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Characterization of Kabuli Chickpea (*Cicer arietinum* L.) Genotypes through Plant Morphological Characters

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Abstract

An experiment was carried out at the Pulses Research Station, Junagadh Agricultural University, Junagadh, to characterize forty twokabuli 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 (21 genotypes) and medium (21). Based on the growth habit, the genotypes were grouped into erect (4 genotypes) and semi erect (38 genotypes). Based on leaf let size, the genotypes were grouped into small (4 genotypes), medium (9 genotypes) and large (29 genotype). Based on peduncle length, the genotypes were grouped into medium (8 genotypes) and long (34 genotypes). Based on plant height, the genotypes were grouped into short (21 genotype) and medium (21 genotypes). Based on pod size, the genotypes were grouped into small (9 genotypes), medium (27 genotypes) and large (6 genotypes). Based on days to maturity, the genotypes were grouped into early (26 genotype) and medium (16 genotypes). Based on the number of branches per plant, the genotypes were grouped into high (40 genotypes) and medium (2 genotypes). Number of pods per plant varied significantly among the genotypes. Number of pods per plant ranged from 15.14 (CSJK 134) to 100.23 (Phule-G-16318) with mean of 38.41. The first pod bearing node varied significantly among the genotypes. First pod bearing node ranged from 17.00 cm (RVSSG 62) to 31.76 cm (GJGK 1823) with mean 22.96 cm.

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

Introduction

Kabuli chickpea or white gram (*Cicer arietinum* L.), in this group the colour of the seed is usually white grains are bold and attractive. Yield potential of this group is poor as compared to desi or brown gram. Plants are generally taller than the desi gram stand more or less erect. Chickpea (*Cicer arietinum* L.) is a self-pollinated true diploid (2n=2x=16) crop, belongs to genus *Cicer,* tribe *cicereae,Fabaceae* family and subfamily *Papilionacea* (1).

Chickpea is an ancient cool season food legume crop cultivated by man and has been found in Middle Eastern archaeological sites dated 7500–6800 BC (2). Its cultivation is mainly concentrated in semi-arid environments. (3) reported that Southwest Asia and the Mediterranean region being the primary centers of origin, with Ethiopia as the secondary center. (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.

Chickpea is the fourth largest grain legume crop in the world with a total production of 13.12 million tons from an area of 13.57 million hectare with productivity of 967 kg/ha. Major chickpea producing countries include India, Australia, Pakistan, Myanmar, Ethiopia, Turkey, Iran, Mexico, USA, Canada, Russian Federation and Tanzania (5). About 90 per cent of chickpea in the world is grown under rain fed conditions, where drought is one of the major constraints, limiting its production (6). India is the largest producer of chickpea contributing more than 75 per cent of the world production. In India, chickpea was grown in an area of 9.67 million hectare with a production 10.09 million tonnes and productivity of 1043 kg/ha. Madhya Pradesh, Rajasthan, Maharashtra, Andhra Pradesh, Karnataka, Uttar Pradesh, Gujarat, Chhattisgarh and Jharkhand are the major chickpea producing states in the country. In Gujarat Chickpea was grown in area of 0.29 million hectare with a production 0.38 million tonnes and productivity 1285 kg/ha (7).

The morphological characteristics of each variety should be completely recognised for the development of high-quality seed, so that sufficient attention may be paid at critical stages of seed production to ensure identity and purity (8). Unfortunately, the majority of currently utilised morphological traits do not meet all of these requirements. Further more, varietal characterisation is determined using the field plot technique, which is time-consuming, labour-intensive, seasonal and susceptible to environ-mental influences.

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Materials and Methods

The field experiment was conducted at the Pulses Research Station, Junagadh Agricultural University, Junagadhduring 2019-20 to characterize the 42 genotypes of chickpea (*Cicer arietinum* L.) *viz.,* GJGK-1824, BG-4009, RKGK-13-499, RLBGK-1, PG-219, HK-13-114, HK-16-30, GJGK-1823, RLBGK-3, IPCK-2009-145, GJGK-1825, PKV-4, GNG-2399, RKGK-18-414, NBeG-723, CSJK-142, IPCK-11-37, CSJK-134, RKV-4, RLVGK-3, JGK-1, ICCV-181314, GLK-17316, GLK-17301, GNG-2446, GJGK-1827, CSJK-174, BG-4008, Phule-G-16318, IPCK-13-163, RVSSG-78, GJGK-1828, GNG-2453, RVSSG-77, ICCV-171318, Phule-G-0517, RLBGK-2, RVSSG-62, JGK-2017-32, GJGK-1826, ICCV-171310, ICCV-181308, based on plant morphological characters.They were sown at 45×10 cm distance. The experiment was carried out in field as per Randomized Block Design with three replications. All the necessary cultural practices were carried out during crop standing. The observations were recorded on 5 randomly selected plants for each replication at different crop growth stages. The data obtained from field experiment conducted in RBD were analyzed as per standard method suggested by (9).

