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Yield Variation of *Dioscorea* Yams using Mini Tubers as a Planting Material

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ABSTRACT. A series of field experiments were conducted at the University Experimental Station, Dodangolla in the mid country intermediate zone, to study the yield variation of Dioscorea yams due to time taken for sprouting, cultivar and size of the planting material. Ten cultivars namely Iniala, Nigerian, Rajala, Thambala, Kahatala, Ratala, Leydantha, Angiliala, Hingurala and Kombuwalli with different set weight groups were investigated using a randomized complete block design with three replicates. In Experiment I, five weight groups namely 200 – 300 g, 300 – 400 g, 400 – 500 g, 500 – 600 g and 600 – 700 g and in experiment II, four weight groups of 100 – 200 g, 200 – 300 g, 300 – 400 g and 400 – 500 g were planted. Mini tuber groups were obtained from previous seasons harvest. The time taken for sprouting of mini tubers in these weight groups had a significant effect on the final tuber yield. The heavy tuber groups sprouted earlier with sprouting percentages of 15.0 and 11.5 at 4 WAP in experiment I and II respectively. The highest yields were obtained from the 300 – 400 g weight group in both experiments whereas the lowest yields were from tubers weighing 200 – 300 g and 100 – 200 g in experiment I and experiment II respectively. The highest multiplication ratio was obtained from 200 – 300 g weight group in experiment I and from 100 – 200 g group in experiment II, but 300 – 400 g weight group was relatively higher compared to other groups in both experiments.

The ten cultivars of Dioscorea which were tested, showed a variation in sprouting. The cv. Ratala had sprouting percentages of 13.3 and 20.2 at 4 WAP in experiments I and II, giving high yields of 29.2 and 40.7 mt/ha with bulking rates of 4.7 and 6.0 mt/ha/month respectively.

In experiment I and II, Hingurala sprouted late and had sprouting percentages of 6.6 and 6.4 at 4 WAP, giving low yields of 18.6 and 18.8 mt/ha with bulking rates of 3.7 and 3.2 mt/ha/month respectively. Therefore, it was concluded that the yield of Dioscorea yams varies with the size of the planting material, cultivar and the time taken for sprouting.

INTRODUCTION

Dioscorea is a tuber crop used as a staple food in many tropical countries, but grown in a very small extent in Sri Lanka. Several species have been recorded throughout the tropics. *D. rotundata*, is the most popular species in Nigeria and many other African countries (Wilson, 1978). *D. alata* is the most common species cultivated in Sri Lanka. The cultivars which belong to this species are, *Rajala*, *Hingurala*, *Angiliala*, *Iniala*, *Kombuwalli*, *Kahatala*, *Ratala*, *Leydantha*, *Thambala*, *Kandala* and *Ratuala* and are the most popular among Sri Lankan farmers. Some of these cultivars are large climbers which can reach 15 m in height and produce large tubers (Harischandra, 1987). Therefore, the species and cultivars available in Sri Lanka have a better potential for higher yields in farmers fields. The yam farmers mainly depend on the previous harvest to supply planting material for the next season. Local farmers use cut tuber pieces as planting material, but small or mini whole tubers can be used for this purpose. Therefore, the study of sprouting time, growth characteristics and yield is very important to improve this crop under local conditions.

Most of the *D. alata* yams produce 1 to 3 tubers per season. Some cultivars produce many branched tubers, which can easily be divided to give several seed tuber sets. The formation of tubers is influenced by several factors. Onwueme (1972) has shown that the length of storage time before planting has affected sprouting, tuber initiation and yield.

Although *Dioscorea* is not a new crop to Sri Lanka, very little agronomic research has been conducted. According to the present recommendations, cuttings from the tuber 'heads' from which the vine and the root arise, is used as planting material. Miege (1957) reported a direct relationship between the weight of the set used for planting and the yield produced. However, Onwueme (1967) reported that some cultivars needed larger sets for satisfactory development. This is probably under drier climatic (moisture stress) conditions, and the water reserve of larger sets gives a it an advantage over smaller weights. However, Miege (1957) found a negative correlation between the time taken for sprouting and yield.

Therefore, the present experiment was designed to determine the most suitable size of planting material to obtain optimum yield and to examine the cultivar differences on different set sizes.

MATERIALS AND METHODS

The experiments were conducted at the University experimental station, situated at Dodangolla in the mid country intermediate agro-ecological zone at an elevation of 367 m above sea level. The mean annual rainfall, mean relative humidity and mean temperature are 1562 mm, 79% and 31 C, respectively. The soil is a reddish brown latosolic with a pH of 5.8. Partly decomposed cow dung at the rate of 2 baskets (5 kg) per hole was applied one week prior to planting.

