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VARIABILITY, HERITABILTY AND GENETIC ADVANCE FOR YIELD, YIELD COMPONENTS AND WILT RESISTANCE IN CHICKPEA (*Cicer arietinum* L.)

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ABSTRACT

The F4 and F5 population of twenty Chickpea (*Cicer arietinum* L..) crosses made between seven local and exotic genotypes were used in this study. Genotypic and phenotypic coefficients of variation, and also heritability and expected genetic gain were estimated for plant height (cm.), height of first pod (cm.), number of branches, pods, seeds / plant, seed weight / plant , seed yield ton / fed. , number of seeds / pod , days to 50 % flowering , days to maturity and wilt disease infection %. Both coefficient of variation were high for all characters except number of seeds / pod in F5 generation. The phenotypic coefficient of variation was greater than Genotypic or environmental coefficient of variation for all characters in both F_4 and F_5 generations. It is therefor suggested that these characters could be used as selection criteria for further improvement of Chickpea. High heritability coupled with high genetic advance observed for plant height , height of first pod , number of pods , seeds / plant , seed yield ton / fed. , 100 seed weight . days to 50 % flowering and wilt disease infection % in F_4 generation , number of pods , seeds / plant , seed weight / plant , seed yield ton / fed., 100 seed weight , days to 50 % flowering and wilt disease infection % in F_5 generation.

INTODUCTION

Grain yield is a complex character influenced by a number of agronomic traits. The development of high yielding , early maturity and resistant to wilt disease of chickpea (*Cicer arietinum* L.) is a main objective in Chickpea breeding programs. In any breeding program effective selection is dependent on the existence of genetic variability. The existence of the genetic variability in a specific breeding population depends on germplasm included in it and its selection history (Hallauer 1981). Various authors have emphasized the utility of estimates of variance components as a basis for predicting the response of quantitative characters to selection in plant breeding. Selection in a given population is a based on the phenotypic value of individuals , while only a portion of the phenotypic value is transmitted to the following generation. Thus it is of primary importance to know the relative magnitudes of the different components of the phenotypic value. Investigations with Chickpea accessions a wide range of variation for yield , yield components Salimath *et al* (1990).

Knowledge of the heritability of quantitatively inherited attributes has bean useful as a tool for improving selection efficiency. Progress under selection depends on the magnitude of heritabilty for the trait under selection in Chickpea. Widely varying estimates of heritabilty and genetic advance for different characters have bean reported by Yadav *et al.* (1987), Sing and Sing (1989), Salimath *et al* (1997) , Patel and Patel (1998) , Toker (1998) , Wahid and Ahmed (1999) and Yadav *et al.* (1999).

The purpose of the present investigation was to estimate twenty crosses of chickpea in F_4 and F_5 generations for genotypic, phenotypic and environmental variation, heritabilty and expected genetic gain from selection for yield and its components and other agronomic characters.

MATERIALS AND METHODS

In the present investigation, F_4 and F_5 populations of seven chickpea (*Cicer arietinum* L.) crosses. The seven genotypes used as parents were Giza 195 , Giza 531 and Giza 88 (new varieties introduced by Legume Section ,A.R.C.). The other four genotypes were Filip 85 - 30 c , Filip 84 - 79 c , Filip 84 - 46 c and $Iccv_2$ introduced by the International Center for Agriculture Research in the Dry Areas (ICARDA). The crosses were made and F_1 , F_2 and F_3 were developed at the ARC. by Abdel - Mohsen (1998) .

