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Characterization of chickpea genotypes based on morphological traits

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Abstract

The cultivated chickpea is one of the important pulse crops of India. The varietal characterization, varietal identification and genetic purity assessment is utmost important for field functionaries, Certification Officers, Seed Production Officers and Seed Growers for maintaining quality of the seed. Fifty eight genotypes of chickpea including desi and kabuli types were evaluated for various plant and seed morphological traits. The results of the present study clearly indicated that the genotypes of chickpea can be distinguished and identified by plant and seed morphological characters. These differences in morphological traits were useful in identification of individual chickpea genotypes.

Keywords: chickpea, DUS, varietal identification, characterization

1. Introduction

Chickpea (*Cicer arietinum* L.) popularly known as Gram, Bengal gram, Egyptian pea, Chana, or Kabuli chana, Garbanzo bean is one of the first grain legumes to be domesticated by humans in old world (Van der Maesen, 1972) [1]. The genus *Cicer* belongs to the sub-family Papilionaceae of the family Leguminosae, (Bentham and Hooker, 1970) [2] now popularly known as Fabaceae and have chromosome number $2n=2x=16$. The origin of the crop is considered to be Western Asia from where it has been transferred in India and other parts of the world (Rathore and Sharma, 2003) [7]. Importance of pulses is relatively more in our country as its contribution in nutrient supply is far more in Indian diet than that in Asia and world as a whole (Ali, 2002) [1].

Generally the quality of seed is estimated by varietal purity including physical and genetical. A variety/cultivar is an assemblage of cultivated plant which is clearly distinguished by any character (morphological, physiological, cytological, chemical or others) and which when reproduced (sexually or asexually) retains its distinguishing characters. Practically, a variety must show, Distinct, Uniform and Stable (DUS) variations in the characters that are adopted for use in varietal identification. To achieve this mission seed certification schemes have been launched to ensure cultivars identity and purity in the market place. Certification of identity has relied primarily on morphology. (Singh, 2001) [9].

Emphasis on characterization, varietal identification and genetic purity assessment of chickpea cultivars is very important to the field functionaries, certification officers, seed production officers and seed growers for regulating quality of the seed. However, standardized procedures are not available to seed analysts for determining cultivar purity. As a general rule, no cultivar can be identified or rejected purely by examining only seed or morphological characters in the field. Therefore, for keeping the purity of cultivars, stable visual diagnostic characters of seed, seedling and plant morphology are utmost essential to know (Lalitha, 2007) [6].

2. Materials and Methods

Present investigation was carried out at Genetics and Plant Breeding Farm, B. A. College of Agriculture, A.A.U, Anand during *Rabi* of 2016-17. The experimental material comprised of 58 diverse chickpea genotypes including desi and kabuli types obtained from different chickpea research station of India. Different genotypes were evaluated in three replications using Randomized Complete Block Design (RCBD) with each entry in a single row of 4.0m length (40 plants/genotype) in each replication. Inter and intra-row space was 30×10cm, respectively. The experiment was surrounded by guard row to avoid damage and border effect. The recommended agronomical and plant protection practices were followed for the successful raising of the crop.

The observations were recorded on 10 randomly selected plants for each character in each replication at different crop growth stages. Data were collected on 18 qualitative traits including morphological and seed characters.

