COLCHICINE-INDUCED DWARF-*CUM*-STERILE MUTANTS IN *SORGHUM VULGARE* L.

E. A. SIDDIQ

Division of Genetics, Indian Agricultural Research Institute, New Delhi-12

TILL 1952, the effect of colchicine was restricted to induction of polyploidy alone and with the pioneer works of Franzke and Ross (1952, 1956, 1957, 1960)[5-8] in Experimental-3, a homozygous sorghum line, the possibility of chromosomal reduction followed by doubling along with a change in the genetic constitution was understood. Through colchicine treatment they could produce a large number of homozygous variants in Experimental-3 all of them showing normal meiosis with ten bivalents. Specifically Chen and Ross (1963)[1] came across a male sterile mutant but with normal meiotic chromosome behaviour. Later Erichsen and Ross (1963),[4] and Erichsen (1963)[3] reported similar male sterile plants following colchicine treatment. Chopde (1965)[2] reported dwarf-*cum*-sterile mutants following colchicine treatment in *Cajanus cajan* Millsp.

During the course of induction of polyploidy through colchicine in sorghum hybrids, two dwarf plants with total sterility were come across in MS × IS 1054.

The seedlings were treated with 0·2% aqueous solution of colchicine for seven to eight hours by inverting the seedlings of 1 cm. long plumule which were decapitated just above the meristematic region before treatment. Two of such treated seedlings gave rise to weak, dwarf and sterile plants. The average height of these dwarfs was less than half the height of the control (Table I). From the measurements of internodal length and number of leaves it was apparent that the reduced internodal length led to the dwarfness. The size of leaf, panicle and spikelet was also found to be proportionately reduced. The pollen was showing a complete sterility. When the plants were pollinated with the pollen from the control plants, they did not set any seed, showing an induced sterility on the female part of the flower also. However the cytological analysis of the PMCs showed a perfect meiosis in all the randomly fixed spikelets except for occasional nucleolar budding to the extent of two to six.

FIG. 1. Control and colchicine induced dwarf-*cum*-*steriles*.

TABLE I

A comparative study on the morphology of the Dwarf mutants and control

(Measurements in cm.)

Material	Height	Internodal length (from top)			Leaf size		Ear length	Spikelet length	% of fertility
		2–3	3–4	4–5	Length	Breadth			
Control ..	173	15·5	15·3	15·3	59	6·3	24·4	0·55	95–98%
Dwarf mutants	68–71	3·5	3·0	2·8	24	2·5	11·0	0·50	Total sterility

The male sterility observed by Ross and his co-workers has been attributed to genic mutation probably occurred during the process of somatic reduction followed by doubling. Though the present study lacks experimental proof for the

existence of the phenomenon of somatic reduction and doubling, there is a strong evidence to show that colchicine acts as a mutagenic agent the details of which will be published separately.

Height character in *Sorghum* is said to be governed by a set of four genes, namely Dw_1, Dw_2, Dw_3 and Dw_4 (Quinby and Karper, 1954).[11] The female parent which is male sterile (Kafir-60) used in the present study is a two dwarf having the genetic consitution of Dw_1 Dw_1 Dw_2 Dw_2 dw_3 dw_3 dw_4 dw_4 whereas the male parent being homozygous dominant for all the four genes, *i.e.*, Dw_1 Dw_1 Dw_2 Dw_2 Dw_3 Dw_3 Dw_4 Dw_4. The plants were of uniform height (Table I) in control, whereas two of the colchicine-treated plants were found to be dwarfs. They were very short with profuse tillering and narrow leaves (Table I). Apart from changes in the vegetative parts both male and female organs of the spike were found to be totally sterile. Occurrence of the dwarfs in the C-1 generation can be explained by the phenomenon of induced mutation caused by colchicine. Possibly two of the height genes which were in their heterozygous condition must have been mutated to their respective recessive condition. If the mutation in the two heterozygous genes is the explanation for their occurrence, the colchicine-induced dwarfs should resemble two-dwarf normal male sterile Kafir-60. However, still reduced height, profuse tillering, narrow and short leaves and female sterility made them differ from normal male sterile parent. In this case it is to be assumed that one or more height genes might have been mutated to recessive or heterozygous condition. Karper (1932)[9] is of the view that any of these four genes may be unstable leading to the spontaneous mutation towards any direction. Further, the decreased height in these mutants was obviously due to the shortened internodes. According to Quinby and Karper (1945, 1954)[10-11] these four independently inherited height genes of a modifying complex influence the elongation of the internodes alone whereas time of blooming, leaf size, etc., remain unaffected. Contrarily the mutants under study were characterised by having comparatively short and narrow leaves with a whorled type of leaf arrangement.

From the sterility point of view, the female parent Kafir-60 is having the genotype of cc, while the male parent IS-1054 has a homozygous dominant gene CC. The fertility character being governed by a dominant gene, the F_1 shows full fertility. The mutants under study showed complete sterility in F_1 itself strengthening the possible occurrence of mutation towards homozygous recessive condition, *i.e.*, from Cc to cc. In such a case the plant should be necessarily male sterile. But the interesting feature was the associated female sterility. Here once again we have to assume the occurrence of induced mutation in the locus governing female fertility.

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