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Investigations on induced macromutants in *Cajanus cajan* (L.) Mill sp.*

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In a study of induced mutagenesis in Cajanus cajan, the frequency of macromutants increased with increasing doses of mutagens up to certain level and thereafter decreased. DES and gamma rays were potent in inducing macromutants in SA. 1 and CO. 2 respectively In both the varieties mutants affecting duration were more frequent. Economically useful mutants possessing increased number of pods per plant, dwarf habit, earliness, uniform maturity and bold seed size were isolated indicating the scope for improving redgram through induced mutagenesis coupled with conventional breeding procedures.

Redgram is the major grain leugme cultivated in Tamil Nadu. Inspite of its important role in solving the protein malnutrition, breeding and genetic research on this crop have been very much limited. Investigations have, therefore, been taken up for induction of mutations in redgram to obtain greater variability and facilitate the selection of desired types.

MATERIAL AND METHODS

Two redgram (*Cajanus cajan* (L.) Mill sp.) varieties viz., SA. 1, a long duration variety with open plant body and CO. 2, a medium duration variety with compact plant body formed the material. Gamma irradiation was carried out using ^{60}Co gamma cell installed at Tamil Nadu Agricultural Uuiversity, Coimbatore. The doses employed were 1, 5, 10, 15, 20, 25, 30 and 40 krad. Treatments with Diethyl Sulphate were performed by keeping the prewater soaked seeds immersed for 6 hours in the concentrations of 3, 6, 9, 12, and 15 mM.

After mutagenic treatments, M_1 generation was raised. The M_2 generation was raised as individual M_1 plant and M_1 branch progeny bases. Scoring of macromutations was done continuously during the entire life cycle of the plants. These mutants were classified on the basis of most conspicuous mutant character and described. Scholz (1969) suggested that those distinguished as viable, macro and systematic mutations could be grouped under the term macromutations and this terminology is followed in the present discussion.

RESULTS AND DISCUSSION

a) *Frequency:* The frequency of macromutations computed on M_1 plant, M_1 branch and M_2 plant bases are presented in table 1. In both the

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varieties, the frequency of macromutations on M_1 plant, M_1 branch and M_2 plant bases increased with doses of gamma rays and DES up to certain dose level and decreased with further increase in doses. The potency of mutagens inducing maximum frequencies varied with varieties (Rangasamy, 1973). DES and gamma rays were potent respectively in SA. 1 and CO. 2. In CO.2 macromutation was not observed at highest doses employed.

b) *spectrum:* A wide spectra of macromutants affecting various morphological characters have been identified in the M_2 generation following treatments with gamma rays (84 in SA. 1 and 128 in CO. 2), and DES (64 in SA. 1 and 43 in CO.2) (Table 2). The first occurrence of macromutants in M_2 and in smaller proportion suggested that each of them might represent changes in a single recessive gene from their parents. Gaul (1964) stated that most of the mutations in diploid organisms were recessive. Among the various classes, mutants affecting duration followed by seed coat colour and pod after gamma irradiation, and mutants for duration and pod after DES treatments, were more frequent than other types in SA.1. Mutants affecting duration were more frequent followed by stature and pod mutants than others in gamma irradiated M_2 population of CO. 2 In DES treated population, mutants for duration were more frequent followed by pod and stature mutants than the rest.

The importance of some of the macromutants are discussed below.

c) *Stature mutants*: They include tall, dwarf, spreading, branchless and weak and slow growing types. Among these branchless types are of more interest. They offer scope for growing as inter-crop with crops like groundnut in view of dwarf and non-branching habit. Jain (1975) state that pulses are ideally suited for intercropping with a wide variety of crops like sugarcane, cotton, sorghum and plantation crops. Kaul *et al.* (1975) proposed that in an intercropping system, the inter-crops grown should possess certain good characteristics, viz., short growing period, short stature and the absence of competition of nutrients. It is worth mentioning that the barnchless mutant isolated in the present study, would partly satisfy the objective proposed by Kaul *et al.*, (1975). However, the grain yield in these mutant types has to be stepped up by appropriate breeding programme. It will be of interest to note that in SA. 1 branchless mutants occurred with a frequency of 4.7 and 4.6 per cent respectively when treated with gamma rays and DES (Table 2). This branchless character can definitely contribute to an overall earliness. In Tamil Nadu there is an appreciable area of sorghum under rainfed cropping with duration of 135 to 140 days. The branchless mutant of SA. 1 would be of great value in intercropping with sorghum in such areas.

Tall mutants occurred more frequently than dwarfs (Table 2). The dwarf mutants isolated in CO. 2 having 65 cm and less height (105-110 cm- CO, 2) showed alterations in more than

Table 1. Frequency of macromutation in M_2 generation

Mutagen and dose	No. of N_1 plant progenies scored		No. of M_1 branch progenies scored		No. of M_2 plants scored		Mutation frequency: Per 100 M_1 plants		Per 100 M_1 branches		Per 100 M_2 plants	
	SA. 1	CO. 2	SA. 1	CO. 2	SA. 1	CO. 2	SA. 1	CO. 2	SA. 1	CO. 2	SA. 1	CO. 2.
I. Control	105	114	281	334	2786	2948	—	—	—	—	—	—
II. *Gamma rays* (krad)												
1	90	97	223	256	2014	2236	8.9	9.3	6.3	6.6	0.8	1.1
5	74	90	172	262	1523	1985	12.2	12.2	10.5	8.4	0.9	1.5
10	70	73	186	183	1156	1364	14.3	15.1	11.8	12.0	1.1	2.1
15	61	69	165	178	980	985	18.0	21.7	13.3	16.9	2.2	2.3
20	42	40	115	109	975	876	21.4	20.0	9.6	18.4	0.9	1.3
25	27	35	63	87	587	652	14.8	17.1	11.1	8.1	1.2	0.9
30	11	18	24	52	276	495	9.1	11.1	8.3	5.8	0.7	0.8
40	8	10	19	24	174	187	12.5	—	5.3	—	0.6	—
III. *DES* (mM)												
3	88	87	208	232	1876	2132	6.8	5.8	5.3	3.0	0.8	0.3
6	50	72	121	178	1092	1756	14.0	8.3	11.6	5.1	1.5	0.6
9	42	54	104	141	956	1315	16.7	11.1	14.4	9.9	2.5	1.1
12	38	32	97	80	823	756	10.5	6.3	9.3	3.8	1.1	1.7
15	13	12	32	29	291	313	7.7	—	3.1	—	0.7	—

