www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(12): 2466-2473

www.thepharmajournal.com
Received: 29-09-2021
Accepted: 14-11-2021

Manoranjan Biswal
Department of Plant Breeding And Genetics, Jawaharlal Nehru Krishi VishwaVidyaaya, Jabalpur, Madhya Pradesh, India

RS Solanki
Department of Plant Breeding & Genetics, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Gwalior, Madhya Pradesh, India

Shailendra Sagar Prajapat
Department of Plant Breeding And Genetics, Jawaharlal Nehru Krishi VishwaVidyaaya, Jabalpur, Madhya Pradesh, India

R Shiv Rama Krishnan
Department of Plant Breeding And Genetics, Jawaharlal Nehru Krishi VishwaVidyaaya, Jabalpur, Madhya Pradesh, India

Anita Babbar
Department of Plant Breeding And Genetics, Jawaharlal Nehru Krishi VishwaVidyaaya, Jabalpur, Madhya Pradesh, India

Corresponding Author:
Manoranjan Biswal
Department of Plant Breeding And Genetics, Jawaharlal Nehru Krishi VishwaVidyaaya, Jabalpur, Madhya Pradesh, India

The exploration of varietal characterization of chickpea *(Cicer arietinum* L.) genotypes based on morphological markers

Manoranjan Biswal, RS Solanki, Shailendra Sagar Prajapat, R Shiv Rama Krishnan and Anita Babbar

Abstract
The cultivated chickpea is one of India's most significant pulse crops. Chickpea genotypes must be characterized, identified, and assessed for genetic purity before they may be used properly. Morphological characterization is the first step in the description and classification of the germplasm. An understanding of morphological characters facilitates the identification, selection of desirable traits, designing new populations and transferring their desirable genes into widely grown food legumes. Observations were recorded as per DUS guide lines and found large variation for different agro-morphological traits. Describing the characteristics of a crop species based on standard descriptors is effective for better utilization and conservation of germplasm.

Keywords: Chickpea, DUS, characterization, genotypes, varietal identification

1. Introduction
Chickpea (*Cicer arietinum* L.), often known as Bengal gram or garbanzo bean, is one of the world's oldest and most frequently grown pulse crops, grown in more than 50 nations. It is a highly self-pollinating (Auckland and van der Maesen, 1980) [3] annual grain legume and a member of the family Leguminaceae, sub-family Papilionacea, tribe Vicieae and genus cicer. Most probably originated in Southeastern Turkey adjoining Syria (Ladizinsky, 1976) [10] and subsequently spread to India and Europe (Singh and Auckland, 1976) [2]. It can be grown in a wide range of temperatures, from 5°C in the subtropics to >30°C in the arid tropics, with annual rainfall of 600-1000 mm. Chickpea genotypes must be characterized, identified, and assessed for genetic purity before they may be used effectively. As a result, persistent visual diagnostic features of seed and plant morphology are critical to know in order to maintain genetic purity (Lalitha, 2007) [11]. Characteristics are used to evaluate the objective for distinctness, homogeneity, and stability. The use of standard descriptors to describe the features of a crop species is useful for better germplasm utilisation and conservation. (Diederichsen and Richards, 2003) [5]. Look at the facts above, which were based on a chickpea descriptors study that classified thirty chickpea lines.

2. Materials and Methods
The experiment was carried out on the site of seed breeding farm, JNKVV, Jabalpur during *Rabi* 2019-20 and 2020-21. The experimental material comprised of 30 advanced breeding lines of Desi chickpea were evaluated in three replications using Randomized Complete Block Design (RCBD) for the identification of promising genotypes of Desi chickpea under diverse environmental conditions. Observations were recorded on twenty morphological traits based on the DUS guide line of chickpea for each character in each replication at different crop growth stages. Out of 20 morphological traits, 14 traits were characterized under plant level and 06 traits were characterized under seed level. Morphological traits along with its descriptors and stage of observation have been depicted in Table 1.

3. Results and Discussion
The primary step in describing and classifying the material under investigation is morphological characterization. Characteristics are used to evaluate the requirements for distinctness, homogeneity and stability. Understanding morphological features, aids in the identification, selection and transfer of favourable genes, as well as the design of new

populations. The present study was conducted to classify 30 chickpea lines using morphological characteristics based on DUS guideline. Because of the wide variation in morphological features, an attempt was made to classify the chickpea genotypes and identify those using descriptors (Table 1). The 30 desi genotypes may well be distinguished from each other based on morphological differences.

