INTERNATIONAL JOURNAL OF SCIENCE AND NATURE

www.scienceandnature.org

STUDIES ON GENETIC VARIABILITY AND HYBRID DEVELOPMENT IN BLACK GRAM VIGNA MUNGO L. HEPPER, THROUGH CONVENTIONAL BREEDING APPROACH

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ABSTRACT

The present investigation was conducted at SHUATS Department of Genetics and Plant Breeding farm & Loyola academy Department of Agriculture students farm , mainly focusing on genetic variability of black gram genotypes and hybrid development specially for the F 1 performance at different environments concluding the parameters for hybrid vigour, hybrid performance, yield performance and stability of f1 cross hybrids in particular cross combinations by which exhibiting the additive x additive , dominance x recessive interactions , of the cross involved in hybridization program.

KEYS WORDS: F1, Hybrid Vigour, Dominance, Cross.

INTRODUCTION

Black gram (*Vigna mungo* L. Hepper) popularly known as urdbean or mash, is a grain legume domesticated from *V. mungo var. silvestris* (Lukoki, 1980). It belongs to family leguminoseae with chromosome number 2n=2x=22. Black gram is reported to be originated in India (Zukovskiji, 1962).

India is the world's largest producer as well as consumer of black gram. It produces about 1.5 to 1.9 million tons of black gram annually from about 3.5 million hectares of area, with an average productivity of 500 kg per hectare. Black gram output accounts for about 10% of India's total pulse production (*Ministry of Agriculture, Govt. of India, 2015*).

In 2014-2015, 1.61 million tonnes Urd production in the country is largely concentrated in five states *viz,* Uttar Pradesh (UP), Maharashtra, Madhya Pradesh, Andhra Pradesh and Tamil Nadu. These five states together contribute for about 70% of total urd production in the country (*Ministry of Agriculture, Govt. of India, 2015*).

In U.P. Blackgram is grown in about 3.91 lakh hectares with a total production of 1.2 lakh tones (Annual Report 2014-2015). Among the states of India, Orissa ranks first in area 777 thousand hectares and production 396 thousand tones. However Punjab is a leading state in productivity with 834.9 kg/hectare (Rajendra *et al.* 2002).

It is a cheap source of dietary protein (24%). It also contributes 76% carbohydrate 3-5% Fibre, 1.74% Fat and a major portion of lysine in the vegetarian diet. It is the richest sources of phosphoric acid. Being 5-10 times richer than other crops. Besides, being used as food for inexpensive source of dietary protein it is better to use for bean sprouts than mungbean for its longer shelf life (Mishra and Khan, 2001).

The productivity of pulse crop is very low compared to cereals, which have been selected for high grain yield under high input conditions, while the selection pressure in case of pulses have been focused on the adaptation to both biotic and abiotic stresses. The reason for low yield is i) adaption of crop to marginal lands of rainfed nature. The crop has been traditionally cultivated under less fertile soils with least inputs, ii) unavailability of cultivars with high potential, iii) stress to diseases insects and environmental fluctuations, etc. Hence, large parts of the genetic variability for yield contributing characters were lost during the course of evolution. Yield is a complex trait determined by several component traits; hence selection for yield should take into account related traits as well. So the knowledge of correlation between yield and its component traits is essential for seed yield improvement through selection programmes (Kumar *et al.* 2015).

These components are further dependent for their expression on several morphological and developmental traits, which are interrelated with each other and therefore, the parent selected for the breeding programmes aimed at increased seed yield should possess wide range of genetic variation for the above said morphological and developmental characters. Besides, it could be of interest to know the magnitude of variation due to heritable component, which in turn would be a guide for selection for the improvement of a population.

MATERIALS AND METHODS

The experiment was conducted during *kharif* season 2015-2016 at the Field Experimental Centre, Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology & Sciences, Allahabad and during the year 2017 to 2018 @ Loyola academy degree and P.G. College, Hyderabad at Loyola farm for hybrid conformation in the black gram lines. About 40 lines were taken for hybrid performance at these two locations, were crossings was involved for the development of good hybrids among the 40 lines, 20 lines were sown in one replication and another 20 lines in

second replication. The crossing plan involved is full-diallele method were all cross-combinations involved in hybridization programme are in equal number .2 staggered sowings were followed for getting proper pollen for crossing with the female parents . List of 40 parental lines are listed below in the table 1.

