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"MORPHOLOGICAL CHARACTERIZATION OF BREEDING TRAITS IN MUNGBEAN [*VIGNARADIATA* (L.) WILCZEK] GENOTYPES AS PER DUS DESCRIPTOR"

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ABSTRACT

A total of 32 Mungbean genotypes for 24 morphological traits were analyzed for the diverse breeding traits as per DUS descriptor during Summer 2020-21. All the genotypes were growning randomized block design with three replications.The results were compared descriptively. Maximum morphological variability was recorded in leaf shape, pod position, stem colour,petiole colour, seed colour, days to flowering, leafsize, premature pod colour, anthocyanin colouration and plant growth habit.The distribution frequency of the traits like petiole colour, leaf shape, anthocyanin colouration and pod colour(6.25%) and days to flowering and leaf size (3.13%) wasverylow. Whereas, the distribution frequency of the traits like stem colour (75.00), plant habit and leaflet lobes (68.75), growth habit, stem pubescence and seed lusture (53.13%) wasvery high. These identified diverse morphological breeding traits is present in very few of the genotypes included in this investigation. The identified diverse breeding traitsmay be employed in hybridization programme in developing diverse morphology based genotype/varieties so that the genotypes with unique morphological identity will easily be identified in between the group of varieties. Maintenance of the varietal purity has been one of the major challenges in the research area and it is very important to check whether the genotypes ortreatments or population under study are satisfying the requirements of morphological characterization protocols which includes distinctness, uniformity and stability. Among the phenotypic correlation association between grain yield per plant with nine other traits studied, significant and positive correlations were observed with number of primary braches per plant, number of pod per plant and number of seed per pod. These characters also showed significant and positive correlation among themselves uniformly in mung bean genotypes.

***Keyword**: Greengram, similaritymatrix, Diversity,variability,DUS descriptor,breeding traits.*

I. INTRODUCTION

Greengram (*Vignaradiata*(L.) Wilczek) (2n = 22) is indigenous to India or Indo-Burma region and is the third mostimportantself-pollinated,short-duration grain legume crop after chickpea and pigeonpea.The central Asian region is believed to be the primary center of genetic diversity for mung bean (Kumar and Kumar, 2014). The genome size ofmung bean is relatively small (579 Mb) (Parida et al., 1990; Kang et al.,2014). It is also known as green gram, green bean, mash bean, golden gram, and green soy (Markam et al., 2018).Mung bean is an important and cheap source of food protein across Asia, especially for the poor, thus plays animperative role in the alleviation of protein malnutrition especially in the developing countries (Selvi et al., 2006). Itcontains a relatively high proportion of easily digestible good quality protein (20-24%) with low flatulence and rich iniron contents (40–70 ppm), making it an ultimate choice for balanced diets (Selvi et al., 2006; Vairam et al., 2016). Besides seeds,its sprouts, which contain high vitamin C and

folate are also very much relished in Asian cuisine(Nairet al., 2013); while its foliage can also be used as fodder, feed, and hay. The major mung bean growing countries include India, China, Pakistan, Bangladesh, Sri Lanka, Thailand, Myanmar, Vietnam, Indonesia, Australia, and thePhilippines (Alam et al., 2014b). Worldwide, India is the largest mung bean producer, during 2019-20, the totalcoverage under mung bean has been about 40.20 million ha with the production of 1.42 million tons (Anonymous,2019-20).

II. MATERIALS AND METHOD

The study on characterization of 32 mung bean genotypes based on plant characters were taken from theResearch Farm, Career Point University, Alaniya, Kota and Rajasthan. It is situated at a center of the south-eastern region of Rajasthan and this region widely known as Hadoti during *summer*2020-2021.These 32 genotypes were evaluated in the field using Randomized block design with three replications. Data were recorded for different plant morphological characters *viz.*, Anthocyanin Colouration, time of flowering,plant growth habit, plant habit, stem colour, stem pubescence, leaflet lobes (terminal), leaf shape, leaf colour, leafvein colour, petiole colour, leaf size, flower colour of petal (Standard), pod colour of pre mature pod, pod pubescence,pod position, plant height, pod colour, pod curvature of mature pod, pod length (mature pod), seed colour, seedlusture, seed shapeand seed size with following standard procedures and the genotypes were grouped.

Characterization and cataloguing of genotypes have been traditionally carried out byusing morpho-agronomic traits. Biodiversity International and PPV & FRA (Protection of Plant Varieties and Farmers' Rights Authority) have come up with as et of DUS (Distinctiveness,Uniformity and Stability) descriptors for characterization of the lines for their registration and protection. Keeping this in view, the present study entitled "Morphological characterization of Breeding Traits in Mungbean [*Vignaradiata* (L.) Wilczek] Genotypes as per DUS Descriptor" was carried out in the 32 genotypes which were, collected from the Research Farm, Career Point University, Alaniya, Kota and Rajasthan. It is situated at a center of the south-eastern region of Rajasthan and this region widely known as Hadoti during *summer* 2020-2021 were characterized using DUS descriptors to know the extent variability present among these genotypes.

Living plant specimens were taken both for generative (flowers, pods, and seeds) and vegetative (stems andleaves) organs. Direct observation and measurement were conducted into detailed specific part of the genotypes.

