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Evaluation of Mungbean Germplasm from Baluchistan

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Abstract: Twenty-six accessions of mungbean (*Vigna radiata* (L.) Wilczek) germplasm endemic to the southeast and south west of Baluchistan (Awaran, Kharan, Khuzdar, Panjgur, Turbat and Gwadar) were evaluated at Faisalabad for various morphoagronomic characters. Coefficient of variations was very high for plant height, leaf area, pods per plant and seed yield per plant. Khuzdar material showed maximum variations for pods per plant, while accessions from Awaran were promising with regard to 100-seed weight and yield per plant. Accessions from Turbat and Gwadar were generally late maturing but produced the maximum number of seeds per pod and pod length. The tallest plants were recorded in the accessions from Turbat and Panjgur whereas Khuzdar material showed the highest pods per plant, the heaviest seeds and the highest yield per plant. Seed yield per plant correlated significantly and positively with most of the characters, especially with pods per plant and leaf area. Almost all the characters showed their minimal values in southeastern while their maximum was in extreme southwestern and northern parts of the province. The entries show good potential for yield enhancement and site-specific ecogeographic adaptation for each character studied.

Key words: *Vigna radiata*, germplasm evaluation, genetic variability, adaptation, correlation

Introduction

Heterogeneity of environments is a very unique and rare feature of Pakistan's landscape, thus promoting and maintaining rich variability of crops including legumes. Genetic erosion has been rampant resultantly major parts of Punjab suffered very badly. Accelerated rate of new introductions and related advanced agricultural activities caused huge damage to the germplasm resources through genetic erosion etc. However, some inaccessible and sub-mountainous nooks and corners await germplasm exploration. Legumes are immensely important for their contributions to human nutrition and soil fertility but because of their sensitivity to salinity, water logging, diseases and other agroclimatic conditions they usually remain in short supply.

Mungbean germplasm has been reported to possess high morphogenetic variability that is useful for crop improvement programmes. Choi *et al.* (1986) evaluated 100 mungbean varieties and lines and reported that average number of days to flowering was 45 (range 39-57) and number of days to maturity was 64 (range 54 to 80). Plant height varied from 47 to 105 cm, number of pods per plant from 4 to 22, number of seeds per pod from 8.5 to 13.0, 1000-seed weight from 32 to 72 g and seed yield from 31 to 136 kg/da (average 93 kg/da). Ali and Shaikh (1987) reported least variation for days to maturity while evaluating 30 mungbean genotypes for 10 characters. Seed size, pod length and plant height were the most important contributors to seed yield. He *et al.* (1987) assessed over 300 mungbean varieties for agronomic traits and reported high variation for most of the characters. Pandey *et al.* (1988) reported pods per plant the most variable character in 30 mungbean varieties, followed by seed yield per plant and flowers per plant. Liu *et al.* (1989) collected 632 mungbean accessions and reported that 177 were very early maturing (less than 70 days) and 255 were early (70 to 80 days). The 100-seed varied from 2.2 to 8.5 g (majority were between 4.5 to 6.0 g). Sharar *et al.* (1999) reported variations in yield and yield components in mungbean varieties. Ali *et al.* (2000) reported significant differences in yield components like number of pod bearing branches per plant, number of pods per plant, number of seeds per pod and 100-seed weight in seven mungbean genotypes. Amanullah and Hatam (2000) reported significant variation in seed yield (range from 719 to 1121 kg/ha) in five lines of mungbean.

Correlation studies revealed significant results of seed yield with various agronomic traits. Seed yield was reported to be positively correlated with plant height (Khan, 1988) but negative correlation was reported by Amanullah and Hatam (2000). Gill *et al.* (1992) reported positive correlation of seed yield with specific leaf area. Significant correlation of seed yield with number of seeds per pod was reported by Shamsuzzaman *et al.* (1983), Khan (1988) and Pundir *et al.* (1992). Number of pods per plant was the most related character to seed yield (Shamsuzzaman *et al.*, 1983; Choi *et al.*, 1986; Pundir *et al.*, 1992; Amanullah and Hatam, 2000). Seed yield also reported to correlate positively with 100-seed weight and pod length (Choi *et al.*, 1986; Pundir *et al.* 1992; Amanullah and Hatam, 2000).

