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EVALUATION OF F_4 PROGENIES EMANATED FROM AN INTERSPECIFIC HYBRIDIZATION OF MUNGBEAN AND BLACKGRAM

H.K. Sharma*, D.P. Singh, Arvind Kumar and P.K. Shrotria

Department of Genetics and Plant Breeding,
G. B. Pant University of Agriculture and Technology, Pantnagar, -263 145,India

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ABSTRACT

A total of 100 F_4 progenies (87 mungbean type and 13 blackgram type) of a wide cross between mungbean (cv BDYR-1) and blackgram (cv DPU 88-1) were evaluated in augmented block design. A wide spectrum of variability was observed for all the characters except for days to first flower. Progeny No.70 was significantly superior over best check for days to first flower, pods/cluster, pod length and seeds/pod. Character association unveiled highly significant and positive association of grain yield with pods/cluster and pods/plant. Metroglyph and index score analysis broadly divided 100 progenies into nine groups across pods/plant and grain yield/plant. Maximum numbers of progenies (60) and maximum variability for different yield contributing characters were found in fifth group. Based on SDS –PAGE analysis dendrogram divided 33 genotypes (31progenies and two parents) into eleven clusters at 85% similarity and the Jaccard's similarity coefficients ranged from 0.26 to 0.96.

Key words: Blackgram, Diversity, Mungbean, Progenies, Variability, Wide cross.

INTRODUCTION

Interspecific hybridization is one of the methods of creation of genetic variability and widening of genetic base of a crop species. Continuous breeding efforts for improvement of greengram or mungbean [*Vigna radiata* (L.) Wilczek] and blackgram or urdbean [*V. mungo* (L.) Hepper] had exhausted the available variability in these crops and only limited improvement is possible. Both of these species have some desirable characters like, mungbean has early maturity, erect growth habit and long pods with large number of seeds/pod and blackgram possess non shattering pods with synchronous maturity, more clusters/plant, pods with large seeds and comparatively more durable resistance to yellow mosaic virus**,** which can be transferred in them via wide hybridization (Singh, 1990). In view of these considerations the investigation was under taken on some 100 F_4 progenies emanating from a wide cross, involving mungbean (cv. BDYR-1) and blackgram (cv. DPU 88-31) to assess variability and genetic diversity.

MATERIALS AND METHODS

One hundred F_4 progenies of a wide cross (BDYR-1× DPU 88-31) were sown in augmented block design in 10 blocks along with four checks (2 mungbean cvs., BDYR-1 and Pant Mung-4 and 2 blackgram cvs., Pant U-35 and DPU 88-31) during *kharif* season on July 17, 2005 at Crop Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand. Row length was kept 3 meters and the spacing between two rows was kept at 60 cm. Recommended agronomic practices were followed during the period of crop growth. Five representative plants from each plot comprising of single row of one progeny were randomly selected and data were recorded on days to first flowering, plant height, primary branches/ plant, clusters/plant, pods/cluster, pods/plant, pod length, seeds/pod, 100-seed weight and grain yield/ plant. The analysis of variance for augmented design was done by using method given by Federer (1956; 1961) and elaborated by Federer and Raghavarao (1975) and Peterson (1985). Associations between all the yield contributing characters, was computed as per Searle (1961), and significance of correlation

*Corresponding author's e-mail: harrygpb@gmail.com

coefficients (r) was tested by comparing with 't' value at (n-2) *d.f.* according to Snedecor and Cochran (1967). The metroglyph and index score analysis was carried out for the eight characters of high variability using the method suggested by Anderson (1957). Molecular diversity of selected progenies was also studied on biochemical basis using SDS-PAGE (Sodium Dodecyl Sulfate Polyacrylamide Gel Electrophoresis) as per procedure standardized for seed protein gel electrophoresis of mungbean and blackgram by Dadlani and Varier (1993). Protein bands were scored for the presence (1) or absence (0) of bands of different molecular weight in the form of binary matrix (1, 0) and data were analyzed by using SIMQUAL program of NTSYS-pc (version 2.11W; Exeter Biological Software, Setauket, NY, Rohlf, 1993).

