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PR Thombre
M.Sc. (Agri), Department of Agricultural Botany, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

DG Dalvi
Assistant Professor, Department of Agricultural Botany, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

AV Pawar
M.Sc. (Agri), Department of Agricultural Botany, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

SL Shinde
M.Sc. (Agri), Department of Agricultural Botany, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Corresponding Author:
PR Thombre
M.Sc. (Agri) Department of Agricultural Botany, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, Maharashtra, India

Studies on morphological traits of mungbean (*Vigna radiata* L.) genotypes

PR Thombre, DG Dalvi, AV Pawar and SL Shinde

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Abstract
In the present investigation, 15 genotypes were studied for morphological traits at Sorghum Research Station, Vasantrao Naik Marathwada Krishi Vidyapith, Parbhani during *kharif* 2021-2022 and observations taken on 20th, 40th, 60th DAS and at harvesting stage. Results revealed that the Mean plant height varied from 5.35-55.47 cm in different varieties of greengram from 20th DAS to harvesting stage. Highest mean plant height was recorded in greengram genotype BM-21-1 at harvesting stage (55.47 cm) followed by AKM-1606 (51.57 cm) as compared to rest of varieties of greengram. The genotype BM-21-2 (27.17) followed by AKM-1606 (21.43) was recorded highest number of leaves per plant at harvesting stage as compared to other genotypes. Similarly, these genotypes also recorded highest fresh weight (g) and total dry weight (g) per plant at harvest. The genotype BM-21-2 also recorded significantly highest primary and secondary branches per plant at harvest.

Keywords: *Vigna radiata* L., plant height, leaves per plant, fresh and dry weight of plant

Introduction
Greengram (*Vigna radiata* L.) is a well-known domesticated legume crop grown widely all over the world providing an important economy for marginal farmers in the developing countries and a high value commodity crop with high nutritional quality in the developed nation. Greengram is a legume of family Fabaceae, sub family Papilionaceae, genus Vigna and species radiata. This family is a wide spread family as it occupies the third largest family of flowering plant with approximately 650 genera and nearly 20,000 species (Doyle, 1994) [2]. Green gram is alternatively known as golden gram, mungbean, moong bean, haricot mungo, mash etc. It is an annual, semi erect to erect or sometimes twining, 25-100 cm tall, deep rooted herbaceous plant (Baldev, 1988) [1]. It can grow under drought stress conditions, where, the short time is available for growth. It grows well under both irrigated as well as rainfed conditions. Somatic chromosome number of green gram is 2n=24. It was domesticated in Persia (Iran). Its progenitor is *Vigna radiata* var. soblobata. It can be cultivated as *Kharif* as well as summer crop. The first fortnight of July is the optimum time for *Kharif* sowing and from March to April is optimum time for summer sowing. It has more protein content and better digestibility than any other pulse crop (Tabasum *et al*., 2010) [9]. Green gram originated in India, where it has been cultivated for millennia. It spread, in early times, to other Asian countries and later to Africa, Australia, the Americas and West Indies. India is the largest producer, followed by China. It's also grown in many tropical African countries. The haulms are used as fodder and the husks and split beans are a useful livestock food. The crop is also grown for hay, green manure and as cover crop (Duke, 1981) [3].

Materials and Methods
The materials used and the methods adopted for the attainment of various objectives of the investigation entitled "Morpho-physiological studies in greengram (*Vigna radiata* L.) genotypes" embodies the comparative studies on the morphological characteristics of certain genotypes of greengram. The seeds of 15 different greengram genotypes were procured from Agriculture research station (ARS), Badnapur, Maharashtra. The experiment was carried out during *Kharif* season, 2021-2022 at Sorghum Research Station Farm, Vasantrao Naik Marathwada Krishi Vidhyapith, Parbhani, India. The seed of green gram genotypes sown with spacing row to row 45 cm and plant to plant 10 cm on date 30 June, 2021 in *Kharif* season. Harvesting was done from each plot separately when the crop attained maturity. Observations were recorded at 20, 40, 60 days after sowing (DAS) and harvest on three randomly selected plants in each entry from each replication for the following morphological traits.

