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A NATURALLY OCCURRING HAPLOID EMBRYO IN THE COCONUT PALM (*COCOS NUCIFERA* L.)

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A NATURALLY OCCURRING HAPLOID EMBRYO IN THE COCONUT PALM (*COCOS NUCIFERA* L.)

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During the course of extensive investigations on cytology of embryo and endosperm in coconuts, a very interesting case of a haploid embryo was encountered in a West Coast Tall palm growing in the Agricultural Experiment Station attached to the Department of Botany, Kerala University, Trivandrum. The embryo in question came from a set of embryos from a bunch fixed for chromosome studies and conformed to the size gradient exhibited by the embryos in that bunch.

Examination of dividing cells of this embryo from different slides showed the chromosome number to be 16 (Figs. 1 and 2). Dividing cells with no other chromosome numbers were met with in this embryo. Estimation of nuclear volume showed that the average volume of haploid nuclei was only about a third of that of the diploid nuclei. A preparation showing the usual diploid number of $2n = 32$ from another embryo in the same bunch is shown in Fig. 3 for comparison. In Fig. 4 is illustrated the triploid number of 48 chromosomes from an endosperm cell.

The present report appears to be the first instance of a nut with a single haploid embryo being reported in the coconut palm with authentic evidence of chromosome numbers. WHITEHEAD and CHAPMAN (1962) reported a diploid-haploid twin (seedling) in coconut, the haploid being the weaker member of the pair. They have not however given photographic evidence of chromosomes in support of their claim.

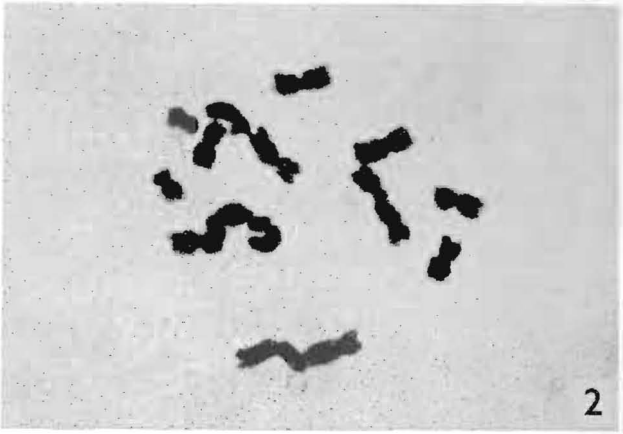
Haploids are known to arise spontaneously and could be induced by delayed pollination, use of abortive pollen, distant hybridisation, high and low temperatures and radiation (X-ray treatment, use of isotopes) and chemicals (MAGOON and KHANNA 1963, KIMBER and RILEY 1963). The origin of the haploid embryo we have studied is spontaneous and probably resulted from haploid parthenogenesis. The endosperm of this nut was quite normal in appearance, but could

not be studied cytologically as the discovery of the haploid embryo was accidental and the endosperm from this nut was not fixed for chromosome study. If it is a case of parthenogenetic development of the egg cell, it is possible that the endosperm is diploid (provided there is no triple fusion) to begin with unlike the triploid endosperm in normal coconuts (ABRAHAM 1963, ABRAHAM and MATHEW 1963). It is perhaps likely that the occurrence of a high degree of endopolyploidy in coconut endosperm (ABRAHAM *et al.* 1965) might serve to offset the disadvantage if any, arising from an initial diploid constitution of the endosperm. It is of interest in this connection that normal nuts devoid of embryos are not very uncommon as has been observed on examination of ungerminated nuts in coconut nurseries (NINAN, unpublished). Critical examination of such nuts has not indicated the presence of abortive embryos or any evidence of embryo abortion. It is possible that such nuts result from fertilization followed by early abortion of the embryo. Study of chromosome constitution of the endosperm in nuts with haploid embryos and those without embryos might throw further light on these aspects.

If the origin of the haploid embryo is due to haploid parthenogenesis, it would mean that parthenogenetic development of embryos occur spontaneously in coconuts and could also possibly be induced. SHARMA and SARKAR (1956) stated that the high percentage of pollen sterility in coconuts stands against the assumption that sexual reproduction becomes effective in the production of fruits, which are abundant in this species. They also suggested that pollination in coconuts may provide a stimulus for apomictic reproduction. NAMBIAR and SWAMINATHAN (1960) however pointed out that the above suggestion finds no support in the available results of breeding experiments on coconuts. Results of trials on induction of haploidy, taken up by one of us (C. A. Ninan) are of interest in this connection. Pollination with irradiated pollen subjected to 50,000r (the LD-50 dose for coconut pollen determined by NAMBIAR (1960) is 25,000r) gave up to 65% setting of nuts compared to 14% in the controls when a good number of female flowers were removed before the others were pollinated. Fairly good seed set has also been obtained when irradiated pollen subjected to 100,000r was used (see Table I). Moreover, the pollen used in the above trials did not germinate *in vitro* and was probably dead, due to the delay in transhipment to Delhi and back, where irradiation was done. Similarly rare nut set was also obtained in trials on interspecific hybridisation with *C. australis*

Figs. 1-4. — Chromosome of *Cocos nucifera* L. All figures ×2000.
Fig. 1. — A cell from the haploid embryo showing 16 chromosomes.
Fig. 2. — Another cell from the same embryo with 16 chromosomes.
Fig. 3. — A cell from a diploid embryo from the same palm showing 32 chromosomes.
Fig. 4. — An endosperm cell showing the triploid number of 48 chromosomes.


