RESEARCH ARTICLE

Characterization of Green Gram Genotypes for Qualitative Traits

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Abstract

Seventy-three accessions of green gram collected from different sources along with three controls were studied for 20 qualitative characters at National Bureau of Plant Genetic Resources (NBPGR), Regional Station, Rajendranagar, Hyderabad, India during 2014–2015. Based on the plant growth pattern, green gram accessions were classified into determinate (10) and indeterminate (66). Based on pod color, the accessions were classified into brown (12) and black (64) colored pods. On the basis of seed luster, green gram accessions were grouped into dull (43) and shiny (33). Based on seed shape, green gram accessions exhibited diversity for seed shape, i.e., oval (43) and drum (33). Among the distinct morphological traits, seed luster may be used as an indicator in broad classification of genotypes into different groups rather than of individual genotype.

Keywords: Green gram, Morphological traits, Plant growth habit, Seed luster, Seed shape.

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Introduction

Seed yield is a complex character and depends on various component agro-morphological characters some of which are highly influenced by the environment, while others are quantitatively inherited. In most of the crop breeding programs, major emphasis is given to the improvement of yield *via* agro-morphological traits. Hence, knowledge of the nature and extent of the diversity present in germplasm collection is of utmost importance. Recognition and exploitation of variation among genetically diverse groups of germplasm are therefore fundamental to plant breeding and genetic engineering. Consequently, the assessment of genetic diversity within and among germplasm accessions including landraces has assumed high priority in recent times. Smith and Smith (1989) considered morphological characterization as an important step in description and classification of crop germplasm as a breeding program mainly depends on the magnitude of genetic variability (Smith *et al.,* 1991).

In the wake of granting rights to farmers and plant breeders for protection of plant varieties and to encourage the development of new varieties of plants in the light of "The Protection of Plant Varieties and Farmers' Rights (PPV&FR) Act, 2001" testing for distinctness, uniformity, and stability (DUS) of any genotype has become mandatory in recent years. Morphological characterization of any crop variety/genotype is essential for granting protection under the PPV&FR Act, 2001. The PPV&FR Authority has established guidelines for the conduct of DUS testing and in green gram has listed out 24 essential morphological characters along with their character states. Any new variety of registration needs to conform to these essential guidelines. Hence, the importance of morphological characterization and evaluation lies in any breeding or registration program. Keeping this in view, an experiment was conducted to characterize green gram genotypes for various qualitative traits.

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Materials and Methods

Studies on characterization of green gram accessions were conducted at National Bureau of Plant Genetic Resources, Regional Station, Rajendranagar, Hyderabad during 2014–2015. Seventy-three accessions of green gram collected from different sources along with three controls for comparison (ML-267, LGG-460, and K-851)were studied for 20 qualitative characters *viz*., plant growth habit, plant habit, stem colour, stem pubescence, leaf pubescence, leaflet lobes (terminal), leaf shape (terminal), leaf colour, leaf vein colour, petiole colour, leaf size (at 5th node from the base), colour of flower petal (standard), colour of premature pod, pod pubescence, pod position, pod colour, curvature of mature pod, seed colour, seed luster and seed shape. Seventy-six accessions of

green gram were laid out in a randomized block design with two replications. Each accession was grown in three rows of 3 m length each with a spacing of 30 × 10 cm. Recommended package of practices was followed to raise a healthy crop. Observations on twenty qualitative characters were recorded for each accession on plot basis for each replication as per the DUS descriptor.

Results And Discussion

Plant Growth Habit

Qualitative characters like plant growth pattern, leaf pubescence, leaf color, petiole, *etc*., are important for plant description (Kurlovich, 1998). Based on the plant growth pattern, green gram accessions were classified into two categories, i.e., determinate and indeterminate. Of the 76 accessions, 66 accessions exhibited indeterminate growth habit and remaining ten accessions had a determinate habit (Table 1 and Graph 1).

Based on plant growth habit, green gram accessions were grouped into three classes, *i.e.,* erect, and spreading. Out of 76 accessions, 6 accessions were erect, 56 accessions were semi-erect and the remaining 14 accessions were spreading (Table 1 and Graph 1). Bisht *et al.* (1998) reported variability in growth (erect, semi-erect) of green gram. Further high diversity in phenotypic traits like plant growth habit was also reported (Thomas *et al*., 2002).

Stem Characters

Based on stem color, 76 green gram accessions were grouped into 3 classes, i.e., green, green with purple splashes and purple and all the accessions possessed green color stem (Table 1). Similar variation in stem pigmentation was reported by Pandian *et al.* (2012) in green gram, Pandey and Dubey (1972) in Dolichos lab and Thomas *et al*. (2002) in the country bean.

