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Morphological Characterization of Elite *Kabuli* Chickpea Lines

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A B S T R A C T

Characterization of 89 *kabuli* chickpea lines were received from different sources (SAU's, ICRISAT and ICARDA) based on seventeen agro-morphological traits recorded in two *rabi* season 2018-19 and 2019-20. Results showed that 28 lines were semi-spreading, 44 semi-erect while 17 lines were erect type. Further, seventy six lines were recorded medium stature, 8 short, whereas 5 lines tall. Lines FLIP12-278C, FLIP122-161C, JGK-2018-5, ICCV1811909 and ICCV181305 had semi erect to erect type with tall stature would be suitable for mechanical harvesting. All lines characterized by white colour flower with no stripes on standard and had one flower per peduncle, no anthocyanin pigmentation and pinnate type of leaf pattern. Foliage colour showed wide variation, 6 lines had dark green, 55 lines had light green and 28 lines had medium green. Results exhibited that 37 lines were recorded as early flowering, better suited to grow under late sown conditions, whereas 50 lines medium and 2 lines were recorded late flowering. All the *kabuli* lines recognized as owl's head shape seed having beige colour seed coat with smooth seed surface. Among 89 lines ICCV181313 was recorded small seeded and 40 lines were medium seeded whereas seven *kabuli* chickpea lines were recorded extra large seeded (JGK-2018-1,2,3,4, RVSVT-K-105,110 and ICCV181307) and 33 large seeded would be screen out as export purpose and also used in hybridization programme. Therefore, characterization facilitates to develop distinct profile of these lines and helped in identification and evaluation of elite *kabuli* chickpea lines.

Introduction

Chickpea provides high quality protein for human and animal consumption as well as offers economic benefits to farmers because of the high market value for chickpea grains and not only meets its own nitrogen requirement but also leaves residual nitrogen for succeeding crop, improves physical and chemical properties of the soil, and decreases pests, diseases and weeds of rainy season (*kharif*) crops *Kabuli* chickpea fetches higher price than *desi* varieties and thus could work as a catalyst in bringing additional area under irrigated condition of the country and also improving livelihood of the pulse growers It.

It is one of the oldest and widely cultivated pulse crops over 50 countries of the world.

Traditionally, characterization of morphological traits has been used as a basis for classification, visual identification, differentiation and cataloguing of the germplasm. It could unveil their phylogeny, which considerably beneficial to a plant breeder in utilizing these germplasm in frontier area of research programme of chickpea. Morphological characterization studies are done by using morphological markers that are highly heritable traits. They are inexpensive, simple and rapid to score. The measurement of the descriptor is used to assess diversity, but the environmental effect on these traits renders this measure relatively insensitive, particularly where differences are small. Therefore, morphological markers need to be supported with more sensitive markers especially when measuring diversity between and within populations of a single species (Williams *et al.,* 1990).

Plant morphological characters have been recognized as the universally undisputed descriptors for DUS testing and varietal characterization of crop varieties (Joshi *et al.,* 2018). Thus, any morphological character that is associated and makes a significant contribution to higher seed yield would be useful in the improvement of yield. According to aforesaid facts, this investigation was carried out to characterize 89 elite *kabuli* lines on the basis of qualitative DUS descriptor which facilitates to identify distinguish line, further it would be used in chickpea improvement programme.

Materials and Methods

The study was conducted on the site of seed breeding farm, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur during two *rabi* seasons of 2018-19 and 2019-20. The experimental material comprised of 89 elite lines of *kabuli chickpea* included 2 checks. Elite lines of *kabuli* chickpea were obtained from ICRISAT (Pattancheru), ICARDA (Morocco) and JNKVV (Jabalpur). All lines were evaluated in three replications using Randomized Complete Block Design (RCBD) with each entry in two rows of 4.0 m length in each replication. Inter and intra-row space was 45 x 10cm. The recommended agronomical and plant protection practices were followed for the successful raising of the crop. Observations were recorded on 18 qualitative traits including morphological and seed traits based on the DUS guide line of chickpea for each character in each replication at different crop growth stages. Qualitative traits along with its descriptors and stage of observation have been depicted in Table 1.

