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Characterization of Chickpea Genotypes (*Cicer arietinum* L.) through Morphological Characters, Chemical Tests and Quality Parameters

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Abstract

An experiment was carried out at the Pulses Research Station, Junagadh Agricultural University, Junagadh, to characterize twenty-five chickpea genotypes based on plant morphological characters. The genotypes were grouped based on the variation in time of flowering the genotypes were grouped as early (13 genotypes) and medium (12 genotypes). Based on the growth habit, the genotypes were grouped into erect (6 genotypes), semi erect (14 genotypes) and spreading (5 genotypes). Based on leaf let size, the genotypes were grouped into small (15 genotypes), medium (9 genotypes) large (1 genotype). Based on peduncle length, the genotypes were grouped into medium (18 genotypes) and long (7 genotypes). Based on plant height, the genotypes were grouped into short (3 genotype), medium (19 genotypes) and tall (3 genotypes). Based on pod size, the genotypes were grouped into small (15 genotypes), medium (5 genotypes) and large (5 genotypes). Based on days to maturity, the genotypes were grouped into early (17 genotype) and medium (8 genotypes). Based on the number of branches per plant, the genotypes were grouped into high (4 genotypes) and medium (21 genotypes). Number of pods per plant varied significantly among the genotypes. Number of pods per plant ranged from 87.28 (DCP 35) to 128.60 (GJG 6) with mean of 106.16. The first pod bearing node varied significantly among the genotypes. First pod bearing node ranged from 13.40 cm (GNG 469) to 25.13 cm (GG 5) with mean 19.42 cm.

Key words : *Chickpea, characterization, plant, morphology.*

Introduction

Chickpea is the common name for an annual plant, *Cicer arietinum* L., of the *Fabaceae* family that is widely cultivated for its typically yellow-brown, pea-like seeds. The name chickpea also used for these edible seeds, which form in short pods and are popular in various cuisines.

Chickpea is a self-pollinated true diploid (2n=2x=16) crop, it is an ancient cool season food legume crop cultivated by man and has been found in Middle Eastern archaeological sites dated 7500–6800 BC (1). Its cultivation is mainly concentrated in semi-arid environments (2). (3) reported that Southwest Asia and the Mediterranean region being the primary centers of origin, with Ethiopia as the secondary centre. (4) suggested that Anatolia in Turkey was the area where chickpea was believed to have originated. Chickpea is popularly cultivated in sub-tropical and semi-arid to warm temperate regions under dry season (5).

India is the largest producer of chickpea contributing more than 75 per cent of the world production. In India, during 2017-18, chickpea was grown in an area of 10.56 million hectare with a production 11.37 million tons and productivity of 1077 kg/ha. Madhya Pradesh, Rajasthan, Maharashtra, Andhra Pradesh, Karnataka, Uttar Pradesh, Gujarat, Chhattisgarh and Jharkhand are the major chickpea producing states in the country. It was grown in area of 0.293 million hectare with a production 0.38 million tons and productivity 1285 kg/ha in Gujarat during 2017-18 (6).

For production of high-quality seed, plant morphological characteristics of each variety should be thoroughly understood, so that proper attention could be paid at critical stages of seed production to maintain identity and purity. But unfortunately, most of the currently used morphological characteristics do not fulfil all these criteria. Moreover, varietal characterization is assessed through field plot technique which is tedious, cumbersome, time consuming, seasonal dependent and may be affected by environment.

Materials and Methods

The field experiment was conducted at the Pulses Research Station, Junagadh Agricultural University, Junagadhduring 2018-19 to characterize the 25 genotypes of chickpea (*Cicer arietinum* L.) *viz.,* DCP 35, GNG 2064, GL 28147, ICCV 05529, GJG 0612, GCP 9602, GJG 0619, GNG 469, SAKI 9516, GCP 960, ICCV 4, JG 14, BG 39, GCP 9603, GJG 0611, GCP 9629, GCP 9808, Jaki9218, Vijay, GCP 2009, GG 1, GG 2, GJG 3,

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Table-1 : Identification and grouping of chickpea genotypes based on time of 50% flowering, growth habit and leaf let size.