III. RESULTS AND DISCUSSIONS

Characterization of thirty elite improved lines of greengram was carried out using DUS descriptors. The characters of Anthocyanin Colouration, time of flowering,plant growth habit, plant habit, stem colour, stem pubescence, leaflet lobes (terminal), leaf shape, leaf colour, leafvein colour, petiole colour, leaf size, flower colour of petal (Std), pod colour of pre mature pod, pod pubescence,pod position, plant height, pod colour, pod curvature of mature pod, pod length (mature pod), seed colour, seedlusture,seed shapeand seed size characteristics during different growth stages of crop growth differed significantly for all 24 characters of DUS descriptors indicating a large and exploitable amount of genetic variability for the individual elite improved line profile development for identification and protection (Table-1). Katiyar*et al*., (2008) also exploited DUS characterization in greengram for the dentification and protection

Hypocotyl: Anthocyanin Colouration. This trait was observed at cotyledonary stage.Out of thirty-two genotypes, thirty showed anthocyanin colouration and only two was without pigmentation (Table 1) and frequency of anthocyanin in genotypes was 93.75% whereas devoid of pigmentation was 6.25%. The intensity of cotyledon colour is affected with both storage conditionand times. So this trait can be utilized only for varietal protection before entering into active seed multiplication chain. Anthocyanin colouration is normally considered as important morphological marker in greengram todiscriminate the lines into two groups based on their presence or absence and was recorded at cotyledonary stage (Mukherjee and Pradhan, 2002 and Khattak*et al*., 2000).

Plant Characters: The characters like petiole colour, growth habit and plant habit were observed at days to 50 percentflowering.Among thirty-two genotypes, tenweregrouped intospreading, seventeen into semi-erect andonly one into erect type of plantgrowth habit.Further tengenotypes showed determinate plant habit whereas; rests were in determinate in nature out ofThirty-two (Table1). Out of the Thirty-twogenotypes, twent-nineweregrouped intogreen

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petiole colour, two into green with purple splashes andonly one into purple colour of petiole colour.Plant morphological characters like petiole colour, plant habit and growth habit wereobserved at days to 50 per cent flowering andat fully developed green pod stages of plant,respectively, and can be used as criteria invarietal purity maintenance and identification.This result was supported by Jain*etal.*,(2002); Singh*etal.*,(2014) and Kaur*et al.*,(2017) inmung bean.

Stem Characters: Out of Thirty-two genotypes twenty-four showed green stem colour, eight genotypesshowed green with purple splashes type of stem colour and no one genotype showed purple type of stemcolour revealing variation in the lines. In case of stem pubescence seventeen genotypes showed stempubescence and rest of the genotypes were not show stem pubescences out of the total Thirty-two genotypes(Table 1). Plant morphological characters like stem colour and stem pubescences were observed at days to 50 per cent flowering andat fully developed green pod stages of plant, respectively, and can be used as criteria invarietal purity maintenance and identification. Indicating similar in the mung bean genotypes for this trait (Jain *et al.,* 2002); (Katiyar*et al.,* 2008);(Singh*etal.*,2014) and (Kaur*etal.*,2017) inmungbean.

Leaf Characters: All these characters showed variability in the studied genotypes and these were classifiedinto different categories (Table 1). Ten genotypes showed the presence of leaflet lobes and the remaining twenty-two were devoid of leaflet lobes. Leaf shape was deltoid in three genotypes; ovate in twenty-six genotypes,lanceo late in two and only one genotype wass how cuneate leaf shape out of Thirty-twogenotypes.Nineteen genotypes had dark green leaf colour while thirten had green leaf colour. Leaf vein colour was greenish purple in seven genotypes, purple in nine genotypes and green in sixteen genotypes. In case of petiole colour twent-nine genotypes showed green colour petiole, two showed green with purple splashes andremaining only one genotype were show purple petiole colour. Out of Thirty-two genotypes only one genotypes showed small leafsize, twenty-two genotypes showed medium size of leaf while rest of the genotypes were show large size of leaf. These characters play an important role in the yielding ability of the genotypes, as the leaves are the points of food synthesis and transpiration site of the plants. All these characters showed variability and the genotypes were categorized into distinct groups. The leaf traits (foliage colour, leaf shape, leaflet lobes and leaf size) showed very good variation and are useful in the characterization but the effect of environmental factors is very high on these traits as they are polygenically controlled. Similar finding reported by (Kaur *et al.,* 2017) and Chakrabarthy and Agarwal (1989) in blackgram.

Flower Characters: Flower colour is a reliable morphological marker for distinguishing the green gramgenotypes. Thirteen genotypes showed yellow flower colour and nineteen genotypes showed light yellowcolour of flower petals. Flower colour is reliable morphological marker and distinguishing the greengram genotypes here variation flower petal colour is present. Hence, this trait is of use in discriminating the genotypes in the present material. Out of Thirty-two genotypes, seven were early, twenty-fourgenotypes were medium whereas rests of the only onegenotypes were late in their flowering duration while in late duration only nine genotypes were noted(Table 1). Flowering time varied within genotypes. Therefore, these lines hold great promise as early maturing genotypes in greengram. The short duration genotypes can overcome the adverse effects of terminal heat stress and untimely rains at the time of harvest. These genotypes are helpful in expanding the area under greengram during summer season. Similar findings and groupings of genotypes based on flower morphological characters were made by Jain *et al.,* (2002); Singh *et al.,* (2014) and Kaur *et al.,* (2017) inmungbean.

Pod Characters: Greengram pod characteristics are highly useful in the identification of genotypes. These areimportant yield attributing traits and affect the yielding ability of plants. Considerable variation was observedin characters mentioned above and were classified into different group. All these characters showed variation and were categorized into distinct groups. These characteristics influence the yielding ability of the plant and are considered as the main yield attributing traits. All these characters showed variation and were categorized into distinct groups. Pod colour is a quite useful morphological marker and may be used in quality seed production programmes at maturity stage to monitor the mixture of other varieties but all the lines showed different pods at the time of maturity indicating this trait is of use for identification of lines in the present material.

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The trait,colour of pre-mature pod was green in thirty genotypes and green with pigmented suture reported in two genotype. Pod pube scence was presentinsixteengenotypesand remaining genotypes had no pod pube scence indicating these traits are of abundant in the studied material and may not use for identification of lines in thepresent material. In case of pod position, out of Thirty-two genotypes twenty-two genotypes showed podposition to above the canopy, ten genotypes showed intermediate pod position and no one genotype hadnot visible pod position. Pod colour is quiet useful morphological marker and may beused in quality seedproduction programmes at maturitystage to monitor the mixture of other varieties. Ten genotypes showed brown pod colour while, remaining twenty-nine genotypes showed black pod colour.

