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INFLUENCE OF PEELSETT LENGTH ON YIELD OF MINITUBERS

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ABSTRACT

Five lengths of peelsett pieces, 1.0 cm, 1.5 cm, 2.0 cm, 3.0 cm and 4.0 cm of two yam varieties, Obiaoturugo (*D. rotundata* Poir) and Um 680 (*D. alata* L.) were compared in 1998 and 1999. Peelsett pieces 3 cm long (6.7g) at 150,000 stands/ha gave the highest tuber yield similar to the tuber yield of minisetts at the same seed-rate (1 tonne/ha). Of the tuber sizes yielded by Obiaoturugo, 78.4% were between 20g and 100g; of Um 680, all the tubers were above 20g with some above 200g. In Obiaoturugo, the percentage sprouting of the 3 cm pieces were 78.2% and 98.5% in Um 680. It is envisaged that minitubers might replace the minisetts (25g) in mass multiplication of seed-yams.

INTRODUCTION

Minisetts (25g yam setts) are designed for mass production of seed yams towards ware tuber (>1 kg) production (Okoli *et al*, 1982). A minisett is about 2.5-4 cm thick. It has been shown that minisetts in which the ground tissue has been sliced down to 1 cm thick (called peelsetts) at the same seed-rate as minisetts (1 tonne/ha) gave higher percentage sprout emergence and equalled or out-yielded the minisetts (Igwilo, 1999). The peelsett is therefore a yam peel 1 cm thick, 2 cm wide and as long as the circumference of the yam tuber, or portion thereof, from where the peelsett was cut. In some locations, it has been suggested that the minisett size of D. rotundata should be bigger than 30 g (instead of 25g) for higher percentage sprout emergence and other attributes (Kalu, 1989).

However, a whole tuber of the same size as yam sett sprouts better than a yam sett because the whole tuber has a head carrying a "corm" or "primary nodal complex – PNC" (Onwueme, 1987, Degras, 1993) from where the sprouts easily emerge. Secondly, the yam does not have dormant buds ("eyes") like the solanum (Irish) patoto. Every point on the periderm of the yam tuber is a potential sprouting locus (Onwueme, 1973). Thirdly, a clean whole tuber does not have wounds like a yam sett whose surface is largely exposed ground tissue susceptible to invasion by soil pathogens on planting, causing rot (Coursey, 1967).

Therefore to solve the problem of low sprout emergence leading to low yield, it would be better to plant small whole tubers (minitubers) of the same size as the minisett (25g) for mass production of seed-yams. In this study, an attempt was made to determine the optimum

length of peelsett piece and its population in the mass multiplication of minitubers.

MATERIALS AND METHODS

In 1998, peelsetts of two yam varieties, Obiatoturugo (*Dioscorea rotundata* Poir) and Um 680, (*D. alata* L.) were cut into lengths – 1.0 cm, 1.5 cm, 2.0 cm, 3.0 cm and 4.0 cm, minisetts (25 g setts) served as control. A split-plot design was used with varieties as main plots and peelsett pieces as subplots and replicated five times on beds between replicates. Seed-rate was 100 g/m (1 tonne/ha) and subplot size was $10m^2$ in 1998 and $8m^2$ in 1999. The seed-rate and spacing were as specified in table 1.

TABLE 1: Sett size and population

Length of peelsett piece	Weight of peelset piece (g)	Number of Peelsett pieces/m^2	Weight of peelsett pieces/m^2(g)	Spacing
1.0 cm	2.5	40	100	25 cm x 10 cm
1.5 cm	3.8	27	100	25 cm x 15 cm
2.0 cm	5.0	20	100	25 cm x 20 cm
3.0 cm	6.7	15	100	25 cm x 27 cm
4.0 cm	10.0	10	100	25 cm x 40 cm
(Minisett) control	25.0	4	100	25 cm x 100 cm

* For any sample in excess of 100g/m2, the ground tissue was slightly sliced down to 100g/m2, any sample less than 100g/mg2 was rejected

Planting was on 24 April 1998. From the first sprout emergence, sprout counts were taken until 9th September 1998 In 1999, only 2 cm, 3 cm and 4 cm peelsett pieces and the minisetts were planted because of poor and irregular sprout emergence of shorter pieces. In 1999, half the seed-rate in each sett size was included. In 1999, half the seed-rate in each sett size was included. In 1999, records were taken of the maximum sprout emergence, plant height, leaf area and final yield. Leaf area was determined from single plant samples/plot from which leaf punches were obtained; the ratio of the dry weight to leaf area of the leaf discs was used to determine the area of all the leaves (Evans, 1972).

