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VARIABILITY FOR ROOT FRESH WEIGHT AMONG TROPICAL TYPE VARIETIES OF SWEETPOTATO

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ABSTRACT: Frequently, farmers in Puerto Rico complain that the tuberous roots from the recommended varieties differ in size, shape and weight, a situation that increases difficulties for marketing. Baseline information on the magnitude of losses related to inappropriate root size is not available. The objective was to assess roots' fresh weight distribution among varieties of sweetpotato of common use in Puerto Rico. Four varieties were grown in a location on the southern coastal valley. For this study roots harvested at 162 days were selected. Roots were weighed individually. Distribution of the individual root fresh weight for each variety was compared to theoretical distributions by using the Kolmogorov-Smirnov Test. There was a high frequency of light-weighted roots. The Normal Distribution does not describe adequately the data for root fresh weight distribution from any of the varieties. Because of a high frequency of roots having lightweight, Lognormal and Weibull Distributions appear more adequate than the Normal Distribution to describe the actual root weight distribution. Roots end to be too small for the market, thus for commercial purposes, results stress that a relatively high percentage of photosynthates accumulated in the roots are lost. More emphasis on the selection for this characteristic is needed.

INTRODUCTION

Throughout the Caribbean Basin, and certainly in Puerto Rico, sweetpotato production is dependent upon tropical-type varieties. Tropical-type varieties are characterized by the intermediate sweetness of their flesh after boiling (Martin and Deshpande, 1985). Along with this sweetness this type usually has light-colored flesh, either white, cream or crystalline yellow. These characteristics are of preference in the American Tropics and the Caribbean Basin (Martin and Rhodes, 1984; Collins and Walter Jr., 1985).

In Puerto Rico sweetpotato is not a typical small farm crop. It is produced on a relatively large scale in the southern coastal valley of the main island. Field management is partially mechanized and includes drip irrigation, fertigation and mechanical harvest. Frequently, local farmers complain that the tuberous roots from the recommended varieties differ widely in size, shape and weight, a situation that increases difficulties for marketing. The result is that a relatively high percentage of roots (about 20%) have to be discarded because they do not possess the physical characteristics established for marketability. Along with this constraint, farmers face low yield stability and susceptibility to the sweetpotato weevil. Baseline information on the magnitude of losses related to inappropriate root size is not available. This information is needed for the development of a quantitative basis for the selection of new clones. The objective of this study was, therefore, to assess roots' fresh weight distribution among tropical-type varieties of sweetpotato of common use in Puerto Rico.

MATERIALS AND METHODS

Cultivars Mina, Miguela, Viola and Dominicana were selected for this study. Tropical-type Mina and Miguela were selected during the 1960s and 70s among local landraces (Badillo-Feliciano et al., 1976). Viola, named after its skin color (purple in Spanish), came out of Dr. Frank Martin's sweetpotato breeding program at the Tropical Agriculture Research Station of the USDA in Mayaguez, Puerto Rico.

This variety is semi-sweet and has been classified as a sub staple-type. Dominicana is cream-fleshed and the standard variety used in Puerto Rico.

The experiment was conducted in 1999 at the Juana Díaz Agricultural Experiment Station farm of the University of Puerto Rico. This location, in the southern coastal valley, has a semiarid climate and elevation of 12 m above sea level. The soil was from the San Antón Series (fine-loamy, mixed, isohyperthermic, Cumulic Haplustolls) with a pH of 7.4 and 1.2% organic matter. The experiment was laid out as a Randomized Complete Block Design with four replications. Plots were seven 10.67 m long rows spaced at 0.91 m. Distance between plants within the row was 30 cm. After planting, standard management practices were followed (UPR - EEA, 1997). Fertilization was at a rate of 922.7 kg/ha with a 6-6-12 fertilizer. Weeds were controlled busing glyphosate at establishment and mechanically thereafter. Drip irrigation was used. Harvests were made at 121, 141 and 162 days after planting. Results of the 162-day harvest are reported herein. Before harvest, above ground parts were removed and tuberous roots were obtained by plowing deep, moving them to the soil surface. Roots were weighed individually.

Data on roots' weight were used to estimate yield. Distribution of the individual root fresh weight for each variety was compared to theoretical distributions by using the Kolmogorov-Smirnov Test. Theoretical distributions evaluated included Normal or Bell-shaped Distribution and the Lognormal, Exponential and Weibull Distributions.