Plant growth habit, an important trait was observed at the stage of 50% flowering. In the present study; out of 30 genotypes, 10 genotypes were reported as semi-erect type, 17 genotypes were noted as semi-spreading type and 03 genotypes were depicted as spreading type (Fig.1 and Fig.2). (Pundir *et al.,* 1991) [12] also reported presence of such variation for plant growth habit in genetic stock of chickpea and identified genotypes which were found to be suitable for different agro-climatic zone. Erect growth habit facilitates mechanical harvesting and allows an increase in plant population, which may increase yield, while the spreading types, may serve to conserve soil moisture. Genotypes were semi erect growth habit provides an opportunity for better yield in rice fellow condition in north east plain zone. Similarly, short duration, semi-spreading and spreading growth habit have large canopy area which reduces the evaporation and provides an opportunity to produce high yield in central zone and south zone of India

Out of 30 genotypes, 18 genotypes were found as anthocyanin pigmentation on stem and rest 12 were noted as absent of anthocyanin colouration. There are 03 categories of stem height at initiation of first flower found in chickpea. 16 genotypes were found as low with less than 8 nodes, 07 genotypes were exhibited as medium with 8-15 nodes and 07 genotypes were reported as high stem height at initiation of first flower with greater than 15 nodes. Fourteen genotypes were found as early and sixteen genotypes were noticed as medium type observed at the stage of 50% flowering. Large variation exhibited for foliage colour; 03 genotypes were found as light green, 03 genotypes were reported as medium green and 24 genotypes were found as dark green foliage, while, 15 genotypes were small leaflet size and remaining 15 genotypes were reported as medium leaflet size. All the genotypes evaluated had pinnate leaf pattern. Flower number per peduncle had recorded single in 29 genotypes and twin peduncle found only one genotype (ICCV 15118).

Flower colour is the one of most important diagnostic characters in chickpea and is widely used as a marker gene in genetic studies and breeding work. In chickpea commonly three types of flower colour *viz.*, pink, white and blue colour are found. In the present investigation: 01 genotype (RVSSG 60) had white flower, 23 genotypes were found as pink flower, whereas, 06 genotypes were reported as blue colour flower. (Qureshi *et al.,* 2004) [13] Observed presence of considerable variation for growth habit, flower colour, seed testa texture and seed shape. Six genotypes were found as absence of flower stripes on standard *viz.*, BRC 305, RKG 13-205, RVSSG 60, IPC 2010-14, JG 2017-49, NOG 15-5, while, presence of flower stripes on standard were reported in remaining genotypes. There are three categories of peduncle length found in chickpea, in this investigation only two types of peduncle length exhibited in the genotypes, out of 30 genotypes under study, 23 genotypes were found as medium peduncle length (5-10 mm) and rest of genotypes *viz.*, BG 3091, RG 2011-04, GNG 2367, PG 205, GL 14015, JG74 X ICCV4958, ICCV15118 were depicted as long peduncle length (>10 mm). Sixteen genotypes were recorded as short plant height (<45 cm), seven genotypes were found as medium plant height(45-65 cm) and remaining seven genotypes were exhibited long plant height (>65 cm) *viz.*, JSC 55, GL 14015, JG63 × ICC4958, JG74 × ICCV4958, BG 3092, GNG 2367 and JG24 which might be found suitable for machine harvesting (Table 1, Fig.1 and Fig.2). Fourteen genotypes were recorded as small pod size (<15 mm), whereas, remaining genotypes were depicted as medium pod size (15-20 mm). Single seed per pod was found in 29 genotypes, while more than one seeds noticed in only one genotype (ICCV 15118).

Large variation in seed colour present in the germplasm is providing good breeding material for varietal development programe, which is recognized by high market price and high profitability to farmers. In the present study; out of 30 genotypes, 2 genotypes were recorded as yellow colour seed *viz.*, RKG17-04, GL 14015, 20 genotypes had brown colour seed, whereas, 08 genotypes were noted as dark brown seed colour (Table 1, Fig.1 and Fig.2). (Raina *et al.,* 1994) [14] reported that plant growth habit, testa colour, pod colour, pod shape and seed colour are each controlled by two genes. (Hamayoon *et al.,* 2011) [7] grouped germplasm based on flower, stem and seed coat colour accessions in desi and kabuli type, as desi (pink flower, green with purplish tinge stem and colored seed coat) and kabuli types (white flower, green stem and beige seed coat). Regarding seed size, 02 genotypes were found as very small seed size (<20 g /100sw) *viz.*, IPC 2010-14, GJG 1503, 12 genotypes were recorded as small seed size (20-25 g /100sw) and 16 genotypes were exhibited as medium seed size (26-35 g /100sw) (Table 1, Fig.1 and Fig.2). This variation in seed size is an important trait for marketing and consumer acceptance in chickpea. Seventeen genotypes were recorded as owl's head shape seed and thirteen genotypes were depicted as angular shape seed. Similar trend was reported by (Upadhyaya *et al.,* 2003) [18]. In chickpea there are 03 categories of seed testa texture *viz.*, rough, smooth and tuberculated. In this investigation, rough and smooth types of seed testa texture exhibited in the genotypes. Out of 30 genotypes, 05 genotypes were observed as rough *viz.*, GL 14015, NOG 15-5, JG12 X JG 16-3, ICC96029 X JG315, JG 14 and remaining genotypes were reported as smooth seed testa texture. Rough seed surface is recognized better group for non-preference of stored grain pests. Smooth seed surface is consumer acceptance trait and it has preference in market. Both rough and smooth seed surface genotypes can be utilized in further breeding programme. Three genotypes were exhibited as absence of seed ribbing *viz.*, BG 3091, RG 2011-04 and BRC 302, while, rest of genotypes were noted as presence of seed ribbing. All the 30 genotypes under investigation had *desi* type of seed.

