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# FIELD PERFORMANCE OF YAM (Dioscorea spp.) PIECES IN RELATION TO SURFACE AREA OF PERIDERM AND SETT THICKNESS

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## ABSTRACT

In an endeavour to exploit the efficiency of small yam pieces in mass production of seed yams, an experiment was conducted in 1990 and repeated in 1992. In this experiment, yam minisetts were cut up into yam pieces with $2cm^2$, $3cm^2$ and $4cm^2$ periderm surfaces. The ground tissue (cortex) of these yam pieces were sliced down to various thickness of 0.25cm, 0.5cm, 1cm, 1.5cm and 2cm. These 15 factorial treatment combinations were planted in a randomised complete block and replicated three times. Plot size was $1m^2$ in which 20 pieces of these yam setts were planted. In 1990, only one yam variety was used - Um 680 (*D. alata*). In 1992, two yam varieties were used - Um 680 (*D. alata*) and Obiaturogo (*D. rotundata*). The result showed that in both yam varieties and both years, the optimum sett thickness was 1cm in terms of sprouting and establishment, leaf area development and tuber yield. Sett thicknesses of 1 - 2cm were similar in these attributes whereas Sett thickness below 1cm were significantly lower in value. Periderm surface area of $2cm^2$ gave lower yields than periderm surface areas of $3cm^2$ and $4cm^2$ between which there were no significant differences in 1990. On the contrary, in 1990 when there were biotic and environmental stresses, $4cm^2$ periderm surface area was clearly superior to $3cm^2$ periderm surface area. Average tuber yield for pieces 1 - 2 cm thick and 3 - 4 $cm^2$ periderm areas was 19.7t/ha in Um 680 in 1990. In 1992, the corresponding tuber yields were 12.8t/ha for Um 680 and 8.3t/ha for Obiaoturogo. The potential number of tubers for this sub-optimal plant population is 200,000/ha. Average multiplication ratios were high: 30.5 in 1990 and 26.0 in 1992 for Um 680 and 17.8 for Obiaoturugo in 1992 which were higher than what was obtained from minisetts (8.8 for Um 680 and 5.2 for Obiaturugo). Potential multipliation ratios were 44-339 in 1990 and 17-88 in 1992. Average percentage sprouting for sett sizes of 1cm thickness and 3-4$cm^2$ periderm surface was 76.1% in 1990 and 69.1% in 1992 for Um 680 and 69.8% for Obiaturugbo in 1992. It is envisaged that yam peels may be the bedrock of

future seed yam multiplication in the farmer's field.

## INTRODUCTION

The major constraint in ware yam production is the cost of seed yam (planting material) which accounts for 30 - 50% of the total outlay in yam production (Oyolu, 1978). Edible tubers serve as planting material in yam production unlike in cassava (*Manhiot esculenta*) and sweet potato (*Ipomoea bitatas*) where the non-edible portions are used as planting materials. It has been estimated that 30% of the current yam output is usually reserved as planting season (Hahn *et al*, 1987). The recommended sett size for ware yam (> 1kg) production is 200 - 300g (Owumeme, 1978). These planting materials are usually obtained as whole tubers arising in the normal course of ware yam production otherwise obtained by cutting larger tubers into setts of desired size.

The average multiplication ratio of yam (weight of yam harvested divided by weight planted) has been given as 5 as against 15 - 25 in legumes and 20 - 80 in cereals (Owumeme, 1978). Thus, at the sett size of 250g at the recommended population of 10,000 stands per hectare (2.5t/ha), the expected tuber yield is 12.5t/ha. Recently, it has been shown that small yam pieces weighing 25g, called minisetts, at 40,000 stands/ha (1t/ha), under good management of timely planting, weeding and staking, gave yields equal or greater than what is obtainable from 2.5t/ha of seed yams (Okoli *et al*, 1982; Igwilo and Okoli, 1988). This suggests that the smaller yam pieces gave higher multiplication ratios than the larger pieces. Indeed, some single tubers weighing up to 1kg were harvested from the minisetts, giving a potential multiplication ratio of 40 (Igwilo and Okoli, 1988). The higher efficiency of the minisett propagules compared with the seed yam propagules has been attributed to earlier foliation and higher net assimilation rate (NAR) of the minisett propagules at early seedling stage coupled with equal or higher leaf area index (LAI) at later stages of growth (Igwilo, 1988). It follows, therefore, that yam pieces smaller than the minisett could give higher multiplication ratios than the minisett.

Thus an experiment was conducted in 1991 and 1992 in which the surface area of periderm and thickness of yam pieces were varied to give yam pieces of various sizes which were considerably smaller than the minisett. The aim was to increase the multiplication ratio (efficiency ratio) of yam under field conditions even if resulting tubers were smaller than the seed yam (200g). The whole tubers harvested could be used to raise seed yams and medium-size and large-size ware yams. Mass production of small whole tubers is likely to promote mechanization of yam planting than yam setts which are usually angular in shape.