RESULTS AND DISCUSSION

Variability: Highly significant differences among check varieties were observed for all the characters (Table 1). The general mean, range and phenotypic coefficient of variation (PCV) are presented in Table 2. Unlike, blackgram type of progenies, mungbean types of progenies flowered earlier and had more plant height, pods/cluster, pod length and seeds/pod, whereas blackgram type of progenies possessed more primary branches/plant, clusters/plant, pods/plant, 100-seed weight and grain yield/plant. In mungbean type of progenies maximum range of variation was noticed for plant height (45.83-149.54 cm), in contrary to that, blackgram type of progenies had maximum range of variation for pods/plant (46.99-115.14). Rahman *et al.* (1993) analysed the genetic variability in segregating F_2 populations of three crosses of mungbean and reported that GCV was high for pods/plant and seed yield/plant. Similarly, Reddy *et al.* (2003) evaluated 36 genotypes of mungbean for genetic variability of seed yield and its contributing characters in summer season and noticed high magnitude of variability for pods/plant and grain yield/plant.

In mungbean type of progenies, the highest and the lowest PCV were recorded for grain yield/plant (52.28%) and days to first flower (7.46%) while in blackgram type of progenies, clusters/plant had the highest PCV (33.98%).

In blackgram type of progenies a wide range of variation was observed for pods/plant (46.99-115.14), plant height (54.33-94.73 cm) and clusters/plant (9.58-35.48). Pal *et al.* (2005) reported similar results for pods/plant and plant height among advanced segregating generations of inter specific crosses between *V. mungo* x *V. umbellata*. Clusters/plant had the highest PCV (33.98%) followed by pods/cluster (27.32%) and pods/plant (22.48%). The highest value of mean was observed for pods/plant (82.83) followed by plant height (73.50cm) and days to first flower (50.32). Vaithiyalingan (2004) reported high GCV for seed yield, pods/plant and clusters/plant, while evaluating the F_1 hybrids derived from crosses between the blackgram lines. Veermani *et al.* (2005) assessed genetic variability in the segregating populations of three crosses, involving 4 parents (LBG 402, LBG 685, LBG 645 and LBG 20). The LBG 645 x LBG 20 cross recorded high estimates of PCV and GCV for plant height, branches/plant, seeds/pod and seed yield/plant. Shafique *et al.* (2011) evaluated 34 Pakistani blackgram cultivars for morphological traits and found more PCV for dry pod weight (71.79%), number of branches per plant (51.16%) and biological yield (50.12%).

TABLE 1: Analysis of variance for different characters of mungbean and blackgram types of progenies.

Characters	Mean squares		
	Blocks (9)	Checks (3)	Error (27)
Days to first flower	5.89	186.78**	2.90
Plant height	107.39	4196.19**	104.67
Primary branches/plant	0.74	14.72**	0.81
Clusters/plant	58.60	1042.52**	72.92
Pods/cluster	0.58	9.86**	0.42
Pods/plant	578.32	7992.73**	457.50
Pod length	0.09	50.04**	0.11
Seeds/pod	0.47	79.35**	0.36
100-seed weight	0.05	4.50**	0.38
Grain yield/plant	28.08	125.89**	24.75

Note: Degrees of freedom are given within parenthesis ** significant at 1% level of probability.

TABLE 2. The general mean, range and phenotypic coefficient of variation (PCV) of mungbean (without parenthesis) and blackgram (in parenthesis) type of progenies for different characters.