Curvature of mature pod was straight in twenty-two genotypes and curved inrest of ten genotypes.Thus,these pod characteristics can be exploited for identification and characterization but are found to be variabledue tomore number of genes and environmental influence on the expression. In case of pod length at maturitystage, out of Thirty-two genotypes eleven genotypes showed short pod length during maturity, fifteengenotypes showed medium pod length, while remaining eight genotypes had long pod length. Sunil *et al.*,(2014) observed straight pods without curvature in their study and this morphology may be helpful to identifythe impurities during quality seed production programme. Based in pod morphological characters,similar observations were made by Singh *et al.,* (2014) and Kaur *et al.,* (2017) in mungbean and Gnyandev*et al.*,(2009) and Bayahi and Rezguy(2015) in chickpea.

Seed characters: The price of premium genotypes of Greengram or consumer acceptance of a variety is decided by the seed characteristics like colour,lusture,shape and size (Pratap*etal.*,2013).Seed morphological characters like colour, lusture, shape and size were observed at mature seed stage of plant in the present experiment(Table1). The price of premium genotypes of greengram or consumer acceptance of a variety is decided by the seed characteristics like colour, size and shape (Pratap*et al*., 2018).

All these characters were assigned into distinct groups. Seed colour was mottled in fourteen genotypes, greenish eighteen genotypes respectively and no one genotype had yellow black colour seeds. Seed lusture was shiny in fifteen genotypes and dull in seventeen genotypes. Seed shape was oval in twenty-two genotypes and drumshaped in ten genotypes. Seed size was small in nine genotypes, medium in nineteen genotypes andlarge shaped in case of four genotypes (Table 1).Venkateswarlu*et al.*,(2001) and Khajudparn and Tantasawat(2011) discussed the use fulness of seed characters in the characterization oflines in green gram.

In the present investigation, anthocyanin colouration, plant habit, stem pubescence, pre mature pod colour and leaf let lobes were same in all the lines and were not useful for discrimination but rest of the trait shad lots of variability which can be exploited for the elite lines identification and utilization as reported by (Patel etal., 2019) and facilitate the easy registration with these distich characters present in the genotypes with PPV&FRA.

IV. ASSOCIATION ANALYSIS

The phenotypic correlation coefficients between ten pairs ofcharacters as observed in mung bean genotypes have been presented separately.(Table 1). Among the phenotypic correlation association between grain yield per plant with nine other traits studied, significant and positive correlations were observed with number of primary braches per plant, number of pod per plant and number of seed per pod. These characters also showed significant and positive correlation among themselves uniformly in mung bean genotypes.

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Table 1 Phenotypic correlation coefficients between different pairs of characters

Traits	GP	DTFF	DTF	DTPE	DTM	PH	NPBPP	NPPP	NSPP	GYPP
GP	1	-0.181	-0.183	0.222	-0.289	0.232	0.233	0.090	0.070	0.045
DTFF		1	0.969*	0.082	0.805*	-0.064	-0.348	-0.264	-0.417	-0.348
DTF			1	0.091	0.839*	-0.016	-0.315	-0.273	-0.333	-0.309
DTPE				1	0.093	-0.155	-0.075	-0.335	-0.261	-0.376**
DTM					1	-0.304	-0.502	-0.403	-0.314	-0.350**
PH						1	0.410**	0.432**	0.085	0.188
NPBPP							1	0.686*	0.109	0.378**
NPPP								1	0.214	0.720*
NSPP									1	0.735*
GYPP										1

Among these association consistent and moderate and high value of correlation coefficient was obtained for grain yield with number of primary branches per plant (0.378), number of pod per plant (0.720) and number of seed per pod (0.735) respectively. Significant association of these traits with grain yield have been previously reported by Gul et al. (2008), Peerajade et al. (2009), Vinay et al. (2010), Tabasum et al. (2010), Khajudparn and Tantasawat (2011), Srivastava and Singh (2012), Khanpara et al. (2012), Zaid et al. (2012), Ahmad et al. (2013), Baisakh et al. (2013), Jyothsna and Anuradha (2013), Begum et al. (2013), Itefa et al. (2014), Lalinia and Khameneh (2014), Narasimhulu et al. (2014) for pods/plant. They recorded correlation among yield contributing characters like number of primary braches per plant, number of pod per plant and number of seed per pod as in present study. For number of branches/plant was in the agreement with conformity of the findings of Battacharya and Vijaylaxmi (2005), Saxena et al. (2007), Verma and Garg (2007), Singh et al. (2009b), Tabasum et al. (2010), Khajudparn, Tantasawat (2011), Itefa et al. (2014) showed grain yield per plant had highly significant positive correlation with number of primary braches per plant. The result revealed that if days to flowering increases, then days to maturity and plant height also increased. Azam et al. (2018) also reported similar findings.

There was no significant association of days to maturity with other traits except with days to first flowering and days to 50 % flowering in mung bean genotypes. Hence it can be concluded that the late maturing tall plants may bear more clusters and produce higher biomass and grain yield. Similar findings were reported by Abbas et al. (2018).

V. CONCLUSION

The study highlighted the importance of introducing new material in the breeding programmes tobroaden the genetic base of the crop. Thus, characterization of elite improved linesholds animportant significance in the identification of lines and their registration with PPV & FRA andmaintenance of line having the information of genetic base. Lines found with unique traits and present only in few of the genotypes will be of great importance for the development of morphologically diverse breeding populations.These lines with unique morphological identity will be consider edasa varietal marker in the seed production chain to maintain the genetic purity of the variety. These traits may also be useful when varieties may mixand purelines can easily be isolated very easily by normal selection procedure.

