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Occurrence of Chromosomal Aberrants in Genome Substitution Lines Indicative of Diversity of Parents in *Eu-Sorghum*[1]

by

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Introduction: Haploids were reported in *Sorghum* by Endrizzi and Morgan (1955) and Brown (1943). These haploids in *Sorghum* as well as those reported subsequently were observed to have originated from hybrid populations involving *Eu-Sorghum* types. The male-sterile combine Kafir-60 which resulted from substitution of 'Kafir' genome in 'Milo' cytoplasm (Stephens and Holland 1954) was also found to throw haploids in its hybrid population (Meenakshi and Thangam 1961). Therefore the genome substitution lines involving m. s. C. K. 60 as seed parent and *S. roxburghii* (A. S. 3880) and *S. subglabrescens* (Co. 18) as pollen parents which were being studied in connection with the development of male-sterility in the latter types, were also studied for the occurrence of any plants with disturbed chromosonnal behaviour. The results are presented and their implications discussed.

Materials and Methods: To develop new male-sterile lines in *Sorghum* types A. S. 3880 *(S. roxburghii)* and Co. 18 *(S. subglabrescens)* using male-sterile combine Kafir-60, a series of back cross populations in various generations were studied for the expression of male-fertility. Incidentally the occurrence of odd type of plants were noted and such plants were cytologically examined. Young anthers were fixed in 1 : 3 acetic-alcohol for three hours, washed and preserved in 70 per cent alcohol. The materials were then squashed and stained with one per cent aceto-carmine and the P. M. Cs. examined for chromosonal behaviour (Smith 1947).

Results: Two lines (lines 5 and 9) in the selfed third backcross (m. s. C. K. 60 x *S. roxburghii*) x *S. roxburghii* (3), exhibited one plant in each with reduced height, small leaves, small panicles and especially tiny spikelets (Table I) (Plate 1). The anthers were very small and completely sterile. The pollen size and stomata size were also considerably reduced. The morphological and anatomical features exhibited by these plants as compared to a normal diploid plant (A. S. 3880) are presented in Table I.

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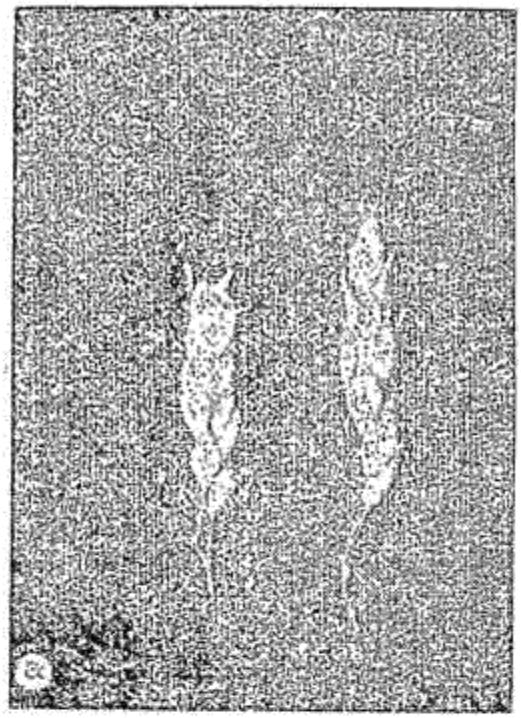
TABLE I

Morphological and anatomical features of haploids.

