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EFFECT OF SEED SETT WEIGHT OF YAMS (*DIOSCOREA ROTUNDATA* POIR) ON YIELD

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ABSTRACT: Two experiments to evaluate ranges of weight of seed setts of yam (*Dioscorea rotundata*, Poir) cv Black Guinea were established in a Typic Hapludults soil in Corozal in the central hill lands of Puerto Rico in 2004 and 2005. The planting distance for both experiments was 30.4 cm by 1.2 m. Treatments in the first experiment were sprouted and non-sprouted seed setts of 42- to 70-g, 71- to 98-g, and 99- to 126-g weight ranges. In the second experiment only non-sprouted seed setts of 42- to 70-g, 71- to 98-g, and 99- to 126-g and 127- to 156-g weight ranges were evaluated. In the first experiment, the average yield of commercial yams ranged from 17.3 mt/ha to 33.7 mt/ha. In the second experiment, the average yield of commercial tubers ranged from 9.96 mt/ha to 20.79 mt/ha. In the first experiment, non-sprouted seed setts yielded more than the seed setts that had six weeks to sprout in a shadehouse before field planting. No differences in commercial yield were found among the non-sprouted seed sett ranges. Therefore, the lighter seed sett range of 42 to 70 g should be used for planting. In the second experiment, no differences in yield were found among the 71- to 98-g, 99- to 126-g and 127- to 156-g ranges. Results indicate that seed setts used for planting should be of the 71 -to 98-g seed sett range. Results of both experiments indicate that a seed sett range of 42- to 98-g should be used for planting.

RESUMEN: En los años 2004 y 2005 se establecieron dos experimentos para evaluar rangos en peso de material de propagación del ñame (*Dioscorea rotundata*, Poir) cv. Guinea Negro en un suelo Typic Hapludults en Corozal en la zona montañosa del centro de Puerto Rico. La distancia de siembra de ambos experimentos fue de 30.4 cm por 1.2 m. Los tratamientos del primer experimento fueron los rangos de peso de 42 a 70 g, 71 a 98 g y 99 a 126 g para material de propagación que estaba brotado, o sin brotar. En el segundo experimento se evaluó el material de propagación sin brotación de los siguientes rangos de peso: 42 a 70 g, 71 a 98 g, 99 a 126 g y 127 a 156 g. En el primer experimento el rendimiento promedio de tubérculos comerciales varió de 17.3 tm/ha a 33.7 tm/ha. En el segundo experimento el rendimiento promedio de tubérculos comerciales varió de 9.96 tm/ha a 20.79 tm/ha. En el primer experimento se encontró que el material de propagación sin brotar produjo mayores rendimientos que el que se había dejado brotar por seis semanas antes de trasplantar al campo. No se encontraron diferencias en rendimiento comercial entre los tratamientos de material de propagación sin brotar. Por lo tanto, el material de propagación de menor rango en peso (42 a 70 g) se debe utilizar para la siembra. En el segundo experimento, no se encontraron diferencias en rendimiento comercial entre los rangos de tratamientos de 71 a 98 g, 99 a 126 g y 127 a 156 g. Los resultados de ambos experimentos indican que un rango de peso de material de propagación entre los 42 y 98 g debe ser utilizado para la siembra del ñame Guinea Negro.

INTRODUCTION

Worldwide production of yams (*Dioscorea* spp.) was 39.9 million metric tons grown on 4.37 million hectares in 2003 (FAO, 2004). During the same year, yam production in the Caribbean was 0.6 million metric tons grown on 68,000 hectares. In the 2005/2006 season, yam production in Puerto Rico was 2,660 metric tons worth $2.82 million dollars at the farm gate (PR Dept. Agric., 2005). Yam is the most important root crop grown on the island.

The per capita consumption per year of yam in Puerto Rico is 3.48 kg. It represents a decrease in consumption of yam of 26% since 1980, when per capita consumption was 4.7 kg. Yam imports to Puerto Rico in the 2005/2006 season amounted to 10,995 metric tons of tubers (PR Dept. Agric., 2006).

