The Andhra Agric. J 67 (3): 152-156, 2020

Genetic Variability Studies Among Yield and Yield Component Traits in Pigeonpea [*Cajanus cajan* (L.) Millsp.]

Nidhi Mohan, J Dayal Prasad Babu, C V Sameer Kumar and V Srinivasa Rao
Acharya N G Ranga Agricultural University, Guntur, Andhra Pradesh.

ABSTRACT

The present investigation was taken up to study genetic variability, heritability and genetic advance in 28 pigeonpea genotypes.High PCV and GCV were recorded for number of primary branches per plant, number of secondary branches per plant and pollen fertility %. Meanwhile medium PCV and GCV were recorded for number of pods per plant, pod weight per plant, 100 seed weight and grain yield per plant. Low value of PCV and GCV was recorded for days to 50% flowering, days to maturity and plant height. The estimates of heritability and genetic advance as per cent of mean were high for the characters *viz.,*number of primary branches per plant, number of secondary branches per plant, number of pods per plant, pod weight per plant, 100 seed weight, grain yield per plant and mean pollen fertility %. High heritability with low genetic advance as per cent of mean was seen in days to 50% flowering and days to maturity. While, moderate heritability and low genetic advance as per cent of mean was recorded in plant height.

Keywords: *Genetic variability, Heritability, Genetic advance and Pigeonpea.*

As world is pacing against time to adapt with changing climate, Pigeonpea once termed 'orphan crop' is now attracting global attention. This climate-smart crop is boon to millions of resource poor farmers in arid and semi-arid regions of the world as it requires less water, enriches soil, withstands weather variability and is packed with nutrients. This crop provides more nutrition per drop not only for humans and livestock but for soil as well through its nitrogen fixing ability.The global pigeonpea area, production and yield in 2013 was approximately 6.23 M ha, 4.74 M T and 762.4Kg ha^{-1} respectively (FAOSTAT 2015). The major producers of pigeonpea are India (63.74% of global production), Myanmar (18.98%), Malawi (6.07%), Tanzania (4.42%) and Uganda (1.98%). In India pigeonpea was cultivated on 5.06 M ha with a total production of 3.29MT and yield of 649.9 Kg ha^{-1} during 2014 (FAOSTAT, 2015). The leading states in pigeonpea production are Maharashtra (0.259 M T), Karnataka (0.51 M T), Madhya Pradesh (0.39 M T), Uttar Pradesh (0.259 M T), Gujarat (0.258 M T) and Jharkhand (0.19 M T). These six states account for 84% of the total production in India during 2014-15 (E-Pulse Data Book, 2016.).

Pigeonpea is mostly consumed as dry split dhal besides several other uses of various parts of pigeonpea plant. Pigeonpea is rich in essential amino acids and high in protein bioavailability (20-22%) among pulses. The high dietary fiber in pigeonpea lowers risk of diabetes, heart ailments and gastrointestinal diseases. Pigeonpea also provide substantial amount of micronutrients such as vitamin E, vitamin B_6, folic acid, iron, potassium, magnesium, calcium, phosphorous, sulfur and zinc. India is home to 194.6 million undernourished people, making malnutrition a national emergency. In such situation pigeonpea comes to the rescue of millions of people from clutches of chronic malnutrition as it is a cheap and easily accessible source of protein for majority of vegetarian population. However, stagnant productivity coupled with declining availability in the recent times has created substantial demand supply gap, forcing heavy import bill on the exchequer and threatening nutritional security of majority of the population for whom pulses are the cheapest source of protein. Despite the fact that a large number of high yielding varieties have been released, productivity of the crop could not be improved over 750 kg ha^{-1} as compared to its potential yield (2500-3000 kg ha^{-1}). Non adoption of improved management practices and lack of proper research and commercial perspective for the crop have turned out to be the major culprits for low productivity and production.

