Physiological Screening of Green gram (*Vigna radiata* L.) varieties by Seedling germination traits Under Drought Stress

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ABSTRACT

Pulses play an important role in Indian diet due to higher protein content. Among the pulses, green gram *(Vigna radiata* L.*)* is one of the leguminous ~~crop~~ crops in India with high nutritional value, short growing period, and soil fertility restoration by biological nitrogen fixation. Drought stress is one of the major constraints for pulse production which negatively ~~affecting~~ affects its growth and production. The present experiment was performed with the objective of studying the seedling germination traits differences in five mung bean genotypes namely, MH421, VBN2, VBN4, CO8, and CO(Gg)912 under a water deficit environment. It was done at laboratory conditions using various concentration of PEG 6000. Using this level of moisture stress, 5 green gram genotypes were screened for their drought stress and the following parameters such as radicle length, shoot length, plant height, germination percentage and seed vigour were recorded.

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Introduction

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Food productivity has emerged as a major concern ~~for~~ worldwide due to the detrimental effects of abiotic as well as biotic factors. This has necessitated the study of stress and ~~minimising~~ minimizing its loss. Among abiotic stresses, drought has been continuously impairing plant growth and imposing a threat to ~~the~~ worldwide food production. Pulses are a part of the daily diet of many vegetarians around the world. Being a short duration crop, it also provides ~~an~~ excellent green fodder for animals. Like other legumes, mung bean fixes atmospheric nitrogen in symbiosis with rhizobium, which not only meets ~~it~~ its own nitrogen need but also benefits the soil fertility[2]. Green gram is rich in protein content. Moong dal is said to be the most enriched in protein, as compared to other dals, it has about 24 grams of protein. Pulses are popularly known as poor man's meat and rich man's vegetable. The total area coverage of green gram is 1, 70,318 hectares with production and productivity of 76,862 tonnes and 451kg/ha respectively. In Namakkal, the total area coverage of green gram 6413 hectares with the total production of pulses is 8116.134 tonnes (Statistical Handbookof Tamil Nadu, 2020).

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The suitable climate for t he cultivation of green gram should be warm humid and within a temperature range of 25^{0}C – 35^{0}C, with ~~a~~ moderate rainfall. Green gram accounts for about 65 and 64% of world acreage and production, among that India is the largest producer and consumer in the world. It thrives well in drought prone areas, it is cultivated in more than 6 million ha in the tropical regions of the world[7]. When compared to other legumes it requires less water for ~~t he~~ crop growth, however, ~~a~~ variability in drought tolerance among the green gram genotype is present. The genotypes which perform better under lower water potential ~~rate~~ rates enable the identification of plant genetic resources suitable for growing under water deficit ~~condition~~conditions [4]. The objective of this investigation is to evaluate the green gram genotypes which can tolerate the moisture stress, so that it can ~~be use~~be used as genetic materials in the crop improvement programme.

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Materials and methods

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Experiment was conducted as petri plate culture with five genotypes in Department of Crop Physiology, PGP College of Agricultural Sciences, Namakkal which is located in the North Western zone of Tamil Nadu during May, 2022. Mung bean seeds of these genotypes such as VBN2, VBN4, CO(Gg)912, and MH421 were obtained from ADA Office, Namakkal, and the latest variety in green gram CO8 ~~were~~ was obtained from the Department of Pulses, Tamil Nadu Agricultural University, Coimbatore. The seeds were treated with Bavistin @2g kg^{-1} of seeds for protection against seed borne diseases. The seeds were sown uniformly in the petri plate. The treatment (T1) was maintained as control. The PEG (6000) were given at the different concentration such as 0%, 5%, 10%, 15%, 18%, 21% as the treatments T1, T2, T3, T4, T5, T6 respectively. Observations were made before the plant reaching the permanent wilting point level which was measured to be by 9th day.

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The physiological parameters and germination traits were recorded under the PEG induced drought stress at the seedling stage. The experiment was laid out in Factorial Completely Randomized Design (CRD). The parameters such as germination percentage, vigour index, radicle length, plumule length, radicle fresh weight, plumule fresh weight, Stress tolerance index were recorded.

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Germination percentage

The number of germinated seeds ~~were~~ was recorded each day (24 hours interval) up to

14 days. Seeds were considered germinated when both plumule and radicle extended to more than 2 mm from the seeds. Germination percentage was calculated using the formula given below.

$$\text{Germination percentage (\%)} = \frac{\text{Number of germinated seeds}}{\text{Number of seeds kept for germination}} \times 100$$

Plant height

Plants were selected randomly in the pots and tagged to measure the height of the plant in each treatment under each replication. The height of the plant was measured from the base of the shoot to the apical portion of the plant and the mean was worked out and expressed in cm.

Shoot length

Seedlings from each replication, were randomly taken and shoot length was measured on 14^{th} day from the collar region to the longest leaf tip and expressed in cm.