3. 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 morphological variation, the 58 genotypes could be identified from each other. Based on anthocyanin pigmentation, all the 58 genotypes were grouped into two groups, with 34 genotypes showing anthocyanin pigmentation and the remaining 24 had absence of anthocyanin pigmentation (Figure 1 and Table 1). Four genotypes showed low insertion of first flower (<8 nodes), three genotypes showed medium insertion (8-15 nodes) and remaining 51 genotypes showed high insertion of first flower (>15 nodes). Variation were observed among genotypes for time of 50% flowering and based on this, genotypes were classified into three group. Thirty three genotypes were early with 40-60 days to 50% flowering, while 22 genotypes were medium with 61-80 days to 50% flowering and only three genotypes showed extra early flowering (<40 days). No variation was found among the genotypes for number of flowers per peduncle and all genotypes had single flower per peduncle. Plant growth habit is a distinguishing feature in varietal characterization. Out of 58 genotypes, 47 genotypes were observed as erect type, 9 genotypes were semi-erect and the remaining two genotypes were spreading type of growth habit. Four groups were made based on intensity of green colour of foliage. Out of 58 genotypes, 14 genotypes showed light green colour, 28 genotypes showed medium, 14 genotypes showed dark green and the remaining two genotype showed greenish purple colour of foliage. With regard to size of leaflets, the variation was observed and the genotypes were categorized into three main groups namely, small, medium and large. Thirty genotypes recorded small size (10mm), 23 genotypes recorded medium (10-15mm) and the remaining five genotypes were had large (>15mm) sized leaf lets (Figure 2). Three groups were made based on variation in flower colour. Flowers of 16 genotypes were white, 40 genotypes showed pink and the remaining two genotypes showed blue colour of flowers (Figure 3). Genotypes were examined for the stripes on standard petal of the flower. In 19 genotypes, the stripes were absent and the remaining 39 genotypes showed stripes on standard of petal (Figure 3). The study of plant peduncle length revealed that chickpea genotypes can be classified in to three categories. The seven genotypes had short peduncle, 22 genotypes recorded as medium and the remaining 29 genotypes showed long peduncle (Figure 4). Based on plant height all genotypes were classified in to three groups. Five genotypes were short in plant height (<45cm), 27 genotypes recorded medium plant height (45-65cm) and the remaining 26 genotypes were tall in plant height (>65cm) (Figure 5). Size of the pod was used in characterizing the chickpea genotypes. Based on pod size, genotypes were classified into

three groups. Twelve genotypes were recorded as small (<15mm), 32 genotypes recorded medium (15-20mm) and the remaining 14 genotypes were classified as large (>20 mm) sized pods (Figure 6). Difference were also found in number of seeds per pod, 29 genotypes showed one seed per pod and remaining 29 genotypes showed two seeds per pod.

Based on variation in seed colour, genotypes were categorized into ten groups *viz.*, brown, dark brown, reddish brown, beige (kabuli with pure white), black, creamy beige, green, orange, yellow and grey in colour (Figure 7). According to seed size (weight of 100 seed), genotypes were grouped into four groups. Very small seed size (<20g) was recorded in 32 genotypes, small seed size (20-25g) in 10 genotypes, medium seed size (26-35g) in 14 genotypes and large seed size (36-45g) was recorded in remaining three genotypes (Figure 8). Significant differences were found among genotypes for seed shape and based on this, the genotypes were classified in to three groups. Eight genotypes had pea shape, 29 genotypes had owl's head and the remaining 21 genotypes had angular seed shape (Figure 9). Three groups were made based on seed testa texture. Rough texture was observed in 28 genotypes, smooth texture in 23 genotypes and tuberculated was found in remaining 7 genotypes (Figure 10). According to seed ribbing, genotypes were categorized into two groups. Forty two genotypes showed presence of seed ribbing and remaining 16 genotypes showed absence of seed ribbing (Figure 11). Among the 58 genotypes, 46 genotypes were desi and remaining 12 genotypes were kabuli type (Figure 12).

Morphological features of genotypes have been a major component of varietal identification. It is not possible to identify varieties 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.

The desi type are characterized by small, irregularly shaped seeds of various colours (light brown, dark brown, yellow pink, green, black or variegated colours) having thick and rough seed coat with pinkish or bluish flowers, small plant stature small leaflets, presence of anthocyanin pigmentation and usually 2-3 seeds per pod. The kabuli type have rams head or round or large owl's head shape, cream colour, larger seed with smooth seed coat, long plant stature, white flowers, bigger leaflets, no anthocyanin and usually one or two seeds per pod. There is no basic difference in chromosome number ($2n=16$) of desi and kabuli and both types cross each other readily.

Similarly, genotypes identification based on distinguishable morphological characters were reported by Lalitha (2007) [6], Upadhyaya *et al.* (2002) [10], Yadav and Shrivastava (2002) [12], Chowdhury *et al.* (2002) [3] and Singh (2001) [9] in chickpea.

