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RESEARCH

SCREENING OF MUNGBEAN (*VIGNA RADIATA* L. WILCZEK) GENOTYPES AGAINST SALINITY STRESS IN SEMI-ARID REGION OF NORTH-WESTERN HARYANA

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Abstract: Mungbean is a vital, eco-friendly legume rich in proteins, vitamins, and minerals, crucial for sustainable agriculture. However, its productivity is severely hampered by various abiotic and biotic stresses, with salinity being a particularly severe environmental challenge. The present filed study was conducted at Soil Research Farm, CCS HAU, Haryana for the screening of thirteen genotypes including for national checks (Pusha Vishal, IPM 02-3, Pusa 9531, Virat (IPM 205-7) under saline water irrigation (EC_{iw} 5-6 dS m^{-1}). The results revealed that while plant height, pods per plant, and pod length are not significantly affected by saline stress, but seed weight, seeds per pod and seed yield varied significantly among different genotypes. The significant highest seed yield obtained for PMS 9 (504.77 kg ha^{-1}) and PMS 12 (501.03 kg ha^{-1}) being statistically at par with PMS 10, PMS 13 and PMS 8. Lowest yield was recorded with IPM 02-3 genotype. Genotypes like PMS 9 and PMS 12 likely possess traits that enhance their ability to manage saline stress, such as improved salt tolerance or adaptability.

Keywords: Mungbean, Screening, Genotypes, Salinity stress

INTRODUCTION

Mungbean (*Vigna radiata* L. Wilczek) is a self-pollinated important food grain legume field crop which is mostly cultivated in arid and semiarid regions of India and rich source of proteins, vitamins, and minerals and a chief source of nutrients for vegetarian human diet (Shukla and Mishra, 2020). Mung beans are commonly cultivated for their use in noodles, edible seeds, sprouts, and dhal in the Asian subcontinent. Pulses, including mung beans, are globally significant food crops due to their high protein content. They contain 20 to 25 percent protein by weight, which is double the protein content of wheat and three times that of rice. Pulse production has seen substantial growth over the past decade, increasing from 1.71 million tons in 2014 to 2.70 million tons in 2024. In India area under pulses is 31.03 Mha and production is 27.69 M tones (Agricultural Statistics at a Glance 2022). Mung bean roots make a symbiotic association with Rhizobia and reduce the cost of nitrogenous fertilizers. Its ability to fix nitrogen and restore soil fertility makes it a valuable crop for sustainable agricultural production (Somta and Srinives, 2007).

Despite developing several cultivars suitable for specific agro-climatic zones, mungbean crop is affected by a wide range of biotic and abiotic stresses (Manasa *et al*., 2017). Mungbean is a salt sensitive crop and salt stress is an important ecological factor restrict the production of mungbean in arid and semiarid regions (Sehrawat *et al*., 2015). Researchers are increasingly focused on improving the agricultural productivity of mung beans, a nutritious staple food crop, to meet the demands of the growing global population, especially in underdeveloped and developing countries. Studies have shown that high levels of soil salinity can reduce the osmotic potential of the soil solution, leading to water stress in plants. This stress, combined with the interaction of salts with mineral nutrition, can cause nutrient imbalances, deficiencies, oxidative stress, and even plant pathology, ultimately resulting in growth arrest, metabolic damage, and plant death (Hasanuzzaman *et al*., 2012 and Sehrawat *et al*., 2015).

Salt stress has significant detrimental effects on crop performance and physiology, often leading to plant death due to growth arrest and metabolic damage (Hasanuzzaman *et al*., 2012). The severity of these adverse effects varies based on factors such as the plant species, duration of stress, growth stage, salt concentration, and method of application. Evaluating crop plants in saline environments can identify valuable agronomic traits or genes that could be

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introduced into salt-sensitive legume crops through breeding (Nair *et al.,* 2012). However, progress in developing salt-tolerant mung bean varieties has been limited due to the complex nature of salinity stress and the challenges in integrating desirable traits or resistant genes (Shukla and Mishra, 2020).

