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Research Notes

Studies on genetic variability in F_2 population of pigeon pea

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Pigeonpea (*Cajanus cajan* (L.) Millsp.) is grown in tropical and subtropical regions. It is one of the major food legumes of the world and is cultivated in about 50 countries. In India, it is the second important legume crop and it provides protein rich diet to the poor people of the country. In India, pigeonpea is cultivated in an area of 3.73 million hectares with a production of 2.12 million tons and with a productivity of 569 kg per hectare during the year 2002-2003 (Anon, 2003). In India, it is grown in the states of Maharashtra, Uttarpradesh, Madhyapradesh, Andhrapradesh, Gujarat, Karnataka, Orissa, Bihar, Tamil Nadu and Jharkhand. In Tamil Nadu, pigeonpea is cultivated in an area of 0.06 million hectares with a production of 0.04 million tons and with a productivity of 658 kg per hectare during the year 2002-2003 (Anon, 2003). Breeder should have the basic information about genetic variability which is a pre-requisite to select desirable genotypes. Crop improvement depends on the magnitude of genetic variability and to the extend to which the desirable characters are heritable. An effective breeding programme could also be planed on the basis of these informations.

Six F_2 populations of the selected hybrids were raised during January, 2004 at Millet Breeding Station, Tamil Nadu Agricultural University, Coimbatore. Each F_2 populations were sown on ridges and furrows in a single row of 5m length with a spacing of 60 x 45 cm, unreplicated. A total of 10 plants per row was uniformly maintained. Each F_2 population consisted of more than 300 plants. The recommended packages of practices as per crop production guide (Anon, 1999) were followed throughout the crop growth.

Observations were taken on each plant in every F_2 population for days to 50 per cent flowering, days to maturity, plant height, number of primary branches per plant, number of clusters per plant, number of pods per plant, pod length, number of seeds per pod, 100 seed weight and seed yield per plant. Their mean values were utilized for statistical analysis, to study the variability (PCV and GCV), heritability, genetic advance and genetic advance as percentage of mean in different F_2 populations. The estimates of variability parameters were worked out in F_2 generation according to the method suggested by Empig *et al* (1970).

The results on genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), heritability, genetic advance and genetic advance as per cent of mean for the F_2 population of six selected cross combination are presented in Table 1 to 3. Among the six crosses studied, for days to fifty per cent flowering, days to maturity and pod length, the GCV and PCV values were low. The performance for plant height in the cross LRG 41 X ICPL 332 expressed high PCV (25.97) and GCV (24.74) whereas in the remaining crosses recorded moderate PCV and GCV values were observed. The

Table 1. Phenotypic and Genotypic coefficient of variation (PCV and GCV), Heritability, Genetic Advance (GA) and GA as per cent of mean for the F_2 populations.

Crosses	Days to 50% flowering	Days to maturity	Plant height (cm)	No.of primary branches plant^{-1}	No.of clusters plant^{-1}	No.of pods plant	Pod length (cm)	No.of seeds pod^{-1}	100 seed weight (g)	Seed yield plant^{-1} (g)
CO5 x ICPL 322										
PCV	8.70	4.22	19.71	24.07	45.74	62.96	9.52	26.42	14.15	46.55
GCV	8.67	4.20	13.70	18.35	35.24	34.69	7.82	25.92	13.88	44.90
Heritability (%)	99.65	99.52	69.50	76.23	77.04	55.09	82.14	98.10	98.09	96.45
GA	14.70	11.69	13.93	2.01	17.5	31.81	0.53	1.29	1.85	5.35
GA as % Mean	17.82	862	19.63	16.37	17.75	39.38	13.23	52.38	28.05	58.66
CO5 x ICPL 87119										
PCV	9.77	2.49	18.59	22.79	68.01	70.25	9.54	26.40	11.14	46.55
GCV	8.24	2.35	14.59	13.55	59.28	65.42	7.84	25.90	7.25	44.90
Heritability (%)	84.29	94.15	78.48	59.45	87.16	93.12	82.18	98.10	65.15	96.45
GA	15.25	20.20	10.25	1.72	10.49	9.55	0.55	1.27	1.04	2.05
GA as % Mean	18.78	14.28	13.06	16.60	14.40	10.76	13.25	52.36	20.09	22.52
VRG17 x ICPL 332										
PCV	7.41	6.20	19.61	24.08	45.73	43.18	10.37	33.18	21.12	58.01
GCV	6.75	5.84	15.16	9.82	40.98	35.43	9.51	20.55	12.11	45.26
Heritability (%)	91.01	96.99	77.30	40.81	89.16	82.05	91.73	61.93	57.33	78.02
GA	10.56	14.25	9.48	1.01	9.92	15.25	0.70	0.55	1.85	2.59
GA as % Mean	12.58	10.23	10.49	8.264	10.06	13.54	17.97	26.21	31.83	32.54
CO6 x ICPL 332										
PCV	8.73	4.64	13.27	24.05	45.73	70.24	8.91	26.87	13.39	59.29
GCV	18.7	4.28	11.6	9.82	3.75	60.90	4.15	22.22	12.82	26.62
Heritability (%)	99.65	92.27	83.34	40.85	67.24	86.83	46.57	82.69	95.74	49.03
GA	14.73	19.24	12.89	1.95	12.40	15.25	1.02	0.69	1.38	2.10
GA as % Mean	17850	13.37	14.45	15.85	12.58	17.18	23.44	37.850	25.281	26.880

Contd...

