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Estimation of genetic variability and heritability for quantitative traits in chickpea (*Cicer arietinum* L.)

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Abstract

A study was carried out in the field of Department of Genetics and Plant Breeding, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, Uttar Pradesh during 2018-2019. Fifty one genotypes of chickpea were evaluated for means and components of variability, heritability, genetic advance for seed yield. Characters like days to maturity, followed by number of pods per plant, number of primary branches, number of secondary branches, number of pods per plant, number of seeds per pod, days to 50% flowering showed high heritability coupled with high genetic advance as percent of mean, respectively suggesting that there was preponderance of additive gene action for the expression of these characters.

Keywords: Chickpea (*Cicer arietinum* L.), GCV, PCV, genetic variability, heritability, genetic advance

Introduction

Chickpea (*Cicer arietinum* L.) is an integral part of an Indian agriculture since time immemorial, because of only its intrinsic value in terms of higher protein content, carbohydrates, minerals, nitrogen fixing ability and indispensability as alternative crop for crop diversification. Chickpea (*Cicer arietinum* L.) occupies a prime position among the pulses in the country with a maximum hectareage, production and its high nutritive value. It is known to have originated in western asia. It belongs to genus *Cicer* and tribe Viciaceae, sub-order Papilionaceae of order Leguminosae (Bentham and Hooker, 1870). Total out of 39 known species are distributed mainly in central and western asia, two are found to be cultivated in india, viz; *Cicer arietinum* (2n = 14) which is most widely cultivated and *Cicer soongaricum* (2n = 16) cultivated in western temperate and alpine regions (9000-15000 ft.in altitude) of the Himalaya. Southwest Asia and the Mediterranean particularly South -East Turkey and Syria are considered as the primary centre of origin of chickpea Ethiopia is regarded as secondary center of origin.

Chickpea is one of the most important Rabi pulse crops in Asia. India is largest producer (25%), importer (20%) and consumer (20%) of pulses in the world. In pulses, chickpea accommodates third position in the world.

Coefficient of variation provides a relative measure of variance among the different traits.

Materials and Methods

Fifty one genotypes of chickpea including check were evaluated during Rabi 2018-2019 following RBD with three replications. The research was conducted at the Field Experimentation Centre of Department of Genetics and Plant Breeding, S.H.U.A.T.S., Prayagraj, situated in the "Middle Gangetic Plains" which falls under agro-climatic zone. All the recommended cultural practices were adopted to maintain a healthy crop growth. Data regarding thirteen attributing traits viz, days to 50% flowering, plant height (cm), days to maturity, number of primary branches, number of secondary branches, number of seeds per pod, number of pods per plant, number of seeds per plant, seed index (g), days to 50% pod setting, biological yield (g), harvest index (%) and grain yield per plant were recorded for all the chickpea genotypes. Genotypic coefficient of variation and Phenotypic coefficient of variation (GCV and PCV) were calculated by the formula given by Burton, heritability in broad sense (h^2) by Burton and Devane and genetic advance given by Johnson *et al.*

Results and Discussion

Coefficient of variation provides a relative measure of variance among the different traits. Analysis of variance showed highly significant difference for all the characters under the study

a at 1% level. This shows ample scope for selection genotypes for yield and other components.

Estimates of genetic parameters

One of the important considerations in any crop improvement is the detailed study of genetic variability. The efficiency of selection largely depends on the magnitude of genetic variability present in the plant population.

The success of genetic improvement in any character depends on the value of variability for any character present in the gene pool for the component characters. Hence assessment of existing variability for any character present in the gene pool of a species of almost importance to a plant breeder for starting a judicious plant breeding.

The estimates of variance, coefficient of variation, heritability and genetic advance for all the thirteen characters under study have been boxed in the Table 1 explained as under.

Table 1: Analysis of variance of 51 Chickpea genotypes for 13 quantitative characters

Sl. No	Characters	Mean Sum of Squares		
		Replication (d.f=2)	Treatment (d.f=50)	Error (d.f=100)
1	Days to 50% Flowering	0.471	9.643**	1.165
2	Days to Maturity	5.438	19.876**	0.858
3	Plant Height	897.5	93.729**	28.776
4	Number of Primary Branches per Plant	0.0135	0.935**	0.027
5	Number of secondary branches	0.0075	8.456**	0.045
6	Number of Pods per Plant	12.769	569.63**	1.997
7	Number of Seeds per plant	41.960	1623.93**	6.466
8	Seeds per pod	0.0085	0.223**	0.012
9	Seed Index	0.313	99.996**	1.880
10	Pod setting	0.496	1.723**	0.557
11	Biological yield	3.933	97.967**	1.371
12	Harvest index	13.599	6.165**	1.808
13	Seed yield per plant	0.417	20.316**	0.230

** Significant at 1% level of significance

Genotypic Coefficient of Variation (GCV) and Phenotypic Coefficient of Variation (PCV)

The studies on GCV and PCV indicated that the presence of high amount of variation and role of the environment on the expression of these traits. The magnitude of PCV was higher

than GCV for all the characters which may due to higher degree of interaction of genotype with the environment. Variability is classified as low if co-efficient of variation is <10%, medium (10-20%) and high (>20%) as proposed by Sivasubramaniam and Menon (1973). The estimates of PCV and GCV from present investigation in Table 2