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The 32 [*Vignaradiata* (L.)Wilczek] genotypes used in the study were genetically variable and morphological traits like were Anthocyanin Colouration, time of flowering, plant growth habit, plant habit, stem colour, stem pubescence, leaf let lobes(terminal), leaf shape, leaf colour, leaf vein colour, petiole colour, leaf size, flower colour of petal (Std), pod colour of pre mature pod, pod pubescence, pod position, plant height, pod colour, pod curvature of mature pod, pod length (maturepod), seed colour, seed lusture, seed shape and seed size all found to be of great importance indistinguishing the genotypes.Morphological characterization provide dan inexpensive means of quickly evaluating the "Mungbean" genotypes.

Correlation analysis indicated that number of primary branches per plant, number of pod per plant and number of seed per pod, respectively and harvest index show significant positive correlation with grain yield plant^{-1}.

Table1:Morphological characterization of 32 mungbean geno types.

Characteristics	**V1**	**V2**	**V3**	**V4**	**V5**	**V6**	**V7**	**V8**	**V9**	**V10**	**V11**	**V12**	**V13**	**V14**	**V15**	**V16**
Hypocotyl: anthocyanin colouration	P	P	A	P	P	P	P	P	P	P	A	P	P	P	P	P
Time of flowering	Medium	Medium	Medium	Medium	Medium	Early	Medium	Medium	Early	Medium	Late	Medium	Medium	Medium	Medium	Medium
Plant: growth habit	Semierect	Semierect	Semierect	Spreading	Semierect	Erect	Semierect	Semierect	Erect	Spreading	Spreading	Spreading	Semierect	Semierect	Semierect	Semierect
Plant: habit	Indeterminate	Indeterminate	Indeterminate	Indetermin ate	Indetermin ate	Indetermi nate	Indeterminate	Indeterminate	Indeterminate	Determinate	Determinate	Determinate	Indeterminate	Indeterminate	Determinate	Indeterminate
Stem: colour	Green	Green	Green	Green with purple splashes	Green with purple splashes	Green	Green	Green	Green	Green	Green with purple splashes	Green with purple splashes	Green	Green	Green	Green
Stem: pubescence	P	P	P	P	P	P	P	P	A	A	P	P	A	A	A	A
Leaflet: Lobes	P	A	P	P	P	A	A	P	A	A	A	A	A	A	A	A

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(terminal)																
Leaf : shape (terminal)	Ovate	Ovate	Deltoid	Ovate	Ovate	Lanceolate	Ovate	Deltoid	Ovate	Ovate	Lanceolate	Ovate	Ovate	Ovate	Ovate	Deltoid
Leaf: colour	Green	Dark green	Green	Green	Dark green	Green	Green	Dark green	Dark green	Dark green	Green	Green	Dark green	Dark green	Dark green	Dark green
Leaf: vein colour	Green	Green	Greenish purple	Purple	Purple	Greenish purple	Greenish purple	Greenish purple	Purple	Green	Purple	Purple	Green	Green	Green	Green
Petiole: colour	Green	Green	Green	Green	Green	Green with purple splash	Purple	Green	Green	Green	Green	Green	Green	Green	Green	Green
Leaf: size (at 5th node from the base)	Large	Medium	Large	Large	Large	Medium	Large	Medium	Medium	Medium	Small	Medium	Medium	Medium	Medium	Medium
Flower: colour of petal (standard)	Yellow	Yellow	Light yellow	light yellow	light yellow	light yellow	light yellow	light yellow	Yellow	Yellow	Yellow	light yellow	Light yellow	Yellow	Yellow	Light yellow
Pod: colour of premature pod	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green with pigmented suture	Green	Green	Green	Green	Green
Pod: pubescence	A	A	P	P	P	P	P	p	A	A	P	P	P	A	A	A
Pod:	Ab	Ab	Int	Inter	Inter	Abov	Int	Ab	Ab	Ab	Abov	Inter	Int	Int	Ab	Ab

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position	ove canopy	ove canopy	ermediate	mediate	mediate	ecanopy	ermediate	ovecanopy	ove canopy	ove canopy	ecanopy	mediate	ermediate	ermediate	ove canopy	ove canopy
Plant: height	Medium	Medium	Long	Long	Long	Long	Long	Medium	Short	Short	Short	Long	Medium	Medium	Medium	Long
Pod: colour	Black	Black	Brown	Brown	Brown	Brown	Black	Black	Black	Black	Black	Brown	Black	Black	Black	Black
Pod: curvature of mature pod	Curved	Straight	Curved	Curved	Straight	Straight	Straight	Curved	Curved	Curved	Straight	Straight	Straight	Straight	Straight	Straight
Pod: length (mature pod)	Medium	Medium	Long	Long	Long	Medium	Medium	Medium	Medium	Short	Short	Long	Short	Short	Medium	Medium
Seed: colour	Green	Green	Mottled	Mottled	Mottled	Green	Mottled	Mottled	Green	Green	Yellow	Green	Mottled	Green	Green	Green
Seed: lusture	Shiny	Dull	Shiny	Dull	Shiny	Shiny	Dull	Shiny	Dull	Dull	Shiny	Shiny	Shiny	Dull	Dull	Shiny
Seed: shape	Drumshaped	Drumshaped	Oval	Oval	Oval	Oval	Drumshaped	Oval	Drumshaped	Drumshaped	Oval	Oval	Drumshaped	Drumshaped	Oval	Oval
Seed 100 seed weight (g) size	Medium	Medium	large	large	large	Medium	Medium	Medium	Medium	Medium	Small	Medium	Small	Medium	Small	Small

