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RESEARCH ARTICLE

HETEROSIS MANIFESTATION OF MAGIC LINES OVER THE PREVALENT LINES OF CHICKPEA (*CICER ARIETINUM* L.)

***,[1]Heena Attri, [1,2]Jamwal, B. S., [1]Amardeep Kour and [1]Ashwani Kumar**

[1]Division of Plant Breeding and Genetics, FoA, Sher-e-Kashmir University of Agricultural Sciences and Technology-Jammu, Main Campus, Chatha (180009) J&K
[2]Chief Scientist-cum-Professor, SKUAST-J, Pulses research Sub-Station, Samba (184121) Jammu, J&K

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ABSTRACT

An investigation entitled "*Heterosis manifestation of MAGIC lines over the prevalent lines of chickpea* (*Cicer arietinum* L.)" was carried out with 40 genotypes, in F_4 derived F_5 MAGIC lines, consisting of eight parents. ICC-4958, ICCV-10, JAKI-9218, JG-11, JG-130, JG-16, ICCV-97105, ICCV-00108 during *rabi* 2012-13 and 2013-14.The observations were recorded for quantitative traits namely, days to 50% flowering, days to maturity, plant height (cm), pods per plant, primary branches, secondary branches, pod length (cm), seed yield (g), 100 seed weight (g),seeds per pod, root length (cm), root weight-fresh and dry (g), relative water content of leaf and partitioning coefficient to roots, stem, leaves and pods. The information was derived on mean performance, range, phenotypic and genotypic coefficient of variation, heritability, genetic advance and heterosis. The highly significant variability was found amongst genotypes. For most of the characters the range in the mean performance was quite wide. The phenotypic and genotypic coefficients of variation were found high in F_5 generation. Seed yield and pod per plant exhibited very high heritability. Also high (plant height, 100 seed weight and secondary branches) to very high (seed yield and pod per plant) genetic advance was recorded. Root length and relative water content of leaf showed very high heritability and genetic advance, too. High heterosis was exhibited in characters like primary branches, secondary branches, pods per plant, grain yield, root length, partitioning coefficient to pods and relative water content.

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INTRODUCTION

Chickpea is a diploid with 2n = 16 chromosomes and genome size of approximately750 Mbp (Arumuganathan and Earle, 1991). *Cicer* genus has 43 species (Van der Maesen, 1987). Eight of these share the annual growth habit with chickpea and are of particular interest to breeders (Arumuganathan and Earle, 1991). Two distinct forms of cultivated chickpeas are desi (small seeds, angular shape, and coloured seeds with a high percentage of fibre) and Kabuli types (large seeds, owl-head shape, beige coloured seeds with a low percentage of fibre). A third type, designated as intermediate or pea-shaped, is characterized by medium to small size, and round/pea-shaped seeds. Hair like structures on its stems leaves and pods secrete acids that provide the first line of defence against pests, reducing the need for chemical sprays (Yadav *et al.,* 2007). In addition to lowering cholesterol, the high fibre content prevents blood sugar levels from rising too rapidly after a meal, making chickpea a good choice for individuals with diabetes, insulin resistance or hypoglycemia (McIntosh and Miller, 2001). Chickpea does not contain any anti-nutritional factors, except the raffinose type oligosaccharides which cause flatulence (Williams and Singh, 1987). However the oligosaccharides can be neutralized by boiling or mere soaking in water (Queiroz *et al.,* 2002).

