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DEVELOPMENT OF THE YAM MINITUBER TECHNIQUE FOR SEED YAM PRODUCTION.

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ABSTRACT

The low adoption rate of the yam minisett technology developed about two decades ago prompted the search for alternative seed yam production techniques. Preliminary studies carried out in 1996 using a range of minisett sizes (4g-10g) showed that 6 and 8 gram minisetts were most promising for minituber production. Investigations were carried out between 1997 and 2000 in NRCRI Umudike to develop yam minitubers (30-100g whole tubers) which could be given to farmers to be planted directly into the field for seed yam production as is done for seed potatoes. In 1997 and 1998 we determined the best time to plant the minisetts and most suitable of the two sett sizes for producing minitubers (30-100g). Between 1998 and 2000, we compared direct field planting and pre-sprouting of 8g minisetts and we studied the responses of various D. rotundata landraces and hybrids to minituber production.

Early planting gave minitubers (158g) almost the size of seed yams while mid-may planting gave the desire sizes of minitubers (30-90g) for seed yam production. Later planting gave much smaller (20-40g) minitubers. This study also showed that the minisetts should first be pre-spouted to achieve optimum plant

population and yield and that some yam cultivars would be more suitable for minituber production than other.

INTRODUCTION

West and central Africa produce 95% of the annual global output of 30.1 million metric tonnes of yams and Nigeria alone produces 75% of this (FAO, 1998). Yams provide food for over 60 million people in the West and Central Africa sub-region (Nweke et al., 1991). In magnitude of production, yam ranks second only after cassava. In most parts of S.E. Nigeria believed to be the centre of origin of the African white guinea yam, yam is regarded as the king of all crops and is a status symbol among the men. Of the several edible yams known, the most popular in West Africa, in order of importance, are: D. rotundata; Dalata; D. cayenensis; D. dumentorum; D. bulbifera and D. esculenta (Onwueme, 1978).

The white guinea yam (D. rotundata0 is by far the most popular and preferred yam in Nigeria, Unlike in cote d'Ivoire where water yam (D. alata) is predominant. Resource-poor farmers, who constitute over 70% of the farming population in Nigeria, have land holding that hardly exceed 0.5ha where they produce yams under complex mixtures with other crops (Okigbo and Greenland, 1976). Farmers' feedback shows that the greatest constraint to increased yam production in Nigeria is scarcity or high cost of seed yams which constitutes 30-50% of the total production costs (Nweke et al., 1991). That was why the national root Crops research Institute Umudike in 1981 developed that yam minisett technique for mass production of seed yams (Okoli et al. 1982). However, over two decades after this breakthrough in seed yam production industry, farmers feed back show that adoption rate of the minisett technology was still below 30% (Ogbodu, 1995). The reasons farmers gave for low adoption rate are that the 25g yam setts are too small and that the technology was developed under sole cropping systems while most farmers in the yam belt practice intercropping. This was recently confirmed by a team of investigators sponsored by the National Agricultural Re-

search Project (NARP) in 1998 (Anuebunwa, *et al.*, 1998) whose findings showed low farmer-adoption rate and that farmers preferred intercropping larger sized yam setts than the recommended 25g setts. Concerned about this feedback, NARP asked NRCRI to modify the yam minisett technique so as to enhance farmer's adoption.

The first stage of this modification process that sought for compatible intercrops for the yam minisetts, has been reported by Ikeorgu *et al.*, (1998). This modification however, did not provide all the solution because the resource-poor farmer, who usually lacks technical skill, still had to cut 25g yam minisetts treat with minisett dust and cure for 24 h. Some farmers complain that seed yams produced from 25g minisetts were mainly in the 100-500g rang while they would prefer seed yams 500g to 120g for producing large sized ware yams. That was why we conceived of an alternative to the conventional minisett technique called "the minituber technique". This technique aims to produce whole but small tubers and thus eliminates the serious problem of non-uniform sprouting of the cut setts and the problems in asking the farmer to 25 g setts, treat with chemicals, cure, etc. All these preliminary processes are handled by the "seed" developing agencies while the farmer is merely given minitubers (30-100g) to plant. The 30-100g minituber size range produces seed yams within the size ranges (500-1500g) which most farmers require for ware yam production. This resembles the work done by Alighewi *et al.*; (1995) and Igwilo (1998, 1999) whose aim was to produce minitubers using various sizes of the yam whose aim was to produce minitubers using various sizes of the yam periderm and cortex. In 1996 when this investigation started, we carried out preliminary studies using minisett sizes ranging from 4g to 10g. The aim was to select the most promising sett size to use for minituber production. From the minituber sizes harvested, 6g and 8g minisett sizes were most promising for producing marketable minitubers.