Root length

Root length of seedlings were measured on 14^{th}day from the stem base to the Longest root tip of the seedlings and expressed in cm.

The following formulas were used to compute the shoot and root toxicity of the plants which is expressed in terms of percentage,

Shoottoxicity=(shootlengthofcontrol–shootlengthoftreatment/shootlengthofcontrol)X100

Roottoxicity=(rootlengthofcontrol–rootlengthoftreatment/rootlengthofcontrol)X100

Stress Tolerance Index

In order to observe the tolerance capacity of the plants at time of giving stress and at control, the tolerance index of the plants is calculated as follows,

Toleranceindex(100%)=(Meanrootlengthinstress/Meanrootlengthincontrol)X100

Statistical analysis

The collected data on various germination traits, presented with means and standard errors by ANOVA were analysed using SPSS 13.0 (Version 133, LEAD Technologies Inc.) software

Results and Discussion

Scarcity of water is the major ~~constraints~~ constraint that affects agricultural production throughout worldwide ~~which~~ and affecting the quality, growth, and production of crops(1). It is considered to be the leading cause of crops yield losses which decrease yield up to 50% depending on its severity. A standardization experiment was conducted with the green gram varieties VBN 2, VBN 4, MH 421, CO 8, CO(Gg) 912 to determine the stress level at which the green gram collection could be screened. ~~Highest~~ The highest germination percent was observed in VBN 2 (96%) when compared with all other varieties (Fig.1.).

It was noticed that the average plant length of control (T1) seems to be higher than the stress induced T2, T3, T4, T5, T6 heights (Fig.2.). PEG induced drought stress reduced the plant height of all the varieties. The variety VBN 2 recorded lesser reduction of plant height at T3 (10% PEG) with a range of 30% when compared with other varieties.

Seed vigour index was an important parameter for deciding the ability of the seeds to germinate and to emerge in the soil. Seedling vigour index of genotypes such as Co 8, MH 421, VBN 2, VBN 4, CO(Gg)912 at control (T1) are 1947.75, 2416, 2436.75, 2200.5, 1697.5 respectively. Among these, VBN 2 shows the high vigour index of seed. Similar trend was followed in Shoot length and root length (Fig.3,4). In, VBN 2, SVI level was classified as this pattern of T2 > T3 >T4 > T5 > T6. It indicates that the seed germination and seedling emergence are potentially the most critical stages susceptible to water stress[1][2].

Tolerance index (TI) was measured in terms of percentage. Tolerance index was also observed in the plants of control (T1) and stressed (T2 and T 3) plants (Fig.5.). On comparing the tolerance index of five genotypes at various ~~concentration~~ concentrations of inducing stress at 5% and 10% are CO 8 (T2 83.7, T3 74.7), MH 421 (T2 68.8, T3 60.7), VBN 2 (T2 94.9, T3 73.4), VBN 4 (T2 73.7, T3 67.3) and Co(Gg) 912 (T2 82.7, T3 65.8). The above observed values allowed us to conclude that the variety VBN 2 has the ability to tolerate under drought stress.

In, all the five varieties, root toxicity and shoot toxicity was higher in T6 (21% PEG concentration). VBN 2 recorded less toxicity in T3 ~~Peg~~ PEG treatment (Fig.6,7). Similar study ~~w~~were in accordance with{2). By the help of seedling germination traits, potential indicator and adaptative varieties were identified for further development in field ~~condition~~conditions. From

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Recent literatures are lacking

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the present study, it was concluded that, when ~~greengram~~ green gram Variety VBN 2 undergoes water stress, showed significant changes in its physiology attributes for its adaptation..

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Conclusion

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Drought stress is important limiting factor for the productivity of crops. Plant shows series of reaction towards drought conditions that are shown by a range of modifications in the morphology, physiology and biochemical parameters of the plants. However the capability of plants to survive in drought stress condition significantly varies from one variety to another. By screening the varieties the potential indicators can be identified for sustaining the yield.

References **References are not in format. Many references are incomplete.**

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Fig.1. Germination speed of green gram varieties at seedling stage

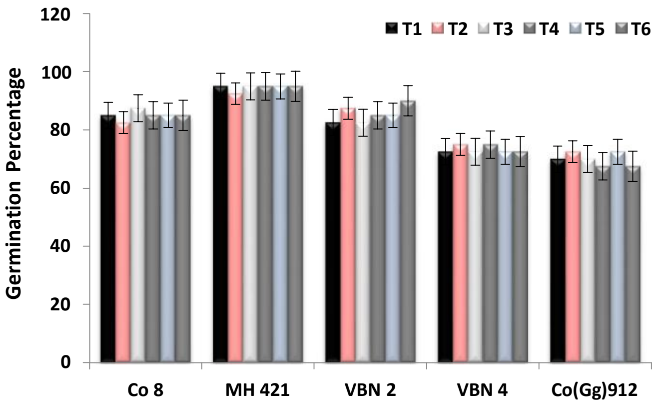

Fig.2. Effect of drought on plant height of green gram varieties at seedling stage