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Characteristics	V17	V18	V19	V20	V21	V22	V23	V24	V25	V26	V27	V28	V29	V30	V31	V32
Hypocotyl: anthocyanin colouration	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Time of flowering	Medium	Medium	Medium	Medium	Early	Medium	Medium	Early	Early	Medium	Medium	Medium	Early	Medium	Medium	Early
Plant: growth habit	Semierect	Semi erect	Semi erect	Spreading	Semierect	Spreading	Spreading	Semi erect	Erect	Erect	Spreading	Semierect	Spreading	Erect	Spreading	Semierect
Plant: habit	Indeterminate	Indeterminate	Determinate	Indeterminate	Determinate	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Indeterminate	Determinate	Determinate	Determinate	Indeterminate	Determinate	Indeterminate
Stem: colour	Green	Green with purple splashes	Green with purple splashes	Green	Green	Green	Green	Green with purple splashes	Green	Green	Green	Green	Green with purple splashes	Green	Green	Green
Stem: pubescence	P	P	P	A	P	A	A	P	A	A	A	A	P	A	P	A
Leaflet: Lobes (terminal)	A	P	P	A	P	A	A	P	A	A	A	A	A	A	P	A
Leaf : shape (terminal)	Ovate	Ovate	Cuneate	Ovate	Ovate	Ovate	Ovate	Ovate	Ovate	Ovate	Ovate	Ovate	Ovate	Ovate	Ovate	Ovate
Leaf: colour	Green	Green	Green	Dark green	Green	Dark green	Green	Dark green	Dark green	Dark green	Dark green	Dark green	Dark green	Dark green	Green	Dark green
Leaf: vein	Purpl	Purpl	Greenish	Gree	Purpl	Gree	Gree	Purpl	Gree	Gree	Gree	Gree	Greenish	Gree	Greeni	Gree

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colour	e	e	purple	n	e	n	n	e	n	n	n	n	purple	n	sh purple	n
Petiole: colour	Green	Green	Green with purple splash	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Leaf: size (at 5th node from the base)	Medium	Large	Medium	Medium	Large	Medium	Medium	Medium	Medium	Medium	Medium	Medium	Large	Medium	Large	Medium
Flower: colour of petal (standard)	Light yellow	Light yellow	Light yellow	Yellow	Light yellow	Yellow	Light yellow	Yellow	Light yellow	Light yellow	Light yellow	Yellow	Light yellow	Light yellow	Yellow	Yellow
Pod: colour of premature pod	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green with pigmented suture	Green	Green	Green
Pod: pubescence	A	P	P	A	P	A	A	P	A	A	A	A	P	A	P	P
Pod: position	Intermediate	Above canopy	Above canopy	Intermediate	Above canopy	Above canopy	Above canopy	Above canopy	Above canopy	Above canopy	Above canopy	Above canopy	Intermediate	Above canopy	Above canopy	Above canopy
Plant: height	Long	Long	Medium	Short	Long	Short	Short	Short	Short	Short	Short	Long	Long	Short	Short	Short
Pod: colour	Black	Brown	Brown	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Black	Brown	Black
Pod: curvature of mature pod	Curved	Straight	Straight	Straight	Straight	Straight	Straight	Curved	Straight	Straight	Straight	Straight	Curved	Curved	Straight	Straight
Pod: length	Medi	Long	Short	Sh	Mediu	Mediu	Sh	Short	Mediu	Mediu	Sh	Sh	Long	Sh	Mediu	Mediu

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(mature pod)	um			ort	m	m	ort		m	m	ort	ort		ort	m	m
Seed: colour	Mottled	Mottled	Green	Green	Mottled	Mottled	Green	Mottled	Green	Green	Green	Green	Mottled	Mottled	Mottled	Green
Seed: lusture	Shiny	Dull	Shiny	Dull	Dull	Dull	Dull	Dull	Dull	Shiny	Shiny	Shiny	Dull	Dull	Dull	Shiny
Seed: shape	Oval	Oval	Oval	Drumshaped	Oval	Oval	Oval	Oval	Oval	Oval	Oval	Oval	Drumshaped	Drumshaped	Oval	Oval
Seed 100 seed weight (g) size	Small	Medium	Medium	Small	Medium	Small	Small	Medium	Medium	Medium	Medium	Medium	large	Small	Medium	Medium

Table2:Frequency distribution of morphological traitsoffourteenmungbeangeno types.

Characters	**Classes**	**Number of entry**	**Total entries**	**Percentage (%)**
Hypocotyl: Anthocyanin Colouration	Present	30	32	93.75
	Absent	2	32	6.25
Time of flowering	Early (<40 days)	7	32	21.88
	Medium (40-50 days)	24	32	75.00
	Late (More the 50 days)	1	32	3.13
Plant: Growth habit	Erect	5	32	15.63
	Semi-erect	17	32	53.13
	Spreading	10	32	31.25
Plant: Habit	Determinate	10	32	31.25
	Indeterminate	22	32	68.75
Stem: Colour	Green	24	32	75.00
	Green with purple splashes	8	32	25.00
	Purple	0	32	0.00
Stem: Pubescence	Absent	15	32	46.88

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	Present	17	32	53.13
Leaflet: Lobes (terminal)	Absent	22	32	68.75
	Present	10	32	31.25
Leaf: Shape	Deltoid	3	32	9.38
	Ovate	26	32	81.25
	Lanceolate	2	32	6.25
	Cuneate	1	32	3.13
Leaf: Colour	Green	13	32	40.63
	Dark green	19	32	59.38
Leaf: Vein colour	Green	16	32	50.00
	Greenish purple	7	32	21.88
	Purple	9	32	28.13
Petiole: Colour	Green	29	32	90.63
	Green with purple splashes	2	32	6.25
	Purple	1	32	3.13
Leaf size(at 5th node from the base)	Small	1	32	3.13
	Medium	22	32	68.75
	Large	9	32	28.13
Flower: Colour of Petal (Std)	Yellow	13	32	40.63
	Light yellow	19	32	59.38
Pod: Colour of pre mature pod	Green	30	32	93.75
	Green with pigmented suture	2	32	6.25
Pod: Pubescence	Absent	16	32	50.00
	Present	16	32	50.00
Pod position	Above canopy	22	32	68.75
	Indeterminate	10	32	31.25
	Not visible	0	32	0.00
Plant: Height	Short (< 50 cm)	13	32	40.63