Based on stem pubescence**,** green gram accessions were categorized into 3 groups, i.e*.,* sparse, moderate and dense. Out of 76 accessions, 14 accessions exhibited sparse stem pubescence, 49 accessions possessed moderate stem pubescence and 13 accessions had exhibited dense pubescence (Table 1 and Graph 2). These findings were in consonance with the reports of Bisht *et al.* (1998) and Pandian *et al.* (2012) in green gram.

Leaf Characters

Based on leaf pubescence, green gram accessions were distinguished into three categories, *i.e.,* sparse, moderate and dense. Out of 76 accessions 53 exhibited sparse pubescence, 16 possessed moderate pubescence and the rest 7 possessed dense leaf pubescence (Table 1 and Graph 2). A wide variation in leaf pubescence (glabrous, very sparse, pubescence, moderately pubescence and densely pubescence) of green gram accessions was also reported by Bisht *et al.* (1998) and Pandian *et al.* (2012).

In general, green gram accessions did not exhibit diversity for leaflet lobes (terminal), leaf shape (terminal), leaf color and leaf vein color. All the 76 accessions possessed terminal leaflet lobes, ovate shaped and green color leaves with greenish purple leaf veins indicating lack of variability among the existing green gram accessions for leaf characters. However, variability in leaf color of green gram was reported by Bisht *et al*. (1998) and Pandian *et al.* (2012).

Similar to leaf characters no variability was noticed for petiole, and all the accessions exhibited green petiole with purple splashes. These results were in contrast with the findings of Bisht *et al.* (1998) and Pandian *et al.* (2012) who grouped green gram genotypes into six and three categories, respectively.

As per the DUS descriptor, leaf size recorded at the 5th node from the base of the plant is grouped into three classes, *i.e.,* small, medium and large size. In the present study, out of 76 accessions, 8 exhibited small sized leaves, 43 possessed medium-sized leaves, and the remaining 25 had large sized leaves (Table 1 and Graph 3). Similar findings of variability in leaf size were reported by Bisht *et al.* (1998) and Pandiyan *et al.* (2012) in green gram. Thomas *et al*. (2002) reported greater diversity for leaf margin, leaf vein, nature of stipule, nature of petiole in country bean indicating that cultivar identification was distinctly possible on the basis of plant morphological characters.

Flower and Pod Characters

All green gram accessions possessed yellow colored standard flower petals; green colored immature pods with pigmented suture and pods with dense pubescence indicating lack of variability among the green gram accessions. Similar results of lack of variability in the color of premature pods were reported by Uma Rani *et al.* (2013). On the other hand, Pandiyan *et al.* (2012) observed variability for pod pubescence in green gram.

As per the DUS descriptor, based on pod position green gram accessions were grouped into 3 classes (above the canopy, intermediate and not visible). In the present study out of 76 accessions, 71 accessions exhibited above the canopy and the remaining 5 exhibited intermediate type (Table 2 and Graph 3).

Based on pod color, green gram accessions were classified into brown and black colored pods. Among 76 accessions, 64 possessed black colored pods, while 12 accessions had brown colored pods (Table 2 and Graph 3). Wide variation in pod color and its classification into three classes (straw, tan, brown) and five classes (straw, tan, brown, brown-black, black and others) was also reported by Bisht *et al.* (1998) and Pandiyan *et al.* (2012) in green gram.

Based on the curvature of mature pods, green gram accessions were distinguished into two classes, *i.e.,* straight and curved. Out of 76 accessions, 73 accessions possessed the straight type of mature pods while three had a curved type (Table 2 and Graph 3). These results were in consonance with the findings of Uma Rani *et al.* (2013) in horse gram.

Table 1: Plant, leaf and flower morphometric traits in different accessions of green gram

