FIELD COMPARISON AND MORPHOLOGICAL CHARACTERS OF GUAR (*CYAMOPSIS TETRAGONOLOBA* L. TAUB.) GENOTYPES UNDER AGRO-CLIMATIC CONDITIONS OF KARACHI, PAKISTAN

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ABSTRACT:- In present study, 12 guar genotypes were evaluated at Institute of Plant Introduction, Pakistan Agricultural Research Council, Karachi, Pakistan. Results revealed that the plant length was high in Acc. No.3 as compared to the other genotypes. Branches per plant were high in Acc. No. 8 as compared to Acc. Nos. 1-7 while, non-significant differences among Acc. Nos. 1, 3, 6 and 9. Moreover, results showed that high number of branches on Acc. Nos. 4, 10 and 11 as compared to Acc. Nos. 2 and 11 accessions, cluster/plant was high in Acc. No.3, 4, 5 and 6 genotypes as compared to Acc. Nos. 7, 10, 11 and 12 accessions whereas, non-significant difference was found in Acc. Nos. 1, 2, 8 and 9. However, pods/cluster was high in Acc. No. 8 as compared to all genotypes and pods length maximum (8.70, 7.88 and 7.86 cm) was high in Acc.No.8, 9 and 3, respectively as compared to other accession numbers. The pods width was high in Acc.No.8 as compared to other accessions. Whereas, Acc. No. 5, 9, 10 and Acc. No. 11 were high as compared to 1- 4, 6, 7 and 12 genotypes. The results indicated that the number of seeds per pods was high in Acc. No. 1, 2 and 4 as compared to rest of the accessions/ genotypes.100-seed weight was high in Acc. No. 4 as compared to rest accessions/ genotypes. The significant differences were observed among all treatments at 5% probability level.

Key Words: Cyamposis tetragomoloba; Genotypes; Agronomic Characters; Physicochemical Properties; Pakistan.

INTRODUCTION

Guar, *Cyamposis tetragomoloba* (L.) Taub. belongs to Leguminosae (Fabaceae) family.This crop is nutritious, high yielding, drought tolerant and have more socioeconomic significance. Guar origin is India and Pakistan, it is cultivated under arid/ semiarid parts of the world (Purseglove, 1981; Rahman and Shafivr, 1967; Patel and McGinnis, 1985). Pakistan is one of the most important guar producing country (Zahoor, 2007). India, Pakistan and US are major suppliers, Australia and Africa with smaller acreages as a cash crop also in other parts of the world (Under-sander et al., 1991; Pathak, et al., 2010). India is the largest producer of guar and contributes 80% of total production. Guar crop has a remarkable journey from a traditional crop to a crop with various industrial usages (Hema et al., 2014). It is also reported that high agro-morphological variation in germplasm was found for days to maturity, plant height, pods per plant and pod length (Sultan et al., 2012). It can be used as edible green like snap bean; cattle feed and as green

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manure (Hymowitz and Matlock, 1963; Arora and Pahuja, 2008). It grows best under conditions with frequent rainfall and tolerates arid conditions.. For the best growth guar beans require proper sun shine, flashing rainfalls that are moderately frequent and well-drained soil. Its yield fluctuate from year to year due to climate change (Keatinge et al., 2012). For root nodules formation, the diverse tested bio-organic treatments induced increases from 25% to 100% over the positive control being the highest with 30 t FYM /fed + rhizobium + Rhodotorula (Gomma and Mohamed, 2007; Whistler and Hymowitz, 1979). Bhatti and Sial (1971) investigated that its ground seeds contain about 5.0%, 31.0%, 4.6%, 6.8% and 5.7% protein, gum, fat, methionine and ash, respectively.

Pakistan is exporting guar and its products to 30 different countries of the world, and earned about 32.3 million US dollars during 1996-97 (GoP, 1997). During 2008-09, it was cultivated on 155000 ha with a gross production of 10200 t having an average yield of 661 kg ha^{-1} (GoP, 2009). It is tolerant to insect pests and disease and requires minimum plant protection (Saleem et al., 2002). The fresh pods have a lettuce, tart flavor which is used as a food in form of curry or fried with spices (Brain, 2012).