Results and Discussion

It was attempted to organise the chickpea genotypes and identify each one using descriptors based on differences in physical traits. 42 genotypes could be distinguished from one another based on plant morphological diversity. (Table-1,2,3 and 4). Based on time of flowering, the genotypes were grouped as early (<60 days) in twenty one genotypes and medium (60-80 days) in twenty one genotypes. The time of flowering ranged from 52.64 days (GJGK-1827) to 65.48 days (ICCV-171310) with a mean of 59.72days. Based on growth habit, the genotypes were grouped as erect in four genotypes and semi erect in thirty eight genotypes. Based on leaf let size, the genotypes were grouped as small (<10 mm) in four genotype, medium (10-15 mm) in nine genotypes and large (> 15 mm) in twenty nine genotypes. The leaf let size ranged from 9.23 mm (CSJK-142) to 25.14 mm (ICCV-181314) with a mean of 18.53 mm.

Based on peduncle length, the genotypes were grouped as medium (5-10 mm) in eight genotypes and long (>10 mm) in thirty four genotypes. The peduncle length ranged from 7.98 mm (JGK-2017-32) to 21.29 mm (ICCV-181314) with a mean of 14.40 mm. Based on plant height, the genotypes were grouped as short (<45 cm) in twenty one genotypes, medium (45-60 cm) in twenty one genotypes. The plant height ranged 36.22 cm (GJGK-1823) to 56.36 cm (BG-4008) with a mean of 46.57 cm.

Based on pod size, the genotypes were grouped as small (<15 mm) in nine genotypes, medium (15-20 mm) in twenty seven genotypes and large (>20 mm) in six genotypes. The pod size ranged 12.99 mm (RVSSG-62) to 23.45 mm (RKGK-18-414) with mean of 17.75 mm. Based on days to maturity, the genotypes were grouped as early (90- 110 days) in twenty six genotypes and medium (110-130 days) in sixteen genotypes. The days to maturity ranged from 99.24 days (RLVGK-3) to 115.89 days (ICCV-181308) with mean of 107.92 days. Based on number of branches per plant, the genotypes were grouped as medium (3-4) in two genotypes and high (10) in forty genotype.

The number of branches per plant ranged 3.23 (GJGK-1825) to 10.50 (CSJK-134) with mean 7.24. Number of pod per plant varied significantly among the forty two genotypes and number of pod per plant ranged from 15.14 (CSJK-134) to 100.23 (Phule-G-16318) with mean of 38.41. The first pod bearing node varied significantly among the forty two genotypes and first pod bearing node ranged from 17.00cm (RVSSG-62) to 31.76 cm (GJGK-1823) with mean of 22.96cm.

On the basis of plant morphological characteristics, chickpea genotypes identification keys are presented in the (Figure-1). The genotypes GJGK-1824 and NBeG-723 were having similar plant morphology *viz.,* early time of flowering, medium plant height, semi erect growth habit, large leaf let size, long peduncle length, medium pod size, early days to maturity and high number of branches per plant. The genotypes BG-4008 was having plant morphology *viz.,* early time of flowering, medium plant height, erect growth habit, large leaf let size, long peduncle length, medium pod size, early days to maturity and high number of branches per plant, while the genotype PG-219 varied from above genotypes with respect to mediumleaf let size and medium days to maturity.

The genotype ICCV-181308 was having early time of flowering, short plant height, semi erect growth habit, large leaf let size, long peduncle length, small pod size, medium days to maturity and medium number of branches per plant, while genotype RVSSG-62 varied from above genotypes with respect to high number of branches per plant.

The genotypes Phule-G-0517 and JGK-2017-32 were having similar plant morphology *viz.,* medium time of flowering, medium plant height, semi erect growth habit, medium leaf let size, medium peduncle length,small pod size, early days to maturity and high number of branches

Table-1 : Identification and grouping of kabuli 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
GJGK-1824	57.59	Early	Semi erect	18.92	Large
BG-4009	61.41	Medium	Semi erect	21.17	Large
RKGK-13-499	64.00	Medium	Semi erect	23.77	Large
RLBGK-1	54.27	Early	Semi erect	14.03	Medium
PG-219	59.26	Early	Erect	14.23	Medium
HK-13-114	53.82	Early	Semi erect	18.01	Large
HK-16-30	57.06	Early	Semi erect	16.82	Large
GJGK-1823	60.10	Medium	Semi erect	13.43	Medium
RLBGK-3	55.38	Early	Semi erect	15.15	Large
IPCK-2009-145	57.89	Early	Semi erect	17.66	Large
GJGK-1825	64.24	Medium	Semi erect	24.01	Large
PKV-4	57.35	Early	Semi erect	17.12	Large
GNG-2399	61.71	Medium	Semi erect	21.48	Large
RKGK-18-414	61.89	Medium	Erect	9.79	Small
NBeG-723	56.89	Early	Semi erect	16.66	Large
CSJK-142	57.79	Early	Semi erect	9.23	Small
IPCK-11-37	61.66	Medium	Semi erect	21.43	Large
CSJK-134	56.32	Early	Semi erect	16.08	Large
RKV-4	62.00	Medium	Semi erect	12.23	Medium
RLVGK-3	63.44	Medium	Semi erect	23.21	Large
JGK-1	55.24	Early	Semi erect	9.59	Small
ICCV-181314	65.37	Medium	Semi erect	25.14	Large
GLK-17316	56.26	Early	Semi erect	16.02	Large
GLK-17301	61.31	Medium	Semi erect	14.12	Medium
GNG-2446	56.29	Early	Semi erect	16.05	Large
GJGK-1827	52.64	Early	Semi erect	12.40	Medium
CSJK-174	62.56	Medium	Semi erect	9.49	Small
BG-4008	56.70	Early	Erect	16.46	Large
Phule-G-16318	62.45	Medium	Erect	22.22	Large
IPCK-13-163	64.55	Medium	Semi erect	24.32	Large
RVSSG-78	61.23	Medium	Semi erect	21.00	Large
GJGK-1828	57.70	Early	Semi erect	17.47	Large
GNG-2453	60.09	Medium	Semi erect	19.85	Large
RVSSG-77	64.00	Medium	Semi erect	23.77	Large
ICCV-171318	55.58	Early	Semi erect	21.12	Large
Phule-G-0517	60.44	Medium	Semi erect	13.67	Medium
RLBGK-2	63.23	Medium	Semi erect	23.00	Large
RVSSG-62	57.07	Early	Semi erect	16.84	Large
JGK-2017-32	63.09	Medium	Semi erect	13.23	Medium
GJGK-1826	64.72	Medium	Semi erect	24.49	Large
ICCV-171310	65.48	Medium	Semi erect	12.78	Medium
ICCV-181308	58.37	Early	Semi erect	18.14	Large
Mean	59.72			18.53	
S.Em ±	2.45			1.01	
C.D. at 5 %	6.98			2.89	
CV %	7.10			9.46	