The field work was conducted at Experimental Farm of Gemmiza Research Station, Gharbia governorate, Egypt during two successive growing seasons started in 2000/2001. The best fifteen plants in seed yield and other desirable traits were selected from each cross of F_3 population and were grown in F_4 generation (five families in each plot) on Nov. 20 th 2000. Each family was represented by one row 3 m. long 60 cm. apart. Five parents (Giza 195, Giza 531 , Giza 88 , $Iccv_2$ and Filip 85 - 30 c number 21 , 22 , 23 , 24 and 25 respectively) were used for comparison. A randomized complete block design with three replicates were used . The best three plants in seed yield and some other selection criteria mentioned before were selected from each selected family and saved for planting in F_5 on Nov. 22 th 2001. F_5 families (or lines) were grown in a randomized complete blocks design with three replicates (five families in each plot) . Plot size and planting distances were as used in F4 generation. During growth period wilt disease infection % was recorded as number of plants that affected by wilt for each cross and time to flowering was recorded as number of days from sowing to 50 % flowering per five families in each plot. Time to maturity was also recorded as number of days from sowing until 90 % of the pods per plot were of golden - brown colour. At harvest 15 individual plants were randomly selected from each plot (three plants for each family) and the following data were recorded on each plant : plant height (cm.), height of first pod (cm.) , number of secondary branches per plant , number of pods , seeds number and weight (g.) per plant, seed index (g.) , number of seeds per pod and seed yield ton per feddan. The recommended cultural practices for Chickpea production were applied during the growing seasons and seeds were not inoculated in any of the studied generations. The analysis of variance was performed for each cross.

Genetic variance (6^2g) was drived from the mean squares for genotypes and error in the regular analysis of variance by separating out the variance components according to Burton (1952). Phenotypic (P.C.V.) and genotypic (G.C.V.) coefficient of variability and broad sense heritability (h^2) estimates were calculated according to the expressions of Anand and Torrie (1963). The expected genetic advance Gs. Is K. H. 6^2 p where K is the value for 5 % intensity of selection and P : is the estimate of the phenotype standard deviation among genotype means.

RESULTS AND DISCUSSION

Results presented in Tables 1 and 2 showed that the genotypes mean squares were significant for all characters studied in both F_4 and F_5 generations except number of seeds per pod in F_5 generation. As shown in Tables 3 and 4 highly significant differences with a wide range at variation were detected among genotypes in plant height and height of first pod (cm.) in F_4 and F_5 generations. This indicates that the genetic material used has sufficient variation which might be useful to select for improving chickpea plant height and height of first pod (cm.). Moderate estimates of phenotypic and genotypic coefficient of variation with low estimates of environmental coefficient of variation were observed in both F_4 and F_5 generations for plant height and height of first pod. These results suggest small effect of environmental on the expression of plant height and height of first pod. This was confirmed by the high heritability values for these two characters in F_4 generation and moderate estimates heritability in F_5 generation. So the genetic advance was high values for plant height and height of first pod in F_4 generation, while it was moderate value in F_5 generation. Similar findings regarding high coefficient of variation of plant height and height of first pod have bean reported by Kidambi *et al.* (1988), Toker (1998), Patel and Patel (1998) , Tripathi (1998) and Wahid and Ahmed (1999).

Table (1): Mean squares values of selected agronomic characters of chick pea genotypes in F_4 generation.

Source of variation	d.f	Plant height cm.	Height of first pod cm.	No.of branches/ plant.	No.of pods/ Plant	No.of seeds/ plant	Seed weight/ plant gm.
Replication	2	30.17	31.77	0.53	86.54*	128.8	5.55
Genotypes	24	80.9**	65.3**	0.64**	223.7**	394.6**	11.1**
Error	48	18.1	7.09	0.29	19.04	43.56	2.15

Table (1) : cont.

Source of variation	d.f	Seed yield ton/fed.	Seed index (gm.)	No.of seeds /Pod	Days to 50% flowering	Days To maturity	Wilt disease infection %
Replication	2	0.021	3.42	0.001	46.7**	42.6**	2.5
Genotypes	24	0.19**	57.0**	0.05**	136.2**	9.5*	89.5**
Error	48	0.009	2.87	0.008	4.91	4.91	7.14

*** , ** : Indicate significant at $p < 0.05$ and $p < 0.01$, respectively.**

Table (2) : Mean squares values of selected agronomic characters of chick pea genotypes in F_5 generation.