Genotypes	Time of 50% flowering	Group	Growth habit	Leaf let size (mm)	Group
DCP 35	58.00	Early	Erect	8.27	Small
GNG 2064	59.00	Early	Spreading	6.80	Small
GL28147	59.00	Early	Semi erect	6.47	Small
ICCV 05529	60.00	Medium	Semi erect	7.43	Small
GJG 0612	57.33	Early	Semi erect	8.23	Small
GCP 9602	60.00	Medium	Semi erect	8.80	Small
GJG 0619	59.00	Early	Semi erect	7.77	Small
GNG 469	63.33	Medium	Erect	7.53	Small
SAKI 9516	60.67	Medium	Spreading	12.27	Medium
GCP 960	61.00	Medium	Erect	8.37	Small
ICCV 4	61.33	Medium	Semi erect	8.73	Small
JG 14	62.00	Medium	Semi erect	12.27	Medium
BG 39	61.33	Medium	Spreading	11.77	Medium
GCP 9603	59.67	Early	Semi erect	7.53	Small
GJG 0611	61.33	Medium	Erect	7.67	Small
GCP 9629	60.33	Medium	Semi erect	7.33	Small
GCP 9808	63.00	Medium	Erect	8.17	Small
Jaki 9218	55.00	Early	Spreading	12.12	Medium
Vijay	53.00	Early	Spreading	12.50	Medium
GCP 2009	61.67	Medium	Erect	8.20	Small
GG 1	52.67	Early	Semi erect	11.43	Medium
GG 2	48.22	Early	Semi erect	15.45	Large
GJG 3	50.02	Early	Semi erect	12.67	Medium
GG 5	53.67	Early	Semi erect	11.50	Medium
GJG 6	54.00	Early	Semi erect	12.30	Medium
Mean	58.18			9.54	
S.Em ±	2.41			0.48	
C.D. at 5 %	7.04			1.41	
CV %	7.14			8.78	

Note : Time of 50% flowering
Early : <60 days
Medium : 60-80 days
Late : >80 days

Note : Leaf let size
Small : <10 mm
Medium : 10-15 mm
Large : >15 mm

GG 5, GJG 6. based on plant morphological characters. The experiment was conducted as per randomized block design with three repetitions. The recommended agronomical and plant protection package of practices were followed for raising successful crop. The observations were recorded on 5 randomly selected plants for each replication at different crop growth stages. Data were collected on 10 morphological characters.The data obtained from field experiment conducted in RBD were analysed as per standard method suggested by (7).

Results and Discussion

Based on variation in physical characteristics, it was attempted to group the chickpea genotypes and identify each and every one of them through descriptors. Based on, plant morphological variation, 25 genotypes could be identified from each other. (Table-1,2,3 and 4) Based on time of flowering, the genotypes were grouped as early (<60 days) in thirteen genotypes and medium (60-80 days) in twelve genotypes. The time of flowering ranged from 48.22 days (GG 2) to 63.33 days (GNG 469) with a mean of 58.52 days.Based on growth habit, the genotypes were grouped as erect in six genotypes, semi erect in fourteen genotypes and spreading in five genotypes. Based on leaf let size, the genotypes were grouped as small (<10 mm) in fifteen genotypes, medium (10-15 mm) in nine genotypes and large (>15 mm) in one genotype. The leaf let size ranged from 6.47 mm (GL 28147) to 15.45 mm (GG 2) with a mean of 9.54 mm.

Based on peduncle length, the genotypes were grouped as medium (5-10 mm) in eighteen genotypes and long (>10 mm) in seven genotypes. The peduncle length ranged from 7.53 mm (GCP 960) to 23.40 mm (VIJAY) with a mean of 15.29 mm. Based on plant height, the genotypes were grouped as short in three genotypes (< 45 cm), medium (45-60 cm) in nineteen genotypes and tall in three genotypes. The plant height ranged from

Table-2 : Identification and grouping of chickpea genotypes based on peduncle length and plant height.

Genotypes	Peduncle length (mm)	Group	Plant height (cm)	Group
DCP 35	9.07	Medium	52.89	Medium
GNG 2064	8.10	Medium	50.02	Medium
GL28147	15.27	Long	53.51	Medium
ICCV 05529	13.77	Long	50.43	Medium
GJG 0612	8.43	Medium	51.66	Medium
GCP 9602	8.63	Medium	47.56	Medium
GJG 0619	8.90	Medium	51.25	Medium
GNG 469	9.97	Medium	49.61	Medium
SAKI 9516	8.56	Medium	50.02	Medium
GCP 960	7.53	Medium	50.02	Medium
ICCV 4	22.13	Long	49.61	Medium
JG 14	17.23	Long	67.65	Tall
BG 39	19.70	Long	63.55	Tall
GCP 9603	8.33	Medium	47.97	Medium
GJG 0611	8.53	Medium	51.25	Medium
GCP 9629	7.57	Medium	47.97	Medium
GCP 9808	8.77	Medium	51.25	Medium
Jaki 9218	20.60	Long	50.84	Medium
Vijay	23.40	Long	64.78	Tall
GCP 2009	9.03	Medium	50.84	Medium
GG 1	9.52	Medium	41.12	Short
GG 2	8.56	Medium	40.55	Short
GJG 3	9.48	Medium	40.22	Short
GG 5	8.89	Medium	46.22	Medium
GJG 6	9.88	Medium	47.65	Medium
Mean	15.29		56.60	
S.Em ±	0.87		3.69	
C.D. at 5 %	2.54		10.76	
CV %	9.86		11.28	