## MATERIALS AND METHODS

Three surface area of periderm ($2cm^2$, $3cm^2$, and $4cm^2$) and five thicknesses of yam setts (0.25cm, 0.5cm, 1cm, 1.5cm and 2cm) were factorial combined to give 15 treatments arranged in a randomised complete block design and replicated three times. In 1990, only *Dioscorea alata* cv. Um 680 was used. Each replicate was represented by a bed 22.5m long, 1m wide and 40cm high. The beds were arranged side by side, 50cm apart. The plots were $1m^2$ in size and there was a distance of 0.5m between plots in each and replicate. Twenty yam pieces were planted in each plot spaced 20cm apart within rows and 25cm between rows. In 1992, two yam varieties were used - Um 680 (D. *alata*) and Obiaturugo (D. *rotundata*) giving rise to 30 treatment combinations. The layout was split plot with yam varieties as main plots and the fifteen factorial treatments were arranged randomly in the sub-plots as in 1990. Again, there were three replicates in 1992 and each replicate was represented by a pair of beds giving rise to three pairs of beds arranged side by side.

To obtain the yam pieces of various sizes, yam tubers were first cut into minisetts (Okoli *et al*, 1982). A small portion of the head and of the tail of the seed yam were cut off. The yam tuber was then cut into discs 2cm thick along the length of the tuber. Two vertical cuts at right angles to each other were used to split each disc into four segments. Each segment was a minisett, about 25g in weight. The disc could be cut into three or five minisetts depending on its diameter. Vertical cuts were again made on each minisett 1cm, 1.5cm or 2cm apart to give yam pieces with periderm surfaces of $2cm^2$, $3cm^2$ or $4cm^2$ respectively. Marked nylon strings were used to measure out these lengths in order to take care of the curvature along the periderm of the yam minisetts. These pieces were finally reduced to varying thickness of 2cm, 1.5cm, 1cm, 0.5cm or 0.25cm. One tip of a pair of dividers dipped in black ink was used to mark the line of cut on each yam piece to obtain appropriate thickness.

Before planting, the twenty setts for each plot were mixed with 1g of carbofuran pesticide. The setts were planted 3cm deep. In 1990, planting was done on 13th June and 13th May in 1992. Earlier, immediately after cutting the yam pieces, ten pieces from each treatment were selected at random and weighed to determine the average fresh weight of each treatment (Table 1).

Sprout counts were taken at intervals. At maximum foliation, two plant samples were taken from each plot for height and leaf area data (24 September in 1990 and 12 September in 1992). For leaf area measurement, the leaves were detached and counted and piled up in batches. A cork borer (18cm diameter) was used to punch out leaf discs from each sample. One hundred leaf discs in each sample were selected and dried to constant weight at 70°C in ventilated ovens. The remaining leaves were similarly dried to constant weight. The area/dry weight ratio of the leaf discs was used to determine the leaf area of the sample.

Table 1: Average fresh weight of single setts planted (g)

| Variety | Surface Area of periderm ($cm^2$) | 1990 Thickness of sett (cm) | | | | | 1992 Thickness of sett (cm) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0.25 | .5 | 1 | 1.5 | 2 | 0.25 | .5 | 1 | 1.5 | 2 |
| Um 680 | 2 | 0.91 | 1.66 | 2.72 | 3.67 | 5.06 | 0.58 | 1.64 | 2.50 | 3.16 | 5.12 |
| (*D. alata*) | 3 | 1.21 | 2.66 | 4.14 | 5.91 | 7.58 | 1.58 | 2.82 | 3.28 | 5.30 | 6.42 |
| | 4 | 2.67 | 3.51 | 5.17 | 8.17 | 11.16 | 2.40 | 3.04 | 5.26 | 7.16 | 10.64 |
| Obiaturugo | | | | | | | | | | | |
| (*D. rotundata*) | 2 | | | | | | 0.68 | 1.28 | 2.58 | 3.36 | 4.08 |
| | 3 | | | | | | 1.36 | 2.10 | 3.86 | 5.70 | 7.14 |
| | 4 | | | | | | 2.00 | 3.48 | 5.48 | 7.98 | 11.64 |

## RESULT

### Sprouting and establishment

In 1990, larger setts of Um 680 started sprouting earlier than smaller setts. By 12 July, 29 days after planting (29 DAP), the number of setts that sprouted per plot increased with increase in surface area of periderm (P = 0.01) as well as sett thickness (P = 0.01) as shown in Table 2. However, there was an interaction (P = 0.01) between area of periderm and sett thickness. With 2cm$^2$ periderm surface area, sprouting increased with sett thickness at 29 DAP whereas with 3cm$^2$ and 4cm$^2$ periderm surface, sprouting increased with sett thickness up to 1cm - sett and tended to decline (P = 0.01) at 2cm - sett. The treatment trends persisted up to maximum sprouting at 66 DAP (17 August) except that the differences between 2cm$^2$ periderm surface on the one hand and 3cm$^2$ and 4cm$^2$ periderm surface on the other tended to narrow down between 29 DAP and 66 DAP. Highest percentage sprouting (91.5%) was obtained at the periderm surface area of 3cm$^2$ and sett thickness of 1cm. At the final stand count on 9 November (145 DAP) before tuber harvest, nearly all the plant stands found at maximum sprouting (66 DAP) survived up to harvest - only 1.7% decline which was not significant.