Source of Variation	d.f	Plant height cm.	Height of first pod cm.	No.of branches/ plant.	No.of pods/ Plant	No.of seeds/ plant	Seed weight/ Plant gm.
Replication	2	30.17	31.8*	0.53	86.5*	128.8	5.55
Genotypes	24	80.9**	65.3**	0.64*	223.7**	394.6**	11.1**
Error	48	18.1	7.09	0.29	19.04	43.56	2.15

*** , ** : Indicate significant at $p < 0.05$ and $p < 0.01$, respectively.**

Table (2) : Cont.

Source of Variation	d.f	Seed yield ton/fed.	Seed index	No.of seeds/pod	Days to 50% flowering	Days to maturity	Wilt disease infection %
Replication	2	0.021	3.42	0.001	46.7**	42.6**	2.5
Genotypes	24	0.19**	57.0**	0.05**	9.5*	9.5*	89.5*
Error	48	0.009	2.87	0.008	4.9	4.9	7.14

In the present study the high heritability value computed for number of branches/plant, number of pods, seeds / plant , seed weight / plant (gm), seed yield ton / fed. and seed index in both $F_4$and F_5 generations with a high to moderate value of genetic advance, suggesting that these characters is probably controlled by additive effects for these genotypes. Wahid and Ahmed (1999) found that heritability (broad sense) was highest for plant height (50 %) followed by seed yield (45 %) and pods/plant (35 %). They decided that plant height and pods/plant had a strong and positive association with seed yield and genotypic coefficients of variation were greatest for plant height, pods/plant and seed yield.

Significant differences were detected among genotypes for number of branches per plant in both F_4 and F_5 generations (Tables 3 and 4). In F_4 generation Means number of branches/plant for genotypes ranged from 3.5 to 7.7 with overall mean 5.7 compared to 5.7 of check , while in F_5 generation ranged from 2.8 to 8.1 with overall mean 5.5 compared to 5.9 of control. High P.C.V. and G.C.V. was observed for number of branches / plant in both F_4 and F_5 generations (Table 5 and 6). Such high range of variability might be useful in selecting genotypes characterized by high number of pods / plant in this material. Hence broad sense heritabilities were high for number of branches / plant and it was 72.8 % and 78.2 % for F_4 and F_5 generations respectively, suggesting that selection for improving this trait well be effective. The values of expected genetic advance were low (1.51 and 2.07 %) for F_4 and F_5 generations respectively. Similar results of high heritabilty for number of branches / plant with expected genetic advance value have bean reported by Patel and Patel (1998) for this trait.

Number of pods, seeds / plant, and seed weight / plant (gm.), 100 seed weight (gm.) and number of seeds / pod were studied herein as yield components characters. Data in Tables 3 and 4 show significant differences among genotypes regarding these components in both F_4 and F_5 generations. In F_4 generation number of pods , seeds , seed weight / plant and 100 seed weight show the widest range of 26.6 to 60.1 with overall mean 43.3 for pods / plant , 33.0 to 84.7 with overall mean 48.8 for seeds / plant , 7.56 to 14.75 (g.) with overall mean 11.37 (g.) for seed weight / plant and 14.83 to 29.83 (g.) with overall mean 23.92 (g.) for 100 seed weight, while it was few for number of seeds / pod. In F_5 generation it ranged 26.1 to 55.0 with overall mean 39.9 for pods / plant , 26.2 to 78.4 with overall mean 46.5 for seeds / plant ,7.22 to 14.85 (g.) with overall mean 10.85 (g.) for seed weight/plant and 15.60 to 31.27 (g.) with overall mean 24.37 (g.) for 100 seed weight. The means of checks were 38.8 , 42.38 10.21 (g.) and 23.09 (g.) for number of pods, seeds/plant, seed weight/plant and 100 seed weight respectively in F_4 generation , while they were 32.57 , 36.89 , 8.75 (g.) and 23.96 (g.) for these characters respectively in F_5 generation. Moustafa (1993) found that the two developed lines with cream - coloured seed had a greater seed yield (15.2 and 16.0 g. / plant) than the main commercial cultivar giza 1 (12.0 g./plant). Variation in F_5 generation was nearly equal to of F_4 generation for these traits. In general, the data of phenotypic , genotypic and environmental coefficients of variation indicate that the four yield components were highly influenced by environmental effects. This is confirmed by the high