S. no.	*Accession no.*	*Growth habit*	*Plant habit*	*Stem colour*	*Stem pubescence*	*Leaf pubescence*	*Leaf size (at 5th node from the base)*	*Pod position*	*Pod color*	*Curvature of mature pod*	*Seed colour*	*Seed lusture*	*Seed shape*
1	CN-8016	Semi-erect	Indeterminate	Green	Moderate	Sparse	Small	Above-canopy	Black	Straight	Green	Shiny	Oval
2	CN-8027	Semi-erect	Indeterminate	Green	Moderate	Moderate	Medium	Above-canopy	Black	Straight	Green	Dull	Oval
3	CN-8067	Semi-erect	Indeterminate	Green	Moderate	Sparse	Large	Intermediate	Black	Straight	Green	Dull	Drum
4	CN-9042	Semi-erect	Indeterminate	Green	Sparse	Sparse	Medium	Above-canopy	Black	Straight	Green	Dull	Oval
5	CN-9074	Semi-erect	Indeterminate	Green	Sparse	Sparse	Large	Above-canopy	Black	Straight	Green	Dull	Oval
6	KARS-104	Semi-erect	Indeterminate	Green	Moderate	Moderate	Small	Above-canopy	Black	Straight	Mottled	Dull	Oval
7	KARS-107	Semi-erect	Indeterminate	Green	Moderate	Dense	Large	Above-canopy	Black	Straight	Green	Dull	Oval
8	KARS-110	Semi-erect	Determinate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Green	Dull	Oval
9	KARS-118	Semi-erect	Indeterminate	Green	Moderate	Dense	Medium	Above-canopy	Black	Straight	Green	Dull	Drum
10	KARS-125	Erect	Indeterminate	Green	Moderate	Sparse	Large	Above-canopy	Black	Straight	Green	Dull	Drum
11	KARS-131	Semi-erect	Indeterminate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Yellow	Shiny	Oval
12	KARS-132	Erect	Indeterminate	Green	Sparse	Sparse	Medium	Above-canopy	Black	Straight	Green	Shiny	Drum
13	KARS-135	Semi-erect	Indeterminate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Green	Dull	Drum
14	KARS-137	Semi-erect	Indeterminate	Green	Moderate	Moderate	Medium	Above-canopy	Black	Straight	Green	Dull	Drum
15	KARS-138	Semi-erect	Indeterminate	Green	Moderate	Sparse	Small	Above-canopy	Black	Straight	Green	Shiny	Oval
16	KARS-147	Erect	Indeterminate	Green	Dense	Moderate	Large	Above-canopy	Black	Straight	Green	Shiny	Drum
17	KARS-149	Semi-erect	Indeterminate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Green	Dull	Drum
18	KARS-169	Semi-erect	Indeterminate	Green	Moderate	Sparse	Large	Above-canopy	Black	Straight	Mottled	Dull	Drum
19	KARS-173	Semi-erect	Indeterminate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Green	Dull	Oval
20	KARS-177	Semi-erect	Indeterminate	Green	Moderate	Sparse	Large	Above-canopy	Black	Straight	Green	Dull	Oval
21	KARS-191	Semi-erect	Indeterminate	Green	Moderate	Sparse	Large	Above-canopy	Black	Straight	Green	Shiny	Drum
22	KARS-212	Semi-erect	Determinate	Green	Moderate	Sparse	Large	Above-canopy	Black	Straight	Green	Shiny	Oval
23	KARS-222	Semi-erect	Indeterminate	Green	Moderate	Sparse	Large	Above-canopy	Black	Straight	Green	Dull	Oval

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S. no.	Accession no.	Growth habit	Plant habit	Stem colour	Stem pubescence	Leaf pubescence	Leaf size (at 5th node from the base)	Pod position	Pod color	Curvature of mature pod	Seed colour	Seed lusture	Seed shape
24	KARS-24	Semi-erect	Indeterminate	Green	Dense	Moderate	Large	Above-canopy	Black	Straight	Green	Dull	Oval
25	KARS-240	Semi-erect	Indeterminate	Green	Dense	Moderate	Medium	Above-canopy	Black	Straight	Green	Shiny	Oval
26	KARS-263	Spreading	Indeterminate	Green	Sparse	Sparse	Large	Above-canopy	Brown	Straight	Green	Shiny	Oval
27	KARS-279	Semi-erect	Indeterminate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Yellow	Dull	Drum
28	KARS-295	Semi-erect	Indeterminate	Green	Moderate	Dense	Medium	Above-canopy	Black	Straight	Green	Dull	Oval
29	KARS-30	Spreading	Indeterminate	Green	Moderate	Moderate	Medium	Above-canopy	Black	Straight	Green	Dull	Oval
30	KARS-39	Spreading	Determinate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Green	Dull	Oval
31	KARS-44	Spreading	Indeterminate	Green	Moderate	Moderate	Medium	Above-canopy	Black	Straight	Green	Dull	Drum
32	KARS-47	Erect	Indeterminate	Green	Moderate	Sparse	Large	Above-canopy	Black	Curved	Green	Dull	Drum
33	KARS-51	Spreading	Indeterminate	Green	Moderate	Moderate	Large	Above-canopy	Brown	Straight	Green	Dull	Oval
34	KARS-53	Semi-erect	Indeterminate	Green	Sparse	Sparse	Medium	Above-canopy	Black	Straight	Green	Dull	Drum
35	KARS-69	Semi-erect	Indeterminate	Green	Sparse	Moderate	Medium	Intermediate	Black	Straight	Green	Dull	Oval
36	KARS-72	Semi-erect	Determinate	Green	Dense	Sparse	Medium	Above-canopy	Black	Straight	Green	Dull	Drum
37	KARS-74	Semi-erect	Indeterminate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Green	Dull	Oval
38	KARS-77	Semi-erect	Indeterminate	Green	Sparse	Sparse	Medium	Above-canopy	Black	Straight	Green	Dull	Drum
39	KARS-84	Spreading	Indeterminate	Green	Sparse	Sparse	Large	Above-canopy	Black	Straight	Green	Dull	Oval
40	KARS-96	Semi-erect	Indeterminate	Green	Dense	Sparse	Medium	Above-canopy	Black	Straight	Mottled	Dull	Drum
41	KDRS-226	Semi-erect	Indeterminate	Green	Moderate	Sparse	Medium	Above-canopy	Brown	Straight	Green	Dull	Drum
42	KSAS-06/140	Semi-erect	Indeterminate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Green	Dull	Oval
43	KSAS-06/235	Semi-erect	Indeterminate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Green	Shiny	Oval
44	KSAS-06/287	Spreading	Indeterminate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Green	Dull	Oval
45	KSAS-06/319	Spreading	Indeterminate	Green	Moderate	Dense	Medium	Above-canopy	Black	Straight	Green	Dull	Oval
46	KSAS-06/359	Semi-erect	Determinate	Green	Moderate	Dense	Medium	Above-canopy	Black	Straight	Green	Shiny	Drum
47	KSAS-06/91	Semi-erect	Indeterminate	Green	Sparse	Sparse	Large	Above-canopy	Black	Straight	Green	Shiny	Drum