Table 1. Contd...

Crosses	Days to 50% flowering	Days to maturity	Plant height (cm)	No.of primary branches plant^{-1}	No.of clusters plant^{-1}	No.of pods plant	Pod length (cm)	No.of seeds pod^{-1}	100 seed weight (g)	Seed yield plant^{-1} (g)
LRG 41 x ICPL 322										
PCV	4.68	3.82	25.97	23.21	45.71	43.16	9.59	35.07	23.27	25.38
GCV	4.51	3.79	24.47	16.69	36.75	35.28	9.03	31.82	19.21	20.21
Heritability (%)	96.26	99.16	94.22	71.90	80.39	81.74	94.16	90.73	82.55	79.62
GA	12.17	25.35	44.88	2.797	25.3	30.5	0.791	1.052	1.831	2.084
GA as % Mean	15.18	17.64	47.52	24.73	25.67	27.08	17.52	59.47	32.68	31.10
LRG 41 x ICPL 87119										
PCV	8.06	3.21	17.24	22.77	68.01	43.17	10.30	26.39	23.25	25.36
GCV	7.25	2.89	15.95	13.53	50.87	38.17	7.37	25.89	19.22	22.10
Heritability (%)	89.95	90.03	92.54	59.42	74.79	88.41	71.63	98.10	82.66	87.14
GA	15.28	24.56	13.87	1.724	18.14	31.63	0.825	1.280	1.830	2.250.
GA as % Mean	18.61	17.89	13.81	16.58	24.91	28.09	17.40	52.36	32.68	33.48.

number of primary branches per plant in all the crosses showed high PCV and moderate GCV values were noticed for this trait. The characters *viz.*, number of clusters per plant, number of pods per plant and number of seeds per pod in all the crosses exhibited high PCV and GCV values. For the trait hundred seed weight, all the crosses exhibited high PCV values, except CO5 X ICPL 332, CO5 X ICPL 87119 and CO6 X ICPL 332 combination which showed moderate PCV values. The GCV and PCV values were higher in all the cross combinations for seed yield per plant, except in the cross combinations LRG 41 x ICPL 332 and LRG 41 x ICPL 87119 where the PCV and GCV values were found to be moderate.

Estimates of heritability, genetic advance and genetic advance as percentage of mean are furnished in Table 1 to 3 .The F_2 population of the cross combination CO 5 x ICPL 332 showed high heritability values for all the characters except number of pods per plant where moderate heritability was observed. The genetic advance as percentage of mean ranged from 8.62 to 58.66 per cent, being highest for seed yield per plant (58.66 per cent) followed by number of seeds per pods (52.38 per cent), number of pods per plant (39.38 per cent) and hundred seed weight (28.05 per cent). Among the characters studied, high heritability and high genetic advance as percentage of mean was observed for three characters *viz.*, seed yield per plant, number of seeds per pod and hundred seed weight.

The F_2 population of the particular cross combination (CO 5 x ICPL 87119) showed high heritability values for all the ten characters, except number of primary branches per plant where moderate heritability was noticed. Number of seeds per pod recorded the highest genetic advance as percentage of mean (52.36 per cent) followed by seed yield per plant (22.52 per cent) and hundred seed weight (20.09 per cent). While for remaining characters low to moderate genetic advances as percentage of mean were observed. Among the characters studied high heritability and high genetic advance as percentage of mean were observed for seed yield per plant and number of seeds per pod.

The F_2 population of the cross combination VRG 17 x ICPL 332, for all the characters recorded high heritability values, except hundred seed weight and number of primary branches per plant showing moderate heritability values of 57.33 and 40.81 per cent, respectively. High heritability and high genetic advance as percentage of mean were noticed for seed yield per plant in the F_2 population of this cross combination.

The cross combination CO 6 x ICPL 332, showed high heritability values for all the characters, except for primary branches per plant (40.85 per cent), pod length (46.57 per cent) and seed yield per plant (49.03 per cent). Number of seeds per pod exhibited high heritability with high genetic advance as percentage of mean in this particular F_2 population. The F_2 population (LRG 41 x ICPL 332) under study showed high heritability values for all the characters. Among the characters, plant height, number of seeds per pod and hundred seed weight recorded high heritability values with high genetic advance as percentage of mean. In the F_2 population of the cross combination LRG 41 x ICPL 87119, all the characters were observed to possess high heritability values, except number of primary branches per plant in which moderate heritability of 59.42 per cent was obsrved. Among the characters studied, high heritability and high genetic advance as percentage of mean was noticed for number of seeds per pod, hundred seed weight and seed yield per plant in this cross combination.