Note : peduncle length
Short : <5 mm
Medium : 5 – 10 mm
Long : >10 mm

Note : Plant height
Short : <45 cm
Medium : 45-60 cm
Tall : >60 cm

40.22 cm (GJG 3) to 67.65 cm (JG 14) with a mean of 58.18 cm.

Based on pod size, the genotypes were grouped as small (<15 mm) in fifteen genotypes, medium (15-20 mm) in five genotypes and large (>20 mm) in five genotypes. The pod size ranged 9.40 mm (GNG 2064) to 23.30 mm (GJG 6) with mean of 14.48 mm. Based on days to maturity, the genotypes were grouped as early (90-110 days) in seventeen genotypes, medium (110-130 days) in eight genotypes. The days to maturity ranged to 93.97 days (GG 5) to 121.00 days (GJG 0619) with mean of 105.71 days. Based on number of branches per plant, the genotypes were grouped medium (2-4) in twenty-one genotypes and high (4) in four genotypes.

The number of branches per plant ranged 2.17 (ICCV 05529) to 5.73 (GNG 2064) with mean 3.26. Number of pods per plant varied significantly among the twenty-five genotypes and number of pods per plant ranged from 87.28 (DCP 35) to 128.60 (GJG 6) with mean of 106.16. The first pod bearing node varied significantly among the twenty-five genotypes and first pod bearing node ranged from 13.40 cm (GNG 469) to 25.13 cm (GG 5) with mean 19.42 cm.

On the basis of plant morphological characteristics discussed above, genotypic identification keys were prepared (Figure-1). The genotypes *viz;* GJG 3 and GJG 6 were having similar plant morphology *viz.,* early time of flowering, semi erect growth habit, medium leaflet size, medium peduncle length, large pod size, and early days to maturity, high number of branches per plant, but differing in plant height with short (GJG 3) and medium (GJG 6). The genotype GG 2 differing from above genotypes with respect to large leatlet size and short plant height. The genotypes *viz;* GG 1 and GG 5 were having similar plant morphology *viz.,* early time of flowering, semi erect growth habit, medium leaflet size, medium peduncle

Table-3 : Identification and grouping of chickpea genotypes based on pod size, days of maturity and number of branches per plant.

Genotypes	Pod size (mm)	Group	Days of maturity	Group	Number of branches per plant	Group
DCP 35	10.27	Small	102.67	Early	2.20	Medium
GNG 2064	9.40	Small	99.67	Early	5.73	High
GL28147	12.00	Small	103.33	Early	2.93	Medium
ICCV 05529	11.20	Small	109.67	Early	2.17	Medium
GJG 0612	10.43	Small	105.67	Early	2.30	Medium
GCP 9602	12.80	Small	118.00	Medium	2.97	Medium
GJG 0619	10.73	Small	121.00	Medium	3.07	Medium
GNG 469	10.20	Small	111.67	Medium	2.33	Medium
SAKI 9516	16.60	Medium	110.33	Medium	3.07	Medium
GCP 960	11.60	Small	101.00	Early	3.37	Medium
ICCV 4	11.60	Small	104.67	Early	3.80	Medium
JG 14	16.50	Medium	110.33	Medium	3.97	Medium
BG 39	16.57	Medium	97.00	Early	3.27	Medium
GCP 9603	11.70	Small	111.33	Medium	2.90	Medium
GJG 0611	11.40	Small	110.00	Early	2.20	Medium
GCP 9629	10.67	Small	107.67	Early	2.57	Medium
GCP 9808	11.30	Small	116.67	Medium	3.17	Medium
Jaki 9218	16.53	Medium	100.67	Early	2.90	Medium
Vijay	16.93	Medium	102.00	Early	2.73	Medium
2GC P 2009	11.70	Small	117.67	Medium	3.27	Medium
GG 1	21.83	Large	105.21	Early	3.77	Medium
GG 2	22.30	Large	97.33	Early	4.07	High
GJG 3	21.87	Large	100.89	Early	4.37	High
GG 5	22.63	Large	102.78	Early	3.97	Medium
GJG 6	23.30	Large	108.89	Early	4.37	High
Mean	14.48		105.71		3.26	
S.Em ±	0.91		4.21		0.18	
C.D. at 5 %	2.64		12.29		0.51	
CV %	10.82		6.90		9.31	