Characters	Mean± SE	Range	Difference in range	PCV (%)
Days to first flower	47.16±0.35 (50.32±0.38)	38.29-56.04 (42.84-54.74)	17.75 (11.90)	7.46 (7.55)
Plant height (cm)	86.80±1.55 (73.50±0.10)	45.83-149.54 (54.33-94.73)	103.71 (40.40)	17.84 (1.39)
Primary branches/plant	3.84±0.10 (5.98±0.12)	1.81-6.61 (3.01-7.31)	4.80 (4.30)	26.68 (19.99)
Clusters/plant	15.17±0.67 (23.80±0.81)	2.43-55.43 (9.58-35.48)	53.00 (25.90)	44.03 (33.98)
Pods/cluster	4.14±0.08 (3.04±0.08)	1.98-6.05 (2.28-5.68)	4.07 (3.40)	19.77 (27.32)
Pods/plant	54.69±1.91 (82.83±1.87)	5.19-99.14 (46.99-115.14)	93.95 (68.15)	34.97 (22.48)
Pod length (cm)	6.17±0.07 (4.46±0.08)	4.56-7.71 (3.16-6.86)	3.20 (3.70)	11.11 (17.65)
Seeds/pod	7.91±0.15 (5.40±0.12)	5.05-11.45 (3.60-8.40)	6.40 (3.70)	18.49 (21.75)
100-seed weight (g)	2.76±0.03 (3.45±0.05)	2.09-3.58 (2.44-4.06)	1.49 (1.62)	10.87 (13.59)
Grain yield/plant (g)	8.64±0.45 (11.05±0.23)	0.58-18.99 (7.56-14.53)	18.41 (6.97)	52.28 (21.24)

In mungbean type of progenies only one progeny (No.6) was found to be significantly superior to the best check (BDYR-1) only for clusters/plant (55.43) while, in blackgram type of progenies four progenies (No. 26, 66, 68 & 70) were significantly superior to the best check for plant height (Table 3). Progeny No.70 was significantly superior for five characters namely; days to first flower, plant height, pods/cluster, pod length and seeds/pod (Table-3). Reddy and Singh (1990) reported significantly higher transgressive segregants for days to first flower and seed weight in mungbean type of progenies from the crosses ML 5 x LM 293 (F_2) and T 44 x ML 5 (BC_2F_2), respectively.

Character association: Significant correlation coefficient between seed yield and its contributing characters presented in Table 4. Significant and negative association was observed between, days to first flower vs. pods/cluster, primary branches/plant vs. pods/cluster, seeds/pod vs. 100-seed weight, while, significant and positive association was noticed between primary branches/plant vs. clusters/plant, clusters/plant vs. pods/plant, pod length vs. seeds/pod, in all three types of category i.e. 100 progenies, 87 mungbean type, 13 blackgram type, respectively.

In all the 100 progenies, gain yield/plant showed highly significant and positive correlation with pods/cluster and pods/plant. Sharma and Gupta (1994) reported similar correlation in 32 breeding lines derived from a mungbean x blackgram wide cross.

In 87 mungbean type of progenies grain yield/plant exhibited positive correlation with pods/plant, pods/cluster, seeds/pod and pod length. Similar association of grain yield with pods/plant was reported by Hedge *et al.* (1996) and Singh and Singh (2000). Highly significant and negative association between grain yield and days to first flower was observed. While, significant and positive correlation of pods/plant with clusters/plant and pods/cluster was noticed. Rajan *et al.*, (2001) also reported significant and positive association of pods/plant with clusters/plant in F_2 population of 21 mungbean crosses. Likewise, Sreedevi and Sekhar (2004) observed same association of clusters/plant with pods/plant in 21 F_4 progenies of greengram.

In 13 blackgram type of progenies pod length had positive and significant association with seeds/pod. likewise, positive and significant association of clusters/plant with primary branches/plant and pods/plant is in agreement with findings of Muthiah and

TABLE 3. List of progenies significantly superior to the best check for different characters.

