Pak. J. Bot., 21(2): 259—263, 1989.

HERITABILITY, GENETIC ADVANCE AND DOMINANCE ESTIMATES OF YIELD AND ITS COMPONENTS IN CHICKPEA (*CICER ARIETINUM* L.)

IMTIAZ AHMED KHAN, ASHRAF H. CHAUDHARY*
BASHIR AHMED MALIK AND ABDUL GHAFOOR

Pulses Programme,
National Agricultural Research Centre, Islamabad , Pakistan.

Abstract

The broad sense heritability, expected genetic advance and dominance estimates for days to 50 % flowering, plant height, primary branches, pods per plant, seeds per plant, 100 seed weight and grain yield per plant were studied in seven crosses of chickpea (*Cicer arietinum* L.). All the characters were quantitatively inherited with varying degrees. For improvement in plant height and seeds per plant, bulk population method was suggested while for the improvement of days to 50 % flowering, primary branches, pods per plant, 100 seed weight and grain yield per plant, simple selection procedures were recommended.

Introduction

Chickpea (*Cicer arietinum* L.) is third largest food legume crop of the world (Anon., 1980). It ranks first among all the pulses in acreage and production in Pakistan. Due to lack of superior genotypes, the yield on per unit area basis is low necessitating development of superior genotypes . The present studies were therefore undertaken to obtain informations regarding inheritance of quantitative characters, broad sense heritability, genetic advance and dominance estimates which could help the plant breeders in predicting the behaviour and effective selection for future varieties.

Materials and Methods

Parents, F_1 and F_2 populations of 7 crosses viz; CM 72 xILC 202, CM 72 x ILC 195, CM 72 x IL C3279, C 141 x CM 72, C 141 x ILC 72, NEC 138-2 x ILC 202 and NEC 138-2 x CM 72, were planted in randomized complete block design with three replications during 1987-88 at the National Agricultural Research Centre, Islamabad. Each plot comprised of 2 rows of 10 plants of each non-segregating material (parents and F_1s) and 12 rows of segregating generations (F_2s). Row to row and plant to plant distances were 70 and 20 cm, respectively. At maturity data were recorded on all the plants discarding 2 plants on each end of each row of non segregating material for plant height, number of primary branches per plant, pods per plant, seeds per plant, 100 seed weight

*Department of Biological Sciences, Quaid-e-Azam University, Islamabad, Pakistan.

and grain yield per plant. Whereas in F_2 populations data were recorded on 10 central rows discarding 20 cm terminal hills for each row for all these characters. Besides data on days to 50 % flowering were recorded on plot basis. Means and standard error were calculated on IBM PC using M-STAT package. The heritability estimates (broad sense) were calculated using the formula given by Mahmood & Kramer (1951)

$$H = [(VF2 - \sqrt{VP1 \times VP2}) / VF2] \times 100$$

where H is heritability (broad sense), VP1, VP2 and VF2 are the variances of female parent, male parent and F_2 populations, respectively. Genetic advance was calculated by the formula given by Singh & Chaudhary (1979)

$$Gs = K\sigma\, pH$$

where Gs is genetic advance, $K\sigma$ p is selection differential expressed in terms of phenotypic standard deviation (K = 2.06 at 5% selection intensity) and H is broad sense heritability. The dominance estimates were computed uising "Potence ratio" method (Griffing, 1950)

$$D.E. = \frac{(F1 - MP)}{(BP - MP)}$$

where D.E is the dominance estimate, F1, MP and BP are observed mean values of F_1, mid parent and better parent, respectively.

Results and Discussion

For days to 50% flowering, plant height, primary branches, seeds per plant and grain yield per plant, F_1s exhibited higher values than their respective mid parent values, which indicated the presence of heterosis due to partial dominance for these characters (Table 1). Similar results were reported by Singh & Paroda (1983), Zaffar & Abdullah (1971) and Bhatt & Singh (1980). F_1 hybrids were equal to their respective better parents in case of pod per plant which showed the presence of complete dominance. This is in close agreement with an earlier report by Singh & Paroda (1983). For 100 seed weight almost all the F_1s exceeded their better parent, indicating over dominance type of gene action for the character. Zaffar & Khan (1968) also reported over-dominance gene action for the character.

The heritability (broad sense), genetic advance (expressed as percentage of mean) and dominance estimates are presented in Table 2. For days to 50% flowering broad sense heritability estimates ranged from 0.48 to 0.62, genetic advance ranged from 25%

Table 1. Mean values for seven agronomic characters in chickpea crosses.