The observed data of the experiment were analyzed by the model using Randomized Block Design (RBD) as per Panse and Sukhante (1967) [6].

Results and Discussion

The experimental findings obtained on the Morphological characteristics of varieties of mungbean are described in the following section:

Plant height (cm)

Height of plant was recorded in centimeters from the base of plant to point of initiation of inflorescence of randomly selected three plants, in genotypes and replication wise. Then mean plant height was calculated. Plant height were recorded at 20, 40, 60 DAS and at harvest.

The data on plant height recorded at 20 days interval from 20 DAS to at harvest were presented in Fig 1. Indicate that the height of the plant increased rapidly up to 60 days after sowing and the increase in plant height was slow onwards. The differences in plant height of the genotypes were significant at all stages. The plant height was maximum in BM-21-1 (55.47 cm) followed by AKM-1606 (51.67 cm) and BPMR-145 (50.77 cm) at harvest. The lowest plant height was observed in AKM-1609 (22.40 cm) at harvest. The present investigation revealed significant differences in plant height among the genotypes at different growth stages. At all growth stages, the genotype BM-21-1 followed by AKM-1606 recorded the highest plant height, whereas both were found at par with check BPMR-145 and BM-2003-2. The significant differences in plant height among the all genotypes of Mungbean here found. Plant height increased from 15 DAS to 60 DAS. Similar results were found by Rohman and Hussain (2003) [8] and Siddique (2006) [10].

Number of leaves per plant

The total number of leaves per plant was recorded from the three plants tagged and their mean number is expressed as number of leaves per plant. The observations were recorded on 20, 40, 60 DAS and at harvest.

The data on mean number of leaves per plant are shown in Fig 2. Data revealed that the mean number of leaves per plant increased up to 60 days of crop growth stage and there after decreased up to harvest in all the varieties and it may be due to senescence of old leaves at maturity. The varietal differences were statistically significant at all the sampling occasions. The number of leaves per plant was highest in BM-21-1 (34.73) followed by AKM-1606 (30.67) and Phule M-402-2-1 (30.48) genotypes at 60 days after sowing. The least number of leaves observed in Phule chetak (21.54) genotype at 60 days after sowing. Due to senescence of old leaves at maturity the number of leaves per plant get reduced and was highest in BM-21-1 (27.17) followed by AKM-1606 (21.43) and check BPMR-145 (20.64) genotypes at harvest. The genotype BM-21-1 was recorded significantly highest number of leaves which was found at par with check BPMR-145. Similar result found by Raju and Varma (1982) [7] that is the correlation between plant height and leaf number was significant and Patil and Deshmukh (1989) [5] as well.

Fresh weight and dry weight (g/plant)

Three randomly selected plants were collected and their fresh weight is measured in gram within half hour after that these plants were kept separately in the oven at 80±2 °C for 72 hours. Total dry weights of the plants were recorded. The observations were recorded on 20, 40, 60 DAS and at harvest.

The data on mean fresh weight (g/plant) is presented in Fig 3. The data revealed that fresh weight per plant increased continuously up to harvest. The differences in total fresh weight of the genotypes were significant at all stages. The mean fresh weight was 42.10 g at harvesting stage. The total fresh weight was significantly highest in BM-21-1 (61.03 g) followed by AKM-1606 (55.34 g) and BPMR-145 (53.80 g). The lowest fresh weight was observed in AKM-1609 (20.88 g) at harvest. Its high fresh weight might be because of its higher plant height, more numbers of leaves as well as number of branches. These results are in conformity with report of Raju and Varma (1982) [7].

