Morphological Characterization of Horse gram genotypes (*Macrotyloma uniflorumm* Lam)

ABSTRACT

Under the provisions of New Seed Policy and the Protection of Plant Varieties and Farmers Rights Act, 2001, all newly developed varieties have to be registered based on the criteria of Novelty, Distinctness, Uniformity and Stability (NDUS) information helps in easy identification of horsegram genotype for each other. In the present study breeder seeds of 24 horse gram genotypes were obtained from pulse breeder, Agricultural Research Station Bailhongal and Regional Agricultural Research Station, Vijayapur for conducting the field experiment at Saidapur Farm University of Agricultural Sciences, Dharwad. The present study was carried out to have information on morphological distinctness of 24 horse gram genotypes for plant height, number of branches, seed coat, flower colour, pod colour, number days taken for pod initiation and pod maturity. All the horsegram genotypes under study were distinguished based on the morphological traits such as days to fifty percent flowering, pod colour and seed coat colour. Among the them seed coat colour and pod colour were most important morphological characters in distinguishing horsegram genotypes as they were least affected by environmental factors. The genotypes differing for .morphological traits serve as markers for maintenance, multiplication and seed certification and also serve as diverse parent for further breeding programe.

Key words – Distinctness, Horsegram., Morphology, Novelty, Seed policy, Uniformity

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Introduction

Horse gram (*Macrotyloma uniflorum* (Lam)), synonymously known as “Kulthi” is an important arid legume crop of India. It has been originated from South India. According to recent taxonomical classification, it belongs to the subfamily *Faboidae* of family *Fabaceae*. In India, it is currently grown on an area of 5.07 lakh ha, contributing to the average annual production of 2.62 lakh tons and productivity of 516 kg/ha (FAOSTAT, 2021).

The development of new and improved plant varieties is a continuous breeding process in horse gram crop improvement programme. It is of critical importance for sustained increase in horse gram

productivity. Under the provisions of New Seed Policy and the Protection of Plant Varieties and Farmers Rights Act, 2001, all newly developed varieties have to be registered based on the criteria of Novelty, Distinctness, Uniformity and Stability (NDUS) has become mandatory. In plant breeding and commercial seed programmes, the characters for which a variety has to be distinct enough from other existing varieties could be morphological, chemical, biochemical, molecular and physiological in nature, which are quite useful in varietal identification, recognition and distinction. Further it is essentially required to characterize and evaluate all categories of germplasm in horsegram as it will enable proper documentation and further utilization. In morphological characterization, grow out test is the usual test conducted by growing seedlings or plants under field condition right from germination until harvest of the crop and the diagnostic growth features of the varieties are observed in fixing the genuineness of a variety under seed production. Morphological descriptors are universally accepted as classical taxonomical approach in varietal recognition and distinction. Our study focused on morphological distinctness of 24 horse gram genotypes for their plant height, number of branches, seed coat colour, flower colour, pod colour, number days taken for pod initiation and pod development.

Materials and methods

The present investigation was carried out at Saidapur Farm, Seed Unit, University of Agricultural Sciences, Dharwad during 2020-21 for morphological characterization for varietal identification and distinctness in horse gram. Further the laboratory studies were carried in Seed Unit, UAS, Dharwad. The experimental material consisted of pure and healthy seeds of 24 different horse gram genotypes obtained from pulse breeder, ARS Bailhongal and RARS, Vijayapur. The experiment was laid out in randomized block design with three replications. All the recommended package of practices were followed to raise the good crop with best expression of traits. Following morphological traits were considered for grouping the horsegram genotypes.

Plant height: The length of the plant from the base of the plant at the ground level (surface of the soil) to the tip of the main stem, at the time of harvesting was measured on a metric scale. Based on height in centimetres (cm), the genotypes were grouped as short (< 100 cm), medium (100-110 cm) and long (> 110 cm).

Number of branches per plant: Numbers of branches were recorded by counting the number of branches on main stem on the earlier selected and tagged plants at the time of harvest and the genotypes were classified as less (< 9), medium (9-9.5) and more (> 9.5).

.**Colour of the flower:**The flower colour was recorded on visual assessment basis at peak flowering stage under natural day light condition.