Therefore, it is essential to improve the productivity of mungbean to meet the demands of the growing population while making more efficient use of scarce natural resources. Considering the significance of these factors, the present study was conducted to evaluate the performance of selected genotypes under saline water irrigation.

MATERIALS AND METHODS

The field trial was conducted in 2024 at the Research Farm, Department of Soil Science, Chaudhary Charan Singh Haryana Agricultural University (CCS HAU), Hisar (29° 8′ N; 75° 70′ E, 215.2 meters above sea level). The experimental site is located in the arid and semi-arid region on the northwestern side of Haryana, India. The soil at this location is sandy loam. The region experiences extreme weather conditions, including severe cold during winter and hot, dry, desiccating winds during summer. Fig.1 illustrates the mean monthly meteorological data, including maximum and minimum temperatures and average rainfall for the cropping season. The initial soil chemical properties are presented in Table 1 and were analyzed using standard methods as described by Antil *et al.* (2002).

Thirteen genotypes of mungbean *viz*: PMS 10, PMD 7, PMS 9, PMS 15, Pusha Vishal, PMS 13, Pusa 9531, PMS 14, PMS 12, PMS 11, IPM 02-3, Virat (IPM 205-7) and PMS 8 were taken for the experimentation. Saline irrigation (EC_{iw}- 5-6 dSm^{-1}) was applied during the cropping season. The bore-well groundwater at the site is saline in nature. During the irrigation intervals of crops, salinity levels of water with a desirable EC_{iw} 5-6 dSm^{-1} were prepared by repeatedly mixing bore-well water with canal water. Water samples were taken at the time of irrigation and standard methods were adopted to calculate the levels of carbonates (CO_3^{2-}), bicarbonates (HCO_3), chlorides (Cl^-), calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), and potassium (K^+) in the water sample (Richard, 1954). Sulphate (SO_4^{2-}) content was determined using the Chesnin and Yien (1950) method by using $BaCl_2$ and gum acacia solution. The chemical composition of irrigation water is presented in table 2.

The data collected from the field experiment fitted in a randomized block design (RBD) were statistically analysed by using the EXCEL and GRAPES statistical software package (Gopinath *et al.* 2021) at the probability (p =0.05).

RESULTS AND DISCUSSION

Plant height: The heights of the genotypes ranged from 60.7 to 70.3 cm (IPM 02-3). The results (Table 3) revealed that salinity did not significantly affect plant height across the genotypes. This uniformity in height implies that, overall, the genotypes are similarly adapted to the saline environment in terms of vertical growth. However, the tallest genotype is IPM 02-3 at 70.3 cm, while the shortest are PMS 10 and PMS 12, both at 60.7 cm and this could be due to higher ion toxicity, osmotic stress, or impaired reproductive development. Despite these variations, all genotypes are statistically similar in plant height.

Pods per plant: The number of pods per plant varies from 13.22 (IPM 02-3) to 18.78 (PMS 9), but all genotypes again failed to produce significant effects (Table 3). This indicates that, while there is some variability, the differences in pod number are not statistically significant under saline conditions. The genotypes have comparable reproductive success in terms of pod production, despite the saline stress. However, genotype PMS 9 (18.78 pods/plant) and PMS 12 (18.11 pods/plant) have higher numbers of pods per plant, which might indicate a higher level of adaptation to saline conditions, allowing them to maintain pod production despite stress. Similar result has been reported by Katiyar *et al.* (2019).

Seeds per pod: Seeds per pod range from 8.93 (PMD 7 and IPM 02-3) to 11.29 (PMS 9). Unlike the other traits, the seeds per pod showed significant variability (Table 3). This indicates that some genotypes are better at maintaining or increasing seed number per pod under saline stress, while others are less effective. PMS 9 however had the highest seeds per pod (11.29). This suggests they might have better tolerance to saline conditions, possibly due to enhanced physiological or biochemical mechanisms such as better ion regulation, osmotic adjustment, or improved nutrient uptake (Ahmed, 2009). While, PMD 7 and IPM 02-3 genotypes had the lowest (8.93) sees per pod.