Cross		Days to flowering (cm)	Plant height	Primary branches	Pods per plant	Seeds per plant	100 seed weight (g)	Grain yield per plant (g)
CM 72 X	P_1	128±4.3	74± 4.2	5±1.1	58± 3.2	73±3.3	21.4±0.2	15.7±1.4
ILC 202	P_2	157±5.6	91± 3.4	3±0.9	29± 2.6	34±3.2	24.1±0.3	8.2±1.3
	F_1	147±4.3	88± 5.1	5±0.8	60± 4.0	69±2.6	26.2±0.7	12.3±2.0
	F_2	132±6.8	82± 8.8	4±1.4	51± 5.3	40±4.9	24.1±1.2	9.7±4.1
CM 72 X	P_1	128±4.3	74± 4.2	5±1.1	58± 3.2	73±3.3	21.4±0.2	15.7±1.4
ILC 195	P_2	145±4.7	85± 4.4	3±1.0	32± 2.5	56±1.7	22.2±0.1	12.6±0.9
	F_1	149±6.1	80± 5.2	5±0.8	61± 2.3	69±4.5	25.7±0.6	15.2±3.0
	F_2	138±9.1	78±11.2	4±1.5	55± 9.6	44±6.7	20.3+1.5	11.3±5.4
CM 72 X	P_1	128±4.3	74±4.2	5±1.1	58±3.2	73±3.3	21.4±0.2	15.7±1.4
ILC 3279	P_2	159±3.6	85±3.3	2±1.0	18±3.4	29±2.6	25.3±0.4	7.3±1.4
	F_1	149±2.1	89±4.7	4±1.2	61±2.5	60±3.0	27.7±0.6	12.3±2.7
	F_2	133±3.9	85±10.1	4±1.2	51±6.5	26±5.9	24.0±1.9	9.4±2.3
C 141 X	P_1	134±3.9	80± 4.0	4±0.6	43± 3.7	56±2.7	25.7±0.2	14.4±2.3
CM 72	P_2	128±4.3	74± 4.2	5±1.1	58± 3.2	73±3.3	21.4±0.2	15.7±1.4
	F_1	139±4.8	80± 2.2	5±0.7	62± 3.6	68±4.1	27.2±0.6	15.9±2.1
	F_2	132±8.6	74± 9.3	5±2.1	50± 9.9	50±6.5	22.3±1.5	13.2±4.3
C 141 X	P_1	134±3.9	80± 4.0	4±0.6	43± 4.7	56±2.7	25.9±0.2	14.4±2.3
ILC 72	P_2	166±2.8	87± 1.8	3±0.7	12± 4.4	18±2.1	25.4±0.4	4.8±1.1
	F_1	159±3.1	84± 2.9	4±0.7	41± 4.1	40±3.0	27.7±0.4	10.0±2.7
	F_2	147±5.8	81±12.1	4±2.3	33± 5.9	29±4.1	23.9±2.0	6.4±5.6
NEC 138-2	P_2	140±4.7	88± 6.1	5±1.2	15± 2.9	82±3.0	25.3±0.3	5.6±2.5
X ILC 202	P_2	157±5.6	91± 3.4	3±0.9	29± 2.6	34±3.2	24.1±0.3	8.2±1.3
	F_1	154±2.6	98± 3.6	5±0.8	30± 4.1	30±4.1	27.5±0.7	7.9±1.7
	F_2	148±7.1	83±12.2	4±2.3	28±11.8	26±6.1	25.2±1.6	4.3±4.6
NEC 138-2	P_1	140±4.7	88± 6.1	5±1.2	15± 2.9	22±3.0	25.3±0.3	5.6±2.5
X CM 72	P_2	128±4.3	74± 4.2	5±1.1	58± 3.2	73±3.3	21.4±0.2	15.7±1.4
	F_1	138±3.5	83± 3.7	5±0.7	62± 3.7	59±3.2	27.2±0.8	11.2±2.3
	F_2	137±7.0	80± 9.7	5±1.8	57± 8.4	40±7.3	26.6±1.8	6.4±4.9

F_1 = Female parent, P2 = Male parent.

to 35%, while dominance estimates ranged from 0.33 to 2.69. Gupta *et al.*, (1970) reported 39%broad sense heritability and 6.17% genetic advance for the character. For plant height, heritability, genetic advance and dominance estimates ranged from 0.27 – 0.46, 11.0 - 34% and 0.09 - 5.7, respectively. Malik *et al.*, (1983) and Govindarasu & Sampath (1983) also reported somilar rsults . In case of primary branches, heritability and genetic advance ranged from 0.60 to 0.81 and 22.0 to 30.0%, respectively. Malik *et al.*, (1983) also reported high values of broad sense heritability and genetic advance for primary branches in mungbean. Heritability and genetic advance were of higher magnitude for pods per plant (0.62 - 0.83 and 25 - 46%, respectively). Dominance estimates were greater than one for all the crosses except C 141 x ILC 72. These results indicate the pres-

Table 2. Heritability (H), genetic advance (Gs, expressed as percentage of mean) and dominance estimates (DE) in seven crosses of chickpea.

