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VARIATION IN BLACKGRAM (*VIGNA MUNGO* (L.) HEPPER) X GREEN GRAM (*VIGNA RADIATA* (L.) WILCZEK) DERIVED GENEPOOL

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Thirty-two elite true-breeding lines of a black gram (HPU 27) × green gram (PIMS 3) cross alongwith checks were evaluated in a randomized block design to study the nature of variation with respect to seed yield and 14 other traits. Analysis of variance revealed significant genotypic Differences for all the traits. Phenotypic and genotypic coefficients of variation were high for seed yield/plant, biological yield/plant, clusters/plant, pods/plant, 100-seed weight, seed crushing hardness and per cent sulphur. Heritability estimates were high (>50%) for 100-seed weight, protein content, pod length seeds/pod and seed crushing hardness. The recombinant derivatives, MM 14, MM 24, MM 30 and MM 31 surpassed the parent(s) for seed yield and some of the other traits studied.

Key words : *Vigna* sp., urid bean, mung bean, hybridization, analysis of variance

Blackgram (*Vigna mungo* (L.) Hepper) and greengram (*Vigna radiata* (L.) Wilczek) are the most important protein rich pulses of the *Vigna* group. These highly prized pulses are extensively cultivated in the tropical countries of the world. Generally, intervarietal hybridization has been used for the improvement of these pulses. However, interspecific hybridization will generate additional variability and extend the scope of combining desirable traits of blackgram and greengram (Verma and Singh, 1986). Black gram is known for its good pod bearing habit and resistance to pod shattering, and synchronous maturity, whereas green gram has higher number of seeds per pod and better seed quality. The desirable attributes of these two pulses can be combined in true-breeding genotypes following their interspecific hybridization. Such a hybridization might also lead to agronomically desirable recombinants due to intergenomic interactions. Although, attempts have been made to evolve interspecific cross derivatives using greengram as female, information is wanting regarding the potentiality of such derivatives using blackgram as the female parent. Therefore, in the present study attempt has been made to evaluate some of the true-breeding lines derived from a cross between blackgram 'HPU

27' and green gram 'PIMS 3' with respect to the nature of variation for seed yield and other traits.

MATERIALS AND METHODS

Thirty-two elite true-breeding lines of a blackgram (HPU 27) × green gram (PIMS 3) cross along with parents and PDU 1 (blackgram) were raised in a randomised block design with 3 replications during 1989 summer at Palampur, situated at 32°6'N, 76°3'E and 1,280 m above msl. Each entry was raised in a single row plot of 1.5m length with row-to-row and plant-to-plant spacings of 30 and 10 cm, respectively. Five random plants per replication were taken to record observations on seed yield per plant (g), biological yield per plant (g), harvest index (%), clusters per plant, pods per plant, pod length (cm), seeds per pod, plant height (cm), 100-seed weight (g) and seed crushing hardness. Data on days to 50 per cent flowering and to complete maturity were recorded on plot basis. Per cent protein, sulphur and phosphorus content in the seeds were determined following the procedures of Mukerhie and Wallaco (1964), Chesnin and Yein (1950) and Jackson (1967), respectively. Phenotypic, genotypic and environmental coefficients of variation were worked out following Burton and Devane (1953), whereas heritability (broad sense) and genetic advance were computed following Johnson *et al.* (1955).

RESULTS AND DISCUSSION

Analysis of variance revealed the existence of sufficient genetic variability among the derivatives under study for seed yield and 14 other traits. A perusal of the nature of variability revealed that coefficient of variation at the phenotypic level was the highest for seed yield, followed by pods per plant, 100-seed weight, clusters per plant, per cent sulphur and biological yield (Table 1). Coefficient of variation at the genotypic level was the highest for 100-seed weight, clusters per plant, percent sulphur and biological yield (Table 1). Coefficient of variation at the genotypic level was the highest for 100-seed weight, followed by seed yield per plant, seed crushing hardness, clusters per plant, per cent sulphur, pods per plant and biological yield. These coefficients were the least for days to maturity. In general, seed yield, biological yield, clusters per plant, pods per plant, 100-seed weight, seed crushing hardness and per cent sulphur content had more than 20 per cent coefficients of variability at the phenotypic and genotypic levels. High values of environmental coefficients of variability for seed yield, biological yield, plant height and pods per plant evince that these traits are highly influenced by the environment.