Total dry weight (g/plant)

The data on mean total plant dry weight is presented in Fig 4. The data revealed that total dry matter per plant increased continuously up to harvest. The differences in total plant dry weight of the genotypes were significant at all stages. The mean total dry weight at harvest was 12.965 g. The total plant dry weight was significantly highest in BM-21-1 (20.593 g) followed by BPMR-145 (17.927 g) and Phule M-402-2-1 (15.913 g). The lowest fresh weight was observed in AKM-1609 (20.88 g) at harvest. The higher total dry matter might be because of its higher plant height, more numbers of leaves as well as number of branches. These results are in conformity with report of Raju and Varma (1982) [7].

Primary and secondary branches per plant

The number of primary branches and secondary branches per plant was counted at each sampling of three tagged plants and mean values was expressed as number of branches per plant. The observations were recorded at 60 DAS and at harvest.

The data on mean number of primary and secondary branches are graphically depicted in Fig 5 and 6 respectively. The number of primary and secondary branches per plant showed significant varietal differences throughout the growth period. The number of primary and secondary branches per plant linearly increased up to 60 days of crop growth stage. The number of primary branches was significantly highest in BM-21-1 (9.80) followed by both check BPMR-145 (9.15) and BM-2003-2 (8.88). The lowest number of primary branches was observed in BM-2019-10 (5.06) at harvest. Similar result found in case the genotype BM-21-1 (6.57) showed significantly highest number of secondary branches followed by both check BPMR-145 (6.53) and BM-2003-2 (5.83). The lowest number of secondary branches was observed in AKM-1609 (1.60) at harvest. In both primary and secondary branches genotype BM-21-1 found at par with two check BPMR-145 and BM-2003-2. The results of the present investigation confirm the earlier findings of Khan and Ahmed (1989) [4].

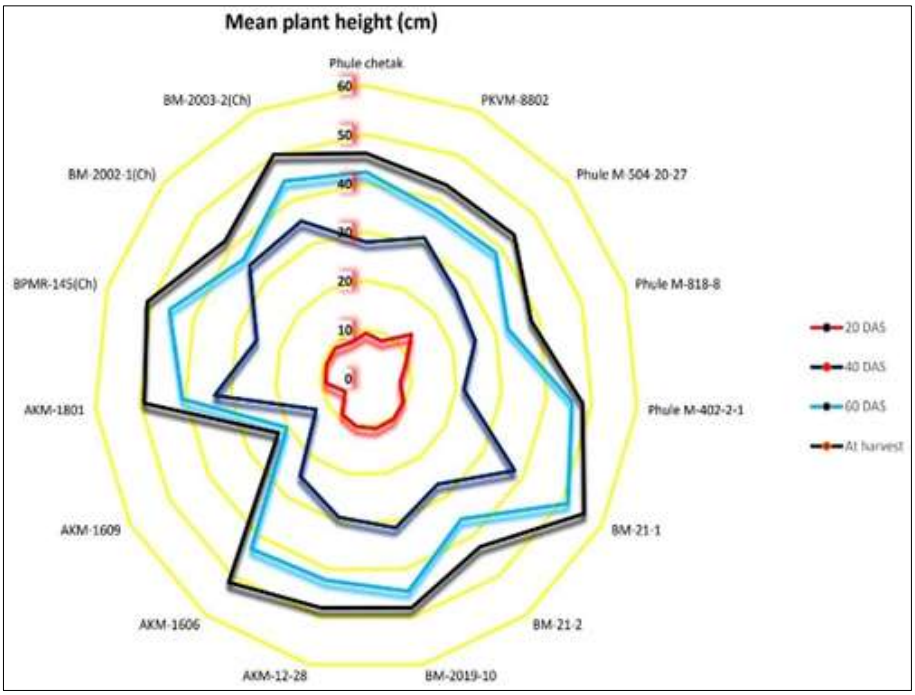

Fig 1: Radar with markers diagram of mean plant height (cm) of fifteen genotypes on 20th, 40th, 60th DAS, and at harvest stage

