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RESEARCH ARTICLE

To identify and select superior M_3 progenies and estimate the magnitude of various genetic parameters in respect of yield and yield attributes in guar [*Cyamopsis tetragonoloba* (L.) Taub.]

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SUMMARY

A study was conducted during *Kharif* 2002 to assess induced variation among 131 (80 selected and 51 bulk) M_3 progenies of guar variety RGC-197 in respect of yield and yield attributes. Analysis of variance revealed significant differences between the progenies and non-significant differences within the progenies for all the characters studied. Based on 't' test, a considerable number of M_3 progenies were significantly different for their mean values from the parent RGC – 197 in respect of all the traits. Progenies, showing significantly lower values of a trait were more frequent than those showing superior values than the control except for 100- seed weight. Variations in respect of various characters were induced to different magnitudes. Based on significantly higher mean values than control and bulk progenies, five selected progenies namely 31-7, 41-6, 78-2, 81-6 and 128-5 were identified as superior ones. The characters *viz.*, plant height, seed yield per plant, pods per plant and 100- seed weight were relatively more heritable than the other character studied.

Key Words : Guar, Progenies, GCV, PCV, Population, C. V., Heritability, RGC-197

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Clusterbean [*Cyamopsis tetragonoloba* (L.) Taub] popularly known as "Guar" is an annual, autogamous, herbaceous, *Kharif* crop belonging to family Leguminoseae and mainly grown under rainfed conditions in the arid and semi-arid regions of tropical India. Its plant is robust, erect annual which usually grows to a height of 90 to 180 cm and has a well developed tap root system. The leaves are trifoliate and toothed. The flowers are borne in short axillary racemes and are generally purplish in colour. The pods are somewhat flattened and are borne in a cluster, hence, the plant is known as clusterbean. Pods are fleshy, beaked and 2.5 to 13 cm long containing 5-12 seeds in it. When the pods are tender they are used as vegetable. The seeds are square in shape and compressed. Clusterbean is grown for green manuring, green fodder, vegetable purpose and for production of seeds. It provides nutritional concentrate and fodder for cattle and adds to the fertility of soil by fixing considerable amount of atmospheric nitrogen. Clusterbean seeds are used as a concentrate for animal feed and for extraction of "gum",

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which is being used in various industries such as textiles, cosmetics, paper, food processing, explosive and oil drilling etc.

Seeds of clusterbean contain 28 to 33 per cent gum. Therefore, India occupies top position in the world trade of guar gum. The guar seeds also contain protein of high nutritional quality, which is 40 per cent and may be used as a human food component if properly processed.

Clusterbean is grown in India, Pakistan, Indonesia, America, Italy, Mexico, Brazil and South Africa. India produces 50 per cent of total guar produced in world followed by Pakistan (45%), U.S.A., Mexico, Brazil and South Africa. India enjoys unique status in the cultivation of guar in the world because of congenial climatic conditions for the crop growth. Researchers namely Dabas *et al*. (1982); Singh *et al*. (2003); Morris (2010) and Sultan *et al*. (2012). In India it is mostly grown in the states of Rajasthan, Haryana, Punjab, U.P. and M.P. In Rajasthan it is mostly grown in the districts of Churu, Sriganganagar, Nagaur, Jalore, Sikar, Jaisalmer, Bikaner, Jaipur, Jhunjhunu and Alwar.

Despite its multifarious importance, the systematic efforts to improve the yielding ability of this crop are limited. Further, lack of usable variation and difficulty in making crosses on account of small flowers which result in poor seed setting poses limitations on our efforts to systematically improve the yielding potential of this crop. Another reason for applying mutation breeding in this crop is its low yielding capacity. Looking into these considerations, the present investigation has been carried out on certain M_3 progenies of guar variety RGC-197 to characterize the induced variation in respect of yield and yield attributes and effectiveness of selection in M_2 generation.