Characters	Best blackgram check	Blackgram progeny significantly superior to the best check	Best mungbean check	Mungbean progeny significantly superior to the best check
Days to first flower	Pant U-35 (47.26)	No. 70 (42.84)	BDYR-1 (40.90)	-
Plant height (cm)	DPU 88-31 (87.68)	No. 26 (61.08) No. 66 (54.33) No.68 (56.53) No.70 (57.14)	BDYR-1 (54.14)	-
Primary branches/plant	DPU 88-31 (6.52)	-	BDYR-1 (5.42)	-
Clusters/plant	DPU 88-31 (31.56)	-	Pant M-4 (12.90)	No. 6 (55.43)
Pods/cluster	DPU 88-31 (3.22)	No. 70 (5.67)	Pant M-4 (4.93)	-
Pods/plant	DPU 88-31 (97.40)	-	Pant M-4 (48.78)	-
Pod length (cm)	DPU 88-31 (4.20)	No. 70 (6.86)	BDYR-1 (8.62)	-
Seeds/pod	Pant U-35 (6.13)	No. 70 (8.40)	Pant M-4 (11.29)	-
100-seed weight (g)	DPU 88-31 (3.86)	-	BDYR-1 (3.69)	-
Grain yield/plant (g)	DPU 88-31 (18.01)	-	Pant M-4 (11.40)	-

Note: Figures in parenthesis are the mean values of the respective checks and progenies

Sivasubramanian (1981) which reported positive association of pods/plant with clusters/plant while evaluating 50 blackgram varieties. Pods/cluster had significant and positive correlation with pod length and seeds/pod. Katna and Verma (2001) reported similar results in 41 blackgram cultivars. Shafique *et al.* (2011) reported positive significant correlation between number of pods/plant and pod length, grain yield and number of seeds/plant, and 100 seeds weight and biological yield in 34 blackgram cultivars. It may be concluded that indirect selection of yield contributing characters like pods/plant, clusters/plant, pods/cluster, seeds/pod, 100-seed weight, pod length instead of direct selection for yield will be fruitful for obtaining high yielding genotype from a segregating population.

Genetic diversity: Wide crossing or distant hybridization is an effective mean for transferring desirable genes into cultivated plants from related species and genera. Metroglyph and Index Score analysis was done for preliminary groping of large number of progenies into different groups, so as to initiate breeding programme to generate more variability for yield and its contributing traits. The Index scores and signs were used for 8 characters for Metroglyph analysis had been shown in Table 5. Each character was illustrated by a ray, the rays for any one character having the same position on each glyph. The index scores were obtained by allotting numerical values (1, 2 or 3) to the three grades of expression recognized in respect of each character and finally summing up the scores obtained by each progeny for all the characters under study. Different range for index score were used for mungbean and blackgram type of progenies.

A scatter diagram was prepared using pods/plant at X-coordinate and grain yield/plant at Y-coordinate (Fig.1). Remaining six characters had been represented by rays at different positions on the glyph and the range by the length of rays. A total of nine groups could be distinguished in scatter diagram. The first group was represented by the 12 progenies similar to mungbean with low yield and low number of pods/plant. Both third and ninth group contained only one mungbean type of progeny each. The fourth group consisted of 5 mungbean progenies and 5 blackgram progenies. The main feature of this group was average yield and high number of pods/plant. The fifth group represented by average pods and average grain yield/plant. This group consisted the highest number of 60 progenies and one blackgram check (DPU 88-31), out of which 5 were blackgram type. The eighth group comprised of 10 mungbean type of progenies and one blackgram check (Pant U-35). The main feature of this group was average number of pods and high yield/plant. The range of index score was from 11 to 23. Genotypes belonging to diverse groups like Group-I and VII, III and IX could be crossed to generate more variability for yield contributing traits.

TABLE 4. Significant correlation coefficients for different characters in progenies of a wide-cross.

