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Variability Parameters in Highly Heterogeneous Populations of Pigeonpea

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Assessment of the genetic variability in the base population is the first step in any breeding programme. The knowledge of nature and magnitude of genetic variance controlling yield and its components is useful for deciding the breeding procedure to be followed improvement of a crop. The selection of superior plants commences from F_2 populations, therefore the information on genetic basis of expression of different characters in such populations provide better idea of practicing selection. The F_2 populations has not been studies earlier. An attempt was made in present study to evaluate individual F_2 plants from 45 F_2 populations.

Fourtyfive F_2 population were produced following a diallel cross involving 10 cultivars. These 45 F_2's were evaluated in a randomized block design with four replications at College Farm, GAU, Sardar Krushinagar. The plants were selected in each plot for recording observation for various traits in each F_2's, resulting forty plants per F_2. These 40 plants were used to compute different variability parameters on plant height (cm), number of braches per plant and seed yield per plant (g). Genotypic coefficient of variation and phenotypic coefficient of variation were worked out as per procedure of (Burton, 1952). The heritability (broad sense) and expected genetic advance were also worked out (Allard, 1960).

The differences among the genotypes were significant for all the characters studied. A wide range of variability existed for seed yield, number of pods, number of branches and plant height as evidenced by range (Table 1). The variance components, coefficients of variability, heritability and genetic advance are presented in Table 1. Character wise description is given below :

Plant height

Various populations exhibited high variability for plant height. It varied from short stature of 58 cm. to the tallest height of 190 cm. The variable population GAUT 82–99 x BWR 245 exhibited high mean height value (144.38) followed by GAUT 82-99 x ICPL 312 (118.48) ICPL 87 x H 76-208 (112.60), H 76-208 x ICPL 151 (110.95) and H 76-208 x ICPL 8306 (96.35).

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TABLE 1

Genetic parameters of four characters in pigeonpea.

F_2 populations	Plant height						Number of branches per plant					
	Range	Mean	PCV	GCV	h^2	GA (%)	Range	Mean	PCV	OCV	h^2	GA (%)
1. ICPL 269 X Pusa Sweta-2	72-140	100.80	19.34	13.25	46.96	18.70	2.10	5.55	38.91	28.77	54.72	43.86
2. ICPL 269 X ICPL 87	74-135	89.83	19.33	12.41	41.31	16.45	3-12	7.18	32.48	24.12	55.24	36.96
3. ICPL 269 X GAUT 82-99	65-140	110.60	19.81	15.01	57.40	23.42	1-12	4.63	48.69	38.64	63.24	63.43
4. ICPL 269 X H 76-208	72-120	95.50	17.92	10.08	31.65	11.68	2-8	5.80	31.52	22.21	49.70	32.28
5. ICPL 269 X ICPL 312	80-152	121.48	16.25	12.08	55.32	18.52	2-12	7.03	34.94	29.53	71.47	51.44
6. ICPL 269 X ICPL 151	58-120	90.50	19.63	12.90	43.22	17.48	3-13	6.30	34.14	14.46	17.92	12.60
7. ICPL 269 X ICPL 8306	81-135	95.68	17.06	8.29	23.56	8.28	2-15	6.90	42.77	38.18	79.68	70.20
8. ICPL 269 X BDN 31	105-155	125.48	13.34	8.08	36.76	10.10	2-14	7.38	41.01	36.58	79.58	67.23
9. ICPL 269 X BWR 245	90-146	119.75	12.77	8.08	20.69	5.54	3-11	6.03	36.73	29.05	62.65	47.40
10. Pusa Sweta-2 X ICPL 87	70-132	90.85	19.15	16.82	77.16	30.44	3-11	6.33	87.12	12.83	22.45	12.54
11. Pusa Sweta-2 X GAUT 82-99	80-157	117.70	19.30	17.41	81.34	32.34	1-11	5.98	34.84	87.12	60.74	43.59
12. Pusa Sweta-2 X H 76-208	100-160	136.68	14.96	13.22	78.04	24.05	4-18	8.03	41.33	38.30	86.00	73.22
13. Pusa Sweta-2 X ICPL 312	70-120	87.90	17.74	15.16	72.96	26.53	2-14	5.65	39.60	32.83	68.80	56.11
14. Pusa Sweta-2 X ICPL 151	72-110	85.35	13.59	9.35	47.28	13.24	3-10	6.73	33.84	18.38	29.54	20.59
15. Pusa Sweta-2 X ICPL 8306	74-145	97.28	19.25	16.42	72.78	28.86	4-12	7.40	32.93	28.08	72.72	89.33
16. Pusa Sweta-2 X BDN 31	67-140	96.18	100.31	13.84	71.99	24.48	3.-14	7.70	31.29	26.23	70.22	45.26
17. Pusa Sweta-2 X BWR 245	82-170	136.63	15.41	14.01	82.62	26.23	3-12	7.60	33.29	28.59	73.75	50.58
18. ICPL 87 X GAUT 82-99	69-110	91.10	10.88	5.60	26.47	5.93	3-12	6.75	43.97	38.58	76.96	69.70
19. ICPL 87 X H 76-208	72-170	112.10	24.78	23.46	88.20	45.02	2-11	6.60	38.33	32.32	71.04	56.09
20. ICPL 87 X ICPL 312	100-160	117.75	13.90	12.77	84.43	84.18	3-14	7.35	40.82	23.84	34.11	88.68