Table (3) : Means of genotypes for different agronomic characters studied in f_4 generation.

Cross No.	Plant height Cm.	Height of first pod cm.	No.of bran-ches/ plant.	No.of pods/ plant	No.of seeds/ plant	Seed weight/ plant (gm).	Seed yield ton/fed.	Seed index (gm)	No.of seeds /pod	Days to 50% flowering	Days to maturity	Wilt disease infection %
1	62.7	20.0	5.23	59.9	84.7	14.41	0.933	17.53	1.43	81.0	158.7	21.34
2	58.7	28.0	5.73	26.6	34.2	8.58	0.965	24.93	1.27	95.7	158.3	16.45
3	58.0	20.0	6.76	29.0	33.0	9.76	1.022	28.87	1.13	73.7	161.3	27.71
4	62.3	25.3	7.70	36.3	46.1	11.27	0.508	28.40	1.47	73.0	158.7	24.05
5	61.3	27.7	5.83	36.8	44.4	12.06	0.969	26.90	1.27	95.7	160.0	16.60
6	51.0	20.7	5.16	34.5	36.7	10.60	0.844	28.03	1.03	91.0	160.0	16.60
7	57.0	21.7	3.50	45.9	57.3	12.43	0.685	21.87	1.17	89.0	161.0	21.34
8	56.7	22.7	6.16	60.1	65.5	12.51	0.389	20.03	1.3	88.0	161.7	27.52
9	55.7	21.7	4.46	39.6	43.2	12.88	0.697	29.83	1.1	89.7	162.7	28.85
10	48.0	16.0	6.76	46.1	48.5	10.57	0.354	20.37	1.0	87.0	163.7	24.05
11	58.7	14.3	6.30	43.9	46.5	12.96	0.548	26.07	1.03	80.7	163.0	27.71
12	55.0	15.7	5.36	48.9	51.9	7.56	0.263	14.83	1.07	77.3	162.7	28.85
13	59.0	23.3	5.56	46.1	57.1	12.17	0.555	19.63	1.13	86.7	161.0	24.05
14	56.0	29.0	5.16	55.7	60.6	14.75	0.802	23.53	1.13	84.7	159.7	16.60
15	54.0	27.7	5.3	49.1	52.9	11.81	0.817	25.33	1.1	85.0	160.7	14.76
16	48.3	20.7	5.83	46.3	52.1	10.47	0.749	19.80	1.13	80.7	162.7	21.34
17	59.3	21.3	6.23	38.9	47.6	12.85	0.564	27.37	1.23	80.7	158.7	25.30
18	44.0	18.0	6.96	39.3	38.9	9.38	0.193	26.93	0.97	80.3	163.7	29.92
19	66.0	29.7	5.13	43.3	51.0	12.51	1.122	27.57	1.23	88.7	164.7	16.60
20	50.3	20.0	5.26	39.9	42.9	7.87	0.281	20.47	1.10	94.7	162.3	12.92
Mean	56.1	22.18	5.72	43.31	48.76	11.37	0.663	23.92	1.17	85.18	161.27	22.13
Range min Max	44.0 66.0	14.3 29.7	3.50 7.70	26.6 60.1	33.0 84.7	7.56 14.75	0.193 1.122	14.83 29.83	0.97 1.47	73.0 95.7	158.3 164.7	12.92 28.85
21	61.7	25.0	5.63	40.5	44.1	9.77	0.610	21.13	1.1	86.3	161.7	26.56
22	56.0	28.7	6.50	46.5	52.2	8.31	0.500	15.27	1.17	76.0	161.3	31.07
23	52.7	25.0	6.43	34.7	38.4	11.63	0.780	28.27	1.03	79.7	162.0	26.45
24	58.3	14.7	6.0	43.0	46.2	11.38	0.715	24.60	1.2	79.7	160.7	30.0
25	60.7	27.0	4.33	29.3	31.0	9.95	0.754	26.17	1.03	95.0	158.7	25.30
L.S.D.0.05	6.98	4.37	0.89	7.16	10.83	2.84	0.158	2.73	0.15	3.64	3.63	4.38

