six groups/classes (2.0-5.0g), (5.01-10.0g), (10.01-20.0g), (2.01-30.0g), (30.1-40.0g) and (40.01-50.0g) were used in the experiment. The result indicates that no significant difference exist in average tuber size among three different classes: (2-5.0g), (5.01-10.0g) and (20.01-30.0g). thus it is recommended that sett class of 2.0-5.0grams should be used for multiply seed yam production technology under adequate cultural management.
Keywords: Sett, Class, Adequate, Management.

INTRODUCTION

Yam (dioscorea) is an important food source especially in rural communities. It is a tuber crop belonging to the family (Dioscreacea). Yam has many species and the species of economic importance include Dioscorea rotundata. D. alata, D. cayenerisis, D, dumetorum, D, bulbifera, and D. esulenta. D. rotundata also known as white yam is the most widely cultivated. Yam is an excellent crop for food security because of its storage properties. It can be stored four to six months without refrigeneration and it provides an important food safety net between growing seasons. As food, yam plays an important role by producing cash and dietary carbogydrate to millions of people. In 2012 world production of yam was estimated at 58.7 million tons with West Africa producing more than 92 percent (FAO, 2014). Despite large quantity produced in West Africa, there is no formal seed yam production to take care of farmers need. Yam is cultivated or propagated by seed yam, setts, or whole tuber yam has low rate of multiplication so increasing the production is a major challenge to the farmers. Hence availability of large quantity of yam propagation materials is one of the major challenge faced by new yam farmers. The easiest way of acquiring large number of planting materials is through the use of yam setts. It has been shown that any piece of healthy yam containing the periderm can be made to sprout and grow to yield a tuber. In the mini sett technology, however, effort is to obtain sizeable seed yams (greater than 200g) from small setts. In studies to determine the optimum sett size for seed yam production Igbokwe and Okoli (2012) evaluated 4 sett sizes (15, 30, 45, and 60g) and 3 widths of periderm 2,3 and 4cm) using 2 cultivars from 2 yam species. Results showed that the bigger the sett size, the higher the yield both in total tuber weight and in the percentage of saleable tubers (weighing more than 200g).

An attempt to investigate the effect of sett size ranging from 2.00g to 50.0 gram prompted this study. Therefore this study is initiated based on the following objectives.

i. To identify the effect of various sett sizes (ranging from 2.0g to 50.0 grams on field establishment, growth, fresh tuber yield and yield related attributed of white yam.

ii. To identify the best sett sizes range suitable for white yam farming economically.

Materials and Methods

Micro setts of white yam ranging between 2.0 – 50 grams were divided into six size classes. (2.0-5.0), (5.01-10.00g) (10.01-20.00g) (20.01-30.0g) (30.01-40.0g), (40.01-50.0g) and were nursed for 4 weeks to sprout before they were transplanted into the field. Sprouted propagates of the six size classes were transplanted in the field using a randomized complete block design in four replicates between March 2016 September, 2016, in Delta State Polytechnic, Ozoro. The soil used was sandy loam texture acidic soil. The physical and chemical properties of the soil are shown in table 1a and 1b respectively. The transplanting was done on ridges through plastic – strip mulch at a spacing of 1.25 m x 0.30 n and a depth of about 5 cm. The planting holes were made with sharpened wooden-splinters. Total plot size was 7.2 m x 1.25 m. Twenty-five plantlets were used per experimental unit. One transplanting row was used per ridge and the experimental plants were bordered by other yam plants growing under plastic mulch.

Table 1: Physical Characteristics of the soils

Depth	Gravel	Mechanical Analysis			Penetro-meter reading kg cm-[2]	Bulk Density g cm-[3]	
		Sand	Silt	Clay		Overall	Fine earth
0-25	9	71.0	11.7	17.3	0.50	1.48	1.46
25-50	44	71.0	11.7	17.3	2.25	1.45	1.25
50-62	60	80.6	6.1	13.3	4.50	1.62	1.32
62-72	50	76.6	7.1	16.3	4.50	1.66	1.08
72-115	35	58.2	5.4	36.4	4.10	1.65	1.45
115-115	14	49.2	13.4	37.4	3.90	1.70	1.61

Source: Field 2015

Table 1b: Chemical Properties of the soils **Table 1b: Chemical Properties of the soils**

