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Determination of genetic variation and heritability estimates for morphological and yield traits in chickpea (*Cicer arietinum*) under late sown conditions

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ABSTRACT

Genetic variability was estimated along with heritability (h^2) and genetic advance (GA) among 45 genotypes of chickpea (*Cicer arietinum* L.). High genotypic and phenotypic coefficients of variability were observed for plant height, leaf length, leaflet length, width of leaflet, number of primary branches/plant, number of secondary branches/plant, number of pods/plant, pod length, pod width, 100-seed weight and seed yield/plant. The differences between genotypic and phenotypic coefficient of variability was very small in all these traits indicating negligible role of environment. The characters, which showed poor estimates for PCV and GCV were days to maturity, days to 50% flowering, number of leaflets/leaf and seeds/pod. In the present study, high heritability coupled with high genetic advance was observed for seed yield/plant, width of leaflet and primary branches/plant indicated the presence of a considerable proportion of total variability due to genetic causes particularly the additive gene effects to be important for determining these traits. On the other hand, high heritability with moderate genetic advance was observed for number of primary branches, number of secondary branches, plant height, pod length, and pods/plant indicating the influence of environment for these traits. Low heritability percentage coupled with low and moderate genetic advancement has been observed for days to maturity indicated that this trait was greatly influenced by environment.

Key words: Chickpea, *Cicer arietinum,* Genetic variability, Genetic advance, Heritability, Late sown

Chickpea (*Cicer arietinum* L.) is an important *rabi* pulse crop of rainfed areas of India. Chickpea is one of the world's most important but less-studied leguminous food crop with 740-Mb genome size. Chickpea ranks third among pulses, fifth among grain legumes, and 15th among grain crops of the world (Khan *et al.* 2011). This crop is highly proteinaceous and seed are used in various ways for human consumption. Chickpea is valued for its nutritive seeds with high protein content, 25.3-28.9%, after de-hulling (Hulse 1991). It has great importance as food, feed and fodder. Due to the increasing need for legumes, chickpea is no longer considered a subsistence crop. The rising trend in its trade suggests that the crop is grown increasingly for the market (Saxena *et al.* 1996). The average yield of this crop is generally low, because of drought, susceptibility to disease and low yield potential of varieties. For improvement of this crop, knowledge on variability and heritability of various plant-parameters, along with genetic advance, are needed to decide about the breeding-strategy for development of appropriate genotypes. The presence of genetic variability is of utmost importance for any breeding program and for that reason the plant breeders have emphasized the evaluation of germplasm for the improvement of crop yield (Virmani *et al.* 1983, Bakhsh *et al.* 1992) as well as for utilization in further breeding programmes. Chickpea has high variation for various qualitative and quantitative characters that can help breeders to release better and superior lines and varieties (Dasgupta *et al.* 1987, Singh 1997). For maintenance and efficient utilization of germplasm, it is important to investigate the extent of genetic variability and its magnitude for the determination of the success of a breeding program (Smith *et al.* 1991). Naidu *et al.* (1991) studied 49 lines of mungbean and observed higher magnitude of PCV than GCV in all the mungbean traits. They also recorded higher estimates of heritability in all the traits. High h^2 was associated with high genetic advance for number of branches, clusters, pods/plant, shoot dry weight and grain yield. Aslam *et al.* (1992) reported higher estimates of PCV than GCV in all the characters studied in mungbean. Path analysis indicated that plant height had very high direct effect on yield, followed by 1 000-seed weight. The estimates of h^2 for days to pod-maturity had large variation. The phenotypic coefficient of

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variability (PCV) was reported to be greater in magnitude than genotypic co-efficient of variability in most of the traits in mungbean (Awan and Malik 1997). They also reported high heritability (h^2) associated with high genetic advance for plant height, indicating additive gene effect for determination of this trait. The results revealed that additive components of variance were significant for days-to-flowering, days to first podding and days to first-pod maturity. They also observed high heritability estimates for days to-flowering, days to first-pod maturity and pod maturity percentage. Ali *et al.* (2008) found high broad sense heritability coupled with high genetic advance for plant height and grain yield. The present experiment was planned to estimate the variability, heritability (broad sense) and genetic advance for various qualitative and quantitative characters in chickpea.

