Article

Does Selection Improve Apomixis in Cassava, *Manihot esculenta* Crantz?

By

Nagib M. A Nassar and Claudio Rodrigues dos Santos

Departamento de Genetica e Morfologia e Departamento de Botanica respectivamente

Universidade de Brasilia, Brasilia, Brazil

Abstract

Apomixis in cassava has a low percentage of 1 to 1.5%. It is due to apospory embryo sacs which arise from cells in nucellus or from cells in the sexual embryo sac. Recurrent Selection was applied to an apomictic population. Survey of apospory embryo sac occurence in its progeny enabled select a plant with 11% of this type compared to 1% in the parents.

Key words: apospory , embryo sac, recurrent selection, Cassava is a principal food for more than 800 million people in the tropics and sub tropics(FAO, 1999). Apomixis which means production of assexual embryos and further seed without fertilization offers many advantages for cassava development. It enables avoid contamination by bacterial germs and virus which prevail in case of using stalk in reproduction. Moreover, it fixes heteroses since the plants are perpetuated through identical offspring for successive generations. This author has reported previously its occurence in cassava and the development of apomictic clones (Nassar, 1974, 1975 , Nassar et al.1998[a], 1998b), He proceeded towards transferrring its genes from the wild to the cultivate and clarified its nature(Nassar et. al. 2000, Nassar,2001). We tried here to use recurrent selection to increase its percentage in cassava.

Material and Methods

The facultative cassava clone UnB 200 obtained formerly through selection within progeny of a cassava hybrid with ***Manihot glaziovii*** was left for open pollinization. From its progeny, thirteen plants were selected on basis on presence of apospory embryo sac. These plants were left for open pollinization, and from each plant , ten plants were raised.

The emryo sac analysis was carried out in ovules of twenty progeny plants raised from two progenitors which are called 200-12, and 200-13. Embryo sac analysis was carried out on both pollinated and unpollinated pistils. Unpollinated pistillate buds were collected 1 day before anthesis. The pollinated ones were collected 2 days after anthesis. Approximate 200 pistillates of each plants were examined for emryo sac analysis. They were fixed in acetic alcohol 1:3 in the field between 7:30 hr and 12:00 hr. Fixed pistills were dissceted under a dissection microscope (magnification x 40, transmitted light). Dissected nucellus and ovules were dehydrated in ethanol series and cleared overnight in the benzyl-benzoate-four-and-a-p-half (BB-41/2)fluid (Lactic acid-chloral hydrate : pehenol : clove oil: xylene: benzyl benzoate= 2:2:2:1:1, w/twt devised by Young et al. (1979) and treated in a modified Herr's fluid as previously reported by Ogburia and Adachi (1994). Trasnparent ovules were then observed and photographed microscopically at 400X magnification using Normarski's differential interference contrast.

Results and Discussion

The ovule anatomical study showed that embryo is formed by apospory from a somatic cell in the nucelus. The megasporogenesis in ovules with aposporous development proceeds normally up to a certain moment when nucellar cells enlarge and the nuclei devide to form aposporous embryo sacs. These aposporous embryo sacs appear to develop faster than sexual embryo sacs probably because they are not delayed by meiotic division.. This is in accordance with Nogler (1984, and Asker 1979). In some cases, it was noted the development of apospory embryo sac from cells within the sexual one Both of the aposporous and sexual embryo grow parallel, finally they coexist together(see photod gallery Fig. 58. This observation is confirmed by what was found by the first author in a previous study where two seedlings grew side by side,

one of them was apomictic, the other was sexual (Nassar, 1995). In literature. there is accordancec with this result . Nogler (1984) reported in Potentilla aposporous and sexual processes coexised in an individual ovule producing several embryos.

Surveying frequency of embryo sac occurence, it was noted that one plant in the progeny of individual 13 called 13-8 had a percentage reached 11 % compared to 1% in its parent. This result may lead to possibility of that apospory embryo sac, and accordingly this type of apomixis in cassava is controlled by multiple factors, which their accumulation in a certain genotype may lead to a higher level of apomixis.

References

FAO, (1999). Production yearbook

Asker, S. (1979). Progress in apomixis research. Hereditas 91:231-240.

Nassar, , N. M. A (1994). Selection of Apomixic cassava clones. Ciencia e Cultura 48:168-170.

Nassar, N. M. A (1995). Development and Selection for apomixis in cassava *Manihot esculenta* Crantz. Can.

J. Plant Sci. 74:857-858.

Nassar, N. M. A , Vieira M. A , Vieira C. and Grattapaglia D. (1998[a]) Evidence of Apomixis in Cassava *Manihot esculenta* Crantz. Genetics and Molecular Biol. 21: 527-530.

Nassar, N. M. A ,Vieira M. A ,Vieira C. and Grattapaglia D. (1998b). Molecular and Embryonic evidence of apomixis in cassava interspecific hybrids (*Manihot* spp.) Can. J. Plant Sci.78:349-352.

Nassar, N. M. A. , Santos E and David S. (2000). The transference of apomixis genes from *Manihot neusana* Nassar to cassava, M. esculenta Crantz. Hereditas 132:167-170.

Nogler, G. A 1984. Gametophytic apomixis. In Embryology of Angiosperms, B. M. Johri,ed (Berlin:Springer-Verlag),pp.475-518.

Ogburia m. N. and Adachi T.(1994). Na improved cleared pistil technique for rapid in toto observation of embryo sac malformation in cassava *Manihot esculenta* Crantz. Proceeding of the second International Scientific Meeting in cassava. Biotechnology Network, Indonesia. P.117-127.

Young B. A Sherwood R.T. and Bashaw E.C. (1970). Cleared pistil and thick sectioning techniques for detecting aposporous apomixis in grasses. Ca. J. Bot. 57: 1668-1672.

Acknowledgement

This work was supported by the Brazilian National Council of Research Development (CNPq). The above mentioned living collection was established at the Universidade de Brasilia by the help of the International Development Research Center(IDRC), Ottawa,

Canada to which I am grateful. Thanks are due to the undergraduate students Sandra David, and Luzia Pereira, for cytological preparations.