Ten cultivars namely *Iniala*, *Nigerian*, *Rajala*, *Thambala*, *Kahatala*, *Ratala*, *Leydantha*, *Angiliala*, *Hingurala* and *Kombuwalli* with different set weight groups were investigated using a randomized complete block design with three replicates. In experiment I, yam sets were divided into five weight groups 200-300 g, 300-400 g, 400-500 g, 500-600 g and 600-700 g during 1988 planting season. In experiment II, four weight groups of 100-200 g, 200-300 g, 300-400 g and 400-500 g were planted in 1989 based on the results obtained in 1988.

In experiment I, the yams were planted under rainfed conditions in April 1988 and harvested in January 1989. In experiment II the weight groups were planted in May 1989 and harvested in January 1990. Planting material of each cultivar weight group was planted in separate plots. Each plot, consisted of 18 hills in 3 rows spaced 1m x 1m and separated from each other by 1m wide furrows. Staking was done at 5 weeks after planting (WAP) and the vines were trained on each stake. No fertilizers were used after planting and hand tools were used for weeding, as the objective was to manage the crop under farmer's conditions.

Plant measurements were made in the centre of each replicate. Sprouting counts were taken at 2 week intervals. Three months after emergence, tuber fresh weight and the bulking rate per vine were determined at monthly intervals. Statistical analysis was done by using LOTUS 1-2-3, MINITAB and SAS packages.

RESULTS

The time taken for sprouting varied between cultivars (Table 1). Cultivar *Kombuwalli* was the first to sprout at 2 WAP. At 4 WAP

almost all the cultivars had sprouted (Table 2), but 10 weeks was required for completion. The sprouting at 4 WAP was closely related to the variation on final yield. The relationship between the sprouting % and the final yield was not displayed in other stages of sprouting. Therefore, the 4 WAP stage was taken as a base to compare the variation of sprouting % and the final yield on the cultivars. At 4 WAP, *cvs. Nigerian* and *Ratala* had the highest sprouting % (Table 1).

In both experiments, final yields and bulking rates were highest in *cvs. Nigerian* and *Ratala* (Table 3). Lowest yields (18.6 and 18.8 mt/ha) and low bulking rates (3.7 and 3.2 mt/ha/mth) were observed in *cv. Hingurala* in both experiments. The rest of the cultivars were intermediate in sprouting % and final yields and the variation was similar in both experiments.

Table 1. Sprouting at 4 WAP of field planted mini tubers (Expt. I and II).

	Expt.I		Expt. II	
Cultivar	No. Sprouted from 270 sets	Sprouting %	No. Sprouted from 216 sets	Sprouting %
Angiliala	30	11.1	24	11.1
Hingurala	18	6.6	14	6.4
Inial	18	6.6	15	6.9
Kahatala	25	9.2	16	7.4
Kombuwalli	18	6.6	14	6.4
Leydantha	21	7.7	15	6.9
Nigerian	36	13.3	44	20.2
Rajala	30	11.1	26	12.0
Ratala	36	13.3	44	20.2
Thambala	18	6.6	14	6.4
LSD (P=0.05)		8.0		10.6
CV %		36.9		36.5

Table 2. Percent sprouting of mini tubers at weekly intervals.

	Weeks after planting			
	3	4	5	6
Experiment I	0.0 – 9.2	6.6 – 13.3	43.3 – 64.4	57.2 – 96.1
Experiment II	0.0 – 10.6	6.5 – 20.3	26.1 – 68.1	33.4 – 98.7

Table 3. Sprouting (spr) % at 4 WAP, final yield (yld) and bulking rate (br) of cultivars (Expt. I and II).

Cultivar	Expt. I			Expt. II		
	spr %	yld mt/ha	br mt/ha/mth	spr %	yld mt/ha	br mt/ha/mth
Nigeria	13.3	33.7	5.8	20.2	31.6	5.4
Ratal	13.3	29.2	4.7	20.2	40.7	5.0
Rajal	11.1	26.9	5.3	12.0	29.0	6.8
Angilial	11.1	26.7	4.7	11.1	28.3	4.8
Kahatal	9.2	24.3	4.6	7.4	40.2	6.8
Leydanth	7.7	24.8	4.4	6.9	30.7	5.2
Thambal	6.6	22.5	4.3	6.4	38.3	6.5
Hingural	6.6	18.6	3.7	6.4	18.7	3.2
Kombuwall	6.6	22.9	4.2	6.4	34.3	5.8
Iniala	6.6	19.4	3.5	6.4	28.0	4.7
LSD (P=0.05)	8.0	3.2	0.9	10.6	5.3	0.7
CV %	26.9	17.7	25.8	36.5	21.5	23.7

Heavy tubers generally sprouted better in both seasons (Tables 4 and 5). The % sprouting decreased with low set weights, with the 300 – 400 g group showing best results. The low weights of planting material

Table 4. Sprouting (spr) % at 4 WAP, mean yield (yld) and multiplication ratio (mr) of weight groups (Expt. I).