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	Medium (50- 70 cm)	7	32	21.88
	Long (> 70)	12	32	37.50
Pod: Colour	Brown	8	32	25.00
	Black	26	32	81.25
Pod: Curvature of mature pod	Straight	22	32	68.75
	Curved	10	32	31.25
Pod: length (mature pod)	Short (< 8cm)	11	32	34.38
	Medium (8 -10 cm)	15	32	46.88
	Long (> 10)	8	32	25.00
Seed: Colour	Yellow	0	32	0.00
	Green	18	32	56.25
	Mottled	14	32	43.75
	Black	0	32	0.00
Seed: Lusture	Shiny	15	32	46.88
	Dull	17	32	53.13
Seed: Shape	Oval	22	32	68.75
	Drum shaped	10	32	31.25
Seed: Size	Small (<3g)	9	32	28.13
	Medium (3-5g)	19	32	59.38
	Large (> 5g)	4	32	12.50

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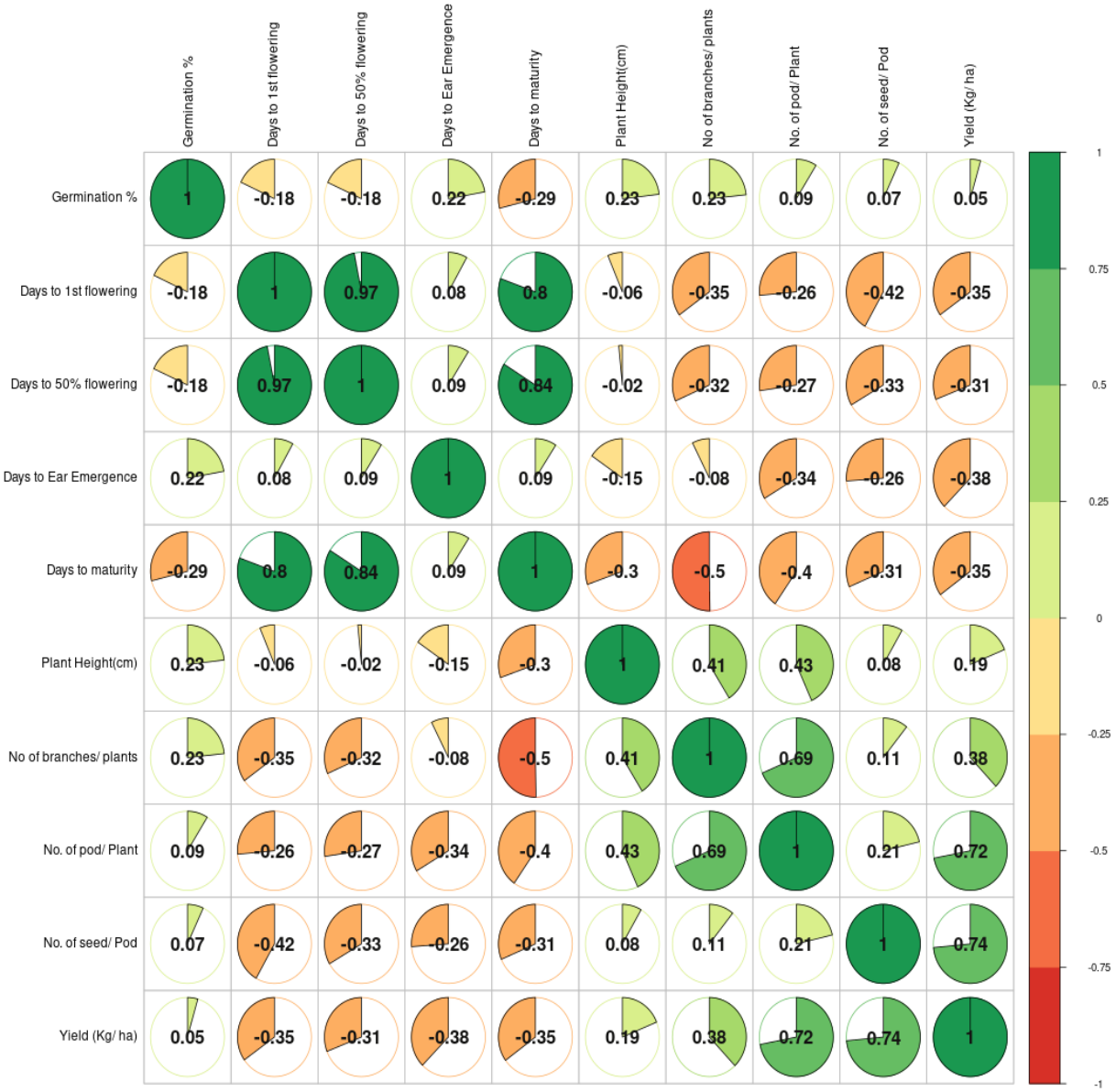

