INDUCED MUTANTS IN GREEN GRAM

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GREEN gram (*Vigna radiata*) is an important pulse crop grown on drylands of Rajasthan, particularly Western Rajasthan. Most of the strains of this crop currently cultivated under rainfed conditions in Rajasthan are selected more for their survival under conditions of acute moisture stress, rather than for productivity (Prasad and Singh, 1973). Work on the varietal improvement of this crop has been rather limited as compared to the other dryland crops such as *sorghum* and pearl millet. Availability of limited genetic variability for important yield components such as pod number per plant (Gupta and Singh, 1969, 1970; Swaminathan and Jain, 1973) may be one of the reasons in this regard. A programme of mutation breeding was, therefore, taken up with a view to isolating mutants with high yield potential and at the same time possessing tolerance to drought conditions prevailing on the drylands of Western Rajasthan.

MATERIALS AND METHODS

Seeds of 'RS 4', a variety considered to be adapted for drylands of this region, were treated with 0·2% and 0·3% aqueous solutions of ethylmethane sulfonate (EMS), for six hours, following pre-soaking in water for 14 hours, in March, 1971. The treated seeds were washed thoroughly and dibbled in 3 m. long rows with a spacing of 5 cm. from plant to plant and 30 cm from row to row, in a well prepared field. The M_1 generation was handled in the usual way and the M_2 generation was raised as M_1 plant progeny rows in July 1972. The M_2 population was screened for variants with higher pod number, as compared to the parent. The M_1 population in each treatment was around 300 whereas the size of the M_2 population was around 21,730 individuals in EMS 0·2% treatment and 15,208 in EMS 0·3% treatment. The individual variants isolated in the M_2 generation were carried forward to M_3 generation in summer 1973 and their performance was compared with the parent and the highest yielding check (S8). The mutants were tested in the subsequent monsoon seasons (1973, 1974 and 1975) alongwith RS4 and S8 in randomised block design under rainfed conditions. In each generation, the segregates not conforming to the mutant plant type were discarded from the population of mutants. In kharif seasons of 1972 and 1974 the crop received fertilisers @ 20 kg N and 40 kg P_2O_5 per hectare. In kharif 1973 fertilisers were applied @ 40 kg N, 60 kg P_2O_5 and 20 kg K_2O per hectare and an additional nitrogen @ 15 kg/ha at flowering. No fertilisers were applied in kharif 1975.

RESULTS AND DISCUSSION

The salient features of the variants isolated in the M_2 generation and the parent are presented in Table 1.

All the isolated mutants represented a shift in the growth habit of plant from spreading to more compact plant type and an increase in the number of pods per plant. The frequency of occurrence of such mutant plants was rather low, considering the large size of the M_2 populations raised.

TABLE 1

Salient features of mutants isolated in the M_2 generation and the parent as recorded in the monsoon season of 1972

Mutagenic treatment	Mutant No. or parent	Description	No. of pods per plant	No. of seeds per pod	Grain yield/ plant (gm)
EMS 0·2%	RS4 (Parent)	Spreading plant type. Late maturing with a duration of 80 to 85 days	13·5	8·5	6·20
	M8	Semi spreading plant type. Early maturing	34·0	9·4	15·00
	M9	Compact plant type. Early maturing	24·0	9·5	11·45
	M10	Semi compact plant type. Early maturing	34·0	12·4	15·32
	M11	Dwarf and compact plant type early maturing with smaller leaves	32·0	10·0	11·72
EMS 0·3%	M13	Semi compact plant type. Early Maturing	33·0	11·2	16·00
	M14	Dwarf plant type. Erect growing and early maturing	28·0	10·8	10·10
	M15	Semi compact plant type	23·0	9·6	9·72
	M16	Erect plant type	23·0	12·9	12·65
	M17	Dwarf plant type	20·0	9·7	9·50
	M19	Dwarf plant type with early maturity	35·0	11·5	17·40

The data presented in Table 2 give a relative performance of the mutants, their parent and S8 variety which has been giving the consistently high yields so far under rainfed conditions at Jodhpur (Singh, Daulay, Prasad and Singh, 1974).

A persual of the data indicates that while all the mutants in the M_3 generation excelled RS4 and S8 varieties both in pod number and grain yield per plant, only M16, M8 and M10 mutants out yielded both the check varieties in kharif 1973, when the rainfall quantum and distribution were favourable. However, under the acute drought conditions of kharif 1974 only the mutant strain M8 significantly, out yielded RS4 and S8 varieties, although yields in general were low, whereas all the rest failed practically. Thus, the acute drought conditions that prevailed in kharif 1974, provided a good selection sieve, for screening the material for tolerance to high degrees of moisture stress. In kharif 1975 too, the mutant strain M8 significantly out yielded both the checks. Although the number of pods in the case of M8, in 1975 was marginally higher than that of S8, it was almost double as compared to that of the parent variety

