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Variability and Heritability in Selection Schemes of Desi Chickpea (*Cicer arietinum* L.)

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ABSTRACT

To study the variability of characters under different parameters in the four selection procedures of 20 progenies of chickpea cross viz., GJG 0719 x SAKI 9516 in F_5 generation in Desi chickpea (Cicer arietinum L.) an experiment was conducted at Junagadh Agricultural University. The analysis of variance revealed significant differences among the cross and selection procedures, respectively for all the traits with few exceptions. Moderate to high heritability and GCV coupled with high expected genetic advance as per cent of mean was observed for PS(EF) and RBP for biological yield per plant by PS(HY); for 100-seed weight by PS(EF) and for seed yield per plant by RBP which indicated the predominant role of additive gene action in the expression of these traits in particular selection schemes.

Key words: *Selection schemes, Variability, Heritability, Chickpea*

INTRODUCTION

Chickpea (*Cicer arietinum* L.) is one of the most important *Rabi* pulse crops of India and development of high yielding cultivars in this crop has received less attention by legume breeders. Chickpea being an autogamous crop most often simple crosses are made between selected pure lines and the segregating generations are handled by one or more of the conventional breeding methods such as pedigree selection, backcross method, bulk method *etc.* Selection is basically most important plant breeding method and its efficiency depends upon nature and amount of genetic variability present in breeding materials. This is influenced by the selection procedure followed as well as the relative importance given to the generations in which the procedure is to be adopted. With this view, the present experiment was planned to compare the relative efficacy of different selection procedures such as pedigree selection, single seed descent selection and random bulk population in F_5 generation in chickpea.

MATERIAL AND METHODS

The comparison of four selection procedures *viz*., pedigree selection for early flowering [PS(EF)], pedigree selection for high yield [PS(HY)], single seed descent (SSD) and random bulk population (RBP) were evaluated in F_5 generations of chickpea cross GJG 0719 x SAKI 9516.

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A total of 80 progenies (20 progenies in each selection scheme of cross) were evaluated in F_5 along with original F_2 and two parental lines during *Rabi* 2015-16 in Randomized Block Design (RBD) with three replications.

Single row plots were adopted for each of the 80 progenies and two parents were planted in two rows. The row length 3.0 m was used to accommodate 20 plants per row at 45 x 15 cm spacing. All the recommended agronomical practices along with necessary plant protection measure were followed timely for the successful raising of crop. Observations were recorded on five randomly selected plants in each entry and replication for ten characters *viz*., seed yield per plant, number of branches per plant, number of pods per plant, biological yield per plant, 100-seed weight and harvest index and their mean values were used for the statistical analysis. The genotypic coefficient (GCV) and phenotypic coefficient of variations (PCV) were estimated as per the formulae suggested by Burton[2], while heritability in broad-sense was calculated by using the formulae suggested by Allard[1].

RESULTS AND DISCUSSION

The analysis of variance in F_5 generation of a cross indicated that all the four selection procedures ([PS(EF)], [PS(HY)], SSD and RBP), two parents and F_2 population differed significantly for all the characters indicating sufficient genetic variability among all the four methods including parents and F_2 population.

A wider phenotypic range and coefficient range was noted among progenies from PS(EF) compared to other selection procedures for number of branches per plant (3.47 – 7.20, 34.96%) and 100-seed weight (13.47 – 21.88, 23.79%). Similarly, wider range was observed among lines derived from SSD for harvest index (30.03 – 57.30, 31.23%); RBP for number of pods per plant (41.33 – 75.67, 29.35%), seed yield per plant (7.68 – 12.67, 24.52%) and PS(HY) for biological yield per plant (21.26 – 36.09, 25.86%). The variation in phenotypic range for different quantitative characters in F_4 derived lines in F_5 generation could be attributed to the substantial change brought about by selection in genetic makeup of the crop through different selection procedures.

In the present experiment, the PS(EF) was found to be superior for seed yield per plant (10.10g) and harvest index (42.31%). PS(HY) was found less effective to rest of the selection procedures for number of branches per plant (4.84), number of pod per plant (50.27), 100-seed weight (14.63g) and seed yield per plant (9.02g). PS(HY), however, did not turn out to be superior in the cross for seed yield per plant in the present study. Such observations were reported in Pushpendra and Ram[13] as well as by Byth *et al*[3]., in chickpea. The effectiveness of early generation selection for seed yield was reported by Voigt and Weber[16], Leffel and Hanson[8] and Ivers and Fehr[5] in soybean which contradictory to the present findings.