RESULTS AND DISCUSSIONS

Mean data for 13 characters *viz*., days to 50% flowering, days to 50% pod setting, plant height, number of branches per plant, days to maturity, number of clusters per plant, number of pod per plant, pod length, number of seed per pod, biological yield, harvest index, 100 seed weight and seed yield per plant were subjected to analysis of variance for experimental design.

The mean sum of squares values for all the 13 characters are presented in table 4.1. The mean sum of squares due to 40 genotypes were highly significant for all the characters studied, suggesting that the experimental materials were genetically variable from each other. This indicates that here is ample scope for selection of promising lines for the present gene pool for yield and its components. The presence of large amount of variability might be due to diverse source of materials taken as well as environmental influence affecting the phenotypes and also development of hybrids by crossing gave less seed yield that is development of F1 hybrids among then 40 lines in 2 replications, (1st replication consider as Male parents & 2nd replication consider as female parents).

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From the mean performance of days to 50% flowering, the genotype PGRV-99022 is showing early flowering, more number of flowers is observed at 50% flowering when we have taken the data, the early flowering was observed for about 46.33 days when compared to other blackgram genotypes. The mean performance of days to 50% pod setting, the genotype SHEKHAR is showing maximum pod setting at days to 50%, when compared to other blackgram genotypes. The mean performance of days to maturity, the genotype UG-27 is showing early maturity, when compared to other blackgram genotypes. The maturity was observed for about 65 days early in the UG-27 genotype. The mean performance for the character plant height (cm) was observed with good and robust height in the genotype UH-82-83 (63.03 cm), when compared to other blackgram genotypes. The mean performance for the character number of clusters per plant was having more clusters for the genotype Azad-1 (6.66), and less clusters was formed in the genotype UH-85-5(3.66),compared to other blackgram genotypes. The mean performance for the character number of pods per plant, was observed more number of pods in the genotype NDU 5-7(30.00), and least number of pods per plant was observed in the genotype IC-24129, when compared to other blackgram genotypes. The mean performance for the character pod length was observed high pod length (cm) in the genotype UG-27 (4.94), and less pod length was observed in the genotype IC-24129 (3.69 cm), when compared to other blackgram genotypes. The mean performance for the character number of seeds per pod was observed having more seeds per pod in the genotype T-9 (6.33), and less seeds per pod was observed in the genotype PKG U3 (3.00), when compared to other blackgram genotypes. The mean performance for the character biological yield per plant (g), was having high biological yield per plant in the genotype NDU 5-7 (65.90g), and less biological yield per plant was observed in the genotype T-9 (35.2).when compared to other blackgram genotypes. The mean performance for the character harvest index (%), was having high harvest index percentage in the genotype IC-140816 (41.4%), and least harvest index percentage was observed in the genotype T-9 (14.07%), when compared to other blackgram genotypes. The mean performance for the character seed index (g) was observed more in the genotype AZAD-1 (5.07g) and less seed index (g) was observed in the genotype PKG-U3 (3.00), when compared to other blackgram genotypes. The mean performance for the character seed yield per plant (g), was observed which is having high seed yield per plant in the genotype IC-140816 (25.96g), and less seed yield per plant was observed in the genotype PKG U3 (2.03 g), when compared to other blackgram genotypes.

Crosses have been made by following full diallele method for obtains good hybrids by having each successful mating with each combination with equal opportunity. Two replications have been taken for crossing program, were one replication contains 20 lines and another replication contains 20 lines, total constituting about 40 lines which were used for crossing program for developing successful hybrids through conventional breeding.