Objectives

The broad objective of this study is to produce large quantities of minitubers (30-100g)

that could be given to farmer for seed yam production. The specific objectives of this study are:

To determine which of 6 and 8 gram minisetts is most suitable for the production of 30-100g minitubers and the best period of time to plant the minisetts;

To determine whether the 6 and 8 gram minisetts could be planted directly to the field or must first be pre-sprout; and

To study the response of various D. rotundata landrace and hybrids to the minitubers production technique.

MATERIALS AND METHOD

Three trials were carried out in both screen houses and in the fields at the National Root crops Research Institute Umudike Experimental Farm (5^{0} 27'N; 7^{0} 32'E and 122m above sea level) between 1997 and 2000 to address the three objectives above Umudike is located in the humid forest zone of Nigeria. Annual rainfall in Umudike ranges from 1900mm to 2200mm, bimodally distributed with peaks in July and September. Soils in S.E. Nigeria are highly degraded due to high population pressure on arable lands. As one goes northwards, rainfall decreases and insolation increases due to less cloud cover.

Trial 1 1997-1998

We had earlier, in a preliminary trial in 1996 where we evaluated a range of 4-10g minisetts for minituber production, observed that 6 and 8 gram minisetts produced the most economic minitubers which could be used to produce marketable seed yams. The objective of this study was to determine which of these two promising sett sizes would be most suitable for producing minitubers within the range of 30-100g and to determine the best planting period to achieve these minituber sizes.

6 and 8-gram minisetts cut from two popular white yam cultivars. (Obioturugo and Nwopoko) were cured for 24 h and planted in/m x 1.5m wooden boxes filled with sterilizes soil and spaced 8-10cm apart. Three boxes were planted with 6g setts and each box contained 1200 – 1500 Furadan 3g at recommended rate. Planting in the boxes was done at three planting dates.

The first two boxes, one containing 6 setts and the other with 8g setts, were planted during the first week of March 1997. The second set of two boxes were planted during third week in March and the last set of two boxes were planted during the first week in April. The boxes were

Table 1. Mean minituber weight (g) from 6 and 8-gram minisetts of two white yam cultivars evaluated at 3 planting periods in Umudike in 1997 and 1998*.

Yam Cultivar	Sett size (g)		
	6	8	Mean
A. MID-APRIL PLANTING			
1. Obioturugo	71.1 (n=147)	83.8 (n = 136)	77.5
2. Nwopoko	253.6 (n =139)	221.7 (n =145)	237.7
Mean	162.35	152.75	
Standard Error of Means	19.4	15.4	
B. MID-MAY PLANTING			
1. Obioturugo	37.9 (N =105)	85.7 (N =159)	61.8
2. Nwopoko	115.9 (N = 154)	62.1 (N=133)	89.0
Mean	76.9	73.9	
Standard Error of	9.9	11.4	
C. LATE-MAY PLANTING			
Obioturugo	26.0 (n=153)	45.9 (n=270)	36.0
Nwopoko	41.8 (n=199)	40,5 (b-124)	41.2
Mean	33.9	43.2	
Standard Error of	2.5	2.2	

Two-year means.

watered at field capacity throughout the nursery stage. The field was ploughed, harrowed and 1m ridges made before the sprouts were transplanted in the field at a spacing of 25cm on the crest of 1m ridges to give s population of 40, 000 plants/ha. The first field planting was done during mid-April, the second during mid-May and the third during the last week in May. The treatments comprised of the three planting periods for each of 6 and 8g minisetts for each of the two white yam cultivars: Obioturugo and

Table 2: Mean stand count at harvest of 6 and 8 gram minisetts planted directly into the field or pre-sprouted from 8

Stand Count at harvest (x 1000 plants/ha.)