In the F_2 population of the cross combination CO 6 x ICPL 332, highest GCV value of 18.70 per cent was recorded for days to 50 per cent flowering. In general, the variability in the F_2 populations studied showed lower values for duration.

For number of branches in the F_2 population of the cross combination LRG 41 x ICPL 332, the maximum GCV of 16.69 was recorded. Variability for number of clusters per plant in the F_2 population of CO 5 x ICPL 87119 with a GCV of 59.28 was noticed and high heritability value of 87.16 per cent but with a low genetic advance (14.40) was recorded for this trait. Hence in this particular F_2 population selection could be exercised to get segregants with higher number of clusters per plant by inter mating the plants of the F_2 population concerned.

Highest variability of 74 to 101 days was observed in the F_2 population of the cross combination CO 6 x ICPL 332, in which highest GCV value of 18.70 was also recorded for days to 50 per cent flowering. Similarly for days to maturity the F_2 population of the cross combination CO 5 x ICPL 332 showed the highest range of variability i.e.123 to 148 days. Similar results were also observed by Deshmukh *et al.* (2000) and Patel and Patel (1998) in their material studied. In

general, the variability in the F_2 populations studied for duration is low. A high amount of variability in the F_2 populations for plant height i.e. from 45.4 to 143.5 cm could be observed which indicates that selection could be exercised for dwarf and tall types utilizing the F_2 populations of the present study. The range of variability for number of branches in the F_2 populations was from 5 to 16. In the F_2 population of the cross combination LRG 41 x ICPL 332 a maximum GCV of 16.69 was observed. Variability for number of clusters per plant was very high ranging from 30 to 200 and the F_2 population of CO 5 x ICPL 87119 recorded a range of 30 to 180 for this trait with a GCV of 59.28 and a high heritability value of 87.16 per cent with a low genetic advance (14.40 per cent). Hence in this particular F_2 population selection could be exercised to get segregants with higher number of clusters per plant after inter mating the plants in the F_2 population.

A very high variability for number of pods per plant was observed in the F_2 populations of the present study i.e. from 24 to 250 pods per plant. The F_2 population of the cross CO 5 x ICPL 87119 with highest GCV showed a range from 24 to 213 pods per plant with a high habitability value of 93.12 per cent, but the genetic advance was the lowest for this F_2 population, hence inter mating in the F_2 population will help to improve this trait. Similar results were also reported by Venkateswaralu (2001) and Mane *et al* (2003) for improvement of this trait. The character pod length showed a very low variability in the F_2 populations studied. The number of seeds per pod ranged from 1 to 4 in the F_2 populations of the present study. For hundred seed weight, the highest variability was observed in the F_2 population of the cross LRG 41 x ICPL 332 (4.23 to 8.40g) and a high heritability (82.55 per cent) with a genetic advance of 32.68 per cent was observed, which indicated that in this particular F_2 population, selection could be exercised to get segregants with improved seed weights, which is in conformity with the results obtained by Patel and Patel (1998) and Deshmukh *et al* (2003) in the material studied by them. The F_2 populations of three crosses showed wide variability for seed yield per plant i.e. CO 5 x ICPL 332, VRG 17 x ICPL 332 and CO 6 x ICPL 332 ranging from 5.0 to 22.28g per plant. GCV was higher in the F_2 populations of CO 5 x ICPL 332 and VRG 17 x ICPL 332 along with high heritability and high genetic advance as per cent of mean. Hence the F_2 populations of the cross combinations CO5 x ICPL 332 and VRG 17 x ICPL 332 will be very useful in future breeding programmes to develop genotypes with higher seed yield per plant. Highest variability, heritability and genetic advance for yield per plant has also been reported by Natarajan *et al.* (1999), Venkateswaralu (2001) and Mane *et al.* (2003) in their studies.

The variability studies in selected F_2 populations indicated that for number of clusters per plant and pods per plant, the hybrid combination CO 5 x ICPL 87119 showed the highest variability i.e highest GCV and higher heritability values, but a lower genetic advance. Hence it is suggested that this particular cross combination can be utilized, provided intermating of selected F_2 plants are first made and then selection exercised to improve this trait in the later generations. The F_2 population of LRG 41 x ICPL 332 showed a high variability, heritability and genetic advance for hundred seed weight and in this particular population selection can be exercised, following pedigree breeding method, to improve

seed weight. The F_2 populations of CO 5 x ICPL 332 and VRG 17 x ICPL 332 possessed higher GCV, heritability and genetic advance for yield *per se* and these populations will be of much use to improve seed yield per plant in future through pedigree breeding procedure.

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Research Notes

Gamma ray induced variation for lodging resistance and its associated characters in littlemillet (*Panicum sumatrense* Rothex-Roem and Schult)

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Being a self pollinated crop, the variability in littlemillet is less. Most of the released strains were evolved through mass selection or pureline selection methods. Breeding of new varieties by hybridization has not been very successful because of the difficulties encountered in the manipulation of the tiny spikelets on brittle pedicels. In view of the above situation, mutation breeding can complement the conventional breeding methods in the improvement of littlemillet. Inducing variability in the base population and applying selection