TABLE 2

Relative performance of the mutants, parents and the highest yielding check

Mutant or check	M_3 generation summer 1973		M_4 generation kharif 1973 (533 mm)		M_5 generation kharif 1974 (136 mm)		M_6 generation kharif 1975 (541 mm)	
	Pod No. per plant	Yield per plant (gm)	Pod No. per plant	Yield (kg/ha)	Pod No. per plant	Yield (kg/ha)	Pod No. per plant	Yield (kg/ha)
M16	4·80	1·06	24·4	2136	2·0	16	12·2	1320
M8	4·00	1·10	24·6	2062	4·0	180	18·5	1780
M10	4·00	1·20	22·2	1850	2·0	26	13·7	1360
M15	2·90	0·81	17·8	1726	3·0	24	12·6	1390
S8 (Highest yielding check)	1·30	0·70	18·5	1748	3·5	97	17·9	1570
RS4 (Parent)	1·20	0·30	16·4	1706	2·0	47	9·5	910
M19	3·20	0·35	17·8	1623	—	—	—	—
M11	3·24	0·90	17·4	1611	—	—	10·2	940
M17	5·80	1·60	16·4	1568	—	—	—	—
M13	2·10	0·55	15·5	1564	—	—	—	—
M9	4·00	1·10	11·2	1486	—	—	—	—
M14	6·50	1·20	14·0	1266	—	—	—	—
SEm±	—	—	—	130	—	18	—	39
CD 5%	—	—	—	378	—	53	—	114

(RS4). Thus, all through, starting from the M_3 generation, this mutant (M8) consistently showed a higher pod number and grain yield over the parent and the highest yielding check. The pod number and yield in kharif 1975 were lower than those of kharif 1973. This might be due to the fact that the crop was grown under conditions of higher fertility in 1973, while no fertiliser was applied in 1975. In addition to this, the experimental sites in these seasons were different.

A comparative account of mutant M8, varieties S8 and RS4 is set out in Table 3. The data are based on the observations recorded over a period of three seasons viz. kharif 1973 to 1975.

It can be seen from the Table that the mutant matured earlier than the parent by 18 days, at the same time yielding over 50% more than the parent. The number of pods in the case of the mutant was almost double that of the parent. The number of seeds per pod in the case of M8 was slightly more than that of RS4, although there was a reduction in the grain weight of the mutant. The mutant was found to be comparable to S8 in maturity, but excelled as far as number of pods per plant, seed weight and grain yield were concerned.

The data set out in Table 4 also indicate that the mutant M8 distinctly excelled many promising varieties tested in kharif 1975, under rainfed conditions

TABLE 3

Performance of M8, S8 and RS4 under dryland conditions, over a period of three seasons (1973 to 1975)

Variety	Mean number of days to maturity	Mean number of pods per plant	No. of seeds per pod	1000 seed weight (gm)	Mean yield (kg/ha)
M8 (Mutant)	66	16	10·2	33·0	1340
S8	65	12	9·6	32·4	1138
RS4 (Parent)	84	9	8·5	36·9	888

at Jodhpur. All these varieties were tested in the same layout referred to in Table 2.

TABLE 4

Performance of M8 and a wide range of other moong varieties in kharif 1975 (*Rainfall :* 541 mm)

Variety	Yield (q/ha)	Days to 50% flowering	Days to maturity	Productivity per day (kg/ha)
M_8	17·8	36	80	22·25
S9	15·5	36	79	19·62
K851	15·3	37	75	20·40
ML4	15·2	46	93	16·34
Madira	14·9	40	80	18·63
PS16	14·3	35	70	20·43
B105	13·6	37	85	16·00
G65	12·8	40	86	14·88
T44	12·7	44	85	14·94
Jawahar 45	12·6	45	93	13·55
288–8	11·3	45	97	11·65
PS7	10·6	40	79	13·42
G1	8·3	45	96	8·65
SEm	0·39			
CD 5%	1·14			
CV %	19·0			

It is evident from the data that the mutant strain M8 showed the highest productivity per day, by virtue of its high yield potential and medium early maturity, a combination of characters conducive to a high level of performance even under the conditions of dryland agriculture (Prasad 1973). The drought

tolerance of the mutant strain was amply brought out by its performance in kharif 1974, characterised by an acute and prolonged (62 days) drought.

The studies carried out by Singh and Malhotra (1970) clearly bring out that the pod number per plant is one of the most important components of yield in green gram. It has also been suggested (Swaminathan 1973) that the increases in yields of pulses could be achieved by enchancing the pod number. The present investigation indicates that such an enhancement in pod number and also concomitant changes in the morphological frame work of moong (green gram) plant could be achieved through induced mutations.

Summary

The seeds of RS4 variety of green gram were treated with aqueous solutions of EMS with 0·2% and 0·3% concentrations and ten mutants showing a higher number of pods than the parent were isolated in the M_2 generation. The mutants were further carried forward and tested under dryland conditions along with the parent and the highest yielding check. It was observed that the mutant strain M8 consistently maintained its superiority in yield and pod number per plant over RS4 and S8 under varying conditions of rainfall, exhibiting a combination of higher yield potential, earliness of maturity and tolerance to drought conditions. It has been suggested that variation for pod number per plant and growth pattern in green gram could be brought about by induced mutations.

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