Original Research Article

Morphological Characterization of Elite Indian bean genotypes of Bundelkhand region

Abstract

The aim of the ~~present experiment~~study~~was~~ to ~~entitled "C~~characterization~~e~~ of Indian bean (*Lablab purpureus* L.) genotypes in agro-climatic conditions of Bundelkhand region by morphological characters~~".~~ It was laid out during *Kharif*,2020 at Vegetable Research Farm, RLBCAU, Jhansi. ~~In current investigation, A~~a total of 21 genotypes of Indian bean were sown in a randomized block design with two replications to estimate genetic variability, heritability and genetic advance and also character association studies and path coefficient analysis among genotypes. Observations were recorded on 8 morphological characters. Dolichos bean germplasm exhibits significant diversity in various qualitative traits, including plant growth habit (ranging from pole to bush), stem colour variations (green, dark green, and purple), diverse flower colours (purple, white, and dark purple), leaf vein colours (light green, green, and purple), distinct leaf densities (sparse, intermediate, and dense), pod colours encompassing green, light green, white, purple, and dark purple, as well as pod characteristics such as curvature (straight, curved, and highly curved) and shape (straight, intermediate, and curved).

Keywords: Indian bean genotype, morphological descriptors

Comment [G1]: In section Material and Methods is 2020-2021. ??????

Comment [G2]: This is not objective of this study.

Comment [G3]: In the material and method are 10 characters

INTRODUCTION

Indian bean (*Lablab purpureus* L.)is also called Indian bean, Hyacinth bean, Egyptian bean and Lablab bean which is grown throughout the tropical areas of Asia, Africa and America. It is an important crop grown throughout the country and also known as poor man's bean [1]

(Ismunandji and Arsyad, 1990). It is the oldest crop and mainly used for food and feed value. It belongs to the family Fabaceae. Its basic chromosome number is x= 11 and somatic chromosome number 2n=2x=22. Indian bean is said to be originated in South East Asia or India, and it was introduced to China, Western Asia, and Egypt (Choudhary, 1972). It is a herbaceous perennial crop, but generally cultivated as an annual bushy and pole erect or climbing type plant. Most of the wild species of Indian bean are perennial. Thick stems can reach up to six meters in length. The leaves are three-pointed leaflets each up to 15 centimeter long. They may be hairy on the undersides. The inflorescence is type of racemes and flowers colour are multi colour, some cultivars have white flowers, others may have purplish or blue color which is a rich source of anthocyanins. Its fruit is leguminous pod which are variable in shape, size, and color. It is usually several centimeters long and bright purple to pale green. It contains up to four to five seeds each having length of about one centimeter. The seeds are white, brown-red, or black in color depending on the cultivars.

Indian bean is primarily grown for green pods used for vegetable purposes. It is a rich source of protein, minerals, vitamins, carbohydrates and fiber. Protein content is found approximate 4% in green pods and 20-25% in dry pods (Ibrahim *et al.*, 2008). Among vitamins and minerals, it contains vitamin C around 5 mg per 100 g, vitamin B_1 0.1 mg per 100 g and vitamin A 312 IU, whereas in minerals potassium content is around 262 mg per 100 g, calcium 210 mg per 100 g, iron 1.7 mg per 100 g. Its carbohydrates content is 6.7 g per 100 g (Gopalan *et al*., 1996). Water soluble polysaccharides such as rhamnose, xylose, arabinose, galactose, glucose, uronic acid, and unidentified carbohydrates and proteins are found in its seeds (Basu *et al*., 2002). Methionine, an amino acidis the limiting factor in Indian bean. It having the highest nutrients index as compared to the French bean. The Indian bean is an old domesticated pulse and multipurpose crop. The leaves and flowers are eaten either raw or cooked. The seeds are used to make tofu and tempeh. The leaves or whole plants of Indian bean have been prepared for silage, hay making, and often used as green fertilizers manures. This crop has good anti-diabetic and can be used as natural cure for bladder burns and cardiac problems. Among all legumes, the Indian bean is a major source of therapeutic agent in both modern and traditional medicine (Morris, 2009). Indian bean is utilized for fodder, soil improvement, soil protection, weed control and can be considered a versatile crop (Shivashankar and Kulkarni, 1989). Indian bean has a taproot with many laterals and well-developed adventitious roots arising from the basis of sprout containing nitrogenous nodules.

