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Insights from Morpho-Physiological Traits Imparting Tolerance for Preharvest Sprouting of Mungbean Genotypes

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Authors' contributions

This work was carried out in collaboration among all authors. Author AMA collected the reviews, did data analysis, Interpretation of results, drafted the manuscript, conceptualized and designed the study. Authors APS and RRL wrote, reviewed and edited the manuscript. Author RVA conducted research trial, observations, collected the data, did data analysis and interpreted the results. Author GRS critically reviewed the manuscript and served as scientific advisor. All authors read and approved the final manuscript.

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ABSTRACT

Due to the absence of fresh seed dormancy (FSD) in mung bean seeds makes them susceptible to pre-harvest sprouting (PHS). Mung bean yield has been proved to be 60–70% reduced in response to PHS, an abiotic stress. By understanding this problem present study was carried out at at experimental field, Department of Agricultural Botany (Plant Physiology) (20.7006^{0}N, 77.0371^{0}E), PGI, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during kharif (rainy) season 2012-13. The experiment entitled "Insights from morpho-physiological traits imparting tolerance for preharvest sprouting of munbean genotypes". The design of experiment is Randomized block design in three replications with sixteen genotypes. It was observed that on the basis of morpho-physiological traits viz., high hard seed %, pod pubescence, lower germination in pod and seed, less seed and pod moisture genotype AKM-9801, AKM-9907, BM-2002-1 and AKM-10-05, genotypes were found to be tolerant to preharvest sprouting. And more interesting fact is the seed yield per hector found efficient in AKM-8802 and AKM-9907. So, it was found that AKM 9907 is best suitable variety of mungbean in kharif season to prevent crop from whether damage and improve yield also.

Keywords: Mungbean; preharvest sprouting; yield.

1. INTRODUCTION

After cereals, pulses are the second most important food in the Indian diet and play a major role. They are abundant in calcium, phosphorus, vitamins, and minerals in addition to protein. Mung bean (*Vigna radiata* L.) is one of the most important legume crops belong to family Fabaceae. In India, mungbean is mainly grown as a rainy season crop and is generally caught in rains at maturity and greatly due to preharvest sprouting due to a lack of fresh seed dormancy (FSD). PHS is an abiotic stress that has been shown to reduce mungbean yield by 60-70% [1,2,3]. Pre-harvest sprouting (PHS) means wheather damage is a condition caused by ecological factors, particularly in humid conditions, that result in significant yield losses in black gram [4,5]. Preventing pre-harvest sprouting or weather damage is important in mungbean crops because it has been identified as a critical constraint that reduces crop yield potential (Smith et al*.* [6]. There are two mechanisms to protect the crop from weather damage one is avoidance and second is tolerance, but avoidance is not possible for a rainy season crop, so it is essential to develop resistance/tolerance in crop by understanding morpho physiological traits against preharvest sprouting [1,7-9]. Keeping in the view of above facts, the study entitled "Insights from morpho-physiological traits imparting tolerance for preharvest sprouting of mungbean genotypes" was conducted along with the objective to determine the best suitable genotypes tolerance against weather damage or preharvest sprouting.

2. MATERIALS AND METHODS

The experiment was plotted in RBD in three replications with sixteen genotypes. For the current study period, Kharif 2012, the rainfall (mm), mean maximum and minimum temperature (^{0}c), and humidity (%) per day was given from the Meteorological Observatory Department of Agronomy, Dr. PDKV., Akola. Total 602.1 mm rainfall was received from 1st June to 30 Sept. 2012. The experiment was structured using a Randomized Block Design (RBD), incorporating sixteen different genotypes with each genotype replicated three times. The genotypes include AKM-8802, PKV-GREEN GOLD, PKVAKM-4, BM-2002-1, BM-2003-2, KOPERGAON, AKM-9907, AKM-09-2, AKM-10-16, AKM-10-21, AKM-0603, AKM-10-05, AKM-10-13, AKM-10-24, AKM-8803 and AKM-9801. Morpho-physiological observations, along with yield and its attributes, were recorded to identify the most suitable genotype for weather damage resilience. The data of plant height was taken at harvest when yield attributes like number of pods per plant, 100 seed rate, hard seed percentage, seed luster, pod orientation, pod wall thickness, pod pubescence, pod length, pod break was taken along with yield per plot and then computed into yield per hectare. Hundred seeds were counted from the samples drawn from the produce of each genotype and replication wise and weight were recorded in grams. Seed coat luster was recorded on the appearance of seeds was categorized into bright and dull. Pod pubescence was recorded by taking half centimeter portion of the dry pod was taken and observed under microscope and recorded hair numbers on pod wall. Two pods were used for this purpose. Pod beak was categorized into straight and curve accordingly. Pod orientation categorized into erect and down accordingly.