Results and Discussion

Crop improvement in chickpea is hampered due to the presence of narrow genetic base which need to be broadened so as to realize the genetic potential of these lines. Hence, assessment of genetic diversity is a prerequisite for formulating crop improvement strategies in any crop. Since, the assessment of the genetic diversity and characterization of primary genetic resource specimens is one of the most important conditions for the proper and rational use of working collections in future breeding programmes. Therefore, agro-morphological traits of different lines studied and showed that although some of the lines have common qualitative features rather than one or few characters, they can be differentiated from each other on the basis of their mono-morphic traits. The objective of this investigation was to characterize the *kabuli* chickpea lines for seventeen qualitative traits on the basis of DUS guideline and prepared their distinct profile to discriminate the different lines.

No variation was found among the elite lines for Leaf pattern and all they had pinnate type of leaf pattern. Plant growth habit is a distinguishing feature in plant characterization of chickpea. Large variation was observed in growth habit 28 lines were semi spreading, 44lines, semi-erect, while 17 lines were erect type. Further, Seventy six lines among 89 recorded medium stature, 8 lines short, whereas 5 lines were tall. Lines *viz.,* FLIP 12-278C, FLIP 122-161C, JGK-2018-5, ICCV 1811909 and ICCV 181305 had semi erect to erect type with tall stature would be suitable for mechanical harvesting. Results indicated that there was wide variation showed in foliage color, 55 lines showed light green, 28 lines observed medium green, while 6 lines showed dark green. It is a visual trait easily observable in vegetative stage of plant. In order to size of leaflets, the variation was observed in the lines which were categorized into three main groups *viz;* small, medium and large, 11 lines observed small size leaflets (10.0mm), 55 observed medium (10.0-15.0mm), while the remaining 23 were large (>15.0mm) leaflets size. Color of flower is one of the most important diagnostic visual easily observable traits. It is widely used as a marker gene in genetic studies and breeding work.

All indegineous and exotic *kabuli* chickpea lines were characterized by white colour flower with no stripes on standard and had one flower per peduncle. No anthocyanin pigmentation and dark coloration on stem, whole plant and pods and all lines had pinnate type of leaf pattern. The peduncle length is a peculiar trait, can be classified in to three categories 7 lines exhibited short peduncle, while in 32 lines noted medium peduncle length and the remaining 50 lines showed long peduncle (Fig. 1–3; Table 2).

Table.1 List of Morphological Traits with Descriptors

S.No.n	Characteristics	Descriptors	Stage of observation
1	Stem: Anthocynin coloration	Absent, Present	Before flowering
2	Plant: Growth habit	Erect, Semi-erect, Semi Spreading, Spreading	50% flowering
3	Color of foliage	Light green, Medium green Dark green, Greenish purple	50% flowering
4	Leaflet: Size	Small, Medium, Large	50% flowering
5	Leaf: Pattern	Simple, Compound, Pinnate	50% flowering
6	Flower: Color	White, Pink, Blue, Purple	50% flowering
7	Peduncle: Length(mm)	Short, Medium, Long	Pod development
8	Seed: Color	Beige (*Kabuli*), Creamy beige, Green, Yellow, Orange, Brown, Dark brown, Grey, Black	30 days after harvest
9	Seed: Size	Very small, Small, Medium, Large, Very large	30 days after harvest
10	Seed: Shape	Pea-shaped, Owl's head, Angular	30 days after harvest
11	Seed: Testa texture	Rough, Smooth, Tuberculated	30 days after harvest
12	Seed: Ribbing	Absent, Present	30 days after harvest

Table.2 Characterization of *kabuli* chickpea lines on the basis of
distinguishable morphological traits

