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Original Research Article

Heterosis Patterns in Urdbean Crosses

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A B S T R A C T

The present study was effectuated to analyses various heterosis effects often crosses of urdbean with single check which was evaluated at Experimental Farm, the Department of Genetics and Plant Breeding, Sam Higgin bottom University of Agriculture, Technology and Sciences (SHUATS), Allahabad during *Kharif* 2017 in Randomized Block Design with three replications. Four crosses *viz.*, IPU7-3xPGRU 99022, AZAD-1xIPU 96-1, IPU 86-7xIPU 96-1, and AZAD-1xPGRU-99022 depicted positive significant economic heterosis ranged from 5.13 to 8.69 for seed yield per plant. One cross, IPU7-3xPGRU 99022 (11.74) were also exhibited positive significant economic heterosis for pods per plant, and for the rest of the characters, all the significant economic heterosis was negative. Out of 10 crosses, six crosses exhibited positive significant better parent heterosis for seed yield per plant with the magnitude ranged from -4.42 (GC-9120xPGRU 99022) to 22.18 (AZAD-1xIPU 96-1). Out of 10 crosses, 9 crosses exhibited positive significant relative heterosis for seed yield per plant with the magnitude ranged from 2.56 (GC 9120xIC 106194) to 22.18 (AZAD-1xIPU 96-1).

Keywords

Urdbean, Relative heterosis, Heterobeltiosis, Economic heterosis, Pulses

Introduction

Pulses are important food crops because they have a higher amount of protein content (20-36%) compared with cereal crops like rice, wheat, maize (Gowda *et al.,* 2014) particularly for fulfilling the human nutritional demands. The world population is to be estimated to grow from the current ~7.3 billion to ~8.9 billion by 2050. Therefore, increasing food production and attaining nutritional security is a challenge. The 68th UN General Assembly declared the year 2016 as the International Year of Pulses (IYP) to create public awareness of the nutritional benefits of pulses as part of sustainable food production. Among pulses, blackgram or urdbean is an important pulse crop of the tropical, semi-arid tropical (SAT) regions of the world and has been identified as a potential crop in many countries (Girish *et al.*, 2012). It is an important pulse crop of India and is mainly cultivated as a source of dietary protein because of its high protein content, which is about 25% in seeds (Haytowitz and Mathews, 1986).

Being a legume crop, it can potentially fix about 80% of its own nitrogen needs through biological nitrogen fixation and also can contribute to the yield of subsequent crops. Crop yield potential is consistent over two decades and significant seasonal, as well as year-to-year variation in yield, was recorded due to non-availability of high yielding and stable performing cultivars. To increase the production and productivity of black gram it is essential to develop a high-yielding pure-line variety by selection from the segregating generations of superior crosses involving superior parents. Previously also heterotic studies have been made in urdbean by Andale *et al.*, 1997, Neog and Talukdar, 1999, Santha and Veluswamy 1999, Singh *et al.*, 2003, Saravanan *et al.*, 2004, Vaithiyalingan 2004, Ram *et al.*, 2013, Kumar *et al.*, 2017. The objective of this study was to identify superior urdbean crosses for yield and their related traits.

Materials and Methods

Tenurdbean crosses with one check UTTARA were evaluated during *Kharif* 2017in Randomized Block Design with three replications at the Experimental Farm, the Department of Genetics and Plant Breeding, Sam Higgin bottom University of Agriculture, Technology and Sciences (SHUATS), Allahabad.

Recommend agronomic packages of practices were followed for a good crop. The technique of random sampling was adopted for recording the observations of various quantitative characters of blackgram. Five plants of each treatment from each replication were selected at random at the time of recording the data on various characters. Data of five plants per replication were averaged and mean data was used for statistical analysis of the present investigation.

Observations were recorded for twelve characters *viz.*, days to 50% flowering (DF), days to maturity (DM), plant height (PH), number of primary branches per plant (BPP), number of clusters per plant (CPP), number of pods per plant (PPP), pod length (PL), seeds per pod (SPP), biological yield per plant (BYP), Seed Index (SI), Harvest Index (HI) and seed yield per plant (SYP).