Non-availability of certified seed is the farmers' major problem for sowing. Present work attempts to identify elite variety to cope up its access to the market. Moreover, it will provide technologies of quality seed, sowing methodology, production, industrial use and nutrition to the farmer community. But it is needed to work on suitable guar genotype/varieties to uplift the economy of the country. This work will also help the breeders who are working for crop improvement in characterization, identification, determination of seed purity and its parental selection.

MATERIALS AND METHOD

The study was conducted at experimental site of Institute of Plant Introduction, Southern Agricultural Research Institute, Pakistan Agricultural Research Council, Karachi, Pakistan during the spring/*kharif* 2013-2014. The site is located at latitude 33° 40' North and longitude 73° 08' East. The yearly average relative humidity was minimum 33-68%, temperature was 28-38.5°C and average 0-128 mm rainfall was recorded there. The experimental site was ploughed, harrowed, leveled, ridged and divided into 24 plots. The plot consisted of four ridges, spacing between ridges and 3m x 3m size holes were 60cm and 15cm, respectively. Each treatment was replicated thrice. Four seeds were sown per hole, at a depth of about 3-4 cm and field was irrigated on the day of sowing. The germination data was recorded after 3 days from sowing. The irrigation was depending on the rainfall. Thinning was as per requirement of crop carried out one week after emergence to three plants per hole. The cultural practices were done as per requirement of crop (Bhatti and Soomro, 1996). Neither fertilizers nor pesticides were used . Soil samples were collected for the analysis of physicochemical properties such as: pH, texture, EC (dSm^{-1}), NPK and organic matter content before cultivation (AOAC, 2000). Data on plant height, branches, clusters pods $cluster^{-1}$, number of pods, pod length, pod width, seeds pod and 100-seed weight were recorded. Collected data were subjected to analysis of variance for each parameter. The experiment was carried out in randomized complete block design (RCBD) with three

replications. Ten plants were selected randomly from each accession and tagged. Duncan's Multiple Range Test was applied to differentiate among treatments (P<0.05) followed by Steel et al. (1996).

Table 1. Physico-chemical properties of the experimental soil site at Institute of Plant Introduction, PARC, Karachi

Soil properties	0-30 cm	31-50 cm	Average
Texture	Sandy loam	Sandy loam	Sandy loam
pH	8.5	8.7	8.6
Organic Matter(%)	0.42	0.45	0.43
{EC} (dSm^{-1})	0.39	0.41	0.40
N (ppm)	0.016	0.009	0.012
P (ppm)	2.7	3.6	3.1
K (ppm)	60.01	62.0	61

RESULTS AND DISCUSSION

The soil samples were collected from the depth of 0-30 and 30-50 cm from the experimental area and analyzed for physico-chemical properties (Table 1). The present experiment was carried out to evaluate the different guar accessions in climatic conditions of Karachi.

The results have shown that the plant length was highest in Acc. No.3. Moreover, no significant difference was found in Acc. Nos. 2, 6 & 9 and 1, 7, 8, 10, 11 & 12 genotypes. The results indicated that branches $plant^{-1}$ were high in Acc. No. 8 as compared to rest of the accessions, while non-significant differences were observed among Acc. Nos. 1, 3, 6 and 9. Significantly (P<0.05)maximum branches in Acc. Nos. 4, 10 and 11 in comparison to Acc. Nos. 2 and 11 were recorded. Cluster $plant^{-1}$ was significantly (P<0.05) high in Acc. Nos. 3, 4, 5 and 6 genotypes as compared to 7, 10, 11 and 12 accessions, whereas, non-significant differences were observed in Acc. Nos.1, 2, 8 and 9 accessions. The study indicated that the pods $cluster^{-1}$ were significantly (P<0.05) high in Acc. No. 8, while non-significant differences among all accessions were observed. The pods length was significantly (P<0.05) high in Acc. No. 8, 9 and 3 (8.70, 7.88 and 7.86 cm, respectively) as compared to other accessions. Acc. Nos. 4, 5, 10, 11 and 12 showed significantly (P<0.05) high pod length in comparison to 1 and 2 accessions. While, non-significant differences were recorded in Acc. Nos.1, 2 and 6. Similarly, non-significant difference was recorded in Acc. Nos. 3 and 9. The pods width was significantly (P<0.05) high in Acc. No. 8 followed by Acc. Nos. 5, 9, 10 and 11 as compared to Acc. Nos. 1- 4, 6, 7 and 12. The results indicated that, the number of seeds per pods was significantly (P<0.05) high in Acc. Nos. 1, 2 and 4 as compared to rest of the accessions/genotypes. Moreover, no significant differences were found in Acc. Nos. 3-7 and 9-12 accessions genotype.