Depth	Exchangeable cations me/100g								CEC me/100g	Organic C	Total N%	Bray p 1 ppm
	H_2O	KC1	Ca	Mg	K	Na	Mn	A1				
0-25	6.5	5.8	3.7	1.0	0.17	0.08	0.01	0.13	5.68	1.34	0.102	5.4
25-50	6.5	5.9	2.12	0.5	0.1	0.07	0.05	Nd*	3.34	0.44	0.033	3.6
50-62	6.3	5.6	1.15	0.25	0.04	0.04	0.02	0.01	2.00	0.19	0.017	4.2
62-72	6.3	5.5	1.45	0.33	0.05	0.05	0.02	Nd	2.50	0.22	0.017	5.8
72-115	6.3	5.3	2.32	0.54	0.05	0.01	0.02	3.47	3.47	0.30	0.025	2.3
115-155	6.3	5.3	2.35	0.58	0.04	0.04	Nd	0.01	3.52	0.13	0.025	2.5

*nd – not detectable; Source: field 2015

The plastic mulch, which had thickness of 0.048 mm, was grayish – white on one side and black on the other. It was laid over the ridges prior to transplanting after a heavy downpour, with the grayish side uppermost. The use of the plastic mulch with regard to the mini setts effectively controlled weed growth and maintained a relatively higher soil moisture content, even at harvest. (Haln 2010). The plants were not staked.

Three month after transplanting, three whole plants were randomly sampled from each plot for Growth Analysis determination. Consequently, counts were made of plants with totally senesced shoots for all the treatments at 4 MAT. The tubers were harvested at 5 MAT by means of iron – diggers using effective plot sizes of 5.7 m x 1.25 m.

(a) Data Management

Growth

The following attributes were derived:

i. Harvest index, (H.I)----- ratio of the tuber dry weight to that of the whole plant.

ii. Relative shoot dry matter (Rsdm)------ ratio of the shoot dry weight to that of the whole plant.

iii. Leaf dry matter content----- ratio of leaf dry weight to its fresh weight, expressed as a percentage.

(b) Harvest

1. Counts of senesced plants at 4 MAT and surviving plants at harvest (Psh) were expressed as percentages. Other attributes considered were:
2. Average tuber sizes (As)........ quotient of the total fresh tuber yield and the total number of tubers
3. Average tuber size: sett size ratio (S) quotient of the average tuber size harvested and the average sett size planted.
4. Number of tubers per plant (Tnp) and per hectare (Tnh).
5. Total fresh tuber yield (Ty) was expressed in tones (t) per hectare (ha).

Statistical Analysis

All the data generated were subjected to analysis of variances. The LSD test was used to compare pairs of treatment means of varieties for which the variables ratio was significant.

RESULTS AND DISCUSSION

Growth

There was a marked inverse relationship between the shoot relative dry matter, (Rsdm), and Harvest index,(H1) as shown in table 2

Table 2: Effects of Sett Size on the Growth of White Yam

Sett Size class (g)	Number of leaves per plant	Leaf dry matter (%)	Relative shoot dry matter (%)	Harvest index
2-5	204	18.1	65	0.35
5.01-10	123	18.7	65	0.35
10.01-20	147	16.7	57	0.43
20.01-30	196	18.8	30	0.70
30.01-40	171	19.7	34	0.66
40.01-50	223	25.6	39	0.61
LSD 5%	N.S	5.0	14.0	0.14

Whilst Rsdm decreased with increasing sett size with a minimum value of 30% at the 20.01-30g sett class the H1 increased with sett size, peaking at the 20.01-30g (table 2). Besides the trends described above, two significantly dissimilar group for both Rsdm and H1 were evident (table 2). Group 1 comprised the 20.01-30g, 30.01-40g and 40.01-50g and group II comprises of 2.0-5.00, 5.01-10.00 and 10.01-20.00g.

Within these broad groups, the Rsdm and H1 were not really different. The subcomponents of Group 11 produced significantly lower H1 values than those of the Group 1 (table 2). This increase in tuber bulking ability (H1) with sett size could be attributed to earlier tuber initiation by the large setts (Ferguson et al, 2014). Furthermore, according to Onwueme (2013) large setts produce more vigorous sprouts, leading to greater photosynthetic activity. It is evident from table 2 that the 40.01-50g setts had significantly greater leaf dry matter content than all the rest, possibly a reflection of the relatively higher photosynthetic activity. However, the retention of assimilates in the shoots of the plants derived from these setts is lower than those of the Group II setts.

There were no real difference among the treatments in number of leaves per plant (Table 2). Moreover, with the similarity in leaf dry matter values among the sett classes, beside that of the 40.01-50g, it is suggestive that the intra-shoot competition for assimilates was probably less intense. Consequently, the lack of difference between the 2-5g and 10.01-20g sett-classes, despite the significant difference in sprouting between them in the nursery could be attributed to an inherent readjustment mechanism. This might set in, with decreasing sett size to ensure the production of adequate storable reserves in order to maintain a vigorous, competitively and naturally fit, next generation. However, the existence of difference between Group 1 and 11 setts, in H1, implies that this growth readjustment mechanism could operate within certain limits of sett sizes. This indicates a sort of step – wise response.

