Evaluation of Genetic Variability in Mungbean (*Vigna radiata* (L.) Wilczek) Germplasm

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Four hundred and sixty eight (468) mungbean germplasm lines were evaluated in kharif season during 2001 and 2002 at Indian Agricultural Research Institute, New Delhi. The evaluated germplasm lines included 87 exotic and 381 indigenous collections. Wide range of variability was recorded in the studied qualitative traits like growth habit, growth pattern, leaf colour, leaf shape, internode length and seedling vigour. The descriptive statistics generated from quantitative traits (days to 50% flowering, number of primary branches, plant height (cm), number of clusters per plant, number of pods per cluster, number of pods per plant, pod length (cm), number of seeds per pod, seed yield per plant (gm), 100 seed weight (gm) and days to maturity) revealed adequate variability in the studied germplasm lines. Genotype PLM 694 exhibited high number of primary branches/plant, pods/ plant, clusters / plant and optimum seed yield/plant. For higher 100 seed weight the promising genotypes identified were EC 52195, EC 52194, PLM 59 etc. Nine genotype Viz. P312, VC 2777-21-B-B-3-B, EC 146298, EC 146323A, EC 146323B, EC 146328 B, ML 610, Ganga-2 and TARM-1 were tolerant against mungbean yellow mosaic virus.

Key Words: Germplasm evaluation, Genetic variability, Mungbean

Mungbean (*Vigna radiata* (L.) Wilczek) is an important grain legume crop in India, occupying 2.75 m ha area, with production of 0.98 m tons in the year 2002-2003 (Anonymous 2004). In spite of the release of 75 varieties in this crop till date, the national average productivity is quite low at 356 kg/ha as against 800 kg/ha in Srilanka, Pakistan, Thailand etc. and more than 1000 kg/ha in China. The main reason for the low productivity is the narrow genetic base of the released cultivars (Kumar *et al.*, 2004), susceptibility to biotic and abiotic stresses and poor seed replacement rate (Anonymous 2000). Mungbean is grown in spring/summer, *kharif* and *rabi* seasons in different parts of the country. Suitable plant types are required for each of these seasons that meet the demands of the individual agro-climatic regions. Resistance to biotic stresses like mungbean yellow mosaic virus, powdery mildew and Cercospora leaf spot must be incorporated into these plant types. Pre-harvest sprouting is a major abiotic stress and materials with top bearing, pods without pubescence but with a higher content of wax and thick, impermeable pod walls and possibly with 7 to 10 days seed dormancy must be selected and used in the hybridization programmes. The narrow genetic base of the released varieties not withstanding, several workers have reported wide variability for various morphological characters in mungbean germplasm (Malik and Singh, 1991; Reddy *et al.*, 1991; Kawalkar *et al.*, 1996; Sharma *et al.*, 1997; and Chen *et al.*, 1998). The nature and amount of variability in plant populations determines the success of breeding programmes undertaken. So, with the aim of evaluation of the variability for the mentioned important traits, both indigenous and exotic germplasm lines of mungbean were evaluated and characterized to identify the potential donors for different agronomic traits and biotic and abiotic stresses.

Materials and Methods

Four hundred and sixty eight mungbean germplasm lines were evaluated during 2001 and 2002 kharif seasons at Indian Agricultural Research Institute, New Delhi. The evaluated germplasm lines included both indigenous and exotic collections. These germplasm lines were evaluated in an augmented design with three checks viz. Pusa Vishal, Pusa 105 and M 1319 B. The row length was 4 m with row-to-row spacing of 30 cm and plant-to-plant distance of 10 cm. Recommended package of practices were followed to raise the crop (Sadaphal 1988). The observations were recorded on growth habit (erect, semi erect and spreading), leaf colour (dark green, light green, and green), growth pattern (determinate and indeterminate types), leaf shape (deltoid, ovate and acute), internodes length (long, medium and short), seedling vigour (vigorous, medium and poor as assessed at 15 days after emergence), internodes length (long, medium and short), days to 50% flowering, number of primary branches, plant height, number of clusters per plant, number of pods per cluster, number of pods per plant, pod length (cm), number of seeds per pod, 100 seeds weight, days to maturity and Mungbean Yellow Mosaic Virus (MYMV) resistance. Preliminary observations were also recorded for resistance to pre-harvest sprouting. For quantitative traits, observations were recorded on ten plants, selected randomly within a line. The data on numerical descriptor were analyzed in an augmented design to obtain adjusted values of means as suggested by Feder and Raghava Rao (1975) and as further elaborated by Paterson (1985). These data were used to create a database in standard format with the help of 'DIPVIEW' software package.

Results and Discussion

Significant variability was recorded for all qualitative and quantitative traits studied in the evaluated germplasm lines. The range of variability recorded is presented in Tables 1 and 2. Table 3 exhibits promising germplasm lines identified for different traits. The percentage frequency of genotypes for qualitative traits and descriptive statistics for quantitative traits indicated adequate variability for the studied traits in the evaluated germplasm lines.

