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Research Article

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Morpho-Physiological Studies on Response of Blackgram (*Vigna mungo* L.) Under Soil Water Deficit Amended with Hydrogel

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ABSTRACT

An experiment was conducted in the Glass house of the Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore during Rabi, 2018 in pot culture to investigate the "Morpho-physiological Studies on response of Blackgram (Vigna mungo L.) under soil Water Deficit amended with Hydrogel". The experimental design was completely randomized design with eight treatments and three replications. The result revealed that significant increase in plant height, number of branches, leaf area, number of pods per plant, number of seeds per pod and seed yield per plant with application of hydrogel (cross linked polyacrylic acid homopolymer) of 0.6g per kg soil when compared to control under 50% field capacity. All morphological and yield characters increased significantly with increase in hydrogel concentration of 0.6g per kg of soil in comparison with control under 50% field capacity.

Key words: *Morphological characters, Blackgram, Hydrogel, Moisture stress.*

INTRODUCTION

Black gram is a summer crop grown for its nutritive protein rich seed. Water stress is a major abiotic stress on black gram. Therefore, understanding crop response to this stress is the basis for regulating crops appropriately and achieving agricultural water savings. There are significant differences in the tolerance of plants to drought stress depending upon intensity and duration of stress, plant species and the stage of development[10].

Water stress is connected with almost all aspects of biology and plant growth It should pointed out that drought is one of the major causes of crop loss worldwide, which commonly reduces average yield for many crop plants by more than 50 percent[9]. Black gram (*Vigna mungo*) is a leguminous crop and occupied fourth position in the entire pulse crop both in acreage and production, water stress is a major abiotic stress on black gram[5].

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One of the means to increase the water content in this soil is the use of super absorbent synthetic polymers (hydrogel) as soil conditioners, which increase water retention in root zones region of the soil. These super absorbent polymers or hydrogels are compound that absorb water and swell into many times of their original size and weight and are used in soil to create a water reserve near the rhizosphere zone (roots) and benefit agriculture[6,12]. The hydrogel polymers lead to increased water use efficiency since water that would have otherwise leached beyond the root zone is captured. When these polymers are incorporated into the soil, it is presumed that they retain large quantities of water and nutrients, which are released as required by the plant[2].

Thus the present investigation aimed at studying the efficacy of hydrogel on morpho-physiological response of blackgram under water deficit condition.

MATERIAL AND METHODS

The pot culture experiment was conducted in the Glass house of the Department of Crop Physiology, Tamil Nadu Agricultural University, Coimbatore during *Rabi*, 2018. The soil used in the pot culture experiment was sandy clay loam in texture, with slightly alkaline in reaction (pH 7.43) and EC were 0.25 dSm^{-1}. It was fertile, being medium in available organic carbon (0.52%), high in available nitrogen (529 kg ha^{-1}), medium in available phosphorus (42.61 kg ha^{-1}) and high in available potassium (369 kg ha^{-1}). The experiment was laid out in completely randomized design with 8 treatments, replicated thrice. The treatments included are;

T_1- Absolute control (100 % FC)
T_2- control (50 % FC)
T_3- 0.1 g of hydrogel kg^{-1} of soil (50 % FC)
T_4- 0.2 g of hydrogel kg^{-1} of soil (50 % FC)
T_5- 0.3 g of hydrogel kg^{-1} of soil (50 % FC)
T_6- 0.4 g of hydrogel kg^{-1} of soil (50 % FC)
T_7- 0.5 g of hydrogel kg^{-1} of soil (50 % FC)
T_8- 0.6 g of hydrogel kg^{-1} of soil (50 % FC)

Treatments T_1 and T_2 have no hydrogel and treatments from T_2 to T_8 were maintained at 50% field capacity by weighing method. The hydrogel used in this study was (cross linked polyacrylic acid homopolymer). Blackgram var. CO 6 seeds were collected from the Department of Pulses, Tamil Nadu Agricultural University, Coimbatore. The duration of the blackgram var. CO 6 variety is 60 – 65 days. As blackgram is a direct sown crop, the seeds were sown in the pot and crop was applied with recommended dose of fertilizers (25 kg N + 50 kg P2O5 + 25 kg K2O ha^{-1}) and other cultivation operations including plant protection measures. Changes in various plant morphological characters like plant height, number of branches, leaf area and leaf area index were recorded at 30 DAS and 55 DAS. Leaf area was recorded by using laser leaf area meter (CI-203, USA).