Corresponding author:* **Heena Attri,
Division of Plant Breeding and Genetics, FoA, Sher-e-Kashmir University of Agricultural Sciences and Technology-Jammu, Main Campus, Chatha (180009) J&K

MATERIALS AND METHODS

The experiment material comprised of 40 chickpea lines with susceptible check, were laid in RCBD design with three replications, at Pulses Research Sub-station, SKUAST-J, Samba, during 2012-13 and 2013-14.The experiment was sown late by 30 days (first week of December) in comparison to normal sowing date, for subjecting the material to terminal drought stress. The material was received from ICRISAT, as chickpea magic lines under ICAR-ICRISAT collaboration work. The genotypes were recorded for drought tolerance score on a1-9 scale on the basis of ICRISAT/ICARDA recommendation. The material was received from ICRISAT,

Hyderabad as F_4 bulk of MAGIC population by the A.I.C.R.P. on chickpea, Sub-Station Samba; under ICAR-ICRISAT collaborative work. MAGIC lines consisted of eight parents (ICC 4958, ICCV 10. JAKI 9218, JG 11, JG 130, JG 16, ICCV 97105, ICCV 00108).In this case of chickpea multi-parent advanced generation inter cross (MAGIC) populations are being developed to enhance the genetic base. Eight elite lines/cultivars (ICC 4958, ICCV 10, JAKI9218, JG11, JG130, JG16, ICCV97105, and ICCV00108) were selected by ICRISAT, Hyderabad from Ethiopia, Kenya and India for development of a MAGIC population for *desi* chickpea. Twenty-eight two-way, fourteen four-way and seven eight-way crosses were made to develop this MAGIC population. The seed was collected and sown at the said location, in *rabi* season of 2013-14 in plant to progeny row, under R.B.D. trial. Each plot consisted of four rows, in each row 10 seeds were sown. The seed was sown manually at an approximate depth of 5 cm below the soil. The data was recorded on different yield and yield contributing traits on 5 plants in each progeny.

Heterosis

The data were statistically analyzed (Steel & Torrie 1980) to determine the significance of difference between genotypes for parameters under consideration. Heterosis was calculated by following formulae:

Economic/Commercial Heterosis: $\frac{F1 - Standard\ check}{Standard\ check} \times 100$

RESULTS AND DISCUSSION

Breeders have been utilizing the available genetic resources to modify the varieties to meet the ever changing requirements. In this regard the most important development in plant breeding of recent times is the extensive use of heterosis (Malik *et al.,* 1987). However in self-pollinated crop the heterosis cannot be exploited directly, hybrid vigor is used to identify superior hybrids as they offer more probability of developing better segregants (Sharif *et al.,* 2001 and Sagar & Chandra, 1977). In chickpea beneficial heterosis for grain filling period, seeds per plant and grain yield were reported by several research workers (Hedge *et al.,* 2002, Jena & Arora, 2002; Gupta *et al.,* 2003). Sagar & Chandra (1977) suggested that the manifestation of heterosis in legumes may be utilized for the selection of potential crosses for their genetic improvement. This is because of high probability of having efficient segregants from better combinations than that from poor hybrids. For the days to 50% flowering, negative heterosis was recorded. However, negative heterosis has been proved beneficial in case of screening drought tolerant lines. As early flowering has been regarded good character in the rainfed areas. The estimate of heterosis was found negative for the

Table 1. Mean, Range and Variance for F_5 generation (morphological and physiological traits) in Chickpea