Comment [G4]: In the text, citations should be indicated by the reference number in brackets [1].

Comment [G5]: In the reference is Chaudhary

Regards to cultivation practices, Indian bean is generally categorized into vegetable type (*Lablab purpureus* L. var. *typicus*) and pulses type (*Lablab purpureus*L. var. *lignosus*).

It is a photosensitive and short-day plant. However, photo-insensitive types are also reported (). Indian bean capable to growing under dry areas with low rainfall conditions. It does well in dry areas with narrow or low rainfall. Including good attributes like multi-purpose utility and ability to withstand drought compare to common bean and cowpea (Mass *et al*., 2010) and adaptation to acidic and saline soils (Murphy, 1998). Indian bean is still regarded as an underexploited vegetable the reason to this are low productivity.

In spite of the fact that a large genetic basis for breeding is available, this crop has still to attract the attention it deserves from geneticists and breeders (Magalingam *et al.*, 2013). Despite being originated in India, very little work has been done of yield and quality aspects of Indian bean. Augmenting the current low on-farm productivity (0.5 t ha^{-1}) to potential level (2.0 t ha^{-1}), Shivashankar and Kulkarni (1989) suggested for broad the genetic base of Indian bean cultivars through enhanced use of diverse germplasm accessions. Precise information on the genetic diversity of available germplasm for economically important traits is required to improve the use of germplasm in future genetic breeding programs and to fulfil the demands of a diverse consumer base. The genotypes of Indian bean found in India have a wide range of variations. The utilization of indigenous and foreign germplasms to improve the crop has been effective in preventing yield barriers (Shivashankar *et al*., 1993) resulting in the development of bushy types plant with short duration and photo-insensitivity. As a result, extensive germplasm collection and evaluation based on morphological, genetical and yield-related traits are important.

The aim of this study was……

Method and Materials

The ~~experiment~~ study was conducted in the Vegetable research farm of RLBCAU, Jhansi during 17 August 2020-2021. The experimental site is situated at 25.31° N latitude and 78.33° E longitude at an altitude of 227 m above mean sea level. ~~The experimental material~~ 21genotypes of Indian bean were included in the trail. All the genotypes are locally collected from different regions of Bundelkhand and Sultanpur district of UP which is see in Table ~~.~~1.

Table 1: Genotypes of Indian bean and their source of collection

Comment [G6]: Please, give references

Comment [G7]: It is one or two years experiment. It is not clear ????

S.N.	Genotype's name	Location of collection	S.N.	Genotype's name	Location of collection
1.	RLBDL-S-1	Sultanpur	**12.**	RLBDL-S-9	Sultanpur
2.	RLBDL- S-1-1	Sultanpur	**13.**	RLBDL-S-10	Sultanpur
3.	RLBDL-S-1-2	Sultanpur	**14.**	RLBDL-S-11	Sultanpur
4.	RLBDL-S-2	Sultanpur	**15.**	RLBDL-S-12	Sultanpur
5.	RLBDL-S-3	Sultanpur	**16.**	RLBDL-S-13	Sultanpur
6.	RLBDL-S-4	Sultanpur	**17.**	RLBDL-S-14	Sultanpur
7.	RLBDL-S-4-5	Sultanpur	**18.**	RLBDL-J-1	Jhansi
8.	RLBDL-S-5	Sultanpur	**19.**	RLBDL-J-2	Jhansi
9.	RLBDL-S-6	Sultanpur	**20.**	RLBDL-J-3	Jhansi
10.	RLBDL-S-7	Sultanpur	**21.**	RLBDL-J-4	Jhansi
11.	RLBDL-S-8	Sultanpur			

S.N.-

Comment [G8]: Describe the abbreviation

The experimental plot's soil was identified as sandy loam with a pH of 6.7, indicating its acidic nature. The soil's organic carbon content was measured at 2.03 g/kg, and the electrical conductivity was found to be 0.4 dS/m. Genotypes were randomly sown in different sub-plots within each replication, following the principles of a Randomized Block Design (RBD). The dibbling method was employed for sowing each genotype, with two to three seeds planted per hill at a spacing of 100x75 cm (row to plant), and the subplot dimensions were 4x2 m (length x width). Immediate irrigation followed the sowing process.

