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Morphological Characterization of Pigeonpea (*Cajanus cajan* (L.) Millsp.) Genotypes

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ABSTRACT

Forty nine genotypes of pigeonpea [*Cajanus cajan* (L.) Millsp.]. were characterized during kharif, 2010-11 at Regional Agricultural Research Station, Lam, Guntur for 15 morphological characters *viz*., anthocyanin colouration of hypocotyls, plant branching pattern, plant growth habit, stem colour, leaf shape, pubescence on lower surface of the leaf, flower colour, pattern of streaks on petal, pod colour, pod surface stickiness, pod waxiness, pod constriction, seed colour, seed colour pattern and seed shape as per Distinctiveness (D), Uniformity (U) and Stability (S) test guidelines of pigeonpea. Variability was observed for all morphological characters studied but for growth habit and stem pigmentation i.e. all genotypes are indeterminate and with green stem. Absence of anthocyanin on hypocotyls (79.59%); erect branches (53.06%); oblong leaves (77.53%); no pubescence (91.84%); yellow flowers(75.51%); sparse streaks on petals (44.59%); waxiness (55.1%); greenish brown pods (49%); non sticky pods (57.14%); slight constriction on pods (63.27%); uniform seeds (77.55%); dark brown colour of seeds (42.86%); and oval seeds (61.22%) are more common. These results help in protection of genotypes besides aiding for further utilization, without repetition or waste of time, to develop high yielding stress tolerant varieties and/or hybrids.

Key words : Cheacterization, DUS testing, Germplasm, Pigeonpea.

Pigeonpea is the second most important pulse crop in India and breeders have been collecting, characterizing, evaluating and utilizing germplasm for releasing as varieties directly or involving in crossing programme. Introduction of Plant Variety Protection under General Agreement on Trade and Tariff (GATT) necessitated the need for precise genotypic characterization with clear Distinctiveness (D), Uniformity (U) and Stability (S). The concept of DUS was fundamental to the characterization of the variety as a unique creation. Morphological characterization of seed, seedling and plant would generally be considered for varietal identification. It is essential to secure Plant Breeder's Rights (PBR) and it also generates official description of a variety. Hence an attempt has been made in the present investigation to characterize 49 genotypes for morphological characters.

MATERIAL AND METHODS

Forty nine genotypes of pigeonpea were sown in randomized block design with three replications at the Regional Agricultural Research Station, Lam, Guntur, during kharif, 2010-11. Each genotype was represented by six rows of four meter length in each replication with a spacing of 90 cm between rows and 20 cm within row. Crop was managed as per ANGRAU recommendations. Morphological characters were recorded as per National Test guidelines for DUS on pigeon pea (Mazumder & Singh, 2006; and Mazumder, 2007). The qualitative characters were recorded as visual assessment by a single observation of a group of plants or parts of plants (VG) or individual plants or parts of plants (VS). The quantitative characters are measured by a single observation of a group of plants or parts of plants (MG) or single plants or parts (MS). It was ensured that the number of aberrant plants or parts of plants should not exceed 5 per cent in the genotype. Plant anthocyanin colouration of hypocotyls (AH) was observed at seedling stage of the plant (VS) and grouped as absent (1) or present (9). Plant branching pattern (BP) was observed visually group of plants before initiation of first flower (MS) and grouped as erect <30 (3) or semi spreading 30-60 (5) or spreading >60 (7). Plant growth habit (GH) was observed visually group of plants at full flowering stage (VG) and grouped as determinate (1) or indeterminate (2).

Stem colour (StC) was observed at full flowering stage (VG) and grouped as green (1) or purple (2). Leaf shape (LS) was observed at full flowering stage (VG) and grouped as oblong (1), obovate (2) or sesamum (3). Leaf pubescence (LP) was observed at full flowering stage (VG) and grouped as absent (1) or present (9). Flower colour (FC) was observed at full flowering stage (VG) and grouped as light yellow (1), yellow (2), orange yellow (3), purple (4) or red (5). Streaks on petal (SP) was observed at full flowering stage (VG) and grouped as absent (1), sparse (3), medium (5), dense (7) or mosaic (9). Pod colour (PC) was observed at full flowering stage (VG) and grouped as green (1), green with brown streaks (2), green with purple streaks (3), purple (4) or dark purple (5). Pod waxiness (PW) was observed at pre matured pods (VG) and grouped as absent (1) or present (9). Pod surface stickiness (PSS) was observed at pre matured pods (VG) and grouped as absent (1) or present (2). Pod constriction (PCon) was observed at pre matured pods (VG) and grouped as slight (3) or prominent (7). Seed colour (SC) was observed at ripe seeds (VG) and grouped as cream (1), brown (2), dark brown (3), grey (4), purple (5) or mottled (6). Seed colour pattern (SCP) was observed at ripe dry seeds (VG) and grouped as uniform (1) or mottled (2). Seed shape (SS) was observed at ripe seeds (VG) and grouped as oval (1), elongated (2) or globular (3).