Table (4): Means of genotypes for different agronomic characters studied in f_5 generation.

Cross No.	Plant height cm.	Height of first pod cm.	No.of bran-ches/plant.	No.of pods/ plant	No.of seeds/ plant	Seed weight/ Plant (gm).	Seed yield ton/fed.	Seed index (gm)	No.of seeds/ pod	Days to 50% flowering	Days to maturity	Wilt disease infection %
1	47.7	17.3	5.3	55.0	78.43	14.85	0..947	18.37	1.27	77.7	158.7	21.34
2	61.3	34.0	5.4	26.13	31.70	7.57	0.963	25.07	1.03	80.0	158.3	16.45
3	48.3	19.7	7.7	28.40	31.17	8.49	0.830	27.73	0.97	71.7	161.3	27.71
4	48.7	17.0	8.1	23.07	48.27	12.46	0.537	27.60	1.13	72.3	158.7	24.05
5	57.0	29.3	5.5	36.80	46.37	11.80	0.967	26.23	1.33	87.7	160.0	16.60
6	65.0	27.7	4.7	25.70	26.23	7. 22	0.893	29.60	1.17	75.0	160.0	16.60
7	56.7	28.3	2.8	34.20	37.17	7. 80	0.787	21.83	1.23	75.3	161.0	21.34
8	49.0	22.7	5.1	51.43	66.07	13. 76	0.390	21.07	1.27	74.3	161.7	27.52
9	48.0	25.0	4.1	33.07	39.17	12. 02	0.847	31.27	1.07	79.7	162.7	28.85
10	54.3	25.0	6.3	42.57	43.50	8. 37	0.402	20.13	1.10	72.0	163.7	24.05
11	54.7	26.7	6.1	43.03	45.57	11. 30	0.613	26.33	1.0	74.0	163.0	27.71
12	48.0	17.7	4.9	46.83	49.90	7. 50	0.305	15.60	1.03	71.7	162.7	28.85
13	54.7	19.3	5.9	42.57	47.97	8. 80	0.547	19.60	1.27	73.7	161.0	24.05
14	53.0	23.0	4.8	51.83	59.23	14. 23	0.937	25.07	1.07	78.0	159.0	16.60
15	56.0	25.0	5.0	47.40	52.13	13. 76	0.775	26.90	1.13	70.0	160.7	14.76
16	58.0	24.7	5.7	46.57	52.43	10. 18	0.833	19.93	1.03	72.0	162.7	21.34
17	52.3	21.7	6.1	36.53	45.77	12. 66	0.630	28.05	1.07	76.0	158.7	25.30
18	50.3	20.0	7.1	36.83	36.83	12. 86	0.220	26.50	1.0	81.7	163.7	29.92
19	59.7	25.7	4.9	43.53	49.0	11. 95	1.037	28.23	1.10	79.0	164.7	16.60
20	60.7	28.0	4.7	37.67	42.50	9. 43	0.302	22.40	1.17	81.0	162.3	12.92
Mean	54.2	23.9	5.5	39.94	46.47	10. 85	0.688	24.37	1.12	76.1	161.27	22.13
Range												
min	47.7	17.0	2.8	26.13	26.23	7. 22	0.220	15.60	0.97	70.0	158.3	12.92
Max	65.0	34.0	8.1	55.0	78.43	14. 85	1.037	31.27	1.33	87.7	164.7	28.85
21	55.7	25.0	5.5	33.0	37.50	8. 16	0.770	21.53	1.10	76.7	161.7	26.56
22	54.0	22.0	7.1	35.30	40.57	6. 90	0.457	16.70	1.20	73.0	161.3	31.07
23	55.7	21.0	6.9	33.07	36.20	10. 46	0.693	28.23	1.20	71.0	162	26.45
24	47.0	21.3	6.0	34.83	40.33	10. 13	0.687	25.73	1.17	71.0	160.7	30.0
25	59.3	31.3	4.3	26.63	29.83	8. 10	0.690	27.63	1.47	83.7	158.7	25.30
L.S.D.0.05	8.62	8.71	0.97	6.06	8.04	2.13	0.149	4.74	N.S	9.56	3.63	4.38

