VARIATION AND CORRELATION STUDIES OF VEGETATIVE AND REPRODUCTIVE CHARACTERISTICS IN TWELVE ACCESSIONS OF GUAR, *Cyamopsis tetragonoloba (L.) Taub.*

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SUMMARY: Two local and ten exotic accessions of guar (cluster bean), Cyamopsis tetragonoloba were evaluated for several vegetative and reproductive characteristics. Variables studied were: plant height, number of clusters per plant, pods per cluster, numbers of pods per plant, pod length, seeds per pod, 10-seed length, 100-seed weight and seed yield per plant. Significant differences among accessions were found for all the traits studied. Results indicated that accessions 'Mirpur' and 'D-safed' can be successfully cultivated for seed production in Sindh. Seed yield was highly significantly correlated to plant height, number of branches, clusters and total pods per plant. Similarly, number of pods per plant was correlated to plant height, number of branches and clusters per plant. Correlations of seed yield with pods per cluster, pod length, 10-seed length and 100-seed weight were positive but statistically non significant.

Key words: Guar, cluster bean, Cyamopsis tetragonoloba, coefficient of correlation, yield components, variation, GXE interaction.

INTRODUCTION

Guar, *Cyamopsis tetragonoloba* (L.) Taub., also known as cluster bean, is a summer annual legume. It is grown primarily as a seed crop for export and as a vegetable crop for local market in Pakistan. Guar seed is a source of natural polysaccharide, commercially known as guar gum, which finds a number of uses in food and other industries, such as paper, textiles, oil well drilling and pharmaceuticals (8).

In the USA almost all of the guar is grown in Texas and Oklahoma. It is the only commercially exploited source of gum. Its pods can be harvested with the grain harvester. Once collected the seeds are separated from pods and the seed coats removed. The endosperm is then dried and ground to fine powder, which is used in several industries (7).

Guar seed is cultivated in Pakistan on about 330 thousand hectares (average figure of five years, 1980-85). The maximum hectarage i.e., 396 thousand hectares is reported for the year 1986-87. The guar seed production was 213 and 262 thousand tonnes for above referred periods respectively. It is reported that guar and its products of worth 581.6 million rupees were exported to the USA from Pakistan in the year 1986-87 (1). Thus, it is an important agricultural produce of Pakistan that earns her foreign exchange.

Improvement in seed yield is the main objective for breeding of guar varieties for gum production. The knowledge of highly developing selection plans. Furthermore, information about yield and its components assist in achieving the desired goals of breeding.

This paper presents studies on variation and correlation among seed yield and its major components for two local and ten exotic accessions of guar under field conditions in Karachi, Pakistan.

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MATERIAL AND METHODS

There is no true breeding cultivar of guar grown in Pakistan. The locally available seed is generally recognized by its source, for example, Nawabshah, Punjab, Mirpur, Lasbella etc. From these accessions 'Mirpur' and 'Nawabshah' were included in the present study. Accession D-safed was from cultivar 'Durgapura Safed' grown in India. The seed of the rest of nine accessions were obtained from Texas and Arizona Agricultural experiment stations, USDA, USA. The origin and main features of these accessions are given below:

TX 71-3292 is a single plant selection from heterogeneous Oklahoma guar accession, G-821. Plants are relatively tall, coarse stemmed and resistant to bacterial blight.

TX 73-2731 is a high yielding F9 selection from the controlled natural cross, T 64001-14-8-3-1 x Lasbella, made at Texas in 1968. It is a hard seeded selection, especially adapted to areas where prolonged wet conditions prevent timely harvest in the fall.

TX 76-2746 is a pink seeded F6 selection from the controlled natural cross, PI 340651-1 x PI 338780-B, made in 1971. Plants are short statured and glabrous, having short internodes and heavy fruiting ability.

TX 76-3114 is a F8 selection from the controlled natural cross, T64001 -12-B-3-2-B-2 x PI 338780-B, made in 1971. Plants are short statured and glabrous, having short internodes and heavy fruiting ability.

TX 76-3285 is a F6 selection from controlled natural cross, T64002-6-1-2-3-2-2 x PI 338780-B, made in 1971. Plants are glabrous with short internodes and high yielding ability.