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

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

Genotypes	Peduncle length (mm)	Group	Plant height (cm)	Group
GJGK-1824	15.07	Long	54.28	Medium
BG-4009	17.32	Long	54.08	Medium
RKGK-13-499	19.91	Long	44.01	Short
RLBGK-1	15.19	Long	42.66	Short
PG-219	10.38	Long	50.22	Medium
HK-13-114	14.16	Long	40.05	Short
HK-16-30	12.97	Long	49.24	Medium
GJGK-1823	9.58	Medium	55.99	Medium
RLBGK-3	11.30	Long	42.06	Short
IPCK-2009-145	13.80	Long	51.54	Medium
GJGK-1825	20.15	Long	39.32	Short
PKV-4	13.27	Long	41.43	Short
GNG-2399	17.62	Long	44.00	Short
RKGK-18-414	9.79	Medium	53.18	Medium
NBeG-723	12.80	Long	49.76	Medium
CSJK-142	9.23	Medium	42.86	Short
IPCK-11-37	17.57	Long	51.15	Medium
CSJK-134	12.23	Long	49.15	Medium
RKV-4	8.38	Medium	44.10	Short
RLVGK-3	19.35	Long	48.16	Medium
JGK-1	9.59	Medium	41.00	Short
ICCV-181314	21.29	Long	46.54	Medium
GLK-17316	12.17	Long	47.15	Medium
GLK-17301	10.27	Long	40.15	Short
GNG-2446	12.20	Long	41.97	Short
GJGK-1827	14.12	Long	55.35	Medium
CSJK-174	9.49	Medium	43.25	Short
BG-4008	12.61	Long	56.36	Medium
Phule-G-16318	18.36	Long	53.87	Medium
IPCK-13-163	20.46	Long	44.10	Short
RVSSG-78	17.14	Long	39.24	Short
GJGK-1828	13.62	Long	49.69	Medium
GNG-2453	16.00	Long	36.22	Short
RVSSG-77	19.92	Long	39.65	Short
ICCV-171318	17.27	Long	51.12	Medium
Phule-G-0517	9.82	Medium	46.23	Medium
RLBGK-2	19.14	Long	47.14	Medium
RVSSG-62	12.99	Long	43.30	Short
JGK-2017-32	7.98	Medium	53.99	Medium
GJGK-1826	20.64	Long	43.03	Short
ICCV-171310	14.68	Long	44.64	Short
ICCV-181308	14.29	Long	42.06	Short
Mean	14.40		46.57	
S.Em ±	0.82		1.77	
80C.D. at 5 %	2.34		5.05	
CV %	9.87		6.59	