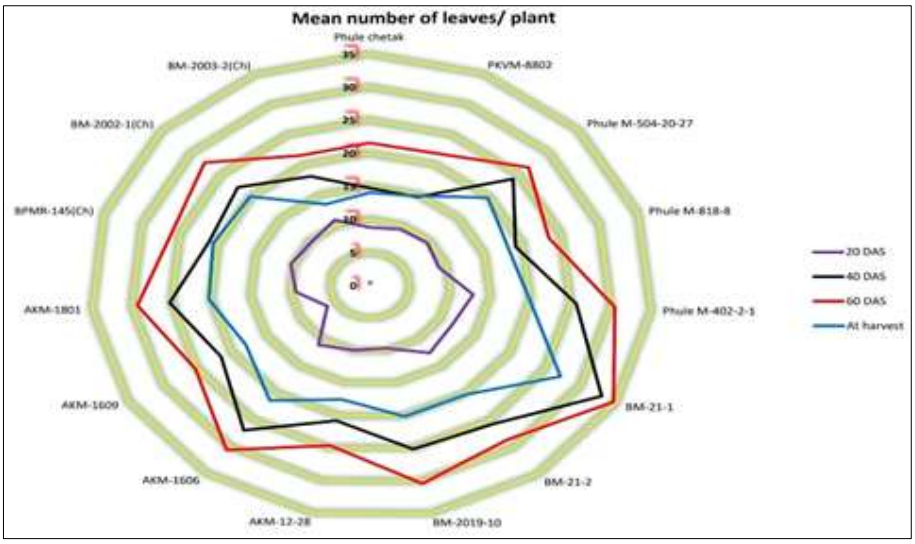

Fig 2: Radar diagram of mean number of leaves/plants of fifteen genotypes on 20th, 40th, 60th DAS, and at harvest stage

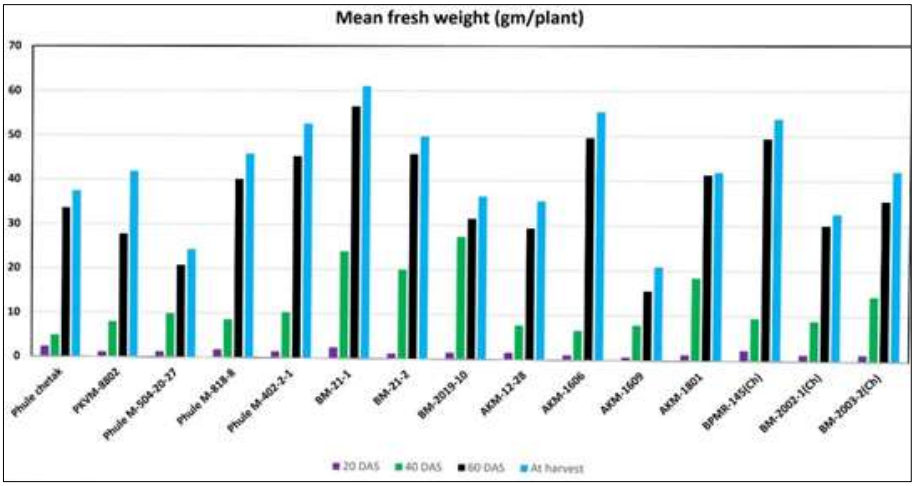

Fig 3: Graph represent mean fresh weight (gm/plant) of fifteen genotypes on 20th, 40th, 60th DAS, and at harvest stage