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
21. ICPL 87 X ICPL 151	67-100	82.55	12.12	8.92	54.23	13.54	2-12	5.03	43.34	17.56	16.46	14.70
22. ICPL 87 X ICPL 8306	85-164	108.25	13.69	11.25	67.50	19.04	2-9	5.70	35.58	25.84	52.69	38.79
23. ICPL 87 X BDN 31	64-120	83.53	13.65	11.05	65.52	4.33	3-10	6.45	32.17	23.36	54.96	36.42
24. ICPL 87 X BWR 245	90-160	130.85	12.93	11.67	81.48	21.70	3-13	7.45	34.61	29.01	70.23	50.07
25. GAUT 82-99 X H 76-208	88-152	120.88	16.48	14.03	75.18	25.05	3-8	5.45	29.07	20.43	49.40	29.58
26. GAUT 82-99 X ICPL 312	70-170	118.48	23.99	21.81	82.68	40.86	3-16	8.40	35.44	22.83	41.43	30.32
27. GAUT 82-99 X ICPL 151	65-160	91.60	16.81	13.93	68.73	23.80	3-13	7.25	43.81	35.70	62.03	53.98
28. GAUT 82-99 X ICPL 8306	68-108	92.20	13.87	8.73	39.67	11.33	3-14	7.38	34.42	30.54	78.75	55.83
29. GAUT 82-99 X BDN 31	70-130	92.70	13.58	10.04	54.50	15.27	2-11	6.03	34.55	28.09	66.28	47.17
30. GAUT 82-99 X BWR 245	62-190	144.38	21.58	20.67	91.74	40.78	3-13	7.88	25.43	20.42	64.59	33.84
31. H 76-208 X ICPL 312	92-145	110.50	12.09	9.67	63.94	15.92	3-9	5.08	32.58	24.90	58.39	39.19
32. H 76-208 X ICPL 151	82-153	110.75	22.82	21.55	89.15	41.92	2-17	7.78	44.12	37.58	72.64	66.02
33. H 76-208 X ICPL 8306	60-185	96.35	25.88	23.51	84.50	44.53	3-9	6.38	31.91	26.92	71.25	46.84
34. H 76-208 X BDN 31	80-140	115.43	16.05	14.40	80.32	26.56	3-14	7.93	29.48	25.72	72.19	46.26
35. H 76-208 X BWR 245	100-156	127.10	12.73	10.74	71.10	18.65	3-17	7.33	38.76	35.65	84.63	67.57
36. ICPL 312 X ICPL 151	60-105	85.85	14.17	11.90	70.56	20.60	2-13	6.38	34.75	20.19	33.80	24.20
37. ICPL 312 X ICPL 8306	62-100	81.38	12.45	7.22	53.68	8.64	2-9	5.05	35.01	36.37	61.02	44.00
38. ICPL 312 X BDN 31	60-97	74.28	13.64	10.52	59.57	16.74	4-15	7.45	40.09	37.00	85.20	70.36
39. ICPL 312 X BWR 245	86-165	131.68	13.76	12.67	84.86	24.05	8-14	8.00	31.39	28.03	79.71	51.54
40. ICPL 151 X ICPL 8306	67-118	94.58	14.80	11.71	62.60	19.08	2-10	4.80	47.23	28.18	35.60	34.64
41. ICPL 151 X BDN 31	62-100	81.13	10.84	6.83	39.66	8.86	2-9	5.43	38.23	16.78	20.69	16.29
42. ICPL 151 X BWR 245	100-170	147.05	8.68	7.07	66.30	11.85	3-14	9.20	33.77	27.26	65.18	45.34
43. ICPL 8306 X BDN 31	60-110	92.30	13.19	9.51	51.99	14.13	3-10	7.68	29.71	25.45	73.46	44.96
44. ICPL 8306 X BWR 245	82-153	123.23	16.79	15.13	81.26	28.11	3-15	10.43	27.47	25.13	83.78	47.41
45. BDN 31 X BWR 245	90-105	128.63	18.75	17.88	90.96	35.13	4.13	7.48	31.92	27.59	74.87	49.23
Ranges	58-190	83.53-147.05	8.68-25.58	5.60-23.51	20.69-91.74	4.33-45.02	1-18	4.63-10.43	25.43-48.64	12.83-38.64	16.46-86.00	12.60-73.22