Fig.-1 Visualization of correlation matrix with the help of correlogram

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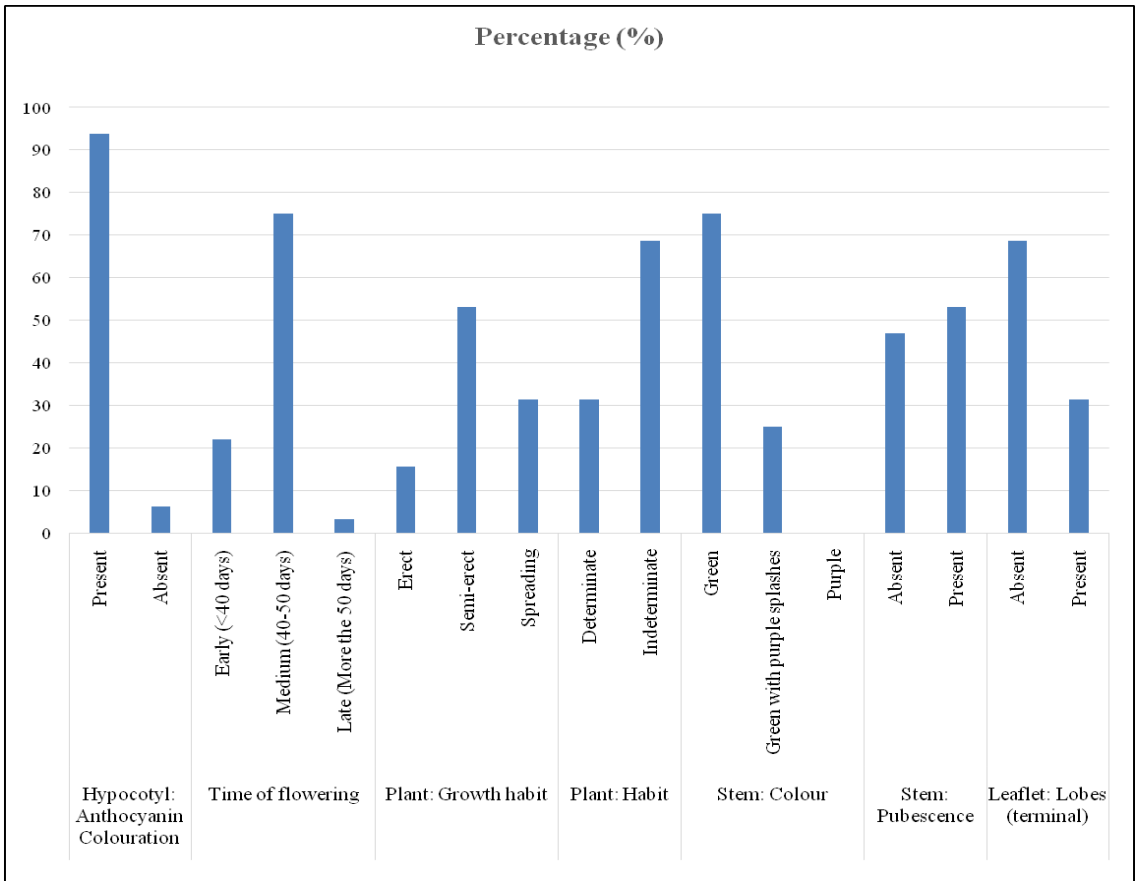

Fig.-2 Frequency distribution of morphological traits of fourteen mungbean genotypes

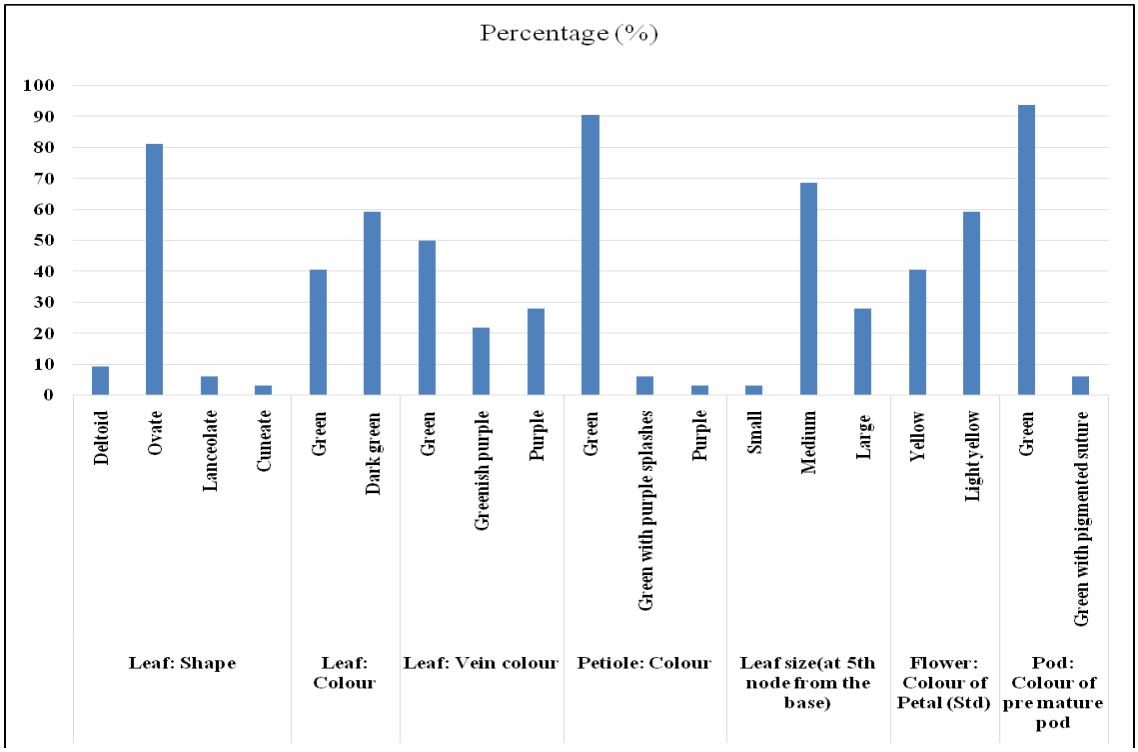

Fig.-3 Frequency distribution of morphological traits of fourteen mungbean genotypes