In West Africa as in Puerto Rico, yam production is limited by the cost of labor and of the planting material. In the Kogi State of Nigeria, it was found that planting material amounted to 70% of the production costs (IITA, 2006). Bakang (1998) indicated that in Ghana, farmers have to set aside a quarter of their yam harvests to be used as planting material. In Jamaica, planting material is sold at the same price as tubers for consumption. Therefore, in the period when yam prices are highest, the price of the planting material is also highest.

Research to overcome the high amount of planting material required to plant a unit of land and to improve quality has been intensified during the past 35 years. One method studied has been the production of small yam tubers from minisetts. A minisett is a yam tuber section ranging from 10 g to 120 g, managed to prevent damage from pathogens, nematodes or insects, and grown in special media or in a shadehouse.

Mantell and Haque (1977) confirmed the results obtained by Maturin and Degras (1974) and Degras and Mathurin (1975). They found that seed setts of *Dioscorea alata* ranging from 10 g to 120 g could result in yields per plant ranging from 637 g to 1540 g. Seed setts of 30 g produced a mean tuber yield per plant of 838 g, whereas those weighing 120 g yielded 1,540 g per plant. Asnani and Harwood (1986) obtained similar results. They indicate that seed setts weighing between 40 and 60 g yielded 800 to 1,000 g per plant when plants were grown for eight months.

Kalu (1989) evaluated seed setts of 20 to 40 g from the head, middle, and tail sections of *Dioscorea rotundata* tubers. He found that as the minisett weight increased progressively in 5-g intervals from 20 g to 40 g, the tuber yield per plant increased from 125 g to 450 g for setts from the head section of the yams.

IITA (1986) reported that seed yams weighing 70 g to 100 g and planted at 1.0 m by 1.0 m produced tubers of *Dioscorea rotundata* variety TDr of an average weight of 1.64 kg. The seed yams could be produced at high population densities (440,000 to 500,000/ha) when using 50 g minisetts grown in a nursery.

In West Africa, farmers traditionally produce ware yams ranging in weight from 3.0 to 7.0 kg. To produce those tubers, seed setts weighing 0.5 to 1.0 kg have to be used for planting. In addition, big mounds have to be made and long stakes have to be used to support the foliage. The production of medium size tubers of 1.0 kg to 2.0 kg could be achieved by using smaller seed setts (IITA, 1986). In Puerto Rico, where the size of a family unit is made of less than four persons, a yam tuber of 1.0 kg to 1.5 kg is adequate for most households.

The purpose of this research is to determine whether high yield of yam (*Dioscorea rotundata)* cv. Black Guinea could be achieved by reducing the weight of the seed setts used for planting from the traditional weight range of 120 g to 175 g.

MATERIALS AND METHODS

Two experiments on yam (*Dioscorea rotundata* Poir) cv. Black Guinea were established in Corozal, in the central hill-lands of Puerto Rico to evaluate the effect of seed sett weight and type in an experiment planted in 2004, and seed sett weight in an experiment in the year 2005. Both experiments were planted in a very fine, parasesquic, isohyperthermic Typic Hapludults of the Corozal clay soil series. The experiments were located at 18° 19' 09" North latitude and 66° 22' 15" longitude at an elevation of 210 m above sea level. The average annual rainfall at the experimental site is 1854 mm, evaporation is 1395 mm; the maximum average temperature is 29° C and the minimum average temperature is 19° C.

In both experiments, yam seed setts were planted in a single row on top of a bed. Beds were spaced 1.2 m apart and planting distance between plants in the bed was 30.4 cm. Yam vines were staked with PVC tubes that had a height of 1.2 m above the bed and which were connected with nylon strings. Strings were used to connect the vine apex to the nylon.