Statistical analysis

Heterosisis expressed as percent increase (+) or decrease (-) of F_1 over the mid parent, better parent and standard check is referred to as Average Heterosis, Heterobeltiosis, and Economic Heterosis, respectively.

Average heterosis (percentage)

Relative heterosis/mid parent Heterosis was calculated as per the procedure suggested by Shull (1908).

Relative heterosis/ mid parent Heterosis (%)

$$= \frac{(\overline{F_1} - \overline{MP})}{\overline{MP}} \times 100$$

Heterobeltiosis (percentage)

Heterobeltiosis was calculated as per the procedure suggested by Fonesca and Patterson (1968).

Heterobeltiosis (%)

$$= \frac{(\overline{F_1} - \overline{BP})}{\overline{BP}} \times 100$$

Economic/standard heterosis (percentage)

Economic Heterosis/Standard Heterosis was calculated as per the procedure suggested by Briggle (1963).

Economic/Standard heterosis (%)

$$= \frac{(\overline{F_1} - \overline{BC})}{\overline{BC}} \times 100$$

Heterosis in a positive direction was considered desirable for all the characters except traits like days to 50 percent flowering, days to maturity, and plant height, where negative direction was considered desirable.

Note: Heterobeltiosis and economic heterosis were calculated only in a desirable direction.

Results and Discussion

In the present study, the performance of the experimental crosses was compared with that of the check variety, UTTARA in terms of the magnitude of standard heterosis so that the crosses with high heterotic potential can be isolated for further evaluation and commercial cultivation. Other than economic heterosis, Heterobeltiosis or better parent and Average heterosis or relative heterosis or mid-parent heterosis also computed among crosses.

Average heterosis

The estimate of Average heterosis or relative heterosis or mid-parent heterosis is summarized in Table 1. Among ten crosses, 5 crosses for days to 50 % flowering, 6 crosses for days to maturity, 2 crosses for plant height, 6 crosses for several primary branches per plant, 5 crosses for clusters per plant, 5 crosses for pods per plant, 2 crosses for pod length, 5 crosses for biological yield per plant, 8 crosses for harvest index, 5 crosses for seed index and 9 crosses for seed yield per plant were found significant relative heterosis and none of the crosses were found significant for seeds per plant. Among five significant crosses, IPU7-3xPGRU 99022, AZAD-1xIPU 96-1, IPU 86-7xIPU 96-1, AZAD-1xPGRU-99022 showed negative directional significant mid parent heterosis for days to 50 % flowering. Similarly, SHEKAR-1xIPU 96-1 and AZAD-1xPGRU-99022 were found negatively significant for days to maturity.Out of 10 crosses, 9 crosses exhibited positive significant relative heterosis for seed yield per plant with the magnitude ranged from 2.56 (GC 9120xIC 106194) to 22.18 (AZAD-1xIPU 96-1). Only one cross GC-9120xPGRU 99022 was found non-significantly relative heterosis.

Heterobeltiosis

The estimate of Heterobeltiosis or better parent is summarized in Table 2. Among ten crosses, 7 crosses for days to 50 % flowering, 4 crosses for days to maturity, 4 crosses for plant height, 5 crosses for the number of primary branches per plant, 9 crosses for clusters per plant, 4 crosses for pods per plant, 1 cross for pod length, 2 crosses for seeds per pod, 6 crosses for biological yield per plant, 5 crosses for harvest index, 7 crosses for seed index and 9 crosses for seed yield per plant were found significantly better parentheterosis. All the seven crosses showed negative directional significant better parent heterosis for days to 50 % flowering.

Similarly, GC 9120xIC 106194, SHEKAR-1xIPU 96-1,and AZAD-1xIPU 96-1 were found negatively significant for days to maturity. Out of 10 crosses, six crosses exhibited positive significant better parent heterosis for seed yield per plant with the magnitude ranged from -4.42 (GC-9120xPGRU 99022) to 22.18 (AZAD-1xIPU 96-1). Only one cross SHEKAR-1xIPU 96-1 was found non-significantly heterobeltiosis.