The results have revealed that 100-seed weight was significantly (P<0.05) higher in Acc. No. 4 as compared to rest of the accessions. Non-significant differences were observed in Acc. Nos. 1, 2, 4 and 7 but significantly (P<0.05) higher than Acc. Nos. 3, 5 , 6, 9, 10, 11 and 12 genotype. It was observed that there was progressive decrease in the accessions. Significant differences among cultivars for plant height, stand ability and plant population were presented but did not indicate any clear ranking of cultivars for agronomic traits correlate to grain yield. In general cultivars with a low degree of branches were ranked higher for grain yield e.g. Acc. No. 3 and Acc. No.5. Cultivar having Acc. No. 6, stood at rank 6^{th} at the

Table 2. Plant length, No. of branches, cluster plant^{-1}, pods cluster, pods length, pods width, seeds pods and 100-seeds weight of guar genotypes cultivated at Karachi

Accession number	Plant length (cm)	No. of branches	Cluster plant^{-1}	Pods cluster^{-1}	Pods length(cm)	Pods width (cm)	Seeds pods^{-1}	100 seed weight (g)
01	90.08 ± 3.31cde	12.33±0.42bc	8.02±0.36bc	9.00±0.42b	6.2±0.31d	0.81±0.02e	9.5±0.42ab	3.32±0.02b
02	101.71±3.45bc	9.00±0.57ef	7.66±0.33bc	9.16±0.30b	6.03±0.10d	0.65±0.04e	9.83±0.60ab	3.70±8.19b
03	160.53 ± 9.38 a	14.33±0.49b	8.50±0.42ab	9.00±0.57b	7.86±0.51ab	0.64±0.02e	8.16±8.19b	3.15±0.16c
04	112.25±3.93b	11.66±0.49cd	9.5±0.42a	9.66±0.66ab	7.61±0.23b	0.63±0.04e	8.33±0.55b	3.80±0.04b
05	72.4±1.50bcd	10.16±0.60def	8.5±0.76ab	9.34±0.03b	7.35±0.34bc	0.73±0.04bc	8.5±0.67b	3.66±0.02c
06	103.66±3.63e	12.5±0.88bc	8.33±0.42ab	9.5±0.56b	6.08±0.20d	0.6±0.02d	8.16±0.30b	3.90±0.01c
07	98.63±6.55bc	9.66±0.55def	6.66± 0.49cd	8.83±0.42b	6.55±0.29d	0.61±0.02d	9.02±0.01b	2.99±0.16b
08	99.16±4.77ded	17.00±0.57a	7.50±0.42bc	10.83±0.30a	8.7±0.40cd	0.81±0.02a	10.66±0.49a	4.20± 4.09a
09	102.15±2.20bc	12.56±0.49bc	7.5±0.42bc	9.33± 0.60b	7.88±0.17ab	1.51±0.91b	8.6±0.30b	3.11±0.06c
10	88.2±3.34cde	11.33±0.33cd	5.83±0.47d	8.5±0.22b	7.6±0.25 b	0.85±0.04bc	9.5±0.42b	3.05±0.04c
11	82±3.24de	8.66±0.66cde	6.66±0.49cd	8.66±0.60b	7.61±0.32b	.5±0.04bc	9.83±0.60b	3.07±0.05c
12	82.5±3.07de	11±1.46cde	5.66±0.42d	8.33±0.57b	7.11±0.24 bc	0.55±0.40c	8.5±0.42b	3.07±0.11c
LSD p <0.05	16.24	1.94	1.32	1.21	0.86	0.67	1.41	0.24