In 1992, there was a significant interaction (P = 0.01) between yam variety and periderm surface area as well as sett thickness (Table 3). With 2cm$^2$ periderm surface area, Obiaoturugo gave more sprouts than Um 680 whereas with 3cm$^2$ and 4cm$^2$ periderm surfaces, the reverse was the case. Again, in yam setts with 3cm$^2$ and 4cm$^2$ periderm surfaces in Obiaoturugo, 0.25cm and 0.5cm sett thickness gave fewer sprouts than sett thickness of 1cm and above between which there were no significant difference whereas the Um 680 sprout counts were similar in all set ticknessess in these two periderm surfaces.. Similar trends were observed in the final stand count. There was a significant (P = 0.05) decline between maximum stand count and final stand count at harvest - 19.0% in Obioturugo and 15.6% in Um 680. In 1992 Um 680 suffered severe anthracnose disease attack on the vines. Obiaoturugbo also suffered same attack of shoe-string virus.

Table 2: Stand count for Um 680 (Number of stands/plot)

1990 data

| Surface area of periderm (cm) | Sett thickness (cm) | Sprouting 29 DAP | Maximum Sprouting 66 DAP | Final stand count 149 DAP |
|---|---|---|---|---|
| 2 | .25 | 0.0 | 5.3 | 5.3 |
| | .5 | 0.3 | 8.0 | 8.0 |
| | 1 | 1.0 | 14.7 | 14.7 |
| | 1.5 | 3.0 | 13.0 | 13.0 |
| | 2 | 3.0 | 14.0 | 14.0 |
| | Mean | 1.5 | 11.0 | 11.0 |
| 3 | .25 | 0.7 | 11.3 | 11.3 |
| | .5 | 6.0 | 16.3 | 16.3 |
| | 1 | 11.7 | 18.3 | 18.3 |
| | 1.5 | 12.0 | 15.3 | 13.3 |
| | 2 | 8.3 | 16.3 | 16.3 |
| | Mean | 7.7 | 15.5 | 15.1 |
| 4 | .25 | 0.5 | 12.3 | 12.3 |
| | .5 | 6.0 | 15.3 | 15.3 |
| | 1 | 7.0 | 15.7 | 15.3 |
| | 1.5 | 6.7 | 15.0 | 15.0 |
| | 2 | 1.3 | 10.7 | 10.7 |
| | Mean | 5.2 | 13.8 | 13.5 |

LSD (0.05) between means

| | | | |
|---|---|---|---|
| Periderm surfaces (P) | 1.1 | 1.9 | 2.1 |
| Sett thickness (T) | 3.5 | 2.5 | 2.6 |
| Sett thickness in each periderm surface | 2.5 | 4.2 | 4.6 |
| Periderm surfaces in each sett thickness | 2.5 | 4.2 | 4.6 |
| P x T interaction | 3.5 | 6.0 | 6.5 |

Table 3: Sprout Count: 1992 Data

| Surface area of periderm ($cm^2$) Mean | Sett thickness ($cm^2$) | Maximum Stand Count Obia | Um 680 | Mean | Final stand count Obia | Um 680 | Mean |
|---|---|---|---|---|---|---|---|
| 2 | 0.25 | 3.3 | 3.0 | 3.2 | 3.0 | 3.2 | 3.2 |
| | .5 | 6.3 | 4.3 | 5.4 | 5.7 | 4.4 | 4.4 |
| | 1 | 9.3 | 5.7 | 7.5 | 6.3 | 5.5 | 5.5 |
| | 1.5 | 9.7 | 5.3 | 7.5 | 6.7 | 5.7 | 5.7 |
| | 2 | 10.3 | 9.0 | 9.7 | 9.0 | 8.2 | 8.2 |
| | Mean | 7.8 | 5.5 | 6.7 | 6.2 | 5.4 | 5.4 |
| 3 | .25 | 4.7 | 10.3 | 7.5 | 4.7 | 9.7 | 7.2 |
| | .5 | 7.3 | 10.0 | 8.7 | 5.7 | 10.0 | 7.9 |
| | 1 | 10.7 | 10.0 | 10.4 | 8.7 | 10.4 | 9.6 |
| | 1.5 | 10.7 | 10.7 | 10.7 | 8.7 | 10.3 | 9.5 |
| | 2 | 11.3 | 11.0 | 11.2 | 8.8 | 10.3 | 9.6 |
| | Mean | 8.9 | 10.4 | 9.7 | 7.3 | 10.1 | 8.7 |
| 4 | .25 | 11.7 | 16.0 | 13.9 | 7.6 | 10.7 | 9.2 |
| | .5 | 12.7 | 16.3 | 14.5 | 9.0 | 13.3 | 11.2 |
| | 1 | 14.3 | 17.7 | 16.0 | 12.0 | 14.3 | 13.2 |
| | 1.5 | 14.0 | 17.3 | 15.7 | 12.2 | 13.3 | 12.8 |
| | 2 | 14.3 | 16.2 | 15.3 | 12.0 | 13.3 | 12.7 |
| | Mean | 13.4 | 16.9 | 15.2 | 10.6 | 13.0 | 11.8 |