Table 2: Estimation of genetic parameters for grain yield and other components in chickpea

Characters	GCV	PCV	Heritability (%)	Genetic Advance	Genetic Advance % mean
50% flowering	1.818	2.144	71.903	2.647	3.175
Maturity	36.75	36.943	98.956	28.188	75.308
Plant height	2.051	2.185	88.08	4.868	3.965
Primary Branches	20.084	20.95	91.908	1.087	39.664
Secondary Branches	24.935	25.135	98.413	3.422	50.957
Number of pods per plant	45.98	46.255	98.815	47.548	94.156
Number of seeds per Plant	16.808	18.215	85.149	0.504	31.95
Number of seeds per pod	26.467	27.217	94.563	11.456	53.018
100-seed weight	25.505	25.939	96.678	5.241	51.66
Pod setting	7.538	11.504	42.94	6.281	10.176
Biological yield	0.599	0.935	41.125	0.824	0.792
Harvest Index	24.473	24.988	95.917	11.448	49.374
Grain yield per plant	2.76	4.138	44.503	1.655	3.793

The estimates of GCV revealed that it ranged from 0.59 (biological yield) to 45.98 (number of pods per plant). GCV estimates were highest for number of pods per plant (45.98) followed by days to maturity (36.75), number of seeds per pod (26.467) 100 seeds weight (25.505), number of secondary branches (24.93), harvest index (24.473) followed by number of primary branches (20.08), moderate was for number of seeds per plant (16.808) while the low GCV observed for biological yield (0.599), days to 50% flowering (1.818), plant height (2.051), by grain yield per plant (2.76) and days to 50% pod setting (7.538).

The estimates of PCV revealed that it ranged from 0.935 (biological yield) to 46.255 (number of pods per plant). PCV estimates were highest for number of pods per plant (45.98) followed by days to maturity (36.94), number of seeds per

pod (27.217) 100 seeds weight (25.939), number of secondary branches (25.135), harvest index (24.98), number of primary branches (20.95), while the low PCV observed for days to biological yield (0.935) followed by days to 50% flowering (1.211), plant height (2.185), grain yield per plant (4.138) and the moderate PCV observed for moderate was for number of seeds per plant (18.815), days to 50% pod setting (11.504). Higher magnitude of PCV and GCV were recorded for number of pods per plant followed by days to maturity followed by number of seeds per pod, 100 seeds weight, number of secondary branches, harvest index.

High difference in GCV and PCV were found in days to 50% pod setting due to high environmental influence on these characters.

Similar finding for variance and its components were reported by Farshadfar *et al.* (2013), Ali *et al.* (2008), Sirohi *et al.* (2007) [3, 1, 10].

Heritability and Genetic advance

According to Burton and Devane (1953) [2] heritability in broad sense is ratio between genotypic variance to total variance. However, the proportion of this genotypic variability which is transmitted from parents to the progeny is reflected by heritability. Broad sense heritability determines the efficiency with which we can utilize the genotypic variability in a breeding programme.

In the present study, the heritability in broad sense (h^2) ranges from 41.125% in biological yield to 98.95% in days to maturity (Table 2). High estimate of heritability (above 60%) recorded for days to 50% flowering (71.90%) followed by number of seeds per plant (85.14%), plant height (88.08%), number of primary branches (91.90%), number of seeds per pod (94.56%), harvest index (95.91%), 100 seeds weight (96.67%), number of secondary branches (98.41%) number of pods per plant (98.81%), days to maturity (98.95%), while moderate estimate of heritability (30-60%) was found in biological yield (41.12%), followed by days to 50% pod setting (42.94%), grain yield per plant (44.50%).

In the present study, the GA % M ranged from 0.79% (biological yield) to 94.15% (number of pods per plant). It was low (below 10%) for days to 50% flowering (0.06%), followed by biological yield (0.79%), days to 50% flowering (3.175%), grain yield per plant (3.79%) and plant height (3.96%), while moderate GA% M (10-20) for days to 50% pod setting (10.17%), while high GA % M (above 20%) recorded in number of seeds per plant (31.95%), number of primary branches (39.66%), harvest index (49.37%), number of secondary branches (50.95%), 100 seeds weight (51.66%), number of seeds per pod (53.01%), days to maturity (75.30%) and number of pods per plant (94.15%).

Most of characters showed high heritability coupled with high GA % M was observed for number of pods per plant (98.81% and 94.15), days to maturity (98.95% and 75.30), number of seeds per pod (94.56% and 53.01), 100 seeds weight (96.67% and 51.66), number of secondary branches (98.41% and 50.95), harvest index (95.91% and 49.37), number of primary branches (91.90% and 39.66) and number of seeds per plant (85.14% and 31.95) whereas moderate heritability coupled with moderate GA% M was observed for days to 50% pod setting (42.94% and 10.17) and high heritability with low GA% M was for days to 50% flowering (71.90% and 3.175), plant height (88.08% and 3.96).

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