After 25 days, weak and non-vigorous seedlings were thinned out, leaving one healthy seedling per hill. Throughout the crop's growth, it was observed that aphids and pod borers were the predominant pests affecting Indian bean. Insecticide in granular form was applied via water spray to mitigate insect and pest issues. Specifically, Aldicarb 10G was used at a rate of 10-15 kg per hectare at the time of sowing to effectively control aphids. To manage pod borer infestation, a spray of Chlorpyriphos 25 EC at a concentration of 1.5 percent was carried out.Additionally, the crop exhibited signs of anthracnose and rust diseases. To address rust disease, a spray of Wettable Sulphur at a concentration of 3g per litre was applied. This

comprehensive pest and disease management approach aimed to ensure the health and productivity of the Indian bean crop in the experimental plot.

Morphological characterization of Indian bean

The data on different morphological parameters studied for 21 genotypes of Indian bean is presented in Table-2.

1. Leaf colour: It was observed dark green leaves colour, green leaf colour, light green leaf colour, whereas one genotype showed dark purple and one genotype had light purple leaf colour.

2. Leaf vein colour: Fully developed primary leaves on inner side were observed and were recorded like light green, green, purple and others.

3. Leaf shape: Twenty-one genotypes of Indian bean were showing different Leaf shape that are round leaf shape and ovate leaf shape.

4. Plant growth habit: The plant growth habit of each genotype was observed i.e. bush, semi pole, pole at flowering stage.

5. Stem color: At the vegetative growth stage, observations of stem colour included white, light green, green, dark green and purple.

6. Flower colour: Before beginning anthesis, fully developed flower buds were seen with the naked eye and were categorised into white, cream, purple, dark purple and blue.

7. Fresh pods curvature: The morphology of fresh matured pods was observed i.e. straight, curved, highly curved and others.

8. Fresh pod pubescence: It was observed that 60 percent genotypes had pubescence pod and remaining were without pubescence pod.

9. Fresh pod colour: Fresh mature pods were examined to determine the colour of the pods, which ranged from white to cream to light green, green, purple.

RLBDL-S-1

Comment [G9]: Move in the result and discussion section. Fig. 2 should be cited in the text.

Fig: 1Variability observed on basis of morphological in Indian bean genotypes

10. Seed colour during maturity: During pod maturity, it was observed that 21 genotypes had black seed colour, red and yellow seed colour.

Fig: 2Variability observed for Indian bean genotypes

Comment [G10]: Move in the result and discussion section. Fig. 2 should be cited in the text.

Comment [G11]: The materials and methods section describes which morphological parameters were monitored and at which stages of plant development they were recorded, but does not describe what was observed (these are the results that are presented in the results and discussion section). If scales have been used to assess morphological parameters they can also be indicated.

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Result and Discussion

Twenty-onegermplasm of Indian beanunder present investigation were characterized based on ten morphological characters (Table1). ~~The present observations are similar with the findings of Chattopadhyay and Dutta. (2010), Chaitanya et al. (2014) Thomas *et al.* (2002), Kumar (2017) and Preetham *et al.* (2020).~~Out of total 21 genotypes leaves colour, it was observed that 7 genotypes had dark green leaves colour while, 8genotypeswere under green leaf color, 4 genotypes under light green leaf colour,whereas one genotype showed dark purple and one genotype had light purple leaf colour.It was observed that 6 genotypes were having dark purple whereas, 9 genotypes as green, one genotype with light green and 5 genotype were purple vine colour.Out of 21 genotypes, round leaf shape was noticed in 8 genotypes and ovate leaf shape was observed in 13 genotypes of Indian bean.The plant growth habit all 21 genotype were observed pole type at flowering stage. Stem colour was

observed that 6 genotypes were having dark purple whereas, 9 genotypes as green, one genotype with light green and 5 genotype were purple vine color.In case of flower colour, it was observed that 15 genotypes with pink purple, 3 white and one genotype with purple colour flower.Fresh pod curvature of Seven genotypes with slight pods curve, nine genotypes fully pod curve and two genotypes straight pod curve were noticed.On the basis of pod colour, it was noticed that 3 genotypes showed creamy, 3 dark green, 5 dark purple, 4 green, one genotype purple and one had dark red pod colour out of 21 genotypes.Seed colour during pod maturity, it was observed that 16 genotypes had black seed colour while, 3 red and one of them also showed yellow seed colour. The present observations are similar with the findings of Chattopadhyay and Dutta (2010), Chaitanya et al. (2014), Thomas *et al*. (2002), Kumar (2017) and Preetham *et al*. (2020).