Characters	100-progenies (mungbean and blackgram type)	Mungbean type of progenies (87)	Blackgram type of progenies (13)
Days to first flower vs. plant height	0.409**	0.544**	-
Days to first flower vs. primary branches/plant	0.393**	0.286**	-
Days to first flower vs. pods/cluster	-0.489**	-0.402**	-0.618*
Days to first flower vs. pod length	-0.290**	-	-
Days to first flower vs. seeds/pod	0.211*	-	-
Days to first flower vs. grain yield/plant	-	-0.259**	-
Plant height vs. primary branches/plant	-	0.182*	0.687**
Plant height vs. pods/cluster	-	-0.200*	-0.591*
Primary branches/plant vs. clusters/plant	0.537**	0.358**	0.695**
Primary branches/plant vs. pods/cluster	-0.572**	-0.382**	-0.848**
Primary branches/plant vs. pods/plant	0.445**	0.229*	-
Primary branches/plant vs. pod length	-0.386**	-	-
Primary branches/plant vs. seeds/pod	-0.302**	-	-
Primary branches/plant vs. 100-seed weight	0.358**	-	-
Clusters/plant vs. pods/cluster	-	-	-0.532*
Clusters/plant vs. pods/plant	0.492**	0.368**	0.501*
Clusters/plant vs. pod length	-0.249*	-	-
Clusters/plant vs. seeds/pod	-0.207*	-	-
Clusters/plant vs. 100-seed weight	0.327**	-	-
Pods/cluster vs. pod length	0.370**	-	0.658**
Pods/cluster vs. seeds/pod	0.207*	-	0.605*
Pods/cluster vs. 100-seed weight	-0.287**	-	-
Pods/cluster vs. pods/plant	-	0.437**	-
Pods/cluster vs. grain yield/plant	0.364**	0.525**	-
Pods/plant vs. pod length	-0.372**	-	-
Pods/plant vs. seeds/pod	-0.293**	-	-0.495*
Pods/plant vs. 100-seed weight	0.204*	-	-
Pods/plant vs. grain yield/plant	0.364**	0.588**	-
Pod length vs. seeds/pod	0.731**	0.593**	0.791**
Pod length vs. 100-seed weight	-0.501**	-	-
Pod length vs. grain yield/plant	-	0.232*	-
Seeds/pod vs. 100-seed weight	-0.505**	-0.269**	-0.522*
Seeds/pod vs. grain yield/plant	-	0.250**	-

Note: *, ** significant at 5% and 1% level of probability, respectively.

TABLE 5. Index scores and signs used for 8 characters for Metroglyph analysis of 100-progenies of a wide cross.

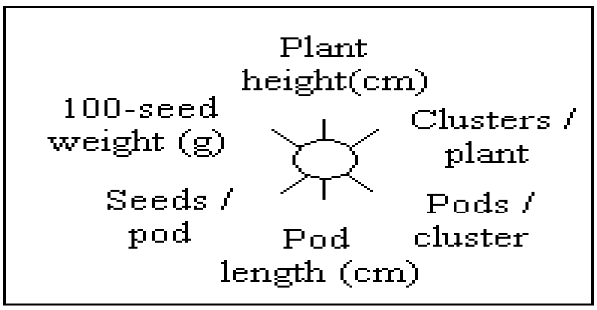
Characters	Score 1		Score 2		Score 3	
	Values less than	Sign	Values between	Sign	Values more than	Sign
Plant height (cm)	80.0 (70.0)		80.0-95.0 (70.0-85.0)		95.0 (85.0)	
Clusters/plant	15.0 (20.0)		15.0-20.0 (20.0-30.0)		20.0 (30.0)	
Pods/cluster	3.5 (2.5)		3.5-4.5) (2.5-3.0)		4.5 (3.0)	
Pods/plant	45.0 (85.0)	-	45.0-65.0 (85.0-90.0)	-	65.0 (90.0)	-
Pod length (cm)	5.5 (4.3)		5.5-6.6 (4.3-4.6)		6.6 (4.6)	
Seeds/pod	6.5 (5.0)		6.5-8.0 (5.0-6.0)		8.0 (6.0)	
100-seed weight (g)	2.5 (3.2)		2.5-3.0 (3.2-3.5)		3.0 (3.5)	
Grain yield/plant (g)	9.0 (12.5)	-	9.0-13.0 (12.5-14.0)	-	13.0 (14.0)	-

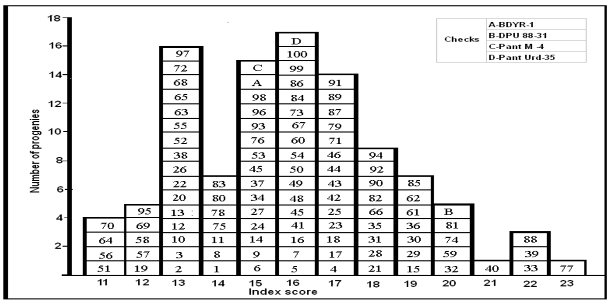
Note: Figures in parenthesis are values for blackgram progenies and figures without parenthesis are values for mungbean progenies.