Table 1: Distinguishable morphological characters in chickpea genotypes

Genotypes	Anthocyanin pigmentation	Height of insertion of first flower	Time of 50% flowering	Growth habit	Color of foliage	Leaflet size
1 GG-2	Present	High	Early	Erect	Medium green	Large
2 Vishal	Present	High	Early	Erect	Medium green	Small
3 JG-130	Present	High	Early	Erect	Medium green	Medium
4 GNG-14	Present	High	Medium	Erect	Medium green	Medium
5 GNG-27	Present	High	Medium	Erect	Medium green	Medium
6 GNG-28	Present	High	Early	Erect	Medium green	Medium
7 ICC-157	Present	Medium	Medium	Erect	Dark green	Small
8 ICC-231	Present	Medium	Medium	Erect	Dark green	Small
9 ICC-1164	Absent	High	Medium	Erect	Dark green	Small

10	ICC-1431	Present	High	Medium	Erect	Dark green	Small
11	ICC-2210	Present	High	Medium	Erect	Dark green	Medium
12	ICC-2277	Absent	High	Medium	Semi spreading	Light green	Small
13	ICC-2919	Absent	High	Early	Erect	Light green	Medium
14	ICC-3230	Present	High	Early	Erect	Dark green	Medium
15	ICC-4463	Present	High	Early	Semi spreading	Medium green	Small
16	ICC-4639	Present	High	Medium	Erect	Medium green	Small
17	ICC-4872	Absent	Low	Early	Semi spreading	Light green	Small
18	ICC-5037	Absent	Low	Medium	Erect	Dark green	Small
19	ICC-7255	Absent	High	Early	Semi spreading	Medium green	Large
20	ICC-8058	Absent	High	Medium	Erect	Medium green	Medium
21	ICC-8151	Absent	High	Medium	Semi spreading	Light green	Large
22	ICC-8195	Present	High	Medium	Erect	Dark green	Small
23	ICC-8318	Absent	High	Early	Semi spreading	Light green	Small
24	ICC-8350	Present	High	Medium	Erect	Medium green	Medium
25	ICC-8522	Present	Low	Early	Erect	Light green	Small
26	ICC-8621	Absent	High	Medium	Erect	Medium green	Medium
27	ICC-8855	Absent	High	Early	Erect	Light green	Medium
28	ICC-9942	Present	Low	Medium	Erect	Dark green	Small
29	ICC-10393	Present	High	Extra early	Erect	Greenish purple	Medium
30	ICC-10399	Present	High	Early	Erect	Medium green	Small
31	ICC-10945	Present	High	Early	Erect	Medium green	Small
32	ICC-12028	Absent	High	Medium	Erect	Light green	Small
33	ICC-12155	Absent	High	Early	Erect	Medium green	Medium
34	ICC-12328	Absent	High	Medium	Spreading	Light green	Medium
35	ICC-12492	Absent	High	Early	Erect	Medium green	Medium
36	ICC-12866	Present	High	Early	Erect	Purple greenish	Medium
37	ICC-12928	Present	High	Medium	Erect	Dark green	Small
38	ICC-13124	Present	High	Early	Semi spreading	Medium green	Medium
39	ICC-13219	Present	High	Early	Erect	Medium green	Medium
40	ICC-13283	Absent	High	Early	Erect	Medium green	Medium
41	ICC-13357	Absent	High	Medium	Semi spreading	Medium green	Medium
42	ICC-13441	Absent	High	Early	Erect	Medium green	Small
43	ICC-13524	Present	High	Medium	Erect	Light green	Small
44	ICC-13764	Absent	High	Early	Erect	Medium green	Small
45	ICC-14669	Present	High	Early	Erect	Medium green	Small
46	ICC-14799	Present	Medium	Medium	Erect	Medium green	Small
47	ICC-14831	Present	High	Early	Erect	Medium green	Small
48	ICC-15264	Absent	High	Early	Semi spreading	Light green	Small
49	ICC-15333	Absent	High	Early	Spreading	Light green	Small
50	ICC-15888	Absent	High	Early	Erect	Dark green	Small
51	GG-1	Present	High	Early	Erect	Dark green	Medium
52	GJG-3	Present	High	Extra early	Erect	Medium green	Large
53	GG-5	Present	High	Early	Erect	Dark green	Medium
54	GJG-6	Present	High	Early	Erect	Dark green	Large
55	JG-16	Absent	High	Early	Erect	Medium green	Small
56	Dahod yellow	Absent	High	Early	Erect	Light green	Small
57	Digvijay	Present	High	Extra early	Erect	Greenish purple	Medium
58	Vijay	Present	High	Early	Erect	Light green	Small

Table 1: Conti...

