SHORT COMMUNICATION

Assessment of Genetic Variability in 1129 Accessions of Pigeonpea [*Cajanus cajan* (L.) Millsp.]

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A total of 1,129 pigeonpea germplasm lines conserved at ICAR-National Bureau of Plant Genetic Resources (NBPGR) under Consortium Research Project on Agro Biodiversity (CRP-AB) were evaluated during *kharif* 2017, 2018 and 2019 for 20 qualitative and quantitative traits for the purpose of genotypic characterization, evaluation and selection of cultivar potentially suitable for growing in Karnataka region. The experiments conducted out at Zonal Agricultural Research Station, Kalaburagi in Augmented Block Design. A wide range of variation was observed for 14 qualitative traits. Out of the total 1,129 genotypes 313 were early maturing (<140 days). The genotypes IC245540, IC245558 and IC245559 were earliest in their maturity (106 days). A total of 92 accessions recorded more than 11 g test weight, highest 100-seed weight 21.0 g was observed in IC525757 and highest number of pods per plant (740 pods/plant) was obtained in IC407203. Grain yield per plant was highest in IC527696 (266.67 g) as compared to best check PT-0012. Thus, morphological characterization led to genotype identification for different traits.

Key Words: Accessions, Genetic variability, Germplasm, Morphology, Pigeonpea

Introduction

Pigeonpea (*Cajanus cajan* L.) is the second most important pulse crop after chickpea in India. It plays an important role in food security, balanced diet and alleviation of poverty because of its diverse usages as a food, fodder and fuel (Rao *et al.*, 2002). It ranks sixth in global grain legume production and worldwide it is cultivated in about more than 5.0 m ha area. India is the largest producer and consumer of pigeonpea with an area of 4.4 m ha, with annual production of 3.68 m t and productivity of 832 kg/ha (Anon., 2019).

To develop high yielding varieties, the existing genetic variability in the crop needs to be assessed and quantified. Yield is a complex trait that is highly influenced by environment. The information on genetic variability for different characters of economic importance is a prerequisite for studies on any plant species (Rathaswammy *et al.*, 1973). Pigeonpea is predominantly self-pollinated with occasional cross-pollination (6-7%) leading to genetic variability. The

exploitation and maintenance of this variability results in evolution of better plants through selection.

So far, varietal improvement of pigeonpea has mainly been limited to selection. For further yield gains not only a large and diverse germplasm collection and preservation is necessary (Frankel and Bennett, 1970) but also its utilization in crop improvement programme in the country. The main aim of this study was categorization of part of the Indian base collection of germplasm conserved in National Genebank at National Bureau of Plant Genetic Resource (NBPGR) based on morphological and quantitative characters and selection of useful genotypes for further breeding programmes.

Materials and Methods

The experiment was conducted during *kharif* 2017, 2018 and 2019 at Zonal Agricultural Research Station (ZARS), Kalaburagi, which is situated in agro-climatic zone-2 (North Eastern Dry Zone) of Karnataka state with 17° 20' N latitude, 76° 49' E longitude, at an altitude of 443.88 MSL.

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A total of 1,129 accessions of pigeonpea germplasm were received from NBPGR, New Delhi along with three checks BSMR-736, Asha and PT-0012. A total of 391 genotypes were evaluated during 2017, 365 and 373 genotypes were evaluated during 2018 and 2019, respectively. Every year genotypes were sown in Augmented Block Design (ABD) with randomisation of checks in each blocks. Each genotype was sown in two rows of three metre length with spacing of 90 cm between rows and 20 cm between plants. Standard agronomic practices were followed and plant protection measures were taken as and when required by following the recommended package of practices (Anon., 2017). Observations were recorded on 10 quantitative traits in five randomly selected plants from each genotype, viz., days to 50% flowering, days to maturity, plant height, number of primary branches, number of secondary branches, pod bearing length, number of pods per plant, seed yield per plant, seed yield per plot and 100-seed weight.

Observations on 14 morphological characters were recorded in the form of multiscale scores using standard pigeonpea descriptors (IBPGR and ICRISAT, 1993) these included seedling vigour, plant growth habit, plant habit, base flower colour, stem colour, leaf and pod pubescence, streak pattern, pod shape, pod colour, seed colour pattern, seed eye width, base seed colour and seed shape. Data recorded on five plants were averaged and were used to determine range and per cent values.

Results and Discussion

Ample variability was observed for various qualitative and quantitative traits. Based on the pooled data ten quantitative traits of pigeonpea germplasm are shown in the Table 1.

Wide variability was observed on quantitative traits in 391 pigeonpea germplasm during the year 2017. Days to 50% flowering ranged between 57 days (IC245519) to 143 days (IC254901), plant height varied between 99.0 (IC368861) to 257.3 cm (IC268784), primary and secondary branches were in the range of 4 (IC245495) to 26 (EC528321) and 0 (IC245471) to 35 (IC407203), respectively. Highest pod set was observed in IC407203 (740 pods/plant) and more pod bearing length was observed in IC407357 (90.7 cm). The variation observed with respect to days to 80% pod maturity was 106 (IC245540) to 195 days (IC254901), highest 100 - seed weight was observed in IC248845 (18.0 g), seed yield per plant (159.33 g) in IC407306 and seed yield per plot (1.98 kg) in EC528313.