Shamsuzzaman *et al.* (1983) recommended pods per plant and primary branches as selection criteria to improve yield. Seed size, pod length, plant height and number of fruit clusters per plant were the most important contributors to seed yield in 30 mungbean genotypes (Ali and Shaikh, 1987). He *et al.* (1987) indicated that high yielding mungbean varieties could be obtained by either selecting short or medium genotypes with more branches with more pods per plant but with small seeds or by selecting genotypes with large seeds, having more seeds per pod but fewer branches. Khan (1988) reported that pod length had the direct positive effect on yield, followed by branch number and plant height in diverse mungbean genotypes. Liu *et al.* (1989) regarded number of pods per plant, seeds per pod and 100-seed weight the most important yield components. Selection for pod number was regarded as important for improving yield. Pundir *et al.* (1992) suggested that pods per plant and 100-seed weight should be given priority in selecting for high yielding strains as they had positive direct and indirect effects on seed yield.

To pile up the suitable genetic variability, mungbean [*Vigna radiata* (L.) Wilczek] germplasm was collected from widely varying ecogeographical conditions of Baluchistan (Awaran, Kharan, Khuzdar, Panjgur, Turbat and Gwadar districts) and evaluated at Faisalabad. Attention was focused on a number of agromorphological characters including yield of single plants in addition to adaptability potential at Faisalabad.

Materials and Methods

Twenty six accessions of mungbean [*Vigna radiata* (L.) Wilczek] germplasm, collected from southwestern Baluchistan (Awaran, Gwadar, Kharan, Khuzdar, Panjgur and Turbat districts) were sown in the research area of Botany Department, University of Agriculture, Faisalabad during second week of March, 1992 (Table 1, Fig. 1). The soil was moderately prepared and seeds of each accession were sown in two rows, where row to row distance was 60 cm and plant to plant 30 cm. Normal irrigation treatment (four irrigations, 6 cm each) was applied up to the maturity of crop. The experiment was conducted in completely randomized design (CRD). Number of days taken to maturity, plant height (cm), leaf area (cm^2), number of pods per plant, pod length (cm), number of seeds per pod, 100-seed weight (g) and seed yield per plant (g) were recorded during the investigation in accordance with IBPGR *Vigna mungo* and *Vigna radiata* Descriptors, 1985.

Collection sites

1.259/1	2.260/5	3.263/10	4.265/5	5.268/5	6.269/1	7.271/2	8.273/7	9.274/1	10.275/4	11.276/1	12.277/3
13.278/3	14.279/5	15.280/1	16.281/2	17.281/4	18.283/4	19.284/6	20.285/2	21.290/1	22.291/1	23.291/4	24.293/4
25.294/5	26.296/2										

Fig. 1: Map of Baluchistan showing the collection sites of mungbean accessions

Table 1: Details of mungbean collecting sites from Baluchistan

District	Accession number	Altitude(m)	Site of collection
Khuzdar	259/1	1110	Moaza Dumb
	260/5	1100	Naal
Kharan	263/10	1280	Basima
	265/5	1330	Naag
Panjgur	268/5	870	Katagiri
	269/1	850	Rahi Nigar
	271/2	630	Daray Khand
Turbat	273/7	65	Beeri
	274/1	65	Dasht-e-
Khuddan	275/4	65	Dasht-e-
Khuddan	276/1	80	Kulanch
	277/3	75	Naloot
	278/3	60	Nalaint
	279/5	60	Chalani
	280/1	75	Kandasol
	283/4	55	Zar-e-Kaoor
	284/6	270	Pidrak
	285/2	270	Dramakool
Gwadar	281/2	30	Shadi Kaur
	281/4	30	Shadi Kaur
Awaran	290/1	570	Tunk
	291/1	585	Gatteyduff
	291/4	585	Gatteyduff
	293/6	560	Mada Kalat
	294/5	495	Awaran
	296/2	295	Arah

For statistical analysis average, standard deviation and range were calculated for each accession and correlation coefficient was calculated among the morphological characteristics in accordance with Steel and Torrie (1980).

Results and Discussion

Among all the characters studied days taken to maturity was the least variable character, ranged from 85 to 110 days (Table 2). The maximum variation within accession was recorded in 274/1-Turbat (CV 9.5) while the lowest was in 277/3-Turbat (CV 2.0). Accessions from Turbat, Gwadar and Awaran were generally late maturing and those from Kharan, Khuzdar and Panjgur were early maturing. Choi *et al.* (1986) reported that days to maturity ranged from 54 to 80 while Liu *et al.* (1989) remarked that very early maturing mungbeans took less than 70 days and early maturing from 70 to 80 days. These results are in accordance with that of Ali and Shaikh (1987) who reported least coefficient of variation for days to maturity.