Means followed by same letters do not doffer significantly at P < 0.05

Acc. No. 2 but Acc. No. 8 (highest ranking yield) was the lowest ranking cultivar. These findings are supported by Kumar et al. (2013). The variation in plant height of the varieties used may be attributed to their genetic variability. The leathery pods are borne on the main stem and branches, which contain up to 10 seeds (Beg and Khaliq, 1990). According to the results of present study the important agro-morphological traits of guar genotypes like, seed/pod/ plant, yield potential and early maturity served as main criteria for promising cultivar/genotype selection.

Plant height stand ability and plant population were present but did not indicate any clear ranking of cultivars for agronomic traits correlate to grain yield. Cultivars with a low degree of branching are ranked higher for grain yield at Acc. No. 3 and Acc. No. 5. Cultivar Acc. No. 6, a standout at rank 6th at Acc. No. 2 but Acc. No. 8 (highest rank-ing yield) was the lowest ranking cultivar. Morris (2010) reported that at 50% maturity, 73 accessions were characterized for morphological, phonological and reproductive traits of guar regeneration cycles. High quality plants were regenerated from most of the accessions and produced 80 to more than 9,300 seeds per accession. During harvesting, small plants were uprooted or cut from the stem and sun dried. Seeds were taken out of the beans, either mechanically or manually, to avoid from shattering. The pods, manually separated from seeds, were sun dried. Like other legumes, guar is an excellent crop for enhancing soil fertility. Its root nodules contain nitrogen-fixing bacteria and crop residues, when ploughed under soil; improve yields of the succeeding crops. Texas cotton growers have measured a 15% increase in yield following guar rotation without nitrogen application (Stafford, 1986).

Pathak et al. (2011) reported from India, guar yield average is 5 to 6 t ha^{-1} (2.2-2.6t acre^{-1}). Genetic diversity is very important for developing new crop varieties with high yield and other desirable traits. Consequently, it assists in increasing food production and improving the level of human nutrition. The wide range of genetic diversity was observed in the present germplasm collection. It is also suggested that the said diversity could be utilized for the improvement in linseed by crossing best performing lines of different clusters, followed by selection in segregating generations

(Singh et al., 2005). It is evident from the present investigation that high range of variability was exhibited by all the plant characters studied that indicated high probability for the selection for various traits in guar cultivars.

The measurement of morphological characters alone to assess genetic diversity may not be very effective. The environmental effect on these characters renders this measure relatively insensitive particularly where differences are very small. More sensitive markers are thus required. Protein markers are widely used technique to reveal seed protein and isozymes. They operate at the gene product level where the environment has very little influence (PGRI, 1995).

It can be concluded from the study that the Acc. No. 1 and 2 increased seedling emergence% that produced tallest plants with many leaves, gave higher grain and dry matter yield. On the basis of overall performance of the genotypes in the trials it is defined that Acc. No. 8 and Acc. No. 6 may prove best commercial genotypes in future. However, the performances of these genotypes need to be tested under different agro-climatic conditions to draw out substantial conclusions.

Hence, there is a need to encourage cultivation of guar by developing a Research and Development Centre as the centre of excellence. The research work primarily intends to utilize the cultivated/ marginal lands for growing guar with underground tube-well and canal water, so it will result in addressing the problem of poor and small farmers of coastal areas of Pakistan. The morphological characters will help the breeders for guar crop improvement in characterization, identification of seed purity and parental selection.

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AUTHORSHIP AND CONTRIBUTION DECLARATION

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1.	Dr. Abdul Hameed Solangi	Concieved idea, Overall management of article. Wrote article, Result and Discussion
2.	Mr. Fateh Khan Nizamani	Technical input at every step
3.	Mr.Aqeel Ahmed Siddiqui	Technical input at every step, Methodology, Data collection
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