A total of 365 accessions were evaluated during 2018, days to 80% pod maturity varied between 127 (IC468571) to 201 days (IC468581), plant height varied between 63 (IC468569) to 174 cm (IC523444), primary

 Table 1. Range of variability for different quantitative traits assessed during 2017-2020.

S. No.	Traits	Minimum			Maximum			
		2017-18	2018-19	2019-20	2017-18	2018-19	2019-20	
1	Days to 50% flowering	57 days (IC245519)	79 days (IC523385)	69 days (IC525855)	143 days (IC254901)	167 days (IC523140)	184 days (IC527697)	
2	Days to 80% pod maturity	106 days (IC245540)	127 days (IC468571)	128 days (IC525855)	195 days (IC254901)	201 days (IC468581)	241 days (IC527477)	
3	Plant height	99 (IC368861)	63 (IC468569)	138.3 (IC 525777)	257.3 (IC268784)	174 (IC523444)	292 (IC527657)	
4	No of primary branches	4 (IC245495)	2 (IC523442)	4 (IC525825)	26 (EC528321)	18 (IC523445)	35 (IC 525759)	
5	No of secondary branches	0 (IC245471)	0 (IC468572)	0 IC525811	35 (IC407203)	22 (IC523108)	25 (IC527705)	
6	Pod bearing length (cm)	14.7 (IC268834)	9.3 (IC468570)	15.3 (IC525843)	90.7 (IC407357)	67.7 (IC523124)	83.7 (IC525812)	
7	No. of pods per plant	42 (IC424214)	31 (IC523456)	37 (IC527473)	740 (IC407203)	306 (IC523446)	347 (IC527543)	
8	100 Seed weight(g)	6.0g (IC268828)	4.5g (IC523266)	5.0g (IC 525818)	18.0g (IC248845).	16.0g (IC523369)	21.0g (IC525757)	
9	Seed yield per plant(gm)	0.05g (IC424214)	3.3g (IC468592)	2.0g (IC525849)	159.33g (IC407306)	76.3g (IC523144)	266.67g (IC527696)	
10	Seed yield per plot (kg)	0.11 kg (IC424217)	0.04 kg (IC523396)	0.06 kg (IC525785)	1.98 kg (EC528313).	1.79 kg (IC523171)	1.4 kg (IC468465)	

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Fig. 1. IC525757 genotype having 100-seed weight of 21.0 g (2019-20)

and secondary branches varied from 2 (IC523442) to 18 (IC523445) and 0 (IC468572) to 22 (IC523108), respectively. Highest pod set was observed in IC523446 (306 pods/plant) and more pod bearing length was observed in IC523124 (67.7 cm). Highest 100 seed weight was observed in IC523369 (16.0g) and seed yield per plot was highest in IC523171 (1.79 kg).

During 2019, a total of 373 pigeonpea germplasm were evaluated, number of primary and secondary branches varied from 4 (IC525825) to 35 (IC525759) and 0 (IC525811) to 25 (IC527705), respectively. Highest 100-seed weight was observed in IC525757 (21.0 g), Fig. 1. The variation observed with respect to days to 80% pod maturity was from 128 (IC525855) to 241 days (IC527477), highest seed yield per plant was obtained in IC527696 (266.67 g) and seed yield per plot in IC468465 (1.4 kg).

Based on pooled data of three years a wide range of variation observed for days to maturity, 100 - seed weight and grain yield per plant and is presented in Table 2 and 3. Out of 1,129 accessions a total of 313 germplasm showed early maturity (<140 days), 139 germplasm showed mid early (140-160 days), 326 germplasm showed medium duration maturity (160-180 days) and 351 genotypes were late maturing (>180 days). Similarly, a total of 790 germplasm showed small sized seeds (<9 g), 247 germplasm showed optimum seed size (9-11 g) and 92 germplasm showed large seed size (> 11 g) 100-seed weight. Comparing three years of yield data with the check entries revealed that grain yield per plant was highest in IC527696 (266.67 g). On par yield with best check (PT-0012, 150 grams) was obtained in genotypes viz., IC407306 (159.33 g) followed by IC254905 (157.17 g) and IC407203 (151.3 g). Similar

Traits	2017-18	2018-19	2019-20	Total	Percentage
Days to maturity	2017-10	2010 17	2017 20	Total	Tereentage
Early maturity (< 140 days)	105	189	19	313	27.72
Mid-early (140-160 days)	63	63	13	139	12.31
Medium (160-180 days)	182	55	89	326	28.87
Late maturity (>180 days)	41	58	257	351	31.08
100 seed weight (g)					
Small seed (< 9 grams)	243	300	247	790	69.97
Optimum seed (9-11 grams)	107	49	91	247	21.87
Large seed (>11 grams)	41	16	35	92	8.15