Days to pod initiation: The number of days taken from opening of first flower to initiation pod development in each genotype was noted on the five randomly selected competitive plants and the average was calculated and expressed as days to pod initiation and the genotypes were grouped as early (<65 days) and late (> 65 days)

Pod colour: The pod colour of the selected genotypes was observed under natural day light condition at harvesting stage by visual assessment and the genotypes were classified as,white, cream, light brown, brown, dark brown and other

Days to maturity: The number of days taken for each genotype from sowing to physiological maturity of pods (based on yellowing of pods and leaves) was recorded for the randomly tagged plants and genotypes were grouped as early maturity types (< 100 days), medium maturity types (100-115 days), late maturity types (> 115 days)

Seed coat colour: The seed coat colour of each genotype was observed visually under natural day light condition and the genotypes were grouped as brown, light brown and cream seed coloured types

Results and discussion

Plant height at harvest varied among different horse gram genotypes (Table 1). The mean plant height of the genotypes was 105.04 cm. The highest plant height was observed in CRHG-02 (126.07cm) and the lowest plant height in the VLG-14

(92.97 cm). Based on plant height, the genotypes were grouped into three categories as short (< 100.00 cm), medium (100.00 - 110.00 cm) and long (> 110.00 cm).

Among the 24 genotypes, the six genotypes were short *viz.*, Paiyur-1, AK-21, CRHG-10, AK-42, VLG-14, VLG-15 and twelve genotypes were grouped under medium *viz.*, BGM-183, CRHG-09, CRHG-06, HL-1, VLG-19, AK-41, PHG-04, CRGH-04, GPM-06, PHG-09, CHG-01, CHG-04 and six genotypes were long *viz.*, AK-44, CRHG-08, Paiyur-2, CRHG-02, CRHG-19, CRIDA-18-R in plant height.Similar results were reported by Manjaya and Bapat., 2008 in soybean and Suhasini., 2006 in sesamum. Wider variation in plant height noticed in the horse gram genotypes may be probably due to the genetic ability of the genotypes involved and also as influenced by agronomical practices and environmental influences.

Number of branches per plant varied among the horse gram genotypes (Table 1). The mean number of branches per plant was 9.25. Significantly highest number of branches was seen in CRIDA-18-R (9.73) and the lowest number in PHG-04 (8.73). Based on number of branches, the genotypes were grouped into three categories as more branches (> 9.50), medium (9.00 – 9.50) and less branches (< 9.00).

Among the 24 genotypes, six genotypes were having more primary branches per plant *viz.*, CRHG-09, AK-44, VLG-14, VLG-15, PHG-09, CRIDA-18-R and fourteen genotypes having medium branches *viz.*, Paiyur-1, AK-21, BGM-183, CRHG-10, CRHG-06, CRHG-08, Paiyur-2, VLG-19, AK-41, CRHG-02, CRHG-04, GPM-06, CRHG-19, CHG-01 while, rest of the four genotypes were having less number of branches *viz.*, HL-1, PHG-04, AK-42 and CHG-04. Similar results were reported by Suhasini.,2006 in sesame and Ushakumari et al., 2000 in cowpea, Chavan, 2010 in soybean, Makanur et al., 2013 in cowpea. The variation in the primary branches was mainly due to genetic factors and the number of primary branches in genotypes determines the pod bearing ability of plant which intern contributes to the seed yield, thus identification and selection of genotypes with more branching ability is necessary.

The seed coat colour varied among the horse gram genotypes. Based on seed coat colour of the 24 tested horse gram genotypes were grouped as light brown, brown, dark brownand black and are presented in Table 2. Genotypes with light brown seed coat colour were CRHG-04, GPM-06, CRHG-19, CRIDA-18-R and CHG-1. The genotypes with brown seed coat colour were AK-21, BGM-183,

CRHG-10, CRHG-09, AK-44, AK-42, CRHG-06, HL-1, CRHG-08, Paiyur-02, VLG-19, VLG-14, AK-41, CRHG-02, VLG-15, CHG-04. Genotypes Paiyur-1 and PHG-09 showed dark brown colour. Whereas, black colour seed coat was seen in PHG-04 genotype.It is imperative that seed colour is selectively influenced by environmental conditions such as prevalence of rainfall/humidity during harvest time and incidence of the diseases Similar results were reported by Arunkumar, 2004, Sankrapandian., 2002, Suhasini., 2006, Sajjan et al., 2008, Chandrashekhar., 2005, Khare et al., 2009, Chavan., 2010 and Makanur et al., 2013.

Based on the presence of purple pigmentation in flower the genotypes were grouped as present and absent for flower colour (Table 2). Among the 24 genotypes, twenty one genotypes had purple pigmentation *viz.*,Paiyur-1, AK-21, CRHG-10, CRHG-09, AK-42, AK-44, CRHG-06, HL-1, CRHG-08, Paiyur-02, VLG-19, VLG-14, CRHG-02, PHG-04, VLG-15, CRHG-04, GPM-06, PHG-09, CRHG-19, CRIDA-18-R and CHG-04 while three genotypes did not show purple pigmentation *viz.*,BGM-183, AK-41 and CHG-01. Similar results were reported by Sajjan et al., 2008 and Chavan, 2010 in French bean and soybean respectively. The flower colour and pigmentation variation are governed by the gene actions in genotypes and they determine the colour by developing or blocking of anthocyanin pigmentation.

