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Characterization of pigeon pea (*Cajanus cajan* (L.) Millsp.) germplasm under CRP-Agro biodiversity

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Abstract

Four hundred pigeonpea germplasm accessions were evaluated and characterized at Pulses Research Station, SDAU Sardarkrushinagar (Gujarat) under Consortium Research Platform on Agro-biodiversity and majority of accession showed good early vigor, semi spreading plant growth habit, indeterminate plant habit, yellow base flower colour, green stem colour, glabrous leaf pubescence sparse streaks pattern, medium maturity, large seed size, plain seed colour pattern, medium seed eye width, orange base seed colour, oval seed shape and very low biotic stress susceptibility. The quantitative characters also showed wide variation and the potential germplasm may be utilized for further breeding program.

Keywords: Agro-biodiversity, correlation, genetic variation, germplasm

Introduction

Germplasm is vital resource in generating new plant types having desired traits that help in increasing crop production and thus improve the level of human nutrition. Plant genetic resources collection and characterization provides researcher with essential genetic variation to develop new varieties that can significantly impact agricultural systems. Germplasm characterization and documentation are important activity in plant genetic resources management and it eases data retrieval and short listing accessions for the genetic improvement. Germplasm utilization is increased if detailed characterization data is obtained for individual accessions, which should include qualitative and quantitative phenotypic traits, genotypic data, and responses to biotic and abiotic stresses. Detailed characterization of data is lacking pigeonpea collections, which emphasizes the need for further data collection. Characterization and evaluation of pigeonpea accessions are the pre-requisite for the utilization of available diversity in the pigeonpea crop improvement programme. Plant genetic resources are invaluable source of genes and gene complexes for yield and several biotic and abiotic factors and provide raw materials for further genetic improvement. Therefore, the collection of Pigeon pea germplasm and its proper characterization and evaluation, conservation and utilization in improvement programmes assume great significance especially in view of climate change. The study of relationships among quantitative traits is important for assessing the feasibility of simultaneous selection of two or more traits and hence for evaluating the effect of selection for secondary traits on genetic gain for the primary trait under consideration. A positive association between two desirable traits makes the job of the plant breeder easy for improving both traits at a time. Hence, the present study was under taken by the ICAR-Indian Institute of Pulses Research (IIPR), Kanpur through the All India Coordinated Research Project on Pigeonpea at Pulses Research Station, Sardarkrushinagar Dantiwada Agriculture University, Sardarkrushinagar under Consortium Research Platform on Agrobiodiversity to characterize 400 accessions of pigeonpea germplasm. The variability present in the germplasm was studied through preliminary characterization for different quantitative and qualitative traits provide essential data to researchers for development of new high yielding varieties in pigeonpea.

Materials and Methods

The trial was sown in Augmented Block Design (ABD) during Kharif 2018 at Pulses Research Station, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar, Gujarat (72.12 °E longitude, 24.9° latitude, 154.5 m altitude above MSL). These accessions were divided into eight blocks and each block consisted of 50 accessions with three check varieties viz., BDN 711, GT 101 and GT 103. The soil of the field was sandy loam in texture with pH value of 7.7 to 8.00 having good physical and chemical properties (Organic Carbon= 0.07,

K₂O= 234.0 kg/ha and P₂O₅= 56.0 kg/ha). The experimental unit was a single-row plot of 4.0 m long, spaced at 0.60 m apart. NPK 25:50:00 fertilizers was applied as basal full dose of nitrogen and phosphorus at the time of sowing. Plots were thinned down after two weeks of crop emergence and plant-to-plant distance of 0.20 m was maintained. The experimental year showed different temperature regimes, humidity, rainfall and sunshine hours during the crop duration. All the other recommended agronomical packages and practices were followed to raise a good crop. Data was collected based on the minimal descriptors released by NBPGR, New Delhi (Mahajan *et al.*, 2000) [2] and the list of pigeonpea descriptor released by Anonymous (2007) [1]. Five representative plants in each accession were tagged for recording the qualitative and quantitative traits. A descriptive statistical analysis and correlation estimate was done for the quantitative characteristics only.

Result and Discussion

The data of preliminary characterization of 400 accessions of pigeonpea germplasm were recorded for 20 agro-morphological characters revealed a wide range of variability in both quantitative and qualitative characters. The range of variability and frequency observed in qualitative characters are given in Table 1. Majority of the accessions showed good early plant vigour (213 acc.), semi spreading plant growth habit (268 acc.), indeterminate plant habit (342 acc.), yellow flower colour (359 acc.), green stem colour (391 acc.), glabrous leaf pubescence (382 acc.), sparse streak (201 acc.), glabrous pod pubescence (398 acc.), cylindrical pod shape (397 acc.), green and purple pod colour (359 acc.), medium maturity (207 acc.) bold seed (54 acc.), plain seed colour pattern (387 acc.), medium seed eye width (398 acc.), orange base seed colour (313 acc.), oval seed shape (233 acc.) and very low biotic stress susceptibility (324 acc.).