Weight group	spr %	yld mt/ha	mr
600 – 700	15.0	26.4	3.7
500 – 600	14.7	25.4	4.2
400 – 500	10.8	24.4	4.8
300 – 400	14.9	28.4	7.1
200 – 300	8.6	24.2	8.2
LSD (P = 0.05)	5.7	2.2	2.6
CV %	36.9	17.7	19.7

Table 5. Sprouting (spr) % at 4 WAP, mean yield (yld) and multiplication ratio (mr) of weight groups (Expt. II).

Weight group	spr %	yld mt/ha	mr
400 – 500	11.5	36.3	7.2
300 – 400	10.3	35.9	8.9
200 – 300	10.8	30.7	10.2
100 – 200	8.6	26.0	13.0
LSD (P = 0.05)	0.9	3.5	2.7
CV %	36.5	21.5	26.4

gave the highest multiplication ratios in both experiments (*eg.* 200 – 300 g weight group in experiment I and 100 – 200 g group in experiment II). (Table 4 and 5).

DISCUSSION

Dioscorea yams are commercially propagated by using small tuber pieces or small (mini) whole tubers. When the small whole tubers were used the rotting of planting material can be avoided. Compared to mini whole tubers the small tuber pieces have a high tendency to rot after planting (Coursey, 1967). Therefore the mini whole tubers are better planting material for the local farmers. The sprouting of mini tubers varies with the size of the planting material and the cultivar (Onwueme, 1973). This indicates the importance of the study on variation of sprouting and yield on the planting material.

Nigerian (*D. rotundata*) showed a high percentage of sprouting. Among the *D. alata* cultivars, *Ratala* was best for sprouting, final yield and bulking rate. During the early weeks of planting *cv. Kombuwalli* sprouted well, but after 3 weeks the sprouting % declined. Thus the yield of this cultivar was 22.9 and 34.5 mt/ha in experiments I and II respectively. This is comparatively lower than early sprouting cultivars (*i.e. Ratala* at 40.7 mt/ha). Low sprouting cultivars were also poor yielders with low bulking rates. For example *Hingurala* yielded 18.6 mt/ha with a bulking rate of 3.7 mt/ha/month (experiment I). This may be due to the slow sprouting ability of this cultivar.

High tuber weights were characterized by early sprouting and usually higher yields. The 600 – 700 g weight group had the highest sprouting % and the final yield of 26.4 mt/ha and the lowest multiplication ratio of 3.7 mt/ha/month. In experiment II 400 – 500 g weight group had the highest sprouting % and a yield of 36.3 mt/ha. This is a higher yield, compared to the same size weight group in experiment I which gave 24.4 mt/ha. This may be due to a seasonal variation, because in experiment II in all weight groups the final yields were higher. The highest yield 28.4 mt/ha in experiment I was given by the 300 – 400 g group. The difference between this weight group and the 400 – 500 g weight group was not significant on final yield and sprouting %, but it was significantly different to 200 – 300 g weight group on final yield. 100 – 200 g group gave low yields and high multiplication ratio. However, the difference

in yield was not statistically significant at weight classes higher than 300 – 400 g (Tables 4 and 5). Therefore 300 – 400 g group had better results on sprouting %, yield and bulking rate. This could be recommended as the correct size of planting material for *D. alata*.

CONCLUSION

Dioscorea is a root crop cultivated by the local farmers as a back yard crop, but the sprouting rate, final yield and the bulking rate varies with the cultivar and the size of planting material. The experimental results showed that *D. rotundata cv. Nigerian* had higher values than *D. alata* cultivars. *D. alata* is very common among the local farmers and *cv. Ratala* showed good results for sprouting, final yield and bulking rate, while *cvs. Hingurala* and *Iniala* were slow sprouting cultivars and low yielders. The 300 – 400 g weight mini tubers performed most consistently and can be recommended as the suitable planting material for *Dioscorea alata* cultivars.

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