Since the horizontal increase in the area under pigeonpea cultivation is unlikely, the only option left for ensuring ever increasing production and productivity of pigeonpea is adoption of new breeding methods like heterosis breeding. Hybrid breeding technology is expected to enhance the production by a margin of 30% or more, thereby shattering the yield plateau. As such before launching any breeding programme, a thorough knowledge of the nature and magnitude of genetic variability, heritability and genetic advance as per cent of mean is very essential. Heritability of a metric trait is a parameter of particular significance to the breeder as it measures the degree of resemblance between the parents and the off springs. Its magnitude indicates the heritability with which a genotype can be identified by its phenotypic expression while genetic advance aids in exercising the necessary selection pressure. The present study was conducted to assess magnitude of the genetic variability, heritability and genetic advance with regard to yield and yield attributes in pigeonpea.

MATERIAL AND METHODS

The experimental material consisted of 28 pigeonpea genotypes grown in randomized block design with three replications during *kharif* 2015, at International Crops Research Institute for Semi-Arid Tropics, Patancheru (17º 53' N lat., 78º 27' E long. and 545 m amsl.). An inter and intra row spacing of 150 and 60 cm was followed and crop was line sown. The plot size was 18.9 cm^2 and consisted of three rows, each of 4.2 m in length. The main characters under focus in this study were days to 50% flowering, days to maturity, plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of pods per plant, pod weight per plant (g), 100 seed weight (g), grain yield per plant (g) and mean pollen fertility %. Genetic parameters of variability *viz.,* phenotypic variance, genotypic variance, heritability and genetic advance were estimated using the formula suggested by Singh and Chaudhary (1977).

RESULTS AND DISCUSSION

The analysis of variance (Table 1) revealed significant differences among the genotypes for all the characters indicating the presence of ample variability among the genotypes. Similar findings were reported by Bhadru (2008), Rekha *et al.* (2013), Kumar *et al.* (2014) and Pandey *et al.* (2015). The mean performance of 28 pigeonpea genotypes is shown in Table 2. The greatest variation was observed in number of pods per plant (ranged from 363.66 to 769.90) followed by number of secondary branches per plant (19.60 to 84.60) and grain yield per plant (102.24 g to 229.68 g). The highest mean performance for grain yield per plant along with some of the component traits was exhibited by ICPH 3762 followed by ICPH 4502 and ICPH 4395.

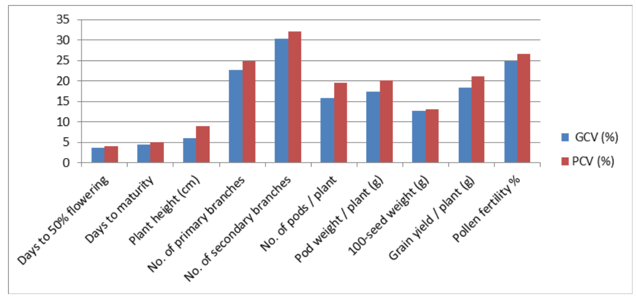

Fig. 1 Genetic variation in yield parameters of pigeonpea

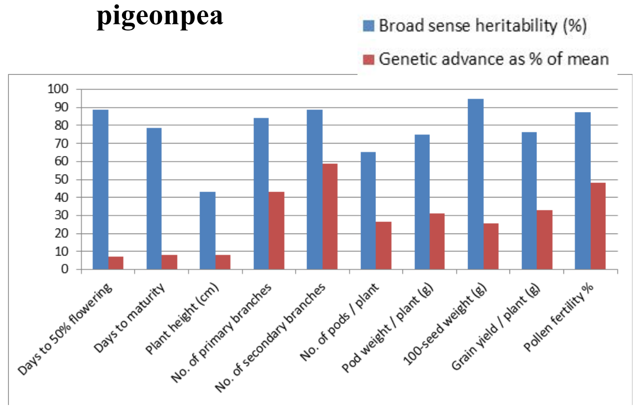

Fig. 2 Heritability and genetic advance as per cent of mean in pigeonpea

Table 1. Analysis of variance (ANOVA) for yield, yield components and pollen fertility (%) in pigeonpea.

CHARACTER	SOURCE OF VARIATION		
	Repilcation [2]	Treatment [27]	Error [54]
Days to 50% flowering	24.14**	38.72**	1.55
Days to maturity	9.48	175.44**	14.59
Plant height (cm)	1303.74**	446.42**	136.42
Number of primary branches / plant	16.29*	83.42**	4.89
Number of secondary branches / plant	22.86	809.50**	32.7
Number of pods / plant	2289.73	23776.05**	3560.4
Pod weight / plant	127.62	4995.56**	506.15
100 Seed weight	0.75**	6.86**	0.13
Grain yield / plant	162.35	2264.05**	214.33
Pollen fertility %	486.06**	1131.25**	51.34

*,** significant at 5% and 1% probability levels, respectively., Values in paranthesis represents degrees of freedom.