Weed control throughout the season was achieved through the preemergence application of 4.48 kg ai/ha of ametryn, and the postemergence directed spray of paraquat. Fertilization included two applications of a 14-1-13-3 formula at 57 g per plant applied at two and four months after planting. A total of 400 kg/ha N, 29 kg/ha P_2O_5, 370 kg/ha K_2O and 86 kg/ha MgO was applied to the experiments.

The first yam experiment had two phases:
1) planting seed setts of three weight ranges in the shadehouse and transplanting the sprouted seed setts from the shadehouse to the field; and 2) planting non-sprouted seed setts of the same weight ranges as in phase 1 in the field. Planting of the seed sett ranges in the shadehouse was done 26 May 2004. Planting of both the sprouted and the non-sprouted seed setts in the field was done 7 July 2004. All treatments were harvested 9 March 2005, eight months after field planting.

The treatments for the first experiment:

Seed sett weights:	**sprouted**	**non-sprouted**
	42 to 70 g	42 to 70 g
	71 to 98 g	71 to 98 g
	99 to 126 g	99 to 126 g

The first experiment had a random block statistical design with six treatments replicated four times each. Each plot consisted of four beds, each with 14 plants for a total of 56 plants per plot. Of these, only the central 14 plants from each of the two middle beds were used for yield purposes.

The second yam experiment was planted 11 May 2005 and harvested 26 January 2006, at 8.5 months after planting. Plots consisted of five beds, each with 14 plants for a total of 70 plants. Only the 42 central plants in an area of 15.3m^2 were used for yield purposes. The treatments were non-sprouted sections of yam tubers of the following weights:

1) 42 to 70 g
2) 71 to 98 g
3) 99 to 126 g
4) 127 to 156 g

The second experiment had a random block statistical design with four treatments replicated four times each.

RESULTS AND DISCUSSION

Experiment 1:

The average yield of commercial tubers in the first experiment ranged from 17.3 mt/ha to 33.7 mt/ha, and the average number of commercial tubers ranged from 17.6 x 10^3/ha to 23.5 x 10^3/ha (Table 1). The highest average yield of commercial tubers was found when non-sprouted seed setts of 99 to 126 g were used. This treatment significantly yielded more ($\alpha = 0.05$) than the sprouted seed setts of the 42- to 70-g and the 71- to 98-g treatments, but did not differ from the other treatments. No differences among treatments were found in the weight of the non-commercial yield, or the number of commercial or non-commercial tubers.

The non-sprouted seed sett treatments tended to yield higher than the sprouted seed sett treatment of the same weight. The commercial yield (weight) of the sprouted treatments ranged from 17.3 mt/ha to 28 mt/ha, whereas that of the non-sprouted setts ranged from 26.7 mt/ha to 33.7 mt/ha.

The results of this experiment suggest that for yam cultivar Black Guinea, it is not necessary to pre-sprout the seed setts prior to field planting. This cultivar is not as photoperiod-sensitive as the White Guinea cultivar. The stress of transplanting plants, with vines that reached over one meter long, was detrimental to crop yield.

No differences in yield were found among the non-sprouted seed setts of the 42- to 70-g, 71- to 98-g or the 99- to 128-g seed sett ranges. The results indicate that the lighter seed sett range of 42 to 70 g should be used for planting.

Experiment 2.

The average yield of commercial tubers in the second experiment ranged from 9.961 mt/ha to 20.793 mt/ha. No differences in commercial yield of yam tubers were found among the two lightest seed sett ranges (42 to 70 g and 71 to 98 g).

No differences were found between the 71 to 98 g, 99 to 126 g and 127 to 156 g seed sett ranges. However, the 127- to 156-g range yielded significantly higher than the 42- to 70-g range (Table 2).

The average total yield of yam tubers ranged from 14.694 mt/ha to 24.219 mt/ha. No differences in total yield of yams were found between the 42- to 70-g, and the 71- to 98-g seed sett ranges. No differences were found among the 71- to 98 g, the 99- to 126-g and 127- to 156-g seed sett ranges. However, the 127- to 156-g range yielded significantly higher than the 42- to 70-g range (Table 2).