Table (5) : Variability, heritability and expected genetic advance for yield and its components in F_4 generation.

Parameters	Plant Height cm.	Height of first pod cm.	No.of branches/ Plant.	No.of pods/ plant	No.of seeds/ plant	Seed weight/ Plant (gm)	Seed yield ton/fed.	Seed index (gm)	No.of seeds/Pod	Days to 50% flowering	Days to maturity	Wilt disease infection %
Mean	56.1	22.18	2.63	43.31	48.76	11.37	0.663	23.92	1.17	85.18	161.27	22.13
Range												
min	44.0	14.3	2.0	26.6	33.0	7.56	0.193	14.83	0.97	73.0	158.3	12.92
Max	66.0	29.7	3.7	60.1	84.7	14.75	1.122	29.83	1.47	95.7	164.7	28.85
6^2ph	39.03	26.49	1.009	87.25	145.56	5.12	0.068	20.86	0.021	48.67	6.44	34.61
6^2g	20.9**	19.4**	0.12*	68.2**	117**	2.97**	0.059*	18.1**	0.013*	43.8**	1.53*	27.5**
6^2e	18.10	7.09	0.29	19.04	43.56	2.15	0.009	2.77	0.008	4.91	4.91	7.14
P.C.V.	11.14	23.20	17.56	21.57	24.74	19.90	41.20	19.09	12.39	8.19	1.57	26.58
G.C.V.	8.15	19.85	13.17	19.07	22.18	15.16	36.64	17.78	9.75	7.77	0.77	23.69
E.C.V.	7.59	12.0	20.48	10.08	13.54	12.9	14.31	6.95	7.65	2.60	1.37	12.08
h^2 %	53.6	73.2	72.8	78.2	70.1	58.0	86.8	86.7	61.9	89.9	23.8	79.4
G.A. %	6.90	7.76	1.51	15.05	17.42	2.70	0.47	8.16	0.19	12.92	1.24	9.62

Table (6) : Variability , heritability and expected genetic advance for yield and its components in F_5 generation.

Parameters	Plant height cm.	Height of first pod cm.	No.of bran-ches/ plant.	No.of pods/ plant	No.of seeds/ plant	Seed weight/ plant (gm)	Seed yield ton/fed.	Seed index(gm)	No.of seeds/pod	Days to 50% flowering	Days to maturity	Wilt disease infection %
Mean	54.2	23.9	5.5	30.3	34.4	7.4	0.521	20.68	1.12	76.1	159.4	22.65
Range												
Min	47.7	17.0	2.8	19.9	18.5	2.95	0.252	10.9	0.97	70.0	153.3	14.67
Max	65.0	34.0	8.1	48.4	63.3	12.85	0.695	28.56	1.33	87.7	163.3	32.14
6^2ph	34.35	38.1	1.65	76.02	143.47	6.72	0.059	19.03	0.033	43.05	18.18	39.21
6^2g	15.75*	9.9**	1.3*	53.3**	91.5**	6.51**	18.4**	14.4**	0.005	9.08*	6.1**	26.4**
6^2e	27.59	28.19	0.35	13.67	24.02	1.69	8.25	8.34	0.027	33.99	12.07	12.85
P.C.V.	12.15	25.83	23.36	21.83	25.78	23.89	35.31	17.90	16.22	8.62	2.68	27.65
G.C.V.	7.32	13.16	20.65	24.1	27.81	34.48	823.55	18.33	6.31	3.96	1.55	22.67
E.C.V.	9.69	22.22	10.76	12.2	14.25	17.57	551.3	13.96	14.67	7.66	2.18	15.83
h^2 %	36.33	25.98	78.18	85.8	90.44	87.35	89.83	94.06	15.15	21.09	33.55	67.23
G.A. %	4.93	3.30	2.07	15.41	23.31	4.66	0.449	8.45	0.057	2.85	2.95	8.67