Yield and yield attributing parameters

On maturity pods were harvested and various yield and yield attributing parameters like number of pod per plant, number of seeds per pod, and finally the weight of seeds per plant were recorded.

Data were analysed using the software SPSS 16, and the comparison of means was done at the 5% significance level, by Duncan's multiple range test.

RESULT AND DISCUSSION

Effect of drought on plant height amended with hydrogel

Plant height was recorded for each treatment at 30 DAS and 55 DAS (Fig. 2). Drought stress has been found to decline the linear growth of shoots in treatment T_2 (23.00 cm and 31.2 cm) with no hydrogel at both stages as compared with other treatments incorporated with hydrogel. Treatment T_8 (41.33 cm and 50.5 cm) recorded highest plant height at both stages and followed by T_7, T_6, T_5 and T_1. Under drought stress, declination in plant growth in terms of height is due to the loss of cell turgor which greatly suppresses cell expansion and cell growth thereby inhibiting the linear growth of shoot. Hence it can be inferred that the slow decline in plant height might be due to lack of adequate moisture (Fig.1) in plant root zone. The reduction in plant height is generally associated with a decline in the cell enlargement under water deficit which is greatly hampered due to low moisture[3].

Effect of drought on number of branches amended with hydrogel

Significantly highest number of branches were observed in T_8 (5 no's) at 30 DAS (Fig. 2) which was on par with T_1 which is absolute control with no water deficit and followed by T_7, T_6, and T_5 but at 55DAS the treatment T_1 (7.33 no's) showed highest number of branches which was closely followed by T_8 (6.67 no's) then followed by T_7, T_6, and T_5. Treatment T_2 (2 and 3.33) showed (Fig. 2) lowest number of branches at both the stages and this shows direct effect drought on number of branches which has no hydrogel incorporated.

Effect of drought on leaf area amended with hydrogel

The leaf area from all treatments varied from 190 to 290 cm^2 at 30 DAS and 402 to 753 cm^2 at 55 DAS. Significantly highest leaf area was noticed (Fig. 3) in treatment T_1 (291.43 and 753.42 cm^2) at both the stages and it was closely followed by the treatment T_8 (285.36 and 722.04 cm^2) and lowest leaf area was observed in treatment T_2 (192.71 and 402.95 cm^2) (Fig. 3) which is control and has no hydrogel. The reduced leaf area observed in the stressed plants in the present study is primarily from a mitotic sensitivity to water stress[11]. Under water deficit conditions, plants first show reduction in cell division resulting in reduced cell number and stop cell elongation inhibiting leaf expansion. This modification in leaf anatomy is one of the basic causes which lead to a reduction in average leaf size under water limiting situation[1].

Effect of drought on yield parameters amended with hydrogel

Pod numbers for all treatments were recorded and highest pod number was obtained in treatment T_1 (22 no's) which is absolute control but in drought imposed treatments T_8 (19.7) obtained highest number of pods followed by T_7, T_6, and T_5. The lowest pods number was obtained in the drought imposed treatment T_2 (10.7) (table 1) with no hydrogel. The reduced soil moisture caused a general reduction in pod number in all drought imposed treatments but the hydrogel application showed improved pod number when compared control with no hydrogel. From the analysis of variance (ANOVA) it was observed that the treatment has a significant impact on number of pods. Drought stress during pre-anthesis stage for 21 days greatly reduced the grain yield of pulses. A large decline in leaf area under water stress is disadvantageous for crop yield as it leads to reduced nutrient uptake[4].