No differences in yield were found among the treatments for average weight or average number of non-commercial tubers or for total number of tubers. The average number of commercial tubers ranged from 9.659 x 10^3 to 17.707 per hectare. No differences in average number of commercial tubers were found among the 42- to 70-, the 71- to 98-, or 99- to 126-g seed sett ranges. No differences were found among the 71- to 98-, the 99- to 126- or the 127-to 156-g seed sett ranges. However, the 127- to 156-g seed sett range produced significantly more commercial tubers than the 42- to 70-g range.

Results of the experiments indicate that for commercial or total production of yams, seed setts used for planting should be heavier that those of the 42- to 70-g range. Since no differences in yield of commercial or total yield were found among the three heaviest seed setts evaluated, the yam grower should use the one requiring the least weight. Therefore, results indicate that yam seed setts of 71-to 98-g be used for planting.

Results from the two experiments with yam cv. Black Guinea indicate that either the lightest (42- to 70-g) or the next to the lightest (71- to 98-g) seed sett weights should be used for planting. In experiment 1, no differences in yield were found among the three non-sprouted seed sett weight ranges studied. In experiment 2, no differences in yield were found among the three heaviest seed setts studied. In each experiment, the lightest seed setts should be chosen for planting because of the savings in planting material when a lighter rather than a heavier seed sett is used for planting. Statistical analyses from both experiments indicate that the seed setts used for planting should be in the range of 42 to 98 g in weight.

Vegetatively propagated plants, such as root and tuber crops, generally have more variability among plants than those propagated by seeds. Although the results of both experiments failed to show differences among some of the treatments, the yield, without taking into account the statistical analysis, shows that the commercial yield of yam increased as the weight of the seed sett increased from 42 to 70 g to 71 to 98 g and to 99 to 128 g in both experiments.

A population of 27,174 plants would be required to plant a hectare of land at the planting distance used in the experiments (1.2 m x 0.304 m). At the seed sett weight range of 120 to 175 g generally used in Puerto Rico, it would require 3,261 kg to 4,755 kg to plant a hectare of yams. At the two lightest seed sett weights evaluated in the experiments (42 to 70 g and 71 to 98 g), it would require 1,141 to 2,663 kg to plant a hectare. A savings of 2,120 to 3,614 kg in planting material (seed setts) would be achieved if farmers use the seed setts in the 42- to 98-g range.

Table 1. Yield of sprouted vs. non-sprouted yam (*Dioscorea rotundata* Poir) cv. Black Guinea seed setts in Corozal. Experiment 1.

	Tuber Weight		Number of Tubers	
Treatments	Commercial	Non-Commercial	Commercial	Non-Commercial
Sprouted Seed Setts	mt/ha		10^3/ha	
42 to 70 g	17.26 a	1.91	19.72	7.22
71 to 98 g	22.77 ab	2.18	17.56	8.90
99 to 128 g	27.99 bc	1.85	31.75	6.01
Non-Sprouted Seed Setts				
42 to 70 g	26.69 abc	0.87	22.61	3.85
71 to 98 g	29.85 bc	1.85	22.13	7.22
99 to 128 g	33.71 c	2.18	23.50	6.73
		n.s.	n.s	n.s.

Table 2. Yield of yam (*Dioscorea rotundata* Poir) cv. Black Guinea seed setts in Corozal. Experiment 2.

Treatments (g)	Tuber weight (mt/ha)			Number of tubers (10^3ha)		
Seed sett weight	Commercial	Non Commercial	Total	Commercial	Non Commercial	Total
42 to 70	9.961 a	4.037	14.694 a	9.659 a	11.590	21.249
71 to 98	16.059 ab	3.920	19.399 ab	13.844 ab	10.818	24.662
99 to 126	20.212 b	2.556	22.767 b	15.454 ab	7.276	22.73
127 to 156	20.793 b	3.427 n.s	24.219 b	17.707 b	10.818 n.s	28.5625 n.s

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