Satyan *et al.* (1991) applied metroglyph and canonical analysis and divided the 21 genotypes of mungbean in nine categories on the basis of seed yield and pod bearing habit. They found that majority of genotypes were low yielder. Sharma *et al.* (1996) used non-hierarchical Euclidean cluster analysis to assess the genetic divergence in mungbean and blackgram. Sharma *et al.* (2000) grouped 30 lines/ cultivars in 4 distinct morphological groups. Haritha and Sekhar (2003) used D^2 and metroglyph analysis and reported that metroglyph analysis may be suitable for preliminary grouping of large numbers of genotypes. Abbas *et al.* (2010) assessed genetic diversity in 40 mungbean germplasm using metroglyph analysis and divided them into eight groups based on 100-seed weight and seed yield.

SDS–PAGE analysis was carried out with both parents and 31 progenies [19 mungbean type (Fig. 2a & 2b) and 12 blackgram type (Fig. 2c). The values of the Jaccard's similarity coefficients ranged from 0.32 to 1.0. The maximum genetic diversity at protein level was noticed between progeny no. 43 & 98 (Jaccard's Coefficient 0.32) while, progeny no. 87 & 101, 93 & 55, 68 & 81, 25 & 80, 74 & 75 were found to be genetically similar at protein level (Jaccard's Coefficient 1.00). Based on dendrogram 33 genotypes grouped into eleven clusters at 85% similarity (Fig. 3).

Renganayaki *et al.* (1993) did SDS-PAGE of single seed to study the salt soluble protein subunits of the parents and interspecific hybrids of *V. radiata* and *V. mungo*. SDS-PAGE analysis was used by various workers for varied purposes *viz.*, to find out the wild progenitor of different crop species (Thakare *et al.*, 1988), to find out existence of genetic diversity in





Frequency diagram.