Comment [G13]: It is missing in the reference.

Use Shannon-Weaver (H') index to analyze the phenotypic frequency of each trait(use the formula of Jain et al. (1975) (Jain, S. K., Qualset, C. O., Bhatt, G. M & Wu, K. K. (1975). Geographical patterns of phenotypic diversity in a world collection of durum wheats. Crop Science, 15, 700-70).

Conclusion

This investigation underscores the substantial variation existing among genotypes concerning their morphological characteristics. The identified morphological descriptors can serve as valuable tools in the process of selections and breeding programs, offering a foundation for targeted and informed decisions in the improvement of these genotypes.

Table: 2. Morphological characterization of Indian bean

S. No.	Genotypes	Leaves colour	Leaves vine colour	Leaf shape	Plant growth habit	Stem colour	Flower colour	Fresh pod curvature	Fresh pod pubescence	Pod colour	Seed colour during maturity
1	**RLBDL-S-1**	Dark green	Dark purple	Ovate	Pole type	Light purple	Pinkish purple	Slight curve	Yes	Cream	Black
2	**RLBDL-S-1-1**	Darke green	Dark purple	Ovate	Pole type	Light purple	Pinkish purple	Slight curve	Yes	Cream	Black
3	**RLBDL-S-1-2**	Light green	Light green	Round	Pole type	Light green	White	Curve	Yes	Light green	Yellow
4	**RLBDL-S-2**	Light green	Green	Ovate	Pole type	Green	White	Straight	No	Dark green	Red
5	**RLBDL-S-3**	Darke green	Dark purple	Round	Pole type	Light purple	Pinkish purple	Curve	Yes	Green purple	Black
6	**RLBDL-S-4**	Green	Green	Ovate	Pole type	Green	Pinkish white	Curve	Yes	Green purple	Black
7	**RLBDL-S-4-5**	Green	Green	Ovate	Pole type	Green	Pinkish white	Curve	Yes	Dark green	Black
8	**RLBDL-S-5**	Light green	Green	Round	Pole type	Green	Pinkish purple	Slight curve	No	Green	Black
9	**RLBDL-S-6**	Green	Purple	Ovate	Pole type	Light purple	Pinkish purple	Curve	No	Dark green	Black
10	**RLBDL-S-7**	Green	Green	Round	Pole type	Green	Pinkish purple	Curve	Yes	Dark green	Black
11	**RLBDL-S-8**	Darke green	Purple	Ovate	Pole type	Light purple	Pinkish purple	Curve	No	Green	Black
12	**RLBDL-S-9**	Light purple	Purple	Round	Pole type	Light purple	Pinkish purple	Slight curve	Yes	Creamy	Black
3	**RLBDL-S-10**	Light green	Green	Round	Pole type	Green	Pinkish purple	Straight	No	Green	Black
14	**RLBDL-S-11**	Dark purple	Purple	Ovate	Pole type	Light purple	White	Slight curve	Yes	Cream purple	Red
15	**RLBDL-S-12**	Darke green	Purple	Ovate	Pole type	Light purple	Purple	Straight	No	Red	Black
16	**RLBDL-S-13**	Green	Green	Round	Pole type	Green	Purple pink	Straight	Yes	Purple	Black
17	**RLBDL-S-14**	Green	Dark purple	Ovate	Pole type	Light purple	White	Straight	Yes	Green	Red
18	**RLBDL-J-1**	Darke green	Dark purple	Ovate	Pole type	Light purple	Pinkish purple	Curve	No	Dark purple	Black
19	**RLBDL-J-2**	Darke green	Dark purple	Ovate	Pole type	Light purple	Pinkish purple	Slight curve	No	Dark purple	Black
20	**RLBDL-J-3**	Green	Green	Ovate	Pole type	Green	Pinkish purple	Slight curve	Yes	Light green	Black
21	**RLBDL-J-4**	Green	Green	Round	Pole type	Green	Pinkish purple	Curve	No	Light green	Black

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Comment [G14]: References must be listed at the end of the manuscript and numbered in the order that they appear in the text. Every reference referred in the text must also present in the reference list and vice versa. In the text, citations should be indicated by the reference number in brackets.
References should be arrange according to journal style.