| LSD (0.05) between means | Maximum stand count | Final stand count |
|---|---|---|
| Varieties | 2.3 | 2.8 |
| Periderm surfaces (P) | 4.3 | 2.0 |
| Sett thickness (T) | 5.5 | 2.6 |
| Periderm surfaces in the same variety | 1.4 | 1.4 |
| Sett thickness in the same variety | 1.8 | 2.2 |
| P x T interaction | 4.4 | 1.7 |
| Between varieties in the same or different periderm surfaces | 6.0 | 4.9 |
| Between varieties in the same or different sett thicknesses | 9.3 | 7.6 |

**Plant height and leaf area**

In 1990, plant height of Um 680 increased with increase in surface area of periderm (P = 0.05) as well as with thickness of sett (P = 0.01). There was a significant interaction (P = 0.05) between the area of periderm and sett thickness. At $2cm^2$ periderm surface, plant height increased with sett thicknesses but at $3cm^2$ and $4cm^2$ periderm surfaces, plant height did not increase at sett thicknesses greater than 1cm (Table 4). A similar trend was observed with the number of leaves/plant and leaf area/plant except that there was a significant decline (P = 0.05) between 1cm sett and 2cm - sett with periderm surfaces of $3cm^2$ and $4cm^2$. Treatment effects on leaf sizes were not significantly different. Average leaf size was $31.5cm^2$. Thus leaf area/plant reflected number of leaves/plant. With leaf area index (LAI), area of periderm again interacted (P = 0.05) with sett thickness. In setts with $2cm^2$ periderm surface, LAI increased with sett thickness but in setts with $3cm^2$ and $4cm^2$ periderm surfaces, sett thicknesses between 1cm and 2cm were similar.

In 1992, variety interacted (P = 0.01) with surface area of periderm (Table 5). With periderm surface area of $2cm^2$, plants of Obiaoturugo ~~were taller than plants~~ of Um 680 whereas with the periderm surface areas of $3cm^2$ and $4cm^2$, the reverse was the case. On the average, surface area of the periderm and sett thickness increased plant height in both vanities. Um 680 produced 17.7% more leaves/plant than Obiaoturugo (P = 0.01). In both varieties, the number of leaves/plant increased with surface area of periderm (P = 0.01) as well as sett thickness (P = 0.01) but setts thicker than 1cm produced no significant difference in the $3cm^2$ and $4cm^2$ periderm surfaces. With $2cm^2$ periderm surface, the number of leaves definitely increased with sett thickness in both varieties; surface area of periderm (P = 0.01) and sett thickness (P = 0.01) increased leaf size. Obiaoturugo had a larger leaf size than Um 680 (P = 0.05). There was an interaction between periderm surface and sett thickness in leaf size. Whereas with $2cm^2$ surface of periderm, leaf size increased with sett thickness, leaf size was also similar in 1cm - 2cm sett thicknesses in $3cm^2$ periderm surface and similar in 0.5cm - 2cm sett thicknesses in $4cm^2$ periderm surface (Table 5). Increase in surface area of periderm increased leaf area index (LAI) in both varieties (P = 0.01). Periderm surface area of $2cm^2$ had larger LAI in Obiaoturugo than in Um 680 whereas with periderm surface of $3cm^2$ and $4cm^2$, the reverse was the case (P = 0.05). Increase in sett thickness increased LAI (P = 0.01) except that LAI did not increase significantly beyond 1cm sett thickness in $3cm^2$ and $4cm^2$ periderm surfaces.