TX 77-3347 is a F6 selection from controlled natural cross, T64001-7-10-1-1-B-3-1 x PI 338780-B, made in 1971. Plants are short and glabrous with short internodes and good yielding ability.

TX 78-3726 is a F6 selection from a controlled natural cross, T64001-12-1-3-2-B-2 x PI 338780-B, made in 1971. Plants are short and glabrous with short internodes and good yielding ability.

TX 79-2741 is a F6 selection from the same cross as the TX 78-3726 selection. Plants are tall having large seeds and good yielding ability.

The experimental material, comprising of two local, viz., 'Bhawalpur' and 'Mirpur' and ten exotic guar accessions, was planted in a Randomized Complete Block Design, with four replications. The individual plot size was 3x3 meters with between rows distance of 75 cm. Seeds were sown about 15 cm apart, in four rows per plot. No chemical fertilizer was applied before or after random for observations. Variables studied were: plant height, number of primary branches, length and width of middle leaflet, clusters per plant, pods per cluster, pods per plant, pod length, seeds per pod, 10-seed length, 100-seed weight and seed yield per plant. The data obtained were subjected to analysis of variance. Duncan's multiple range test was used to compare the treatment means. Coefficient of correlations were estimated. The statistical analysis of data was performed by the methods described in Das and Giri (2).

RESULTS AND DISCUSSIONS

The data comprising of average plant height, number of primary branches, length and width of middle leaflet, number of clusters per plant and number of pods per cluster are presented in Table 1. Twelve guar accessions exhibited differences in plant height, number of primary branches, length and width of middle leaflet, number of clusters per plant and number of pods per cluster. The maximum mean plant height was observed in 'D-safed'

Table 1: Comparisons of means through Duncan's multiple range tests for six variables in twelve accessions of guar. Means with common letters in each column are non significantly different from each other.

Accessions	Plant height (cm)		No. of prim. branches		Middle leaflet				Clusters per plant		Pods per cluster	
					Length (cm)		width (cm)					
Bhawalpur	97.0	ab	13	a	8.3	a	5.6	a	55	abc	7	a
Mirpur	76.2	cd	13	a	8.4	bcd	4.2	bc	66	a	6	a
D-safed	105.5	a	12	a	7.9	ab	5.2	ab	56	ab	7	a
TX 71-3292	86.8	bc	14	a	7.4	ab	4.5	abc	65	a	7	a
TX 73-2731	71.5	de	12	a	6.5	bc	4.4	abc	53	abc	5	bc
TX 76-2746	68.8	de	1	c	6.7	bc	4.2	bcd	23	de	7	a
TX 76-3114	49.8	f	4	b	5.3	cd	3.4	cde	30	cde	4	c
TX 76-3285	74.5	cd	1	c	7.3	ab	4.3	abcd	20	e	6	ab
TX 77-3347	64.5	def	14	a	4.1	d	2.7	e	70	a	6	ab
TX 78-3337	69.5	de	13	a	4.5	d	2.9	de	58	ab	6	ab
TX 78-3726	57.2	ef	4	b	6.4	bc	3.9	bcd	38	bcd	5	bc
TX 79-2741	57.2	ef	4	b	6.7	bc	3.9	bcd	48	abc	5	bc

Table 2: Means for seed yield and some of its components in guar accessions. The figures with common letter(s) in the columns non significantly different from each other.

Accessions	Pods per plant		Pod Length (cm)		Seeds per pod		10-seed length (cm)		100-seed weight (gm)		Seed yield per plant (gm)	
Bhawalpur	149	abc	5.6	a	8	a	4.3	a	3.6	ab	39	abc
Mirpur	171	abc	5.6	a	9	a	4.3	a	3.7	a	50	a
D-safed	188	b	5.5	a	8	a	4.3	a	3.6	ab	42	ab
TX 71-3292	217	a	5.5	a	8	a	4.1	b	3.1	c	40	abc
TX 73-2731	128	abc	5.8	a	8	a	4.3	a	3.2	bc	25	cd
TX 76-2746	104	bc	5.4	a	9	a	3.7	de	2.6	de	19	de
TX 76-3114	83	c	5.0	a	8	a	3.6	e	2.3	f	10	e
TX 76-3285	84	c	4.7	b	7	b	3.7	de	2.4	ef	12	e
TX 77-3347	183	abc	4.9	b	8	a	3.6	e	2.4	ef	33	bc
TX 78-3337	156	abc	4.7	b	7	b	4.1	b	2.7	d	23	de
TX 78-3726	109	bc	5.5	a	8	a	3.9	bc	2.6	de	19	de
TX 79-2741	128	abc	5.5	a	8	a	3.9	bc	2.6	de	26	cd

