

VARIABILITY IN *GUAR***

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GUAR [*Cyamopsis tetragonoloba* (L.) Taub.] has now come to occupy the status of a crop of commercial importance in India in view of its potentialities as a source of gum which has diversified uses in industry. The gum is contained in the endosperm lying between the seed coat and cotyledons. The gum content averages around 30 per cent. on whole-seed basis.

India, being the chief *guar*-growing country, is the largest exporter of *guar*. If varieties with heavy yields and high gum content could be evolved it would augment the country's potential for earning foreign exchange. Rajasthan and Kutch are the major *guar*-growing areas in India, but, broadly speaking, it is under cultivation in the north-west of the country comprising parts of Punjab, U.P., Rajasthan and Gujarat States. Evidently *guar* is grown under different agro-climatic regions and it should, therefore, be of interest to know its variability under different environments. The components of variation and other genetic parameters as estimated in a *guar* collection under two different environments are presented here.

MATERIALS AND METHODS

Seventy three *guar* cultures which included a number of pure-breeding accessions and certain fixed single plant selections maintained in the Division of Plant Introduction were used. These lines were grown at two locations. Location I was at Jodhpur in semi-arid zone of Rajasthan with an annual rainfall of around 30 cm. Location II was at Delhi having an annual rainfall of 60 cm.

The experiment at both the places was laid out in randomized block design with four replications. Sowing was done on July, 1966. Each culture was sown in single rows 3 meters long with row to row spacing of 60 cm., keeping plant to plant distance as 15 cm.

Observations were taken on five normal plants in each culture in each replication. The mean values of these plants studied for different characters furnished data for the particular strain in one replication. Observations were

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recorded on eleven characters, viz., flowering days, days to first maturity, plant height, branches per plant, peduncle length, pods per peduncle, total pods per plant, pod length, seeds per pod, 100-seed weight and yield per plant. Excepting flowering and first maturity, all other observations were taken when plants reached full maturity.

Heritability in the broad sense was estimated by the formula $\frac{V-e}{r} / \frac{V-e}{r} + e$ and genetic advance according to Johnson, Robinson and Comstock (1955).

RESULTS

PHENOTYPIC VARIABILITY

Varietal differences in respect of all characters were highly significant. The extent of phenotypic variability present in various characters under study is given in Table 1. Maximum range of variation was observed in total number of pods per plant, followed by plant height, yield and days to maturity. Variation of very small magnitude was shown by pod length, seeds per pod and 100-seed weight. There was little difference in the mean values of these characters under the two environments. The means of days taken to flower, days to maturity, height, branches per plant and total pods showed wide differences at the two locations; the difference in the mean values of yield, however, was comparatively smaller.

COMPONENTS OF VARIANCE AND COEFFICIENT OF VARIATION

Estimates of components of variance and coefficients of variation for the characters are given in Table 1. Relative amount of variation in different environments can be best judged by comparing the coefficients of genotypic and phenotypic variation for each character in two locations. The coefficient of variation in general did not appear to show such wide differences in the two locations as the variances in respect of certain characters. But, they did show similar trends. The estimates were high for pods per plant and low for days taken to flower. The magnitude of the difference between the coefficients of variation in case of yield in two locations is the largest, while for days taken to flower, days to maturity, pod length and seeds per pod, it has been very small indicating that this category of characters is the least affected by the change in location.

HERITABILITY

The estimates obtained for heritability and genetic advance are given in Table 1. Heritability values in respect of flowering days, first maturity, plant height, branches per plant, total pods and yield were high in environment II (Delhi) in comparison to those in I (Jodhpur). Amongst the characters which gave over 70 per cent. heritability at one or the other location were days to first maturity, pods per peduncle and pod length. Heritability, in general, was observed to be considerably variable with the change in environment.