100 seed weight (g): The weight of 100 seeds ranged from 3.61 g (IPM 02-3) to 4.97 g (PMS 9), and this trait shows significant variability under salt stress (Table 3). This suggests that salinity impacts seed weight significantly, with some genotypes maintaining heavier seeds better than others. Genotypes like PMS 9 that have a higher seed weight may possess traits that help them better manage saline stress and maintain seed quality. For instance, PMS 9, which had the highest 100 seed weight, may possess traits or mechanisms that confer better tolerance to salinity, allowing it to maintain seed size and quantity under stress. Conversely, genotypes like IPM 02-3, with lower values for this yield attributing character, may be less able to cope with the saline conditions, leading to reduced seed weight and fewer seeds per pod. Similar result has been reported by Ahmed (2009) and Katiyar *et al.* (2019).

Pod length (cm): Pod length ranged from 6.67 cm (PMS 11) to 8.24 cm (PMS 9), but all genotypes are statistically similar in this trait (Table 3). This indicates that, similar to plant height and pods per plant, pod length is relatively stable across genotypes under saline conditions. Salinity does not seem to have a differential impact on pod length among the genotypes. The lack of statistical variation suggests that the genotypes may have adapted similarly to the saline environment, resulting in comparable growth patterns and reproductive structures despite the stress. Similar result has been reported by Katiyar *et al.* (2019).

Seed yield: Under saline water irrigation, the performance of different moongbean genotypes varied significantly, reflecting their ability to withstand and adapt to saline stress (Fig. 2). The genotypes *i.e.*, PMS 9 and PMS 12 stand out with the highest seed yields, demonstrating their resilience and effective adaptation to saline conditions. These genotypes also exhibit superior yield attributes such as higher pod counts per plant, greater seeds per pod, and heavier 100-seed weight. This enhanced performance is indicative of their ability to maintain reproductive efficiency and overall plant health despite the stressful environment. On the other hand, genotypes like Pusa 9531 and IPM 02-3 show lower seed yields, which is likely a result of their reduced performance in key attributes such as pod number and seed weight. The correlation between high seed yields and favourable yield attributes highlights the importance of these traits in coping with saline stress. Genotypes with higher pod counts and seed weights are better equipped to produce more seeds, underscoring that effective stress management and optimal yield attributes are crucial for achieving high productivity under saline conditions. The present research is in accordance with the findings of serval researchers (Sehrawat *et al.*, 2015; Sehrawat *et al.*, 2019).

Soil properties: The mungbean genotypes did not significantly affect soil properties such as pH, electrical conductivity (EC), and available nitrogen, phosphorus, and potassium (NPK) under saline water irrigation (Table 4). However, compared to initial values, both electrical conductivity and available potassium in the soil increased. This increase is attributed to the continuous application of saline water, which elevated the salt concentration in the soil solution (Ankush *et al.*, 2020). Conversely, the levels of available nitrogen and phosphorus decreased from their initial values, likely due to a reduction in microbial populations and their activities, which are crucial for nutrient recycling in the soil (Ankush *et al.*, 2020).

Table 1. Initial soil chemical properties

Soil parameter	Values	Methods/Instruments used
EC (dSm^{-1})	0.42	EC meter
pH	8.24	pH meter
N	185.02	Alkaline permanganate method
P	23.20	Olsen's method using 0.5 M $NaHCO_3$ as an extracting agent
K	329.57	Extraction with 1 N ammonium acetate at pH 7.0 and determined by Flame photometer

Table 2 Chemical composition of irrigation water

Salinity	Soluble cations me/l)			Soluble anions (me/l)			
	Na^+	K^+	$Ca^{2+} + Mg^{2+}$	CO_3^{2-}	HCO_3^-	SO_4^{2-}	Cl^-
5.84 dSm^{-1}	40.29	0.24	17.97	Nil	1.40	14.71	42.51