RESULT

1998 Data

In the 1998 trial, in Obiaoturugo, percentage sprout emergence in 2 cm peelsett pieces was not significantly higher than in shorter peelsett pieces, whereas sprouting increased significantly from 2 cm peelsett to the minisett (Table 2). In Um 680, percentage sprout emergence increased progressively from 1 cm peelsett although 3 cm and 4 cm peelsetts were not significantly different. Similarly 3 cm and 4 cm peelsetts out-yielded 2 cm pieces, when pooled, yields of propagules of 3 cm and 4 cm pieces and those of minisetts. 1999 Data

In 1999, at maximum sprouting, Um 680 had 9.6% (P=0.05) more sprouts than Obiaoturugo. Within the varieties, half-population of Obiaoturugo sprouted more than full-population by 10% whereas the reverse was the case in Um 680 (7.2% less). In both varieties, sprouting increased with sett size. In the final stand count taken near tuber maturity (191 DAP), 3 cm and 4 cm peelsetts had similar stand counts with the minisetts in both varieties (Table 3). Between maximum and final stand counts, Obiaoturugo declined by

14.3% (P=0.05) whereas in Um 680, the decline was not significant (8.2%). Minisetts did not decline in number within the interval in both varieties. (Table 3).

TABLE 2: Differences in sprouting percentage and tuber yield from different sett lengths in 1998

Sett Length	Sprouting%		Tuber yield (t/ha)	
	Obia	Um 680	Obia	Um 680
1.0 cm	31*.4(4\31.0)*	38.1(39.0)	1.30	5.77
1.5 cm	42.4(40.9)	47.8(54.8)	3.00	7.85
2.0 cm	60.1(72.0)	63.2(78.5)	3.60	23.68
3.0 cm	63.7(77.0)	68.5(84.0)	4.63	26.19
4.0 cm	65.2)79.1)	74.7(88.0)	4.68	25.80
(Minisett) control	67.2(82.2)	87.0(97.5)	4.62	25.35
Mean	55.0/63.7	63.2/73.6	3.64	19.27

+ Aresine √% transformed values

* Actual values

Between variety (LSD 0.05)	4.5	3.86
Within variety (LSD 0.05)	10.4	3.99
Sett size X variety		
Interaction (LSD 0.05)	14.8	5.0

Table 3: Sprouting and establishment: 1999 data

Sett size	Population	Days to maximum Sprouting		Maximum Spouting (%)		Final count stand	
		Obia	Um 680	Obia	Um 680	Obia	Um 680
2 cm peelsett	Half	82.0	67.3	80.0	83.5	55.0	75.0
	Full	82.0	64.3	72.5	88.8	53.8	72.5
3 cm peelsett	Half	66.0	53.8	90.6	90.6	71.9	87.5
	Full	72.0	54.8	78.2	98.5	71.9	88.9
4 cm peelsett	Half	63.0	54.8	90.0	85.0	80.0	85.0
	Full	63.0	52.8	80.0	97.5	81.5	86.3
Peelsett		71.3	58.7	81.9	90.7	72.7	82.5
Mini-ett mean		66.3	38.0	87.3	100.0	87.5	100.0

LSD (0.05) between treatment means			
Varieties	5.7	17.9	8.2
Sett sizes in each variety:	9.9	-	11.3
Population in each variety:	5.7	-	9.2
Peelsett and minisett in each variety:	10.4	-	19.6

At maximum leaf area index (116DAP) plants of Um 680 (table 4) were taller than those of Obiaoturugo (P=0.01). within the varieties, propagules of larger sett sizes were not taller than those of smaller sett sizes. Plants of full population were taller than those of half-population. Number of nodes/plant varied with plant variety. Um 680 had more nodes than Obiaoturugo. Within the varieties, larger sett sizes had more nodes than smaller sett sizes but there was no significant effect of plant population. Um 680 had more leaves/plant than Obiaoturugo (P=0.05) and bigger sett sizes more than smaller sett sizes but plant population also had no significant effect. Again Um 680 had more leaf area/plant than Obiaoturugo (P = 0.05) and longer peelsets more than shorter peelsetts. The minisetts definitely had larger leaf area/plant than peelsetts in both varieties. Um 680 had larger leaf area index (LAI) than Obiaoturugo (P = 0.05) and full-population more than half-population. However, in both varieties, progagules of 4 cm peelsetts had the lowest LAI (P=0.05). In Obiaoturugo, 3 cm peelsetts had the largest LAI while 2 cm peelsetts had the largest LAI in Um 680 (Table 4). Um 680 out-yielded Obiaoturugo (Table 5) and full-population more than half-population per hectare (P = 0.01). In both varieties, the tuber yields/ha of progagules of 3 cm and 4 cm peelsetts (full population) were similar and when pooled together out-yielded (P=0.01) 2 cm peelsetts (full population). In both varieties, also, the yields of 3 cm and 4 cm peelsetts were similar to those of minisetts. In Obiaoturugo, tuber yield/stand was similar to the situation in tuber yield/ha