These visual traits showed overlapping of expression in various combinations, yet proved to be of great utility as identity of all the genotypes could be established individually. Morphological features of genotypes have been a major component of varietal identification (Gediya *et al.,* 2018) [6]. It is not possible to identify advanced promising lines using any single parameter. A detailed morphological description of plants and seeds should therefore be prepared. Utilization of these features in sequential fashion is useful and convenient to distinguish different genotypes. Similarly, genotypes identification based on distinguishable morphological characters were reported by (Kaul *et al.*, 2007; Upadhaya *et al*., 2007; Sarao *et al.*, 2009; Araujo and Vello 2010; Keneni *et al.*, 2011; Shrivastava *et al.*, 2012; Bayahi *et al.*, 2015) [1, 4, 8, 9, 15-17].

Table 1: Frequency distribution of morphological and seed traits in chickpea genotypes according to DUS guideline

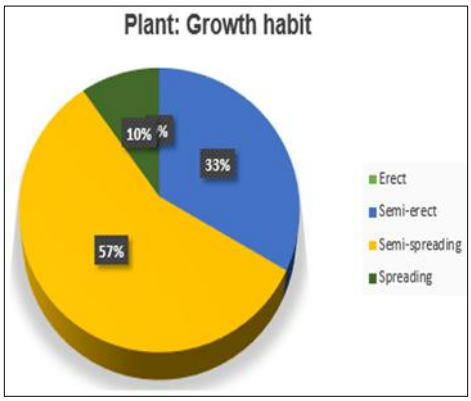
S. No.	Characteristics	Stage of observation	Expression/ States	Note/ Score	Genotype frequency	Percentage contribution	Name of Genotypes
1.	Stem: Anthocyanin coloration	Before flowering	Absent	1	12	40.0	IPC 2010-14, BRC 302, GJG 1503, RVSSG 60, NOG 15-5, DC 16-116, JSC 55, JG 11 X JG 14, JG74 X ICCV4958, ICC96029 X JG315, ICCV15118, JG 14
			Present	9	18	60.0	Phule G 1018-9-6, BG 3091, PG 187, BRC 305, RG 2011-04, RKG 13-205, GNG 2367, JG 2017-49, RKG17-04, PG 205, GL 14015, BG 3092, JG 2016-1614, JG63 X ICC4958, JG12 X JG 16-3, JG12 X JG16-1, JG 36, JG 24
2.	Stem: Height at initiation of first flower	First flowering	Low (< 8 nodes)	3	16	53.4	JG 2016-1614, BRC 305, NOG 15-5, Phule G 1018-9-6, RKG 13-205, JG 14, DC16-116, JG12x JG 16-1, JG12 × JG 16-3, ICCV 15118, JG2017-49, JG 36, GJG 1503, BRC 302, JG 11 × JG 14, RKG17-04
			Medium (8-15 nodes)	5	07	23.3	PG 187, IPC 2010-14, BG 3091, RVSSG-60, ICC 96029 × JG315, RG 2011-04, PG 205
			High (>15 nodes)	7	07	23.3	JSC 55, GL 14015, JG63 × ICC4958, JG74 × ICCV4958, BG 3092, GNG 2367, JG24
3.	Time of flowering (50% of the plants with at least one open flower)	First flowering	Extra early (<40 days)	1	0	0.00	Nil
			Early (40- 60 days)	3	14	46.7	JG 2016-1614, JSC 55, NOG 15-5, Phule G 1018-9-6, JG63 × ICC4958, RKG 13-205, JG 14, JG74 × ICCV4958, RVSSG-60, ICC 96029 × JG315, BRC 302, BG 3092, JG24, RKG17-04
			Medium (61-80 days)	5	16	53.3	BRC 305, GL 14015, PG 187, IPC 2010-14, DC16-116, JG12 X JG 16-1, JG12 × JG 16-3, ICCV 15118, JG2017-49, JG 36, GJG 1503, GNG 2367, JG 11 × JG 14, RG 2011-04, PG 205, BG 3091
			Late (>80 days)	7	0	0.0	Nil
4.	Plant: Growth habit	50 % flowering	Erect (0-15^0 from vertical)	3	0	0.0	Nill
			Semi-erect (16-25^0 from vertical)	5	10	33.3	GNG 2367, JG 2017-49, BRC 302, BG 3092, JSC 55, JG 11 X JG 14, JG12 X JG 16-3, JG74 X ICCV4958, ICC96029 X JG315, JG 14
			Semi-spreading (26-60^0 from vertical)	7	17	56.7	Phule G 1018-9-6, BG 3091, BRC 305, RG 2011-04, RKG 13-205, IPC 2010-14, RKG17-04, GJG 1503, RVSSG 60, NOG 15-5, PG 205, GL 14015, JG 2016-1614, JG63 X ICC4958, JG12 X JG16-1, JG 36, JG 24
			Spreading (61-80^0 from vertical)	9	03	10.0	PG 187, DC 16-116, ICCV15118
5.	Plant: Colour of foliage	50% flowering	Light green	1	03	10.0	IPC 2010-14, JG 2017-49, NOG 15-5
			Medium green	2	03	10.0	BRC 305, RKG 13-205, RVSSG 60
			Dark green	3	24	80.0	Phule G 1018-9-6, BG 3091, PG 187, RG 2011-04, GNG 2367, RKG17-04, BRC 302, GJG 1503, DC 16-116, PG 205, GL 14015, BG 3092, JSC 55, JG 11 X JG 14, JG 2016-1614, JG63 X ICC4958, JG12 X JG 16-3, JG12 X JG16-1, JG74 X ICCV4958, ICC96029 X JG315, ICCV15118, JG 14, JG 36, JG 24
			Greenish Purple	4	0	0.0	Nil
6.	Leaflet: Size (length) (middle of	50 % flowering	Small (<10mm)	3	15	50.0	Phule G 1018-9-6, RG 2011-04, RKG 13-205, GNG 2367, JG 2017-49, RKG17-04,