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S. no.	Accession no.	Growth habit	Plant habit	Stem colour	Stem pubescence	Leaf pubescence	Leaf size (at 5th node from the base)	Pod position	Pod color	Curvature of mature pod	Seed colour	Seed lusture	Seed shape
48	KVSA-1738	Semi-erect	Indeterminate	Green	Sparse	Sparse	Small	Above-canopy	Black	Straight	Green	Shiny	Drum
49	KVSA-1741	Semi-erect	Indeterminate	Green	Dense	Moderate	Large	Above-canopy	Brown	Straight	Green	Dull	Drum
50	KVSA-1748	Semi-erect	Indeterminate	Green	Sparse	Sparse	Medium	Above-canopy	Brown	Straight	Green	Shiny	Oval
51	KVSA-1760	Spreading	Indeterminate	Green	Dense	Sparse	Medium	Above-canopy	Black	Straight	Green	Shiny	Oval
52	KVSA-1761	Semi-erect	Indeterminate	Green	Dense	Sparse	Large	Above-canopy	Black	Straight	Green	Shiny	Oval
53	KVSA-1762	Semi-erect	Indeterminate	Green	Dense	Sparse	Large	Intermediate	Black	Straight	Green	Shiny	Drum
54	KVSA-1779	Semi-erect	Indeterminate	Green	Dense	Moderate	Medium	Above-canopy	Brown	Straight	Green	Shiny	Drum
55	KVSA-1784	Semi-erect	Indeterminate	Green	Moderate	Moderate	Large	Above-canopy	Black	Straight	Green	Shiny	Oval
56	KVSA-1787	Semi-erect	Indeterminate	Green	Moderate	Sparse	Small	Above-canopy	Brown	Straight	Green	Shiny	Drum
57	KVSA-1789	Semi-erect	Indeterminate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Green	Shiny	Oval
58	KVSA-1790	Spreading	Indeterminate	Green	Moderate	Sparse	Large	Above-canopy	Black	Curved	Green	Shiny	Oval
59	NSKMS-111	Semi-erect	Indeterminate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Yellow	Shiny	Oval
60	NSKMS-148	Semi-erect	Determinate	Green	Sparse	Sparse	Large	Above-canopy	Black	Straight	Green	Dull	Oval
61	NSKMS-161	Semi-erect	Indeterminate	Green	Moderate	Sparse	Large	Above-canopy	Black	Straight	Mottled	Dull	Drum
62	NSKMS-177	Semi-erect	Determinate	Green	Moderate	Moderate	Small	Above-canopy	Black	Straight	Yellow	Dull	Drum
63	NSKMS-48	Semi-erect	Indeterminate	Green	Dense	Sparse	Medium	Intermediate	Black	Curved	Green	Dull	Oval
64	NSKMS-72	Spreading	Determinate	Green	Moderate	Sparse	Large	Intermediate	Black	Straight	Green	Shiny	Oval
65	NSKMS-91	Semi-erect	Indeterminate	Green	Moderate	Moderate	Medium	Above-canopy	Black	Straight	Yellow	Shiny	Drum
66	SK-11	Erect	Indeterminate	Green	Dense	Sparse	Medium	Above-canopy	Brown	Straight	Green	Dull	Oval
67	SK-37	Semi-erect	Indeterminate	Green	Moderate	Moderate	Medium	Above-canopy	Brown	Straight	Green	Shiny	Oval
68	SK-41	Semi-erect	Indeterminate	Green	Dense	Sparse	Medium	Above-canopy	Brown	Straight	Green	Dull	Drum
69	SKN-137	Semi-erect	Indeterminate	Green	Moderate	Dense	Medium	Above-canopy	Brown	Straight	Green	Shiny	Drum
70	SKN-139	Spreading	Indeterminate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Green	Shiny	Oval
71	SKN-155	Erect	Indeterminate	Green	Sparse	Sparse	Medium	Above-canopy	Black	Straight	Green	Shiny	Oval