S. No.	Traits	Expressions	No of genotypes belonging to each class	Percentage contributions %
1.	Growth habit	Erect (0-15^0 from vertical)	17	19.1
		Semi-erect (16-25^0 from vertical)	44	49.4
		Semi-spreading (26-60^0 from vertical)	28	31.4
2.	Size of leaflets	Small (<10mm long- 4mm wide)	11	12.3
		Medium (10-15mm long, 412mm wide	55	61.8
		Large (>15mm long, >12mm wide)	23	26
3.	Time of 50% flowering	Early (40-60 days)	37	41.5
		Medium (61-80 days)	50	56.1
		Late (>80 days)	2	2.2
4.	Plant height (cm)	Short (< 45cm)	8	8.9
		Medium (45-65cm)	76	85.3
		Tall (> 65cm)	5	5.6
5.	Flower stripes on standard	Absent	89	100
6.	Flower color	White	89	100
18.	Flower number per peduncle	One	89	100
7.	Foliage colour	Dark green	6	6.7
		Light green	55	61.8
		Medium green	28	31.5
8.	Leaf pattern	Pinnate	89	100
9.	Stem anthocyanin coloration	Absent	89	100
10.	Peduncle length (mm)	Short (<5mm)	7	7.9
		Medium (5- 10mm)	32	35.9
		Long (>10mm)	50	56.2
11.	Seed colour	Beige	89	100
12.	Seed size	small	1	1.1
		Medium	48	53.9
		Large	33	37.1
		Extra large	7	7.8
13.	Seed shape	Owl head	89	100
14.	Seed surface/ texture	Smooth	89	100
15.	Seed ribbing	Absent	89	100
16.	Seed type	kabuli	89	100
17.	Shattering resistance (%)	Absent	89	100

Fig.1 Plant growth habit
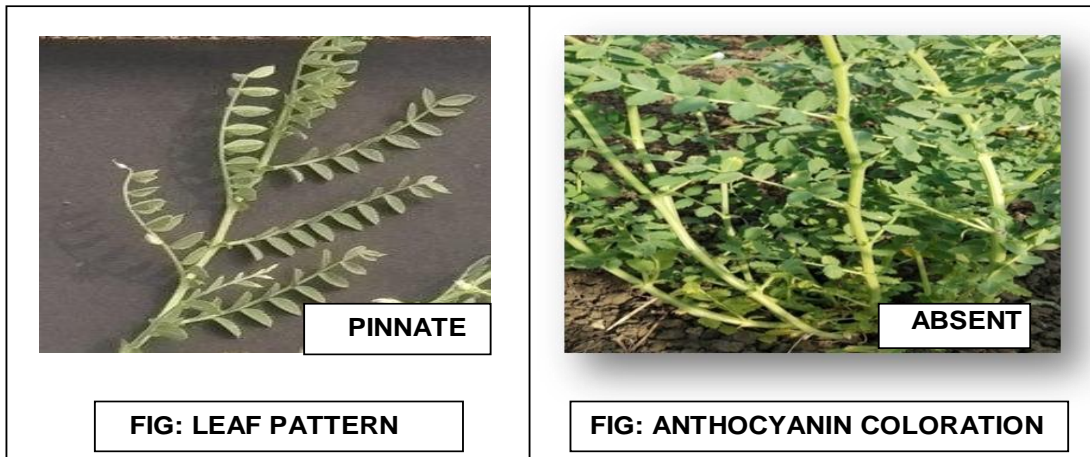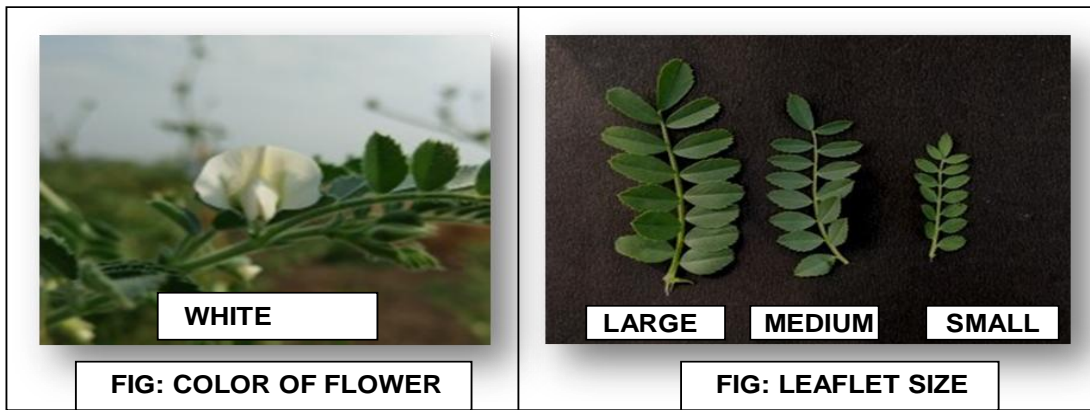
Fig.2 Seed size (weight of 100 seeds at 10% moisture