one trait such as dwarf combining reduction in internodal length. Similar results were reported by Rangaswamy (1973) in sesame. The tall mutants, in general, were late and yielded equal to control in respect of grain weight. Hence, tall mutants may have limited economic value.

d) *Mutants for duration:* The duration mutants were either early or late. At maturity the earliness became more conspicuous in 13 mutants of SA.1 and 14 of CO.2 which showed synchrony in maturity of most of the pods by 20 days earlier to their respective controls (SA.1 - 170 days and CO.2 - 115 days). The long duration obsetved in most of the redgram varieties under cultivation handicapped their inclusion in multiple cropping pattern. The identification of early types in the present study has broken this handicap, and gave for evolving early maturing varieties which could be fitted in such a cropping pattern. Eventhough these mutants gave low yield than their controls, they could be tried as an intercrop with other crops. Early mutants coupled with synchronized maturity of almsot all the pods is a welcome feature. Hence, these mutants offer scope for further study to improve yield potential. The lateness of the mutants isolated, may be due to the mitotic arrest in the flower primordia (Vindhiya Varman *et al.,* 1980).

e) *Pod and seed mutants:* A major production advance in pulses, similar to that obtained in cereals, could be achieved by evolution of high yielding types followed by judicial management practices (Jain, 1975). For this aspect, the mutants isolated in the present study showing increased number of pods (642 to 756 in SA. 1 mutants as against 325 to 370 in SA. 1 and 191 to 214 in CO 2 mutants as against 165-190 in CO. 2), also showing increase in seed yield compared to the parent will offer scope for exploitation. Among them, six of CO. 2 and four of SA.1 yielding more than the respective controls also had compact plant type and determinate growth habit. Identification of increased number of seeds per pod (4 to 6 as against 3 or 4 in SA. 1) and bold-seeded type (100 seed weight ranged from 8.9 to 9.2 grams as against 7.5 to 7.7 in SA.) resulting in increased single plant yield (91.3 to 96.4 grams in mutants as against 72.8 to 75.6 in SA.1) offer further scope in maximising yield levels.

Mutants possessing blackish-purple, light red, dull yellow and creamy white seed-coat colour were isolated in SA. 1 whose seed-coat colour being reddish brown. Various seed-coat colour mutants were reported by Moh (1971) in French bean, Rao and Jana (1976) in blackgram and Vindhiya Varman *et al.* (1980) in *Vigna marina*

f) *Other mutnats*: Other types of mutants, included sterile mutants, stem fasciation, tetrafoliate leaves and mutants with 2 to 4 clusters per axil as against one cluster in praent. In tetra foliate leaf mutants. One or two nodes gave rise to leaves with four leaf lets instead of three leaflets. Multifoliate leaf mutants are of common occurrence in cowpea (Louis and Sundaram, 1973) and *Vigna marina* (Vindhiya Varman *et al.*, 1980)

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Table 2. Spectrum of macromutants in M_2 generation:

	Mutants	Percentage of individual type of mutants to the total number of mutants			
		Gamma rays		DES	
		SA. 1	CO.2	SA. 1	CO. 2
1	2	3	4	5	6
I.	*Stature mutants*				
	a) Tall types	—	6.3	—	4.7
	b) Dwarf types	—	3.9	—	—
	c Spreading types	—	7.0	—	4.7
	d) Branchless types	4.7	7.8	4.6	13.9
	e) Weak and slow growing	2.4	—	1.5	—
II.	*Mutants for duration*				
	a) Early types	9.5	14.1	19.7	13.9
	b) Late types	17.8	15.6	13.7	7.0
	c) Uniform maturity	9.5	8.6	7.6	7.0
III.	*Pod mutants*				
	a) Increased number of pods	13.1	20.3	9.1	18.6
	b) Number of seeds per pod	1.2	—	4.6	—
	c) Crinkled Pod shape	—	—	—	7.0
IV.	*Seed size mutants*				
	a) Bold seeded types	3.6	—	1.5	—
	b) Small seeded type	2.4	2.3	1.5	—
V.	*Seed-coat colour mutants*				
	a) Blackish purple	2.4	—	—	—
	b Light red	3.6	—	1.5	—
	c) Dull yellow	2.4	—	4.5	—
	d) Creamy white	8.3	—	3.0	—
VI.	*Other mutants*				
	a) Linear leaves	—	—	4.5	—
	b) Small and bisected leaves	3.6	2.3	—	—
	c) Tetrafoliate leaves	1.2	—	3.0	—
	d) Stem fasciation	10.7	6.3	9.1	13.9
	e) More than one clusrer per axil	3.6	—	6.1	—
	f) Sterile mutants	—	3.9	4.5	7.0
	g) Semi-sterile mutants	—	1.6	—	2.3
	Total	100.0	100.0	100.0	100.0