Table.1 Estimates of Mid parent heterosis or average heterosis of urdbean crosses

Genotypes	DF	DM	PH	PBP	CPP	PPP	PL	SPP	BYP	HI	SI	SYP
GC-9120xPGRU 99022	-0.83	7.28**	10.34**	7.32*	34.62**	31.58**	0.00	0.00	28.04**	-22.57**	-0.53	-0.81
SHEKAR-3xIC 106194	0.43	1.29	3.14	1.23	-1.66	6.06	0.27	9.68	-9.76**	19.80**	2.74	8.29**
IPU7-3xPGRU 99022	-7.00 **	4.64*	0.00	11.39**	8.06	34.19**	0.54	9.68	4.69	9.92*	-3.63*	16.54**
GC 9120xIC 106194	6.67 **	-1.30	5.10**	-5.88*	-2.82	0.64	0.09	12.50	-7.78	11.45*	5.46**	2.56*
GU-1xIC 106194	-2.16	4.66*	2.91	4.88	-18.56**	-2.27	-1.82	-15.15	-4.17	17.13**	-0.28	12.03**
SHEKAR-1xIPU 96-1	-2.48	-5.26**	-2.78	-12.20**	35.54**	18.17**	4.03	17.24	13.09**	-7.13	-13.53**	4.84**
AZAD-1xIPU 96-1	-6.28**	-5.13**	-2.99	0.00	34.17**	9.63*	-6.88**	-9.09	2.29	19.80**	-2.41	22.18**
IPU 86-7xIPU 96-1	-7.95**	-1.53	-2.38	10.00**	2.86	-17.80**	1.32	6.25	-3.45	20.46**	-3.76*	17.34**
IPU 7-3xIC 106194	-1.75	0.50	1.18	4.88	-4.47	-2.50	7.04**	16.13	-10.22**	18.76**	-3.19	7.14**
AZAD-1xPGRU-99022	-9.47**	5.60**	-0.89	9.09**	20.65**	12.41*	-1.31	0.00	11.58**	3.51	-8.47**	15.72**

Table.2 Estimates of Heterobeltiosis of urdbean crosses

Genotypes	DF	DM	PH	PBP	CPP	PPP	PL	SPP	BYP	HI	SI	SYP
GC-9120xPGRU 99022	-4.03	6.99**	8.99**	2.33	31.32**	23.06**	-1.38	0.00	26.90**	-24.70**	-5.87**	-4.42**
SHEKAR-3xIC 106194	-4.92*	-1.51	1.02	-2.38	-12.43**	5.26	-4.10	6.25	-14.54**	18.48**	1.21	3.73**
IPU7-3xPGRU 99022	-8.87**	0.00	-2.54	10.00**	6.35	28.69**	0.18	6.25	-6.02	-2.97	-4.95*	14.44**
GC 9120xIC 106194	3.45	-4.52*	2.64	-6.98*	-13.31**	-0.25	-3.63	12.5	-10.10*	2.89	2.02	-2.99*
GU-1xIC 106194	-7.38**	1.51	0.88	2.38	-19.53**	-5.58	-4.26	-17.65*	-7.4	13.25*	-2.48	11.98**
SHEKAR-1xIPU 96-1	-3.28	-5.50*	-4.46*	-18.18**	33.33**	13.57*	3.38	13.33	11.50*	-13.11**	-14.91**	-0.57
AZAD-1xIPU 96-1	-6.67**	-7.50**	-3.95*	-6.82*	33.06**	7.61	-8.86**	-16.67*	0.58	17.85**	-4.18*	22.18**
IPU 86-7xIPU 96-1	-8.33**	-3.50	-2.59	0.00	-10.56*	-20.91**	0.35	0.00	-13.73**	8.85	-5.82**	15.83**
IPU 7-3xIC 106194	-5.88*	-0.49	0.15	2.38	-17.75**	-5.85	4.84	12.50	-16.82**	10.12	-4.06*	7.01**
AZAD-1xPGRU-99022	-11.29**	4.21	-6.06**	7.69*	18.25**	5.77	-3.41	-5.56	8.36	-1.46	-9.72**	13.36**