Table 2. Mean performance of pigeonpea genotypes for yield, yield components and pollen fertility (%)

Genotypes	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of primary branches	No. of secondary branches	No. of pods / plant	Pod weight / plant (g)	100 Seed weight (g)	Grain yield / plant (g)	Pollen fertility (%)
ICPH 3933	91.00	159.00	174.00	19.73	39.40	429.53	196.13	13.22	119.37	86.33
ICPH 2671	90.00	155.66	160.80	23.00	51.70	560.60	198.26	11.07	121.62	90.33
ICPH 2740	95.33	166.66	191.00	31.20	50.60	523.66	192.93	12.04	135.19	88.66
ICPH 3477	98.33	173.66	183.33	25.93	54.00	480.06	235.69	12.46	162.40	84.21
ICPH 2751	95.33	172.66	172.00	25.60	62.26	402.00	152.16	11.62	109.16	86.99
ICPH 3461	97.00	176.33	168.80	29.33	74.40	493.86	219.20	10.45	149.80	86.99
ICPH 3762	96.33	173.00	168.53	27.60	84.10	769.90	337.65	10.89	229.68	86.44
ICPH 3337	94.00	164.66	163.00	28.70	62.20	495.66	247.70	10.40	151.83	55.55
ICPH 3473	91.00	155.66	163.53	18.13	51.50	614.13	214.00	10.28	131.36	87.77
ICPH 4395	89.33	162.66	168.86	14.86	44.06	583.53	265.77	12.96	170.70	59.99
ICPH 4485	93.33	167.33	191.06	21.20	43.26	466.06	254.04	12.80	160.58	82.22
ICPH 4187	93.66	162.66	163.66	16.73	43.96	463.46	232.97	12.93	143.04	59.22
ICPH 4539	90.66	162.66	178.20	16.86	41.20	562.13	264.00	12.83	150.90	76.66
ICPH 4275	91.00	152.66	176.66	22.06	54.33	507.73	196.94	11.62	122.12	92.77
ICPH 2680	92.00	160.66	170.66	27.60	52.26	639.20	174.40	9.38	118.64	68.33
ICPH 3816	90.00	164.33	174.20	25.00	53.33	542.60	252.33	10.69	153.61	87.55
ICPH 4488	93.33	166.00	180.46	27.50	74.00	605.93	197.92	10.79	122.47	82.55
ICPH 4500	98.66	168.66	174.33	25.60	69.66	441.00	224.20	12.48	151.76	87.44
ICPH 4502	98.33	177.00	168.93	22.80	53.90	484.80	309.23	13.30	200.35	50.77
ICPH 4540	92.33	164.33	165.40	15.00	35.80	552.73	211.06	11.25	119.52	72.77
ICPH 4542	92.66	153.00	194.40	18.13	29.20	363.66	192.86	15.74	119.40	26.32
ICPH 4611	86.66	169.33	157.53	12.13	22.73	396.43	172.83	15.26	102.24	15.66
ICPH 4671	96.66	175.00	151.46	25.13	84.60	625.86	241.70	11.94	150.11	79.99
ICPH 3474	91.00	158.33	169.60	25.33	64.66	609.93	231.54	10.56	149.65	86.99
Asha	99.00	176.00	179.06	26.80	66.66	500.50	213.60	11.86	147.96	89.33
Maruti	101.00	161.00	150.60	21.20	41.80	564.33	226.90	10.41	129.44	87.90
LRG 41	99.00	173.66	177.53	24.00	59.00	458.33	182.20	10.14	119.88	82.20
BDN 711	93.00	152.00	141.06	12.33	19.60	429.66	185.46	10.30	123.46	92.16
Mean	93.92	165.16	170.66	22.48	53.00	520.26	222.27	11.77	141.65	76.22
Range:										
Minimum	86.66	152.00	141.06	12.13	19.60	363.66	152.16	9.38	102.24	15.66
Maximum	101.00	177.00	194.40	31.20	84.60	769.90	337.65	15.74	229.68	92.77
CV	1.32	2.31	6.84	9.84	10.78	11.46	10.12	3.04	10.33	9.40
SE	0.72	2.20	6.74	1.28	3.30	34.45	12.99	0.21	8.45	4.14
CD (0.05)	2.04	6.25	19.12	3.62	9.36	97.67	36.83	0.58	23.96	11.73

