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Assessment of genotypes of pigeonpea (*Cajanus cajan*) for higher productivity in semi-arid Vertisols*

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Pigeonpea (*Cajanus cajan* (L.) Millsp.) is an important pulse crop grown in rainfed condition in Maharashtra. It is grown mainly as intercrop with sorghum, cotton and soybean. Among different crops grown in rainy (*kharif*) season, pigeonpea would normally perform better under drought prone condition (Choulwar *et al.* 2010). However, there is a large variability in the performance of pigeonpea genotypes for grain yield under rainfed condition. Breeding of genotypes thus would require identification of specific attributes that may be transferred to high-yielding cultivars. The present study was undertaken to assess genetic variation of genotypes and identify genotypes for rainfed condition in a semi-arid Vertisol. Twenty three pigeonpea genotypes were tested for yield contributing traits during *kharif* 2007, 2008 and 2009 under rainfed condition in a semi-arid Vertisol at Marathwada Agricultural University, Parbhani in Maharashtra. Parbhani is located at a latitude of 19^0 16', longitude of 76^0 47' and altitude of 409 m above mean sea level. The trials were conducted in a randomized block design with three replications.

The genotypes were sown with row × plant spacing of 60 x 30 cm in net plot size of 3.6 x 4.8 m with seed rate of 15 kg/ha. They were sown on 30.6.2007 and harvested on 16.1.2008 in first year; sown on 30.6.2008 and harvested on 02.02.2009 in second year; sown on 11.7.2009 and harvested on 28.1.2010 in third year. Recommended fertilizer (30:60:30 NPK kg/ha) was applied as basal dose. Observations were recorded on five plants of each genotype for drought tolerance and yield contributing traits. Different traits measured are days to 50% flowering, days to maturity, plant height (cm), number of primary branches/plant, number of pods/plant, dry matter (g/plant), leaf water potential (-bar), relative water content (RWC, %) and rain water-use efficiency (RWUE, kg/ha/mm).

Genotypic (GCV) and phenotypic coefficient of variation (PCV) were derived as

$$PCV = (\sqrt{\sigma^2 p}/\text{Mean of trait}) \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$GCV = (\sqrt{\sigma^2 g}/\text{Mean of trait}) \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where $\sigma^2 p$ is phenotypic variance; $\sigma^2 g$ is genotypic variance.

The broad sense 'heritability' was estimated as

$$\text{Heritability } (h^2) = (\sigma^2 g/\sigma^2 p) \times 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The genetic advance was measured as

$$\text{Genetic advance (GA)} = h^2 \times \sigma p \times K$$

$$\text{Genetic advance (\%)} = (\text{GA/Mean}) \times 100 \quad \ldots\ldots\ldots (4)$$

where K = Selection differential at 5% level = 2.06.

Genotypic correlation coefficient (rgxy) can be given as

$$rgxy = (\text{cov } (gx, gy))/(\sqrt{(\sigma^2 gx)\ (\sigma^2 gy)}) \quad \ldots\ldots\ldots\ldots\ldots (5)$$

where cov (gx, gy) = genotypic covariance between traits × and y; σ^2 gx and σ^2 gy are genotypic variances of traits × and y.

The phenotypic correlation coefficient (rpxy) can be given as

$$rpxy = (\text{cov } (px, py))/(\sqrt{(\sigma^2 px)\ (\sigma^2 py)}) \quad \ldots\ldots\ldots\ldots\ldots (6)$$

where cov (px, py) = phenotypic covariance between x and y; σ^2 px and σ^2 py are phenotypic variances of x and y.

The relative leaf water content (RWC) in a leaf is measured as

$$RWC = (\text{Fresh weight} - \text{Dry weight})/(\text{Turgid weight} - \text{Dry weight}) \times 100 \quad \ldots\ldots\ldots\ldots (7)$$

The data was analyzed based on analysis of variance (ANOVA). Differences between genotypes are examined based on Least Significant Difference (LSD) at $P < 0.05$ level and inferences are drawn (Gomez and Gomez 1984). There was a rainfall of 838 mm in 2007, 636 mm in 2008 and 654 in 2009. Based on ANOVA, differences between genotypes were significant for all traits. BDN 2009 attained significantly higher yield of 1496 kg/ha, followed by K2 (1 406 kg/ha). RWUE of genotypes was derived as ratio of yield (kg/ha) and rainfall (mm) received in each year. BDN 2009 gave significantly higher RWUE of 3.39 kg/ha/mm.

*Short note

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Dry matter (g/plant) was higher in BDN 2009 (50.7). Badnapur local, GAUT 001, GAUT 0202, BSMR 736, GT 101 and PT 9230 matured in 160 days; compared to BDN 2009 with 180 days. Maximum of 12 branches/plant was observed in K2. JKM 207 was superior with maximum number of 86 pods/plant, while JKM 206 had maximum plant height of 199 cm. K2 took maximum 130 days for 50% flowering. Significant difference was observed among genotypes for leaf water potential at flowering stage. BSMR-736 had maximum leaf water potential (–15.67), while GT-101 had maximum RWC (92.3%). Deshmukh *et al.,* (2009) reported maximum RWC in JKM 189 and BDN 2009. Mean, variation (%) and LSD of traits are given in Table 1.