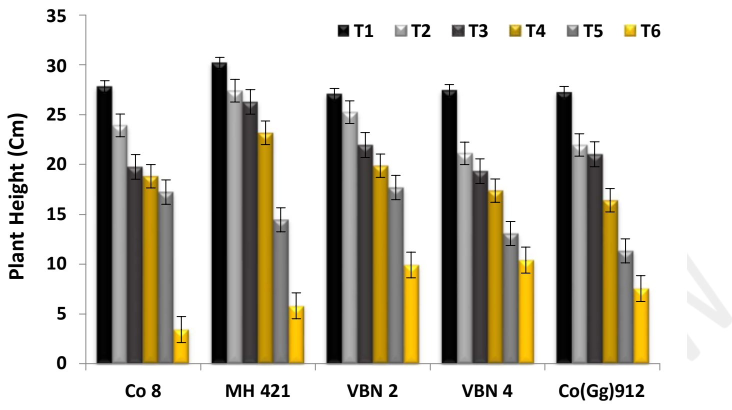

Fig.3. Effect of drought on root length of green gram varieties at seedling stage

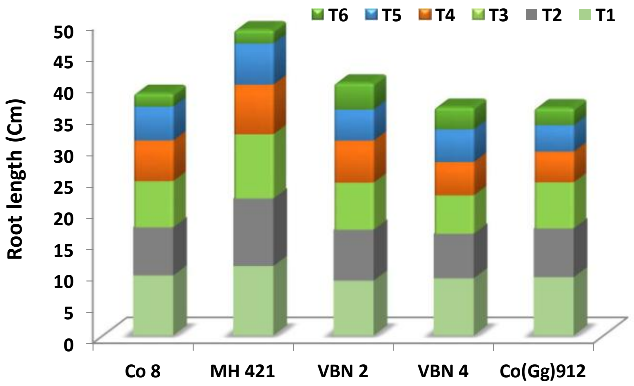

Fig.4. Effect of drought on shoot length of green gram varieties at seedling stage

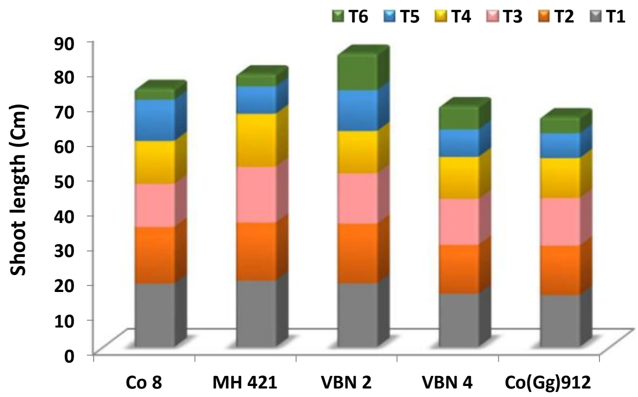

Fig.5. Effect of drought on stress tolerance index of green gram varieties at seedling stage

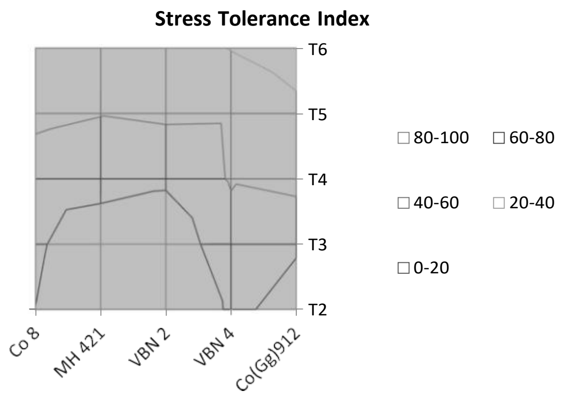

Fig.6. Effect of drought on root toxicity of green gram varieties at seedling stage

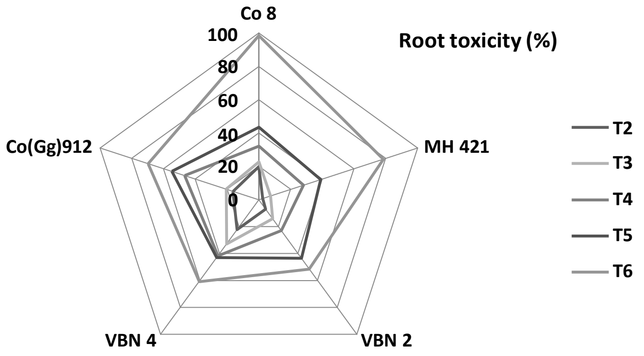

Fig.7. Effect of drought on shoot toxicity of green gram varieties at seedling stage