to moderate estimates of heritability for these characters , which also suggest that little progress may be achieved in Chickpea through these characters. However the genotypes showed high heritability for number of pods , seeds , seed weight / plant and 100 seed weight in F_4 generation respectively , while they were 85.8 % , 90.44 % , 87.35 % and 94.06 % for these characters respectively in F_5 generation. The expected genetic advance values were 15.05 % , 17.42 % 2.70 % and 8.16 % for number of pods, seeds , seed weight / plant and 100 seed weight respectively in F_4 generation , while they were 15.41 % , 22.31 % , 4.66 % and 8.45 % for these characters respectively in F_5 generation. Estimates of heritability and expected genetic advance were moderate to low for number of seeds / pod in both F_4 and F_5 generations (Tables 5 and6). Maloo and Sharma (1987) ,Jivani and Yadavendra (1988), Patel and Patel (1998), Yadav and Sharma (1998) ,Wahid and Ahmed (1999) and Yadav *et al.* (1999) , also estimated high or moderate broad sense heritabilty , moderate and low expected genetic advance for one or more of the above four yield component characters.

For seed yield ton / fed. ranged from 0.193 to 1.122 ton / fed. comparing to 0.672 ton / fed. of mean control in F_4 generation , while it ranged from 0.220 to 1.037 ton / fed. comparing to 0.659 ton / fed. of mean control in F_5 generation. The overall mean in F_4 was 0.663 and 0.688 ton / fed. for F_4 and F_5 generations respectively. Genotypes number 1 , 2 , 3 , 5 , 6 , 14 , 15 and 19 gave seed yield / plant and seed yield ton / fed. higher than the other genotypes and mean of check. Two genotypes gave the highest value of seed yield ton / fed. genotype number 3 (1.022 ton / fed.) , genotype number 19 (1.122 ton / fed.) in F4 generation. In F_5 generation it was (0.830 ton / fed.) for genotypes number 3 and it was (1.037 ton / fed. for genotypes number 19. Estimated (P.C.V.) for seed yield ton / fed. was high and greater in magnitude as compared with (G.C.V.) which was also relatively high. Existence of such wide range of variability for seed yield might be useful to select higher yield genotypes although (E.C.V.) values were also higher in magnitude. Estimates of heritability in broad sense were high in both F_4 (86.81 %) and F_5 generation (89.83 %), suggesting that selection for improving this character will be high effective. Values of expected genetic advance were low in both F_4 (0.47 %) and F_5 generation (0.44 %). Similar results of high heritability for seed yield ton / fed. coupled with low expected genetic advance valu have bean reported by Rajesh *et al* (1988) , Arun *et al* (1998) , Rao and Jain (1998) , Tripathi (1998) , Jagannath *et al* (1999), Khan and Sharma (1999), , Vivek *et al* (1999) and Shiv *et al* (2001).