TABLE

Range, mean, standard deviation, variances, coefficient of variation, heritability and genetic

Estimates	Environ- ments	Days to flower	Days to first maturity	Plant height (cm)	Branches per plant
Range	I	32-45	64-80	34.4-86.4	0.0-12.8
	II	54-72	89-117	72.7-201.8	1.0-24.6
Mean \pm S.E.	I	37.84 \pm 0.85	72.37 \pm 1.56	57.57 \pm 3.86	8.32 \pm 0.96
	II	63.53 \pm 1.22	107.29 \pm 1.05	141.09 \pm 9.18	14.65 \pm 1.23
Phenotypic variance	I	6.18	13.74	149.54	14.12
	II	22.18	64.61	1,488.28	71.45
Genotypic variance	I	3.29	3.92	85.86	10.40
	II	16.22	60.21	1,150.72	55.37
Environmental variance	I	2.89	9.82	63.68	3.72
	II	5.96	4.40	337.56	6.08
Coefficient of variation	I	6.55	5.13	21.24	45.19
	II	7.41	7.49	27.24	57.68
Genotypic coefficient of vari- ation	I	4.78	2.74	16.08	38.70
	II	6.34	7.23	24.04	50.78
Heritability %	I	22.15	9.07	25.21	41.14
	II	67.41	77.38	46.04	69.48
Genetic advance	I	0.94	0.69	6.35	3.20
	II	0.54	12.81	30.56	12.10
Genetic advance as % of mean	I	2.48	0.95	11.03	38.47
	II	10.29	11.93	21.66	82.59

GENETIC ADVANCE

It was noted that some characters though they showed high heritability did not show high genetic advance, while others gave high values in both the parameters. As for instance pod length gave a high heritability of 80.88 per cent. and 75.14 per cent. at the two locations but expressed low genetic advance between 1.86 per cent. and 2.18 per cent. On the other hand, in case of total pods, high heritability was associated with high predicted genetic advance in one environment.

The predicted genetic advance expressed as percentage of the population mean was high for branching, pod number and yield under Delhi conditions and for peduncle length at Jodhpur. In general it appeared to indicate that there is less scope of improvement in flowering days, maturity days and seeds per pod in comparison to other characters through straight selection.

DISCUSSION

The study of phenotypic variability revealed that whereas mean values for such characters as plant height, branches per plant and total pods were

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gain of the characters studied in guar at two locations

Peduncle length (cm.)	Pods per peduncle	Total pods per plant	Pod length (cm.)	Seeds per pod	100-seed weight (gm.)	Yield plant (gm.)
1.58-8.33	2.70-12.08	18.0-158.0	4.01-9.36	6.32-10.50	2.62-4.49	6.37-25.75
1.67-6.54	1.25-6.04	11.4-144.6	4.07-9.78	5.88-10.04	2.60-4.24	2.30-35.26
3.00±0.29	5.66±0.51	69.67±10.75	4.97±0.15	8.00±0.19	3.49±0.11	14.20±1.67
2.90±0.25	3.35±0.24	75.67±10.03	4.98±0.17	9.14±0.21	3.28±0.09	14.82±1.81
3.02	5.73	932.63	1.71	0.43	0.30	28.75
1.41	1.16	2,433.98	1.44	0.37	0.17	112.98
2.69	4.65	469.79	1.61	0.29	0.25	17.62
1.16	0.93	2,030.96	1.33	0.20	0.14	99.88
0.33	1.08	462.84	0.10	0.14	0.05	11.13
0.25	0.23	403.02	0.11	0.17	0.03	13.10
58.01	42.23	43.83	26.36	8.25	15.76	37.75
41.03	32.24	65.19	24.10	7.52	12.50	61.59
54.67	38.16	31.10	25.55	6.75	14.33	29.58
37.24	28.66	59.56	23.09	5.42	11.28	59.39
66.67	72.80	20.24	80.88	32.72	57.53	28.36
53.69	49.34	55.75	75.14	21.63	51.29	65.59
2.39	0.36	12.73	2.18	0.44	0.64	3.14
1.32	1.09	56.66	1.86	0.23	0.43	14.36
79.67	6.36	18.27	43.86	5.50	18.34	22.11
45.52	32.54	74.88	37.35	2.52	13.11	85.37