The significantly better mean performance of SSD was observed for 100-seed weight (19.25g). For number of pods per plant, SSD (53.17) was found to be superior to PS(EF) (50.31) and PS(HY) (50.27). SSD (9.44) population was superior to PS(HY) (9.02) and RBP (9.29) for seed yield per plant. Thus, SSD seemed to be an effective alternative in case when it is not possible for a breeder to handle large segregating materials with limited resources. RBP was found superior for number of branches per plant (5.68), number of pods per plant (53.42), biological yield per plant (28.09).

Coefficient of variation measures the relative amount of variation for different characters by bringing various measure of dispersion on a uniform scale and are, therefore, comparable. The high values of GCV and PCV were observed with PS (EF) for 100-seed weight (11.97%, 13.38%); SSD for harvest index (14.52%, 22.39%); RBP for number of pods per plant (12.16%, 15.37%) and seed yield per plant (14.04%, 16.81%). The highest values of GCV (16.88%) and PCV (22.20%) were observed with RBP and SSD respectively for number of branches per plant. Likewise, the highest values of GCV (14.00) and PCV (17.69) was recorded in PS(HY) and PS(EF), respectively for biological yield per plant. Therefore, selection based on phenotypic performance would be effective for improvement of seed yield and its component traits by different selection procedures[9].

High heritability values was recorded for number of branches per plant in PS(EF) (69.15%) and RBP (65.55%); for number of pods per plant in RBP (62.63%); for biological yield per plant in PS(HY) (65.56%) and RBP (60.67%); for 100-seed weight in all four selection procedures *viz*., PS(EF) (80.03%), PS(HY) (90.14%), SSD (92.50%) and RBP (86.78%) and for seed yield per plant in RBP (69.75%). High heritability values for 100-seed weight was also reported by Salimath and Bahl[15]; Kumar *et al*[7].,; Gul *et al*[4].,; Monpara and Gaikwad[10]. Similarly, expected genetic advance as per cent of mean was high values for number of branches per plant in all selection procedures *viz*., PS(EF) (27.30%), PS(HY) (23.95%), SSD (20.47%) and RBP (28.14%); biological yield per plant in PS(HY) (23.36%); 100-seed weight per plant in PS(EF) (22.06%) and seed yield per plant in RBP (24.17%). High genetic advance for seed yield per plant was recorded by Muhammad *et al*[11]., and Gul *et al*[4]. High heritability accompanied with high expected genetic advance as per cent of mean was observed for number of branches per plant by PS(EF) (69.15% and 27.30%) and RBP (65.55% and 28.14%); for biological yield per plant by PS(HY) (65.56% and 23.36%); for 100-seed weight by PS(EF) (80.03% and 22.06%) and for seed yield per plant by RBP (69.79% and 24.17%). High heritability values for different traits coupled with high genetic advance revealed that additive gene action was important for these characters in respective selection schemes. High heritability along with high genetic advance was also noted for 100-seed weight and seed yield per plant by Muhammad *et al*[11].,; Saki *et al*[14].,; Kumar *et al*[6]., and Neelu Kumari *et al*[12].

Overall mean performance showed that PS(EF) was found superior for seed yield per plant and harvest index; SSD for 100-seed weight; RBP for number of branches per plant, number of pods per plant and biological yield per plant. High heritability along with moderate to high genetic advance as per cent of mean was observed in PS(EF) for number of branches per plant and 100-seed weight per plant; PS(HY) for biological yield per plant and RBP number of branches per plant and seed yield per plant. In general, it was observed that PS(HY) in cross either in combination with PS(EF) or SSD retained greater genetic variability, high heritability coupled with high expected genetic advance as per cent of mean for most of the traits in F_5 generation. Hence, these characters should be given top priority for further improvement of seed yield and yield components. As the results are based on one-year data, it can prove helpful in further experimentation.

