Heritability of agronomically relevant traits in cassava

J.C. Perez, H. Ceballos, J.I. Lenis, E. Ortega, and N. Morante

International Center for Tropical Agriculture (CIAT), Apdo Aéreo 6713. Cali, Colombia.

INTRODUCTION

Cassava (*Manihot esculenta* Crantz) is one of the most important calorie-producing crops in the tropics. It is an efficient in carbohydrate production, adapted to a wide range of environments. Although its most common product is the starch root, the foliage has an excellent nutritional quality for animal and human consumption and offers great potential.

In spite of the importance of cassava for human and animal food, little is known about the inheritance of agronomically relevant traits for this crop. Heritability in the broad-sense (h^2) quantifies the relative magnitudes of genotypic and phenotype variances for a trait and serves a predictive role in selections procedures (1). It thus gives an idea of the total variability that is due to genetics causes and enables the plant breeder to determine the most efficient selection procedure to adopt in his breeding program.

OBJECTIVE

To estimate broad-sense heritability coefficients of agronomic relevant traits in cassava using individual and across locations data.

MATERIAL AND METHODS

Thirty-eight elite clones were evaluated in a uniform regional trial across thirteen locations in the northern coast of Colombia. Broad sense heritability coefficients were estimated for individual locations and across location data for fresh root productivity, harvest index, dry matter content and fresh foliage productions.

RESULTS

Mean fresh root productivity (Table 1) ranged from 53.0 (Carepa, Antioquia Department) down to 14.8 t/ha (Sahagun, Córdoba Department). Heritability coefficients for this trait, based on individual location data ranged from 0.876 (Corozal, Sucre Department) down to 0.304 (Necoclí, Antioquia Department) with a mean value of 0.560. In the analysis combined across the 13 locations, heritability coefficient (which is already corrected by the effect of genotype by environment interaction) was 0.789. (Table 2).

Heritability coefficients in the combined analysis across the thirteen locations for dry matter content in the roots, harvest index and fresh foliage production were 0.947, 0.929 and 0.840 respectively. Coefficients of variability for fresh root yield, based on individual location data, ranged from 30.9 down to 19.4% with a mean of 24.5%. In the analysis combined across the thirteen locations, the coefficient of variation was 24.8%.

(1) Allard R.W. 1960. Principles of Plant Breeding. John Wiley and Sons Co. New York, Toronto. 485p.

Table 1. Averages for fresh root productivity, dry matter, harvest index and fresh foliage of 38 cassava clones evaluated in 13 environments in the Northern Coast of Colombia.

Department	Environment	Fresh Root t/ha	Dry Matter %	Harvest Index	Fresh Foliage t/ha
Atlántico	Pital	23.3	36.6	0.59	16.8
	Santo Tomas	18.9	33.4	0.50	19.2
	Caracolí	18.3	34.3	0.62	11.5
	Baranoa	25.8	35.6	0.64	14.3
Sucre	La Unión	26.4	34.9	0.52	25.2
	Corozal	22.1	30.8	0.49	22.0
Córdoba	C. de Oro	23.9	33.9	0.50	23.5
	Sahagun	14.8	28.4	0.45	17.9
Urabá	Necoclí-1	31.4	33.3	0.67	15.7
	Carepa-1	35.3	36.7	0.55	29.0
	Necoclí-2	32.8	34.7	0.70	14.8
	Carepa-2	53.0	35.7	0.61	34.9
	Mutatá	26.6	37.8	0.51	25.9
Average		27.1	34.1	0.56	20.8

Table 2. Heritability (h^2) and coefficients of variation (CV) for individual location and across locations of thirty-eight clones evaluated in thirteen environments.

Department	Environment	Fresh Root		Dry Matter		Harvest Index		Fresh Foliage	
		h^2	CV (%)	h^2	CV (%)	h^2	CV (%)	h^2	CV (%)
Atlántico	Pital	0.400	27.1	0.871	3.8	0.760	9.9	0.681	29.2
	Santo Tomás	0.498	30.9	0.922	3.4	0.858	11.6	0.437	28.0
	Caracolí	0.434	26.1	0.894	3.4	0.600	10.0	0.483	32.2
	Baranoa	0.605	23.9	0.918	2.8	0.726	10.0	0.421	28.5
Sucre	La unión	0.580	23.2	0.801	6.2	0.974	12.7	0.440	29.0
	Corozal	0.876	19.4	0.924	4.6	0.880	11.6	0.606	23.2
Córdoba	Cienaga de Oro	0.663	22.9	0.896	3.4	0.866	9.0	0.799	19.76
	Sahagun	0.761	30.5	0.416	13.5	0.798	15.5	0.552	25.74
Urabá	Necoclí-1	0.525	22.7	0.454	7.8	0.750	7.8	0.767	25.9
	Carepa -1	0.597	19.5	0.804	4.2	0.813	9.9	0.685	26.1
	Necoclí-2	0.304	24.0	0.482	5.4	0.622	7.9	0.438	37.7
	Carepa-2	0.448	22.1	0.773	4.0	0.805	10.1	0.553	32.2
	Mutatá	0.585	25.9	0.642	7.6	0.649	12.3	0.593	25.6
Across locations		0.786	24.8	0.947	5.8	0.929	10.5	0.840	29.2

CONCLUSIONS

Results indicate the high potential of this crop as a source of raw material for different purposes (mean fresh root productivity of 33.8 t/ha) but also the possibilities of a genetic improvement of the crop based on these relatively high heritability estimates.