S. No	Name of Germplasm Replication -1 (Female)	S. No	Name of Germplasm Replication -2 (Male)
1	IC-24129	21	IC-250190
2	IC-250188	22	UH-85-5
3	IPU 96-1	23	IPU-199-60
4	PLU-277	24	IC-91567
5	PGRV-99022	25	IC-456048

6	NDU-5-7	26	PKG-U3
7	PLU-710	27	UH-10
8	IC-250107	28	U-5
9	SHEKHAR-3	29	UH-82-35
10	P-1	30	IC-56048
11	PLU-648	31	U-9
12	IPU-7-3	32	UTTARA
13	IPU-96-1	33	STNP 2
14	IC-140016	34	IPU 94-10
15	T-9	35	IPU 99-16
16	AZAD-1	36	PLU 826
17	SPS-33	37	UH-81-89
18	UH82-15	38	PANT-U-30
19	UH82-83	39	IC-106194
20	UG-27	40	PU-31

Crossing Combinations List:

1.	(IC-24129 X IC-250190)
2.	(IC-250188. X UH-85-5)
3.	(IPU 96-1 X. IPU-199-60)
4.	(PLU-277 X. IC-91567)
5.	(PGRV-99022 X. IC-456048)
6.	(NDU-5-7 X PKG-U3)
7.	(PLU-710 X UH-10)
8.	(IC-250107 X U-5)
9.	(SHEKHAR-3 X. UH-82-35)
10.	(P-1 X IC-546048)
11.	(PLU-648 X U-9)
12.	(IPU-7-3 X. UTTARA)
13.	(IPU-96-1 X. STNP-2)
14.	(IC-140016. X. IPU 94-10)
15.	(T-9 X. IPU-99-16)
16.	(AZAD-1 X PLU826)
17.	(SPS-33 X. UH-81-89)
18.	(UH82-15 X. PANT -U-30)
19.	(UH82-83 X. IC -106194)
20.	(UG-27 X. PU-31)

Among the cross combination list some of the cross hybrids have been showed good general combiners with the following male lines when crossed with female lines , among them the following cross combinations showed a genetic drift among the parental lines for developing good cross combines, the cross combinations (AZAD-1 X PLU826), (SPS-33 X UH-81-89), (SHEKHAR-3 X UH-82-35), (IPU 96-1 X IPU-199-60), (NDU-5-7 X PKG-U3) , these 5 cross combinations are consider to be good general combiners in terms of yield attributes , in terms of early flowering and hybrid performance these cross combinations have been developed during the season kharif 2015 and these hybrids were further evaluated during the seasons kharif 2017 and rabi 2017 trial conducted at Loyola academy degree and P.G .College @ department of agriculture students farm and these hybrids performed good yield , early flowering compared to the individual parents which were sown separately which is highlighted in table 1.

TABLE.1

S.no	Male Parents	50% Flowering Data	Female Parent	50% Flowering Data	Cross Combination (F1)	(F1) Flowering Data
1.	IC-250190	50	IC-24129	50.00	(IC-24129 X IC-250190)	52
2.	UH-85-5	48	IC-250188	48.33	(IC-250188. X UH-85-5)	49
3.	**IPU-199-60***	**46.33**	**IPU 96-1**	**48.00**	**(IPU 96-1 X. IPU-199-60)**	43
4.	IC-91567	47.66	PLU-277	49.00	(PLU-277 X. IC-91567)	48
5.	IC-456048	47.66	PGRV-99022	46.33	(PGRV-99022 X. IC-456048)	47
6.	**PKG-U3***	**48.66**	**NDU-5-7**	**45.66**	**(NDU-5-7 X PKG-U3)**	44
7.	UH-10	49.33	PLU-710	50.33	(PLU-710 X UH-10)	48.33
8.	U-5	47.00	IC-250187	48.33	(IC-250187 X U-5)	47