Pod colour varied significantly among the horse gram genotypes. On the basis of pod colour, the genotypes were grouped as white, cream and light brown. (Table2). Among the 24 genotypes, seventeen genotypes exhibited cream pod colour *viz.*, Paiyur-1, CRHG-09, AK-44, AK-42, CRHG-06, Paiyur-2, VLG-19, AK-41, CRHG-02, PHG-04, VLG-15, CRHG-04, GPM-06, PHG-09, CRHG-19, CHG-01 and CHG-04, whereas, AK-21, BGM-183, CRHG-10, HL-1, CRHG-08, VLG-14, CRIDA-18-R were light brown in pod colour (seven genotypes) at maturity. Similar findings were also reported by Sankrapandian., 2002, Sarutayophat et al., 2007 and Chavan., 2010. The variation in the pod colour was due to genetic control.

Days to pod initiation varied significantly among the horse gram genotypes. The average numbers of days taken by the genotypes for pod initiation were 59.09. The genotype CHG-04 took more number of days for pod initiation (70.67 days) whereas, the genotype AK-42 took less number of days for pod initiation (49.87 days). Based on number of days to pod initiation, the genotypes were grouped into two categories as early (<65.00 days), late (>65.00 days) (Table 3).

Among the 24 genotypes, eighteen genotypes were grouped under early pod initiation *viz*., AK-21, BGM-183, CRHG-10, CRHG-09, AK-42, CRHG-06, CRHG-08, Paiyur-02, VLG-14, AK-41, CRHG-02, PHG-04, VLG-15, CRHG-04, GPM-06, PHG-09, CRHG-19 and CRIDA-18-R, while, six genotypes as late pod initiation types *viz*., Paiyur-1, AK-44, HL-1, VLG-19, CHG-01, CHG-04. . Similar results were reported by Chandrashekhar., 2005 and Rashmi., 2015. Early pod initiation indicates the earliness of the genotype. Though, this trait is genetically controlled, also influenced by the environmental factors.

Days to pod maturity varied significantly among the genotypes (Table 3). The average numbers of days taken by the genotypes for pod maturity were 106.65. The genotype CHG-01 took more number of days for pod maturity (123.67 days) whereas the genotype CRIDA-18-R took less days for pod maturity (82.73 days). The genotypes were grouped in to three categories as early (< 100 days), medium (100 - 115 days) and late (> 115.00 days).

Among the 24 genotypes, seven genotypes were categorized as late pod maturity types *viz*., CRHG-10, AK-44, VLG-19, VLG-14, VLG-15, GPM-06, CHG-01 while nine had medium pod maturity *viz*., Paiyur-01, BGM-183, CRHG-09, Paiyur-02, AK-41, CRHG-02, PHG-04, PHG-09, CHG-04, whereas, eight genotypes exhibited early pod maturity *viz*., AK-21, AK-42, CRHG-06, HL-1, CRHG-08, CRHG-04, CRHG-19, CRIDA-18-R.Similar type of variation and grouping for pod maturity was also confirmed by the earlier workers like Suhasini., 2006 in sesame genotypes, Chandrashekhar., 2005 and Sajjan et al., 2008 in frenchbean, Makanur et al., 2013 in cowpea. Though the duration of the crop growth is a genetically controlled character, but, it is also influenced by the existence of environment and crop growth conditions such as soil moisture, humidity, temperature.

Conclusion:

Morphological characterization of germplasm helps in identification of elite genotypes with specific /unique traits thus aids in differentiation of the relative genotypes. From the study it can be revealed that the 24 horsehram genotypes could be effectively distinguished based on the morphological traits. The most important distinguishing morphological characters in horsegram were the seed coat colour, pod colour etc. Further, the key traits could be used to distinguish the genotypes in breeding and genetic resources conservation.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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Table 1: Grouping of horse gram based on plant height and number of branches per plant

Treatments		Plant height (cm)	Groups	Number of branches per plant	Groups
HG-1	Paiyur-1	97.00	Short	9.13	Medium