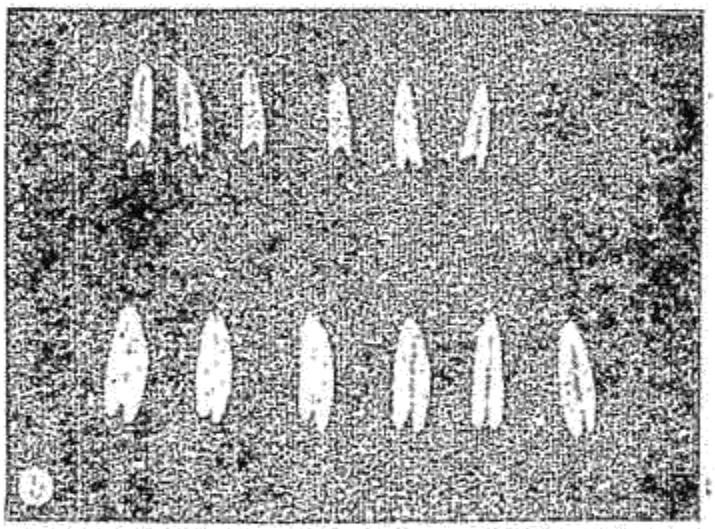
S. No.	Characters	Haploid I	Haploid II	Haploid III	Diploid (A. S. 3880)
1.	Height of plant (cm.)	96·5	70·0	77·0	140·0
2.	Leaf length 4th from top (c. m.)	31·0	40·0	28·0	47·0
3.	Leaf width 4th from top (c. m.)	2·8	3·0	2·0	4·0
4.	No. of nodes	4	4	4	4
5.	Thickness of stem (m. m.)	0·9	0·6	0·4	0·8
6.	Length of peduncle (c. m.)	37·0	35·0	33·0	65·0
7.	Length of panicle (c. m.)	19·5	22·0	17·0	29·0
8.	Spread of panicle (c. m.)	9·0	8·0	6·5	13·0
9.	Length of spikelet (m. m.)	5·21 ± 0·046	4 38 ± 0·095	3·95 ± 0·011	6·65 ± 0·053
10.	Width of spikelet (m. m.)	2·24 ± 0·030	2·68 ± 0·053	1·97 ± 0·081	2·91 ± 0·061
11.	Length of ovary (m. m.)	1·02 ± 0·029	0·93 ± 0·020	0·77 ± 0·061	1·51 ± 0 037
12.	Length of stigma (m. m.)	0·66 ± 0·022	0·75 ± 0·050	0·87 ± 0·049	1·22 ± 0·033
13.	Length of anther (m. m.)	2·52 ± 0·020	2·35 ± 0·054	1·73 ± 0·020	0·91 ± 0·025
14.	Width of anther (m. m.)	0·63 ± 0·008	0·63 ± 0·016	0·51 ± 0·017	0·91 ± 0·020
15.	Pollen stainability (%)	0·14	0·00	0·00	96·7
16.	Pollen diameter in (μ)	25·20 ± 0·329	32·86 ± 1·225	33·27 0·876	43·75 ± 0·210
17.	Seed set open	Nil	Nil	Nil	Full
18.	Seed set selfed	Nil	Nil	Nil	Full
19.	Seed set crossed (%)	2·7	2·0	...	Full
20.	Length of stomata (U)	24·5 ± 0·245	27·1 ± 1·204	29·9 ± 0·140	35·0 ± 0·525

Meiosis was studied in both the plants. The pollen mother cells exhibited 10 unpaired chromosomes at the meta-anaphase I (the term used by Kimber and Riley, 1963) (Plate 2-a). Rarely homologous pairing was observed. In one plant a few cells exhibited greater number of bodies at meta-anaphase I. In 25 per cent of the cells studied 15, 20, 25 and more number of chromosomes were observed (Plate 2-g to i). Unequal distribution of chromosomes to poles such as 1/9, 2/8, 3/7 and 4/6 and rarely an equal distribution of 5/5 were noticed (Plate 2 b to f). Univalent divisions and non-disjunction bridges were also noted in a few cases. There was complete pollen sterility. There was no seed set in both the plants when selfed. But when dusted with pollen from *S. roxburghii* (A. S. 3880) or C. K. 60, and seven from haploid plant-1 x *S. roxburghii* crosses were raised and studied for male-fertility. The plants from both the crosses were highly fertile and gave complete seed set when selfed.

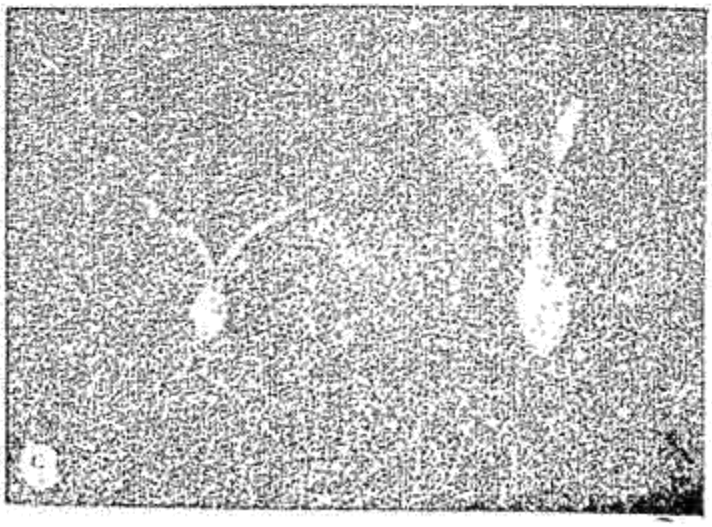
A third haploid plant appeared in the backcross of one of the male-sterile segregates in the F_2 *S. roxburghii* x *S. subglabrescens* with *S. subglabrescens*. The plant possessed all the morphological and anatomical features of the two haploids previously described (Table I). The pollen fertility was nil. The selfed and open seed set were also nil.