MATERIALS AND METHODS

Forty five genetically diverse genotypes/varieties of chickpea were obtained from the Genetics Division, IARI**,** New Delhi and Department of Genetics and Plant Breeding, ND University of Agriculture and Technology, Kumarganj, Faizabad (Uttar Pradesh). These genotypes/varieties were Pant G 186, 486 18, GCP 105, Vishal, BG 256, Udai, ICCV 15676, ICC 11535, Anupam, BG 261, JB 315, BG 209, BG 391, Green 112, BG 1108, BG 376, BG 2019, BG 1101, BG 390, EC 539009, BG 1107, Pusa 1088, BG 1044, ILC 2002, ICCV 88503, BG 1103, Pusa 372, ICRISAT 3070, KLB 97-5, NDL 2-96-21, KLB 97-8, IPL 110, KLB 97-7, IPC 2002-36, KLB 97-8, Awarodhi, BG 203, Pusa 256, ICRISAT 3074, BG 1105, BG 1053, ICRISAT 3073, BG 1073, K 850 and HOO 108. The experimental trial was laid out in Randomized Block Design in three replications at the Agricultural Research Farm of SDJ Post Graduate College, Chandeshwar, Azamgarh, UP during 2008-10. Each plot comprised 3 rows of 3m length, spaced 30cm apart with plant to plant spacing of 10cm. All the necessary requirements of the crop such as irrigation and inter cultural operations were fulfilled and the crop was maintained properly. Observations were recorded on 10 competitive plants randomly selected from each replication for plant height (cm), leaf length (cm), number of leaflets/leaf, leaflet length (cm), width of leaflet (cm), number of primary branches/plant, number of secondary branches/plant, number of pods/plant, pod length (cm), pod width (cm), number of seeds/pod, 100-seed weight (g), seed yield/plant(g), while data on days to 50% flowering and days to maturity were recorded on plot basis. Broad sense heritability (h^2) was calculated, following Burton (1952). The expected Genetic advance (GA), with selection intensity (K), was also calculated using the following formula, proposed by Singh and Chaudhary (1985):

$$GA = K \times \sigma_p \times h^2$$

where, GA is Genetic advance, σ_p is phenotypic standard deviation of mean performance of population, K (2.06) is the constant standardized selection-differential at 5% and h^2 is broad sense heritability.

Table 1 Analysis of variance (pooled) for different characters of chickpea

Source of variation	Degree of Freedom	Mean sum of squares												
		DF	DM	PH	LL	NL/L	LtL	WL	NPB	NSB	NP/P	PL	PW	NS/P	100SW	YPP
Environment (E)	1	9961.38**	2720.00**	2967.38**	9.75**	3.96*	2.35**	1.21**	24.06**	1288.81**	1633.84**	7.43**	1.85**	9.04**	988.44**	631.56**
Replication (r)	2	0.313	0.25	2.16	0.07	0.40*	0.003	0.003**	0.04	1.63*	12.00*	0.04*	0.00002	0.02	27.86	0.15
E×r	2	7.25	20.00	2.97	0.04	0.14	0.01*	0.001	0.10	2.29**	13.22*	0.07**	0.01*	0.02	26.59	1.24
Genotype (G)	44	141.44**	145.98**	248.05**	1.30**	4.61**	0.09**	0.12**	5.09**	19.50**	258.61**	0.28**	0.07**	0.16**	106.59**	26.65**
G×E	44	57.94**	105.90**	43.36**	0.33**	0.67**	0.03**	0.02**	1.23**	11.72**	144.77**	0.06**	0.02**	0.08**	46.97**	3.27**
Error	176	3.19	7.34	3.41	0.07	0.09	0.001	0.001	0.06	0.41	3.59	0.01	0.001	0.01	24.28	0.49

DF: Days to 50% flowering; DM: Days to maturity; PH: Plant height (cm); LL: Leaf length (cm.); NL/L: Number of leaflets per leaf ; LtL: Leaflet length(cm.); WL: Width of leaflet (cm.); NPB: Number of primary branches per plant; NSB: Number of secondary branches per plant; NP/P: Number of pods per plant; PL: Pod length, (cm); PW: Pod width (cm.) NS/P: Number of seeds per pod; 100 SW: 100-seed weight (g); YPP: Seed yield per plant (g). * Significant at P = 0.05, ** Significant at P = 0.01

RESULTS AND DISCUSSION

Forty five genotypes of chickpea were studied for 15 quantitative characters to evaluate genetic variability. The genotypes differed significantly for all traits. Mean squares for genotypes as shown in Table 1 were found to be significant for days to 50% flowering, days to maturity, plant height (cm), leaf length (cm), number of leaflets/leaf, leaflet length (cm), width of leaflet (cm), number of primary branches/plant, number of secondary branches/plant, number of pods/plant, pod length (cm), pod width (cm), number of seeds/pod, 100-seed weight (g) and seed yield/plant (g).