Note : Pod size
Small : <15 mm
Medium : 15-20 mm
Large : >20 mm

Note : days to maturity
early : 90-110 days
medium : 110-130 days
late : >130 days

Note : No. of branches per plant
Low : 1-2 branches
Medium : 3-4 branches
High : > 4 branches

Table-4 : Identification and grouping of chickpea genotypes based on number of pods per plant, first pod bearing node.

Genotypes	Number of pods per plant	First pod bearing node (cm)
DCP 35	87.28	15.23
GNG 2064	93.18	17.83
GL28147	105.66	20.40
ICCV 05529	109.92	20.27
GJG 0612	97.64	23.17
GCP 9602	93.57	21.03
GJG 0619	100.85	18.33
GNG 469	89.35	13.40
SAKI 9516	101.63	15.67
GCP 960	89.07	15.23
ICCV 4	101.11	20.60
JG 14	111.18	22.17
BG 39	114.95	22.27
GCP 9603	100.08	15.63
GJG 0611	114.24	14.77
GCP 9629	105.47	13.60
GCP 9808	111.23	17.00
Jaki 9218	104.32	18.93
Vijay	99.91	21.00
GCP 2009	100.10	22.83
GG 1	114.17	23.03
GG 2	125.72	23.17
GJG 3	126.15	21.55
GG 5	128.53	25.13
GJG 6	128.60	23.37
Mean	106.16	19.42
S.Em ±	4.38	0.84
C.D. at 5%	12.77	2.47

length, large pod size, early days to maturity, medium number of branches per plant, but differing in plant height with short (GG 1) and medium (GG 5).The genotypes *viz;* GCP 9603 and GJG 0619 were having similar plant morphology *viz.,* early time of flowering, semi erect growth habit, small leaflet size, medium peduncle length, medium plant height, small pod size, medium days to maturity, medium number of branches per plant. The genotype GJG 9602 differing from above genotypes with respect to medium time of flowering. The genotype GCP 9629 and GCP 960 were having similar plant morphology *viz.,* medium time of flowering, small leaflet size, medium peduncle length, medium plant height, small pod size, early days to maturity, medium number of branches per plant but differing in growth habit semi erect (GCP 9629) and erect (GCP 960).

GCP 9808, GCP 2009 and GNG 469 were having similar plant morphology *viz.,* medium time of flowering, erect growth habit, small leaflet size, medium peduncle length, medium plant height, small pod size, medium days to maturity, medium number of branches per plant. GJG 0612 and GL 28147 were having similar plant morphology *viz.,* early time of flowering, semi erect growth habit, small leaflet size, medium plant height, small pod size, early