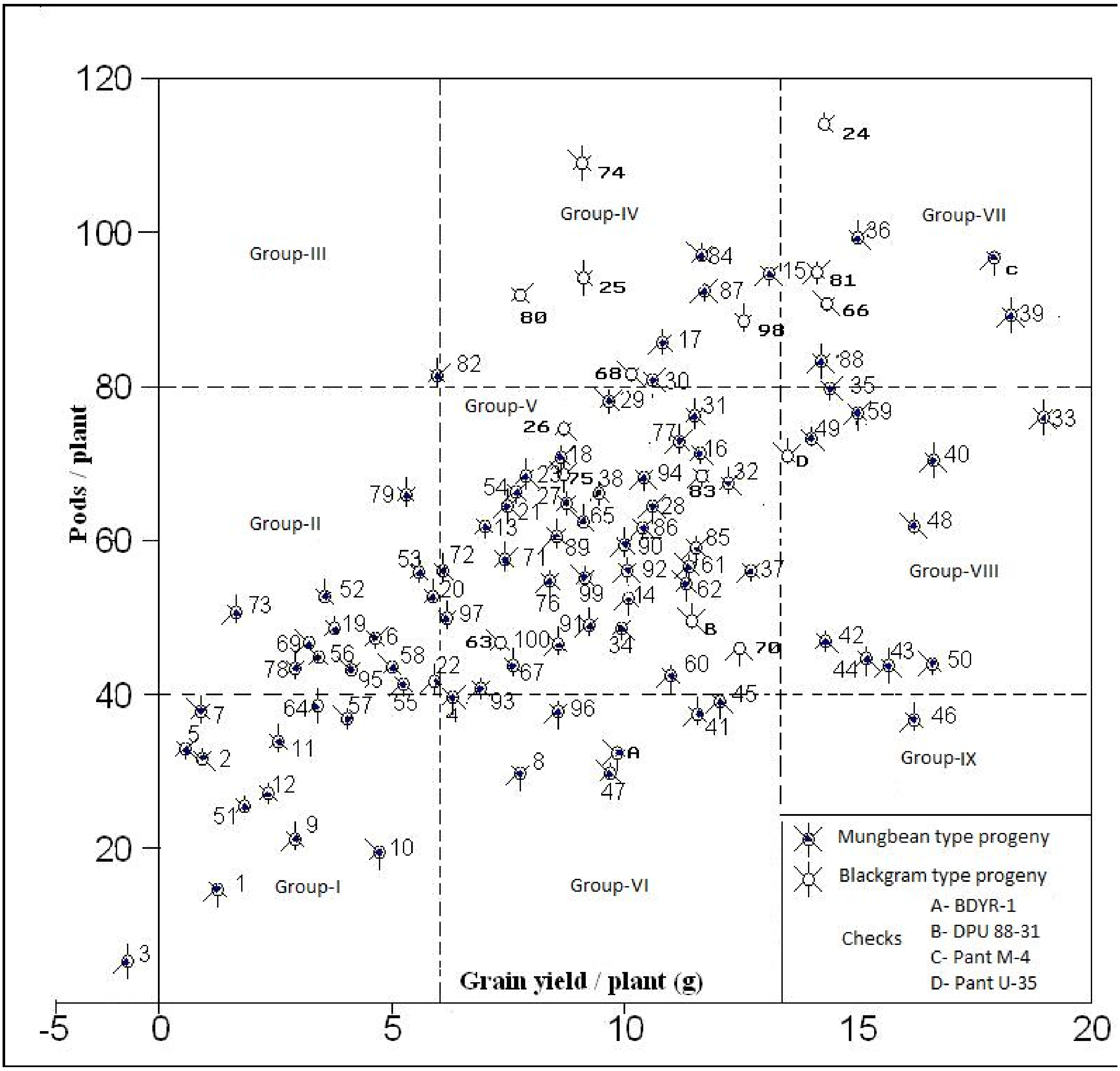


FIG. 1. Scatter diagram of Metroglyph analysis of 100 progenies of a wide cross and their parents (BDYR-1and DPU 88-31) and checks (Pant M-4 and Pant U-35).

germplasm (Custodio *et al.*, 1994), for detection of genetic relationship between mungbean and blackgram (Ghafoor *et al.*, 2002), and for QTL identification (Ghafoor *et al.*, 2005). Dixit *et al.* (2009) applied RAPD, URP and SSR markers for molecular characterization of ûxed lines of mungbean. Shafique *et al*. (2011) assessed genetic diversity in 34 Pakistani blackgram cultivars using RAPD and SDS-PAGE markers.

It may be concluded that wide hybridization is a very useful breeding method for creation of large amount of variability for yield and yield contributing characters and for obtaining transgressive segregants. Some of these could be released as variety after fixation of alleles and others may be used as donors in hybridization programme to generate more variability for important yield and quality traits.

