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Physiology of Yield Determination of Mungbean (*Vigna radiata* L.) Genotypes to Irrigation at Various Growth Stages in Bundelkhand Region, Jhansi, Uttar Pradesh, India

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ABSTRACT

The effect of irrigation at the vegetative and flowering stages and also continuous irrigation conditions on Seed yield, Biological yield, Harvest Index, Protein, Proline and Chlorophyll Content of five mung bean genotypes (WGG-34, K-851, Samrat, SML-668 and T-44) were investigated Experiment was conducted at the Bundelkhand region Jhansi, during summer session 2010 and 2011. The experiment was set up in randomly block design with three replications. Also, results indicated that, the irrigation at vegetative and flowering stages, decreased the Seed yield, Biological yield, Harvest Index while, increased proline content in five mungbean genotypes. Irrigation at the vegetative stage was more effective than irrigation at the flowering stage on Seed yield, Biological yield and Harvest Index, but Protein content in seed was not influenced by irrigation application. The higher value of total chlorophyll content was recorded when crop irrigated at all the stage Cultivar SML-668 was less affected which, getting higher profit from summer green gram by applying irrigation at all the stages, gave higher yield under Jhansi region of Uttar Pradesh.

Key words: *Vigna radiata, Biological yield, Harvest Index, Seed yield*

INTRODUCTION

Pulses are important world food crops, because they are a cheap source of vegetable proteins. In India and many other parts of the world, vegetable proteins are preferred over animal proteins, because of the cultural, religious, economic or even health criteria[5] which make pulses a very important constituent of our diet. For a balanced nutritional requirement, both pulses and cereals are eaten together, because they complement each other very well and that is why '*dal-roti'* is a major and staple food combination of Indian diets[2].

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Among the pulses, mungbean (*Vigna radiata* (L.) Wilczek) is a well-known crop among Asian countries. The dietary or nutritional value of mungbean has been very popular from the ancient times. Saleem *et al.*[12] reported that the seed contains the following components namely total protein (22.88 -24.65 per cent), total amino acid (20.98-25.61 per cent), crude fibre (4.30 - 4.80 per cent) and lipids (1.53 - 2.63 per cent). Like other pulses, the protein of mungbean is rich in lysine, an essential amino acid that is absent in cereal grains. Mungbean is also known for its nutritional and medicinal uses. As the seeds of this plant is highly digestible. Also the roots of this plant are thought to be narcotic, used to relieve bone pain, seeds, raw or boiled used in poultices, the green gram feeding decreases the cholesterol level in blood. It also improves the soil fertility with the help of soil bacterium, *Rhizobium* that lives in the root nodules of this plant[6].

Water is very important in the life of plants. It does not only provide the nutrients in it for plants but also serves as an indicator of their current status and vulnerability under various environmental conditions. However, water is not always present, and with this problem arises the concept of water stress. Water stress in plants is the condition when plants are unable to absorb enough water to replace water lost in transpiration or when there is too much water available in the root of the plant which causes imbalances to the plant life processes. Many people consider a plant to be water stressed if it does not have the enough water it needs for its growth and development, but it also applies when the water is too much for the plant. These conditions bring different effects on the plant.

MATERIAL AND METHODS

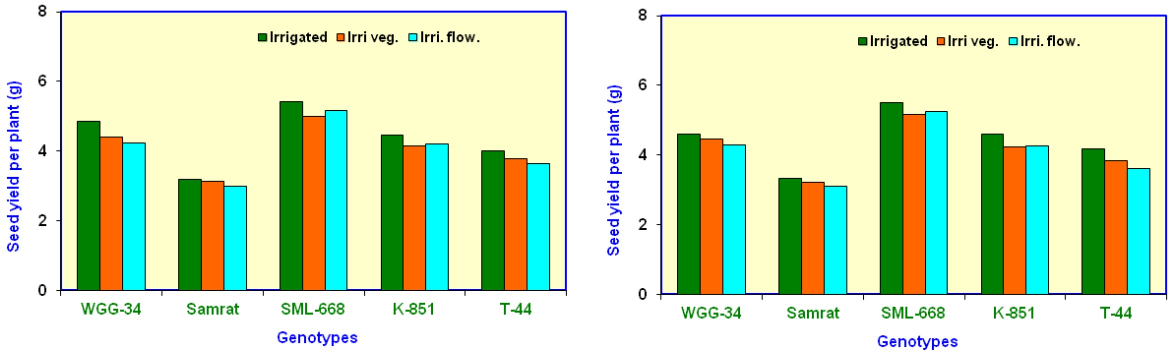
A field experiment was conducted at Bundelkhand region Jhansi, during 2010 and 2011 summer sessions to study the effect of irrigation on five mungbean genotypes. The soil of the experimental field was collected from 0-15 cm depth from the Bundelkhand field. The soil of this region is alkaline in nature, the observed pH was 7.2, Available Phosphorus was 17.7 kg/ha, Potassium was observed 236.9 kg/ha, nitrogen was 116.6 kg/ha. The crop was sown at the rate of 30 kg seed ha^{-1}. The experiment consisted of five mungbean genotypes viz., WGG-34, K-851, Samrat, SML-668 and T-44 and three levels of irrigation viz., continuous irrigation, irrigation at vegetative stage and irrigation at flowering stage. The soil was fertilized @ 25kg urea, 74kg DAP and 50kg P_2O_5 ha^{-1}. The experiment was laid out in a Randomized Block Design (RBD) with three replications. To evaluate the seed yield, biological yield, harvest index, protein, proline and chlorophyll content in leaves observations on individual plant parameters were recorded from randomly selected plants. The average values of all parameters were statistically analyzed to find out the level of significance by applying "Analysis of Variance" (ANOVA) technique suggested by Panse and Sukhatme[11].