Cross		Days to flowering	Plant height	Primary branches	Pods/ plant	Seeds/ plant	100 seed weight	Grain yield/ plant
CM 72 X	H	0.56	0.38	0.72	0.67	0.31	0.82	0.76
ILC 202	Gs	27%	11%	27%	25%	21%	31%	29%
	DE	0.33	0.65	0.50	1.14	0.82	2.50	0.22
CM 72 X	H	0.61	0.29	0.69	0.80	0.29	0.89	0.56
ILC 195	Gs	32%	21%	28%	44%	27%	36%	36%
	DE	1.44	0.09	1.00	1.23	0.53	9.75	0.69
CM 72 X	H	0.59	0.46	0.77	0.73	0.35	0.87	0.71
ILC 3279	Gs	25%	23%	26%	37%	19%	29%	32%
	DE	0.37	1.78	0.47	1.14	0.39	2.20	0.19
C 141 X	H	0.48	0.37	0.81	0.62	0.32	0.79	0.69
CM 72	Gs	31%	34%	30%	39%	23%	38%	27%
	DE	2.67	1.10	1.60	1.56	0.45	1.68	1.33
C 141 X	H	0.62	0.41	0.69	0.83	0.35	0.82	0.66
ILC 72	Gs	29%	25%	23%	31%	30%	40%	31%
	DE	0.56	0.29	1.80	0.90	0.14	11.0	0.10
NEC 138-2	H	0.58	0.27	0.75	0.71	0.36	0.81	0.64
X ILC 202	Gs	26%	39%	26%	46%	26%	37%	35%
	DE	0.67	5.70	1.10	1.16	0.37	2.10	0.77
NEC 138-2	H	0.56	0.39	0.78	0.76	0.27	0.78	0.68
X CM 72	Gs	35%	26%	25%	33%	25%	31%	36%
	DE	0.67	0.60	3.00	1.19	0.43	1.95	0.12

ence of transgressive segregants which is of paramount importance for conducting selection from the population. For seeds per plant, heritability, genetic advance and dominance estimates ranged from 0.27 to 0.36, 19 to 30% and 0.14 to 0.81, respectively. Very high heritability estimates (0.78 - 0.89) were observed for 100 seed weight. High genetic advance and dominance estimates revealed the presence of transgressive segregates of valuable importance. These results were in close agreement with earlier reports by malik *et al.*, (1983) and Gupta *et al.*, (1970). Broad sense heritability estimates for grain yield per plant ranged from 0.56 (CM 72 x ILC 195) to 0.76 (CM 72 x ILC 202). Genetic advance of high magnitude (29 -36%) was observed. Dominance estimates ranged from 0.10 to 1.33.

For plant height and seeds per plant broad sense heritability values and genetic advance were low in most of the crosses, so bulk population method is suggested for the improvement of these characters. It is also suggested that bulking should be practiced till F_4 / F_5 (depending upon the diversity of the parents involved) and then single plant selections should be made and evaluated for desired plant height and number of seeds per plant. For days to 50% flowering, primary branches, pods per plant, 100 seed weight and grain yield per plant, most of the crosses showed high heritability values, better genetic advance and dominance estimates, which indicated that improvement for these characters is possible through simple selection procedures.

References

Anonymous. 1980. FAO Production year book, 34: 121-127.

Bhatt, D.D. and D . P. Singh. 1980. Combining ability in chickpea. *Indian J. Genet. Pl. Breed.*, 40: 456-460.

Govindarasu, P. and V. Sampath. 1983. Genetic variability in snap bean (*Phaseolus vulgaris* L .). *Legume Research*, 6: 97-98 .

Griffing , J . B . 1950 . Analysis of quantitative gene action by constant parent regression and related techniques. *Genetics , 35* : 303-312.

Gupta , S. P., R.C. Luthra, A.S. Gill, and P. S. Phul. 1970. Variability and correlation studies on yield and its components in gram. *J. Res.*, 9: 405-409.

Kumar, A. and S.N. Mishra. 1983. Genetic variability for seed yield and other traits in cowpea. *Legume Research*, 6: 83-85.

Mahmood, I. and H.H. Kramer. 1951. Segregation for yield , height and maturity in a soybean cross. *Agron . J.* , 43: 605-609.

Malik, B. A., S.A. Hussain, A.M. Haqqani and A.H. Chaudhary. 1983. Genetic variability in mungbean (*Vigna radiata*). *Pak. J. Agric. Res.*, 4: 171-174.

Singh, O. and R. S. Paroda. 1983. Genetic analysis of irradiated and non irradiated diallel populations in chickpea. Proc. XV Int. Cong. Genetics, New Delhi 12-21 Dec. 1983. Abst. 1134.

Singh, R. K. and B. D Chaudhary. 1979. *Biometrical methods in quantitative genetic analysis.* Kalyani Publishers, New Delhi.

Zaffar, A. M. and M. Abdullah. 1971. Diallel analysis of some economic characters in gram (*Cicer arietinum* L.). *J. Agric. Res.*, 9: 14-24.

Zaffar , A. M. and M. A. Khan. 1968. Comparative studies on gram hybrids and their parents. *W. Pak. J. Agric. Res.*, 6: 33-41.

(Received for publication 25 October 1988)