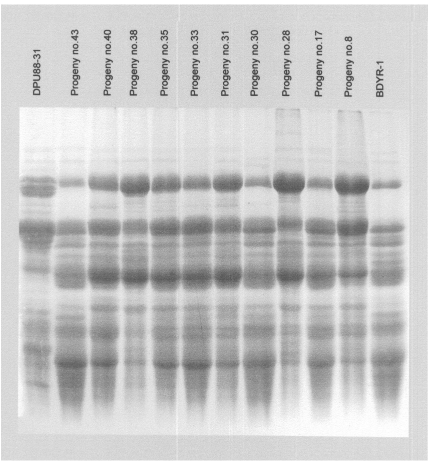


FIG. 2a

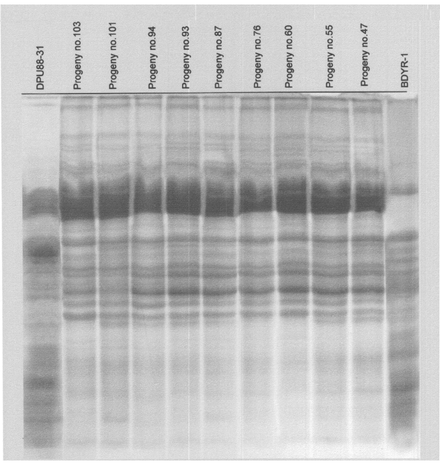


FIG. 2b

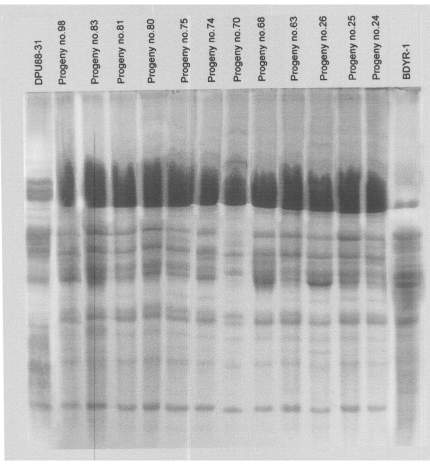


FIG. 2c

FIG. 2a-2c: SDS-PAGE electrophoresis pattern of 31 progenies [19 mungbean type (2a & 2b) and 12 blackgram type (2c)] and their parents (DPU 88-31, BDYR-1).

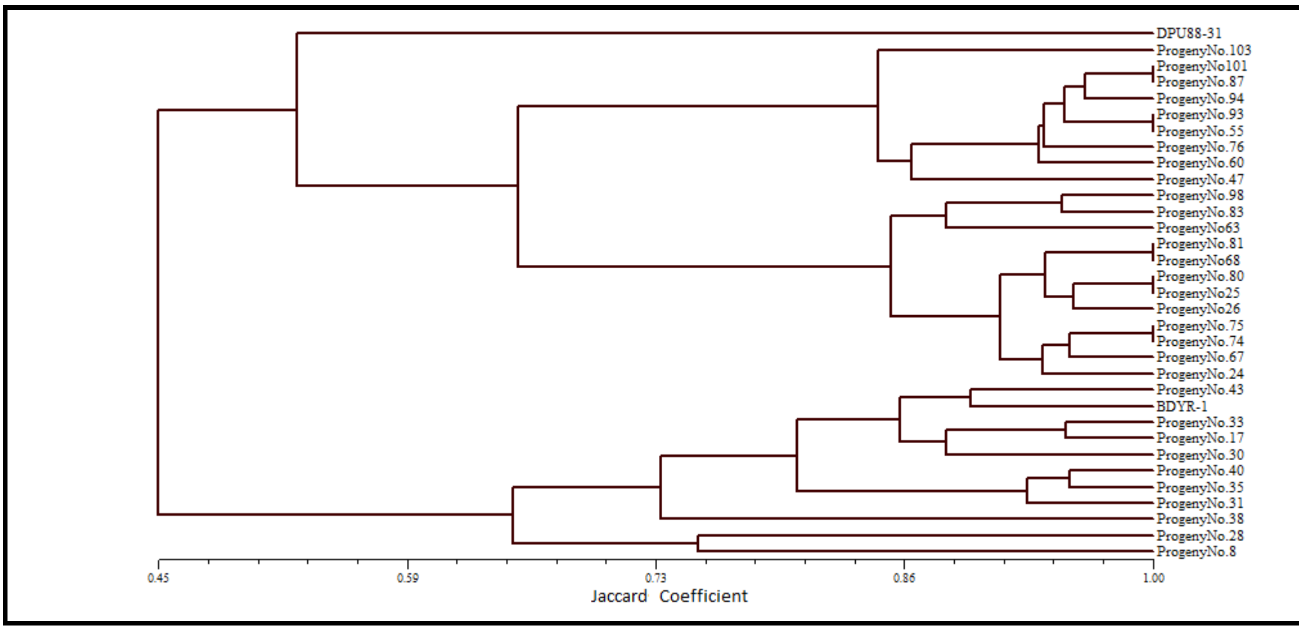


FIG. 3. Dendrogram of SDS-PAGE analysis of 31 progenies (19 mungbean type and 12 blackgram type) and their parents (DPU 88-31, BDYR-1).

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