9.	**UH-82-35***	**49.00**	**SHEKHAR-3**	**47.33**	**(SHEKHAR-3 X. UH-82-35)**	44
10.	IC-56048	47.66	P-1	47.00	(P-1 X IC-546048)	47
11.	U-9	46.33	PLU-648	50.66	(PLU-648 X U-9)	50
12.	UTTARA	49.66	IPU-7-3	48.66	(IPU-7-3 X. UTTARA)	47
13.	STNP 2	49.66	IPU-96-1	47.66	(IPU-96-1 X. STNP-2)	47
14.	IPU 94-10	50.00	IC-140816	46.66	(IC-140816. X. IPU 94-10)	50
15.	IPU 99-16	47.66	T-9	47.00	(T-9 X. IPU-99-16)	47
16.	**PLU 826***	**48.00**	**AZAD-1**	**48.33**	**(AZAD-1 X PLU826)**	45
17.	**UH-81-89***	**49.66**	**SPS-33**	**48.00**	**(SPS-33 X. UH-81-89)**	47.88
18.	PANT-U-30	49.66	UH82-15	49.33	(UH82-15 X. PANT -U-30)	49
19.	IC-106194	48.00	UH82-83	48.66	(UH82-83 X. IC -106194)	48
20.	PU-31	49.33	UG-27	49.00	(UG-27 X. PU-31)	49

TABLE 1.1 Analysis of variance for 13 different quantitative characters in 40 genotypes of black gram

S. No.	Characters	Mean sum of squares		
		Replications (d.f.=2)	Treatments (d.f.= 39)	Error (d.f.= 78)
1	Days to 50% flowering	0.85	5.10*	3.17
2	Days to 50% pod setting	0.075	4.21**	2.33
3	Plant height	1.83	14.45**	2.55
4	Number of branches per plant	0.32	1.26**	0.4
5	Number of clusters per plant	0.05	0.98*	0.5
6	Pods per plant	2.70	19.90*	1.13
7	Pod length	0.018	0.27**	0.02
8	Number of seeds per pod	0.77	1.48**	0.34
9	Days to maturity	0.97	9.23**	5.68
10	Seed index	0.35	1.19**	0.47
11	Harvest index	11.92	24.24**	15.10
12	Biological yield	0.52	262.04**	0.47
13	Seed yield per plant	4.09	92.65**	4.98

TABLE 1.2 A & B): Mean performance of 40 blackgram genotypes for 13 quantitative characters

No	Character	Days to 50% Flowering	Days to 50% Pods Setting	Plant Height (cm)	Branches/ Plant	Clusters/ Plant	Pods /Plant	Pod Length (cm)	Seeds / Pod	Days to Maturity	Seed Index (g)	Seed Yield/ Plant (g)	Biological Yield (g)	Harvest Index (%)
1	IC-24129	50.00	58.00	53.86	2.66	6.66	18.00	3.69	5.33	68.33	4.19	4.23	62.33	6.47
2	IC-250188	48.33	60.00	52.13	1.33	4.66	22.00	4.58	5.33	68.66	3.07	2.90	63.33	5.02
3	IPU96-1	48.00	57.00	40.50	4.00	5.33	25.33	4.72	5.66	67.33	3.89	5.36	42.83	5.45
4	PLU-277	49.00	59.00	37.63	3.33	5.33	27.33	4.27	5.66	68.00	3.33	4.70	45.91	9.42
5	PGRV-99022	46.33	57.33	43.63	1.66	5.33	26.33	3.80	4.33	65.33	3.74	13.83	47.33	28.60
6	NDU 5-7	45.66	60.33	55.90	2.66	5.66	28.66	4.25	4.00	67.33	4.20	5.36	65.90	7.45
7	PLU-710	50.33	58.66	56.53	1.33	5.33	30.00	4.16	4.33	69.66	3.54	4.76	53.53	6.13
8	IC-250187	51.33	60.33	52.56	4.66	5.33	22.00	4.32	5.33	70.33	3.68	2.33	61.16	2.90
9	SHEKHAR-3	47.33	56.33	53.40	2.66	5.00	24.33	4.34	5.66	66.66	3.63	17.33	47.55	30.89
10	P-1	47.00	57.33	52.60	3.00	5.66	27.00	4.30	5.66	65.33	5.67	14.63	64.85	18.71
11	PLU-648	50.66	60.00	55.63	3.33	5.33	26.33	4.15	5.33	72.00	3.35	5.33	56.70	8.26
12	IPU 7-3	48.66	58.00	57.16	2.66	5.33	28.00	4.25	5.33	64.66	5.13	12.90	37.66	27.99
13	IPU-96-1	47.66	57.66	56.26	2.66	5.66	27.33	4.36	5.00	67.00	3.33	4.53	35.76	8.27
14	IC-140816	46.66	57.33	42.90	2.33	5.66	27.66	4.31	6.00	66.33	5.03	25.96	44.66	41.44
15	T-9	47.00	59.33	46.90	3.33	5.33	25.33	4.42	6.33	66.66	3.38	5.66	35.26	14.79
16	AZAD-1	48.33	58.00	48.30	3.00	6.66	27.00	4.46	5.66	66.66	5.75	21.46	55.96	23.79
17	SPS-33	48.00	59.00	43.60	3.00	5.00	23.00	4.45	5.66	67.66	4.11	3.36	39.28	8.33
18	UH82-15	49.33	59.66	57.26	3.33	4.66	19.66	4.80	5.66	69.33	4.76	4.133	44.00	10.72
19	UH82-83	48.66	58.66	63.03	2.66	3.66	23.00	4.74	3.33	68.00	3.10	3.40	57.66	4.48
20	UG-27	49.00	58.33	61.23	2.66	4.66	24.00	4.90	5.66	65.00	4.00	5.73	43.31	11.82
21	IC-250190	48.33	58.33	60.46	2.66	5.00	25.00	4.19	6.00	69.33	3.59	3.00	43.00	12.29
22	UH-85-5	48.00	57.33	48.66	2.66	3.66	26.66	4.76	5.33	71.66	4.03	6.03	38.00	14.94
23	IPU-199-60	46.33	56.00	57.33	3.33	4.66	25.66	4.26	5.33	65.33	3.65	3.56	49.00	7.14
24	IC-91567	47.66	57.00	55.50	2.66	5.33	25.66	4.19	5.33	71.66	3.56	3.36	51.86	6.11
25	IC-56048	48.00	57.66	62.93	3.33	5.00	25.00	4.78	5.66	65.33	3.14	10.33	52.66	12.43