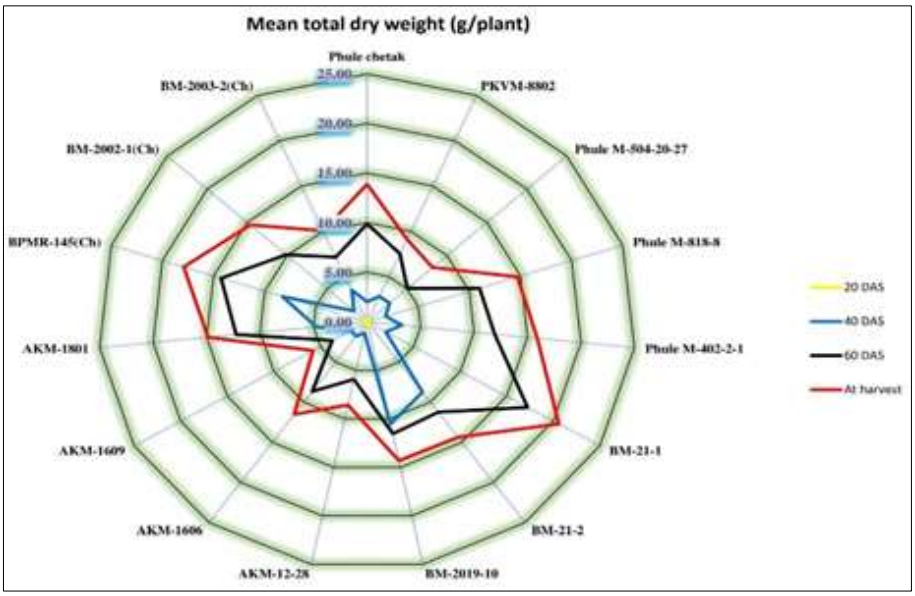

Fig 4: Radar diagram of Mean total dry weight (gm/plant) of fifteen genotypes on 20th, 40th, 60th DAS, and at harvest stage

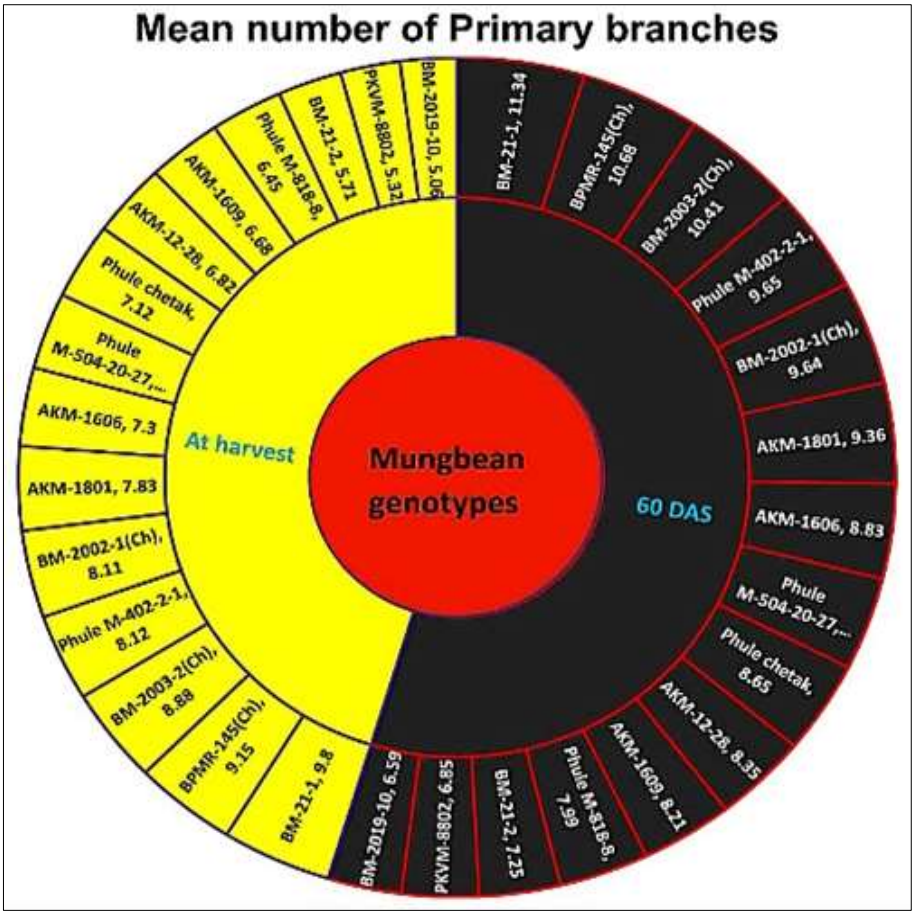

Fig 5: Sunburst chart of mean number of primary branches of fifteen genotypes on 60th DAS and at harvest stage