Table 1: Phenotypic range, mean and variability parameters for various trait in F_5 generation of chickpea

Selection procedure	Phenotypic range	Coefficient of range (%)	Mean ± S.E.	PCV (%)	GCV (%)	h^2 (%)	GA (% mean)
Number of branches per plant							
PS (EF)	3.47-7.20	34.96	5.18 ± 0.31	19.16	15.94	69.15	27.30
PS (HY)	3.73-6.80	29.15	4.84 ± 0.35	19.92	15.21	58.38	23.95
SSD	3.60-6.67	29.89	5.29 ± 0.49	22.20	14.83	44.62	20.47
RBP	3.47-7.00	33.72	5.68 ± 0.39	20.84	16.88	65.55	28.14
F_2	2.33-3.67	22.33	2.70 ± 0.34	-	-	-	-
P_1	4.00-5.00	11.11	4.67 ± 1.11	-	-	-	-
P_2	3.00-5.00	25.00	4.20 ± 0.67	-	-	-	-
Number of pods per plant							
PS (EF)	38.33-60.00	22.04	50.31 ± 2.36	12.34	9.09	54.23	13.79
PS (HY)	41.33-61.67	19.75	50.27 ± 2.80	13.47	9.14	46.10	12.79
SSD	46.33-65.67	17.27	53.17 ± 2.92	11.81	6.67	31.87	7.75
RBP	41.33-75.67	29.35	53.42 ± 2.82	15.37	12.16	62.63	19.83
F_2	10.33-120.00	84.15	53.46 ± 9.79	-	-	-	-
P_1	40.67-52.00	12.33	47.60 ± 2.26	-	-	-	-
P_2	42.67-49.67	7.58	45.27 ± 2.72	-	-	-	-
Biological yield per plant (g)							
PS (EF)	18.63-31.17	25.18	24.46 ± 1.79	17.69	12.00	46.03	16.78
PS (HY)	21.26-36.09	25.86	27.33 ± 1.56	17.29	14.00	65.56	23.36
SSD	19.39-31.60	23.95	25.38 ± 1.69	16.31	11.22	47.30	15.89
RBP	24.16-36.64	20.53	28.09 ± 1.51	15.22	11.86	60.67	19.03
F_2	5.87-69.57	84.44	26.60 ± 3.34	-	-	-	-
P_1	18.85-24.33	12.89	21.59 ± 0.89	-	-	-	-
P_2	21.20-29.47	16.32	23.28 ± 3.57	-	-	-	-
100-seed weight per plant (g)							
PS (EF)	13.47-21.88	23.79	18.28 ± 0.62	13.38	11.97	80.03	22.06
PS (HY)	12.58-16.29	12.85	14.63 ± 0.18	7.10	6.74	90.14	13.18
SSD	16.20-21.13	13.21	19.25 ± 0.19	6.43	6.19	92.50	12.26
RBP	14.20-17.03	9.06	15.58 ± 0.18	5.67	5.28	86.78	10.14
F_2	19.60-27.50	16.77	23.71 ± 1.74	-	-	-	-
P_1	18.00-21.53	8.93	19.34 ± 0.66	-	-	-	-
P_2	18.87-25.00	13.97	22.02 ± 0.89	-	-	-	-
Seed yield per plant (g)							
PS(EF)	7.97-12.43	21.86	10.10 ± 0.61	14.20	9.33	43.20	12.63
PS(HY)	7.73-10.83	16.70	9.02 ± 0.50	12.50	7.73	38.21	9.84
SSD	7.33-11.83	23.49	9.44 ± 0.83	17.81	8.51	22.81	8.37
RBP	7.68-12.67	24.52	9.29 ± 0.48	16.81	14.04	69.79	24.17
F_2	3.27-18.16	69.48	9.05 ± 1.57	-	-	-	-
P_1	6.67-10.67	23.07	8.60 ± 0.81	-	-	-	-
P_2	6.67-9.00	14.87	7.67 ± 0.48	-	-	-	-
Harvest index (%)							
PS (EF)	33.06-53.85	23.92	42.31 ± 4.18	20.16	9.94	24.32	10.10
PS (HY)	28.38-40.56	17.67	33.62 ± 2.55	15.46	7.55	23.85	7.60
SSD	30.03-57.30	31.23	37.92 ± 3.64	22.39	14.52	42.08	19.41
RBP	26.81-40.82	20.72	33.40 ± 2.57	16.35	8.95	29.94	10.08
F_2	22.01-62.63	47.99	41.76 ± 4.24	-	-	-	-
P_1	33.41-43.65	13.29	39.57 ± 2.47	-	-	-	-
P_2	31.12-42.12	15.02	34.49 ± 4.90	-	-	-	-

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