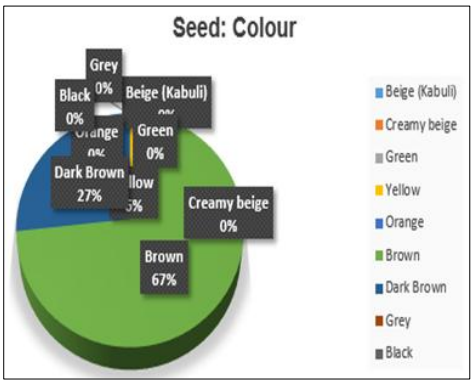
	the plant and middle of the leaf)						BRC 302, NOG 15-5, DC 16-116, PG 205, JSC 55, JG12 X JG 16-3, JG12 X JG16-1, JG74 X ICCV4958, ICC96029 X JG315
			Medium (10-15mm)	5	15	50.0	BG 3091, PG 187, BRC 305, IPC 2010-14, GJG 1503, RVSSG 60, GL 14015, BG 3092, JG 11 X JG 14, JG 2016-1614, JG63 X ICC4958, ICCV15118, JG 14, JG 36, JG 24
			Large (> 15 mm)	10	0	0.0	Nil
7.	Leaf Pattern	50% flowering	Simple	1	0	0.00	Nil
			Compound	2	0	0.00	Nil
			Pinnate	3	30	100.0	JG 2016-1614,JSC 55,BRC 305, NOG 15-5,Phule G 1018-9-6,GL 14015,JG63 × ICC4958,PG 187, RKG 13-205,JG 14,JG74 × ICCV4958,IPC 2010-14,DC16-116,JG12 JG 16-1,BG 3091,JG12 × JG 16-3,RVSSG-60,JG2017-49, JG 36,GJG 1503,ICC 96029 × JG315,BRC 302,BG 3092,GNG 2367,JG 11 × JG 14,JG24,RKG17-04,RG 2011-04,PG 205, ICCV 15118
8.	Flower: Number per peduncle	50% flowering	Single	1	29	96.7	JG 2016-1614,JSC 55,BRC 305, NOG 15-5,Phule G 1018-9-6,GL 14015,JG63 × ICC4958,PG 187, RKG 13-205,JG 14,JG74 × ICCV4958,IPC 2010-14,DC16-116,JG12x JG 16-1,BG 3091,JG12 × JG 16-3,RVSSG-60,JG2017-49, JG 36,GJG 1503,ICC 96029 × JG315,BRC 302,BG 3092,GNG 2367,JG 11 × JG 14,JG24,RKG17-04,RG 2011-04,PG 205
			Twin	3	01	3.3	ICCV 15118
9.	Flower: Colour	50% flowering	White	1	01	3.3	RVSSG 60
			Pink	2	23	76.6	Phule G 1018-9-6, PG 187, BRC 305, RG 2011-04, RKG 13-205, GNG 2367, RKG17-04, BRC 302, GJG 1503, NOG 15-5, DC 16-116, PG 205, BG 3092, JSC 55, JG 11 X JG 14, JG63 X ICC4958, JG12 X JG 16-3, JG12 X JG16-1, JG74 X ICCV4958, ICC96029 X JG315, JG 14, JG 36, JG 24
			Blue	3	06	20.0	BG 3091, IPC 2010-14, JG 2017-49, GL 14015, JG 2016-1614, ICCV15118
10.	Flower: Stripes on standard	50 % flowering	Absent	1	06	20.0	BRC 305, RKG 13-205, RVSSG 60, IPC 2010-14, JG 2017-49, NOG 15-5
			Present	9	24	80.0	Phule G 1018-9-6, BG 3091, PG 187, RG 2011-04, GNG 2367, RKG17-04, BRC 302, GJG 1503, DC 16-116, PG 205, GL 14015, BG 3092, JSC 55, JG 11 X JG 14, JG 2016-1614, JG63 X ICC4958, JG12 X JG 16-3, JG12 X JG16-1, JG74 X ICCV4958, ICC96029 X JG315, ICCV15118, JG 14, JG 36, JG 24
11.	Peduncle: Length	Pod development	Short (<5 mm)	3	0	0.00	Nil
			Medium (5-10 mm)	5	23	76.7	Phule G 1018-9-6, PG 187, BRC 305, RKG 13-205, IPC 2010-14, JG 2017-49, RKG17-04, BRC 302, GJG 1503, RVSSG 60, NOG 15-5, DC 16-116, BG 3092, JSC 55, JG 11 X JG 14, JG 2016-1614, JG63 X ICC4958, JG12 X JG 16-3, JG12 X JG16-1, ICC96029 X JG315, JG 14, JG 36, JG 24
			Long (>10 mm)	7	07	23.3	BG 3091, RG 2011-04, GNG 2367, PG 205, GL 14015, JG74 X ICCV4958, ICCV15118
12.	Plant: Height	Fully developed green pod	Short (<45 cm)	3	16	53.4	JG 2016-1614, BRC 305, NOG 15-5, Phule G 1018-9-6, RKG 13-205, JG 14, DC16-116, JG12x JG 16-1, JG12 × JG 16-3, ICCV 15118, JG2017-49, JG 36, GJG 1503, BRC 302, JG 11 × JG 14, RKG17-