Genotypic performance

Mean performance of genotypes on pooled basis (2008-10) for 15 different characters are given in the Table 2. The general pooled mean of number of days to flowering was 67.60 days, and it ranged from 54.83 days (ICRISAT 3074) to 76.33 days (Green 112). The genotypes ICRISAT 3074 and BG 376 were significantly early flowering which take 54.83 and 55.67 days, respectively. Whereas, mean value of number of days to maturity was 112.74 days and it ranged from 105.00 days (ICCV 88503) to 124.50 days (Green 112). The varieties significantly late in maturity were Green 112 (124.5 days) and BG 261 (120.67 days). The varieties/genotypes significantly early in maturity were Pant G-186, GCP 105, BG 256, Anupam, EC 539009, BG 1107, BG 1044, ICCV 88503, ICRISAT 3070, NDL 2-96-21, IPL 110, KLB 97-7, IPC 2002-36, KLB 97, BG 1105 and HOO 108. They matured in 105 to 109.33 days. Pooled mean for plant height was 49.78cm, and it ranged from 36.27 cm (ICC 11535) to 67.67 cm (ICRISAT 3070). The pooled data showed that general mean of leaf length was 4.25cm. Leaf length ranged from 3.45cm (Pant G-186) to 5.65 cm (IPL 110). Average number of leaflets/leaf (pooled basis) was 12.58. Number of leaflets/leaf ranged from 10.52 (ICRISAT 3074) to 15.27 (IPL 110). Number of primary branches/plant ranged from 2.75 (BG 1107) to 6.95 (BG 261) with pooled mean of 4.63. Highest number of secondary branches per plant were observed in BG 203 (15.23) and lowest were recorded in ICRISAT 3074 (4.88). Maximum number of pods per plant (on pooled basis) was produced in BG 209 (48.97) and minimum number was observed in the genotype EC 539009 (16.58) with pooled mean of 34.51.

The pooled mean of 100-seed weight was 17.60g and it ranged from 8.83g (BG 203) to 25.32g (Pusa 372). Significantly superior varieties regarding 100-seed weight were Pusa 372 (25.32g), Pusa 1088 (23.78g), BG 1108 (23.63g), BG 390 (22.45g), BG 1103 (21.75g), BG 1107 (21.75g), ICC 11535 (22.63g), BG 391 (20.83g), Vishal (20.30g), EC 539009 (20.17g), BG 2019 (19.75g), 486-18 (19.77g), BG 1044 (19.4g), GCP 105 (18.72g), BG 1101 (18.53g) and BG 251 (18.12g). Seed yield/plant ranged from 2.40g (JB 315) to 16.68g (Pusa 372) with pooled mean of 8.42g. Significantly superior varieties regarding seed yield/plant were Pusa 256 (13.76g) and Pusa 372 (12.77g). Next significantly better varieties were IPL 110 (12.57g) and EC 539009 (11.83g) as given in Table 2.

Variability

In pooled data, estimates of PCV was the highest for 100-seed weight (33.24), followed by moderate estimates for seed yield/plant (24.84), width of leaflets (19.78), number of primary branches (18.12) and number of secondary branches (15.35), pods/plant (13.77), pod length (13.38), plant height (12.30), leaf length (11.38) and leaflets/leaf (10.52). The characters which showed poor estimates for PCV were days to maturity (3.32), days to 50% flowering (6.12), number of leaflets/leaf (6.88) and seeds/pod (9.75) (Table 3).

Genotypic coefficient of variation (GCV) was the highest for seed yield/plant (23.43%), followed by width of leaflet (19.46%), 100-seed weight (17.91%) and number of primary branches (17.31%). Genetic variability was lowest for days to maturity (2.29%) (Table 3).