FLIP 12-342C

FIG: SEED SHAPE: OWL'S HEAD

ICCV 181307

FIG: SEED RIBBING: ABSENT

FLIP 12-37C

FIG: SEED COLOUR: BEIGE

SHORT   **MEDIUM**   **LONG**

PEDUNCLE LENGTH

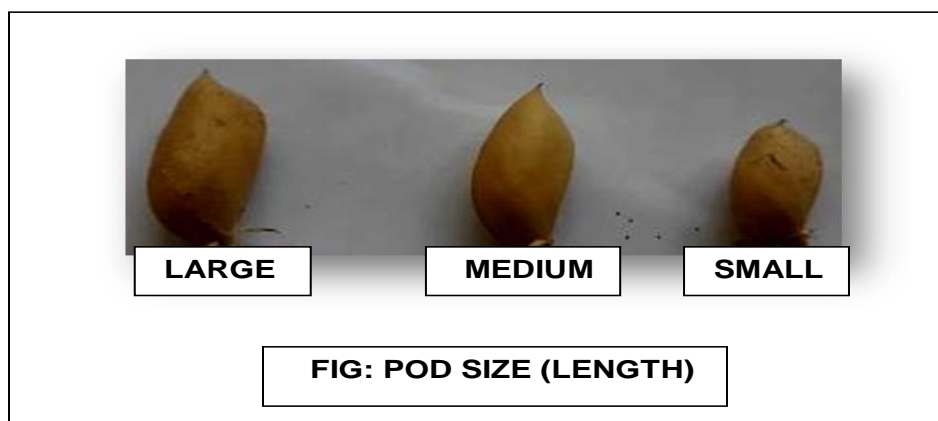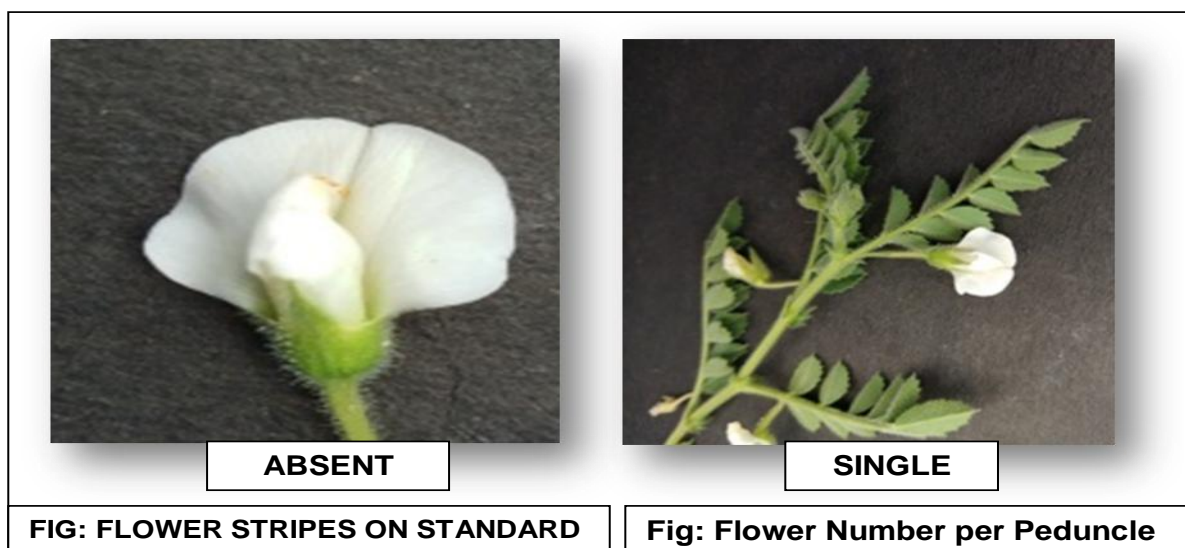**ICCV 181213**   **RVSVT-K-103**   **FLIP 88-85 C**   **RVSVT-K-105**