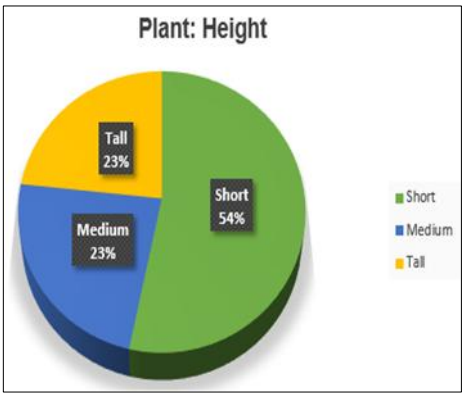
							04
			Medium (45-65 cm)	5	07	23.3	PG 187, IPC 2010-14, BG 3091, RVSSG-60, ICC 96029 × JG315, RG 2011-04, PG 205
			Tall (>65 cm)	7	07	23.3	JSC 55, GL 14015, JG63 × ICC4958, JG74 × ICCV4958, BG 3092, GNG 2367, JG24
13.	Pod: Size (length)	Harvest maturity	Small (<15 mm)	3	14	46.7	IPC 2010-14, GJG 1503, BG 3091, RKG 13-205, RKG17-04, BRC 302, RVSSG 60, PG 205, GL 14015, JG12 X JG 16-3, JG74 X ICCV4958, ICC96029 X JG315, JG 14, JG 36
			Medium (15-20 mm)	5	16	53.3	Phule G 1018-9-6, PG 187, BRC 305, RG 2011-04, GNG 2367, JG 2017-49, NOG 15-5, DC 16-116, BG 3092, JSC 55, JG 11 X JG 14, JG 2016-1614, JG63 X ICC4958, JG12 X JG16-1, ICCV15118, JG 24
			Large (>20mm)	7	0	0.0	Nil
14.	Pod: Number of seeds	Harvest maturity	One	1	29	96.7	JG 2016-1614,JSC 55,BRC 305, NOG 15-5,Phule G 1018-9-6,GL 14015,JG63 × ICC4958,PG 187, RKG 13-205,JG 14,JG74×ICCV4958, IPC2010-14, DC16-116, JG12x JG 16-1,BG 3091,JG12 × JG 16-3,RVSSG-60,JG2017-49,JG 36,GJG 1503,ICC 96029 × JG315, BRC 302, BG 3092,GNG 2367, JG 11 × JG 14, JG24, RKG17-04,RG 2011-04,PG 205,
			More than one	3	01	3.3	ICCV 15118