PCV was relatively higher compared to GCV. Number of pods/plant had maximum PCV of 24.61%, while days to maturity had minimum PCV of 2.06%. Similarly, number of branches/plant had maximum GCV of 13.70%, while days to maturity had minimum GCV of 2.03%. Number of branches/plant had PCV of 18.25%, dry matter had 17.93%, RWC had 17.48% and yield had 17.40%. The days to maturity had a GCV of 2.0%, plant height had 3.9% and leaf water potential had 8.2% indicating low genetic variation. Days to maturity had maximum heritability of 97.1%, followed by leaf water potential with 77.6%, yield with 57.8% and RWC with 41.3%, while lower heritability was attained by plant height with 26.90% and number of pods/plant with 27.08%. Hence days to maturity, leaf water potential, yield and RWC would become important to plant breeders for selection. Maruti Sankar and Raghuram Reddy (2005) reported similar relation in maize under Alfisols.

Genetic advance (%) was highest in RWC (1146.7%), followed by number of pods/plant (719%), plant height (640.6%), dry matter (562.1%) and days to maturity (412.1%). Leaf water potential, RWC, number of pods/plant, yield, number of branches/plant exhibited high heritability with medium genetic advance indicating role of additive gene effect. Venkateswarlu (2001) reported high genetic advance for number of pods/plant and pigeonpea yield. Similar yield trend was reported by Deshmukh *et al.* (2009), while Shrinivas *et al.* (1999) reported maximum genetic advance for pods/plant.

Number of branches/plant had significant genotypic correlation with pods/plant (0.75**); dry matter (0.74**); and yield (0.53**); compared to pods/plant with dry matter

Table 1 Performance of pigeonpea genotypes for different traits (mean of three years)

Genotype	Days to 50% flowering	Days to maturity	Plant height (cm)	No. of branches/ plant	No. of pods/ plant	Dry matter (g/plant)	Leaf water potential	RWC (%)	Yield (kg/ha)	RWUE (kg/ha/ mm)
GAUT 001	122	160	159.4	7	73	33.5	-17.25	53.84	1095	2.22
BSMR 736	122	160	193.8	9	58	48.0	-15.67	56.19	1101	2.41
Gulliyal local	121	162	174.2	8	52	41.9	-17.66	62.27	1086	2.26
BDN 2010	126	165	186.2	9	66	41.3	-20.25	69.99	1330	3.03
PT 9230	120	160	186.8	11	63	41.5	-18.00	66.19	1130	2.83
BSMR 853	119	161	182.2	8	51	44.2	-19.25	85.09	1113	2.87
GAUT 0201	120	165	172.6	11	70	40.2	-16.00	81.72	1021	2.62
PT 25-06	124	166	186.6	9	58	42.5	-18.75	80.96	1286	2.49
BDN 708	129	167	181.6	11	78	34.1	-18.75	79.31	1216	2.70
GAUT 0202	120	160	190.0	7	50	34.6	-17.50	78.55	883	2.03
PT 11-38	123	170	179.8	10	68	35.6	-17.00	73.53	1065	2.44
JKM 205	122	172	172.0	9	74	52.7	-16.25	70.19	1172	3.06
JKM 206	120	170	199.0	12	84	37.8	-16.91	81.08	1122	2.69
JKM 207	126	172	174.9	11	86	32.4	-19.00	84.82	953	2.25
JKM 208	128	172	184.8	9	72	42.3	-21.50	88.03	981	2.85
JKM 209	128	173	131.0	9	57	46.8	-20.33	83.96	1106	1.95
JKM 112	128	173	178.0	11	62	40.2	-19.25	89.92	1196	2.70
K2	130	175	172.6	12	80	47.3	-16.23	86.37	1406	3.15
BDN 2009	127	180	167.0	10	82	50.7	-16.08	90.64	1496	3.39
GT 101	120	160	185.5	9	58	47.5	-17.25	92.26	972	2.33
JSA 59	122	161	188.6	7	62	49.8	-17.00	68.43	1300	2.74
JSA 41	122	166	197.2	10	60	43.9	-18.50	74.80	1253	2.89
Badnapur local	124	160	178.9	11	67	43.4	-18.17	75.32	1270	2.48
Mean	124	167	180.9	9	70	42.3	17.93	77.24	1154	2.63
LSD ($P < 0.05$)	2.4	2.9	13.1	2.7	21.6	9.7	1.25	16.57	243	0.16
CV (%)	12.2	10.9	4.5	17.9	19.4	14.4	4.4	13.4	13.2	13.9

(0.66**) and yield (0.26*). Dry matter had significant genotypic correlation with plant height (0.36*) and yield (0.56**); and phenotypic correlation with pods/plant (0.54**) branches/plant (0.43*) and yield (0.39*). The seed yield is a complex character and depends on different traits. Number of branches/plant and pods/plant had significant genotypic correlation while dry matter had significant genotypic and phenotypic correlation with yield. Yield was significantly correlated with number of pods/plant and dry matter indicating that selection of these traits is highly effective. Yield increased with RWUE in all genotypes. BDN-2009 was superior for yield and RWUE. Based on ranks assigned for performance of traits, K2 and BDN 2009 were superior. Number of branches/plant had significant genotypic correlation with pods/plant and dry matter compared to pods/plant with dry matter. Our study revealed that branches/plant, pods/plant and dry matter are important for further yield improvement.

SUMMARY

Field experiments of pigeonpea with 23 genotypes indicated that leaf water potential, RWC, number of pods/plant have a moderate to high phenotypic and genotypic coefficient of variation. High heritability with genetic advance for these traits indicated selection for improving yield. BDN 2009 and K2 retained maximum leaf water potential, RWC and attained maximum number of pods/plant and yield. Based on ranks assigned to genotypes for performance of traits, K2 was superior with lowest rank sum in a Vertisol.

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