Besides the information on coefficients of variability, heritability is useful in predicting the expected progress to be achieved through selection. In the present study, 100-seed weight and per cent protein content exhibited more than 80 per cent heritability (Table 1). This shows that these two traits are less influenced by the environment. Heritability estimates were more than 50 per cent for pod length, seeds per pod and seed crushing hardness and less than 50 per cent for the remaining traits. Johnson *et al.* (1955) emphasized that for estimating the real effect of selection, heritability alone is not sufficient and genetic advance in conjunction with heritability is more useful. High genetic advance was observed for 100-seed weight followed by seed crushing hardness, seed yield, seeds per pod and clusters per plant. High heritability coupled with high to moderate genetic advance was recorded for seed crushing hardness and seeds per pod exhibiting the probable prevelence of additive genes for these traits, thereby reflecting the efficiency of selection for the improvement of these traits.

Table 1. Estimates of parameters of variability with respect to 15 traits studied

Traits	Phenotypic coefficient of variation (PCV)%	Genotypic coefficient of variation (GCV)%	Environ-mental coefficient of variation (ECV)%	Herita-bility (%)	Genetic advance (% of mean)
Seed yield/plant (g)	45.51	27.52	36.24	36.60	34.24
Biological yield/plant (g)	33.46	20.96	26.08	39.30	27.05
Harvest index (%)	20.29	13.81	14.86	46.40	19.37
Clusters/plant	35.51	23.28	26.81	43.00	31.41
Pods/plant	40.80	21.05	34.95	26.60	22.37
Pod length (cm)	14.72	11.60	9.06	62.10	18.82
Seeds/pod	23.93	19.51	13.88	66.30	32.70
Plant height (cm)	22.92	13.50	18.52	34.70	16.40
Days to flowering	5.97	3.50	4.83	34.40	4.22
Days to maturity	2.66	1.23	2.36	21.20	1.16
100-seed weight (g)	36.64	35.50	8.03	95.10	71.24
Seed crushing hardness (kg/seed)	32.64	24.33	21.76	55.60	37.36
Per cent protein content	13.20	12.12	5.23	84.30	22.93
Per cent sulphur content	34.16	22.13	26.03	42.00	28.46
Per cent phosphorus content	17.18	9.45	14.34	30.30	10.50

Table 2. Estimates of mean value of 35 lines with respect to 15 traits studied

	Seed yield/ plant (g)	Biological yield/ plant (g)	Harvest Index (%)	Cluster plant	Pods/ plant	Pod length (cm)	Seeds/ pod	Plant height (cm)	Days to flowering	Days to maturity	100 seed weight (g)	Seed crushing hardness (kg/ seed)	Percent protein content	Per cent sulphur content	Per cent phosphorus content
Greengram type															
MM 7	4.38	15.33	20.81	6.20	23.00	6.53	8.07	46.33	49.67	85.67	2.97	5.07	20.54	0.19	0.41
MM 9	3.22	23.81	22.90	6.23	26.60	6.20	5.87	47.33	47.67	85.67	3.17	4.60	21.58	0.16	0.45
MM 11	4.57	18.00	22.00	5.87	21.80	5.70	7.23	36.57	50.67	87.00	3.90	4.20	19.25	0.18	0.46
MM 19	4.70	18.92	24.44	7.30	22.00	6.63	9.73	49.47	51.33	84.33	2.98	3.93	16.92	0.15	0.46
MM 20	6.61	24.58	26.64	7.17	27.13	7.27	10.53	58.67	49.67	3.35	4.40	26.64	0.15	0.46	
MM 22	4.14	18.75	22.36	6.47	24.17	6.77	7.47	45.10	48.33	87.00	3.25	6.00	21.88	0.14	0.49
MM 27	3.38	15.00	22.45	5.67	21.10	6.33	9.47	36.27	47.33	86.00	2.26	3.33	16.92	0.14	0.38
MM 28	5.69	19.00	29.23	6.50	20.73	8.23	8.47	54.97	51.67	86.33	2.60	5.60	15.46	0.14	0.42
Blackgram type															
MM 2	8.66	25.00	32.60	18.00	5.47	6.20	49.00	50.33	89.00	5.43	7.27	23.92	0.11	0.36	
MM 4	6.74	22.33	29.53	10.90	26.63	5.27	5.47	53.43	54.00	89.00	4.49	8.80	25.67	0.12	0.38
MM 8	6.87	17,50	33.44	12.07	34.60	5.20	5.33	56.37	52.00	90.00	4.41	6.40	21.29	0.09	0.39