No	Character	Days to 50% Flowering	Days to 50% Pods Setting	Plant Height (cm)	Branches/ Plant	Clusters/ Plant	Pods /Plant	Pod Length (cm)	Seeds / Pod	Days to Maturity	Seed Index (g)	Seed Yield/ Plant (g)	Biological Yield (g)	Harvest Index (%)
26	PKG U3	48.66	59.33	58.21	2.66	5.33	25.66	4.88	3.00	66.66	3.00	2.03	47.33	1.79
27	UH-10	49.33	59.33	53.83	3.33	5.33	23.00	4.44	5.66	68.66	3.70	11.30	57.66	7.66
28	U-5	47.00	58.33	60.93	2.66	4.66	24.33	4.38	5.33	69.00	3.48	11.30	37.66	12.63
29	UH-82-35	49.00	56.66	52.13	2.33	5.00	25.00	4.60	5.66	68.00	3.74	6.03	51.96	10.28
30	IC56048	47.66	58.00	46.80	3.33	5.00	26.66	4.66	5.66	65.33	4.06	8.30	62.76	11.10
31	U-9	46.33	57.33	57.03	2.33	5.66	28.66	4.78	5.66	66.33	3.48	8.80	37.66	9.54
32	UTTARA	49.66	58.66	53.83	2.00	5.33	27.66	4.83	5.33	68.66	4.28	9.50	58.33	7.09
33	STPN2	49.66	59.00	59.66	2.66	5.66	27.66	4.64	4.0	68.33	3.75	12.36	61.43	16.42
34	IPU 94-10	50.00	58.66	45.53	2.33	5.33	27.33	4.64	5.33	69.66	3.78	6.60	52.70	10.97
35	IPU 99-16	47.66	57.00	39.03	2.66	5.00	27.33	4.62	5.33	67.33	3.66	10.63	63.70	14.18
36	PLU 826	48.00	58.33	43.20	3.66	5.33	26.33	4.84	4.33	66.66	3.43	5.56	38.33	6.20
37	UH 81-89	49.66	57.33	48.50	3.00	5.66	27.33	4.05	5.33	69.66	3.75	11.66	57.66	7.78
38	PANTH U-30	49.66	59.66	53.83	3.66	4.66	29.66	4.87	5.33	70.00	3.69	8.33	57.30	8.73
39	IC-106194	48.00	56.66	62.83	3.33	5.33	29.00	4.25	5.66	67.33	3.61	14.56	55.60	10.86
40	PU-31	49.33	60.33	50.63	3.00	5.33	28.66	4.93	5.33	69.66	3.92	17.76	43.11	29.23
	Mean	48.38	58.300	52.54	2.85	5.21	25.88	4.48	5.25	67.82	3.86	8.47	50.57	12.74
	C.V	3.68	2.62	3.30	23.62	13.70	4.11	1.01	11.23	3.51	17.80	26.33	1.35	31.15
	F.ratio	1.60	1.80	55.07	2.78	1.92	17.52	131.89	4.26	1.62	2.52	18.59	54.41	14.84
	F.Prob	0.03	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
	S.E	1.02	0.88	0.92	0.38	0.41	0.61	0.02	0.34	1.37	0.39	1.28	0.39	2.24
	C.D.5%	2.89	2.48	2.59	1.09	1.16	1.73	0.07	0.95	3.87	1.11	3.62	1.11	6.31
	C.D.1%	3.84	3.29	3.44	1.45	1.54	2.29	0.09	1.27	5.14	1.48	4.81	1.48	8.3
	Range lowest	45.66	56.00	37.63	1.33	3.66	18.00	3.59	3.00	64.66	3.00	2.03	35.26	1.79
	Range Highest	51.33	60.33	63.03	4.66	6.66	30.00	4.94	6.33	72.00	5.75	25.96	65.90	41.55