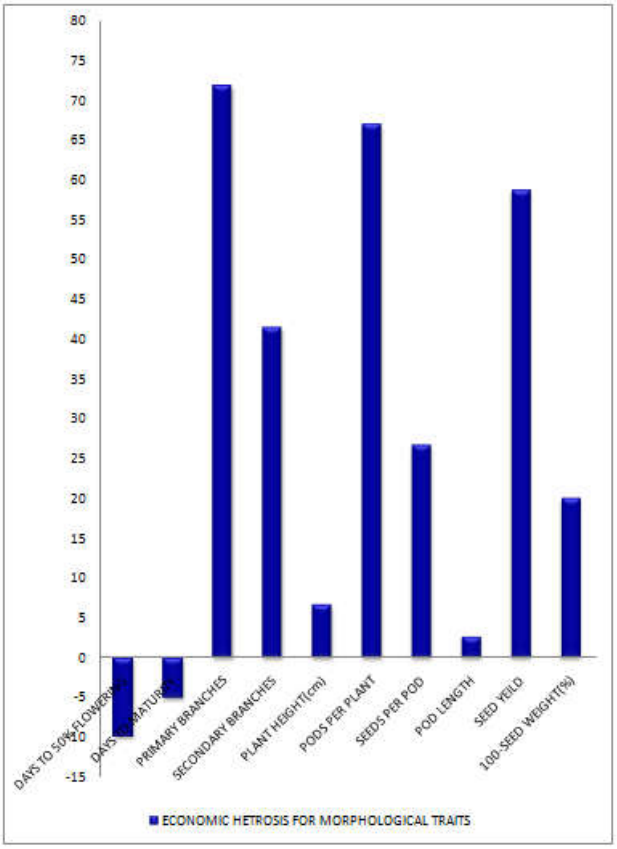
Parameters / Traits	Mean	Range	Variance
Days to 50% flowering	102.083±1.259	113.000- 98.000	4.760
Daystomaturity	151.433±1.144	159.333-149.333	3.930
Primary branches	4.541±1.131	7.000-2.333	3.840
Secondary branches	21.05±3.767	32.667-8.333	42.570
Plant height(cm)	61.052±3.114	73.800-50.800	29.080
Pods per plant	48.166±4.650	75.000-18.333	64.860
Seedsperpod	2.10 ±0.424	3.000-1.333	0.540
Pod length(cm)	1.94±0.123	2.167-1.600	0.050
Seed yield (g)	35.915±1.456	48.761-11.831	6.365
100-seed weight(g)	20.205±4.503	27.372-17.082	6.780
Root length(cm)	21.17±1.256	28.433-15.800	4.730
Root fresh weight(g)	3.271±0.220	3.900-2.600	0.150
Root dry weight (g)	2.242±0.234	2.967-1.533	0.160
Relative Water content(%)	41.670±3.023	55.618-27.741	27.420
Partitioning Coefficient to pods(%)	23.36±1.483	27.900-19.084	6.600
Partitioning Coefficient to roots(%)	33.273±1.630	39.372-29.719	7.970
Partitioning Coefficient to leaves(%)	22.943±1.487	27.808-17.893	6.630
Partitioning Coefficient to stem(%)	23.974±1.446	29.441-17.995	6.270

Table 2. Estimation of Economic heterosis for morphological and physiological traits of F_5 generation in Chickpea during 2013-14

Parameters / Traits	F_5	Standard check (SCS-3)	Economic heterosis (%)
Days to 50% flowering	101.803	113.000	-09.900
Days tomaturity	151.230	159.333	-05.100
Primary branches	04.589	02.667	71.700
Secondary branches	21.213	15.000	41.400
Plant height(cm)	61.146	57.400	06.510
Podsperplant	48.931	29.333	66.810
Seedsperpod	02.119	01.667	26.570
Pod length(cm)	01.952	01.600	02.560
Seed yield (g)	36.252	22.842	58.600
100-seed weight(g)	20.204	16.847	19.920
Root length (cm)	21.314	15.800	34.898
Root fresh weight (g)	03.260	03.467	-05.970
Root dry weight (g)	02.245	02.133	05.250
Partitioning Coefficient to roots(%)	33.252	34.092	-02.463
Partitioning Coefficient to stem(%)	23.951	24.881	-03.737
Partitioning Coefficient to leaves(%)	22.838	27.043	-15.549
Partitioning Coefficient to pods(%)	23.476	19.084	23.014
Relative Water content (%)	41.836	35.243	18.707

Table 3. Genetic parameters of segregating population (F_5) of the morphological and physiological traits in Chickpea