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S. no.	Accession no.	Growth habit	Plant habit	Stem colour	Stem pubescence	Leaf pubescence	Leaf size (at 5th node from the base)	Pod position	Pod color	Curvature of mature pod	Seed colour	Seed lusture	Seed shape
72	SKN-61	Semi-erect	Indeterminate	Green	Moderate	Sparse	Small	Above-canopy	Black	Straight	Green	Shiny	Drum
73	VKAP-39	Semi-erect	Indeterminate	Green	Moderate	Dense	Small	Above-canopy	Brown	Straight	Green	Shiny	Drum
74	K-851(c)	Spreading	Indeterminate	Green	Moderate	Sparse	Large	Above-canopy	Black	Straight	Green	Dull	Drum
75	LGG-460 (c)	Semi-erect	Indeterminate	Green	Sparse	Sparse	Large	Above-canopy	Black	Straight	Green	Shiny	Oval
76	ML-267(c)	Semi-erect	Indeterminate	Green	Moderate	Sparse	Medium	Above-canopy	Black	Straight	Green	Shiny	Oval

Seed Characters

As per the DUS descriptor, based on seed color, green gram accessions were categorized into four groups, i.e., yellow, green, mottled and black. In the present study, out of 76 accessions, 67 accessions had green colored seeds, five were yellow colored and remaining four exhibited the mottled type of seed color (Table 2 and Graph 4). Similar variability in seed color was also reported by Bisht *et al.* (1998) in green gram, Ghafoor *et al.* (2001) in Bengal gram, Nisar *et al.* (2008) in pea, Pandiyan *et al.* (2012) in green gram and Uma Rani *et al.* (2013) in horse gram.

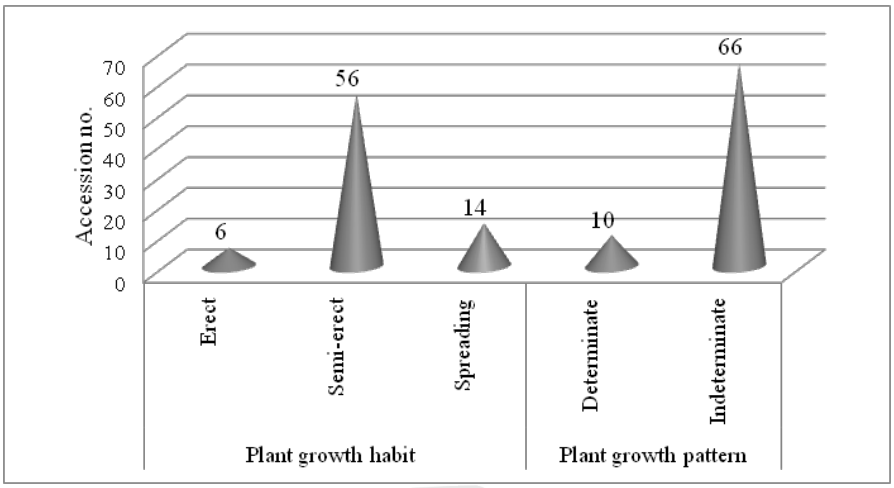
Seed luster is an important criteria in green gram which can be used as an indicator for characterization. Based on seed luster, green gram accessions were grouped into dull and shiny. Out of 76 green gram accessions, 43 were dull type and the remaining 33 had the shiny type of luster (Table 2 and Graph 4). Similar variability in seed luster was reported by Pandiyan *et al.* (2012).

Based on seed shape, green gram accessions exhibited diversity for seed shape, i.e., oval and drum. Among 76 accessions, 43 exhibited oval seed shape and the remaining 33 were drum-shaped (Table 2 and Graph 4). Similar variability in seed shape was reported by several scientists (Bisht *et al.*, 1998 and Pandiyan *et al.*, 2012 in green gram and Uma Rani *et al.*, 2013 in horse gram).

