INTRAVARIETAL YIELD VARIABILITY OF SWEET POTATO

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ABSTRACT

BNAS 51, Centennial and *Kinangkong* yielded 27.42, 14.32 and 5.41 t/ha of tubers, respectively, with a corresponding coefficient of variation (C.V.) of tuber yield among hills of 41.92, 46.02 and 107.65%. Yield among hills was slightly more uniform at a spacing of 60 x 75 cm (C.V. = 56.39%) than at 30 x 75 cm (C.V. = 74.01%), although the difference in variability was not statistically significant. A high C.V. of tuber yield among hills (80.66%) was obtained by applying 200-190-230 kg/ha of N-P_2O_5-K_2O, while a low C.V. (54.81%) was observed at zero fertilizer application. Vine weight, vine number, vine diameter, leaf weight and leaf area were significantly and positively correlated to root yield. Variability in vine weight, vine number and leaf weight were significantly and positively correlated to the variability in root yield.

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INTRODUCTION

Sweet potato *(Ipomoea batatas* (L.) Lam) is a viny plant primarily grown for its large edible storage root, which can be utilized as food, as livestock feed, and as raw material for industrial purposes. It is said to be richer in Vitamins A and C, food energy, and minerals, such as Ca and Fe, than white potato (Edmond and Ammerman, 1971).

Several researchers have found a considerable degree of variability in storage root yield of root crops, especially sweet potato. This variability has been observed among hills of a sweet potato variety growing in more or less identical environmental and soil factors. However, Steinbauer *et al.* (1943) showed that a considerable plant-to-plant variation in storage root yield existed in adjacent plants of a sweet potato crop, thus discounting environmental and soil factors as the only sources of variation. If the possible factors affecting the crop's intravarietal yield variability can be identified and the yield variation minimized through the manipulation of some cultural management practices, such as variety, distance of planting and fertilizer application, this could lead to increased production of more uniform storage roots, as suggested by Haynes and Wholey (1971). In addition to increased yield, uniform roots have preferential demand for processing purposes such as canning and dehydration.

This study sought to determine the degree of yield variability among hills of sweet potato; evaluate the influence of variety, plant spacing and rate of fertilizer application on root yield and its variability; and, determine variability of agronomic characters as they relate to yield.

MATERIALS AND METHODS

Soil analysis. — Composite soil samples were collected and their pH, N, P and K contents were analyzed.

Experimental design. — The experiment was conducted on a three-factor factorial randomized complete block design with 3 replications. The three factors were: variety, distance of planting, and fertilizer level. Each treatment plot, measuring 5 m long and 2.25 m wide, consisted of 3 rows.

Varieties. — Three sweet potato varieties, namely, BNAS 51, Centennial and *Kinangkong* were used in this study. The test plants were planted and maintained in a nursery to ensure uniformity in age and size of planting materials. The stalks were cut for use in the experiment in about 4 months.

Distance and Method of Planting. — The plants were planted at a distance of 30 x 75 cm and 60 x 75 cm. Shoot apical cuttings, measuring 30 cm long, were planted in a slanting position using 1 cutting per hill with 3 nodes buried in the furrows.

Fertilizer Treatment. — Three levels of fertilizer application, namely 0-0-0, 100-95-115 and 200-190-230 kg/ha of N, P_2O_5 and K_2O were used. The N was applied in 3 equal doses: at planting, 10 days and 30 days after planting, while P and K were all applied at planting in the furrow.

RESULTS AND DISCUSSION

Soil Analysis.

Results of the soil analysis are as follows:

pH, using glass electrode pH meter	:	5.70
Total N, with Modified Kjeldahl Method	:	1,100.00 ppm
Available P, using Bray No. 2	:	23.52 ppm

Exchangeable K,
with ammonium
acetate extrac-
tion method : 257.40 ppm

Yield Variability and Yield.

BNAS 51 had low yield variation but had high root yield (27.42 t/ha) among hills (Tables 1 and 2). *Kinangkong,* on the other hand, showed relatively the highest variability but had the lowest yield (5.41 t/ha) among the varieties. This finding shows an inverse relationship between yield variability and yield, which closely agrees with the study of Haynes and Wholey (1971) suggesting that a reduction in variability might lead to increased sweet potato productivity. Nevertheless, the high root yield variability obtained in *Kinangkong* might be explained by the corresponding high C.V. values in its vine number, vine weight and leaf weight (Table 3), which in turn were directly and significantly correlated to root yield variation (Table 4).

Based on the results, it is more desirable, especially for commercial planting, to select sweet potato cultivars that exhibit low variabilities in yield as well as in vine weight, vine number and leaf weight, to obtain increased yield. The following indices are indicative of high-yielding varieties under prevailing field conditions: heavy vine weight, long main vine, large vine diameter, and high leaf area at harvest.

The data showed insignificant yield variability differences between the two distances of planting. However, their yields were signifi-

Table 1. Variability (percent C.V.) of storage root yield and yield components among hills of sweet potato.