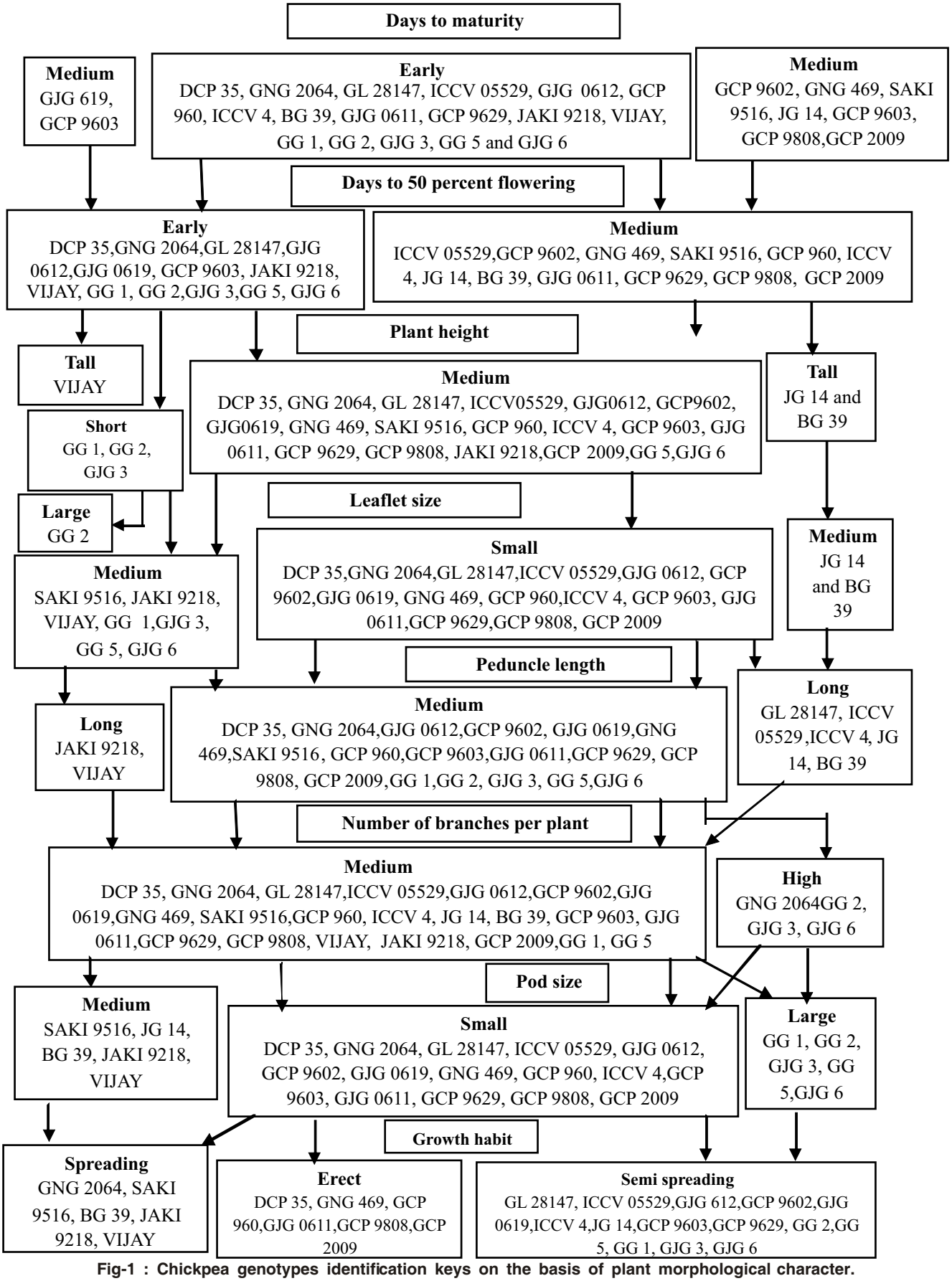

Fig-1 : Chickpea genotypes identification keys on the basis of plant morphological character.

days to maturity, medium number of branches per plant. But differing in peduncle length long (GL 28147) and medium (GJG 0612).

Jaki 9218 and Vijay were having similar plant morphology *viz.,* early time of flowering,spreading growth habit, medium leaflet size, long peduncle length, medium pod size, early days to maturity, medium number of branches per plant but differing in plant height with medium (Jaki9218) and tall (Vijay). The genotype BG 39 differing from above genotypes with respect to medium time of flowering. ICCV 05529 and ICCV 4 were having similar plant morphology *viz.,* medium time of flowering,semi erect growth habit, small leaflet size, long peduncle length, medium plant height, small pod size, early days to maturity and medium number of branches per plant.

The genotype GNG 2064 was having plant morphology *viz.,* early time of flowering, spreading growth habit, small leaflet size, medium peduncle length, medium plant height, small pod size, early days to maturity and high number of branches per plant.The genotype SAKI 9516 was having plant morphology *viz.,* medium time of flowering, spreading growth habit, medium leaflet size, medium peduncle length, medium plant height, medium pod size, early days to maturity and medium number of branches per plant. The genotype JG 14 was having plant morphology *viz.,* medium time of flowering, semi erect growth habit, medium leaflet size, long peduncle length, tall plant height, medium pod size, medium days to maturity and medium number of branches per plant.The genotype GJG 0611 was having plant morphology *viz.,* medium time of flowering, erect growth habit, small leaflet size, medium peduncle length, medium plant height, small pod size, early days to maturity and medium number of branches per plant.Similar findings and grouping of genotypes based on plant morphological characters were made by (8,12,13) in chickpea.

Conclusions

From the above discussion, it can be stated that the assessment of genetic purity is an important criterion in seed production programme. Therefore, simple and reliable techniques need to be developed for genetic purity assessment and variety characterization. The identified morphological characteristics of chickpea genotypes could be utilized in DUS testing, seed production programme and genetic purity testing. The result of chemical test is useful in identifying and grouping of chickpea genotypes and also in genetic purity testing.

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