Table.3 Estimates of Standard heterosis of urdbean crosses

Genotypes	DF	DM	PH	PBP	CPP	PPP	PL	SPP	BYP	HI	SI	SYP
GC-9120xPGRU 99022	-4.03	-1.97	0.07	0.00	2.96	12.69*	-2.90	-11.11	-0.87	-25.68**	-6.73**	-4.42**
SHEKAR-3xIC 106194	-6.45**	-3.45	-2.68	-6.82*	-12.43**	-0.36	-4.26	-5.56	-21.36**	-1.02	-1.27	1.00
IPU7-3xPGRU 99022	-8.87**	0.00	-8.04**	0.00	-20.71**	11.74*	-4.09	-5.56	-9.36*	-9.51*	-5.82**	6.13**
GC 9120xIC 106194	-3.23	-6.40**	-1.13	-9.09**	-13.31**	-7.00	-5.11*	0.00	-26.05**	1.55	-3.45	-2.99*
GU-1xIC 106194	-8.87**	-0.49	-2.82	-2.27	-19.53**	-5.58	-8.18**	-22.22**	-23.82**	1.32	-3.45	-0.14
SHEKAR-1xIPU 96-1	-4.84*	-6.90**	-6.35**	-18.18**	-2.96	7.24	-1.02	-5.56	-12.26**	-13.11**	-14.91**	-1.35
AZAD-1xIPU 96-1	-9.68**	-8.87**	-3.95*	-6.82*	-4.73	-2.73	-8.86**	-16.67*	-18.11**	2.68	-4.18*	8.69**
IPU 86-7xIPU 96-1	-11.29**	-4.93*	-4.51*	0.00	-14.79**	-25.50**	-2.04	-5.56	-13.73**	-5.16	-5.82**	5.77**
IPU 7-3xIC 106194	-9.68**	-0.49	-3.53	-2.27	-17.75**	-12.22*	-0.34	0.00	-19.77**	-8.01	-7.55**	-4.34**
AZAD-1xPGRU-99022	-11.29**	-2.46	-6.06**	-4.55	-11.83**	-4.39	-3.41	-5.56	-11.77**	-8.11	-10.55**	5.13**

*, ** Significant at 5 % and 1 % level of significance

Standard heterosis

The estimate of standard heterosis or economic heterosis is summarized in Table 3. Among ten crosses, 8 crosses for days to 50 % flowering, 4 crosses for days to maturity, 5 crosses for plant height, 4 crosses for the number of primary branches per plant, 7 crosses for clusters per plant, 4crosses for pods per plant, 3 crosses for pod length, 2 crosses for seeds per pod, 9 crosses for biological yield per plant, 3 crosses for harvest index, 7 crosses for seed index and 7 crosses for seed yield per plant were found significant economic heterosis over the check UTTARA. All the eight crosses showed negative directional significant economic heterosis for days to 50 % flowering. Similarly, GC 9120xIC 106194, SHEKAR-1xIPU 96-1, IPU 86-7xIPU 96-1, and AZAD-1xIPU 96-1 were found negatively significant for days to maturity. Out of 10 crosses, four crosses exhibited positive significant economic heterosis for seed yield per plant with the magnitude ranged from -4.42 (GC-9120xPGRU 99022) to 8.69 (AZAD-1xIPU 96-1).Three crosses, SHEKAR-3xIC106194, GU-1xIC106194, and SHEKAR-1xIPU 96-1 were found non-significantly economic heterosis.

Four crosses *viz.*, IPU7-3xPGRU 99022, AZAD-1xIPU 96-1, IPU 86-7xIPU 96-1, and AZAD-1xPGRU-99022 depicted positive significant economic heterosis ranged from 5.13 to 8.69 for seed yield per plant. One cross, IPU7-3xPGRU 99022 (11.74) were also exhibited positive significant economic heterosis for pods per plant, and for the rest of the characters, all the significant economic heterosis was negative. Hence, we can say that except for three traits such as days to maturity, days to 50% flowering and plant height other traits weren't showing a positive impact with seed yield per plant.

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Conflicts of Interest

The authors declare no conflict of interest.

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