RESULTS

Results on seed yield, biological yield, harvest index, protein, proline and chlorophyll content as influenced by irrigation treatments of mungbean genotypes are presented as follows-

Seed Yield (g/plant)

Result indicated that the grain yield was significantly varied among different genotypes in both the years. SML-668 resulted maximum (5.19 and 5.30 g) seed yield per plant and the lowest grain yield (3.11 and 3.21g) was recorded in Samrat during 2010 and 2011, respectively. (Figure 1). The maximum grain yield was recorded under irrigated crop which was significantly higher than single irrigation applied at vegetative or flowering stage in both the years.

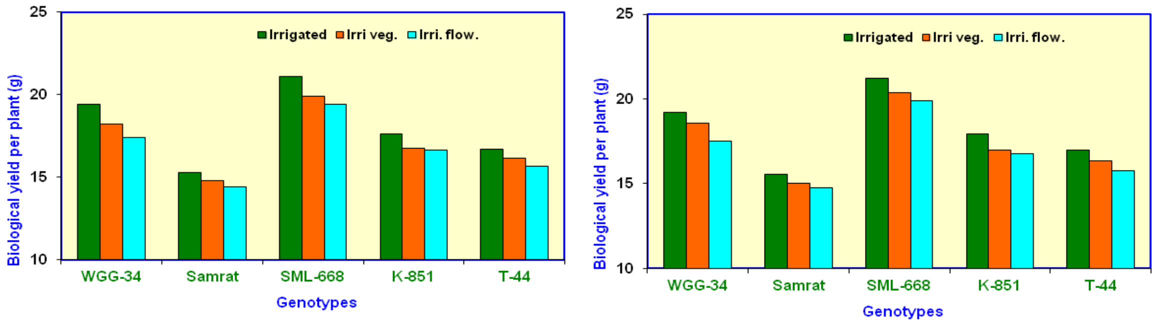


a. 2010-2011 **b. 2011-2012**

Fig. 1: Effect of different irrigation treatments on Seed yield per plant of mungbean genotypes

Biological yield (g/plant)

Results showed that biological yield varied significantly due to various genotypes in both the years. Genotypes SML-668 produced the highest (20.13 and 20.49 g/plant) and minimum biological yield was recorded by Samrat (14.86 and 15.10 g/plant) during 2010 and 2011, respectively. (Figure 2). Continuous application of irrigation produced highest which was significantly higher than other irrigation treatments during both the years.

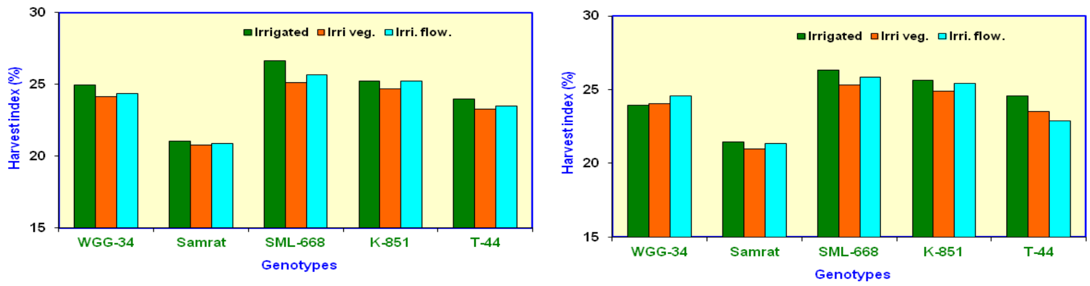


a. 2010-2011 **b. 2011-2012**

Fig. 2: Effect of different irrigation treatments on Biological yield per plant of mungbean genotypes

Harvest index (%)

Results indicated that genotype had significant differences in harvest index during both the years. Genotype SML-668 recorded highest values (25.81 and 25.85) of harvest index whereas, genotype Samrat (20.91 and 21.25) produced minimum harvest index during 2010 and 2011, respectively. (Figure 3). Highest value of harvest index was recorded with continuous irrigation.