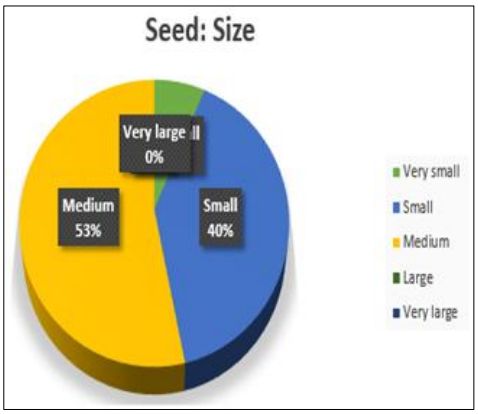
S. No.	Characteristics	Stage of observation	Expression/ States	Note/ Score	Genotype frequency	Percentage contribution	Name of Genotypes
15.	Seed: Colour	30 days after harvest	Beige (Kabuli)	1	0	0.0	Nil
			Creamy beige	2	0	0.0	Nil
			Green	3	0	0.0	Nil
			Yellow	4	2	6.7	RKG17-04, GL 14015
			Orange	5	0	0.0	Nil
			Brown	6	20	66.7	PG 187, RKG 13-205, BG 3092, JG63 X ICC4958, JG 14, JG 36, JG 24, Phule G 1018-9-6, BRC 305, RG 2011-04, IPC 2010-14, JG 2017-49, BRC 302, GJG 1503, RVSSG 60, NOG 15-5, JG12 X JG 16-3, JG74 X ICCV4958, ICC96029 X JG315, ICCV15118
			Dark Brown	7	08	26.7	BG 3091, GNG 2367, DC 16-116, PG 205, JSC 55, JG 11 X JG 14, JG 2016-1614, JG12 X JG16-1
			Grey	9	0	0.0	Nil
			Black	10	0	0.0	Nil
16.	Seed: Size (weight of 100 seeds at 10% moisture content)	30 days after harvest	Very small (<20g)	1	02	6.7	IPC 2010-14, GJG 1503
			Small (20-25g)	3	12	40.0	BG 3091, RKG 13-205, RKG17-04, BRC 302, RVSSG 60, PG 205, GL 14015, JG12 X JG 16-3, JG74 X ICCV4958, ICC96029 X JG315, JG 14, JG 36
			Medium (26-35g)	5	16	53.3	Phule G 1018-9-6, PG 187, BRC 305, RG 2011-04, GNG 2367, JG 2017-49, NOG 15-5, DC 16-116, BG 3092, JSC 55, JG 11 X JG 14, JG 2016-1614, JG63 X ICC4958, JG12 X JG16-1, ICCV15118, JG 24
			Large (36-45g)	7	0	0.0	Nil
			Very large (>45g)	9	0	0.0	Nil
17.	Seed: shape	30 days after harvest	Pea-shaped	1	0	0.0	Nil
			Owl's head	2	17	56.7	Phule G 1018-9-6, BRC 305, RG 2011-04, RKG 13-205, GNG 2367, BRC 302, GJG