TABLE 1 (Contd.)

F_2 Populations	No. of pods per plant						Seed yield per plant					
	Range	Mean	PCV	GCV	h^2	GA (%)	Range	Mean	PCV	OCV	h^2	GA (%)
1. ICPL 2698 X Pusa Sweta-2	50-217	153.25	42.33	38.39	82.70	72.11	16.3-76.9	38.7	37.13	25.10	45.72	34.97
2. ICPL 269 X ICPL 87	53-399	166.50	44.76	40.69	82.65	78.21	16.8-89.9	39.05	43.11	36.26	70.74	62.82
3. ICPL 269 X GAUT 82-99	28-330	130.15	48.50	38.79	63.96	63.90	10.0-60.8	31.36	55.58	49.08	77.96	89.26
4. ICPL 269 X H 76-208	15-299	107.23	54.53	42.75	61.46	69.04	7.2-59.1	23.51	46.86	21.12	20.31	19.61
5. ICPL 269 X ICPL 312	45-487	161.03	61.33	58.82	92.00	116.23	8.0-134.1	37.43	67.04	59.75	79.42	109.68
6. ICPL 269 X ICPL 151	22-357	128.50	59.37	54.81	85.23	104.24	8.8-109.1	34.35	63.69	54.59	73.48	96.41
7. ICPL 269 X ICPL 8306	50-275	119.85	40.31	29.23	52.58	43.66	14.8-125.9	38.26	57.22	53.34	86.91	102.44
8. ICPL 269 X BDN 31	33-281	147.90	48.61	44.43	83.53	83.73	10.0-117.2	45.40	58.75	54.94	86.87	105.13
9. ICPL 269 X BWR 245	10-244	124.58	44.95	40.46	81.01	75.01	6.0-78.6	32.54	49.35	44.08	79.78	81.11
10. Pusa Sweta-2 X ICPL 87	45-358	135.33	57.28	54.65	90.05	106.26	13.5-103.7	41.43	56.06	50.45	80.97	93.51
11. Pusa Sweta-2 X GAUT 82-99	12-282	143.65	44.62	39.38	77.91	71.61	10.0-91.2	36.19	54.39	47.82	77.56	86.75
12. Pusa Sweta-2 X H 76-208	34-332	150.33	54.27	50.15	85.42	95.50	7.0-92.5	38.95	59.38	51.43	75.03	91.78
13 Pusa Sweta-2 X ICPL 312	12-303	111.98	49.99	46.41	86.19	88.73	11.2-90.0	35.63	49.9	43.18	77.36	78.23
14. Pusa Sweta-2 X ICPL 151	61-232	137.73	36.56	32.66	79.80	60.10	11.0-88.7	38.11	38.82	30.17	62.00	49.58
15. Pusa Swerta-2 X ICPL 8306	35-243	101.73	43.22	33.69	60.77	54.11	10.0-100.0	32.55	68.68	62.78	83.51	118.15
16 Pusa Sweta-2 X BDN 31	46-406	154.65	45.69	43.32	89.89	84.61	10.7-90.8	42.97	43.69	30.89	50.00	45.00
17. Pusa Sweta-2 X BWR 245	38-343	187.93	44.06	43.26	96.38	87.48	9.2-127.0	49.44	49.88	43.59	76.37	78.47
18. ICPL 87 X GAUT 82-99	70-359	141.40	38.24	29.84	60.91	47.98	20.5-114.9	40.47	42.08	36.50	75.23	65.21
19. ICPL 87 X H 76-208	62-530	178.25	48.53	44.45	83.89	83.84	5.8-146.2	40.79	62.96	57.76	84.17	109.16
20. ICPL 87 X ICPL 312	44-566	204.60	53.51	52.00	94.43	104.09	15.2-83.5	35.87	47.47	41.31	75.72	74.05
21. ICPL 87 X ICPL 551	37-203	123.63	35.04	27.18	60.18	43.44	12.6-63.7	36.50	38.31	32.58	72.35	57.10
22. ICPL 87 X ICPL 8306	47-383	160.35	51.59	47.11	83.38	88.61	5.1-82.5	34.87	52.51	48.15	84.08	90.95
23. ICPL 87 X BDN 31	67-337	152.48	35.74	30.97	75.08	55.28	12.1-100.5	37.46	47.31	40.42	73.03	71.17