Table 5: **Effect of area of periderm and thickness of yam setts on plant height, number of leaves and leaf Area:**

| Surface area of periderm ($cm^2$) | Sett thickness (cm) | Plant Ht. (Cm) Um Obia | Plant Ht. (Cm) Um 680 | Plant Ht. (Cm) Mean | No. of leaves/Pl. Um Obia | No. of leaves/Pl. Um 680 | No. of leaves/Pl. Mean | Leaf size ($Cm^2$) Um Obia | Leaf size ($Cm^2$) Um 680 | Leaf size ($Cm^2$) Mean | Leaf Area/Pl ($dm^2$) Um Obia | Leaf Area/Pl ($dm^2$) Um 680 | Leaf Area/Pl ($dm^2$) Mean | Leaf area index Um Obia | Leaf area index Um 680 | Leaf area index Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 0.25 | 30.0 | 20.3 | 25.2 | 8.0 | 12.0 | 10.0 | 11.0 | 10.5 | 10.9 | 0.88 | 1.29 | 1.09 | 0.03 | **0.04** | 0.04 |
| | 0.5 | 50.7 | 24.3 | 37.5 | 13.3 | 15.3 | 14.3 | 15.5 | 11.5 | 13.5 | 1.01 | 1.65 | 1.83 | 0.11 | **0.05** | 0.08 |
| | 1 | 53.3 | 42.7 | 48.0 | 17.7 | 18.0 | 17.9 | 25.8 | 13.0 | 19.4 | 4.56 | 2.34 | 3.45 | 0.25 | **0.11** | 0.20 |
| | 1.5 | 105.0 | 61.7 | 83.4 | 20.7 | 20.0 | 20.4 | 26.8 | 17.0 | 21.9 | 4.54 | 3.45 | 4.00 | 0.37 | **0.16** | 0.27 |
| | 2 | 123.7 | 80.0 | 101.9 | 23.3 | 22.0 | 22.7 | 29.3 | 19.3 | 24.3 | 6.02 | 3.02 | 4.92 | 0.61 | **0.22** | 0.42 |
| | Mean | 75.2 | 45.6 | 59.2 | 16.6 | 27.5 | 27.2 | 21.7 | 14.4 | 18.0 | 3.96 | 2.35 | 3.06 | 0.23 | **0.12** | 0.20 |
| **3** | 0.25 | 26.7 | 35.7 | 31.2 | 12.0 | 12.7 | 12.4 | 16.4 | 12.5 | 14.5 | 1.98 | 1.59 | 1.79 | 0.09 | **0.15** | 0.12 |
| | 0.5 | 49.0 | 69.0 | 59.0 | 17.0 | 23.0 | 20.0 | 16.6 | 14.5 | 15.6 | 2.81 | 3.54 | 3.18 | 0.16 | **0.33** | 0.25 |
| | 1 | 84.0 | 99.7 | 9.9 | 20.3 | 38.0 | 29.2 | 30.8 | 23.8 | 27.3 | 7.32 | 9.03 | 8.13 | 0.63 | **0.94** | 0.79 |
| | 1.5 | 130.3 | 146.3 | 138.3 | 23.5 | 38.3 | 30.9 | 30.0 | 24.1 | 27.1 | 7.29 | 9.10 | 8.20 | 0.64 | **0.94** | **0.79** |
| | 2 | 126.3 | 137.3 | 131.8 | 23.3 | 37.7 | 30.5 | 30.5 | 23.5 | 27.0 | 3.61 | 9.00 | 8.31 | 0.67 | **0.93** | **0.80** |
| | Mean | 83.2 | 97.4 | 90.4 | 19.2 | 29.9 | 24.6 | 24.9 | 19.7 | 22.3 | 5.38 | 8.41 | 5.92 | 0.44 | **0.66** | 0.55 |
| | 0.25 | 44.2 | 60.0 | 62.1 | 13.3 | 15.3 | 14.3 | 14.3 | 16.0 | 15.2 | 1.90 | 2.91 | 2.41 | 0.14 | **0.31** | 0.23 |
| | 0.5 | 76.3 | 98.0 | 86.2 | 17.7 | 33.7 | 20.7 | 25.8 | 20.5 | 23.2 | 4.56 | 4.86 | 4.71 | 0.41 | 0,65 | 0.53 |
| | 1 | 102.3 | 151.3 | 126.8 | 27.0 | 38.9 | 32.9 | 28.3 | 20.8 | 24.6 | 7.73 | 8.89 | 0.93 | 0.93 | **1.23** | 1.08 |
| | 1.5 | 143.7 | 166.3 | 154.0 | 27.3 | 38.7 | 33.0 | 28.7 | 23.6 | 26.2 | 7.78 | 9.00 | 8.32 | 0.95 | **1.20** | 1.08 |
| | 2 | 134.5 | 212.7 | 173.5 | 27.2 | 38.2 | 32.7 | 28.5 | 23.4 | 26.0 | 7.76 | 8.88 | 8.32 | 0.93 | **1.18** | 1.06 |
| | Mean | 99.8 | 141.7 | 126.7 | 22.5 | 30.9 | 26.7 | 25.1 | 20.8 | 23.0 | 5.95 | 6.91 | 6.43 | 0.67 | **0.91** | 0.80 |
| LSD (0.05) between Means : | | | 22.2 | | | 2.7 | | | 5.5 | | | 1.8 | | | **0.17** | |
| Periderm surface variety : | | | 26.3 | | | 2.8 | | | 2.8 | | | 0.92 | | | **0.17** | |
| **Sett thickness :** | | | 26.2 | | | 4.2 | | | 3.7 | | | 1.19 | | | **0.14** | |
| **Periderm means in each variety:** | | | 49.8 | | | 4.8 | | | 4.0 | | | 1.30 | | | **0.10** | |
| **Sett thickness means in each** variety : | | | **64.3** | | | 6.7 | | | 5.2 | | | 1.60 | | | 0.15 | |
| **Variety X periderm surface** : | | | - | | | - | | | - | | | 1.84 | | | 0.22 | |
| Variety X sett thickness : | | | 37.1 | | | - | | | 7.3 | | | - | | | - | |