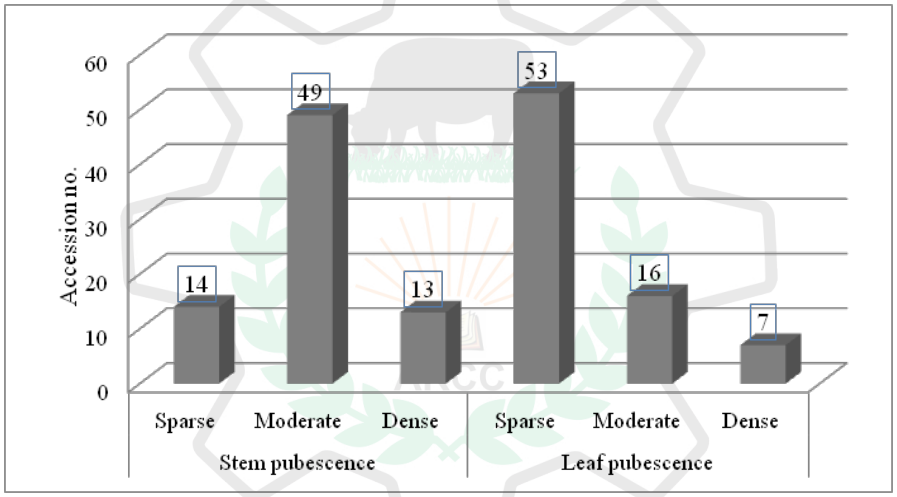
Qualitative characters are important for plant descriptors (Kurlovich, 1998) and are influenced by consumers preference, socioeconomic conditions, and natural selection. Some of the qualitative traits are related to some biotic/abiotic stresses. A hairy plant is more tolerant against insect pests, whereas glabrous cultivars are easy to harvest and trample. Similarly, pod characters like pod position, pod wall thickness, hairiness of the pods and seed coat thickness contribute to pre-harvest sprouting. Pod hairiness, seed luster, seed shape, and seed size are the distinct morphological characters which aid in the identification of off-types; thereby maintaining the varietal genetic purity.

Green gram is a self-pollinated crop, and the existing variability for various qualitative characters in the crop is very limited. Characterization of different accessions with a single morphological character would be difficult. Therefore, a group of morphological characters may help in better classification. Plant morphological characters have been used for the classification of several crop varieties like lettuce, chilli, cabbage (Harris and Beever, 2004) and French bean (Sajjan *et al.*, 2006).

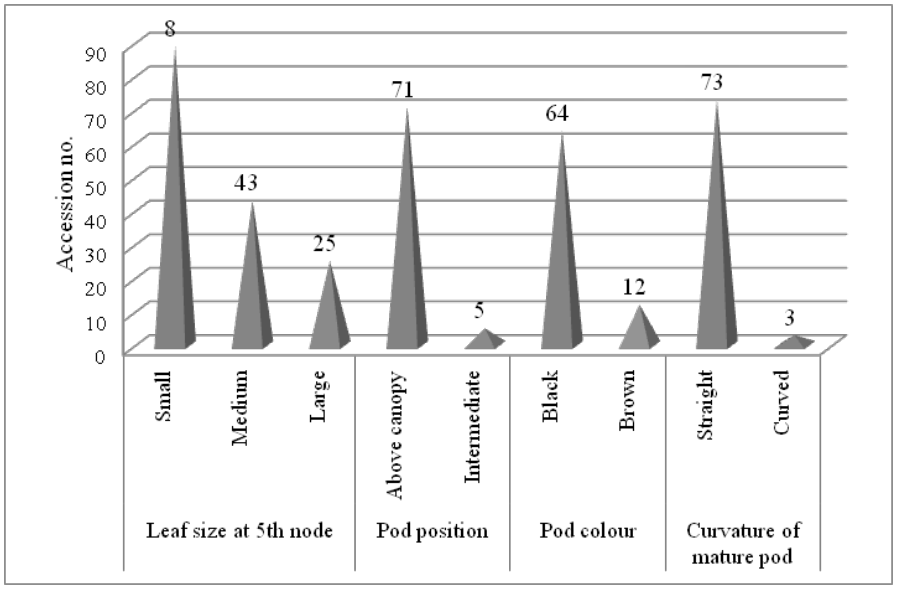
Classification of green gram accessions for various qualitative characters serves as a key for the identification of different accessions on the basis of growth habit, stem pubescence, leaf pubescence, leaf size (at 5th node from the base), pod position, pod colour, curvature of mature pod, seed lustre, seed colour and seed shape. Among the distinct morphological traits, seed luster may serve as a key character and useful in broad classification of genotypes into different groups rather than of individual genotype.