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
24. ICPL 87 X BWR 245	41-377	175.05	45.54	43.77	92.40	88.68	5.4-87.4	44.21	44.63	42.11	89.02	81.82
25. GAUT 82-99 X N 76-208	37-345	152.98	43.40	35.26	66.03	59.03	6.2-113.2	37.03	54.87	48.64	78.58	88.82
26. GAUT 82-99 X ICPL 312	38-581	225.65	46.81	44.75	91.40	88.14	22.6-138.8	62.38	44.45	40.47	90.20	78.88
27. GAUT 82-99 X ICPL 151	27-340	133.00	51.70	45.67	78.03	83.10	12.8-141.7	43.29	60.12	58.48	94.60	117.16
28. GAUT 82-99 X ICPL 8306	44-644	200.35	53.80	50.74	88.94	98.57	11.2-141.3	43.78	53.02	51.05	92.74	102.29
29. GAUT 82-99 X BDN 31	21-292	152.95	40.38	34.49	72.96	60.56	12.2-66.7	38.57	38.85	32.37	69.42	55.56
30. GAUT 82-99 X BWR 245	45-406	163.78	55.67	53.00	90.68	103.86	11.3-114.2	42.49	50.03	48.53	94.09	96.98
31. H 76-208 X ICPL 312	20-537	212.13	45.36	42.78	88.96	83.13	15.6-94.9	45.62	38.86	31.99	67.77	54.25
32. H 76-208 X ICPL 151	25-346	142.03	58.11	53.21	83.83	100.35	7.0-103.8	37.49	63.49	58.55	85.00	111.17
33. H 76-208 X ICPL 8306	62-472	192.38	50.29	46.53	85.60	88.68	10.0-115.0	40.2	55.71	50.80	83.19	95.47
34. H 76-208 X BDN 31	52-488	147.50	54.01	49.13	82.73	98.05	12.5-91.8	36.49	51.03	41.67	66.67	70.08
35. H 76-208 X BWR 245	52-531	179.30	46.94	44.07	88.17	85.26	9.0-158.1	39.84	63.17	59.38	88.37	115.00
36. ICPL 312 X ICPL 151	47-281	124.60	53.00	49.46	87.07	95.06	9.6-76.0	54.46	43.72	38.51	77.57	69.86
37. ICPL 312 X ICPL 8606	32-334	119.13	39.06	30.91	62.58	50.35	8.1-83.4	34.6	50.43	46.08	83.50	86.74
38. ICPL 312 X BDN 31	32-188	120.28	49.06	44.96	84.01	84.90	6.8-80.0	28.1	63.60	54.80	74.42	96.50
39. ICPL 312 X BWR 245	46-332	161.28	42.45	41.06	93.60	81.85	8.4-112.4	42.08	58.84	56.86	93.38	113.19
40. ICPL 151 X ICPL 8306	33-320	101.63	56.23	51.46	83.76	97.02	10.0-91.3	37.24	38.02	55.88	92.74	110.82
41. ICPL 151 X BDN 31	20-220	101.30	51.07	32.66	63.25	53.51	5.8-56.8	26.12	59.29	44.62	67.57	82.53
42. ICPL 151 X BWR 245	65-375	184.60	41.77	40.42	93.60	80.54	11.6-105.0	46.27	52.17	51.11	96.00	103.17
43. ICPL 8306 X BDN 31	45-302	148.43	38.16	32.53	72.65	57.11	11.7-80.6	33.72	52.42	46.70	79.36	85.69
44. ICPL 8306 X BWR 245	63-453	236.43	38.03	36.52	92.26	72.28	10.0-137.6	54.08	53.13	52.40	97.27	106.46
	43-271	130.38	46.77	41.82	79.99	77.07	14.0-118.9	41.41	72.42	70.22	94.01	140.25
Ranges	10-644-	101.3-236.43	35.04-61.33	27.18-58.82	20.31-96.38	43.44-116.23	5.1-158.1	25.51-62.38	37.13-72.42	21.12-70.22	21.12-97.27	19.61-140.25