MATERIAL AND METHODS

The present investigation was carried out at Agronomy farm, S.K.N. College of Agriculture, Jobner during the *Kharif* 2002. The objective was to evaluate the extent of variation among promising M_3 progenies for seed yield and its attributes in guar variety RGC-197.

The seeds in respect of each of the 131 M_3 progenies were sown in a single row plot of 3 M length. Eight of such rows were allotted to beds of size 3 m x 2.4 m. The check variety RGC-197 was included with these progenies once after every 10 rows. While sowing row to row distance was kept at 30 cm and plant to plant distance was maintained at 10 cm by thinning. All recommended package of practices was followed to raise a healthy crop. The estimation of magnitude of variability such as variance and co-efficient of variation (C.V.) was done on family and population basis using the standard statistical procedures outlined by Snedecor and Cochran (1967).

RESULTS AND DISCUSSION

In the present study an attempt was made with an objective to evaluate 131 M_3 progenies of guar variety RGC-197 which were obtained by harvesting seeds of 95 M_2 families. The data recorded on 10 randomly selected plants were subjected to variance analysis. The results of ANOVA (Table 1) revealed that the mean sum of squares between the progenies was highly significant for all the characters studied. The application of mutagens to induce mutation becomes indispensable when a breeder is faced with lack of adequate

Table 1 : Analysis of variance in respect of different quantitative characters observed in M_3 progenies of guar variety RGC-197 subjected to different gamma-rays treatments

Source of variation	d. f.	Plant height (cm)	Cluster per plant	Pods per cluster	Pods per plant	Seed per pod	Pod length (cm)	100-seeds weight (g)	Seed yield per plant (g)
Between progeny	130	442.657**	1.9255**	3.5032**	97.9154**	2.2224**	1.0693**	0.3543**	11.7636**
Bulk progeny	50	381.421**	2.4491**	3.5474**	91.1774**	2.3207**	1.4583**	0.2583**	9.2478*
Individual progeny	79	484.942**	1.6174**	3.5196**	103.291**	2.1882**	0.8350**	0.4064**	13.3008**
Bulk v/s individual	1	163.828	0.07568	0.0009	10.1405	0.0042	0.1273	1.0275	16.1068
Within progeny	1179	15.956	0.87523	0.9426	14.0450	0.3190	0.3806	0.0821	1.5561
Control	129	4318.38	28.19829	23.8837	648.4961	55.8449	55.8449	11.4555	37.1770

* and ** indicate significance of values at P=0.05 and 0.01, respectively

Table 2 : Genetic parameters for different characters in M_3 progenies

Genetic parameters	Plant height (cm)	Cluster per plant	Pods per cluster	Pods per plant	Seed per pod	Pod length (cm)	100-seeds weight (g)	Seed yield per plant (g)
Genotypic co-efficient of variation (%)	10.285	6.807	11.305	13.128	5.514	4.740	4.868	19.546
Phenotypic co-efficient variation (%)	12.056	20.796	24.459	21.469	12.158	12.111	9.754	28.257
Heritability (broad sence %)	72.783	10.713	21.362	37.388	20.574	15.320	24.891	47.849
Genetic advance (%)	18.075	4.589	10.764	16.536	5.152	3.822	5.003	24.853

Table 3 : Mean and C.V. in respect of various yield attributes of high yielding M_3 progenies