Variations with regard to plant height (Table 2) were quite high ranging from 12.1 to 67.2 cm; its maximum was recorded in 273/7 Turbat (CV 51.4), whereas its minimum was in 279/5 Turbat (CV 12.9). Tall accessions were recorded from Turbat, Gwadar and Panjgur and the shorter from Awaran, Khuzdar and Kharan. Choi *et al.* (1986) reported plant height from 47 to105 cm, much higher than those used in present investigation.

A huge variation was recorded in leaf area ranging from 12.4 to 188.3 cm^2 (Table 2). Coefficient of variation was the maximum in 271/2 Panjgur (CV 54.9) and the minimum in 259/1 Khuzdar (CV 11.3). Accessions from Khuzdar ((259/1), Turbat (276/1, 278/3, 284/6), Gwadar (281/1, 281/4) and Awaran (291/4) were generally large-leaved while those from Panjgur (271/2), Turbat (274/1) and Awaran (296/2) were very small-leaved.

Number of pods per plant was the maximally varied character (Table 2), ranging from 2 to 162, its maximum was observed in 259/1-Khuzdar (CV 94.7) and the minimum in 290/1-Awaran (CV 42.6) Accessions from Khuzdar, Turbat and Gwadar produced greater number of pods. The highest pods producing accessions were 259/1 Khuzdar (range 11 to 162), 277/3 Turbat (range 13 to 145), 281/4 Gwadar (range 17-144), 269/1 Panjgur (range 11-120),

291/1 Awaran (range 11-110) and 283/4 Turbat (range 13-101). Number of pods per plant seems to a very important component of yield and has tremendous exploitable potential. The search of literature shows that pods per may be of the highest rank apt to contribute significantly towards higher yields. Choi *et al.* (1986) reported its range from 4 to 22. Shamsuzzaman *et al.* (1983), Liu *et al.* (1989) and Pundir *et al.* (1992) based pods per plant as the selection criterion. Similar findings were observed by Pandey *et al.* (1988) who reported pods per plant as the most variable character.

Variations regarding pod length (Table 3) were ranged from 3.7 to 8.5 cm; its maximum variability was seen in 265/5 Kharan (CV 19.0) and the minimum in 283/4 Turbat (CV 2.8). Longer pods were noted in the accessions from Turbat and Gwadar. Number of seeds per pod ranged from 5.6 to 12.6 (Table 3). The maximum variation was noticed in 296/2-Awaran (CV 21.7) and the minimum in 281/4-Gwadar (CV 5.3). Entries from Gwadar and Turbat showed greater number of seeds per pod. Choi *et al.* (1986) reported seeds per pod from 8.5 to 13.0.

Variations with regard to 100-seed weight ranged from 2.2 to 5.2 g (Table 3). Coefficient of variability was the maximum in 290/1-Awaran (CV 18.0) whereas its minimum was noted in 281/4-Gwadar. Accessions from Khuzdar and Gwadar showed heavier seeds. Choi *et al.* (1986) reported variations for 1000- seed weight from 32 to 73 g and Liu *et al.* (1989) for 100-seed weight from 2.2 to 8.5 g. In view of their counts the variation recorded in our stocks is very low because they were small and light seeded entries.

Yield per plant was among the most variable characters (Table 3), ranging from 0.2 to 45.4 g; its maximum was recorded in 291/4-Awaran (CV 88.5) while its minimum was in 291/1-Awaran (CV 41.7). High yielding accessions were recorded from Khuzdar, Panjgur and Turbat. Choi *et al.* (1986), Pandey *et al.* (1988), Sharar *et al.* (1999) and Amanullah and Hatam (2000) reported high variations for seed yield, so was the case of its coefficient of variability. Abysmally low yielding accessions were a miss adapt at Faisalabad environments because they fail to flower in time and continued their indeterminate growth while majority of the other entries had matured. It is guessed that these materials need retrial in most monsoon season with longer photoperiod. This is highly fascinating to note that the lowest and the highest yielding accessions generally originate from exactly the same field (same accession) depicting that the environmental influence at Faisalabad is highly different than that of endemism.

Correlation studies (Table 4) showed significant results among most of the characters. Seed yield per plant positively correlated with plant height, leaf area, pods per plant, pod length and seeds per pod. Pods per plant showed the strongest correlation, followed by leaf area. On contrary, no correlation was observed for 100-seed weight with any of the character studied. Similar results were reported by Shamsuzzaman *et al.* (1983), Khan (1988) and Gill *et al.* (1992), whereas Pundir *et al.* (1992) reported negative correlation of yield with plant height and Amanullah and Hatam (2000) reported negative correlation of yield with days to maturity, plant height and seeds per pod.