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	Seed yield/ plant (g)	Biological yield/ plant (g)	Harvest Index (%)	Cluster plant	Pods/ plant	Pod length (cm)	Seeds/ pod	Plant height (cm)	Days to flowering	Days to maturity	100 seed weight (g)	Seed crushing hardness (kg/ seed)	Percent protein content	Per cent sulphur content	Per cent phosphorus content
MM 13	7.05	23.00	27.96	10.57	30.30	5.33	5.33	6.53	57.10	54.33	91.00	4.54	8.00	17.79	0.14
MM 15	5.26	14.75	35.68	8.00	2.27	4.53	5.90	33.23	51.33	89.67	4.41	8.50	18.38	0.10	0.47
MM 16	6.38	16.67	35.39	10.73	27.63	4.93	5.70	52.23	50.00	87.33	3.95	6.13	22.17	0.08	0.38
MM 17	10.45	29.00	35.18	12.47	36.07	5.73	6.20	47.47	50.33	88.33	5.59	7.67	20.71	0.07	0.39
MM 18	5.71	20.92	26.28	9.77	27.57	5.60	6.27	50.90	49.67	87.33	4.64	8.13	21.00	0.12	0.39
MM 23	8.14	33.75	22.04	10.23	32.23	5.57	8.47	61.13	47.00	87.67	4.38	5.47	21.00	0.11	0.43
Recombinants															
MM 1	5.31	18.00	29.10	6.30	21.37	6.57	9.80	54.00	53.67	85.67	2.29	5.07	21.58	0.11	0.34
MM 3	3.07	23.25	22.79	7.07	16.37	5.03	8.50	37.33	49.67	95.67	2.88	5.67	23.04	0.09	0.35
MM 5	4.49	37.58	24.40	8.27	24.00	6.57	9.80	54.00	53.67	2.29	5.07	21.58	0.11	0.34	
MM 6	3.61	14.55	24.07	6.20	13.77	6.37	9.53	49.73	51.67	85.00	2.75	6.13	21.00	0.17	0.41
MM 10	5.52	19.33	27.07	7.93	22.33	6.77	9.00	51.07	53.33	89.00	3.33	4.13	18.67	0.16	0.38
MM 12	2.61	12.50	20.81	5.20	16.00	5.90	7.00	36.20	53.67	89.67	2.94	4.07	20.42	0.12	0.42
MM 14	5.81	17.17	35.35	6.35	18.13	6.97	11.00	42.20	53.67	86.67	3.54	4.40	21.88	0.13	0.49