but in Um 680, tuber yield/stand increased steadily with length of peelsett. On the average, tuber yield/stand tended to decline with plant population but was more remarkable in Um 680 than in Obiaoturugo (P = 0.01). Tuber yield/stand in minisetts was more than in peelsett pieces. Tuber size was almost similar to tuber yield/stand because the plants yielded almost single tubers (Table 5). Tuber size distribution (Table 6) showed that 3 cm peelsett pieces in) Obiaoturugo gave the highest percentage (78.4%) of whole tubers (minitubers) weighing 20 – 100g. In Um 680, the number of minitubers weighting 20-100g was similar between 2 cm and 3 cm peelsett pieces (30.8-31.2%).

Table 4:Plant Growth features 116 DAP: 1999 Data

Sett size		Population		Plant height (m)		No. of Nodes/plant		No. of leaves per plant		Leaf size (cm^2)		Leaf Area per plant (dm^2)		Leaf are Index	
		Obia Um 680	Um 680	Obia	Um 680	Obia	Um 680	Obia	Um 680	Obia	Um 680	Obia	Um 680	Obia	Um 680
	Half	1.44	2.14	61.5	124.5	80.3	123.0	24.0	44.5	19.0	53.3	1.03	3.93		
2 cm peelsett	Full	1.44	2.58	63.8	133.5	91.8	138.0	24.8	48.2	21.8	59.8	2.31	8.78		
	Half	1.44	2.35	81.0	128.5	106.5	119.8	22.4	38.4	25.2	51.9	1.45	1.78		
3 cm peelsett	Full	1.58	2.99	79.5	151.8	100.8	159.0	23.4	45.6	23.9	68.8	2.75	3.17		
	Half	1.43	2.45	83.5	180.5	100.8	186.0	20.7	42.4	23.9	80.5	0.90	1.08		
4 cm peelsett	Full	1.70	3.04	81.3	151.3	97.0	175.3	26.9	40.5	23.0	75.9	1.73	2.04		
Peelsett mean		1.51	2.59	75.1	145.0	96.2	150.2	23.7	43.3	22.8	65.0	1.70	3.46		
Miniset mean		1.92	3..	139.0	210.8	161.0	313.5	28.2	42.5	33.2	135.8	1.33	3.53		
LSD (0.5) between treatment means:															
Varieties		0.28		14.8		18.2		5.0		7.7		0.45			
Sett sizes in each variety:		-		25.3		2.3		-		9.5		0.78			
Population in each variety:				-		-		-		-		-			
Peelsett and minisett in each variety:		-		38.0		44.5		-		15.7		0.90			

Table 5: Yield and yield components: 1999 data

Sett size	Population	Yield (t/ha)		Tuber yield/stand (g)		Tuber sizes (g)		No. of tubers/plant	
		Obia	Um 680	Obia	Um 680	Obia	Um 680	Obia	Um 680
2 cm peelsett	Half	1.66	11.88	30.5	132.8	32.2	188.6	0.98	0.88
	Full	3.98	18.13	34.5	123.2	34.5	161.6	0.95	0.80
3 cm peelsett	Half	3.56	15.15	69.1	212.8	70.8	216.8	1.00	0.95
	Full	5.96	27.55	50.3	193.7	55.2	225.9	0.98	0.88
4 cm peelsett	Half	3.43	19.30	56.6	477.4	58.1	256.1	0.95	1.38
	Full	5.75	26.65	57.9	306.9	64.5	284.0	0.93	1.10
Peelsett mean		4.05	19.78	49.8	241.1	52.6	238.8	0.97	1.00
Minisett mean		5.93	27.25	217.8	856.3	217.8	732.5	1.00	1.20

LSD (0.5) between treatment means:

Varieties	1.92	21.3	23.5	-
Sett sizes in each variety:	3.33	36.9	67.7	-

Table 6: Tuber size distribution (%) 1999 data

Variety	Sett sizes	Tuber Sizes					
		<20g	20-30g	30-50g	50-100g	100-200g	>200g
Obioturugo	2 cm	33.3	27.3	24.2	13.6	1.5	-
	3cm	12.1	19.3	31.8	27.3	4.5	-
	4cm	22.5	10.0	25.0	20.0	22.5	2.5
	Minisett	20.0	-	-	26.7	13.3	4.0
	2 cm	13.0	2.6	10.4	18.2	22.1	33.8
	3 cm	-	2.6	11.5	16.7	26.9	42.3
	4 cm	6.5	-	3.2	12.9	17.7	59.7
	Minisett	-	-	-	5.3	15.8	78.9