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

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

Genotypes	Pod size (mm)	Group	Days to maturity	Group	Number of branches/plant	Group
GJGK-1824	17.23	Medium	105.23	Early	5.67	High
BG-4009	15.39	Medium	110.67	Early	6.19	High
RKGK-13-499	18.34	Medium	111.45	Medium	5.34	High
RLBGK-1	19.23	Medium	107.76	Early	7.30	High
PG-219	16.72	Medium	113.39	Medium	4.79	High
HK-13-114	21.25	Large	110.34	Early	5.28	High
HK-16-30	18.91	Medium	105.12	Early	6.89	High
GJGK-1823	16.28	Medium	103.65	Early	7.00	High
RLBGK-3	18.56	Medium	101.78	Early	8.89	High
IPCK-2009-145	22.25	Large	108.45	Early	5.37	High
GJGK-1825	15.98	Medium	112.34	Medium	3.23	Medium
PKV-4	19.74	Medium	102.36	Early	7.39	High
GNG-2399	20.00	Medium	105.47	Early	8.20	High
RKGK-18-414	23.45	Large	112.11	Medium	9.09	High
NBeG-723	18.29	Medium	101.33	Early	9.41	High
CSJK-142	22.37	Medium	115.23	Medium	7.59	High
IPCK-11-37	19.67	Medium	100.00	Early	8.56	High
CSJK-134	16.87	Medium	112.56	Medium	10.50	High
RKV-4	15.89	Medium	111.78	Medium	7.34	High
RLVGK-3	18.46	Medium	99.24	Early	9.68	High
JGK-1	22.14	Large	105.01	Early	9.23	High
ICCV-181314	16.82	Medium	110.86	Medium	5.34	High
GLK-17316	13.11	Small	114.23	Medium	6.00	High
xtx180GLK-17301	18.54	Medium	101.23	Early	8.45	High
GNG-2446	16.72	Medium	112.34	Medium	6.68	High
posy43GJGK-1827	14.32	Small	107.49	Early	8.46	High
CSJK-174	21.98	Large	111.52	Medium	7.73	High
BG-4008	16.39	Medium	108.41	Early	8.45	High
Phule-G-16318	14.65	Small	102.40	Early	8.89	High
IPCK-13-163	19.45	Medium	106.32	Early	9.89	High
RVSSG-78	19.76	Medium	114.22	Medium	5.65	High
GJGK-1828	13.62	Small	109.22	Early	4.56	High
GNG-2453	16.00	Medium	115.78	Medium	7.42	High
RVSSG-77	19.92	Medium	114.89	Medium	5.61	High
ICCV-171318	17.27	Medium	101.37	Early	6.19	High
Phule-G-0517	14.35	Small	100.14	Early	5.44	High
RLBGK-2	19.14	Medium	100.45	Early	9.35	High
RVSSG-62	12.99	Small	113.00	Medium	8.27	High
JGK-2017-32	13.56	Small	103.65	Early	7.82	High
GJGK-1826	20.64	Large	109.35	Early	10.48	High
ICCV-171310	14.68	Small	104.74	Early	6.89	High
ICCV-181308	14.29	Small	115.89	Medium	3.54	Medium
Mean	17.75		107.92		7.24	
S.Em ±	0.75		3.81		0.42	
C.D. at 5 %	2.14		10.88		1.20	
CV %	7.32		6.12		10.05	

Note :

Pod size			days to maturity			No. of branches per plant		
Small	:	<15 mm	Early	:	90-110 days	Low	:	1-2 branches
Medium	:	15-20 mm	Medium	:	110-130 days	Medium	:	3-4 branches
Large	:	>20 mm	Late	:	>130 days	High	:	> 4 branches

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

Genotypes	Number of pod per plant	First pod bearing node (cm)
GJGK-1824	33.38	26.19
BG-4009	36.29	22.02
RKGK-13-499	17.38	22.49
RLBGK-1	43.67	28.02
PG-2191	20.49	25.44
HK-13-114	18.69	21.94
HK-16-30	37.59	25.78
GJGK-1823	45.48	31.76
RLBGK-3	56.68	25.58
IPCK-2009-145	40.00	18.60
GJGK-1825	18.68	19.63
PKV-4	21.89	17.42
GNG-2399	39.71	18.93
RKGK-18-414	23.16	23.66
NBeG-723	36.45	22.78
CSJK-142	58.39	23.25
IPCK-11-37	72.89	21.64
CSJK-134	15.14	24.48
RKV-4	28.30	23.75
RLVGK-3	37.78	18.34
JGK-1	62.45	21.49
ICCV-181314	25.38	25.12
GLK-17316	29.63	23.42
GLK-17301	40.28	23.35
GNG-2446	18.79	23.04
GJGK-1827	38.81	23.86
CSJK-174	37.14	20.60
BG-4008	72.69	19.19
Phule-G-16318	100.23	29.52
IPCK-13-163	32.57	18.96
RVSSG-78	21.82	24.41
GJGK-1828	31.67	20.31
GNG-2453	28.35	21.91
RVSSG-77	18.35	20.01
ICCV-171318	16.46	20.99
Phule-G-0517	53.86	25.56
RLBGK-2	29.35	28.63
RVSSG-62	37.78	17.00
JGK-2017-32	67.19	29.86
GJGK-1826	98.59	24.86
ICCV-171310	26.71	20.48
ICCV-181308	22.28	20.26
Mean	38.41	22.96
S.Em ±	1.20	1.14
C.D. at 5 %	3.43	3.26
CV %	5.42	8.61

per plant, while the genotype ICCV-171310 varied from above genotypes with respect to short plant height and long peduncle length. RKGK-18-414 was having medium time of flowering, medium plant height, erect growth habit, small leaf let size, medium peduncle length, large pod size, medium days to maturity and high number of branches per plant, while the genotype CSJK-174 varied from above genotypes with respect to short plant height and semi erect growth habit.