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	Seed yield/ plant (g)	Biolo- gical yield/ plant (g)	Harvest Index (%)	Cluster plant	Pods/ plant	Pod length (cm)	Seeds/ pod	Plant height (cm)	Days to flowe- ring	Days to matu- rity	100 seed weight (g)	Seed crus- hing hard- ness (kg/ seed)	Percent prote- in content	Per cent sulphur content	Per cent phos- phorus content
MM 21	6.43	25.00	24.26	7.97	88.43	6.53	9.93	60.27	62.67	86.67	3.12	4.47	18.09	0.15	0.42
MM 24	11.54	33.75	33.63	12.73	44.87	7.37	10.00	61.43	52.67	87.00	3.56	6.80	21.00	0.16	0.40
MM 25	6.53	24.08	26.32	7.53	29.67	6.93	8.93	51.47	50.00	86.00	3.20	5.27	23.05	0.14	0.41
MM 26	4.40	18.50	23.52	6.60	19.90	6.53	9.73	40.87	47.33	86.33	2.70	5.13	22.75	0.17	0.38
MM 29	5.95	20.33	29.33	8.60	27.30	6.50	8.80	50.23	50.67	86.00	2.83	3.87	20.71	0.10	0.39
MM 30	9.16	25.83	34.86	12.13	40.07	6.70	10.53	66.47	52.67	88.00	2.61	3.90	21.59	0.13	0.41
MM 31	4.43	16.83	25.87	7.77	20.10	6.00	7.20	47.60	50.67	86.33	3.11	3.40	24.79	0.10	0.42
MM 32	5.33	19.75	25.32	11.10	38.73	6.07	6.67	63.97	53.00	87.31	3.05	4.33	18.38	0.12	0.35
PDU 1	7.94	25.3	31.07	13.20	14.23	5.07	8.33	41.20	50.67	88.00	4.88	7.00	20.13	0.06	0.29
HP 27	8.16	24.67	32.64	11.37	34.17	5.27	6.67	52.00	48.67	89.00	5.24	7.13	21.88	0.12	0.33
Gc and Mean	5.94	20.16	27.88	8.52	26.13	6.20	7.99	49.07	50.88	87.31	3.70	5.55	20.64	0.13	0.40
Ss (m) 1	1.14	3.07	2.39	1.32	5.27	0.32	0.64	5.25	1.42	1.19	0.17	0.71	0.62	0.02	0.00
CD 5%	3.51	8.66	6.76	3.73	14.89	0.92	1.81	14.82	4.01	3.37	0.48	2.01	1.76	0.05	0.09

The estimates of mean performance of the derivations for different traits are given in Table 2. From this table, it can be perceived that derivatives resembling black gram and green gram, and recombinants (having traits of both black gram and green gram) superior to the respective or both the parents have been generated. However, the number of outstanding recombinants was more than the parent like derivatives. Recombinants MM 24 and MM 30 were promising for seed yield and its related traits. Because of the seed coat colour (dull green to brown) these recombinants may not gain popularity among the farmers, but can further be improved using recombination breeding. Verma and Yadava (1986) reported the occurrence of desirable combination of traits in the advanced generation derivatives of green gram × black gram.

Increasing the seed yield of pulse crops may not be useful unless the quality attributes are given due weightage. The main quality attribute in pulses is protein content in the seeds. Besides quantity, quality of protein in terms of relative contribution of different amino-acids increases their nutritional quality. The estimation of sulphur content gives an idea about the enrichment of protein with sulphur containing amino-acids. Phosphorus, an important nutrient, is the major constituent of nucleic acids. Increased level of phosphorus is expected to enhance protein biosynthesis. Moreover, increased P-uptake efficiency of a genotype is the index of its tolerance to low pH. The recombinant line, MM 31, had the maximum seed protein and surpassed its parents. The line also had higher percentage of phosphorus. Two derivatives MM 2 and MM4, resembling black gram also had significantly high protein than HPU 27, the superior parent for this trait. Recombinant, MM 14, was the superior most with respect to per cent phosphorus in the seeds. Since seed yield had no association with phosphorus content, and at the same time, per cent sulphur is positively correlated with per cent phosphorus (Gupta *et al.* unpub.), all these traits can be combined in one genotype through recombination breeding. It may be concluded that interspecific hybridization of black gram × green gram has generated enormous useful variation for agro-morphological and quality attributes, which can be utilised for the improvement of black gram and green gram besides the development of some novel genotypes having the desirable traits of both the species.

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