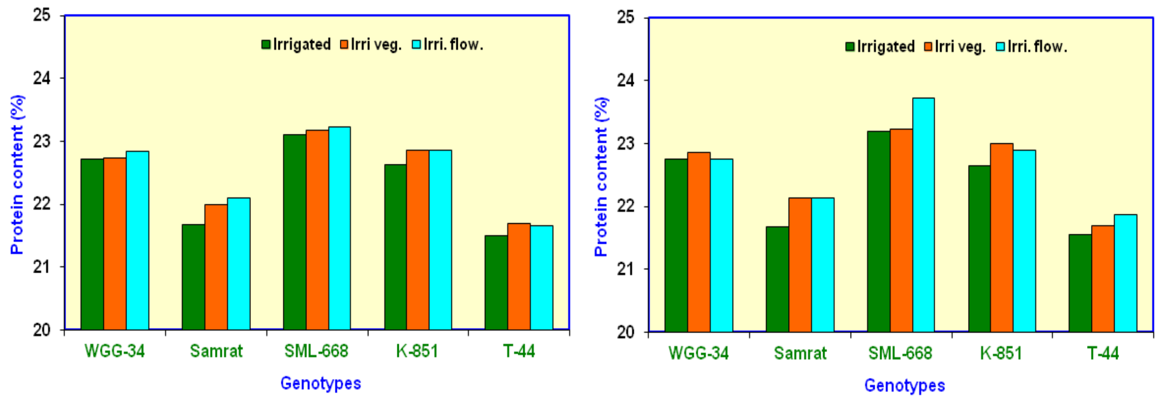


a. 2010-2011 **b. 2011-2012**

Fig. 3: Effect of different irrigation treatments on Harvest index of mungbean genotypes

Protein content (%)

The protein content in seed had significantly influenced by genotypes during both the years. Genotype SML- 668 (23.16 and 23.38 %) recorded significantly higher protein content and T 44 (21.62 and 21.70 %) recorded minimum protein content in both the years. (Figure 4). However, irrigation applied at flowering stage recorded maximum protein content in seed but the difference was not significant in both the years.

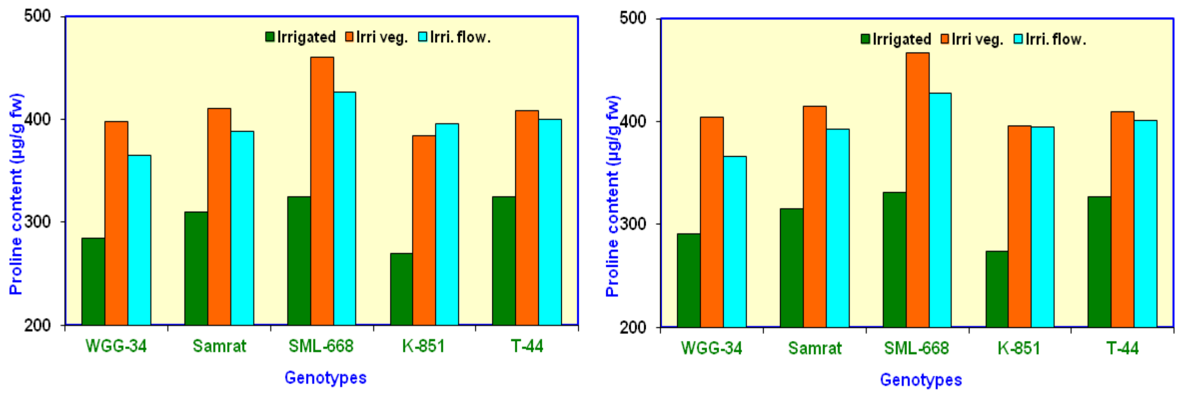


a. 2010-2011 **b. 2011-2012**

Fig. 4: Effect of different irrigation treatments on Protein content of mungbean genotypes

Proline content (µg/fw)

Proline content in leaves was significantly varied among different genotypes in both the years. SML-668 resulted maximum (404.03 and 408.20 µg/fw) proline and the lowest proline content was recorded in WGG-34 (349.13 and 353.77 µg/fw) during 2010 and 2011, respectively. (Figure 5). The maximum proline content was recorded by irrigation received at vegetative plots followed by irrigation given at flowering stage.