The estimates of phenotypic and genotypic coefficient of variation (PCV and GCV), heritability in broad sense (h^2) and genetic advance are presented in Table 3. Perusal of results revealed that PCV estimates of all characters were slightly more than that of GCV indicating less influence of environment and traits may be under genetic control. This is in accordance with the findings of Vange and Moses (2009), Mahiboobsa *et al.* (2012) and Saro *et al.* (2013). High PCV and GCV were recorded for number of primary branches per plant (24.79, 22.76), number of secondary branches per plant (32.22, 30.36) and pollen fertility % (26.61, 24.89). Meanwhile medium PCV and GCV were recorded for number of pods per plant (19.51, 15.78), pod weight per plant (20.13, 17.40), 100 seed weight (13.08, 12.72) and grain yield per plant (21.15, 18.45). Low value of PCV and GCV was recorded for days to 50% flowering (3.98, 3.75),

Table 3. Genetic parameters of variation, heritability and genetic advance for yield, yield components and pollen fertility (%) in pigeonpea.

Parameters	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of primary branches	No. of secondary branches	No. of pods / plant	Pod weight / plant (g)	100 Seed weight (g)	Grain yield / plant (g)	Pollen fertility (%)
GCV (%)	3.75	4.43	5.96	22.76	30.36	15.78	17.40	12.72	18.45	24.89
PCV (%)	3.98	5.00	9.07	24.79	32.22	19.51	20.13	13.08	21.15	26.61
Broad sense heritability (%)	88.90	78.60	43.10	84.20	88.80	65.40	74.70	94.60	76.10	87.50
Genetic advance	6.84	13.37	13.75	9.67	31.23	136.78	68.89	3.00	46.98	36.56
Genetic advance as % of mean	7.28	8.10	8.05	43.02	58.92	26.29	30.99	25.49	33.16	47.97

days to maturity (5.00, 4.43) and plant height (9.07, 5.96). This indicates that there is considerable amount of variability for majority of the characters studied. These findings are similar to those of Venkateshwarlu (2001), Prakash (2011), Nagy *et al.* (2013), Prasad *et al.* (2013), Ajay *et al.* (2014) and Pandey *et al.* (2015).

Although GCV is measure of genetic variation, the amount of heritable portion can only be determined with the help of heritability and genetic advance estimates. The estimates of heritability and genetic advance as per cent of mean were high for the characters *viz.,*number of primary branches per plant (84.20, 43.02), number of secondary branches per plant (88.80, 58.92), number of pods per plant (65.40, 26.29), pod weight per plant (74.70, 30.99), 100 seed weight (94.60, 25.49), grain yield per plant (76.10, 47.97) and mean pollen fertility % (87.60, 47.97) suggesting the presence of additive gene action controlling these traits. Similar results were obtained by Prasad *et al.* (2013), Nagy *et al.* (2013), Saroj *et al.* (2013), Kumar *et al.* (2014) and Pandey *et al.* (2015). High heritability with low genetic advance as per cent of mean was seen in days to 50% flowering (88.90, 7.28) and days to maturity (78.60, 8.10), which indicates the influence of environment on the traits leading to their unstable expression. This is in agreement with the findings of Bhadru (2010), Prasad *et al.* (2013), Rekha *et al.* (2013) and Kumar *et al.* (2014). While, moderate heritability and low genetic advance as per cent of mean was recorded in plant height (43.10, 8.05) indicating the predominance of non-additive gene action in the inheritance of this trait as earlier reported by Deshmukh *et al.* (2000), Venkateshwarlu (2001) and Prasad *et al.* (2013).