Number of seeds per pod was observed highest in treatment T_1 (7 no's) (table 1) which is absolute control but in the stress imposed treatments T8 (6.33) showed highest number of seeds per pod which is followed by T_7. The treatments T_6 and T_5 was on par with each other and lowest was observed in treatment T_2 (4.67 no's) with no hydrogel

Seed yield per plant was recorded highest in the treatment T_1 (5.32 g) which is absolute control but in the stress imposed treatments T_8 (4.46 g) showed highest seed yield per plant (table 1) and it was followed by T_7, T_6, and T_5 and lowest seed yield was obtained in treatment T_2 (1.80 g) with no hydrogel. The yields of the crop in the non-stress environment clearly out yielded in the stress environment (Table 1).

Most of the study reveals that drought stress greatly reduces the yield, which is dependent on the level of defoliation due to the water stress during early reproductive growth[8]. Reduced photosynthesis and decreased translocation of assimilates to the grain during drought result in lower grain weight and produce more empty grains[7].

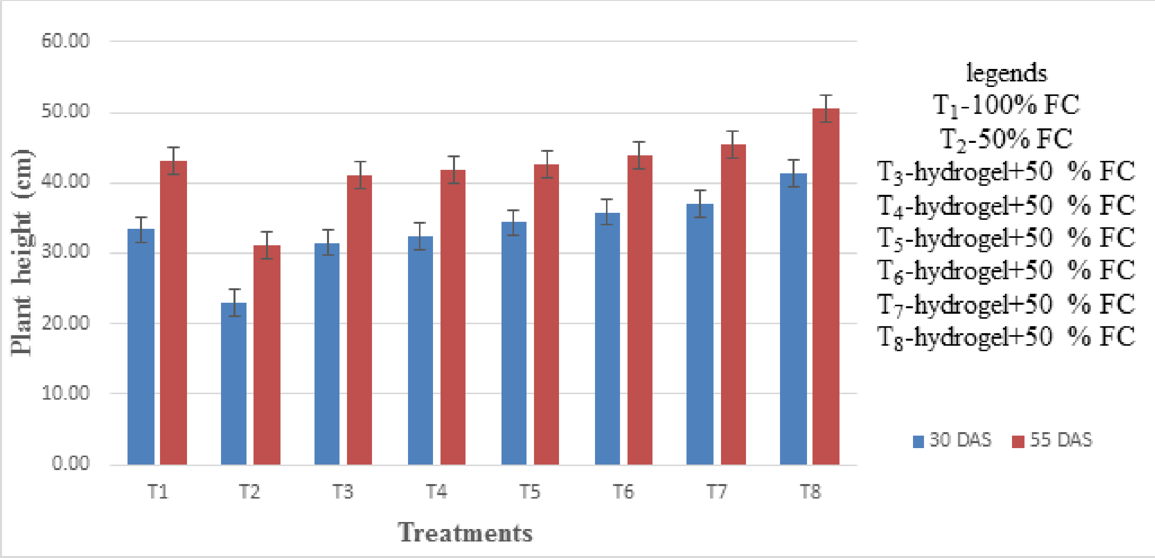

Fig. 1: Effect of drought on plant height amended with hydrogel

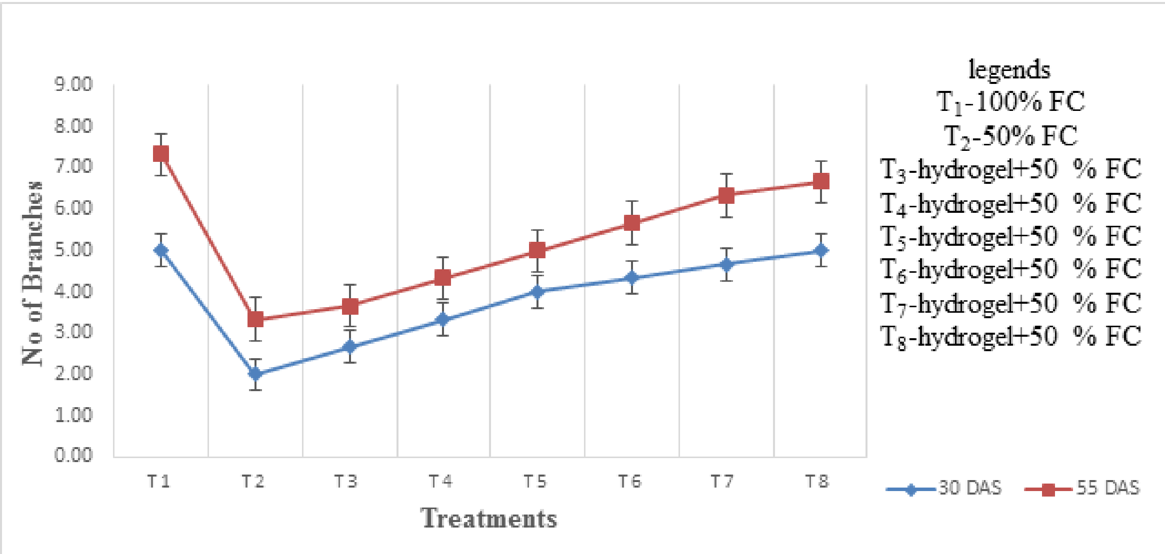

Fig. 2: Effect of drought on number of branches amended with hydrogel

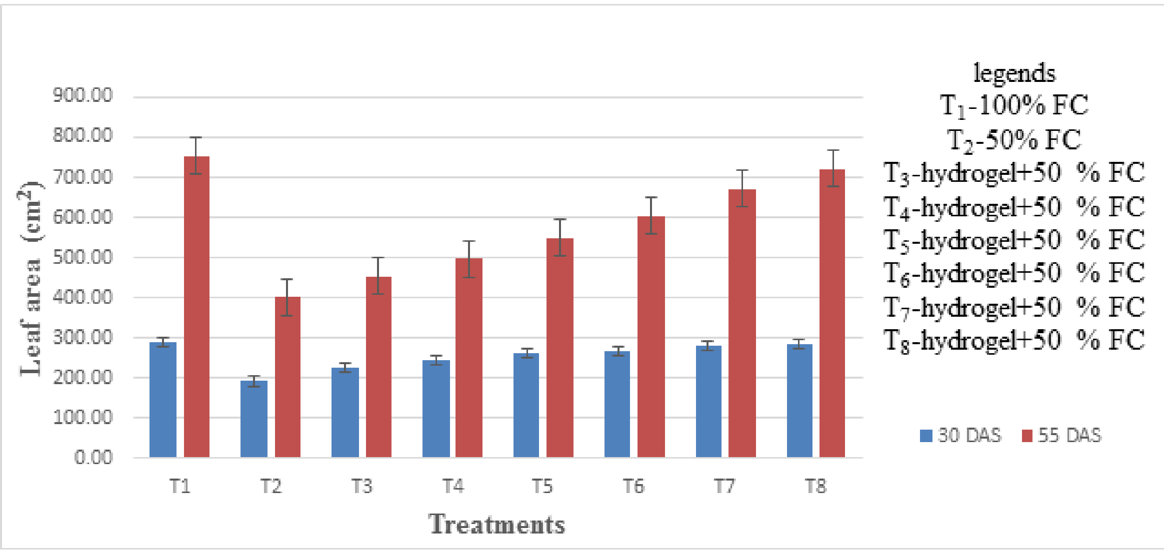

Fig. 3: Effect of drought on leaf area amended with hydrogel

Table 1: Effect of drought stress on yield parameters amended with hydrogel

Treatments	Number of pods per plant (no's)	Number of seeds per pod (no's)	Seed yield per plant (g)
T_1: Absolute control (100 % FC)	22.00	7.00	5.32