	Genotypes	Flower color	Stripes on standard of flower	Peduncle length	Plant height	Pod size	No. of seeds per pod
1	GG-2	Pink	Absent	Medium	Medium	Medium	One
2	Vishal	Pink	Present	Long	Medium	Large	One
3	JG-130	Pink	Present	Long	Medium	Medium	One
4	GNG-14	Pink	Present	Medium	Medium	Medium	One
5	GNG-27	Pink	Present	Medium	Medium	Large	Two
6	GNG-28	Pink	Present	Long	Medium	Medium	Two
7	ICC-157	Pink	Present	Medium	Short	Medium	Two
8	ICC-231	Pink	Present	Long	Short	Small	One
9	ICC-1164	White	Absent	Long	Medium	Medium	Two
10	ICC-1431	Pink	Present	Medium	Medium	Medium	One
11	ICC-2210	Pink	Present	Medium	Medium	Small	One
12	ICC-2277	White	Absent	Medium	Tall	Large	One
13	ICC-2919	Pink	Present	Medium	Tall	Medium	One
14	ICC-3230	Pink	Present	Long	Medium	Small	One
15	ICC-4463	Pink	Present	Medium	Tall	Medium	Two

16	ICC-4639	Pink	Present	Medium	Medium	Medium	Two
17	ICC-4872	Pink	Present	Long	Short	Medium	One
18	ICC-5037	White	Absent	Medium	Medium	Small	One
19	ICC-7255	White	Absent	Long	Tall	Large	Two
20	ICC-8058	White	Absent	Medium	Tall	Large	Two
21	ICC-8151	White	Absent	Medium	Tall	Large	One
22	ICC-8195	Pink	Present	Medium	Medium	Small	One
23	ICC-8318	Pink	Present	Long	Medium	Medium	One
24	ICC-8350	Pink	Absent	Long	Tall	Large	One
25	ICC-8522	Pink	Present	Long	Medium	Small	Two
26	ICC-8621	Pink	Present	Medium	Tall	Medium	Two
27	ICC-8855	White	Absent	Medium	Tall	Large	Two
28	ICC-9942	Pink	Present	Medium	Short	Small	One
29	ICC-10393	Pink	Present	Long	Medium	Medium	Two
30	ICC-10399	Pink	Present	Medium	Medium	Medium	Two
31	ICC-10945	Pink	Present	Long	Medium	Medium	Two
32	ICC-12028	Pink	Present	Medium	Tall	Medium	One
33	ICC-12155	Pink	Present	Short	Medium	Medium	Two
34	ICC-12328	White	Absent	Long	Tall	Large	One
35	ICC-12492	White	Absent	Short	Medium	Medium	Two
36	ICC-12866	Pink	Present	Long	Tall	Small	Two
37	ICC-12928	Pink	Present	Short	Tall	Small	One
38	ICC-13124	Pink	Present	Long	Tall	Medium	One
39	ICC-13219	Pink	Present	Medium	Medium	Medium	Two
40	ICC-13283	White	Absent	Short	Tall	Large	One
41	ICC-13357	White	Absent	Short	Tall	Medium	One
42	ICC-13441	White	Absent	Long	Medium	Medium	One
43	ICC-13524	Pink	Present	Short	Tall	Small	Two
44	ICC-13764	White	Absent	Long	Tall	Medium	Two
45	ICC-14669	Pink	Present	Long	Medium	Medium	One
46	ICC-14799	Pink	Present	Medium	Short	Small	One
47	ICC-14831	Pink	Present	Long	Tall	Medium	Two
48	ICC-15264	White	Absent	Medium	Tall	Medium	Two
49	ICC-15333	White	Absent	Long	Tall	Large	One
50	ICC-15888	White	Absent	Long	Medium	Small	Two
51	GG-1	Pink	Present	Long	Medium	Medium	Two
52	GJG-3	Pink	Present	Long	Tall	Large	Two
53	GG-5	Pink	Absent	Long	Tall	Medium	Two
54	GJG-6	Pink	Present	Long	Medium	Large	One
55	JG-16	Pink	Present	Long	Medium	Medium	Two
56	Dahod yellow	Pink	Present	Short	Tall	Medium	Two
57	Digvijay	Pink	Present	Long	Tall	Large	Two
58	Vijay	Pink	Present	Long	Tall	Medium	One