CONCLUSION

From the present investigation it can be concluded that the estimation of genetic variability, heritability and genetic advance are useful for identification of superior varieties for yield and yield traits. ICPH 3762 followed by ICPH 4502 and ICPH 4395 were found to be high yielders among 28 genotypes on the basis of *per se* performance.

LITERATURE CITED

Ajay B C, Byregowda M, Babu H P, Kumar G.N.V and Reena M 2014 Variability and transgressive segregation for yield and yield contributing traits in pigeonpea crosses. *Electronic Journal of Plant Breeding*. 5(4): 786-791.

Bhadru D 2008 Genetic variability, heritability and genetic advances in pigeonpea [*Cajanus cajan* (L.) Millsp.]. *Research on Crops.* 9 (3): 661-662.

Bhadru D 2010 Studies on genetic parameters and inter-relationships among yield and yield contributing traits in pigeonpea [*Cajanus cajan*(L.) Millsp.]. *Legume Research.*33(1): 23-27.

Deshmukh R B, Rodge R G, Patil J V and Sahane D V 2000 Genetic variability and character association in pigeonpea under different cropping systems. *Journal of Maharashtra Agricultural Universities.* 25(2): 176-178.

E-Pulse Data Book 2016 Area, production and yield of pigeonpea in different states. *http://www.iipr.res.in/e-pulse-data-book.html.*

FAOSTAT 2015 Online Agriculture Statistics. *http://www.faostat.org*

Kumar S, Kumar S, Singh S S, Elanchezhian R and Shivani 2014 Studies on genetic variability and inter-relationship among yield contributing characters in pigeonpea grown under rainfed lowland of eastern region of India. *Journal of Food Legumes.*27(2): 104-107.

Mahiboobsa M, Dharamraj P S, Muniswamy S, Yamunara, Sony T, Avinalappa H, Patil R and Bankar C 2012 Genetic variability studies on stable male sterile, maintainer and restorers lines of pigeonpea [*Cajanus cajan* (L.) Millsp.]. *Karnataka Journal of Agricultural Sciences.*25 (4): 525-526.

Nagy K, Sharma R N, Nandah C and Kanwer S S 2013 Genetic variability and association studies among yield attributes in pigeonpea [*Cajanus cajan*(L.) Millsp.] accessions of Bastar. *The Ecoscan.*4: 267-271.

Pandey P, Kumar R and Pandey V R 2015 Genetic studies for quantitative traits in pigeonpea [*Cajanus cajan* (L.) Millsp.]. *Research on Crops.* 16(1): 154-161.

Pandey P, Kumar R and Pandey V R 2015 Genetic studies for quantitative traits in pigeonpea [*Cajanus cajan* (L.) Millsp.]. *Research on Crops.* 16(1): 154-161.

Prakash N B 2011 Genetic divergence based on metric and physiological traits in pigeonpea [*Cajanus cajan* (L.) Millsp.]. *M.ScThesis*. Acharya N GRanga Agricultural University, Andhra Pradesh, India.

Prasad Y, Kumar K and Mishra S B 2013 Studies on genetic parameters and inter-relationships among yield and yield contributing traits in pigeonpea [*Cajanus cajan* (L.) Millsp.].*The Bioscan.* 8(1): 207-211.

Rekha R, Prasanthi L, Reddi M S and Priya M S 2013 Variability, character association and path analysis for yield and yield attributes in pigeonpea. *Electronic Journal of Plant Breeding*. 4(4): 1331-1335.

Saroj S K, Singh M N, Kumar R, Singh T and Singh M K 2013 Genetic variability, correlation and path analysis for yield attributes in pigeonpea. *The Bioscan*. 8(3): 941-944.

Singh R K and Chaudhary B D 1977 *Biometrical methods in quantitative genetic analysis.* Kalyani Publishers., New Delhi.77-78.

Vange T and Moses O E 2009 Studies on genetic characteristics of pigeonpea germplasm at Otobi, Benue state of Nigeria. *World Journalof Agricultural Sciences.*5(6): 714-719.

Venkateswarlu O 2001 Genetic variability in pigeonpea [*Cajanus cajan*(L.) Millsp.]. *Legume Research*. 24 (3): 205-206.

Received on 31.05.2016 and revised on 29.09.2020