(105.5 cm); however, it was non-significantly different from 'Bhawalpur'. TX 76-3114' produced significantly short statured plants (49.8 cm). Generally taller plants showed higher values for length and width of middle leaflets. Both the characteristics seem to be interrelated. 'TX 71-3292' and 'TX 77-3347' possessed the highest number of primary branches (14), followed by 'Bhawalpur', 'Mirpur', 'D-safed', 'TX 87-3337' and 'TX 73-2731'. However, the differences were statistically non significant.

The data on seed yield, total pods per plant, pod length, seeds per pod, 10-seed length and 100-seed weight are presented in Table 2. The seed yield per plant was maximum in accession 'Mirpur' (50 g); which, however, was non-significantly higher than 'D-safed', 'TX 71-3292' and 'Bhawalpur'. The yield of 'TX 76-3114' (10 g) was significantly lower than others. It may, therefore, be inferred that poor performance with respect to seed yield, by most accessions might be due to non acclimatization of these accessions to our environment. It may also be due to lesser plant height, lower number of primary branches, lesser number of clusters and pods per plant. From the data, it is concluded that yield per plant of local cultivar 'Mirpur' was the best. It was five times more than 'TX 76-3114'. It is also evident that, 'D-safed' possesses high genetic potential for adaptability and seed production. Hence, these accessions can be developed successfully as a seed crop cultivars and could be utilized in the breeding programmes for improvement of local stock.

It is worth mentioning that purposely no chemical fertilizer was applied during the entire growing period; as this is the usual practice of guar cultivation in Pakistan, especially in the areas that are not irrigated. Poor performance of American accessions may be due to the reason that these were probably selected under cultivation with chemical fertilizers. The accessions that are reported to be better in yield under optimum conditions of cultivation may not perform well, due to genotype environment interaction, under the cultivation with minimum inputs. It is, thus, suggested that breeders in Pakistan may try to develop cultivars of guar separately for rain fed areas and irrigated lands.

Inter-relationships between quantitative characters of guar were evaluated. Phenotypic correlations between seed yield, total pods per plant and other yield components are presented in Table 3. Analysis of correlation coefficients revealed positive and highly significant associations between seed yield and plant height, number of pri-

Table 3: Coefficients of correlations for seed yield and pods per plant with some variables in guar.

Variables	Seed Yield	Pods/Plant
Plant height	0.79**	0.60*
Number of braches	0.74**	0.83**
Total clusters	0.75**	0.87**
Pods/cluster	0.56n.s.	0.39n.s.
Total pods	0.92**	
Pod length	0.43n.s.	-
10-seed length	0.06n.s.	-
100-seed weight	0.48n.s.	-

n.s: Non significant

*,**: Significant at .05 and .01 levels of probability respectively.

- : not studied.

mary branches, clusters per plant and number of total pods. Pods per plant, in turn, were positively and significantly correlated to the plant height, number of primary branches and number of clusters per plant. These results are in accordance with those of Shanghi and Sharma (6), Mital and Thomas (4), Mital *et al.* (5) and Menon *et al.* (3). Correlation between total number of pods per plants and number of pods per cluster was positive but non-significant. Similarly correlations between seed yield per plant and number of pods per cluster, pod length, 10-seed length and 100-seed weight were positive but non significant. Mital and Thomas (4) and Mital *et al.* (5) reported negative correlations between seed yield and pod length, seed size and seed weight. The present findings are in agreement with those of Menon *et al.* (3) for green pod yield in guar. The seed yield has a strong positive association with plant height, number of primary branches, total number of clusters per plant and number of total pods. Total number of pods was similarly correlated to plant height, number of primary branches and number of total clusters per plant. For the rest of characteristics correlations were positive but non-significant. These relationships need to be considered by the guar breeder while making selections for superior genotypes with desirable characters.

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