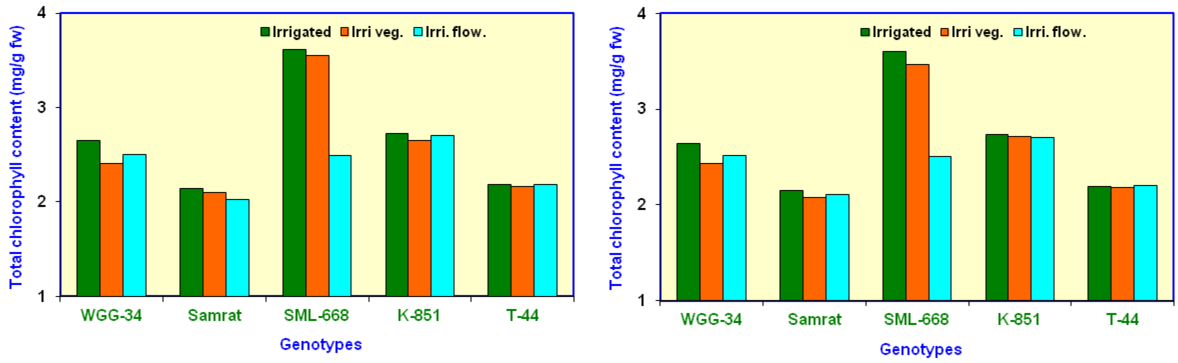


a. 2010-2011 **b. 2011-2012**

Fig. 5: Effect of different irrigation treatments on Proline content of mungbean genotypes

Chlorophyll content (mg/g fw)

Genotype SML-668 produced higher (3.22 and 3.19 mg/g fw) chlorophyll content among the genotypes and genotype Samrat (2.09 and 2.11 mg/g fw) recorded least amount of chlorophyll content in both the years. (Figure 6). Application of Irrigation had significant variation in chlorophyll content and recorded highest chlorophyll content with continuous irrigation.



a. 2010-2011 **b. 2011-2012**

Fig. 6: Effect of different irrigation treatments on Total chlorophyll content of mungbean genotypes

DISCUSSION

Higher yield with SML-668 was obtained due to grain weight and also boldness of grain. The higher seed yield in SML-668 might be attributed due to higher values of yield attributes. Similar results were reported by Singh *et al.*[15], Sheoran *et al.*[13], Kumar *et al.*[7] and Singh and Sekhon[14]. The grain yield of mungbean increased significantly with irrigation (continuous irrigation) over irrigation at flowering and vegetative stage only. The genotype SML-668 also produced higher biological and harvest index as compared with rest of the genotypes. The harvest index is the conversion efficiency of non-grain in to grain position by turning up nutrient uptake and its utilization. Maqsood *et al.*[11], also reported similar result. Water stress decreases the biological yield. Moreover, the biological yield was more affected by the Irrigation applied at flowering stage. Thomas *et al.*[17], Asadyzzaman *et al.*[1], and De costa *et al.*[3], were observed similar results. The content of protein in seed was perceptibility differed probably due to fact that composition of various genotypes is largely genetically controlled. Protein content was higher in SML-668, which is due to higher nitrogen content in seed of this genotype. Sheoran *et al.*[13], recorded higher protein content in SML-668, while Kumar *et al.*[8], did not found any significant differences in protein content among the genotypes. The protein content in seed of mungbean was not improved by different irrigation treatment. Proline content in leaves was significantly varied among different genotypes. SML-668 resulted maximum proline during 2010 and 2011, respectively. Proline content increased with increased stress in the plants. The maximum proline content was noticed under irrigation received at vegetative stage while, minimum proline content was noted in irrigated crop. Maiti *et al.*[9], reported that increased proline accumulation is a mechanism for plant adaptation to abiotic stress as it protect cells from damage resulted by stress[4]. The limited irrigation to crop significantly decreased the total chlorophyll in the leaves of mungbean plants in all the genotypes. Continuous application of irrigation recorded higher total chlorophyll content in SML-668. Decrease in chlorophyll content in the leaves of plant may be attributed to high rate of degradation of chlorophyll more than its biosynthesis under water stress[18]. Thaloot *et al.*[16], also observed that drought stress at any growth stage decreased the chlorophyll a and b and carotenoid in leaves of mung bean plants. They also observed drought induced decrease in Chlorophyll a and b and carotenoids in mung bean.

CONCLUSION

Results of the present experiment indicated that, mung bean is the most sensitive to irrigation system. Irrigation at the vegetative stage or at flowering stage reduces the Seed yield, Biological yield and Harvest Index.

Protein content was not influenced by irrigation application. Proline content was maximum under irrigation applied at vegetative stage only and Chlorophyll Content was adversely affected which ultimately reduced. Cultivar SML-668 showed that, it is adaptability more than other genotype under the different irrigation conditions. Thus, Bundelkhand regions of Jhansi can be cultivated SML-668. In addition, for improvement in the yield of mung bean, major emphasis should be placed on the Seed yield, Biological yield and Harvest Index.

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