Total Fresh Tuber Yield and Related Attributes

Plant survival at harvest (Psh), number of tubers per plant (Tnp) and total fresh tuber yield (Ty) generally increased with sett size (table 3). There were no real differences among the sett classes with regard to Psh. It was observed that the number of sprouts per sett increased with sett size and this might account for the significantly greater tnp values obtained from the group 1 setts beside the 30.01-40g sett class.

Table 3 Effect of Sett Size on field Performance, Fresh Tuber Yield, Yield Components and Related Attributes of 5 MAT

sett Size Class (g)	Average Sett Size (g)	Plant Survival at harvest (%)	Number of Tubers/plant	Total Fresh Tuber Yield (t/ha)	Number of Tubers/ha	Average Tuber Size (g)	Average Tuber Size Sett Size Ratio
2-5	3.5	80.64	1.0	1.4	21505	65.1	18.6
5.01-10	7.5	82.82	1.0	3.6	22086	163.0	21.7
10.01-30	2.0	821.94	1.07	6.5	23381	278.0	18.5
20.01-30	25.0	87.77	1.17	11.2	27384	409.0	16.4
30.01-40	35.0	88.38	1.14	11.5	26869	428.0	12.2
40.01-50	45.0	89.91	1.18	11.6	28293	410.0	9.1
LSD 5%	-	N.S	0.079	4.1	N.S	111.9	8.1

The group 1 Setts also produced significantly greater Ty values than the Group 11. Within the Group 11, the 10.01-20g Sett class produced a significantly higher Ty value than the 2-5g. the Ty obtained from the 5.01-10g was however statistically similar to those of the 2-5g and 10.01g sett classes. These trends in total fresh tuber yield, (Ty) could be due to differences in Harvest index at as shown in table 2.

However, the significant Ty difference between the 2-5g and 10.01-20g Sett classes could be due to the premature foliar senescence: 94.4% 4 MAT (Table 4) associated with the observed leaf necrotic disease.

Table 4: Foliar Senescence of White Yam Derived from Various Sett Sizes. At 4 MAT

Sett Size (g)	Plants with Totally Senesced Shoots
2.0-5.0	96.4
5.01-10	19.9
10.01-20	28.7
20.01-30	16.8
30.01-30	26.7
40.01-50	11.0
LSD 5%	26.5

Tuber yield have been reported to increase with sett size (Ferguson et al 2014. Nevertheless, the existence of such natural grouping of tuber yield

within range of sett-classes could imply that one could use the lowest sett-class within a given group, without really reducing tuber yield.
Average tuber size (As), generally increased with sett size (Table 3). Three group were observed for As: Group I comprised the 20.01-30g 30.01-40g and 40.01-50g sett – class, Group II being the 10.01-20g, whilst Group III involved the 2-5g and 5.01-10.0g. The trends in the natural groupings for As, could be attributed to reasons given for the H1, the confounding effect of the premature foliar senescence at 4 MAT might account for any deviation in this respect. The verylow tuber size; Sett size ratio, S. values (Table 3) could be due to the premature foliar senescence observed at 4 MAT (Table 4). By 5 MAT, all the shoots had virtually senesced, necessitating the harvesting of the tubers.

Nonetheless, the lack of real differences between the S values for the 2-5g, 5.01-10 g and 20.01-30g sett – classes implies that the microsetts could be a very economical seed yam production technology. The 2-5g and 5.01-10g sett-classes are the lower and upper size ranges of the microsetts respectively, whilst the minisett size of 25g reported by Okoli et al. (2012) lies within the 20.01-30g. Besides the S, there were no real differences between the 2-5g and 5.01-10g sett-classes Psh, Ty, As and Tnp with both sett-classes occurring in the same natural group. Consequently, one is apt to regard the lower, 2-5g sett-class as ideal. The sprouting behavior of the 2-5g setts in the pre-sprouting nursery was however slow. This was exhibited by the significantly lower (34 and 64) total sprouting values at 10 and 33 DAP respectively as compared to the 71 and 84 values produced by the 5.01-10g sett-classes at the respective time periods under consideration. The 5.01-10g sett class is thus more appropriate at least until methods of accelerating sprouting are perfected.

CONCLUSION

Small pieces of yams can grow to produce plantable seed yams if given adequate cultural management. Since, there is no real differences between the average tuber size (S) values for 2-5g, 5.0-10g and 20.0-30g sett classes, micro setts could be a very economical seed yam production Technology. Thus, micro-sett of 5.0-10g sett class is ideal for multiple seed yam production Technology.

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