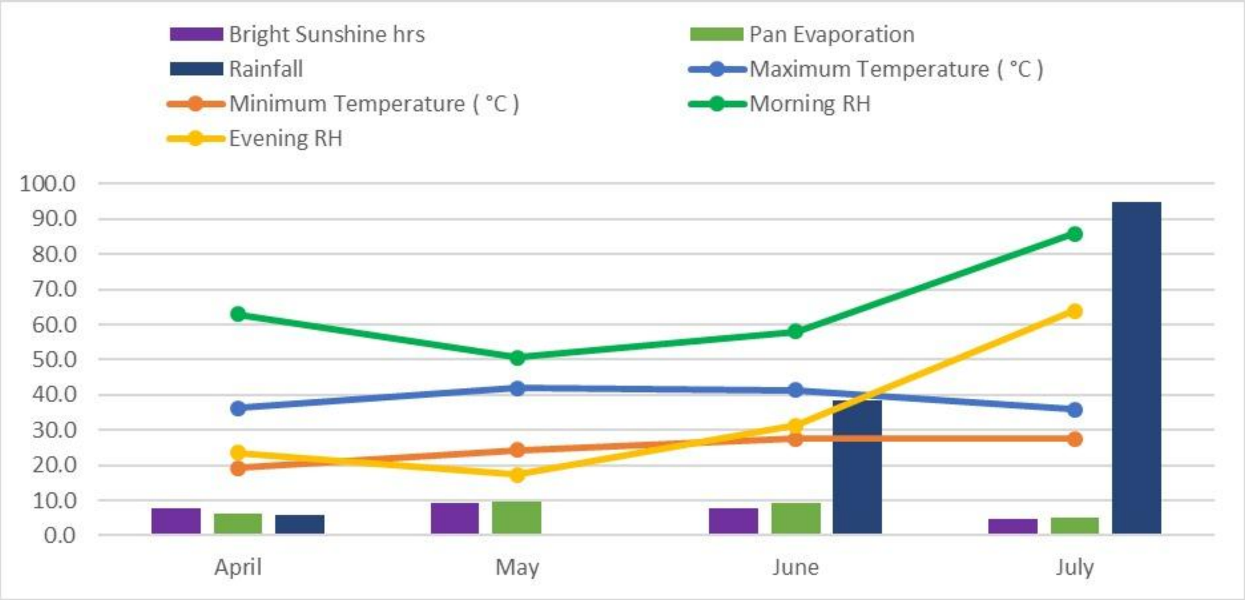

Fig. 1 Meteorological data of mungbean crop season

Table 3. Effect of saline water on yield attributes of mungbean genotypes

Genotypes	Plant height (cm)	Pods/plant	Seeds/pod	100 seed weight (g)	Pod length (cm)
PMS 10	60.7a	16.89a	10.85a	4.47bc	6.83a
PMD 7	69.6a	14.00a	8.93b	3.81fg	6.74a
PMS 9	61.2a	18.78a	11.29a	4.97a	8.24a
PMS 15	64.4a	15.67a	10.56ab	4.27bcd	6.98a
Pusha Vishal	61.3a	17.11a	10.93a	4.59b	7.63a
PMS 13	61.9a	16.44a	10.81a	4.32bcd	7.24a
Pusa 9531	65.8a	13.78a	8.96b	3.71fg	7.06a
PMS 14	66.3a	15.56a	10.41ab	4.22cde	7.37a
PMS 12	60.7a	18.11a	11.07a	4.62ab	7.28a
PMS 11	66.8a	15.44a	9.07b	3.87efg	6.67a
IPM 02-3	70.3a	13.22a	8.93b	3.61fg	7.41a
Virat (IPM 205-7)	66.4a	15.22a	9.71ab	4.04g	6.92a
PMS 8	62.2a	15.89a	10.81a	4.30bcd	6.89a