Progenies	Seed yield per plant (g)		Plant height (cm)		Clusters per plant		Pods per cluster		Pods per plant		Seeds per pod		Pod length (cm)		100-seed weight (g)	
	Mean	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.	Mean	C.V.
78-2 (30 kR)	7.82**	16.59	74.80**	8.14	5.40	17.89	5.20	15.17	30.50**	21.65	8.20*	9.62	5.80	7.27	3.38	6.49
41-6 (10 kR)	7.70**	29.75**	69.80	5.04	5.10	14.47	5.10	19.50	27.70	20.71	7.70	10.69	5.50	9.58	3.90**	5.71
90-6 (30 kR)	7.68**	12.57	66.60	6.69	5.40	21.74	4.40	28.75	23.20	18.04	7.50	11.33	5.60	15.06	3.55	3.47
20-6 (70 kR)	7.65**	20.30	74.40**	5.12	4.90	15.06	4.90	15.06	26.50	17.63	7.40	6.98	5.60	9.22	3.73**	5.56
11 (10 kR)	7.38**	29.33**	71.80*	6.46	6.20**	28.25*	3.70*	13.06	28.60*	31.71**	8.00	10.21	5.70	14.44	2.99**	10.89
108 (80kR)	7.30**	8.26	70.10	3.33	5.10	11.13	4.30	15.70	22.90	11.73	6.90	12.69	5.40	9.56	3.55	9.31
81-6 (70 kR)	7.25**	13.68	64.00	6.38	4.70	17.90	4.90	20.29	23.20	17.34	7.50	7.03	5.80	15.89	3.61*	8.25
31-7 (80 kR)	7.21**	18.71	76.70**	7.53	5.20	15.17	4.50	11.71	25.00	15.08	6.70*	10.07	5.60	12.49	3.60*	8.75
108-4 (80 kR)	7.06*	13.90	63.60	8.09	5.00	28.28	4.70	30.17	21.50*	15.07	6.80	11.60	5.20*	8.11	3.56	8.19
128-5 (50 kR)	6.98*	11.80	70.50	3.22	4.50	18.89	6.10**	19.63	27.70	6.82	7.90	11.08	6.00	13.61	3.64*	4.41
90 (30 kR)	6.96*	16.71	66.30	10.43	5.50	23.08	4.40	26.68	23.70	16.17	7.60	12.71	5.60	12.49	3.45	4.73
133-3 (10 kR)	6.95*	17.78	69.80	6.11	4.90	24.43	4.90	24.43	25.40	18.20	7.70	12.32	5.60	9.22	3.65*	8.28
133-10 (10kR)	6.89*	29.56	68.60	7.18	5.10	26.87	4.40	15.89	25.10	31.56**	7.10	12.33	5.30	12.73	3.51	8.17
108-3 (80 kR)	6.84*	18.72	66.00	4.74	4.50	21.60	4.70	28.46	21.50*	10.80	7.30	9.25	5.50	9.58	3.53	6.05
Mean	5.26		63.51		4.76		4.47		22.06		7.26		5.53		3.38	
Control	5.92	22.73	64.71	15.28	5.16	22.34	4.68	28.38	24.87	20.03	7.36	14.35	5.74	11.93	3.35	10.75

* and ** indicate significance of values at P=0.05 and 0.01, respectively

variability in respect of a particular character in the gerplasm (Chopra, 2000).

The variance within the progenies was non-significant for all the characters studied. The estimates of various genetic parameters *viz.*, genotypic co-efficient of variation (GCV), phenotypic co-efficient of variation (PCV), heritability in broad sense and genetic advance (GA) in respect of various characters studied have been presented in Table 2. The intraprogeny variance was non-significant for all the characters studied. Significant interfamily variance and non-significant intraprogeny varfiance have also been reported in guar by Mahla *et al.* (1999) and Amrita (2002).

The results revealed that PCV for seed yield per plant was relatively high (28.26 %) followed by pods per cluster (24.46 %) as compared to rest of the traits for which the magnitude of PCV was below 21.47 per cent and as low as 9.75 per cent observed for 100 seed weight. On the other hand the magnitude of GCV was invariably down than PCV and below 19.54 per cent recorded for seed yield per plant followed by pods per plant (13.13 %) and pods per cluster (11.30 %). The trait pod length showed lowest value of GCV (4.74 %).

The estimates of heritability (broad sense) were moderate to low (Table 2). The maximum heritability was observed for plant height (72.78 %) followed by seed yield per plant (47.85 %), pods per plant (37.39 %), 100 seed weight (24.89 %), pods per cluster (21.36 %), seed per pod (20.57 %), pod length (15.32 %) and cluster per plant (10.71 %).