Table 1: Continue

	Genotypes	Seed color	Seed size	Seed shape	Seed testa texture	Seed ribbing	Seed type
1	GG-2	Brown	Medium	Owl's head	Rough	Present	Desi
2	Vishal	Dark brown	Medium	Owl's head	Rough	Present	Desi
3	JG-130	Brown	Medium	Angular	Rough	Present	Desi
4	GNG-14	Brown	Medium	Pea shaped	Rough	Absent	Desi
5	GNG-27	Green	Very small	Owl's head	Rough	Present	Desi
6	GNG-28	Brown	Very small	Angular	Tuberculate	Present	Desi
7	ICC-157	Brown	Very small	Angular	Rough	Present	Desi
8	ICC-231	Brown	Very small	Owl's head	Smooth	Present	Desi
9	ICC-1164	Orange	Very small	Pea shaped	Rough	Absent	Desi
10	ICC-1431	Brown	Small	Owl's head	Smooth	Absent	Desi
11	ICC-2210	Yellow	Very small	Owl's head	Smooth	Present	Desi
12	ICC-2277	Creamy beige	Medium	Owl's head	Rough	Absent	Kabuli
13	ICC-2919	Beige Kabuli	Small	Angular	Rough	Present	Kabuli
14	ICC-3230	Green	Very small	Owl's head	Rough	Present	Desi
15	ICC-4463	Black	Very small	Angular	Smooth	Present	Desi
16	ICC-4639	Brown	Very small	Angular	Rough	Present	Desi
17	ICC-4872	Orange	Small	Pea shaped	Rough	Absent	Desi
18	ICC-5037	Green	Small	Pea shaped	Smooth	Absent	Desi
19	ICC-7255	Creamy beige	Medium	Owl's head	Smooth	Present	Kabuli
20	ICC-8058	Creamy beige	Very small	Owl's head	Smooth	Absent	Desi
21	ICC-8151	Creamy beige	Large	Owl's head	Tuberculate	Present	Kabuli
22	ICC-8195	Grey	Very small	Owl's head	Smooth	Present	Desi

23	ICC-8318	Yellow	Very small	Angular	Tuberculate	Present	Desi
24	ICC-8350	Reddish brown	Medium	Pea shaped	Rough	Absent	Desi
25	ICC-8522	Black	Very small	Angular	Smooth	Present	Desi
26	ICC-8621	Creamy beige	Small	Owl's head	Rough	Present	Kabuli
27	ICC-8855	Creamy beige	Small	Pea shaped	Smooth	Absent	Desi
28	ICC-9942	Brown	Very small	Angular	Rough	Present	Desi
29	ICC-10393	Reddish brown	Very small	Angular	Smooth	Present	Desi
30	ICC-10399	Brown	Very small	Angular	Smooth	Present	Desi
31	ICC-10945	Dark brown	Very small	Angular	Tuberculate	Present	Desi
32	ICC-12028	Kabuli beige	Medium	Angular	Smooth	Present	Kabuli
33	ICC-12155	Brown	Very small	Angular	Rough	Present	Desi
34	ICC-12328	Creamy beige	Large	Owl's head	Smooth	Present	Kabuli
35	ICC-12492	Creamy beige	Very small	Pea shaped	Smooth	Absent	Desi
36	ICC-12866	Yellow	Very small	Angular	Rough	Present	Desi
37	ICC-12928	Yellow	Very small	Owl's head	Smooth	Present	Desi
38	ICC-13124	Reddish brown	Medium	Owl's head	Smooth	Present	Desi
39	ICC-13219	Yellow	Very small	Angular	Tuberculate	Present	Desi
40	ICC-13283	Creamy beige	Medium	Owl's head	Smooth	Absent	Kabuli
41	ICC-13357	Creamy beige	Medium	Owl's head	Rough	Present	Kabuli
42	ICC-13441	Creamy beige	Small	Owl's head	Rough	Absent	Kabuli
43	ICC-13524	Black	Very small	Angular	Smooth	Present	Desi
44	ICC-13764	Creamy beige	Very small	Owl's head	Smooth	Absent	Desi
45	ICC-14669	Yellow	Very small	Angular	Tuberculate	Present	Desi
46	ICC-14799	Yellow	Very small	Angular	Rough	Present	Desi
47	ICC-14831	Yellow	Very small	Owl's head	Rough	Present	Desi
48	ICC-15264	Creamy beige	Medium	Owl's head	Smooth	Absent	Kabuli
49	ICC-15333	Creamy beige	Large	Pea shaped	Tuberculate	Absent	Kabuli
50	ICC-15888	Orange	Very small	Owl's head	Rough	Absent	Desi
51	GG-1	Dark brown	Very small	Owl's head	Smooth	Present	Desi
52	GJG-3	Brown	Medium	Owl's head	Rough	Present	Desi
53	GG-5	Dark brown	Small	Owl's head	Smooth	Present	Desi
54	GJG-6	Dark brown	Small	Owl's head	Rough	Present	Desi
55	JG-16	Brown	Very small	Owl's head	Rough	Present	Desi
56	Dahod yellow	Yellow	Very small	Angular	Rough	Present	Desi
57	Digvijay	Dark brown	Medium	Owl's head	Rough	Present	Desi
58	Vijay	Brown	Small	Angular	Rough	Present	Desi