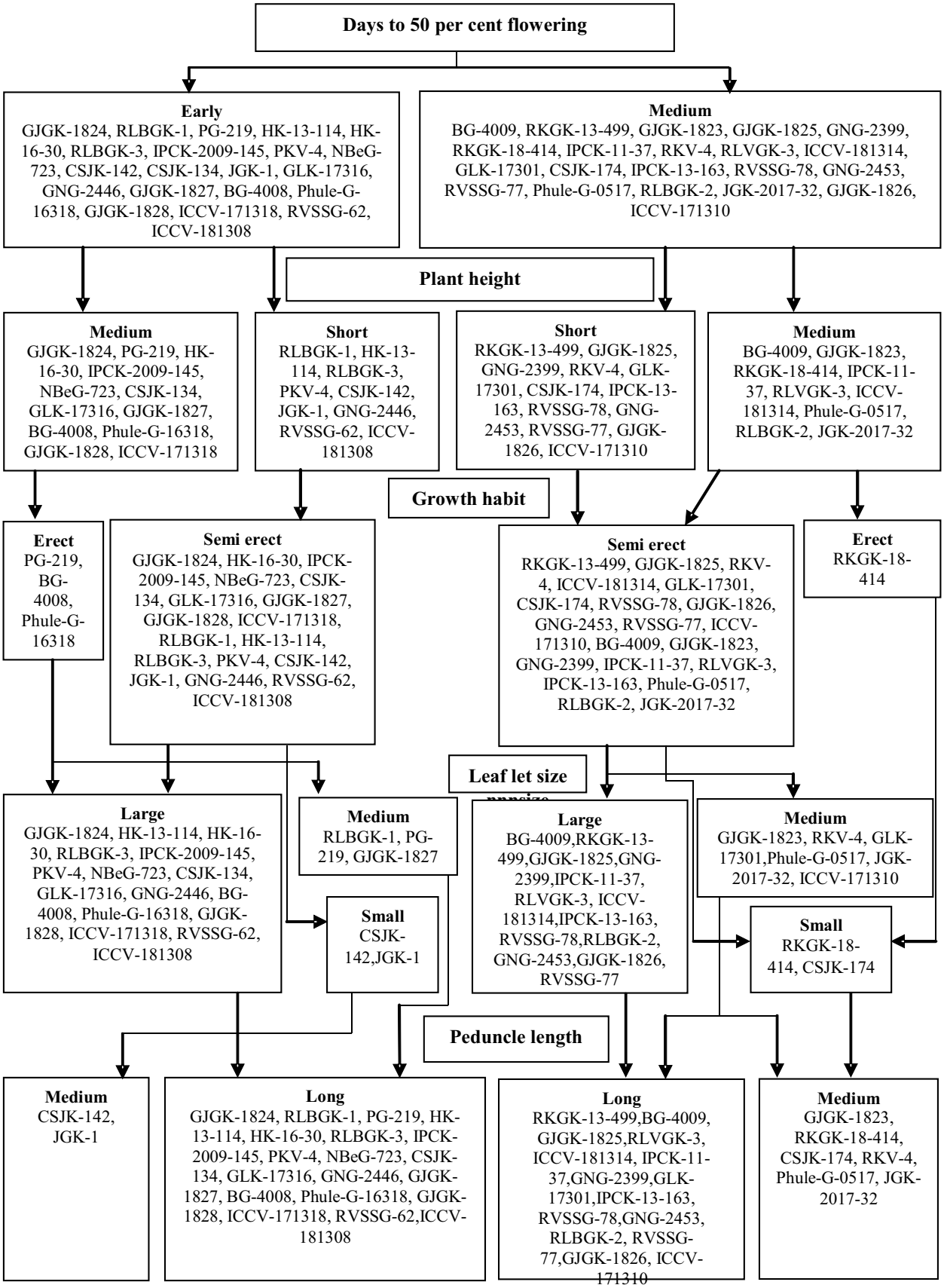
The genotypes HK-13-114 and IPCK-2009-145 were having similar plant morphology *viz.,* early time of flowering, semi erectgrowth habit, large leaf let size, long peduncle length, early days to maturity and high number of branches per plant, but differing in plant height short (HK-13-114) and medium (IPCK-2009-145) groups.

The genotypes CSJK-142 was having early time of flowering, short plant height, semi erect growth habit, small leaf let size, medium peduncle length, medium pod size, medium days to maturity and high number of branches per plant. While, the genotype JGK-1 differed from above genotypes with respect to large pod size and early days to maturity. The genotypes RLBGK-1 and RLBGK-3 were having early time of flowering, short plant height, semi erect growth habit, long peduncle length, medium pod size, early days to maturity and high number of branches per plant, but differing in leaf let size with medium (RLBGK-1) and large (RLBGK-3) groups.

The genotype RLBGK-2 was having medium time of flowering, large leaf let size, medium pod size, long peduncle length, high days to maturity and high number of branches per plant and semi erect growth habit and medium plant height. Genotype RKGK-13-499 was having medium time of flowering, short plant height, semi erect growth habit, large leaf let size, long peduncle length, medium pod size, medium days to maturity and high number of branches per plant,while the genotype GJGK-1825 varied from above genotypes with respect to medium number of branches per plant.

The genotypes GJGK-1827 and GJGK-1828 were having similar plant morphology *viz.,* early time of flowering, medium plant height, semi erect growth habit, long peduncle length, small pod size, early days to maturity and high number of branches per plant, but differing in leaf let size with medium (GJGK-1827) and large (GJGK-1828) groups, while the genotype Phule-G-16318 varied from above genotypes with respect to erect growth habit.

The genotypes BG-4009, IPCK-11-37 and RLVGK-3 were having similar plant morphology *viz.,* medium time of flowering, medium plant height, semi erect growth habit, large leaf let size, long peduncle length, medium pod size,