Env. I=Jodhpur

Env. II=Delhi.

higher at location II (Delhi) than at I (Jodhpur), difference in mean yield, at the two locations, though significant, was not of comparable magnitude. This appeared to be due to the number of pods per peduncle which was 60 per cent. more at Jodhpur than at Delhi. This probably resulted in reducing the gap in total pod formation at the two locations, which was ultimately reflected on yield. It was also indicative of the fact that number of pods per peduncle tend to increase when plants are shorter and have fewer branches. There would, of course, be certain optimal levels for these characters contributing to higher yields.

The other characters, viz., pod length, seeds per pod and 100-seed weight did not show appreciable variability in the two environment indicating a comparatively stable nature.

From the study of components of variance and coefficient of variation it was seen that in all the cases excepting days to maturity at Jodhpur, genotypic variance was more than environmental variance.

In case of days to maturity, genotypic effects were masked by the environmental effects at Jodhpur where low rainfall conditions, besides light soil and low humidity, appeared to be instrumental in hastening maturity period. Athwal and Singh (1966) while working on *kangni* (*Setaria italica*) also concluded that season and soil factors exerted considerable influence on expression of variability, and hence, are important considerations in study of quantitative variation.

In view of higher estimates of genotypic and phenotypic variation for the characters such as days taken to flower, first maturity, plant height, branches per plant, peduncle length, total pods and seed yield at Delhi as compared to Jodhpur, more variability in respect of these characters can be obtained under Delhi conditions for a wider spectrum of selection. On the other hand, Jodhpur climate offered better scope for selection in pods per peduncle which appeared to have considerable bearing on yield.

Since predicted genetic advance was low at both the locations in respect of days to flower, maturity days, seeds per pod and 100-seed weight, there does not seem to be much scope for improvement in these traits. While comparable high heritability was obtained for peduncle length, pods per peduncle and pod length, the values for their genetic gain were very variable. However, peduncle length and pods per peduncle gave better and higher genetic gain than pod length. As was cautioned by Johanson *et al.* (1955) in their studies with soybean that heritability values as well as estimates of genetic advance should be considered more useful than heritability alone while making selection, it would appear that breeding for pods per peduncle and peduncle length would be more fruitful than pod length. Plant height also in this context did not seem to be of much consequence.

The parallelism as expressed in the magnitudes of the values of heritability and genetic advance in respect of branching, peduncle length, total pods per plant and yield in the two environments are indicative of the usefulness of these characters in a breeding programme for *guar*.

Although heritability of various characters under study was calculated in the broad sense its estimates when accompanied by high genetic advance can be given due weightage in selection.

SUMMARY

Seventy three single plant selections of *guar* [*Cyamopsis tetragonoloba* (L) Taub.] from indigenous collections were studied under two environments—one at Delhi and the other at Jodhpur, the former having a comparatively higher rainfall, heavier soil and higher humidity than the latter. The varietal differences were highly significant showing a wide range of variation in respect of all the characters under study. A high range of variation was observed in plant height and total pods per plant at both the locations while pod length, seeds per pod and 100-seed weight did not show significant differences. Differ-

ences between estimates of coefficient of genotypic variation for days to flower, days to maturity, pod length, seeds per pod at the two locations were very small indicating that these characters are the least affected by the change in environment. Phenotypic variation in various characters was largely genetic and heritability values were quite high, although heritability estimates changed with change of environment. Generally speaking heritability values were lower at Jodhpur than at Delhi. Low genetic advance in respect of flowering days, first maturity and seeds per pod indicated that there was less scope for improvement in these characters by straight selection. Branching, peduncle length, total pods and yield having high heritability and high genetic advance appeared to be useful characters in *guar* breeding.

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