RESULTS AND DISCUSSION

The frequency, percentages and details of descriptor values were given in Table 1 and Fig. 1; Table 2; and Table 3, respectively. No plant of any genotype studied showed a deviation to characteristics from the mentioned morphological characters. Variability was observed for all morphological characters studied but for growth habit (GH) and stem pigmentation (StC) i.e. all the genotypes are indeterminate and with green stem. In spite of 13:3 (determinate: indeterminate) genotypic ratio, indeterminate types are preferred due to re growth after biotic and abiotic stresses. Similarly, though purple is dominant over green (3:1 in F_2), usually green stem types are selected due to more photosynthetic activity. Anthocyanin colouration (AH) was present in 10 genotypes (20.41%) and absent in 39 genotypes (79.59%). Branching pattern (BP) was erect type in 26 genotypes (53.06%), semi spreading type in 21 genotypes (42.85%) and remaining two genotypes (4.08%) were showed spreading type. Erect type of branching pattern is dominant over semi spreading and spreading types that can lodge under adverse conditions. In the leaf characteristics, variation was observed for leaf shape and leaf pubescence on the surface of the leaf. Leaf shape (LS) was oblong in 38 genotypes (77.53%), sesamum in seven genotypes (14.29%) and obovate in four genotypes (8.16%). More occurrence of oblong types could be due to its dominance over sesamum and obovate. Leaf pubescence (LP) was present in four genotypes (8.16%) and absent in 45 genotypes (91.84%). Rameis, *et al* (1999) reported imparting resistance by pubescence while Navasero and Rangaswamy (1991) observed enhanced oviposition. Among the flower characteristics, variation observed for colour of petal and pattern of streaks on petal. Flower colour (FC) was yellow in 37 genotypes (75.51%), light yellow in 10 genotypes (20.41%), one genotype (2.04%) each of purple and red. In flower colour most of the genotypes showed yellow colour as it is mainly due to Iy gene which inhibits both the W1 and W2 duplicate genes to produce yellow colour. Pattern of streaks on petal (SP) was sparse in 22 genotypes (44.59%), medium in 20 genotypes 40.82%), absent in four genotypes (8.16%) and dense in three genotypes (6.12%). Among the pod characteristics, variation was observed for pod colour, pod waxiness, surface stickiness and pod constriction. Pod waxiness (PW) was present in 27 genotypes (55.1%) and absent in 22 genotypes (44.9%). Surface waxes protect the plant against desiccation, insect feeding and diseases (Lal, *et al,* 1988). Pod colour (PC) was greenish brown in 24 genotypes (49%), purple in 14 genotypes (28.57%), greenish purple in five genotypes (10.2%) and three genotypes (6.12%) each of dark purple and green. Pod surface stickiness (PSS) was absent in 28 genotypes (57.14%) and present in 21 genotypes (42.86%). Pod constriction (PCon) was slight in 31 genotypes (63.27%) and prominent in 18 genotypes (36.73%). Among the seed characteristics, variation was observed for seed colour, seed colour pattern and seed shape. Seed colour (SC) was dark brown in 21 genotypes

Table 1. Frequency of descriptor scores in 49 genotypes of pigeonpea [*Cajanus cajan* (L.) Millsp.] for different morphological characters.