The quantitative characters also showed wide variation in the characterized pigeonpea germplasm. In the quantitative traits, days to 50% flowering (89-159 days), primary branches (3.2-11.2), days to maturity (135-217 days), 100 seed weight (6.85-13.11 g), plant height (133-224 cm), pods per plant (14.6-208.2), pod length (2.78-5.64 cm) and seeds per pod

(2.2-6.2) showed wider ranges. The preliminary characterization and descriptive statistics revealed that seed yield, plant height, 100 seed weight, pod length, days to 50% flowering and seeds per pod were the most variable characters because they showed higher variance and standard deviation. Earlier reports by Ramesh (2017) [3], Rupika and Kannan Bapu (2014) [4], and Upadhyaya *et al.* (2007, 2017) [5, 6] have also exhibited the presence of variation for different quantitative characters in pigeonpea germplasm accessions.

Generally, seed yield is the complex characters controlled by several components which reflect positive and negative effect on these traits. Thus, to achieve regular enhancement in the yield and component traits, understanding of mechanism of association provides a foundation for formulating suitable breeding approaches for enhancing the yield. On the basis of the present data on seed yield per plant, showed positive and significant correlation with primary branches per plant (+0.415), branches per plant (+0.417), pods per plant (+0.391) and pod length (+0.047) while days to flowering (-0.168) and days to maturity (-0.189) showed negative correlation with seed yield which help to identify high seed yield genotypes. High positive and significant correlation was observed between days to 50% flowering with days to maturity (+0.986) and plant height (+0.268), whereas primary branches per plant positively correlated with pods per plant (+0.997) which helps in identifying early genotypes with high yield.

The other component traits were also showed inter-correlated with each other which will also help in selection of suitable sorghum genotypes. Based on the mean some of the accessions showed outstanding performance for different agro-morphological traits *viz.*, early flowering (IC468557 and IC468545 with 89 and 90 days), plant height (IC468162 and IC468263 with 133 cm), primary branches per plant (IC468284 and IC468175 with < 11.0), pods per plant (IC468348 208.2), pod length (IC468531, IC468543 and IC468565 with < 5.4 cm), seeds per pod (IC468469 6.6) 100 seed weight (IC468208, IC468211, IC468215 and IC468372 with > 12.95 g) and seed yield (IC468355 and IC488328 with < 62 g). These accessions with potential for different agro-morphological traits may be utilized in crop improvement program for developing superior varieties and parental lines.

Table 1: Range of variability and frequency observed in qualitative characters.

Sr. No.	Characters	Score				
		1: Poor (14)	2: Good (213)	3: Very good (170)	99: Others (1)	
1	Early Plant Vigour					
2	Plant growth habit	1: Erect & Compact (17)	2: Semispreading (268)	3: Spreading (113)	4: Trailing(0)	99: Others(0)
3	Plant habit	1: Determinate (0)	2: Semideterminate (56)	3: Indeterminate (342)	99: Others (0)	
4	Days to flowering	3: Early 61-90 days (4)	5: Medium 91-130 days (241)	7:late131-160 days(152)	9: Very late >160 days (1)	
5	Base flower colour	1: Ivory(0)	2: Light yellow(0)	3: yellow (359)	4: Orange yellow(0)	99: Others (0)
6	Stem colour	1: Green (391)	2: Sunred (6)	3: Purple (1)	4: Dark purple (0)	99: Others (0)
7	Leaf pubescence	1: Glabrous (382)	2: Pubescent (0)	99: Others (16)		
8	Streaks pattern	3: Sparse streaks (201)	5: Medium streaks (71)	7: Dense streaks (35)	9: Uniform coverage of second colour (88)	99: Others (3)
9	Pod pubescence	1: Glabrous (398)	2: Pubescent (0)	99: Others (0)		
10	Pod shape	1: Flat (1)	2: Cylindrical (397)	99: Others (0)		
11	Pod colour	1: Green (18)	2:Purple (21)	3: Green &Purple (359)	4: Dark purple (0)	99: Others (0)
12	Days to 80% maturity	1: Early 121-150 days (23)	2:Mid early 151-165 days (70)	3:Medium 166-185 days (207)	4:Late 186-200 days (75)	5: Very late >200 (23)
12	100 seed weight(g)	3: small <7 (1)	5: medium7-9 (162)	7: large>9-11 (181)	9: very large>11 (54)	
13	Seed colour pattern	1: Plain (387)	2: Mottled (1)	3: Speckled (2)	4: Mottled & Speckled (8)	99: Others (0)
14	Seed eye width	3: Narrow (0)	5: Medium (398)	7: Wide (0)	99: Others (0)	
15	Base seed colour	1: white (13)	3: Orange (313)	9: Dark purple (6)	99: Others (66)	
16	Seed shape	1:Oval (233)	2: Globular (49)	3: Square (98)	4: Elongate (18)	99: Others (0)
17	Biotic stress susceptibility	1: Very low(324)	3: Low (69)	5: Intermediate(5)	7: High (0)	9: Very high (0)

Table 2: Correlation among yield and yield attributing traits.

Characters	Seed yield	Days to flowering	Primary branches	Days to maturity	100 seed weight	Plant height	Pods per plant	Pod length
Seed yield	1							
Days to flowering	-0.168	1						
Primary branches	0.415	0.011	1					
Days to maturity	-0.189	0.986	-0.029	1				
Seed weight	0.010	-0.192	0.137	-0.194	1			
Plant height	-0.067	0.268	0.284	0.283	0.096	1		
Pods per plant	0.391	-0.133	0.413	-0.162	-0.012	-0.0786	1	
Pod length	0.047	0.001	0.010	-0.006	0.295	0.0522	-0.015	1

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