**Table 6:** Effect of surface area of periderm and thickness of yam pieces on tuber yield and yield components of water yam (*D. alata*) 1990 expt

| Surface area of periderm ($Cm^2$) | Sett thickness (Cm) | No. of tubers/ plot | Tuber yield ((t/ha) | tuber yield /plant (g) | tuber size(g) | Average multi. ratio | Largest single stand yield (g) | Potential mult. ratio |
|---|---|---|---|---|---|---|---|---|
| 2 | .25 | 5.7 | 3.8 | 71.3 | 66.7 | 78.4 | 150.2 | 165.1 |
| | .5 | 9.7 | 9.3 | 84.5 | 95.9 | 50.9 | 351.1 | 211.5 |
| | 1 | 15.7 | 15.2 | 103.4 | 96.8 | 38.0 | 299.8 | 110.2 |
| | 1.5 | 15.7 | 16.8 | 136.9 | 107.0 | 37.3 | 500.1 | 136.3 |
| | 2 | 1.0 | 17.8 | 140.7 | 111.3 | 27.8 | 619.7 | 122.5 |
| | Mean | 12.6 | 12.6 | 107.4 | 95.5 | 46.5 | 384.2 | 149.1 |
| 3 | .25 | 12.0 | 10.3 | 106.9 | 85.8 | 88.3 | 409.9 | 338.7 |
| | .5 | 17.0 | 18.0 | 110.5 | 105.9 | 41.5 | 360.3 | 135.5 |
| | 1 | 18.7 | 20.4 | 111.5 | 109.1 | 26.9 | 421.1 | 101.7 |
| | 1.5 | 16.3 | 18.0 | 120.3 | 112.5 | 20.4 | 341.2 | 57.7 |
| | 2 | 19.3 | 20.0 | 111.1 | 103.6 | 14.5 | 659.7 | 85.9 |
| | Mean | 16.7 | 17.3 | 112.0 | 104.4 | 30.3 | 438.4 | 143.9 |
| 4 | .25 | 13.7 | 13.8 | 105.9 | 100.7 | 39.7 | 401.2 | 150.3 |
| | .5 | 1.3 | 14.4 | 100.7 | 100.7 | 27.9 | 259.0 | 72.0 |
| | 1 | 15.7 | 20.4 | 202.9 | 133.1 | 34.0 | 420.1 | 70.4 |
| | 1.5 | 15.3 | 20.6 | 152.0 | 135.4 | 18.6 | 360.2 | 44.1 |
| | 2 | 14.0 | 18.0 | 168.2 | 128.6 | 15.1 | 759.8 | 68.1 |
| | Mean | 14.6 | 17.6 | 143.9 | 119.8 | 27.1 | 440.2 | 81.0 |
| LSD (0.05) between means: | | | | | | | | |
| Periderm surfaces (p) | : | 2.2 | 3.3 | 30.0 | 15.8 | 13.8 | - | - |
| Sett thicknesses (T) | : | 2.8 | 4.3 | 38.7 | 20.0 | 17.8 | - | - |
| P & T interaction | : | 6.8 | 10.5 | N.S | 22.9 | 43.5 | - | - |
| Sett thickness in each periderm | : | 4.8 | 7.4 | 67.0 | 35.2 | 30.8 | - | - |

Table 7 Effect of surface area of periderm and sett thickness of yam pieces on tuber yield and yield components, 1992 expt.