$$Hardseed(100\%) = \frac{Hard\ seeds}{Total\ seed\ put\ for\ germination} \times 100$$

3. RESULTS AND DISCUSSION

The data to find out the best suitable genotype tolerance to preharvest sprouting of mung was recorded and furnished in Table 1, Fig. 1 and Fig.2.

3.1 Morphological Attributes

Plant height: A result of plant height was recorded at 60 days. It was observed that BM-2003-2 (82.37 cm) has recorded highest plant height followed by AKM-0603 (75 cm) and AKM-8802 (73.51 cm). A tall genotype having greater number of long pods, with high pod wall, small beak, epicuticlar wax and hard seed coat are suitable for developing resistance to pre harvest sprouting [1].

Hard Seed (%): Hard seed percentages were highest in genotype AKM-9801 (61.33%), which was followed by AKM-9907 (59.67%), BM-2002-1 (53.33%), and AKM-10-05 (45.67%), all of which were significantly higher than the mean (22.17). Mung beans with hard seeds have an impermeable seed coat composed of suberin layers and absence of pores in the epidermis. Harder-seeded mung bean genotypes survive weathering superior in the field. Rolston [10], Imrie [11], Rao [12], Lwan [13], and Anonomyous [14] discovered similar outcomes.

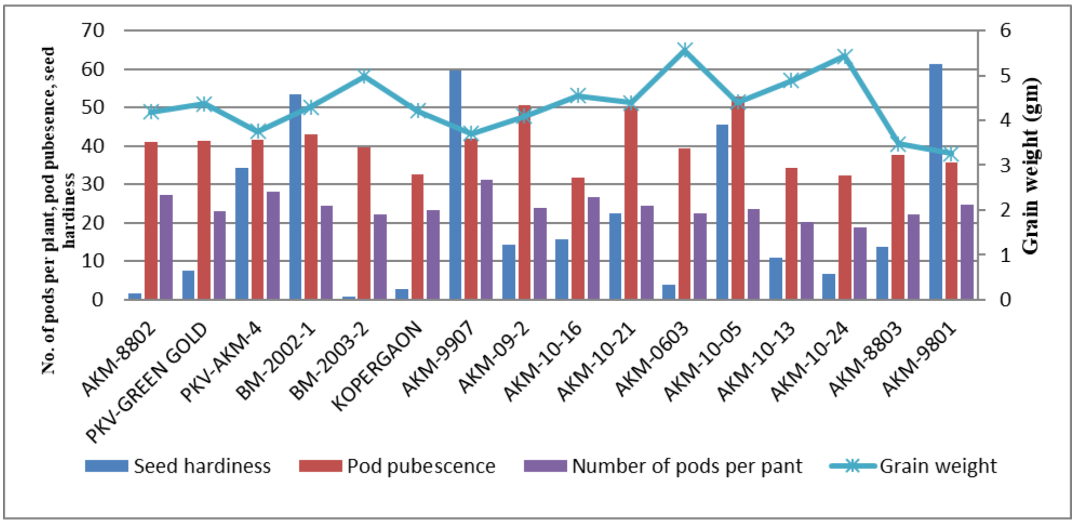

Fig. 1. Data of No. of pod per plant, pod pubesence, seed hardiness and grain weight