(a) A flowering branch—Left—
haploid Right—diploid



(b) Anthers—Top—haploid
Bottom—diploid



(c) Pistil—Left—haploid
Right—diploid

(a) x 1¼; (b) x 4; (c) x 6

PLATE 1. *Haploid Sorghum*

PLATE 2

Meiosis in haploid

(a) Meta — anaphase I — Eight Univalent chromosomes and an association of two chromosomes (x 1300)

(b) to f — different kinds of anaphase distribution (x 1300)

(g) to i — Cells with more than 10 univalent chromosomes (x 1700, x 1300 and x 1500 respectively)

Discussion : Kihara and Tsunewaki (1962) observed that the frequency of haploids increased when a nucleus has been substituted in an alien cytoplasm. The substitution lines of *Triticum vulgare* var. *erythrospermum* and Taylor's 'Triticale' both having the cytoplasm from *Aegilops caudata* had a haploid frequency of 1·7 per cent and 53 per cent respectively. No haploids were found in either of these lines when the nucleus was not in alien cytoplasm. Similar increase in haploidy was also reported when nuclei of maize were substituted in teosinte cytoplasm (Mazoti and Maulenberg, 1958).

In the present study, two haploids appeared in the selfed third backcross progeny of the hybrid m. s. C. K. 60 x *S. roxburghii* (A. S. 3880) and one chromosomally abnormal plant was found in one of the second backcross lines of the hybrid C. K. 60 x *S. subglabrescens* (Co. 18) with *S. subglabrescens* (Co. 18). One more haploid appeared in the first backcross of the sterile segregate in the F_2 of the hybrid *S. roxburghii* (A. S. 3880) x *S. subglabrescens* (Co. 18), with *S. subglabrescens* (Co. 18). The occurrence of haploids with frequencies ranging from 4·4 to 9·1 per cent of the populations studied cannot be merely a chance event. On the other hand it lends evidence that the parents involved in the above crosses are genetically differentiated and genome substitution by back crossing heads to disturbed cyto-nuclear harmony resulting in the formation of haploids in greater frequencies than by chance.

Almost all the haploids so far reported in *Sorghum* are in some way connected with a hybrid population involving distinct varieties *viz.*, Kafir, Feteritas and wild grass *Sorghums* or with a cytoplasmic genic male-sterile (Endrizzi and Morgan, 1955; Brown, 1943; Meenakshi and Thangam 1961).

A haploid mutant was obtained by Simantal and Ross (1964) by colchicine treatment of seedlings of *Sorghum* variety experimental-3. Erichsen and Ross (1963) obtained male-sterile plants by the use of colchicine on the varieties 'Martin' and 'Reliance' and these male-steriles in no way differed from the cyto-steriles, A-Martin and A-Reliance used in hybrid production programmes (Erichesen and Rose, 1963). The above facts seems to indicate that the mutagen colchicine acts through the cytoplasm by disturbing the cyto-nuclear harmony. The cyto-nuclear disharmony in the present study may be due to genome substitution by back crossing-an index of differentiation in the parents involved.

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Progressive Changes in Soil Available Phosphorus and Relationship with yield and Uptake in Co. 7 *Ragi* *

by

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Introduction: Phosphorus is highly susceptible to fixation in soils and a complex set of factors determine its availability. Three major groups of South Indian soils have been examined for availability of phosphorus in relation to yield and uptake in Co. 7 *ragi*.

Review of literature: Aldrich and Buchanan (1954) found a highly significant correlation between acid extractable and total phosphorus in Southern Californian soils. Moser and his associates (1959) gave the

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