| Surface area of periderm ($Cm^2$) | Sett thickness (Cm) | No. of tubers/plot | | Tuber yield (t/ha) | | Tuber yield Plant (g) | | Average multiplication ratio | | Average tuber size (g) | | Largest single plant | | Potential Multiplication | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Um 680 | Obia | Um 680 | Obia | Um 680 | Obia | Um 680 | Obia | Um 680 | Obia | Um 680 | Obia | Um 680 | **Obia** |
| 2 | 0.25 | 3.0 | 3.8 | 0.7 | 0.6 | 23.3 | 18.2 | 23.8 | 26.8 | 23.3 | 15.8 | 32.5 | 65.2 | 33.1 | **95.4** |
| | 0.5 | 3.7 | 6.2 | 1.3 | 2.6 | 43.2 | 45.6 | 26.4 | 35.6 | 35.1 | 41.9 | 52.5 | 90.5 | 32.0 | 70.7 |
| | 1 | 5.1 | 6.5 | 3.4 | 3.5 | 72.3 | 55.6 | 28.4 | 21.6 | 66.7 | 53.8 | 80.2 | 85.4 | 32.1 | 33.1 |
| | 1.5 | 5.0 | 7.2 | 3.6 | 4.3 | 76.6 | 64.2 | 24.2 | 19.1 | 72.0 | 59.7 | 95.1 | 105.1 | 30.1 | **31.3** |
| | 2 | 8.2 | 10.2 | 9.9 | 6.4 | 80.8 | 71.1 | 15.8 | 17.4 | 72.0 | 61.0 | 135.0 | 210.3 | 26.5 | **51.5** |
| | Mean | 5.0 | 6.8 | 3.1 | 3.5 | 59.2 | 50.9 | 23.8 | 24.1 | 53.8 | 46.4 | 79.2 | 111.3 | **30.8** | **56.5** |
| 3 | 0.25 | 10.0 | 5.2 | 5.3 | 2.7 | 54.6 | 57.4 | 34.6 | 42.2 | 53.0 | 51.9 | 90.2 | 68.1 | 43.1 | **50.1** |
| | 0.5 | 11.2 | 6.1 | 7.8 | 3.4 | 78.0 | 59.6 | 27.7 | 28.4 | 69.6 | 55.7 | 160.8 | 120.4 | 57.0 | **57.3** |
| | 1 | 11.7 | 9.0 | 8.2 | 5.3 | 78.8 | 60.9 | 24.0 | 15.8 | 70.1 | 58.9 | 285.0 | 160.3 | 87.1 | **41.5** |
| | 1.5 | 12.1 | 9.1 | 8.5 | 5.7 | 82.5 | 65.5 | 15.6 | 11.5 | 70.2 | 62.6 | 310.9 | 140.7 | **40.2** | **24.7** |
| | 2 | 11.2 | 9.3 | 8.1 | 5.6 | 78.6 | 63.6 | 12.2 | 8.9 | 72.3 | 60.2 | 311.4 | 175.5 | **48.5** | **24.6** |
| | Mean | 11.2 | 7.7 | 7.6 | 4.5 | 74.5 | 61.4 | 22.8 | 21.4 | 67.0 | 57.9 | 231.9 | 133.0 | **55.2** | 39.6 |
| 4 | 0.25 | 12.2 | 8.7 | 7.6 | 4.6 | 69.2 | 60.5 | 28.8 | 30.3 | 46.3 | 57.5 | 125.5 | 50.5 | **52.3** | 45.0 |
| | 0.5 | 15.0 | 9.0 | 0.7 | 5.6 | 80.5 | 62.2 | 26.5 | 16.1 | 71.3 | 62.2 | 135.0 | 90.7 | **44.4** | 23.5 |
| | 1 | 16.1 | 12.5 | 4.0 | 12.0 | 146.9 | 108.3 | 27.9 | 19.8 | 110.4 | 104.0 | 105.6 | 180.4 | **20.1** | 32.9 |
| | 1.5 | 15.0 | 12.5 | 14.5 | 10.1 | 109.0 | 82.8 | 20.7 | 10.4 | 96.7 | 96.0 | 158.3 | 120.9 | **22.1** | 21.4 |
| | 2 | 14.9 | 12.9 | 16.1 | 10.8 | 121.1 | 90.0 | 11.4 | 7.7 | 108.1 | 83.7 | 190.7 | 240.1 | **17.9** | **20.6** |
| | Mean | 14.6 | 11.0 | 13.4 | 8.8 | 105.3 | 80.8 | 23.1 | 16.9 | 86.6 | 80.1 | 143.0 | 154.5 | **31.4** | 29.7 |
| **LSD (0.05) between means:** | | | | | | | | | | | | | | | |
| **a) Variety** | | | 2.7 | | 4.5 | | 28.4 | | 7.6 | | 22.7 | | - | | - |
| **b) Periderm surfaces (p) in the same variety** | | | 1.5 | | 2.3 | | 14.5 | | 3.9 | | 11.6 | | - | | - |
| **c) Thickness (T) in the same variety** | | | 1.3 | | 3.5 | | 22.1 | | 5.9 | | 17.7 | | - | | - |
| **d) PT interaction in the same variety** | | | 1.7 | | 2.7 | | 17.0 | | 4.6 | | 13.6 | | - | | - |
| **e) Varieties in the same or different periderm surfaces** | | | 4.3 | | 6.7 | | 39.8 | | **10.7** | | 31.8 | | - | | - |
| **f) Varieties in the or different thickness** | | | 6.5 | | 10.3 | | 47.0 | | **12.6** | | 37.6 | | - | | |