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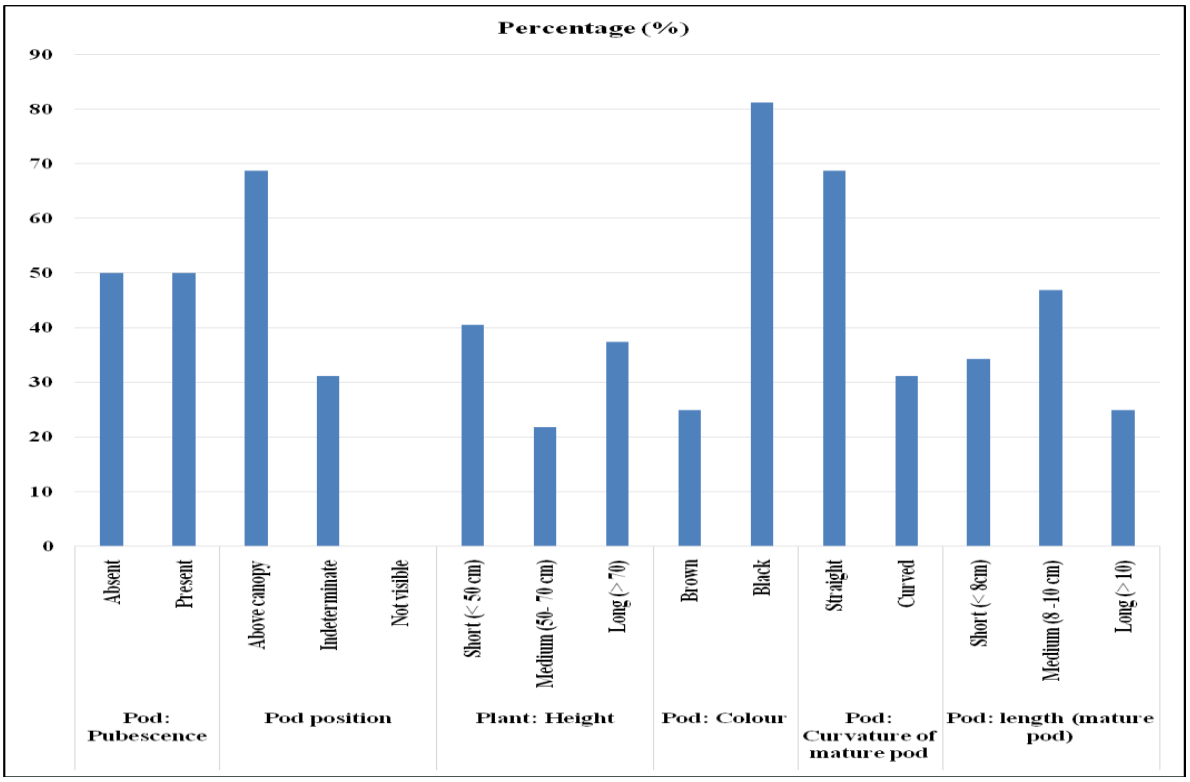

Fig.-4 Frequency distribution of morphological traits of fourteen mungbean genotypes

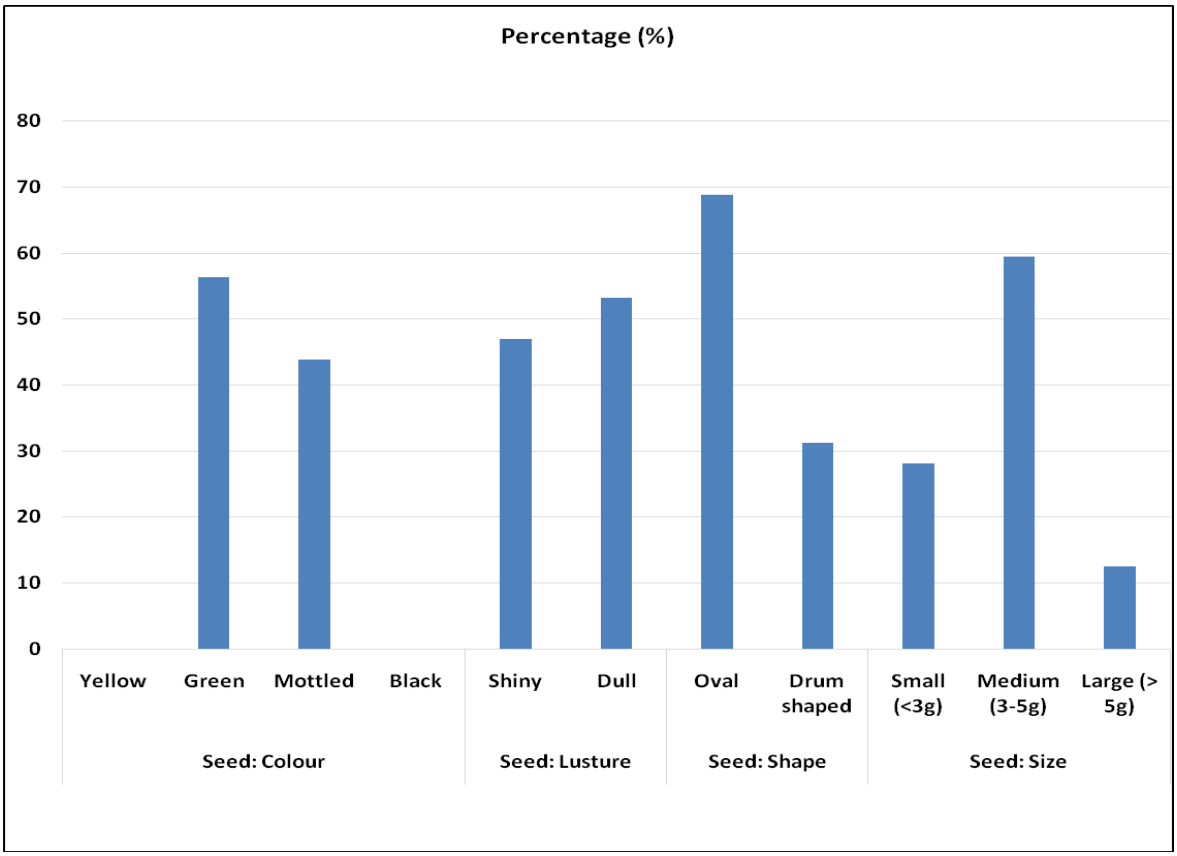

Fig.-5 Frequency distribution of morphological traits of fourteen mungbean genotypes

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