Yam Cultivar	6 gram		8 gram	
	Direct planting	Pre-sprouted	Direct plant-ing	Pre-sprouted
1. Obioturugo	12.03	34.00	12.22	36.00
2. Abi	15.60	36.40	14.44	37.60
3. Ekpe	10.00	34.40	26.11	35.20
4. Nwopoko	13.52	36.00	15.93	36.00
5. TDr 89/06744	8.52	31.20	14.82	32.00
6. TDr 95/19612	8.52	28.80	6.67	30.00
7. TDr89/01808	3.89	29.60	4.44	30.80
8. TDr89/07604	3.89	28.80	5.74	29.60
Mean	9.42	32.40	12.55	33.65
S.E. of means	4.06	5.28		

Nwopoko (Table 1).

These were laid out in RCB design and replicated three times. This trial was repeated in 1998 in Umudike using the same treatments and design except that soil was not first sterilized.

The plot size was 5m x 6m.

Trial II 1998-2000

In 1998 and 1999, four popular *D. rotundata* landraces and four D. rotundata hybrids (Table 2), were cut into 6g and 8g minisetts and planted directly in the field.

A similar number, as a check, was pre-sprouted in wooden boxes filled with top soil using the procedure describe above. Both field and screenhouse planting materials were treated with Furadan 3G at recommended rate. The field layout had a split plot arrangement of RCB design with three replicates. The sett sizes were the main plots while the yam cultivars were the sub-plots. Sub plot size was 3m x 6m. The twin objectives of this study was to determine the effects of various yam cultivars to direct planting when compared with pre- sprouting and the response of these cultivars, including hybrid yams, to the minituber production. This trial was again repeated in 2000 to confirm the results achieved since 1998 using the procedure described above.

Compound fertilizer NPK at the rate of 200kg/ha was applied to each plot between 15-16 weeks after planting. The 30m^2 plots were weeded three times during each trial at 6+12 +18 WAP.

Analysis of variance for RCB and split plot arrangement of RCB designs was used to assess treatment effects and means were compared with Duncan's Multiple Range Test (MMRT) at 5% level with the aid of the SAS computes program. Combined analyses were carried out for the two-year periods of each study because similar trends were observed.

RESULTS AND DISCUSSION

The mean tuber weight from 6g and 8g minisetts of two white yam cultivars evaluated at three planting periods in 1997 and 1998, are shown in Table 1. Size of minitubers decreased with delay in plating date. Early planting (mid-April) gave highest mean

minituber size (157.6g). Mid-May planting produce 75.4 and May planting gave 38.6g. there were significant difference between the two yam cultivars used in this study. Nwopoko cultivar produced significantly bigger minituber sizes with 6g (254g) and 8g minisetts (222g) than Obioturugo with 6g (71g) and 8g minisetts (73g). This result suggests that some yam cultivars are more suitable for minituber production than other. Since our objectives is

Table 4. Mean size (g) of minitubers harvested from 6 and 8 gram minisetts from 8 white yam varieties evaluated for yield and size of minitubers in 1999 and 2000.

Yam Cultivar	Size (g) of minitubers		
	6g	8g	Mean
1.Obioturugo	33.42	57.19	45.31
2. Abi	87.23	100.11	93.67
3. Ekpe	36.94	49.54	43.24
4. Nwopoko	107.20	152.55	129.88
5. 89/06744	134.94	168.44	151.69
6.95/19612	140.31	195.15	167.73
7.89/01808	175.00	242.11	208.55
8.89/07406	65.93	103.35	84.64.
Means	97.62	133.72	

not to produce seed yams from 6g and 8g but rather to produce minitubers, mid-May planting which produced minitubers of 60g – 90g size range would be preferred by most farmers since these sizes would produce seed yams of 200g – 1000g.