Germplasm material from remote areas of Baluchistan showed huge variations with regard to all the characters studies except days taken to maturity, indicating their potential to be successfully used for crop improvement programmes like breeding and single line selection for various traits, especially high yielding lines. Correlation studies pointed out positive relationship of seed yield with most of the characters, in particular with pods per plant, leaf area, pod length and seeds per pod. For high yielding genotypes, characters like pods per plant, leaf area, seeds per pod and pod length can safely be concluded as selection criteria.

In general, it was recorded that the maximum of almost all the characters was concentrated in south west of Baluchistan. The heaviest seeds to Gwadar, Panjgur, Turbat and Awaran, heavy yielding plants were concentrated at Kharan, western Turbat and Khuzdar while the early maturing entries were restricted to Kharan

Table 2: Range and coefficient of variance for days to maturity, plant height, leaf area and pods per plant of mungbean germplasm

		Days to maturity			Plant height (cm)			Leaf area (cm^2)			Pods per plant		
District	Acc No.	Min	Max	CV	Min	Max	CV	Min	Max	CV	Min	Max	CV
Khuzdar	259/1	100	105	2.6	25.7	52.8	20.2	100.1	160.3	11.3	11	162	94.7
	260/5	88	105	6.0	27.4	45.0	17.5	51.6	95.8	19.8	8	40	47.4
Kharan	263/10	88	101	7.2	33.5	55.5	18.0	56.9	133.9	25.0	16	94	53.7
	265/5	88	104	6.8	14.4	46.9	26.3	28.8	128.6	41.0	7	78	57.9
Panjgur	268/2	88	101	4.6	36.5	57.1	16.8	46.0	98.5	21.4	9	60	64.2
	269/1	88	105	5.7	33.8	65.1	21.5	74.4	143.1	29.3	11	120	83.2
	271/2	91	105	4.8	18.2	44.5	24.4	12.4	107.4	54.9	4	40	51.7
Turbat	273/7	91	105	7.5	24.7	49.1	51.4	39.6	137.8	51.4	2	81	69.5
	274/1	85	105	9.5	23.3	41.4	36.3	18.6	93.1	36.3	4	51	68.1
	275/4	91	105	7.0	29.1	44.6	21.8	39.9	111.6	31.8	5	42	55.7
	276/1	88	110	8.1	33.1	58.4	36.4	66.1	188.3	26.4	5	123	93.7
	277/3	106	110	2.0	12.1	54.2	14.0	75.5	121.2	14.0	13	145	56.3
	278/3	93	110	7.4	28.5	48.1	30.3	52.2	153.2	30.3	8	75	59.3
	279/5	93	110	6.3	32.0	55.0	12.9	86.2	119.6	12.9	17	98	59.1
	280/1	93	110	5.9	27.0	50.1	24.4	67.1	144.3	24.4	2	66	53.9
	283/4	97	106	4.4	36.4	56.5	14.9	70.6	138.5	23.8	13	101	74.3
	284/6	97	106	4.6	40.5	67.2	15.9	49.1	180.6	39.9	14	70	56.1
	285/2	97	106	4.6	20.5	60.2	29.8	44.1	153.7	37.1	14	79	48.0
Gwadar	281/1	93	106	6.5	27.4	65.3	18.9	39.5	161.4	39.4	12	62	58.7
	281/4	93	110	6.5	42.0	65.2	18.9	75.7	184.4	30.0	17	144	72.8
Awaran	290/1	97	106	4.4	29.1	54.2	17.7	35.6	104.9	28.1	10	54	42.6
	291/1	99	106	2.9	25.9	52.0	19.2	21.4	127.1	39.9	11	110	65.3
	291/4	99	106	3.5	24.0	46.3	24.4	54.1	165.4	37.0	7	70	64.3
	293/6	99	110	3.9	28.1	49.3	19.6	23.4	110.5	35.6	4	56	59.8
	294/5	99	106	3.3	15.3	48.2	31.6	21.9	104.7	39.4	2	60	68.9
	296/2	99	106	2.9	24.0	39.1	16.8	28.5	81.2	26.0	4	26	51.2

Acc. No. = Accession number, Max = Maximum value, Min = Minimum value, CV = Coefficient of variance

Table 3: Range and coefficient of variance for pod length, seeds per pod, 100-seed weight and yield per plant of mungbean germplasm