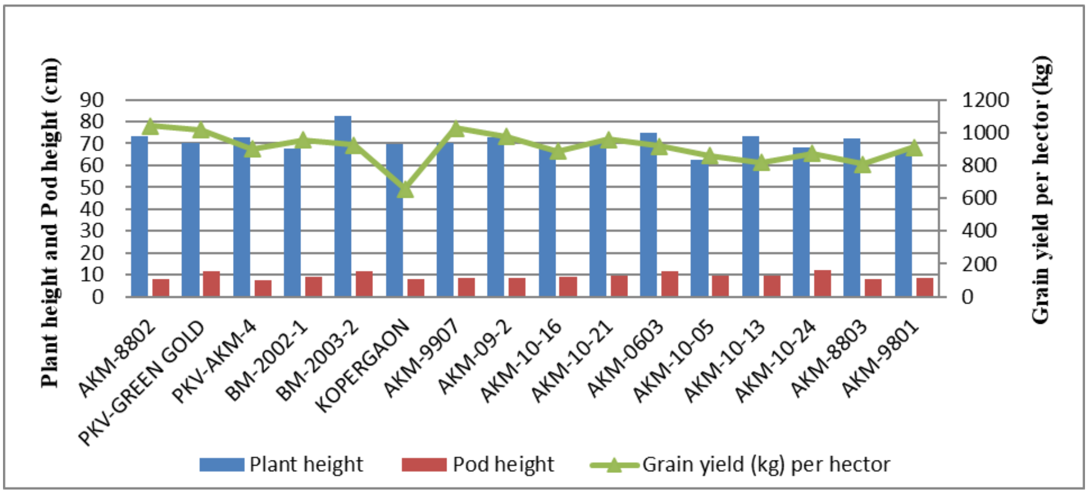

Fig. 2. data of plant height (cm), pod height (cm) and grain yield per hector (kg)

Table 1. Morpho-physiological, yield and yield attributes traits of mungbean genotypes

Genotypes	Plant height	Seed hardiness	Seed Coat Luster	Pod Orientation	Pod Wall thickness	Pod Beak	Pod pubescence	Pod length	Number of pods per pant	Grain weight	Grain yield (kg) per hector
AKM-8802	73.51	1.67	Bright	Down	Thick	Straight	41.00	8.02	27.33	4.19	1042.63
PKV-GREEN GOLD	70.09	7.67	Bright	Down	Thin	Straight	41.33	11.56	23.11	4.37	1015.77
PKV-AKM-4	72.60	34.33	Dull	Down	Thick	Straight	41.67	7.36	28.22	3.75	899.04
BM-2002-1	67.64	53.33	Bright	Down	Thick	Straight	43.00	8.82	24.44	4.29	956.57
BM-2003-2	82.37	0.67	Bright	Down	Thick	Straight	39.67	11.60	22.22	4.98	923.35
KOPERGAON	69.82	2.67	Bright	Down	Thick	Straight	32.67	7.80	23.33	4.21	658.72
AKM-9907	70.10	59.67	Bright	Down	Thick	Curve	42.00	8.62	31.11	3.71	1028.35
AKM-09-2	72.69	14.33	Dull	Down	Thin	Straight	50.67	8.30	23.89	4.09	977.31
AKM-10-16	67.60	15.67	Bright	Down	Thick	Straight	31.67	9.13	26.56	4.55	887.70
AKM-10-21	70.79	22.33	Bright	Down	Thin	Straight	50.33	9.71	24.56	4.39	959.35
AKM-0603	75.00	4.00	Bright	Erect	Thick	Curve	39.33	11.58	22.33	5.56	916.06
AKM-10-05	62.77	45.67	Bright	Down	Thick	Straight	53.00	9.60	23.56	4.40	860.86
AKM-10-13	73.06	11.00	Bright	Down	Thick	Straight	34.33	9.70	20.11	4.89	818.66
AKM-10-24	67.99	6.67	Bright	Down	Thick	Straight	32.33	12.07	18.67	5.43	873.70
AKM-8803	72.50	13.67	Bright	Down	Thick	Straight	37.67	8.17	22.22	3.48	806.33
AKM-9801	66.30	61.33	Bright	Down	Thick	Straight	35.67	8.71	24.78	3.26	910.73
Mean	70.93	22.17					40.40	9.42	24.15	4.35	908.45
SE(m)±	0.29	1.77					1.23	0.38	1.10	0.17	27.14
CD at 5%	0.83	5.11					3.54	1.11	3.17	0.50	78.40

Seed coat Luster: Among 16 genotypes of Mungbean the genotype PKV-AKM-4 and AKM-09-2 were observed dull apperance of seed coat luster and the other 14 genotypes were show bright seed coat luster (Table 1). During the maturity period, dew, high humidity, and rainfall increase atmospheric moisture, this is absorbed by dry pods and seeds, increasing the rate of seed respiration and causing testa to expand. When seeds are dried out in between rainy seasons, the testa contract and go back to their physiologically dormant stages. This causes the testa to discolor and crack, which lowers the seed quality and increases the risk of fungal infection.