Similarly the magnitude of GA was maximum for seed yield per plant (24.85%) followed by plant height (18.07 %), pods per plant (16.53 %), pods per cluster (10.76 %), seeds per pod (5.15%), 100-seed weight (5 %), clusters per plant (4.59 %) and pod length (3.82 %). The mean values with its co-efficient of variation in respect of all the characters studied for each of the 131 M_3 families have been listed in Table 3. Both the mean and C.V. values were tested for significance using pooled 't' test and 'F' test, respectively. In Table 3 an attempt has been made to classify the progenies which have either significantly different (low or high) mean value than the control or are at par with the control. Most of the progenies taken in the present study have originated from 80 kR and 10 kR gamma rays treatment.

Plant height (cm):

Among all the superior M_3 progenies, the average mean value was found to be 63.51 cm. The mean plant height of control population was 64.71 cm. The C.V. of the trait in the control population was 15.28 per cent.

Clusters per plant:

The mean of clusters per plant in the control population was 5.16 whereas, all superior M_3 progenies the average mean value was found to be 4.76. The C.V. values was 22.34 per cent in the control population.

Pods per cluster:

The mean of pods per cluster of all the progenies was 4.47. Whereas, the M_3 progenies the control population was found to be 4.68. While the C.V. of the control population was found to be 28.38 per cent.

Pods per plant:

The mean of pods per plant in the control population was 24.87. All superior M_3 progenies average mean value was found to be 22.06. The C.V. in control population was 20.03 per cent.

Seeds per pod:

The mean values of all the superior M_3 progenies was found to be 7.26. The mean number of seeds per pod was 7.36 in the control population. The C.V. of the control population was 14.35 per cent.

Pod length (cm):

The mean of pod length was 5.74 cm in the control whereas, among all M_3 progenies the mean value was found to be 5.53 cm. Whereas, the C.V. of the control population was found to be 11.93 per cent.

Seed yield per plant (g):

The mean seed yield per plant of the control population was 5.92 g. All superior M_3 progenies the mean value was found to be 5.26 g. The C.V. of control population was 22.73 per cent. Keeping the aforesaid problems in view a mutation breeding programme was taken up in the Department of Plant Breeding and Genetics with guar variety RGC- 197 (Amrita and Jain, 2003). In her work she had evaluated 95 M_2 progenies of guar variety RGC- 197 resulting from gamma rays treatment and identified certain promising M_2 progenies. The present investigation, however, dealt with the evaluation of 131 M_3 progenies (80 selected and 51 bulk) of guar variety RGC- 197 which were obtained by harvesting seeds of these 95 M_2 families.

100 seed weight (g):

The mean 100 seed weight of M_3 progenies of control population was 3.35 g. All superior M_3 progenies average mean value was found to be 3.38 g. The C.V. among all control population was found to be 10.75 per cent. Numerically, the number of progenies exhibiting significant increase in the value of a character, were generally less as compared to the progenies showing significant decrease for all the characters except 100 seed weight. For polygenic trait the occurrence of progenies with positive or negative shift in the mean value is a common observation (Joshi *et al.,* 2007). This is expected because in M_3 generation, variance should decrease as a result of selection. Whereas, the M_2 generation of these progenies had exhibited high mean with high or low C.V. than the control (Yadav *et al*., 2004). Numerically, the number of progenies exhibiting significant increase in the value of a character, were generally less as compared to the progenies showing significant decrease for all the characters except 100-seed weight. For polygenic trait the occurrence of progenies with positive or negative shift in the mean value is a common observation (Khan *et al*., 2000). Similar work on the related topic was also done by Dass *et al*. (1973); Gipson and Balkrishnan (1990); Ibrahim *et al*. (2012); Mital and Thomas (1969) and Pathak *et al*. (2009).

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