T_2: control (50 % FC)	10.67	4.67	1.80
T_3: 0.1 g of hydrogel kg^{-1} of soil (50 % FC)	14.67	5.00	2.56
T_4: 0.2 g of hydrogel kg^{-1} of soil (50 % FC)	16.33	5.33	3.14
T_5: 0.3 g of hydrogel kg^{-1} of soil (50 % FC)	17.33	5.67	3.67
T_6: 0.4 g of hydrogel kg^{-1} of soil (50 % FC)	18.67	5.67	3.81
T_7: 0.5 g of hydrogel kg^{-1} of soil (50 % FC)	19.00	6.00	4.10
T_8: 0.6 g of hydrogel kg^{-1} of soil (50 % FC)	19.67	6.33	4.46
Mean	17.29	5.71	3.61
SEd	0.645	0.373	0.211
CD (P=0.05)	1.368	0.790	0.446

CONCLUSION

In the present experiment, it has been observed that the effectiveness of basal application of hydrogel was studied separately on the growth, physiological and biochemical parameters of black gram under water stress and found that hydrogel helped to overcome the effect of drought stress on black gram.

REFERENCES

1. Baroowa, B., Gogoi, N., Effect of induced drought on different growth and biochemical attributes of black gram (*Vigna mungo* L.) and green gram (*Vigna radiate* L.), *J. Env. Res. Develop.*, **6:** 584-593 (2012).
2. Bhardwaj, A. K., Shainberg, I., Goldstein, D., Warrington, D. N. and Levy, G. J., Water retention and hydraulic conductivity of cross-linked polyacrylamides in sandy soils, *Soil. Sci. Soc. Ame. J.*, **71:** 406-412 (2007).
3. Bhatt, R. M., Srinivasa Rao, N. K., Influence of pod load response of okra to water stress, *Ind. J. Pl. Phy.*, **10:** 54-59 (2005).
4. Cabuslay, G. S., Ito, O., Alejar, A. A., Physiological evaluation of responses of rice (*Oryza sativa* L.) to water deficit, *Pl. Sci.*, **163:** 815-827 (2002).