RESULTS AND DISCUSSION

Average weights for individual roots for varieties Mina and Miguela were similar and tended to be lower than those of Viola and Dominicana (Table 1). Range from minimum to maximum weight was considerable for all varieties. Overall there was a high frequency of light-weighted roots. When a graphic representation of a Normal Distribution was over imposed over an actual distribution visual inspection revealed that individual fresh weight for the root was not normally distributed. This result was corroborated by the Kolmogorov-Smirnov test (Table 2).

The Kolmogorov-Smirnov test evaluates the discrepancy between the actual distribution and a selected theoretical distribution. When using this test the null hypothesis is that there is not a statistically significant discrepancy between the theoretical distribution and the actual distribution. For the Normal Distribution, all Kolmogorov-Smirnov estimators (D) were significant at the 1% level. Therefore, the Normal Distribution does not describe adequately the data for root fresh weight distribution from any of the varieties (Table 2). Studying the distribution among root weights in orange-fleshed varieties, Lowe and Wilson (1975) determined that variances for this characteristic were not homogeneous among varieties. Along with genotype effects, variability for this characteristic was attributed to differences in the quality of the propagation material, planting season and in the rate of development of the tuberous root. None of the theoretical distribution evaluated in this study adjusted to the response of Mina or Miguela (Table 2). For Dominicana, however, Lognormal Distribution adequately adjusts to the results. Whereas for Viola the Weibull Distribution was adequate. Results were consistent in indicating high frequency light-weighted roots.

In Puerto Rico, the market for fresh sweetpotato has established a standard root weight from 226 to 681 g. This standard was used to calculate the percentage of commercial roots for each variety (Table 3). Overall results indicate that less than 60% of roots harvested in this study conformed to the marketable weight (Table 3). If this parameter were applied to all roots harvested in this study, more than 40% of them would be discards. For Miguela, for example, only 46% of the roots had the weight that is commercially acceptable. Conversely, for Dominicana 44% of the roots had weight above the accepted. The latter result, however, is indicative of a late harvest. In a practical situation, Dominicana should be harvest earlier than at 162 days after planting.

Overall results indicate that root fresh weight for traditional varieties of sweetpotato used in Puerto Rico is not normally distributed. Because of a high frequency of roots having lightweight, Lognormal and Weibull Distributions appear more adequate than the Normal Distribution to describe the actual root weight distribution. For commercial purposes, results stress that a relatively high percentage

of photosynthates accumulated in the roots are lost. Roots are usually too small, and sometimes too large, for the market. The goal should be to select varieties that accumulate photosynthates in commercially marketable roots. In our project selection is for genotypes having high frequency of roots weighing from 340 to 681 g. New clones have increased percentage of commercial roots compared to that of the traditional varieties Mina and Miguela. However, more emphasis on the selection for this characteristic is needed.

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Table 1. Number of tuberous roots weighted, average root weight and maximum and minimum weight for individual root for four varieties of sweet potato harvested 162 days after planting.

Variety	Roots weighed	Average weight	Weight Range minimum	maximum
	- no. -	- g -	- g -	- g -
Dominicana	296	380	17	2,553
Miguela	665	298	15	1,955
Mina	870	270	11	1,584
Viola	355	389	23	1,948

Table 2. Kolmogorov-Smirnov values (D) and probability level for the adjustment of theoretical distribution on the actual distribution of root fresh weight of tuberous roots harvested at 162 days after planting.

Theoretical Distribution	Variety	D	P value
Normal	Dominicana	0.18	<0.01
	Miguela	0.17	<0.01
	Mina	0.16	<0.01
	Viola	0.12	<0.01
Lognormal	Dominicana	0.06	NS
	Miguela	0.05	<0.01
	Mina	0.06	<0.01
	Viola	0.06	<0.01
Exponential	Dominicana	0.07	0.04
	Miguela	0.07	<0.01
	Mina	0.06	<0.01
	Viola	0.12	<0.01
Weibull	Dominicana	0.06	0.02
	Miguela	0.05	<0.01
	Mina	0.04	<0.01
	Viola	0.04	NS

NS=Non-significant, indicates that actual distribution does not significantly differ from the theoretical distribution.

Table 3. Yield at 162 days after planting and percentage of yield accumulated in commercial and non-commercial roots based on a market preference for weight between 226 to 681 g per root.

Variety	Yield*	Below < 226 g/root	Above 226 to 681 g/ root	Commercial >681 g/root
	kg/ha	---------- % ----------		
Mina	5,082	20	54	26
Miguela	7,307	19	46	35
Viola	5,082	11	52	37
Dominicana	4,138	14	42	44

*There were no statistical differences for yield among varieties. Yield includes both commercial and non-commercial roots.