SMALL   **MEDIUM**   **LARGE**   **VERY LARGE**

FIG: SEED SIZE (WEIGHT OF 100 SEEDS AT 10% MOISTURE

Fig.3 Morphological Characters

ABSENT

FIG: FLOWER STRIPES ON STANDARD

SINGLE

Fig: Flower Number per Peduncle

LARGE　　　MEDIUM　　　SMALL

FIG: POD SIZE (LENGTH)

All the *kabuli* lines recognized as owl's head shape seed, having beige colour seed coat with smooth seed surface. For *kabuli* chickpea, seed size is a most preferable traits to the consumers because large and extra large seeded *kabuli c*hickpea fetches 2-3 times higher price than *desi* varieties and thus it could work as a catalyst in bringing additional area and improving livelihood of the pulse growers. Seed size traits showed mono-morphic as well as polymorphic.

Among 89 lines, a line ICCV 181313 recorded as small seed size (20-25g), showed mono morphic in nature, whereas 40 lines noted as medium seeded (26-35g), 33 elite lines as large seed seeded (36-45g) and seven *kabuli* chickpea lines recorded as extra large seeded (JGK- 2018-1,2,3,4, RVSVT-K-105, 110 and ICCV 181307). These large and extra large seeded lines would be screenout as export purpose and also used in chickpea hybridization programme.

Understandings of various seed traits *viz.,* seed color, size, shape and texture facilitate the identification for selection of desirable traits, designing new populations and transferring their desirable genes. These results supported by the research of (Solanki *et al.,* 2019), and Loko *et al.,* (2018), Bayahi *et al.*(2015), Shrivastava *et al.,* (2012), Upadhyaya *et al.,* (2008), Kaul *et al.,* (2007). Morphological features of the lines have been a major component of varietal identification, distinctness, characterization and evaluation of best elite lines. Similar findings reported by earlier scientists (Gediya *et al.,* 2018), Sangram Singh *et al.,* (2018), Kosev and Vasileva (2018), Joshi *et al.,* (2018), Bayahi and Rezgui (2015)**,** saha (2017) and Zaccardelli *et al.,* (2013).

It is not possible to identify advanced promising lines using any single parameter. A detailed morphological description of plants and seeds should therefore be assigned distinctive morphological profiles. Similar facts suggested by Janghel *et al.,* (2020), Solanki *et al.,* (2019), and Adem and Tesso (2019).

Differential behaviour in respect of growth, dry matter production potential and translocation of photosynthates from source to sink showed significant variation in yield which leads to distinguish lines from each other. Similar results noticed by Bodake *et al.,* (2014) and Heidarvand *et al.,* (2011).

Utilization of agro-morphological features in sequential fashion is useful and convenient to distinguish different genotypes. Similarly, genotypes identification based on distinguishable morphological characters were reported by (Sarao *et al.,* 2009), Lalitha (2007), Upadhyaya *et al.,* (2002), Yadav and Shrivastava (2002), Chowdhury *et al.,* (2002) and Singh (2001) in chickpea, However systematic characterization leads to a more

efficient use of material under consideration in chickpea improvement programme.

Results of investigation concluded that distinct morphological profile would be most practically valuable to a plant breeder while selecting genotypes in field and seed level. Morphological character those associated with higher seed yield or which makes a significant contribution to yield would be useful in the improvement of seed yield. Therefore, morphological characterization facilitates to develop distinct profile of these lines and helped in identification, characterization and evaluation of elite *kabuli* chickpea lines. Hence, systematic characterization leads to a more efficient use of material under consideration in chickpea improvement programme and these lines prefer to selection.

Acknowledgment

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