Heritability and genetic advance estimates

Heritability estimates was the highest for width of leaflets (96.7%), followed by number of primary branches/plants, plant height, seed yield/plant, number of leaflets/leaf, length of leaflets, pod width, days to 50% flowering, number of secondary branches and pod length exhibited high estimate of heritability (91.2, 90.9, 88.9, 87.4, 87.4, 87.3, 81.4, 76.0 and 74.2 percent), which indicated that a major proportion of the total variability was due to genetic causes. The differences between genotypic and phenotypic coefficient of variability was very small (Table 3) indicating negligible role of environment. High heritability estimate for these traits indicated the success of improvement through selection. The results are in accordance with the finding of Iqbal *et al.* (1994). Heritability estimate for yield/plant was high (88.90%), indicating the success of selection for this trait. The differences between genotypic and phenotypic coefficient of variability was very small indicating negligible role of environment. The results are in accordance with the findings of Iqbal *et al.* (1994). Ali *et al.* (2008) also observed high broad-sense heritability for plant height and grain yield/plant.

Moderate estimates of heritability were recorded for leaf length (68.9%), number of seeds/pod (53.2%) and 100-seed weight (53.0%). This indicated that total variability was due to genetic causes as well as due to environment. The differences between genotypic and phenotypic coefficient of variability showed the environmental influence. The results are in agreement with Jahagirdar (1994) who found moderate estimate of heritability for these characters. Days to maturity (47.6%) showed low estimates of heritability (Table 3).

Only heritability itself does not provide the clue for genetic gain resulting from the best selected individuals. Burton (1952) suggested that h^2, in combination with genetic advance (GA), was more reliable in predicting the effect of selection. The estimates of genetic advance (as percent of mean) ranged from 3.26 for days to maturity to

Table 2 Pooled mean performance of chickpea genotypes for different characters during 2008-10