Determinate types in general were early in maturity in comparison to the indeterminate types. The former (P 384, LM 234, LM 238, PLM 379, IC 39432 etc) are suited for summer season, where farmers get hardly 60-70 days in between wheat harvest and the subsequent planting of the *kharif* crops. Days to flowering ranged from 32 to 53 days, the earliest flowering lines were P 285, 76-56 and LM 447 that flowered in around 32 days. These earliest flowering lines matured in about 60 days, a character of top priority to be incorporated into the varieties for summer cultivation. Germplasm lines LGG 458, LGG 468, LGG 480, LGG 40, LGG 316 and MGG 136 were bushy and exhibited heavy foliage. These lines are suitable for fodder purpose and can also be used for green manuring. Varieties with this habit will not be suitable for intensive cropping systems. Most of the mungbean materials produce enough biological yields per unit area. The objective here should be to channelise maximum possible of this biological yield into economical yield. In other words concerted efforts must be made to enhance the harvest index of the new varieties.

IC 102955 and IC 734656 revealed terminal pod bearing. This trait is useful for mechanical harvesting of the crop. Varieties with this trait will be preferred in states like Punjab and Andhra Pradesh, where machine harvesting is practiced. Plant height ranged from 21 to 71cm. The short stature genotypes identified were LGG 498, LM 17, 2184 B, 2984, 3184 B-1 and tall types were LGG 502, LGG 458, LGG 429. Shorter genotypes matured in around 60 days. Studies in soybean and others crops have shown that tall but determinate genotypes are positively correlated with grain yield through more number of pod bunches and pod number itself per plant. However, for spring/summer cultivation in northern plains after wheat harvest, short plant structure with earliness is desirable. The tall but determinate habit will be more suitable for spring (March sowing after mustard, sugarcane, potato etc.) and *kharif* plantings. The number of primary branches ranged from 1.0 to 5.0. Two to four erect branches per

Table 1. Variability recorded for qualitative traits in mungbean germplasm

Character	Classification	No of Accession
Growth habit	Erect	416
	Intermediate	41
	Prostrate	11
Growth pattern	Determinate	89
	Indeterminate	379
Leaf colour	Dark green	78
	Light green	39
	Green	351
Leaf shape	Deltoid	368
	Ovate	95
	Acute	5
Inter node length	Long	89
	Medium	336
	Short	43
Seedling vigour	Vigorous	92
	Medium	173
	Poor	293

Table 2. Descriptive Statistics for quantitative traits in 468 mungbean germplasm lines

Characters	Plant height (cm)	Number of primary branches	Days to 50% flowering	Days to maturity	Number of pods/ cluster	Number of pods / plant	Pod length (cm)	Number of seeds per pod	100 seed weight (gms)	Seed yield/ Plant (gms)
Mean value	42.6	2.2	43.5	66.7	2.8	15.4	6.6	10.1	3.1	4.2
Maximum value	71	5	53	80	14	63	10.5	13.3	5.9	25.1
Minimum value	21	1	32	56	1	1.4	3.2	1	1.6	0.4
Variance	67.7	0.8	19.3	17.0	1.5	67.4	0.7	1.6	0.3	11.2
SD	8.2	0.9	4.8	4.8	1.3	8.2	0.85	1.2	0.5	3.2
Skewness	0.07	0.59	-1.39	-0.11	3.29	1.250	0.64	-1.3	0.28	2.6

plant are desirable which arise at an angle of 15 to 30 degrees with the main axis. This sort of plant architecture was found in lines VC 4735-4-B and 76-20.

Table 3. Promising mungbean germplasm lines for important traits Recommended to be used as donors in the new cultivar development

Sl.No.	Characters	Promising lines
1.	Days to maturity (<60 days)	PS 63-1, 76-27, LM 72, LM 62 B
2.	Cluster per plant (>17cluster/plant)	P 604, P 522 II, P 562 A, Sel.513 , 1315++, Pusa 103
3.	Pods per plant (> 40pods/plant)	LGG 505, PLM 694, PLM 748
4.	Seed per pod (>13 seeds/pod)	LGG 498, P 269-1, PLM 694
5.	100 seed weight (> 4.5 gm)	ET 52194, ET 52195, PLM 759, LGG 488, 137-1, HUM 4
6.	Seed yield per Plant (>15 g/plant)	ML 337, 76-6, EC 146286 B, VC 2719-29-1-B-12-1-B EC 146333, LGG 490, LGG 463

The maximum number of 19.3 pod clusters/plant was recorded for genotype P 604 and this character ranged from 1.6 to 19.3 in the germplasm lines. An ideal plant type in mungbean will be the one in which pod clusters start from basal nodes itself with shorter internodes. But plant has to be erect and compact, so that the pods of the basal clusters develop fully, have well filled seeds and do not get damaged by irrigation water. The exotic germplasm line EC 10148 exhibited 14 pods/cluster. More than 40 pods/plant were recorded for germplasm lines LGG 505, PLM 694, and PLM 748. This character, as reported by almost all mungbean breeders, is positively correlated with seed yield/plant and hence is the most important yield component. The pod length ranged from 9 to10.5 cm., the longest pods being exhibited by ET 52195,PLM 88 and PLM258B. The maximum numbers of seeds/pod (>13) were recorded in germplasm lines LGG 498, P296-1 and PLM 694.

