Introduction of inbreeding and analysis of inbreeding depression in eight S1 cassava families

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Introduction

To consolidate the relevance of cassava in tropical agriculture more efficient breeding approaches need to be developed and validated. It is also necessary to develop information about the genetic structure and the inheritance of relevant traits. Consolidated results from three different diallel studies(1) revealed strong non-additive effects (dominance and epistasis) affecting fresh-root yield in cassava, whereas resistance to diseases and pests was mostly due to additive genetic effects (which also includes the impact of single dominant sources of resistance). For an efficient exploitation of non-additive genetic effects reciprocal recurrent selection would be appropriate. Moreover, the use of inbred parents would greatly facilitate the process. Inbreeding offers numerous advantages but also presents some problems for the genetic improvement of the crop. One of the concerns is that inbreeding depression may be too drastic for partially inbred materials to survive. The objective of this study was to quantify inbreeding depression in cassava.

Materials and Methods

Large S1 families (represented by about 100 genotypes each) from eight elite clones were developed and evaluated in a replicated trial at one location (three replication with three plants per replication). The results from the evaluation allowed to measure inbreeding depression (average performance of S1 lines / average performance of parental S0 clone) levels for key traits.

Results

A summary of the results is presented in Table 1. Inbreeding depression was stronger for fresh-root yield (0.35) and negligible for dry matter content in the roots (0.95). Inbreeding depression for fresh-foliage yield was 0.61, for harvest index was 0.75, and for plant height was 0.90. Results demonstrate that inbreeding depression is not necessarily an unsolvable problem. The major obstacle is that segregation in the process to develop inbred material also include flowering. This implies that rather than selecting for agronomically superior, inbreeding-tolerant germplasm, the breeder ends up selecting for the capacity of the segregating progenies to flower. To overcome this problem two alternatives can be suggested: the production of doubled-haploids through anther (or ovule) culture (a project currently supported by the Rockefeller Foundation) and the induction of flowering through the exogenous application of phyto-hormones (no research in this regard in currently underway). The induction of flowering would also facilitate the operations of cassava breeding nurseries, reducing significantly the time required to produce recombinant botanical seed.

Table 1. Average performance of eight elite clones (S0) and their respective S1 families (made up of 100 genotypes). Highlighted in red and blue the highest and lowest expressions of inbreeding depression for each trait.

Clone		Plant height (cm)	Fresh root yield (kg/pl)	Fresh foliage yield (kg/pl)	Harvest Index	Dry matter content (%)
SM	S_0	239.3	3.5	1.9	0.65	35.8
1669-7	S_1	182.5	1.1	1.0	0.49	33.2
SM	S_0	207.6	4.2	2.7	0.61	31.8
1669-5	S_1	191.8	1.5	1.3	0.49	30.4
SM	S_0	216.8	4.5	1.8	0.71	35.3
1511-6	S_1	193.9	1.6	1.0	0.59	32.3
SM	S_0	174.8	3.3	1.9	0.63	32.1
1665-2	S_1	164.3	1.6	1.6	0.47	31.2
SM	S_0	208.0	1.0	2.0	0.33	29.7
1565-5	S_1	188.0	0.4	1.3	0.19	29.6
SM	S_0	223.7	4.9	2.6	0.65	26.1
1460-1	S_1	222.0	2.1	1.8	0.53	25.7
SM	S_0	246.2	9.9	2.9	0.76	29.7
1219-9	S_1	229.1	3.2	2.1	0.57	27.7
MTAI	S_0	202.7	4.5	2.5	0.60	30.0
8	S_1	171.1	1.0	1.1	0.38	27.5
Mean S_1/S_0 ratio		**0.90**	**0.35**	**0.61**	**0.75**	**0.95**

(1) References:

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