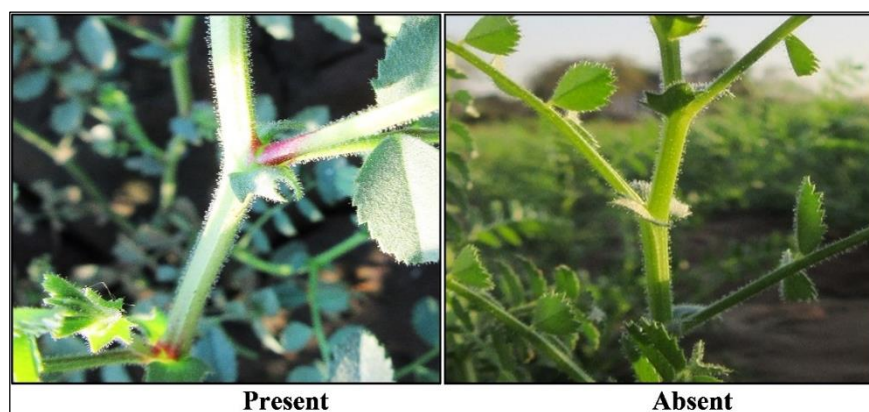


Fig 1: Stem: Anthocyanin pigmentation

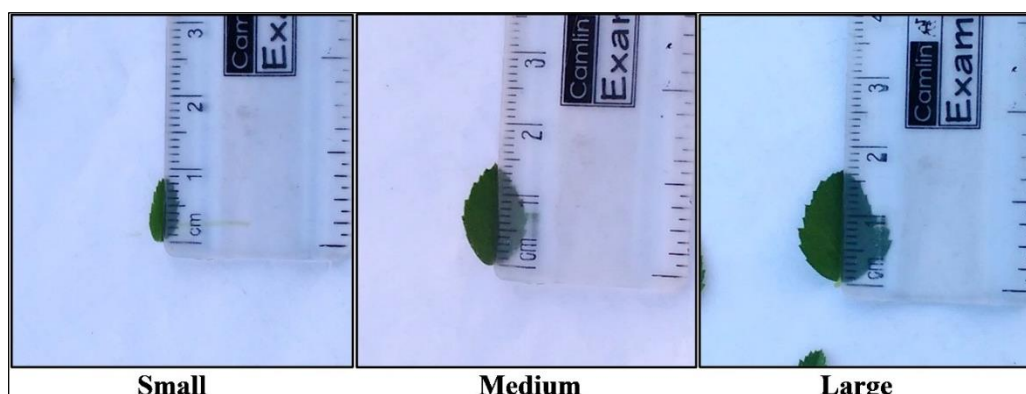


Fig 2: Leaflet: size (length) (Middle of the plant and middle of the leaf)