Pod orientation: 15 mungbean genotypes were examined, and it was found that most of them had a downward pod orientation while genotype AKM-0603 had an erect pod orientation. With AKM-0603 exhibiting a unique genotype, this observation highlights the existence of genetic diversity within the mungbean population. The difference in pod orientation matters when it comes to crop resistance to weather-related stress, especially when it comes to problems like lodging and pod rot. A thorough comprehension of these morphological differences may help guide genotype selection tactics meant to improve crop resilience and performance in a variety of environmental circumstances.

Pod wall thickness: The thin Pod wall was found in genotype PKV-Green Gold, AKM-09-2 and AKM-10-21. Rest of the genotypes of mungbean show thick Pod Wall. The pod wall functions as a barrier, reducing the amount of moisture available, which is essential for the start of germination. Mungbean pod wall thickness is associated with preharvest sprouting tolerance due to water imbibition hindrance. Similar results were found by Tekrony et al. [15] in soyabean, Satyanarayana et al*.* [16] in mungbean, Anupama et al. [17] in mungbean. However, Cheralu et al*.* [1] on soyabean, regarding Post harvest sprouting, there was a noteworthy inverse relationship between the thickness of the pod wall and its ability to absorb water. Because a thicker wall can hold and absorb more moisture a condition that is ideal for seed germination there is a higher chance that a seed will sprout inside the pod when the wall is thicker.

Pod Beak: The dataset showed that different genotypes had different pod beak phenotypes. For example, AKM-9907 and AKM-0603 had curved pod beaks, whereas other genotypes had straight pod beaks. This finding suggests that the examined germplasm contains genetic variability in the pod morphology. Curved pod beaks are associated with particular genotypes, which may indicate phenotypic responses to environmental cues or selective breeding for desired features. It may be possible to better understand genetic variety and develop breeding plans that will increase agricultural output and adaptation to environmental stresses by looking into these morphological variations in more detail.

Pod length (cm): The Pod length was differed significant in all genotypes. The genotypes AKM-10-24 (12.07 cm) recorded highest pod length followed by BM-2003-2 (11.60 cm) and AKM-0603 (11.60 cm). Significantly lowest pod length was found in to the genotype PKV-AKM-4 (7.36 cm). The all mungbean genotypes shown significant difference in pod length. Similar results were found by Zaid et al*.* [18].

Pod pubescence: The genotype AKM-10-05 (53) were recorded highest pod pubescence followed by AKM-10-21 (50.67), AKM-09-2 (50.67). Significantly lowest pod pubescence found in genotype AKM-10-24 (32.33).

The Mungbean Genotype AKM-10-05 (53) recorded highest Pod pubescence which were associated with less pre-harvest sprouting. Similar result found by Dougherty and Boerma [19] in Soyabean.

3.2 Yield and Yield Attributes

Number of pods per plant: The genotype AKM-9907 (31.11) recorded no. of pods per plant significantly higher than the general mean (24.15). More no. of pods/plant in AKM-9907 resulted into more grain yield in this genotype (1028.35kg/ha).

Grain Weight: The genotype AKM-0603 (5.56 g) recorded significantly higher grain weight than general mean (4.35 g).

Grain Yield (kg) per hectare: The grain yield per hectare was differed significantly in all genotypes. The genotype AKM-8802 (1042.63 kg) recorded highest grain yield (kg) per hectare followed by AKM-9907 (1028.35 kg) and PKV-

Green gold (1015.77) and lowest grain yield was found in AKM-8803.

4. SUMMARY AND CONCLUSION

PHS is an abiotic stress that has been shown to reduce mungbean yield by 60-70%. To reduce the losses due to PHS, the experiment was conducted and it is found that on the basis of morpho-physiological traits viz., high hard seed %, pod pubescence, lower germination in pod and seed, less seed and pod moisture genotype AKM-9801, AKM-9907, BM-2002-1 and AKM-10-05, genotypes were found to be tolerant to preharvest sprouting but seed yield per hectare found efficient in AKM-8802 and AKM-9907. So, it is concluded the AKM-9801, AKM-9907, BM-2002-1 and AKM-10-05 and AKM-8802 are the best suitable genotype to prevent pre harvest sprouting.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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