Treatment	Total Root			Marketable Root	
	Weight	Number	Diameter	Weight	Number
Variety					
BNAS 51	41.92b	40.26b	26.24b	51.90b	48.38b
Centennial	46.02b	47.48b	42.44b	62.45b	57.98b
Kinangkong	107.65a	77.09a	81.86a	182.41a	170.30a
Distance (cm)					
60 x 75	56.39a	48.37a	43.12a	88.66a	84.56a
30 x 75	74.01a	61.53a	57.23a	109.19a	99.87a
Fertilizer (kg/ha) N-P_2O_5-K_2O)					
0-0-0	54.81b	50.80a	40.98b	74.82b	67.78b
100-95-115	60.14ab	49.27a	45.36b	93.43ab	86.08ab
200-190-230	80.66a	64.76a	64.19a	128.51a	122.78a

Within columns (variety, distance and fertilizer considered separately), means sharing a common letter are not significantly different at 5% probability level using DMRT.

Table 2. Root yield and yield components of 3 varieties at 2 distances of planting and 3 levels of N-P_2O_5-K_2O.

Treatment	Total Root			Marketable Root	
	Yield (t/ha)	Number/ hill	Diameter (cm)	Weight/ hill (g)	Number/ hill
Variety					
BNAS 51	27.42a	5.72a	4.80a	788.11a	3.16a
Centennial	14.32b	3.95b	3.75b	381.52b	1.76b
Kinangkong	5.41c	2.27c	2.03c	128.23c	0.62c
Distance (cm)					
60 x 75	13.75b	4.23a	3.78a	539.92a	2.14a
30 x 75	17.96a	3.72b	3.27b	325.32b	1.56b
Fertilizer (kg/ha) N-P_2O_5-K_2O)					
0-0-0	16.26a	3.76a	3.88a	432.98b	1.99a
100-95-115	17.06a	4.20a	3.55b	472.30a	1.98a
200-190-230	14.28a	3.98a	3.14c	392.58c	1.58b

Within columns (variety, distance and fertilizer considered separately), means sharing a common letter are not significantly different at 5% probability level using DMRT.

Table 3. Variability (percent C.V.) of agronomic characters.

Treatment	Vine			Leaf	
	Weight	Number	Internode Diameter	Weight	Area
Variety					
BNAS 51	47.01b	38.52b	15.40a	54.08b	48.02a
Centennial	43.70b	40.68b	15.62a	47.71b	38.06a
Kinangkong	58.82a	47.42a	14.46a	76.16a	38.66a
Distance (cm)					
60 x 75	44.60b	39.19b	14.24a	55.19b	46.36a
30 x 75	55.09a	45.23a	16.09a	63.45a	36.81b
Fertilizer (kg/ha) (N-P_2O_5-K_2O)					
0-0-0	47.64b	40.62b	15.22a	53.88b	35.28b
100-95-115	46.70b	40.42b	15.51a	57.36ab	40.75ab
200-190-230	55.19a	45.58a	14.76a	66.72a	48.72a

Within columns (variety, distance and fertilizer considered separately), means sharing a common letter are not significantly different at 5% probability level using DMRT.

Table 4. Correlation of variability in in yield percent (C.V.) to variabilities in agronomic characters at harvest.

Character	Correlation coefficient	Significance
Weight of vine	0.56	**
Number of vine	0.38	**
Diameter of vine internode	-0.21	ns
Leaf area	0.08	ns
Leaf weight	0.80	**

cant. As the plants were planted at a wider spacing (60 x 75 cm), however, they tended to consistently show more uniform roots and had comparatively higher yield per plant than those planted at closer spacing (30 x 75 cm). This was probably due to the presence of relatively more space per plant, resulting in less interplant competition for moisture, nutrients and light absorption. This, in turn, enhanced better growth efficiency of storage roots as well as vegetative organs. The studies of Hollar and Haber (1943) on yield and Agbigay (1964) on yield variability in sweet potato concurred with these findings. Plant spacing at 30 x 75 cm would tend to increase yield per ha due to the greater plant density per unit area. The bigger-sized roots produced at the wider spacing did not compensate for the increased yield at the higher plant density which was approximately twice more in plant population than at the 60 x 75 cm spacing. Therefore, tonnage of roots per ha was closely associated to the number rather than to the size of storage roots at harvest.

Results showed yield and yield variability differences in diameter of total roots as well as in marketable roots due to the different rates of fertilizer application. Increased variation was noted with increased fertilizer application, with a greater increase from fertilizer treatments 100-95-115 to 200-190-230 than from zero to 100-95-115 kg/ha. This trend was observed as well in variation of agronomic features measured except for diameter of vine internode. These data indicated that the NPK contents of the soil were quite sufficient, thus resulting in minimal variability, but were still deficient in giving maximum yield which was attained at fertilizer treatment 100-95-115 kg/ha. The maximum yield attained at fertilizer treatment 100-95-115 kg/ha may be ascribed largely to the increased agronomic yield that favored the formation and development of storage roots due to an increased size of photosynthesizing organs. This trend is well supported by the findings of Corpuz (1971), Yong (1970), and Morita (1969). Excessively high amounts of available nutrients in the soil, however, encouraged vegetation at the expense of root growth. In this study, applying fertilizer at the rate of 200-190-230 kg/ha N, P_2O_5 and K_2O in NPK-rich soil gave significantly small-sized total roots and lesser marketable root yield. From the results, it can be deduced that sweet potato requires a certain amount of NPK fertilizers for maximum yield, beyond which there may be a corresponding reduction in yield.

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