S.No.	Character*	Descriptor score								
		1	2	3	4	5	6	7	8	9
1	AH	39	-	-	-	-	-	-	-	10
2	BP	-	-	26	-	21	-	2	-	-
3	GH	-	49	-	-	-	-	-	-	-
4	StC	49	-	-	-	-	-	-	-	-
5	LS	38	4	7	-	-	-	-	-	-
6	LP	45	-	-	-	-	-	-	-	4
7	FC	10	37	-	1	1	-	-	-	-
8	SP	4	-	22	-	20	-	3	-	-
9	PC	3	24	5	14	3	-	-	-	-
10	PW	22	-	-	-	-	-	-	-	27
11	PSS	28	21	-	-	-	-	-	-	-
12	PCon	-	-	31	-	-	-	18	-	-
13	SC	2	19	21	5	2	-	-	-	-
14	SCP	38	11	-	-	-	-	-	-	-
15	SS	30	19	-	-	-	-	-	-	-

* AH: Plant anthocyanin colouration of hypocotyls (1= absent or 9= present); BP: Plant branching pattern (3= erect, 5= semi spreading or 7= spreading); GH: Plant growth habit (1= determinate or 2= indeterminate); StC: Stem colour (1= green or 2= purple); LS: Leaf shape (1= oblong, 2= obovate or 3=sesamum); LP: Leaf pubescence (1= absent or 9= present); FC: Flower colour (1= light yellow, 2= yellow, 3= orange yellow, 4= purple or 5= red); SP: Streaks on petal (1= absent, 3= sparse, 5= medium, 7= dense or 9= mosaic); PC: Pod colour (1= green, 2= green with brown streaks, 3= green with purple streaks, 4= purple or 5= dark purple); PW: Pod waxiness (1= absent or 9= present); PSS: Pod surface stickiness (1= absent or 2= present); PCon: Pod constriction (3= slight or 7= prominent); SC: Seed colour (1= cream, 2= brown, 3= dark brown, 4= grey, 5= purple or 6= mottled); SCP: Seed colour pattern (1=uniform or 2= mottled); and SS: Seed shape (1= oval, 2= elongated or 3= globular).

(42.86%), brown in 19 genotypes (38.78%), grey in five genotypes (10.2%), two genotypes (4.08%) each of purple and cream. Brown or dark brown are mostly proffered due to less damage by pod borer (Nanda, *et al*, 1996) and relatively more resistance to stored pests in comparison with the white grains. Seed colour pattern (SCP) was uniform in 38 genotypes (77.55%) and mottled in 11 genotypes (22.45%). Seed shape (SS) was oval in 30 genotypes (61.22%) and globular in 19 genotypes (38.78%).

The present study indicates that among the characters, anthocynin pigmentation of hypocotyle is the most stable and uniform for distinguishing or identification at seedling stage. Growth habit, stem colour, petal colour, pubescence on lower surface of the leaf, pod waxiness, and pod surface stickiness are most stable DUS traits at field level. Seed colour is the most DUS trait after harvesting. Plant pigmentation is stable but slightly varies in intensity. Seed shape and branching pattern are uniform but fluctuate with environment. (Mazumder *et al*, 2008). These observations are comparable to those of Tulasi, *et al* (2112) in cotton and help in protection of genotypes besides aiding for further utilization, without repetition or waste of time, to develop high yielding stress tolerant varieties and/or hybrids.

Table 2. Frequency distribution for different morphological characters of pigeonpea [*Cajanus cajan* (L.) Millsp.]

S. No.	Morphological character	Total No. of genotypes	Frequency (%)
1	Plant anthocyanin colouration of hypocotyls: i. Absent	39	79.59
	ii. Present	10	20.41
2	Plant branching pattern: i. Erect,	26	53.06
	ii. Semi spreading	21	42.85
	iii. Spreading	2	4.08
3	Plant growth habit: Indeterminate	49	100
4	Stem colour: Green	49	100
5	Leaf shape: i. Oblong	38	77.53
	ii. Obovate	4	8.16
	iii. Sesamum	7	14.29
6	Leaf pubescence: i. Absent	45	91.84
	ii. Present	4	8.16
7	Flower colour: i. Light yellow	10	20.41
	ii. Yellow	37	75.51
	iii. Purple	1	2.04
	iv. Red	1	2.04
8	Streaks on petal: i. Absent	4	8.16
	ii. Sparse	22	44.90
	iii. Medium	20	40.82
	iv. Dense	3	6.12
9	Pod colour: i. Green	3	6.12
	ii. Green with brown streaks	24	49.00
	iii. Green with purple streaks	5	10.20
	iv. Purple	14	28.57
	v. Dark purple	3	6.12
10	Pod waxiness: i. Absent	22	44.90
	ii. Present	27	55.10
11	Pod surface stickiness: i. Absent	28	57.14
	ii. Present	21	42.86
12	Pod constriction: i. Slight	31	63.27
	ii. Prominent	18	36.73
13	Seed colour: i. Cream	2	4.08
	ii. Brown	19	38.78
	iii. Dark brown	21	42.86
	iv. Grey	5	10.20
	v. Purple	2	4.08
14	Seed colour pattern: i. Uniform	38	77.55
	ii. Mottled	11	22.45
15	Seed shape: i. Oval	30	61.22
	ii. Elongated	19	38.78