Sprouting and establishment numbers, growth attributes and yield components followed the same pattern (Tables 2, 3, 4 & 5). This suggests that 1cm is the optimal thickness for yam pieces or yam setts used as planting materials. Indeed, in 1990, sett thickness of 2cm depressed sprouting and tuber yield in yam pieces of Um 680 with $4cm^2$ periderm surfaces (Tables 2 & 6). The thickness of 1cm falls within the range of thickness of yam peels (0.3 - 1.3cm thick) normally thrown away when processing yam tubers for food. Yam peels are therefore potential planting materials in yam production and their use provides opportunity for recycling what otherwise would have been discarded as waste. Sett thickness of 2cm and periderm surface of $4cm^2$ depressed sprouting in Um 680 (Table 2) probably because of exposure of a large surface area of ground tissue (cortex) to parasitic soil micro-organisms. Perhaps the sett thickness of 2cm falls outside the protection of the antifungal components of yam peels (Ogundana *et al*, 1983).

Yam pieces with $2cm^2$ periderm surface area gave lower stand count and tuber yields tnan $3cm^2$ and $4cm^2$ periderm surfaces especially in 1992 (Tables 2, 3, 6 & 7). As stand count has been shown to be an important yield determinant, yam pieces of $2cm^2$ periderm surface areas are not suitable for yam multiplication. Again propagules from $2cm^2$ periderm surface and those of 0.25 and 0.5 sett thicknesses tend to be more tender than the other propagules rendering them easy to cut by millipedes, crickets, snails and toads. The alternative cutting and regrowing slow down their pace of growth and development. In 1990, $3cm^2$ and $4cm^2$ periderm surfaces gave similar sprouting, growth and yield attributes in Um 680 (Tables 2, 4 & 6). But in 1992 when the plants were subjected to biotic and environmental stresses, the performance of $4cm^2$ periderm surface area was superior to $3cm^2$ periderm surface area. Thus yam peels of 1cm thickness and of $4cm^2$ or larger periderm surfaces are recommended in yam multiplication.

In 1990, the average tuber yield of Um 680 for setts with periderm surfaces of 3 - $4cm^2$ and sett thicnesses of 1 - 2cm was 19.7t/ha and 12.8t/ha in 1992. Corresponding value for Obiaoturugo in 1992 was 8.3t/ha. At 20 setts/$m^2$, the potential plant population was 200,000 stands as against 40,000 stands/ha with minisetts. From LAI values (Table 5), 200,000 stands/ha is a sub - optimal population. With 80 - 90% establishment in a favourable season, this population is capable of raising 160 - 200 thousand seed tubers/ha which can plant up 16 - 20 hectares for ware yam production (at 10,000 seed tubers/ha) as against 4 hectares from tubers raised from minisetts. Even in seasons when tubers turn out to be small, the number of seed tubers raised from one hectare using peel micro-setts can plant up 4 - 5 hectares (at 40,000 seet tubers/ha) to raise the larger size of seed tubers (about 500g).

Tuber yield of Um 680 (*D. alata*) in 1992 is 65.0% of the tuber yield in 1990. The difference was caused by anthracnose disease attack of the vines and unfavourable weather conditions in 1992. The total rainfall amount and sunshine hours in 1990 were 1929.3mm and 1537.7 hours respectively. Corresponding values of 1992 were 1711.9mm and 1117.6 hours. Lower sunshine hours combined with disease incidence to reduce yield in 1992. Crop yield in the rain forest zone of Nigeria is highly correlated with sunshine hours (Igwilo, 192). The highest rate of bulking of tuber occurs in September/October (Igwilo, 1988). Sunshine duration in September/October was 222.9 hours in 1990 and 84.5 hours in 1992. Bulking of tuber has been shown to occur from current photosynthesis with little or no transfer of reserve metabolites from the vines (Igwilo, 1994).

For yam pieces 1cm thick and 3 - 4cm$^2$ periderm surfaces, the average multiplication ratio for Um 680 was 36.5 in 1990 and 26.0 in 1992. The corresponding value for Obiaoturugo in 1992 was 17.8. In an adjacent experiment in1992 involving minisetts, the multiplication ratio for Um 680 was 8.0 and 5.2 for Obiaoturugo. Thus using yam pieces 1cm thick and 3 - 4cm$^2$ periderm surfaces as planting material have proved to be a more efficient method of raising seed yams than the minisetts and will serve the need of farmers especially those with small land holdings for profitable yam production. With this size of planting material, the average multiplication ratio of yam will be comparable to those of legumes and cereals (Onwueme, 1978). The potential multipliction ratios of 44-339 in 1990 and 17-88 in 1992 (Tables 6 & 7) suggest that there is great room for improvement.

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