S.No.	Characters	Genotypic Coefficient of variation	Phenotypic coefficient of variation	Heritability (%) (broad sense)	Genetic advance	Genetic advance as % of mean
1	Days to 50% flowering	1.6	4.40	17	0.68	1.40
2	Days to 50% pod setting	1.36	2.95	21	0.75	1.28
3	Days to maturity	12.90	3.86	17	0.93	1.37
4	Plant height	18.24	13.25	95	13.59	25.87
5	Number of branches/ plant	7.61	29.85	37	0.65	22.97
6	Cluster /plant	9.66	15.68	24	0.40	7.60
7	Pods /plant	6.69	10.50	85	4.47	18.32
8	Seed /pod	11.72	16.23	52	0.91	17.43
9	Pod length	1.60	6.76	98	0.61	13.62
10	Biological yield /plant	18.46	18.51	99	19.18	37.93
11	Harvest index	66.94	38	82	15.59	25.02
12	100-seed weight	12.68	21.85	34	0.59	15.55
13	Seed yield /plant	63.79	69.01	85	10.59	18.32

Genetic parameters for 13 biometrical characters of 40 black gram genotypes:

Moderate heritability was recorded for days to 50% pod setting (21%), Days to 50% flowering (17%), seed index (34%), and number of clusters per plant (24%), when compared to other genetic parameters for heritability. A perusal of genetic advance (table 4.3) revealed that it was high for Biological yield/plant (19.18), harvest index (15.59), plant height (13.59), seed yield/plant (10.59), pods/plant (4.47), days to maturity (0.93), seed/pod (0.91), days to 50% pod setting(0.75), days to 50% flowering (0.68), 100 seed weight (0.59), clusters/plant (0.40). Heritability alone provides no indication of the amount of genetic improvement that would result from selection of individual genotypes. Hence knowledge about genetic advance coupled with heritability is most useful. It is also expressed as the shift in gene frequency towards the superior side on exercising selection pressure.

CONCLUSION:

Based on the research trial conducted for study of genetic variability and hybrid development in blackgram the following hybrids are best suitable for hybrid selections , AZAD-1 X PLU826),(SPS-33X UH-81-89), (SHEKHAR-3 X UH-82-35), (IPU 96-1 X IPU-199-60), (NDU-5-7 X PKG-U3), these 5 cross combinations are consider to be good general combiners in terms of yield attributes , in terms of early flowering and hybrid performance, these

hybrids have shown a diverse genetic drift among the parents in developing a perfect hybrids in terms of high yield and early flowering parameters.

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