Table 3. Morphological characters for Pigeon pea {*Cajanus cajan* (L.) Millsp.} Genotypes.

S. No.	Genotypes	Characters *														
		AH	BP	GH	StC	LS	LP	FC	SP	PC	PW	PSS	Pcon	SC	SCP	SS
1	JKM 250	1	3	2	1	1	1	2	3	5	1	1	3	3	1	1
2	RVSA 07-31	1	3	2	1	3	1	2	5	2	9	1	7	3	1	1
3	SKNP 0845	1	5	2	1	3	1	2	1	2	9	2	3	2	2	1
4	WRG 168	1	3	2	1	1	1	2	3	4	1	1	7	3	1	3
5	ICP8863	1	5	2	1	2	1	2	5	2	9	1	7	3	1	1
6	BRG 2	1	7	2	1	1	1	1	3	1	1	1	7	3	2	3
7	PT00-012-1	9	5	2	1	1	9	2	1	4	9	2	7	4	1	1
8	GAUT 93-17	1	5	2	1	1	1	2	3	3	1	1	3	3	1	1
9	CO -6	1	5	2	1	1	1	2	7	3	1	1	3	2	1	3
10	GRG 2010	1	3	2	1	1	1	2	3	2	1	2	3	2	1	1
11	GJP 0901	9	3	2	1	1	1	1	3	3	1	2	3	4	1	3
12	NTL 554	1	3	2	1	2	1	1	5	2	9	2	3	5	1	3
13	AKT-HR- 2001-18	1	3	2	1	1	1	2	1	2	9	2	3	2	1	1
14	JKM 249	9	5	2	1	1	1	2	5	2	1	2	7	2	1	3
15	NTL 520	1	3	2	1	1	1	2	3	5	9	2	7	2	2	1
16	RVSA 07-24	1	5	2	1	1	1	2	3	2	1	1	3	2	2	3
17	WRG 173	1	5	2	1	1	9	2	5	2	1	1	7	3	1	1
18	WRP -1	1	3	2	1	1	1	2	3	2	9	2	7	4	1	3
19	AKT 08-2	1	3	2	1	1	1	2	3	3	9	1	3	2	1	1
20	BDN 2010	9	5	2	1	1	1	2	7	4	9	1	3	5	1	1
21	GJP 0902	1	3	2	1	1	1	1	5	2	1	1	3	1	1	3
22	PT04-149	1	3	2	1	1	1	2	3	4	9	2	3	2	1	3
23	GAUT 2003 -1	1	3	2	1	1	1	1	3	2	1	1	3	4	1	1
24	LRG 88	9	5	2	1	3	1	2	5	2	1	1	3	2	2	3
25	LRG 89	1	5	2	1	1	1	1	3	2	9	1	7	2	1	1