1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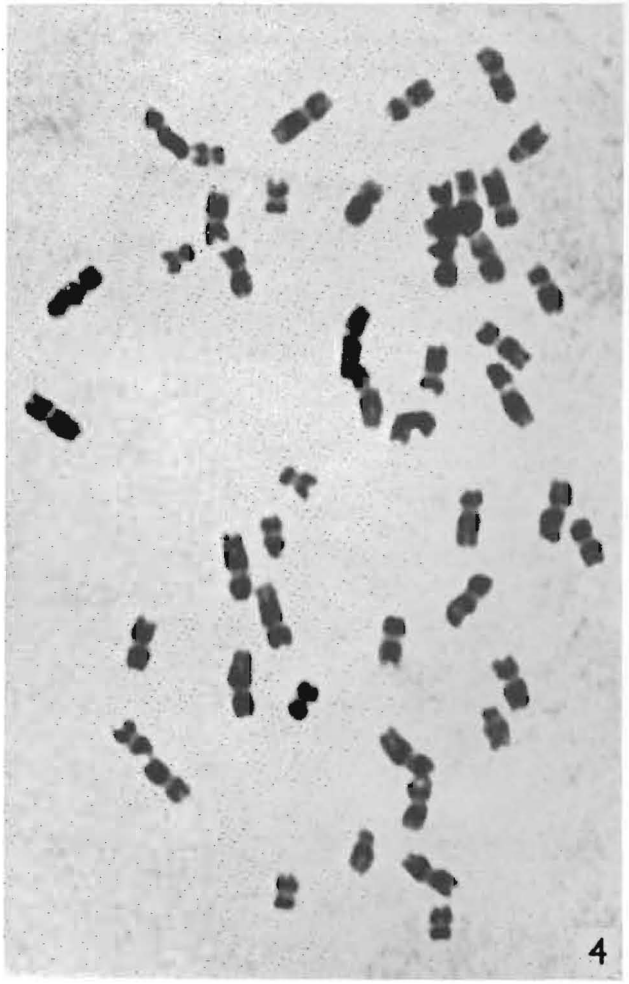
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TABLE I

Details of pollen irradiation and seed-setting in Coconuts.

Sl. No.	Dosage	Female parent		Male parent (variety)	No. of female flowers pollinated	No. of nuts set	Setting percentage
		Variety	No. of trees pollinated				
1.	10.000r	W. C. Tall	2	Tall × Dwarf (hybrid)	23	5	21.7
2.	15.000r	do.	3	do.	55	13	23.6
3.	25.000r	do.	3	do.	66	4	6.0
	»	Philippine Kalambahim (Tall)	1	W. C. Tall	16	9	56.3
		Total			82	13	15.8
4.	50.000r	W. C. Tall	1	W. C. Tall	57	0	0.0
	»	do.	3	Dwarf green	60	4	6.6
	»	S. S. Green (Tall)	1	do.	24	2	8.3
	»	T × D hybrid	1	W. C. Tall	23	15	*65.2
	»	Dwarf orange	1	do.	10	2	20.0
		Total			174	23	13.2
5.	100.000r	W. C. Tall	1	Dwarf green	8	1	12.5
	»	do.	1	W. C. Tall	18	0	0.0
	»	Gangabondam	1	do.	47	7	14.8
		Total			73	8	10.9

* Some of the female flowers from this bunch were removed as irradiated pollen was not available for pollination.

($n = 15$) as pollen parent. Cytological examination of some of the seedlings obtained however showed that they were diploids with $2n = 32$. It is possible that they arise as a result of pseudogamy followed by chromosome doubling in the egg cell, as has been reported in other plant species. While the present methods adopted in bagging the coconut inflorescence with close meshed muslin cannot be considered wholly effective in preventing entry of mongrel pollen, it appears from the above observations, coupled with the present finding of haploid embryo that haploid parthenogenesis occur in coconuts and could possibly be induced. In view of the importance of haploids in breeding and genetical investigations on the coconut palm (HARLAND 1957), critical investigations on the above aspects are highly to be desired.

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SUMMARY

A nut with a single haploid embryo having 16 chromosomes in its cells has been reported for the first time in a palm belonging to the West Coast Tall variety of coconuts. From this and evidences on distant hybridisation and use of irradiated pollen, it is suggested that haploid parthenogenesis occur in coconuts and could possibly be induced.

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