5. Deepalakshmi, A. J., Anandakumar, C. R., Creation of genetic variatiability for different polygenic traits in black gram (*Vigna mungo* L.) through induced mutagenesis, *Leg. Res.*, **27:** 188-192 (2004).
6. Han, Y. G., Yang, P. L., Luo, Y. P., Ren, S. M., Zhang, L. X., and Xu, L., Porosity change model for watered super absorbent polymer-treated soil, *Env. Ea. Sci.*, **61:** 1197-1205 (2010).
7. Liu, K., Ye, Y., Tang, C., Wang, Z., Yang, J., Responses of ethylene and ACC in rice grains to soil moisture and their relations to grain filling, *Fron. Agri. China.*, **2(2):** 172-180 (2008).
8. Monneveux, P., Sanchez, C., Beck, D., Edmeades, G. O., Drought tolerance improvement in tropical maize source populations: evidence of progress, *Cr. Sci.*, **46:** 180-191 (2006).
9. Shao, H. B., Liang, Z. S., Shao M. A., Changes of anti-oxidative enzymes and MDA content under soil water deficits among 10 wheat (*Triticum aestivum* L.) genotypes at maturation stage, *Colloids. Surf. B. Bioint.*, **45:** 7-13 (2005).
10. Singh, S., Gupta, A. K., Kaur, N., Differential responses of antioxidative defence system to long-term field drought in wheat (*Triticum aestivum* L.) genotypes differing in drought tolerance, *J. Agr. Cr. Sci.*, **198(3):** 185-195 (2012).
11. Wullschleger, S. D., Yin, T. M., DiFazio, S. P., Tschaplinski, T. J., Gunter, L. E., Davis, M. F., Tuskan, G. A., Phenotypic variation in growth and biomass distribution for two advance dgeneration pedigrees of hybrid poplar, *Can. J. For. Res.*, **35:** 1779-1789 (2005).
12. Zohuriaan-Mehr, M. J. and Kabir, K., Super absorbent polymer materials: a review, *Ira. Poly J.*, **17:** 451-477 (2008).