							1503, RVSSG 60, NOG 15-5, PG 205, JG 11 X JG 14, JG63 X ICC4958, JG12 X JG 16-3, JG74 X ICCV4958, ICC96029 X JG315, ICCV15118, JG 14
			Angular	3	13	43.3	BG 3091, PG 187, IPC 2010-14, JG 2017-49, RKG17-04, DC 16-116, GL 14015, BG 3092, JSC 55, JG 2016-1614, JG12 X JG16-1, JG 36, JG 24
18.	Seed: Testa texture	30 days after harvest	Rough	1	05	16.7	GL 14015, NOG 15-5, JG12 X JG 16-3, ICC96029 X JG315, JG 14
			Smooth	2	25	83.3	Phule G 1018-9-6, BG 3091, PG 187, BRC 305, RG 2011-04, RKG 13-205, IPC 2010-14, GNG 2367, JG 2017-49, RKG17-04, BRC 302, GJG 1503, RVSSG 60, DC 16-116, PG 205, BG 3092, JSC 55, JG 11 X JG 14, JG 2016-1614, JG63 X ICC4958, JG12 X JG16-1, JG74 X ICCV4958, ICCV15118, JG 36, JG 24
			Tuberculated	3	0	0.0	Nil
19.	Seed: Ribbing	30 days after harvest	Absent	1	03	10.0	BG 3091, RG 2011-04, BRC 302
			Present	9	27	90.0	Phule G 1018-9-6, PG 187, BRC 305, RKG 13-205, IPC 2010-14, GNG 2367, JG 2017-49, RKG17-04, GJG 1503, RVSSG 60, NOG 15-5, DC 16-116, PG 205, GL 14015, BG 3092, JSC 55, JG 11 X JG 14, JG 2016-1614, JG63 X ICC4958, JG12 X JG 16-3, JG12 X JG16-1, JG74 X ICCV4958, ICC96029 X JG315, JG 14, JG 36, JG 24, ICCV15118
20.	Seed: Type	30 days after harvest	Desi	1	30	100.0	All genotype
			Kabuli	3	0	0.0	Nil









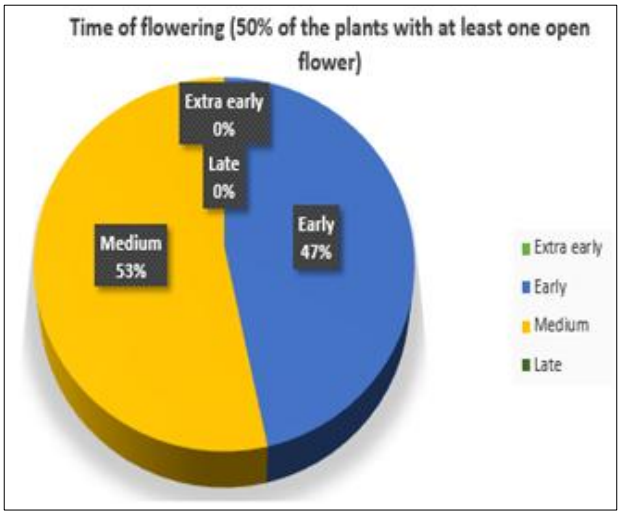
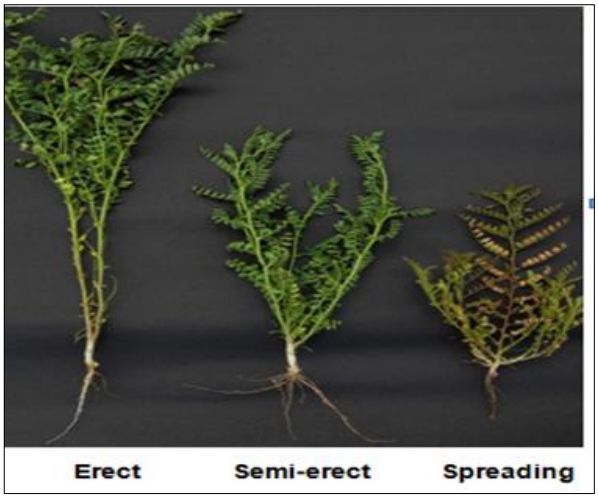
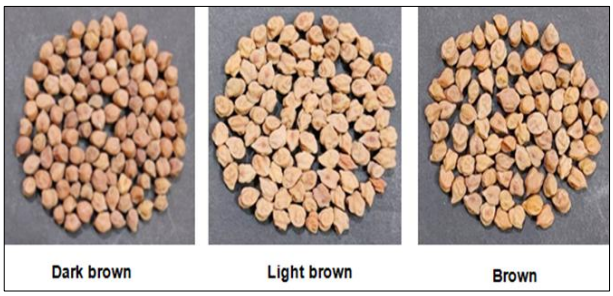


Fig 1: Pie chart of frequency distribution of morphological and seed traits of promising traits





4. Conclusions

Genetic resources provide basic material for selection and improvement through breeding to ensure food security needs of the world's rapidly rising population. However systematic characterization leads to a more efficient use of material under consideration in chickpea improvement programme. Large variation was observed in seed coat colour, seed size, plant height, days to flowering and growth habit. Selection of genotypes with erect growth habit facilitates mechanical harvesting, increase in plant population that may increase yield, whereas, spreading types, may serve to conserve soil moisture. Genotypes were semi erect growth habit provides an opportunity for better yield in rice fellow condition, while short duration, semi-spreading and spreading growth habit have large canopy area which reduces the evaporation and provides an opportunity to produce high yield in central zone and south zone of India. Large variation in seed colour present in the germplasm has high market price and high profitability to farmers. Genotypes with long plant height might be found suitable for machine harvesting. Considering these traits make easy identification of the promising genotypes may be helpful for breeder for further chickpea seed production programme.