Days to 50 per cent flowering
Early
GJGK-1824, RLBGK-1, PG-219, HK-13-114, HK-16-30, RLBGK-3, IPCK-2009-145, PKV-4, NBeG-723, CSJK-142, CSJK-134, JGK-1, GLK-17316, GNG-2446, GJGK-1827, BG-4008, Phule-G-16318, GJGK-1828, ICCV-171318, RVSSG-62, ICCV-181308
Medium
BG-4009, RKGK-13-499, GJGK-1823, GJGK-1825, GNG-2399, RKGK-18-414, IPCK-11-37, RKV-4, RLVGK-3, ICCV-181314, GLK-17301, CSJK-174, IPCK-13-163, RVSSG-78, GNG-2453, RVSSG-77, Phule-G-0517, RLBGK-2, JGK-2017-32, GJGK-1826, ICCV-171310
Plant height
Medium
GJGK-1824, PG-219, HK-16-30, IPCK-2009-145, NBeG-723, CSJK-134, GLK-17316, GJGK-1827, BG-4008, Phule-G-16318, GJGK-1828, ICCV-171318
Short
RLBGK-1, HK-13-114, RLBGK-3, PKV-4, CSJK-142, JGK-1, GNG-2446, RVSSG-62, ICCV-181308
Short
RKGK-13-499, GJGK-1825, GNG-2399, RKV-4, GLK-17301, CSJK-174, IPCK-13-163, RVSSG-78, GNG-2453, RVSSG-77, GJGK-1826, ICCV-171310
Medium
BG-4009, GJGK-1823, RKGK-18-414, IPCK-11-37, RLVGK-3, ICCV-181314, Phule-G-0517, RLBGK-2, JGK-2017-32
Growth habit
Erect
PG-219, BG-4008, Phule-G-16318
Semi erect
GJGK-1824, HK-16-30, IPCK-2009-145, NBeG-723, CSJK-134, GLK-17316, GJGK-1827, GJGK-1828, ICCV-171318, RLBGK-1, HK-13-114, RLBGK-3, PKV-4, CSJK-142, JGK-1, GNG-2446, RVSSG-62, ICCV-181308
Semi erect
RKGK-13-499, GJGK-1825, RKV-4, ICCV-181314, GLK-17301, CSJK-174, RVSSG-78, GJGK-1826, GNG-2453, RVSSG-77, ICCV-171310, BG-4009, GJGK-1823, GNG-2399, IPCK-11-37, RLVGK-3, IPCK-13-163, Phule-G-0517, RLBGK-2, JGK-2017-32
Erect
RKGK-18-414
Leaf let size
Large
GJGK-1824, HK-13-114, HK-16-30, RLBGK-3, IPCK-2009-145, PKV-4, NBeG-723, CSJK-134, GLK-17316, GNG-2446, BG-4008, Phule-G-16318, GJGK-1828, ICCV-171318, RVSSG-62, ICCV-181308
Medium
RLBGK-1, PG-219, GJGK-1827
Small
CSJK-142,JGK-1
Large
BG-4009,RKGK-13-499,GJGK-1825,GNG-2399,IPCK-11-37, RLVGK-3, ICCV-181314,IPCK-13-163, RVSSG-78,RLBGK-2, GNG-2453,GJGK-1826, RVSSG-77
Medium
GJGK-1823, RKV-4, GLK-17301,Phule-G-0517, JGK-2017-32, ICCV-171310
Small
RKGK-18-414, CSJK-174
Peduncle length
Medium
CSJK-142, JGK-1
Long
GJGK-1824, RLBGK-1, PG-219, HK-13-114, HK-16-30, RLBGK-3, IPCK-2009-145, PKV-4, NBeG-723, CSJK-134, GLK-17316, GNG-2446, GJGK-1827, BG-4008, Phule-G-16318, GJGK-1828, ICCV-171318, RVSSG-62,ICCV-181308
Long
RKGK-13-499,BG-4009, GJGK-1825,RLVGK-3, ICCV-181314, IPCK-11-37,GNG-2399,GLK-17301,IPCK-13-163, RVSSG-78,GNG-2453, RLBGK-2, RVSSG-77,GJGK-1826, ICCV-171310
Medium
GJGK-1823, RKGK-18-414, CSJK-174, RKV-4, Phule-G-0517, JGK-2017-32

Contd.....