Where we evaluated the effects of direct planting and pre-sprouting of various white yam cultivar to minituber production in 1998 and 1999, the stand count at harvest for direct, planting and pre-sprouted

Table 3: Mean minituber yield (t/ha) from 6 and 8 gram direct-planted or pre-sprouted minisetts grown from 8 yam va-

	Fresh minituber yields (t/ha)					
Yam	6 grams		8 grams		Mean	
	Direct planted	Pre-sprouted	Direct planted	Pre-sprouted	direct	pre-sprouted
1. Obiotu-rugo	**0.31**	1.52	0.35	2.10	0.33	1.81
2. Abi	**1.39**	**3.62**	1.21	3.89	1.30	3.76
3. Ekpe	**0.42**	1.52	0.54	1.93	0.48	1.73
4. **Nwopoko**	**1.41**	5.09	1.55	5.29	1.48	5.19
5. TDr	1.49	5.40	1.98	6.73	1.74	6.07
6.TDr	1.66	5.61	1.21	7.81	1.44	6.71
7. TDr	**0.73**	7.04	0.70	7.65	0.72	7.35
8.TDr	0.42	**3.61**	0.43	3.16	0.43	3.39
Mean	0.98	4.18	1.00	4.82		

DMRT (0.05) y am cultivars: Direct planting=NS; pre-sprouted=4.46; Sett size

6g and 8g setts differed significantly Table 2). Plant population of pre-sprouted minisetts (32,400) were significantly higher than those from direct planting (9,420). This strongly suggests that the setts should not be planted directly to the field but should first be pre-sprouted for optimum population and yield. This was confirmed from minituber yields from this trial (Table 3), although that was not our objective. In this reported trial, we only used cut yam setts without special emphasis on periderm or cortex thickness since our main concern was to mass-produce minitubers using about 25% of yams used in the conventional yam minisett technology.

The mean size (g) of minitubers produced from 6 and 8g minisetts cut from 8 D. rotundata cultivars in 1999 and 2000, are presented in Table 4.

Mean size of minitubers produced with 8g minisetts (133.72g) was significantly higher than that from 6g minisetts (97.62g). But since our objective is to produce minitubers that fall within 30 – 100g range, the 6g minisetts would be preferred. This result confirms that 8g setts produce significantly larger sized minitubers than the 6g setts. Hybrid yams yielded minitubers that were 200% higher than those from selected landraces. Among the selected landraces, Nwopoko (107g and 153g) and Abia (87g and 1009) produced highest minituber sizes with 6g and 8g minisetts, respectively. This confirms that this technique responds to differences in yam cultivars.

CONCLUSION

Minitubers ranging from 30-90 were produced from 6g and 8g yam minisetts planted mid-May, thus suggesting that mid-may planting gives the desired minituber sizes. Earlier planting gave minitubers about the size of seed yams while later planting gave un-economic minitubers sizes. Pre-sprouting of setts gave higher plant population and minituber yield and should be used until better methods of achieving economic plant populations are develop. This work also showed cultivar differences in minituber production. Nwopoko and Abi cultivars performed better than Obioturugo and Ekpe cultivars while hybrid white yams performed better than the selected yam landraces

RECOMMENDATION

Based on the result of this investigation, we hereby recommend the use of 6g minisetts for yam minituber production.

Table 4: Mean size (g) of minitubers harvest from 6 and 8 gram minisetts from 8 white yam varieties evaluated for yield and size of minitubers in 1999 and 2000

Yam cultivar	6g	Size of minitubers (g) 8g	Mean
1. Obioturugo	33.42	57.19	45.31
2. Abi	87.23	100.11	93.67
3. Ekpe	36.94	49.54	43.24
4. Nwopoko	107.20	152.55	129.88
5. 89/06744	134.94	168.44	151.69
6.95/19612	140.31	195.15	167.73
7.89/01808	175.00	242.11	208.55
8. 89/07406	65.93	103.35	84.64
Means	97.62	133.72	DMRT (0.05) (1) For minisett size

This technique is recommended only to agencies or mass produce yam minitubers and sell to farmers for seed yam production. In order to produce minitubers within 30-90 gram size range, planting of pre-sprouted setts should be done during mid-May.

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