5. Acknowledgments

Authors are grateful to AICRP on Chickpea, JNKVV, Jabalpur, Madhya Pradesh and ICRISAT, Patencheru, Hyderabad for providing experimental material consists of 30 indigenous and exotic advanced breeding lines of *desi* chickpea.

6. References

1. Araujo MMD, Vello NA. Characterization of soybean genotypes for Asian soybean rust reaction. Crop Breeding and Applied Biotechnology 2010;10(3):197-203.
2. Auckland AK, Singh KB. The exploitation of natural genetic variability for the improvement of chickpea (*Cicer arietinum* L.). In Genetic diversity in plants. Springer, Boston, MA. 1977, 83-95.
3. Auckland AK, Van der Maesen LJG. Chickpea. Hybridization of crop plants. 1980, 249-259.
4. Bayahi K, Rezgui S. Agro-morphological characterization and genetic study of new improved lines and cultivars of chickpea (*Cicer arietinum* L.). Journal of Plant Breeding and Genetics 2015;3(3):59-65.
5. Diederichsen A, Richards K. Cultivated flax and the genus *Linum* L.: Taxonomy and germplasm conservation. In *flax* CRC Press 2003, 34-66.

6. Gediya LN, Patel DA, Kumar D, Vekariya KJ, Nayak JJ. Characterization of chickpea genotypes based on morphological traits. Journal of Pharmacognosy and Phytochemistry. 2018;7(4):3008-3015.
7. Hamayoon R, Khan H, Naz L, Munir I, Arif M, Khalil IA, *et al*. Performance of chickpea genotypes under two different environmental conditions. African Journal of Biotechnology 2011;10(9):1534-1544.
8. Kaul J, Kumar S, Gurha SN. Evaluation of exotic germplasm of kabuli chickpea. Indian Journal of Plant Genetic Resources 2007;20(2):160-164.
9. Keneni G, Bekele E, Getu E, Imtiaz M, Dagne K, Asefa F. Characterization of Ethiopian chickpea (*Cicer arietinum* L.) germplasm accessions for response to infestation by Adzuki bean beetle (Callosobruchus chinensis L.) II. phenotypic diversity and performance evaluation. Ethiop. J. Agric. Sci 2011;21:65-83.
10. Ladizinsky G, Adler A. The origin of chickpea *Cicer arietinum* L. Euphytica. 1976;25(1):211-217
11. Lalitha A. Varietal Characterization of Chickpea *(Cicer arietinum)* Varieties. Doctoral dissertation, Acharya NG Ranga agricultural university, Rajendranagar, Hyderabad 2007.
12. Pundir RPS, Reddy KN, Mengesha MH. Genetics of some physio-morphic and yield traits of chickpea (*Cicer arietinum* L.). Legume Research. 1991;14(4):157-161.
13. Qureshi AS, Shaukat A, Bakhsh A, Arshad M, Ghafoor A. An assessment of variability for economically important traits in chickpea (*Cicer arietinum* L.). Pakistan Journal of Botany. 2004;36(4):779-785.
14. Raina R, Singh RM, Singh AP, Nandan R. Variability and inheritance studies in a distant cross of pigeonpea (*Cajanus cajan* L. Mill sp.). Crop Research. 1994;8(1):126-30.
15. Sarao NK, Joshi MA, Sharma RC, Sandhu JS, Kumar J. Characterization of chickpea based on morphological markers. Journal of Food Legumes. 2009;22(4):251-253.
16. Shrivastava A, Babbar A, Shrivastava SP, Shukla SS. Variability studies in some genotypes of chickpea (*Cicer arietinum* L.) under rice fallow. Journal of Food Legumes. 2012;25(1):70-72.
17. Upadhyaya HD, Dwivedi SL, Gowda CLL, Singh S. Identification of diverse germplasm lines for agronomic traits in a chickpea (*Cicer arietinum* L.) core collection for use in crop improvement. Field Crops Research. 2007;100(2-3):320-326.
18. Upadhyaya HD. Geographical patterns of variation for morphological and agronomic characteristics in the chickpea germplasm collection. *Euphytica*. 2003;132(3):343-352.