Genotypes	DF	DM	PH	LL	NL/L	LtL	WL	NPB	NSB	NP/P	PL	PW	NS/P	100 SW	YPP
Pant G-186	70.33	108.83	49.40	3.45	12.17	0.88	0.44	5.83	9.65	35.23	1.40	0.86	1.60	12.62	5.36
486-18	67.00	111.50	52.30	4.10	12.50	1.08	0.67	4.43	6.72	26.40	1.68	1.08	1.40	19.77	8.70
GCP 105	70.17	106.67	45.73	4.05	13.17	1.01	0.55	4.70	8.47	24.20	1.50	1.01	1.50	18.72	6.50
Vishal	62.83	112.50	48.00	4.25	13.70	1.06	0.74	4.70	8.62	31.63	1.87	1.03	1.53	20.30	8.58
BG 256	69.00	107.50	50.67	3.98	12.57	1.01	0.67	4.97	8.88	38.42	1.52	0.99	1.30	18.12	9.78
Udai	70.67	118.00	46.17	4.38	13.13	0.94	0.54	5.53	9.67	33.43	1.55	0.87	1.93	12.98	8.30
ICCV 15676	66.83	118.50	43.07	3.73	11.80	0.93	0.48	4.20	9.37	31.10	1.42	0.87	1.67	12.20	6.54
ICC 11535	70.50	117.50	36.27	3.62	12.37	0.84	0.42	5.97	9.05	35.30	1.25	0.76	1.57	22.63	7.16
Anupam	69.33	108.17	45.90	3.73	12.10	1.02	0.54	5.52	8.95	34.47	1.48	0.93	1.80	10.90	8.83
BG 261	74.67	120.67	42.23	3.62	12.97	0.86	0.43	6.95	12.38	41.97	1.35	0.81	1.77	9.88	8.20
JB 315	66.50	115.50	46.43	4.25	11.73	1.04	0.62	4.37	8.82	33.82	1.35	0.88	1.48	12.90	5.32
BG 209	72.00	122.00	45.30	3.65	13.43	0.88	0.51	5.47	8.05	48.97	1.42	0.88	1.72	10.43	7.18
BG 391	65.33	118.50	47.57	3.83	11.90	1.07	0.55	5.00	9.75	39.57	1.55	0.94	1.63	20.83	6.40
Green 112	76.33	124.50	50.07	4.17	12.80	1.12	0.70	4.77	7.20	40.87	1.62	1.03	1.78	14.35	10.58
BG 1108	66.33	119.83	57.00	4.67	12.37	1.16	0.90	5.00	6.83	28.43	1.95	1.12	1.55	23.63	11.46
BG 376	55.67	109.83	63.00	4.40	11.93	0.92	0.65	3.93	7.12	31.17	1.50	0.88	1.53	15.93	5.48
BG 2019	65.67	111.83	53.77	4.32	12.00	1.21	0.83	4.95	6.83	27.13	1.80	0.99	1.63	19.75	6.34
BG 1101	73.83	119.00	62.40	4.32	12.40	1.06	0.71	5.00	8.33	35.93	1.80	1.03	1.62	18.53	9.26
BG 390	71.00	117.00	52.87	4.43	12.07	1.02	0.62	5.33	7.37	39.53	1.63	0.97	1.42	22.45	11.02
EC 539009	71.50	108.00	63.53	5.08	13.87	1.07	0.82	3.07	5.07	16.58	1.88	1.07	1.33	20.17	11.83
BG 1107	64.17	108.17	53.73	4.58	12.83	1.09	0.76	2.75	8.07	20.70	1.95	1.07	1.40	21.75	7.20
Pusa 1088	71.67	109.67	50.97	4.43	12.52	1.25	0.88	4.02	8.77	26.07	2.02	1.08	1.65	23.78	7.72
BG 1044	58.50	105.67	42.70	4.77	11.73	1.29	1.10	3.23	6.93	28.27	2.07	1.13	1.35	19.40	5.68
ILC 2002	66.33	112.50	48.60	3.93	12.93	0.96	0.52	3.23	8.77	33.03	1.37	0.75	1.77	11.73	6.51
ICCV 88503	59.33	105.00	46.27	3.83	11.60	0.87	0.50	4.45	8.88	42.33	1.40	0.94	1.63	14.13	9.65
BG 1103	70.17	112.83	51.70	4.18	12.43	0.95	0.65	5.02	9.20	37.20	1.73	1.01	1.47	21.75	8.33
Pusa 372	70.00	111.50	48.73	4.65	12.87	1.08	0.68	5.07	7.78	41.27	1.63	0.93	1.47	25.32	12.77
ICRISAT 3070	59.67	106.67	67.67	4.97	11.40	1.20	0.86	3.92	9.17	39.20	1.83	1.08	1.77	19.13	7.15
KLB 97-5	71.67	112.00	41.77	4.05	12.58	0.94	0.63	3.98	8.08	36.92	1.62	0.83	1.68	15.08	10.19
NDL 2-96-21	67.67	108.67	49.90	3.82	12.37	1.16	0.59	4.25	9.25	27.37	1.65	1.12	1.58	19.68	8.22
KLB 97-8	71.83	110.17	52.97	4.13	13.90	0.93	0.58	4.73	8.30	43.87	1.63	0.95	1.60	15.53	9.18
IPL 110	69.33	109.33	44.95	5.65	15.27	1.11	0.61	4.42	9.40	31.27	1.90	1.05	1.57	18.78	12.57
KLB 97-7	64.33	107.50	42.80	4.27	11.40	1.14	0.71	3.72	5.48	31.33	1.50	0.91	1.52	16.35	4.20
IPC 2002-36	69.83	109.17	46.67	4.12	12.63	1.13	0.73	6.13	10.67	34.70	1.80	1.10	1.55	19.00	8.61
KLB 97	69.67	109.00	50.53	4.10	13.93	0.95	0.54	5.40	9.60	37.33	1.57	0.99	1.47	15.93	7.22
Awarodhi	70.50	117.17	37.07	4.22	12.80	0.94	0.55	5.32	8.18	35.23	1.43	0.79	1.87	14.17	8.60
BG 203	70.83	120.17	46.30	3.88	13.00	0.96	0.50	5.70	15.23	42.27	1.45	0.86	1.90	8.83	9.70
Pusa 256	69.83	116.67	53.40	4.13	12.80	0.97	0.73	4.43	10.62	44.10	1.70	1.02	1.58	22.43	13.76
ICRISAT 3074	54.83	112.50	50.10	4.43	10.52	1.13	0.64	3.37	4.88	37.80	1.70	1.00	1.58	16.75	7.48
BG 1105	68.33	109.17	56.03	3.92	12.32	1.08	0.77	3.92	6.90	35.63	1.77	1.01	1.42	17.52	10.00
BG 1053	66.50	113.67	47.20	4.55	12.95	1.03	0.68	4.20	8.83	32.00	2.07	1.09	1.62	22.40	8.01
ICRISAT 3073	58.83	111.17	48.07	5.05	11.27	1.28	0.70	4.13	7.33	30.90	1.63	0.92	1.90	14.75	8.67
BG 1073	65.67	113.83	54.20	5.20	12.10	1.22	0.72	4.48	6.45	29.83	2.00	1.20	1.83	16.70	7.92
K 850	64.83	117.33	52.30	4.77	14.47	1.12	0.79	3.03	8.38	36.63	1.90	1.07	1.42	23.35	8.85
HOO 108	72.17	108.17	54.10	3.92	12.90	1.30	0.76	6.15	10.57	43.57	1.70	1.05	1.35	20.63	7.38
Mean	67.60	112.74	49.78	4.25	12.58	1.05	0.65	4.63	8.50	34.51	1.65	0.97	1.59	17.60	8.42
CD	2.89	4.38	2.80	0.44	0.50	0.06	0.04	0.40	1.03	3.06	0.18	0.06	0.17	7.97	1.13