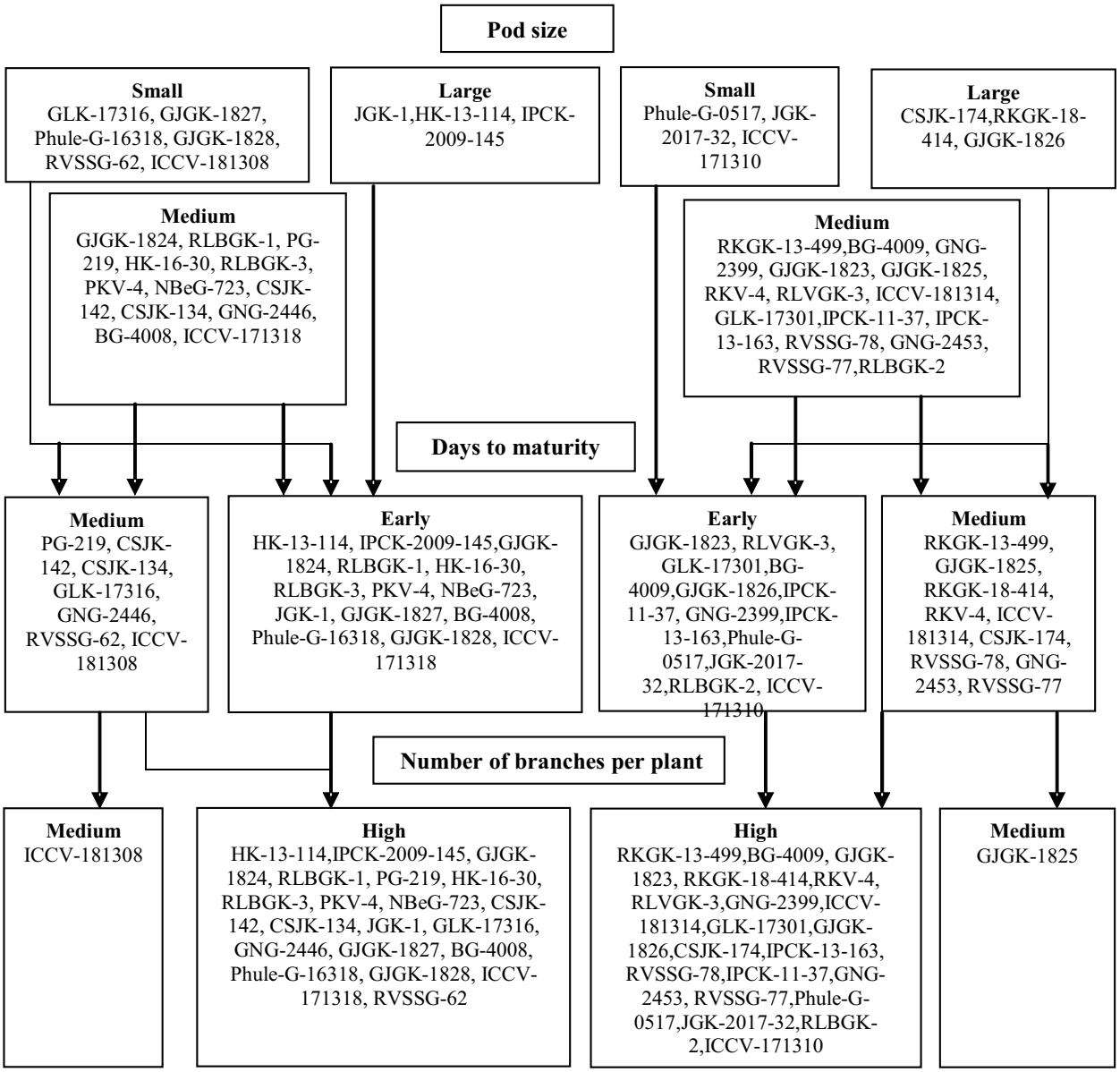


Figure-1 : Kabuli chickpea genotypes identification keys on the basis of plant morphological characters.

early days to maturity and high number of branches per plant,while the genotype GJGK-1823 varied from above genotypes with respect tomediumleaf let size, mediumpeduncle length and genotype ICCV-181314 varied with respect to medium days to maturity.

The genotypes HK-16-30 and ICCV-171318 were having similar plant morphology *viz.,* early time of flowering, medium plant height, semi erect growth habit, large leaf let size, long peduncle length, medium pod size, early days to maturity and high number of branches per plant,while the genotype PKV-4 varied from above genotypes with respect tosmall plant height and genotype CSJK-134 differed with respect to medium days to maturity.

The genotypes GNG-2399 and IPCK-13-163 were having similar plant morphology *viz.,* medium time of flowering, small plant height, semi erect growth habit, large leaf let size, long peduncle length, medium pod size, early days to maturity and high number of branches per plant, while the genotype GLK-17301 varied from above genotypes with respect tomediumleaf let size.The genotypes RVSSG-78, GNG-2453 and RVSSG-77 were having similar plant morphology *viz.,* medium time of flowering, small plant height, semi erect growth habit, large leaf let size, long peduncle length, medium pod size, medium days to maturity and high number of branches per plant,while the genotype GJGK-1826 varied from above genotypes with respect to early days to maturity.