		Pod length (cm)			Seeds per pod			100-seed weight (g)			Yield per plant (g)		
District	Acc No.	Min	Max	CV	Min	Max	CV	Min	Max	CV	Min	Max	CV
Khuzdar	259/1	5.8	8.2	9.8	8.6	12.0	9.7	3.1	5.2	12.6	2.4	45.4	77.7
	260/5	5.5	7.3	9.2	8.0	11.6	10.3	2.8	4.2	11.6	1.9	11.1	49.2
Kharan	263/10	5.8	8.0	8.4	8.4	11.6	9.1	3.3	4.8	11.3	2.9	27.3	58.4
	265/5	3.7	8.1	19.0	7.0	11.6	17.2	2.9	4.6	13.6	0.8	23.0	74.2
Panjgur	268/2	5.5	7.9	11.5	7.6	11.6	12.4	3.3	4.4	9.5	1.8	17.5	70.7
	269/1	6.1	8.0	9.8	9.0	12.2	11.1	3.5	4.7	10.5	2.4	38.2	86.9
	271/2	4.9	7.4	10.1	7.4	11.6	12.5	3.5	4.6	8.9	1.0	10.7	54.6
Turbat	273/7	5.5	7.8	13.4	8.0	11.6	11.5	2.3	5.0	10.9	0.4	19.4	66.7
	274/1	5.1	7.2	13.0	7.0	11.4	17.1	3.4	4.6	9.7	1.1	14.5	70.4
	275/4	5.4	7.4	10.6	6.0	10.6	14.6	3.1	4.7	13.9	1.0	10.8	59.8
	276/1	5.0	8.0	16.2	7.0	11.5	20.0	3.3	4.4	9.9	1.2	31.3	83.1
	277/3	6.2	7.7	7.5	9.8	12.0	7.2	3.4	4.2	7.9	3.9	33.0	61.8
	278/3	6.0	7.8	7.9	9.4	11.8	7.5	3.4	4.1	6.8	2.6	23.7	77.1
	279/5	6.6	7.9	6.4	8.0	11.6	8.0	3.4	4.4	8.1	4.6	26.1	61.7
	280/1	5.3	7.8	10.7	9.0	11.6	8.2	2.8	4.6	13.1	0.2	14.3	51.4
	283/4	6.2	7.8	2.8	8.6	12.0	9.3	3.6	4.4	7.4	3.6	24.3	65.6
	284/6	5.7	7.9	10.4	9.6	12.0	7.5	3.4	4.1	6.7	3.1	17.5	64.6
	285/2	6.7	8.5	9.3	6.0	12.6	17.9	3.3	4.4	9.1	4.0	19.6	50.3
Gwadar	281/1	6.3	8.2	8.4	8.4	12.0	10.6	3.7	4.8	3.5	3.5	17.5	63.4
	281/4	6.7	8.0	5.3	9.6	11.6	5.3	3.8	4.6	5.6	3.3	29.3	61.5
Awaran	290/1	4.8	7.8	13.9	7.4	11.6	11.0	2.6	4.4	18.0	1.0	14.5	52.9
	291/1	6.4	7.8	7.0	8.6	12.0	9.3	2.9	4.5	12.8	4.0	16.6	41.7
	291/4	4.7	7.5	17.0	5.8	11.6	21.0	3.2	4.5	12.7	0.8	19.2	88.5
	293/6	5.7	7.8	11.3	7.0	11.0	13.7	3.6	4.8	11.1	1.1	16.1	63.4
	294/5	5.2	7.8	12.6	6.6	11.6	17.2	3.5	4.3	8.4	0.4	9.9	61.0
	296/2	3.7	7.3	18.2	5.6	12.0	21.7	2.2	4.6	17.6	0.5	7.1	67.9

Acc. No. = Accession number, Max = Maximum value, Min = Minimum value, CV = Coefficient of variance

Table 4: Correlation coefficients for agromorphological characteristics of mungbean germplasm from Baluchistan

Characters	Days taken to maturity	Plant height	Leaf area	Pods per plant	Pod length	Seeds per pod	100-seed weight
Plant height	0.30						
Leaf area	0.43	0.78**					
Pods per plant	0.51*	0.54*	0.72**				
Pod length	0.15	0.62**	0.59**	0.61**			
Seeds per pod	0.16	0.66**	0.61**	0.62**	0.76**		
100-seed weight	0.04	0.14	0.18	0.18	0.05	-0.14	
Seed yield per plant	0.33	0.51**	0.76**	0.93**	0.61**	0.62**	0.29*

* = Significant at 95% level, ** = Significant at 99% level

and Panjgur. The distribution patterns reflect site-specific valuable ecogeographical adaptations virtually for each character studied. Cardinal limits of each character are seen well spread, independently in each geographical entry thus the germplasm has potential for utilization in the crop improvement programmes. Entries from Khuzdar and Turbat hold promise for higher yields.

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