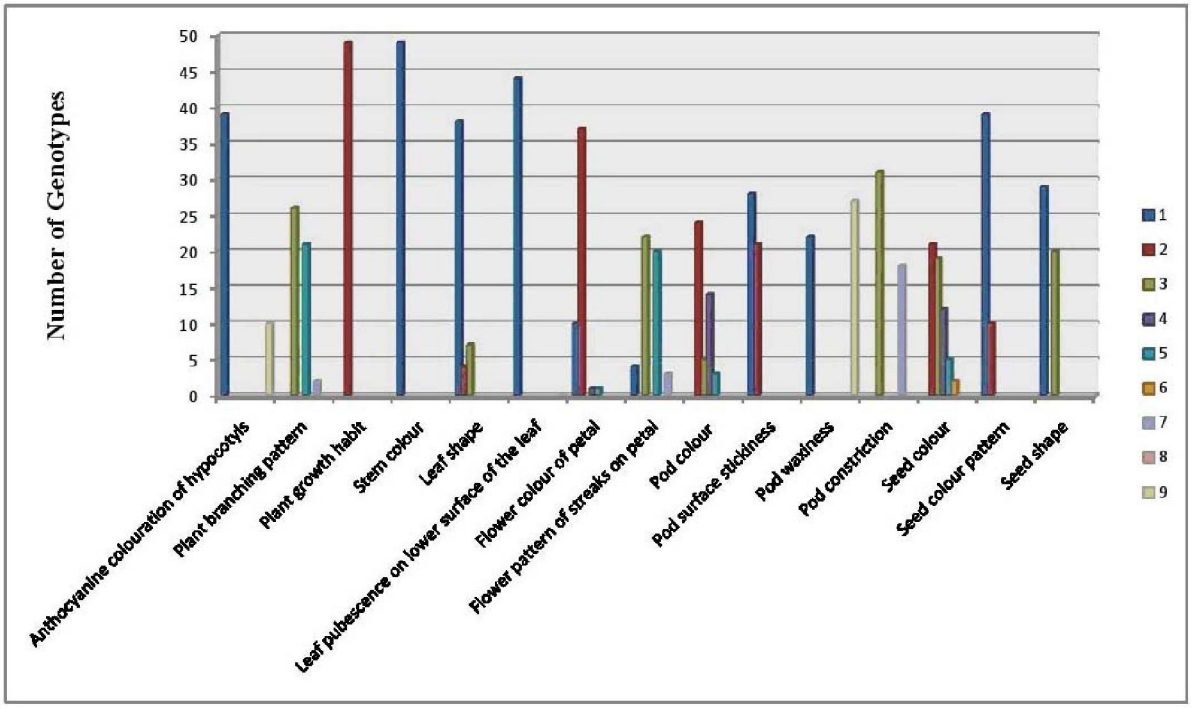
* as given for Table1

Table 3 continued.....

S. No.	Genotypes	Characters *														
		AH	BP	GH	StC	LS	LP	FC	SP	PC	PW	PSS	Pcon	SC	SCP	SS
27	LRG 61	1	3	2	1	1	1	2	3	3	9	2	3	3	1	1
28	RGT 4	1	3	2	1	1	1	2	5	2	1	1	3	3	1	1
29	WRG 179	9	5	2	1	1	1	2	3	4	9	1	3	2	1	1
30	LRG 52	1	5	2	1	1	1	2	3	5	1	1	3	3	2	3
31	TRG 38	1	7	2	1	1	1	2	7	4	9	2	3	3	2	1
32	LRG 41	1	5	2	1	3	9	2	3	4	9	1	3	3	1	3
33	LRG 90	1	5	2	1	1	1	1	3	2	1	1	7	3	1	1
34	LRG 91	1	3	2	1	1	1	2	3	4	1	1	3	2	2	1
35	LRG 92	9	3	2	1	1	1	2	5	2	9	2	3	2	1	3
36	LRG 93	1	5	2	1	3	1	1	5	2	9	2	7	3	1	1
37	LRG 94	1	5	2	1	3	1	2	5	2	1	1	3	1	1	3
38	LRG 95	1	3	2	1	1	1	2	3	1	1	1	3	3	1	1
39	LRG 96	9	3	2	1	1	1	2	5	4	9	1	3	2	1	1
40	LRG 97	1	3	2	1	2	1	4	5	2	1	1	7	3	2	1
41	LRG 98	1	5	2	1	2	1	2	5	4	9	1	7	2	1	3
42	LRG 99	1	5	2	1	1	1	2	5	4	9	2	3	3	1	1
43	LRG 100	9	3	2	1	1	9	1	1	1	9	2	3	4	1	1
44	LRG 101	1	3	2	1	1	1	1	3	2	9	2	7	3	1	3
45	LRG 102	1	5	2	1	1	1	2	5	4	1	1	7	2	1	1
46	LRG 103	9	3	2	1	3	1	2	5	4	9	2	7	2	2	1
47	LRG 104	1	5	2	1	1	1	5	3	2	9	2	3	3	2	1
48	LRG 105	1	3	2	1	1	1	2	5	2	9	2	7	2	1	3
49	LRG 106	1	3	2	1	1	1	2	5	4	9	2	3	3	1	1

* as given for Table1

Fig 1. Morphological characters of pigeon pea (cajanus cajan (L.) Millsp.) Genotypes.



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