DF: Days to 50% flowering; DM: Days to maturity; PH: Plant height (cm); LL: Leaf length (cm.); NL/L: Number of leaflets/leaf; LtL: Leaflet length(cm.); WL: Width of leaflet (cm.); NPB: Number of primary branches/plant; NSB: Number of secondary branches/plant; NP/P: Number of pods/plant; PL: Pod length, (cm); PW: Pod width (cm.) NS/P: Number of seeds/pod; 100.SW: 100-seed weight (g); YPP: Seed yield/plant (g)

Table 3 Estimates of pooled genetic parameters for quantitative traits in chickpea

Genetic parameter	Characters														
	DF	DM	PH	LL	NL/L	Lt.L	WL	NPB	NSB	NP/P	PL	PW	NS/P	100.SW	YPP
σ^2g	46.08	46.21	81.55	0.41	1.50	0.03	0.04	1.68	6.36	85.01	0.09	0.02	0.05	27.44	8.72
GCV	5.52	2.29	11.73	9.44	6.43	9.84	19.46	17.31	13.38	12.62	11.53	9.46	7.11	17.91	23.43
σ^2p	49.27	53.55	84.95	0.48	1.60	0.03	0.04	1.74	6.77	88.60	0.10	0.02	0.06	51.72	9.21
PCV	6.12	3.32	12.30	11.38	6.88	10.52	19.78	18.12	15.35	13.77	13.38	10.13	9.75	33.24	24.84
σ^2e	3.19	7.34	3.41	0.07	0.09	0.001	0.001	0.06	0.41	3.59	0.01	0.001	0.01	24.28	0.49
h^2_{bs}	81.40	47.60	90.90	68.90	87.40	87.40	96.70	91.20	76.00	84.10	74.20	87.30	53.20	53.00	88.90
GA	10.25	3.26	23.04	16.18	12.39	19.05	39.55	34.05	24.11	23.88	20.54	18.44	10.69	44.61	45.47

σ^2g: Genotypic variance; GCV: Genotypic coefficient of variability; σ^2p: Phenotypic variance; PCV: Phenotypic coefficient of variability; h^2_{bs}: Broad sense heritability; GA: Genetic advance; DF: Days to 50% flowering; DM: Days to maturity; PH: Plant height (cm); LL: Leaf length (cm); NL/L: Number of leaflets/leaf; LtL: Leaflet length(cm); WL: Width of leaflet (cm); NPB: Number of primary branches/plant; NSB: Number of secondary branches/plant; NP/P: Number of pods/plant; PL: Pod length, (cm); PW: Pod width (cm) NS/P: Number of seeds/pod; 100.SW: 100-seed weight (g); YPP: Seed yield/plant (g)

45.74 for grain yield/plant (Table 3). Analysis of pooled data showed that estimates of genetic advance (as % of mean) were high for seed yield/plant (45.47%), 100-seed weight (44.61%), width of leaflet (39.55%) and number of primary branches/plant (34.05%). Number of secondary branches (24.11%), number of pods/plant (23.88%), plant height (23.04%), pod length (20.54%), leaflet length (19.05%), pod width (18.44%) and leaf length (16.18%) showed moderate estimate of genetic advance. Days to maturity, days to 50% flowering and number of seeds/pod had low genetic advance.

High heritability coupled with high genetic advance was observed for seed yield per plant, width of leaflet and primary branches per plant indicated additive gene effects to be important for determining these traits. On the other hand, high heritability with moderate genetic advance was observed for number of primary branches, number of secondary branches, plant height, pod length, and pods per plant indicating the influence of environment for these traits. Low heritability percentage coupled with low and moderate genetic advancement has been observed for days to maturity indicated that this trait was greatly influenced by environment as also observed by Noor *et al.* (2003) and Arshad *et al.* (2004). These results are supported by the findings of Yaqoob *et al.* (2010), Miah and Bhadra (1989), Aslam *et al.* (1992).

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