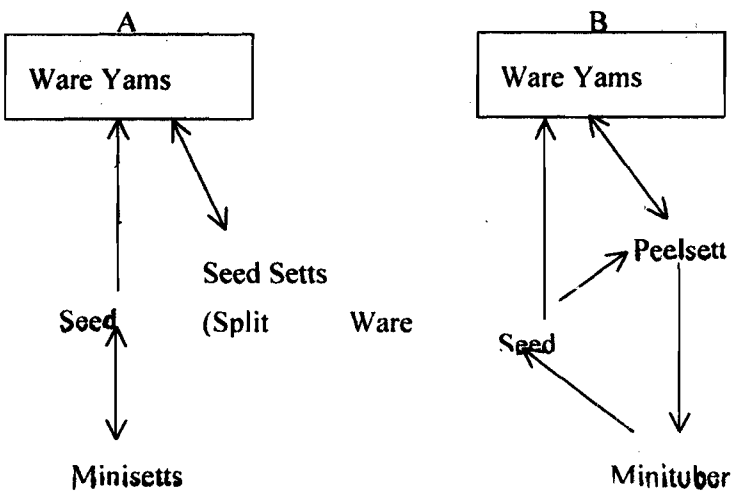
Summary (%)

Variety	Set size	Tuber sizes		
		20-100g	>100g	Total
Obia	3 cm	65.1	1.5	66.6
	3 cm	78.4	4.5	82.9
	4 cm	55.0	24.5	79.5
	Minisett	26.7	43.3	70.0
Um 860	2 cm	31.2	55.9	87.1
	3 cm	30.8	69.2	100.0
	4 cm	16.1	77.4	93.5
	Minisett	5.3	94.7	100.0

DISCUSSION

Peelsett pieces 3 cm long (6.7g) at the same seed-rate as the minisett (1 tonne/ha) have similar yields as the minisett (Table 5). The minisetts (25g) are obtainable by splitting seed yams. The peelsetts are obtainable from the peels of seed and ware tubers prone to being thrown away during processing of yam tubers for food if not recycled, as in this case. The minitubers (whole tubers) so harvested from the peelsett pieces will give almost 100% sprouting on planting the following season because in addition to the PNC, every point on the tuber surface is a potential sprouting locus, as earlier stated (Onwueme, 1973). This will go a long way to solve the problem of sprout emergence in seed yam variety of D. rotundata (the predominant species grown in Nigeria), the minitubers

yielded (Table 6) contained about 20% of 20 – 30g tuber sizes (minisett sizes) and 78% of 20 – 100g minitubers. The tuber sizes of Um 680 were bigger. Some farmers in some locations of the yam-producing zone plant supra-optimal sizes of seed yams (800-100g) in order to harvest and market larger and ceremonial ware tubers. These sizes of seed yams may be yielded by minitubers 30 – 100g. In Obioturugo, 3 cm peelsett pieces yielded 4.5% minitubers weighting even 100-200g (Table 6). In Um 680, 3 cm peelsett pieces yielded 43.3% tubers weighting more than 200g (seed yams). Therefore, using minitubers (from peelsett pieces) also solves the problem of choice of sett sizes in seed yam production. Furthermore, the cost of seed yam production will be greatly reduced.



Thus, a new sector in the yam production industry is hereby proposed- minituber production using peelsett pieces–a garden sector (Fig. 1). This is important to farmers with small land holdings in the sustenance of the yam production industry. Resource-poor farmers may find seed yam production by minisett technique expensive. Minituber production using otherwise wast-able peels of seed and ware tubers may be more suitable. These farmers will produce minitubers, which they sell to seed-yam producers who in turn sell to ware yam producers. In Obioturugo, with 78% final stand count (table 3), single tuber yield per plant (Table 5) and 80% of the tubers weighing greater than 20g (Table 6), this is equivalent to 86,400 plantable tubers/ha. At 40,000 minitubers/ha (minisett population), the minitubers yielded per hectares can plant up 2.2 hectares to seed yams the following year.

The protective property of the yam tuber is contained in the peels (Ogundana *et al.*, 1983) and minituber is completely protected by the periderm. Thus both the minituber and seed yam producers (using minitubers) may have no need to use pesticides against soil pathogens, thereby

protecting the farmers from the hazards of handling agro-chemicals.

In this location (05° 01'N, 06° 57'E), the tuber yields of 2 cm peelsett pieces were lowest in 1999 (Table 5) in spite of the high LAI especially in UM 680 with LI up to 8 in the full population (Table 4). This may be due to mutual shading as the growing season here is also characterized by frequent overcast. The mutual shading led to extension growth (note plants from smaller and bigger peelsetts with similar heights, Table 4). The incoming assimilates were probably partitioned in favour of this aerial growth (Beevers *et. al.*, 1969) leading to low tuber yield (Table 5). It is likely that in that in higher latitudes (more northerly locations) with longer duration of bright sunshine and less overcast, the yield might be better.

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