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The Mutated Locus and the Changes in the Background Genotype of Jute (*C. olitorius* L.)

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Summary. Morphologically similar leaf characters of two X-ray induced and independently isolated jute mutants from a common mother cultivar, JRO-632, were controlled by the same locus. However, they differed significantly in such quantitative characters as plant height, middle diameter, days to flower, node number and fibre yield/plant. Combining ability analysis from a 9 x 9 diallel set of crossing including these two mutants revealed that the mutants significantly differed in general combining ability (gca) effects for most of the traits in either direction or magnitude. Specific combining ability (sca) effects of the inter-mutant cross, as well as crosses with the common mother cultivar, JRO-632, also differed for most of the traits studied. It was suggested that X-irradiation induced random mutations effecting changes in the common background genotype, independent of the mutated locus.

Key words: Background genotype – Combining ability – Macromutant – Pleiotropy

Introduction

X-rays effectively induced macro-mutations in jute, the most common type being leaf mutations. The crumpled phenotype of leaves, due to sinuosity and wrinkling of the lamina surface resulting from different X-ray dosages, was designated as crumpled leaf, crinkle leaf or even ornamental leaf for its foliar attraction (Basu 1963; Singh et al. 1973; Ghosh and Sen 1971; Rakshit 1970). Both crinkle leaf and ornamental leaf traits were monogenic recessive to the normal leaf shape of the mother cultivar JRO-632; the genes were, however, designated as *cr/cr* and *ol/ol* respectively (Ghosh and Sen 1971; Rakshit 1970). Presence of extreme variability in various quantitative traits among X-ray induced macro-mutants of the same phenotypic class whithin the same inbred line of peanuts led Gregory (1956b) to postulate that mutations were induced in the back-ground genotype either simultaneously or concurrently with the induction of a mutation controlling the discrete mutant phenotype. Later, Emery et al. (1964) demonstrated from their studies with normal appearing F_2 families segregated from macro-mutant crosses, that background mutations were not necessarily closely linked to the deleterious mutant locus. The present study was undertaken to elucidate the nature of the induced changes in the background genotype of the two X-ray induced macro-mutants of similar phenotype in relation to the mutated locus.

Materials and Methods

Seeds of the true breeding macromutants of similar phenotypes Crinkle leaf and Ornamental leaf, isolated from 100 Kr and 40 Kr X_2 lines of *Corchorus olitorius* L. cv. JRO-632, respectively (Ghosh and Sen 1971; Rakshit 1970), were collected from the original sources. These two mutants along with three other macromutants, the two cultivars JRO-632 and JRO-620, two non-cultivated genotypes 'Sudan Green' and 'Wild Olitorius' were involved in a diallel set of crossing. The parents and F_1 hybrids without reciprocals were grown in single row plots, each of 1.5 metres long, in a Randomized Block Design with three replications, at the District Seed Farm, Kalyani in 1975. Observations on plant height, base diameter, middle diameter, node number, days to flower and fibre yield/plant were recorded from ten competitive plants of each treatment per replication. Average leaf area of each treatment was measured from three specific leaves of five plants per replication. General and specific combining ability effects were estimated from mean values following the method-2 model-1 suggested by Griffing (1956). Results from only the Ornamental and Crinkle leaf mutant crosses have been presented here.

Results and Discussion

All the individuals of the F_1 and F_2 populations of the cross Ornamental x Crinkle showed the mutant pheno-

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Table 1. Estimates of gca effects and parental mean values

Parent	Plant height		Base diameter		Middle diameter		Fibre yield/ plant (gm)		Node number		Days to flower		Average leaf area (m^2)	
	gca	mean	gca	mean	gca	mean	gca	mean	gca	mean	gca	mean	gca	mean
JRO-632	9.33**	267.7	0.0753*	1.23	0.039**	0.846	0.706*	9.43	3.44**	66.5	2.09*	127.7	0.248	50.7
Ornamental	2.21	194.0	−0.144**	0.910	−0.032**	0.583	−0.381	4.66	−0.352	58.0	5.53**	129.5	−2.73*	40.9
Crinkle	−19.52**	122.4	−0.009	0.893	−0.017	0.526	−0.279	2.38	−3.14**	43.9	−3.39**	103.4	1.24	46.2
S.E. (gi)	± 5.52		±0.033		±0.014		±0.342		±0.819		±0.935		±1.64	

*,** Significant at $p < 0.05$ and $p < 0.01$, respectively

Table 2. Estimates of sca effects for 3 cross combinations, and their mean values

Cross	Plant height		Base diameter		Middle diameter		Fribre yield/ plant (gm)		Node number		Days to flower		Average leaf area (m^2)	
	sca	mean	sca	mean	sca	mean	sca	mean	sca	mean	sca	mean	sca	mean
Ornamental × JRO-632	36.12**	238.8	0.017	1.07	0.003	0.770	0.027	7.96	−3.18*	57.8	−4.23*	106.8	− 8.58**	49.3
Crinkle × JRO-632	18.97	215.6	0.047	1.24	0.044	0.756	1.26	7.55	−1.49	59.2	−0.73	87.8	10.74**	52.2
Ornamental × Crinkle	43.14**	184.4	0.106	0.803	0.122**	0.586	2.58*	2.96	8.66**	54.4	9.65**	110.1	1.71	41.2
S.E. (S_{ij})	± 17.7		± 0.107		± 0.044		± 1.10		± 2.60		± 3.00		± 5.27	

*, ** Significant at $p < 0.05$ and $p < 0.01$, respectively

type, Crinkle/Ornamental leaf revealing the control of the character by the same locus. Hence, only one gene symbol *cr/cr*, as designated by Ghosh & Sen (1971), may be accepted. The comparison of mean values of seven quantitative characters (Table 1) revealed significant differences in plant height, fibre yield, node number and days to flower between the two mutants. Crinkle leaf was inferior for most of the traits. The mutants also differed in average leaf area though possessed a similar leaf character. Both mutants were inferior to their common mother cultivar JRO-632 for all the traits studied. The significant differences of the quantitative characters between the two mutants indicated independent mutations of polygenes other than the mutated locus.

Assessment of gca and sca effects further revealed the genetic diversity between the two mutants. The gca effects for the quantitative traits of the two mutants, estimated from 9 × 9 diallel crosses, indicated that they differed not only in magnitude but also in direction (Table 1). The gca effects for plant height, days to flower and average leaf area showed different directions for the two mutants, while those of base diameter, middle diameter, fibre yield and node number differed only in their magnitude. The magnitude of gca effects of Ornamental were higher for all characters except node number and average leaf area. For most of the traits, negative gca effects of the mutants were registered against the positive values of their mother cultivar. Negative gca effects for most of the traits from both mutants indicated the preponderance of unfavourable additive genes induced by X-rays in comparison to the mother cultivar JRO-632.

Differences in sca effects for plant height, node number, days to flower and average leaf area between the crosses Ornamental × JRO-632 and Crinkle × JRO-632 (Table 2) indicated the presence of different non-additive genes or gene complex in the two mutants. Significant sca effects for five out of seven characters in the inter-mutant cross further substantiate the above indication.

These observations led the authors to suggest that the changes in the background of the macromutants associated incidentally with the discrete mutant phenotype were not necessarily pleiotropic in nature. It may be assumed that random micromutations were induced in the back-ground genotype independently of the mutated locus.

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