Parameters / Traits	h^2	PCV	GCV	G.A	G.A. over mean (%)	C.V.
Days to 50% flowering	45.68	2.90	1.96	2.79	2.73	2.14
Daystomaturity	26.58	1.53	0.79	1.27	0.84	1.31
Primary branches	02.76	43.03	7.14	0.11	2.44	42.43
Secondary branches	24.29	35.51	17.50	3.75	17.77	30.90
Plant height(cm)	29.12	10.49	5.66	3.84	6.29	8.83
Podsper plant	76.16	34.25	29.89	25.88	53.73	16.72
Seedsperpod	1.18	11.66	1.27	0.01	0.28	11.59
Pod length(cm)	11.20	33.27	0.00	0.16	7.68	35.09
Seed yield (g)	91.95	25.31	24.27	16.84	47.93	7.18
100-seed weight(g)	28.31	15.35	8.17	1.79	8.79	13.00
Root length(cm)	58.25	15.90	12.13	04.04	19.08	10.27
Root fresh weight(g)	18.54	12.92	5.56	0.16	04.94	11.66
Root dry weight (g)	19.23	20.32	08.91	0.18	08.05	18.26
Relative Water content(%)	60.05	19.88	15.41	10.25	24.59	12.57
Partitioning Coefficient to pods(%)	27.81	12.94	06.82	01.73	07.41	10.99
Partitioning Coefficient to roots(%)	18.17	09.38	04.00	01.17	03.51	08.49
Partitioning Coefficient to leaves(%)	36.11	14.09	08.47	02.40	10.48	11.26
Partitioning Coefficient to stem(%)	32.82	12.75	07.30	02.07	08.62	10.45



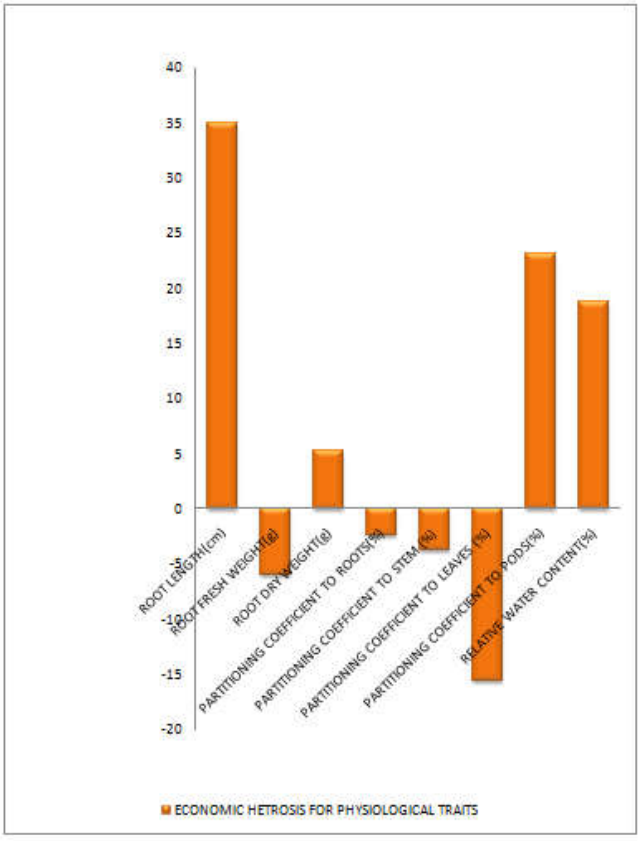


Fig.1. Estimation of economic heterosis for morphological traits **Fig.2. Estimation of economic heterosis for the physiological traits**

days to maturity. As early maturing genotypes has been preferred for the drought tolerant genotypes. Very high to high range of estimate of heterosis were observed in primary branches, pods per plant and followed by seed yield giving the values 71.70, 66.81 and 58.60 % respectively. Similarly, high estimates of heterosis was recorded in case of physiological characters *viz,* root length, partitioning coefficient to pods and relative water content of leaf giving the values 34.89, 23.01 and 18.70 % respectively This suggested that the genotypes selected are far superior than the prevalent variety.

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