Graph 1: Plant morphometric traits in different green gram accessions



Graph 2: Stem and leaf morphometric traits in different green gram accessions



Graph 3: Leaf and pod morphometric traits in different green gram accessions

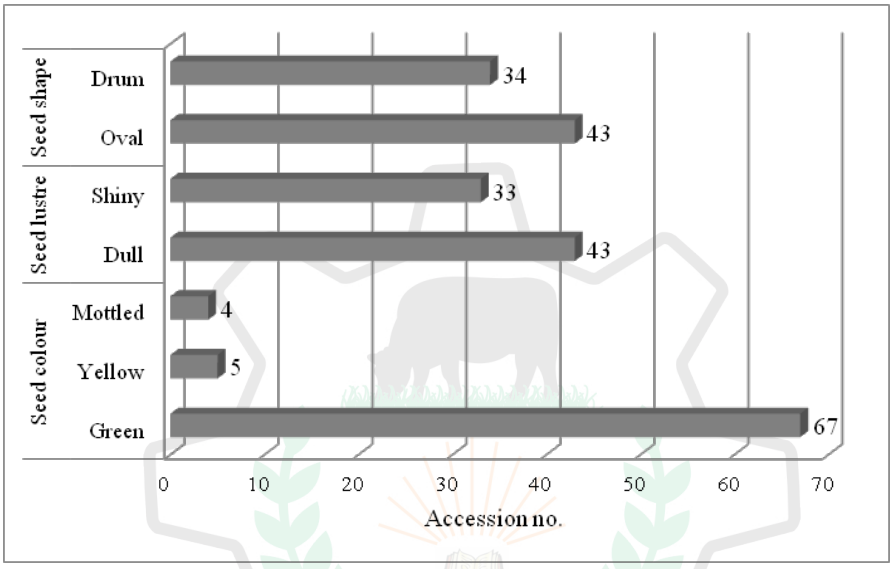
Table 2: Pod and seed morphometric traits in different accessions of green gram

