Microsporogenesis in *Manihot esculenta*¹

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Received December 7, 1966

Manihot esculenta, an important food plant in lowland tropical areas, has come to us as a product of probably as much as 4,000 years of vegetative propagation. During the cultivation of this plant there has undoubtedly been an accumulation of spontaneous mutations which due to the factor of vegetative propagation, have not been selected against. These mutations have affected pollen and ovule fertility, as well as seed viability (Jennings 1962, Moh 1965), and their effects can be clearly seen in the meiotic irregularities that are found in many of the cultivars (Hsu and Valerio 1966).

Of the eighty-five cultivars that are being used in the Nuclear Energy Program at the Instituto Interamericano de Ciencias Agrícolas (I.I.C.A.) in Turrialba, Costa Rica, some were found to have regular meiotic divisions (Sohmer 1966, Hsu and Valerio 1966) and in two of these, the course of microsporogenesis was recorded.

Materials and methods

All materials used came from the I.I.C.A. The inflorescences were collected from only those cultivars shown to have nearly 100% fertile pollen (Valerio 1965): Cultivars numbers 6 and 22 were utilized for this study. These inflorescences were fixed in Carnoy's 3:1:1 (absolute alcohol, glacial acetic acid, chloroform) for a period of twelve to twenty-four hours and then transferred to 70% ethanol and stored at 4°C until used. The iron-acetocarmine squash technique was used (Belling 1926) except that the pollen mother cells were squeezed out of the anthers in a drop of the iron-acetocarmine and the anther debris removed before the coverslip was placed on the slide and pressure applied.

Observations

The microsporocytes are relatively large, and arise directly from the archesporocytes, of which there are four single rows in each anther. Microsporogenesis was found to be normal insofar as there were few irregularities in the various stages. The chromosome number of the cultivars studied was found to be 18 which agrees with the findings of other investigators (Perry

¹ Work made possible through a research grant of the Organization for Tropical Studies, San Jose, Costa Rica.

Figs. 1-9. Microsporogenesis in *Manihot esculenta*. 1 and 2, microsporocytes that have arisen directly from the archespores. $\times 330$. The cells in Fig. 2 are squashed. 3, metaphase II. $\times 1300$. 4, metaphase I, 18 bivalents, opened and closed. $\times 3700$. 5, anaphase I $\times 3000$. 6, 4 nucleate stage just prior to formation of cell walls. $\times 1600$. 7, prophase I, pachytene. $\times 3000$. 8, formation of cell walls. $\times 1300$. 9, microspore tetrad. $\times 330$.

1943, Graner 1941, Hsu and Valerio 1966). In the formation of the microspore tetrad, cell wall formation is simultaneous.

Summary

Microsporogenesis was investigated in selected cultivars of *Manihot esculenta* being cultivated at the Instituto Interamericano de Ciencias Agrícolas in Turrialba, Costa Rica. The course of microsporogenesis was found to be "normal" in these cultivars and various stages of the process were recorded.

Acknowledgments

The author wishes to acknowledge the technical aid of Dr. Alan S. Heilman, Botany Department, The University of Tennessee.

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