Table 4. Donors for hybridization programme in mungbean with two or more desirable characters.

Characters	Days to maturity	No of pods per plant	Plant height (cm)	No of Pr. Branches/plant
Days to maturity	PS 63-1, 76-27, LM 72, LM 62 B (<60 days)		LGG 502 (60 days/71cm)	P 123(5br./60 days)
No of Clusters per plant (>17) P 604, P 522II, P 562 A, Sel.513, 1315++, Pusa 103	1315++ (60 days/17.7 cl.)	Pusa 103 (39.0 pods/ 17.3 cl.)	P604 (42cm./19.3 cl.) P 522II(40cm/19.0 cl.)	P604 (3.6 br./19.3 cl.) P 522 II (4 br./ 19.0 cl.)
No of Pods per plant	TARM-2 (60 days/ 37.3 pods) 13160 (60 days/ 33.7 pods)	LGG 505, PLM 694, PLM 748 ((>40 pods/plant)	PLM 748 (56.7cm/ 63 pods) Pusa 103 (56.7 cm/ 39 pods) MGM 1013 (51.0 cm/ 38 pods)	PLM 694 (48 pods/ 5 br.) LM 84 (38 pods/ 4.6 br.) M 186 (32.2 poods/4.3 br.)
Seed per pod (>13) LGG 498, P 269-1, PLM 694	LGG 498 (60 days/ 13.3 seeds)	P269-1 (28.3 pods/ 13 seeds) LGG 498 (20.8 pods/ 13.3 seeds)	P 269-1(47.8 cm/13.0 seeds) V2276 (42.3 cm/12.1 seeds)	LM 629 (4 br./12.2 seeds)
100 seed weight (> 4.5 gm) ET 52194, ET 52195, PLM 759, LGG 488, 137-1, HUM 4	EC 52195 (66 days/5.9 gm) EC 52194 (60 days/5.0 gm) PLM 759 (65 days/ 4.8 gm) LGG 488 (66 days/ 4.8 gm)	LGG 4579 (23.3 pods/ 4.6 gm)	EC 52195(54 cm/ 5.9 gm) LGG 488(60.3 cm/4.8 gm)	
Seed yield per Plant (>15 gm) ML 337, 76-6, EC 146286 B, VC2719-29-1-B-12-1-B, 2184B EC 146333, LGG 490, LGG 463	LM 331(60 days/12.1 gm) 1356++(60 days/ 12.3 gm) LGG 503(60 days/12.4 gm)	PLM 694 (48 pods/ 11.5 gm) LGG 503 (32 pods/ 12.4 gm) 2184 (32.8 pods/ 16.8 gm) VC2719-29-1(32 pods/ 16.7 gm)	2184B (28.7 cm/16.8 gm) LM 389(31.3 cm/13.2 gm) 13-56++(31.7 cm/12.3 gm)	PLM 694 (5 br. /14.4 gm)

Abbreviation used: cl. = no. of pod bearing clusters / plant, gm= grams, br. = no. of branches / plant, cm= centimeter

Wide variation was recorded for 100 seed weight from 1.6 to 5.9 gms. the maximum seed weight being of accession EC 52195. Medium bold and bold seeded varieties with 100 seed weight above 4 gms are preferred by farmers and consumers both. Bold seeded varieties have lesser hard seeds, cook well and produce better sprouts. The promising germplasm lines identified for bold seed size are EC 52195, EC 52194, PLM 759 and LGG 488. Seven genotypes viz. ML 337, 76-6, EC 146286B, VC 2719-29-1B-12-1-B, EC 146333, LGG 490 and LGG 463 exhibited 15 to 25 gm seed yield per plant. It ranged from 0.4 to 25.1 gm in the studied germplasm lines.

Nine germplasm lines viz. P312, VC2777-21-B-B-3-B, EC 146298, EC146323A, EC 146323B, EC 146328 B, ML 610, Ganga-2 and TARM-1 expressed mungbean yellow mosaic resistance on the basis of field observations during both the years of study. Selection 224, IC 1627, Sel.A, EC 146323, EC 146323 B, AKM 9310 and AKM 9602 expressed pre-harvest sprouting resistance. These lines had pods without any pubescence (rain water does not stick to such surfaces) and had thicker pod walls with a well developed inner parchment membranes, which does not allow rain water to seep into the pods easily. These lines possibly may also have a higher wax content in the pod walls, which however needs to be worked out. Resistance to pre-harvest seed sprouting in the field due to untimely long spells of rains in *kharif* season is becoming a very important character. The seed damage is basically due to the zero dormancy of the seeds in this crop and many a time farmers loose the entire produce, as the resource poor farmers are not able to harvest the crop in time. So realizing the importance of this character, it may be transferred from these lines to the good agronomic bases. Table 4 denotes the various selections made that combine two or more useful traits. These selections may be used by the breeders as donors of more than one useful character. The more useful traits may be pyramidised into the same agronomical bases.

The promising germplasm lines identified from this investigation, can be used by pulse breeders in hybridization programmes for generation of breeding materials and commercial varieties with broad genetic base.

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