S. no.	*Accession no.*	*Pod position*	*Pod colour*	*Curvature of mature pod*	*Seed colour*	*Seed lusture*	*Seed shape*
1	CN-8016	Above-canopy	Black	Straight	Green	Shiny	Oval
2	CN-8027	Above-canopy	Black	Straight	Green	Dull	Oval
3	CN-8067	Intermediate	Black	Straight	Green	Dull	Drum
4	CN-9042	Above-canopy	Black	Straight	Green	Dull	Oval
5	CN-9074	Above-canopy	Black	Straight	Green	Dull	Oval
6	KARS-104	Above-canopy	Black	Straight	Mottled	Dull	Oval
7	KARS-107	Above-canopy	Black	Straight	Green	Dull	Oval
8	KARS-110	Above-canopy	Black	Straight	Green	Dull	Oval
9	KARS-118	Above-canopy	Black	Straight	Green	Dull	Drum
10	KARS-125	Above-canopy	Black	Straight	Green	Dull	Drum
11	KARS-131	Above-canopy	Black	Straight	Yellow	Shiny	Oval
12	KARS-132	Above-canopy	Black	Straight	Green	Shiny	Drum
13	KARS-135	Above-canopy	Black	Straight	Green	Dull	Drum
14	KARS-137	Above-canopy	Black	Straight	Green	Dull	Drum
15	KARS-138	Above-canopy	Black	Straight	Green	Shiny	Oval
16	KARS-147	Above-canopy	Black	Straight	Green	Shiny	Drum
17	KARS-149	Above-canopy	Black	Straight	Green	Dull	Drum
18	KARS-169	Above-canopy	Black	Straight	Mottled	Dull	Drum
19	KARS-173	Above-canopy	Black	Straight	Green	Dull	Oval
20	KARS-177	Above-canopy	Black	Straight	Green	Dull	Oval
21	KARS-191	Above-canopy	Black	Straight	Green	Shiny	Drum
22	KARS-212	Above-canopy	Black	Straight	Green	Shiny	Oval
23	KARS-222	Above-canopy	Black	Straight	Green	Dull	Oval
24	KARS-24	Above-canopy	Black	Straight	Green	Dull	Oval
25	KARS-240	Above-canopy	Black	Straight	Green	Shiny	Oval
26	KARS-263	Above-canopy	Brown	Straight	Green	Shiny	Oval
27	KARS-279	Above-canopy	Black	Straight	Yellow	Dull	Drum
28	KARS-295	Above-canopy	Black	Straight	Green	Dull	Oval
29	KARS-30	Above-canopy	Black	Straight	Green	Dull	Oval
30	KARS-39	Above-canopy	Black	Straight	Green	Dull	Oval
31	KARS-44	Above-canopy	Black	Straight	Green	Dull	Drum
32	KARS-47	Above-canopy	Black	Curved	Green	Dull	Drum
33	KARS-51	Above-canopy	Brown	Straight	Green	Dull	Oval
34	KARS-53	Above-canopy	Black	Straight	Green	Dull	Drum
35	KARS-69	Intermediate	Black	Straight	Green	Dull	Oval
36	KARS-72	Above-canopy	Black	Straight	Green	Dull	Drum
37	KARS-74	Above-canopy	Black	Straight	Green	Dull	Oval
38	KARS-77	Above-canopy	Black	Straight	Green	Dull	Drum
39	KARS-84	Above-canopy	Black	Straight	Green	Dull	Oval
40	KARS-96	Above-canopy	Black	Straight	Mottled	Dull	Drum
41	KDRS-226	Above-canopy	Brown	Straight	Green	Dull	Drum
42	KSAS-06/140	Above-canopy	Black	Straight	Green	Dull	Oval
43	KSAS-06/235	Above-canopy	Black	Straight	Green	Shiny	Oval
44	KSAS-06/287	Above-canopy	Black	Straight	Green	Dull	Oval
45	KSAS-06/319	Above-canopy	Black	Straight	Green	Dull	Oval
46	KSAS-06/359	Above-canopy	Black	Straight	Green	Shiny	Drum
47	KSAS-06/91	Above-canopy	Black	Straight	Green	Shiny	Drum
48	KVSA-1738	Above-canopy	Black	Straight	Green	Shiny	Drum
49	KVSA-1741	Above-canopy	Brown	Straight	Green	Dull	Drum
50	KVSA-1748	Above-canopy	Brown	Straight	Green	Shiny	Oval
51	KVSA-1760	Above-canopy	Black	Straight	Green	Shiny	Oval
52	KVSA-1761	Above-canopy	Black	Straight	Green	Shiny	Oval
53	KVSA-1762	Intermediate	Black	Straight	Green	Shiny	Drum
54	KVSA-1779	Above-canopy	Brown	Straight	Green	Shiny	Drum
55	KVSA-1784	Above-canopy	Black	Straight	Green	Shiny	Oval
56	KVSA-1787	Above-canopy	Brown	Straight	Green	Shiny	Drum
57	KVSA-1789	Above-canopy	Black	Straight	Green	Shiny	Oval
58	KVSA-1790	Above-canopy	Black	Curved	Green	Shiny	Oval
59	NSKMS-111	Above-canopy	Black	Straight	Yellow	Shiny	Oval
60	NSKMS-148	Above-canopy	Black	Straight	Green	Dull	Oval
61	NSKMS-161	Above-canopy	Black	Straight	Mottled	Dull	Drum
62	NSKMS-177	Above-canopy	Black	Straight	Yellow	Dull	Drum
63	NSKMS-48	Intermediate	Black	Curved	Green	Dull	Oval
64	NSKMS-72	Intermediate	Black	Straight	Green	Shiny	Oval
65	NSKMS-91	Above-canopy	Black	Straight	Yellow	Shiny	Drum
66	SK-11	Above-canopy	Brown	Straight	Green	Dull	Oval
67	SK-37	Above-canopy	Brown	Straight	Green	Shiny	Oval
68	SK-41	Above-canopy	Brown	Straight	Green	Dull	Drum

Cont...

Cont...

S. no.	Accession no.	Pod position	Pod colour	Curvature of mature pod	Seed colour	Seed lusture	Seed shape
69	SKN-137	Above-canopy	Brown	Straight	Green	Shiny	Drum
70	SKN-139	Above-canopy	Black	Straight	Green	Shiny	Oval
71	SKN-155	Above-canopy	Black	Straight	Green	Shiny	Oval
72	SKN-61	Above-canopy	Black	Straight	Green	Shiny	Drum
73	VKAP-39	Above-canopy	Brown	Straight	Green	Shiny	Drum
74	K-851 (c)	Above-canopy	Black	Straight	Green	Dull	Drum
75	LGG-460 (c)	Above-canopy	Black	Straight	Green	Shiny	Oval
76	ML 267 (c)	Above-canopy	Black	Straight	Green	Shiny	Oval



Graph 4: Seed morphometric traits in different green gram accessions

Therefore the study suggested that some of these distinct morphological traits can be considered as key characters and useful for seed production programs in varietal identification and identification of off-types in seed plots of different classes of seed.

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