HG-2	AK-21	94.73	Short	9.27	Medium
HG-3	BGM-183	108.13	Medium	9.00	Medium
HG-4	CRHG-10	96.13	Short	9.33	Medium
HG-5	CRHG-09	102.43	Medium	9.53	More
HG-6	AK-44	113.17	Long	9.67	More
HG-7	AK-42	94.03	Short	8.87	Less
HG-8	CRHG-06	104.77	Medium	9.13	Medium
HG-9	HL-1	104.50	Medium	8.93	Less
HG-10	CRHG-08	118.07	Long	9.33	Medium
HG-11	Paiyur-02	114.20	Long	9.40	Medium
HG-12	VLG-19	106.43	Medium	9.07	Medium
HG-13	VLG-14	92.97	Short	9.67	More
HG-14	AK-41	103.10	Medium	9.20	Medium
HG-15	CRHG-02	126.07	Long	9.00	Medium
HG-16	PHG-04	105.20	Medium	8.73	Less
HG-17	VLG-15	93.07	Short	9.53	More
HG-18	CRHG-04	105.33	Medium	9.20	Medium
HG-19	GPM-06	106.00	Medium	9.40	Medium
HG-20	PHG-09	101.53	Medium	9.53	More
HG-21	CRHG-19	112.37	Long	9.13	Medium
HG-22	CRIDA-18-R	115.60	Long	9.73	More
HG-23	CHG-01	100.97	Medium	9.27	Medium
HG-24	CHG-04	105.10	Medium	8.93	Less
Mean		105.04		9.25	
S.Em. ±		5.52		0.17	
C.D. (p=0.05)		15.72		0.48	

Plant height

Short : < 100 cm

Medium : 100-110 cm

Long : > 110 cm

Number of branches per plant

Less : < 9

Medium : 9-9.5

More : > 9.5

Table 2: Grouping of horse gram genotypes based on seed coat colour

Treatments		Seed coat colour	Flower colour (purple pigmentation)	Pod colour
HG-1	Paiyur-1	Present	Present	Cream
HG-2	AK-21	Present	Present	Light brown
HG-3	BGM-183	Absent	Absent	Light brown
HG-4	CRHG-10	Present	Present	Light brown
HG-5	CRHG-09	Present	Present	Cream
HG-6	AK-44	Present	Present	Cream
HG-7	AK-42	Present	Present	Cream
HG-8	CRHG-06	Present	Present	Cream
HG-9	HL-1	Present	Present	Light brown
HG-10	CRHG-08	Present	Present	Light brown
HG-11	Paiyur-02	Present	Present	Cream
HG-12	VLG-19	Present	Present	Cream
HG-13	VLG-14	Present	Present	Light brown
HG-14	AK-41	Absent	Absent	Cream
HG-15	CRHG-02	Present	Present	Cream
HG-16	PHG-04	Present	Present	Cream
HG-17	VLG-15	Present	Present	Cream
HG-18	CRHG-04	Present	Present	Cream
HG-19	GPM-06	Present	Present	Cream
HG-20	PHG-09	Present	Present	Cream
HG-21	CRHG-19	Absent	Absent	Cream
HG-22	CRIDA-18-R	Present	Present	Light brown
HG-24	CHG-04	Present	Present	Cream

Table 3: Grouping of horse gram genotypes based on pod initiation and pod maturity

Treatment		Pod initiation (days)	Groups	Pod maturity (days)	Groups
HG-1	Paiyur-1	66.00	Late	113.60	Medium
HG-2	AK-21	50.40	Early	95.13	Early
HG-3	BGM-183	50.73	Early	110.47	Medium
HG-4	CRHG-10	59.60	Early	117.20	Late
HG-5	CRHG-09	59.93	Early	105.93	Medium
HG-6	AK-44	65.00	Late	122.20	Late
HG-7	AK-42	49.87	Early	90.13	Early
HG-8	CRHG-06	61.67	Early	99.53	Early
HG-9	HL-1	67.33	Late	88.80	Early
HG-10	CRHG-08	64.00	Early	97.80	Early
HG-11	Paiyur-02	62.67	Early	107.53	Medium
HG-12	VLG-19	69.00	Late	118.53	Late
HG-13	VLG-14	56.47	Early	122.07	Late
HG-14	AK-41	53.13	Early	106.27	Medium
HG-15	CRHG-02	50.07	Early	113.80	Medium
HG-16	PHG-04	53.27	Early	111.13	Medium
HG-17	VLG-15	51.60	Early	120.07	Late
HG-18	CRHG-04	54.47	Early	96.73	Early
HG-19	GPM-06	62.00	Early	116.67	Late
HG-20	PHG-09	63.33	Early	104.00	Medium
HG-21	CRHG-19	55.47	Early	85.80	Early
HG-22	CRIDA-18-R	54.80	Early	82.73	Early
HG-23	CHG-01	66.67	Late	123.67	Late
HG-24	CHG-04	70.67	Late	109.80	Medium
Mean		59.09		106.65	
S.Em. ±		0.91		0.76	
C.D. (p=0.05)		2.59		2.17	

Pod initiation:
Early : < 65 days
Late : >65 days

Pod maturity:
Early : <100 days
Medium : 100 - 115 days
Late : >115 days