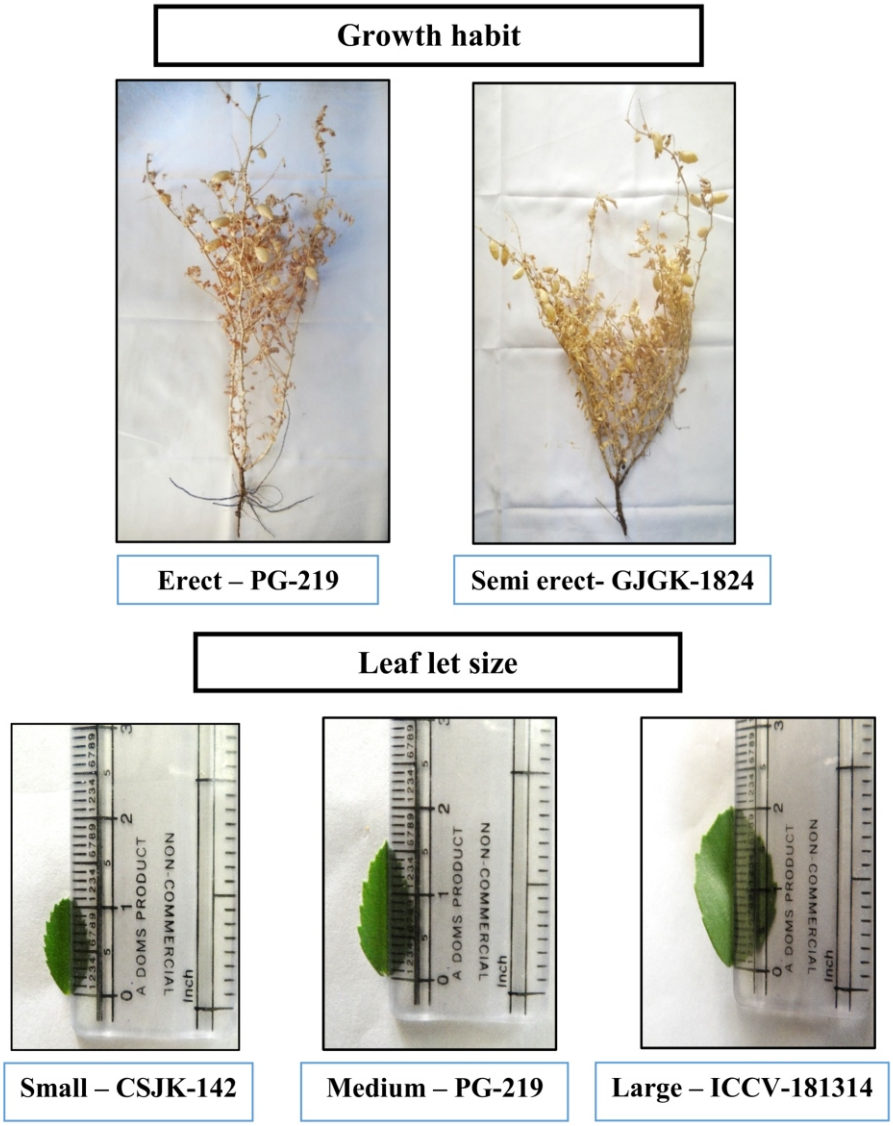


Figure-2 : Growth habit and leaflet size of chickpea genotypes.

The genotypes GLK-17316 and GJGK-1827 were having similar plant morphology *viz.,* early time of flowering, medium plant height, semi erect growth habit, long peduncle length, small pod size and high number of branches per plant, but differed in leaf let size and days to maturity with large, medium (GLK-17316) and medium, early (GJGK-1827) groups respectvely.The genotype GNG-2446 was having early time of flowering, short plant height, semi erect growth habit, large leaf let size, long peduncle length, medium pod size, medium days to maturity and high number of branches per plant.

The genotype RKV-4 was having medium time of flowering, short plant height, semi erect growth habit, medium leaf let size, medium peduncle length, medium pod size, medium days to maturity and high number of branches per plant. The genotype Phule-G-16318 was having early time of flowering, medium plant height, erect growth habit, large leaf let size, long peduncle length, small pod size, early days to maturity and high number of branches per plant.

Similar findings and grouping of genotypes based on plant morphological characters were made by (11,12,13,14,15,16) in chickpea.

Conclusion

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

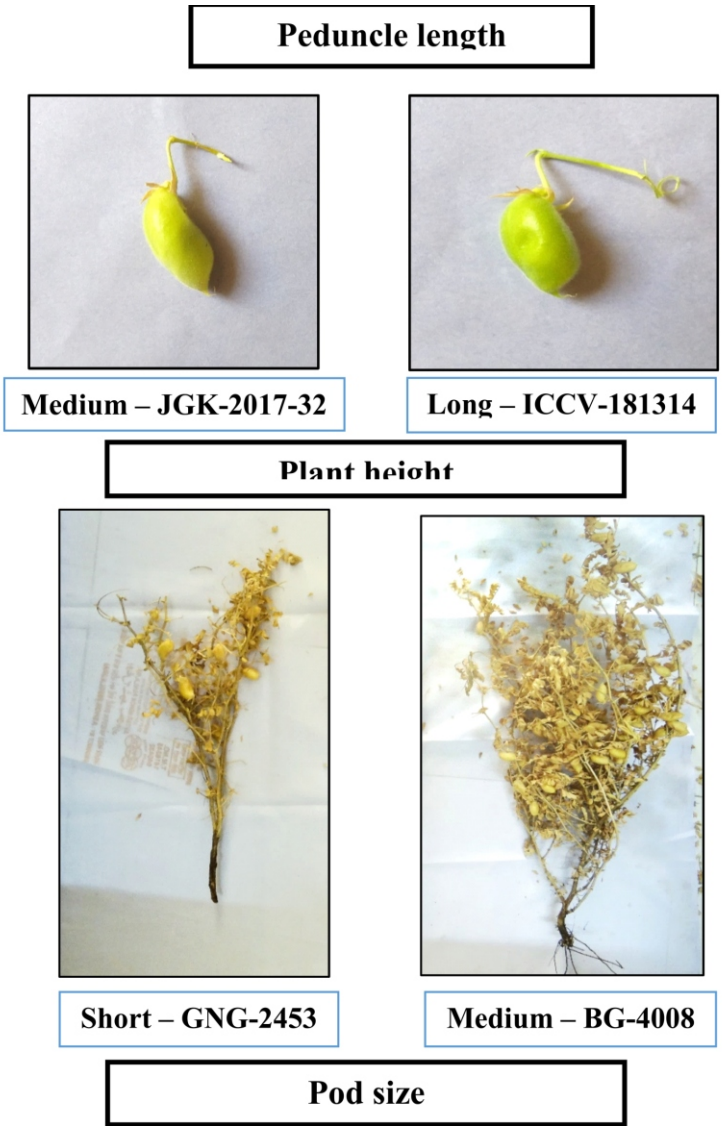


Figure-3 : Pod size, peduncle length and plant height of chickpea genotypes.

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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