Fig 3: Flower: Colour and Stripes on standard of flower

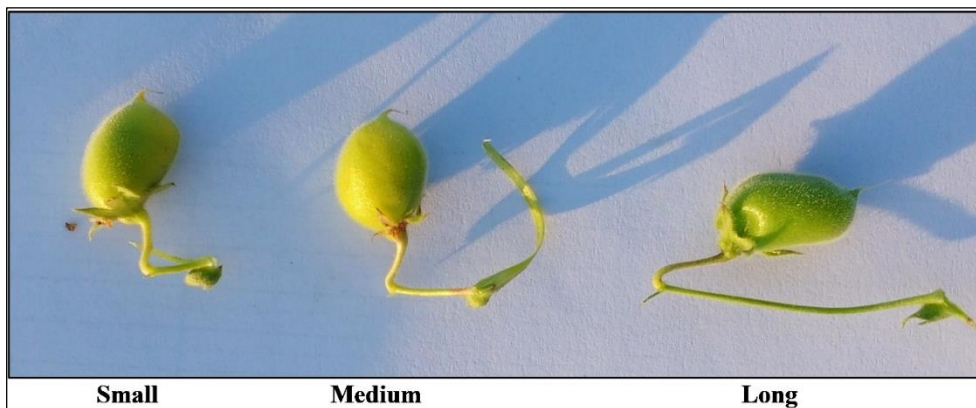


Fig 4: Peduncle: Length

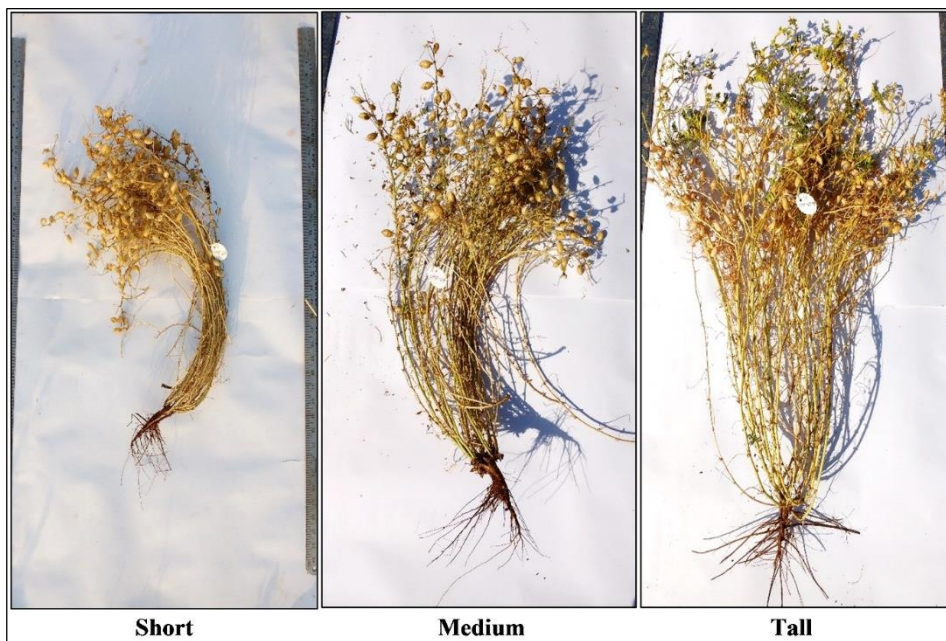


Fig 5: Plant: Height

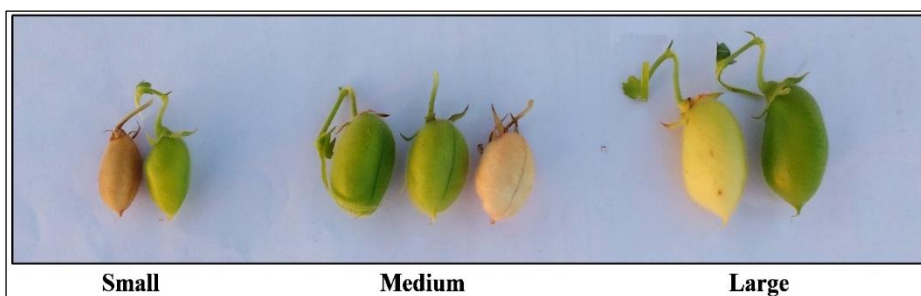


Fig 6: Pod: Size



Fig 7: Seed: Colour (one month after harvest using colour chart)