These crosses exhibited high PCV as well as GCV coupled with high heritability and moderate genetic advance among respective F_2's. This suggest that simple selection would not be effective for the improvement of this character.

Number of branches per plant

The magnitude of variability for branches per plant in the F_2's was of high order. The number of branches varied from 1 to 18. It was more prominent in Pusa Sweta 2 x H 76–208 (4.18) and H 76–208 x BWR 245 (3-17) with mean values of 8.03 and 7.33, respectively.

The estimates of phenotypic and genotypic coefficients of variability were highest in cross ICPL 269 x GAUT 82-99 followed by ICPL 87 x GAUT 82-99. Pusa Sweta 2 x H 76-208, ICPL 269 x ICPL 8306 and ICPL 269 x BDN 31 along with high heritability and high genetic advance. This suggested the effectiveness of selection for this character based on phenotypic performance.

Number of pods per plant

A wide range for pods per plant from minimum value of 10 (ICPL 269 x BWR 245) to maximum of 644 (GAUT 82-90 x ICPL 8306) was observed among 45 F_2's. The values of phenotypic as well as genotypic coefficient of variability were highest in crosses ICPL 269 x ICPL 312 followed by ICPL 269 x ICPL 151, Pusa Sweta x ICPL 87, H 76–208 x ICPL 151 and GAUT 82–99 x BWR 245. These corsses also exhibited high heritability coupled with high genetic advance. These crosses, therefore, would enhance chances for selection.

Seed yield per plant

The seed yield per plant of 45 F_2 populations exhibited wide range of variability. It ranged from 5.1 g. to 158.1 g. The F_2 of H 76-208 x BWR 245 showed maximum range (9.0 g. — 158.1 g.) with mean yield of 39.84 g. The highest mean yield of 62.89 g. was recorded by GAUT 82-99 x ICPL 312. The estimate of phenotypic and genotypic coefficient of variation were high in respect of all the F_2 populations. The highest phenotypic and genotypic coefficients of variation were noticed in BDN 31 x BWR 245. The other variable F_2's were Pusa Sweta 2 x ICPL 8306, ICPL 269 x ICPL 312, H 76–208 x BWR 245, H 76–208 x ICPL 151 and GAUT 82-99 x ICPL 151. These F_2 populations would increase the scope for selection and isolation of high yielding segregants.

The most variable F_2's discussed earlier for the character such as number of pods, number of branches and seed yield, exhibited high heritability alongwith high genetic advance, indicated the effectiveness of selection. The condition appears due to additive gene action, thereby, indicating that selection based on phenotypic performance can be effectively exercised in this material for genetic improvement of these characters with a satisfactory degree of accurancy. Results of Rathnaswamy *et al.* (1973) and Gupta *et al.*, (1975) confirmed the present findings. Shoram (1983) had also reported similar results for number of pods per plant and plant height.

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