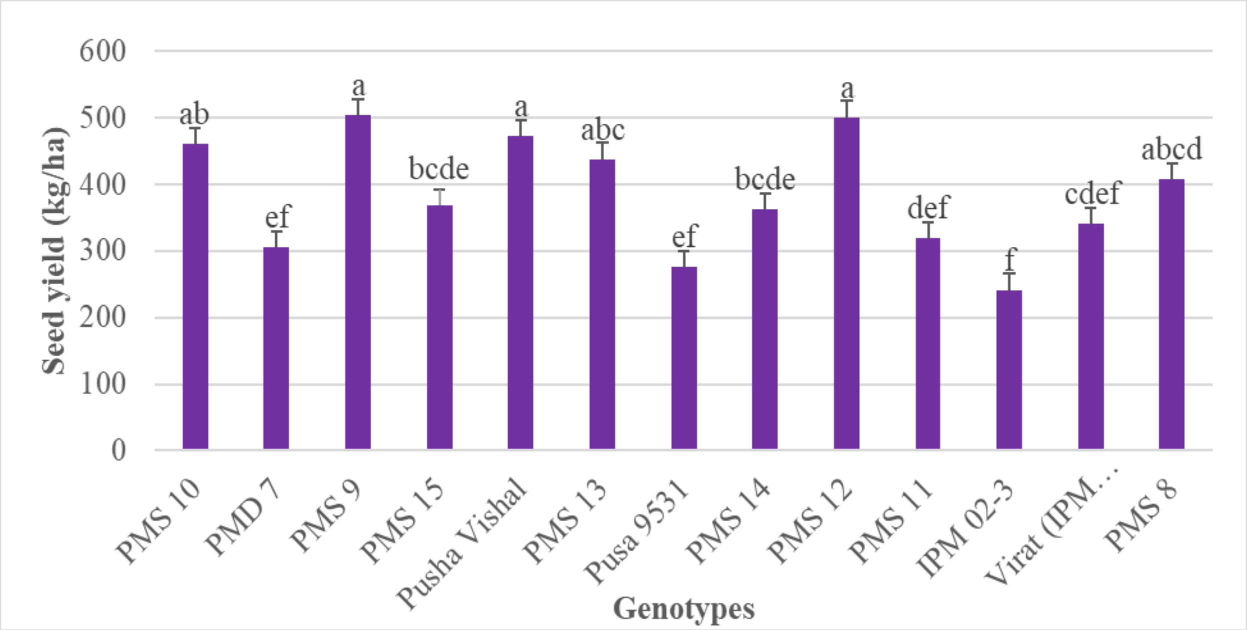

Fig. 2 Effect of saline water on seed yield (kg ha^{-1}) of mungbean genotypes

Table 4. Effect of saline water on soil properties after harvest of mungbean

Genotypes	pH	EC	Available nutrients (kg ha^{-1})		
		(dS m^{-1})	Nitrogen	Phosphorus	Potassium
PMS 10	8.14a	1.08a	181.22a	22.98a	311.28a
PMD 7	8.16a	1.36a	180.5a	22.58a	318.64a
PMS 9	8.10a	1.07a	183.5a	22.45a	315.4a
PMS 15	8.13a	1.27a	182.1a	23.05a	312.57a
Pusha Vishal	8.36a	1.48a	179.6a	22.41a	311.6a
PMS 13	8.11a	1.12a	179.50a	22.02a	310.00a
Pusa 9531	8.03a	1.23a	180.4a	21.89a	317.55a
PMS 14	8.01a	1.27a	181.25a	22.74a	318.67a
PMS 12	8.07a	1.03a	181.67a	22.38a	314.27a
PMS 11	8.17a	0.87a	181.64a	22.67a	317.68a
IPM 02-3	8.13a	1.24a	182.55a	22.19a	314.55a
Virat (IPM 205-7)	8.05a	1.55a	183.00a	22..76a	315.87a
PMS 8	8.00a	1.48a	182.18a	22.07a	318.66a

CONCLUSION

The results indicate that while plant height, pods per plant, and pod length are not significantly affected by saline stress, while seed weight, seeds per pod and seed yield varied significantly. Moongbean is generally sensitive to saline conditions, which can impact germination, growth, and yield. High-yielding genotypes like PMS 9 and PMS 12 may possess traits that allow them to better manage saline stress, such as improved salt tolerance mechanisms or better adaptability. Understanding these differences can help in selecting genotypes with better salinity tolerance, which is crucial for improving crop performance in salt affected areas.

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