Table 2. Categorization of germplasm based on variability parameters

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Table 3. Trait specific genotypes obtained after evaluating 1129 accession

S. No.	Trait	Genotypes
1	Early maturing genotypes	IC245540 (106 days), IC245558 (106), IC245559 (106), IC245501 (107) and IC245516 (107)
2	More number of pods per plants	IC407203 (740), IC406880 (715), EC528319 (656), EC13693 (653) and IC268837 (640)
3	Test weight (100 seed wt.)	IC525757 (21 g), IC525760 (18.1 g), IC248845 (18.0 g), IC268796 (17.0g) and IC268842 (17.0g)
4	More yield/plants compared to best check (PT-0012)	IC527696 (266.67g), IC407306 (159.33g), IC254905 (157.17g), IC407203 (151.33g)

(Values in the parenthesis indicate the values of genotype for each trait)

results were also obtained by Rangare *et al.* (2013), Singh *et al.* (2010), Kumara *et al.* (2013), Muniswamy *et al.* (2014), Chethana *et al.* (2015) Baldaniya *et al.* (2018) and Hariprasad (2018).

Results on trait specific genotypes are shown in Table 3. Emphasis should be given on these traits while selecting genotypes for desirable traits *viz.*, early maturity, 100-seed weight, more number of pods per plant and more yield per plant and such genotypes could be utilized in hybridization program for improvement in yield and its component traits in pigeonpea.

Morphological traits are important for varietal description. The percentage of variation for each morphological trait

S.No.	Trait	Phenotype	2017-18	2018-19	2019-20	Total	Percentage
1	Plant vigour	Good	372	270	220	862	76.35
	-	Very good	6	90	85	181	16.03
		Poor	13	5	68	86	7.62
2	Growth habit	Erect and compact	273	131	180	584	51.73
		Semi spreading	118	148	155	421	37.29
		Spreading	0	86	38	124	10.98
3	Base flower colour	Light Yellow	50	28	47	125	11.07
		Yellow	309	303	322	934	82.73
		Orange yellow	27	28	0	55	4.87
		Red	5	6	4	15	1.33
4	Stem colour	Green	351	293	351	995	88.13
		Purple	37	65	16	118	10.45
		Sun red	3	7	6	16	1.42
5	Streaks pattern	Sparse streaks	229	228	219	676	59.87
	-	Medium streaks	137	115	108	360	31.89
		Uniform streaks	0	0	18	18	1.59
		Dense streaks	25	22	28	75	6.64
6	Pod colour	Green	0	18	26	44	3.89
		Purple	23	31	40	94	8.32
		Green and Purple	368	316	306	991	87.78
7	Pod shape	Flat	391	354	348	1093	96.81
		Cylindrical	0	11	25	36	3.19
8	Seed colour pattern	Plain	359	348	339	1047	92.74
		Mottled	7	1	9	17	1.51
		Speckled	16	10	14	40	3.54
		Mottled and Speckled	9	5	11	25	2.21
9	Base seed colour	Cream	34	43	37	114	10.09
		White	20	12	11	43	3.81
		Orange	41	31	106	178	15.76
		Light brown	106	128	92	326	28.87
		Reddish brown	176	93	38	307	27.19
		Dark Purple	11	8	12	31	2.75
		Dark grey	3	0	6	9	0.79
		Mix	0	50	71	121	10.72
10	Seed shape	Oval	238	236	171	654	57.93
		Globular	109	80	130	319	28.26
		Square	41	39	62	142	12.58
		Elongate	3	1	10	14	1.24

Table 4. Morphological characterization of 10 characters of pigeonpea germplasm-pooled analysis (2017-2020)

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is presented in Table 4. Morphological variation was not observed for plant growth habit, leaf pubescence and pod pubescence. Unique genotypes were observed for characters like dark purple stem colour, cylindrical pod shape, mottled, specked seeds and elongated seed shape. The traits like early plant vigour, branching pattern, base flower colour, stem colour, streak pattern of base petal, pod colour and seed characteristics exhibited lot of variation. Similarly, more variability was observed for plant vigour, growth habit, base flower colour, pattern of streaks, pod colour, pod form and seed colour pattern. Considering the individual trait a majority of genotypes i.e. 82.73 per cent showed yellow base flower colour, 51.73 per cent showed erect and compact growth habit, 87.78 per cent showed mixed green and purple pod colour, 96.81 per cent showed flat pod shape, 28.87 per cent showed light brown colour seeds and 59.87 per cent showed sparse streak pattern. Similar results were reported by Upadhyaya et al. (2007) and Manyasa et al. (2008) for growth habit, base flower colour, pattern of streaks, pod color, pod form and seed color pattern. These traits can be used for identifying individual germplasm. Similar findings for plant vigour and plant growth habit were observed by Muniswamy et al. (2014), Kumar et al. (2016) and Hariprasad (2018) found similar results for branching pattern and stem colour. Kallihal et al. (2016) observed similar morphology in case of streaks pattern on base petal, pod shape and pod colour.

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