As shown in Tables 3 and 4 highly significant differences with a wide range of variation were detected among genotypes in both F_4 and F_5 generations for number of days to 50 % flowering and 90 % maturity. This indicates that the genetic material used has sufficient variation which might be useful to select for earliness in flowering and maturity. Moderate estimates of phenotypic and genotypic coefficient of variation with low estimates of environmental coefficient of variation were observed for number of days to 50 % flowering in both F_4 and F_5 generations. These results suggest small effect of environment on the expression of flowering. This was confirmed by the high heritability values of genotypes in F_4 generation (89.9 %) moderate in F_5

generation (21.09 %). For number of days to maturity estimated of heritability was moderate in both F_4 (23.8 %) and F5 (33.55 %) generations. Therefore selection for these two characters will provide a chance for genetic improvement. Estimates of genetic advance were moderate to low for number of days to 50 % flowering and 90 % maturity in both F_4 and F_5 generations. These findings were reached before by, Jivani and Yadavendra (1988), Kidambi *et al.* (1988), Patel and Patel (1998) , Toker (1998) and Kumar *et al.* (1999).

Wilt disease infection % ranged from 12.92 to 28.85 % with overall mean 22.13 % in F_4 generation , while it ranged from 14.76 to 32.14 % with overall mean 22.65 % in F_5 generation. The mean values of wilt disease infection for check were 27.88 and 27.36 % in F_4 and F_5 generations respectively. Seven genotypes were more resistant to wilt disease infection numbers 2 , 5 , 6 , 14 , 15, 19 and 20 in both F_4 and F_5 generations. Variation in both F_4 and F_5 generations was nearly equal for this trait. Higher phenotypic and genotypic coefficient variation was observed for wilt disease infection in both F_4 and F_5 generation , suggesting that selection for improving this trait will be high effective. Estimates of heritability in broad sense and expected genetic advance were high in both F_4 and F_5 generations. This indicates that the genetic material used has sufficient variation which might be useful to select for resistant to wilt disease. Morales *et al.* (1994) stated that F_4 lines from two crosses and selection at F_8 gave rise to pitic 93 and it was resistant to oxysporium f. sp. Ciceris.

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التباين الوراثي وكفاءة التوريث والتقدم الوراثي للمحصول ومكوناته والمقاومة لمرض الذبول في الحمص

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استخدمت في هذه الدراسة هجن الجيل الرابع والخامس لسبعة أباء من الحمص اثنان محليان وخمسة أباء استقدمت من المركز الدولي للزراعة في المناطق الجافة ؛ أيكاردا ؛ وتم تقدير التباين الوراثي ودرجة التوريث والمكسب الوراثي المتوقع لكل الهجن وقد أقيم هذا البحث في محطة البحوث الزراعية بالجميزة محافظة الغربية خلال موسمين زراعيين ٢٠٠٠/٢٠٠١ ؛ ٢٠٠١ /٢٠٠٢ .

وتتلخص أهم نتائج الدراسة فيما يلي:-

١-كان التباين الوراثي معنويا لمعظم الصفات تحت الدراسة في الجيل الرابع والخامس عدا صفة عدد البذور بالقرن في الجيل الخامس وفى نفس الوقت كان التباين البيئي مرتفعا ويمثل الجزء الأكبر من التباين المظهري بالنسبة لصفات المحصول ومكوناته وطول النبات وارتفاع أول قرن على النبات وعدد الفروع على النبات والتزهير والنضج وأيضا النسبة المئوية للإصابة بمرض الذبول وقد انعكس ذلك على قيم الكفاءة الوراثية والمكسب الوراثي من الانتخاب والتى تراوحت بين المرتفع في صفات المحصول وبين المتوسط والمنخفض في بعض الصفات الأخرى

٢ - بناء على نتائج معامل الاختلاف الوراثي ودرجة التوريث والمكسب الوراثي فانه يمكن إحراز تحسنا كبيرا عند الانتخاب للصفات المحصولية وفى النضج وطول النبات وعدد الفروع على النبات والمقاومة لمرض الذبول وتحسن متوسط في الصفات الأخرى تحت الدراسة.