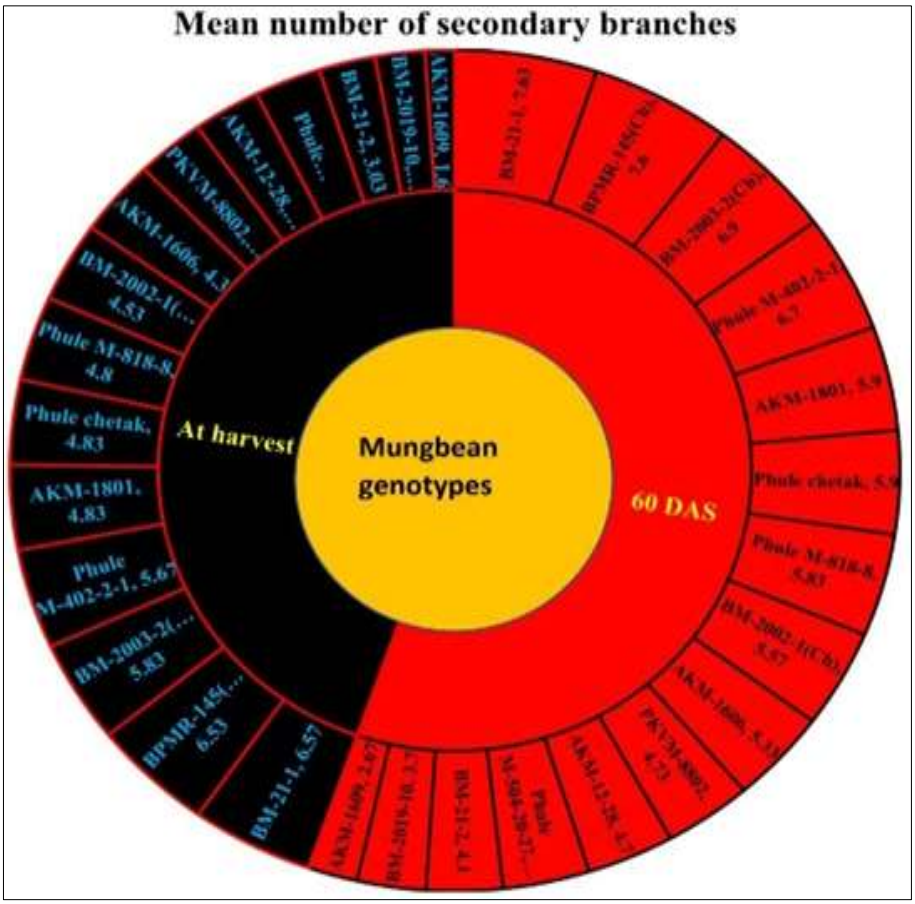

Fig 6: Sunburst chart of mean number of secondary branches of fifteen genotypes on 60th DAS and at harvest stage.

Conclusion

From this study, it is concluded that a wide range of variability existed for the different morphological parameters in mungbean genotypes. Among these genotypes of mungbean, the genotype BM-21-1 was superior in respect of various morphological parameters *viz* plant height (cm), number of leaves per plant, fresh weight (gm), total dry weight (gm), number of primary and secondary branches. The genotype BM-21-1 was found significantly superior for total dry matter accumulation due to its efficient translocation to pod development. Therefore, breeders have made attempts to breed high-yielding genotypes based on morphological characters.

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