Fig 8: Seed: Size (weight of 100 seeds at 10% moisture content)

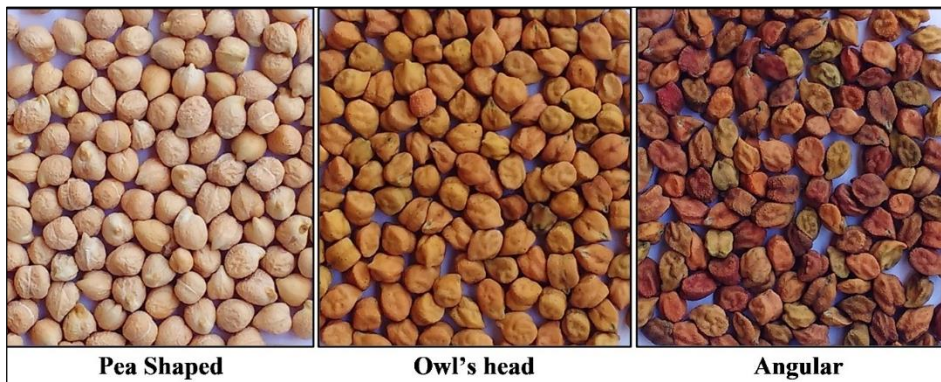


Fig 9: Seed: Shape

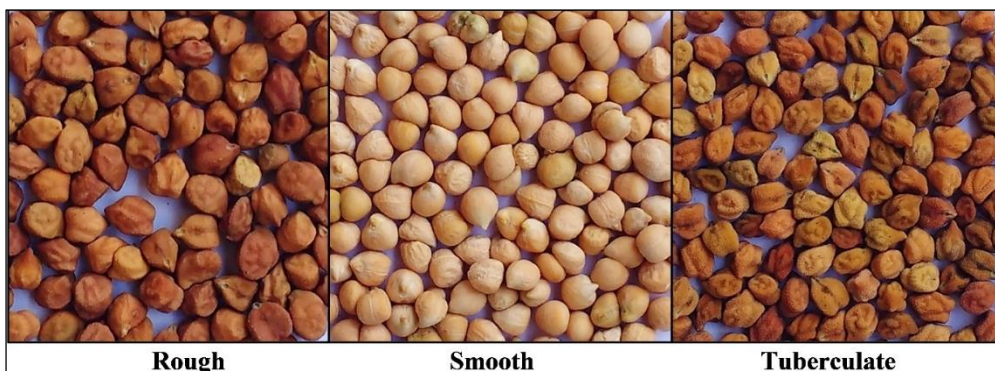


Fig 10: Seed: Testa texture

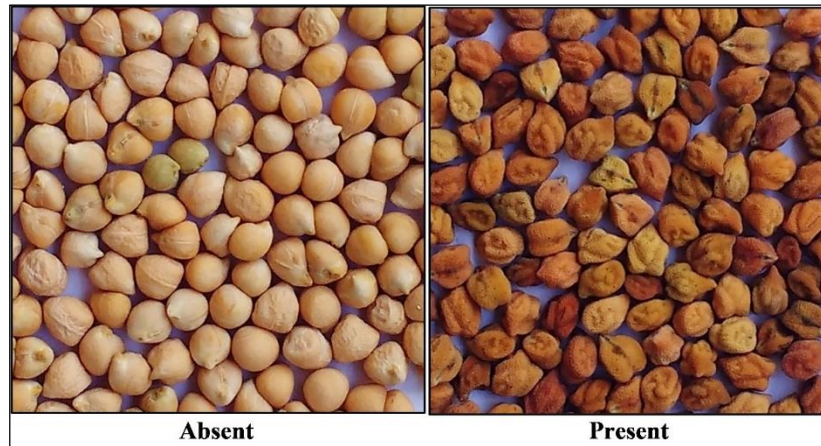


Fig 11: Seed: Ribbing



Fig 12: Seed: Type

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