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HIGH SOIL MOISTURE AT FLOWERING STAGE OF BORO RICE VARIETIES REDUCES HIGH TEMPERATURE EFFECT

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ABSTRACT

Islam MT (2021) High soil moisture at flowering stage of boro rice varieties reduces high temperature effect. *Int. J. Expt. Agric*. 11(2), 11-14.

Global climate change is making high temperatures a critical factor for plant growth and productivity. The flowering stage of rice is critical for high temperatures. Maintaining proper soil moisture level at this stage is very important to reduce yield loss. An experiment was carried out at BINA, Mymensingh, Bangladesh during December 2019 to May 2020 with three boro rice varieties. The objective of the study was to estimate proper soil moisture level at flowering stage to reduce high temperature effect. So, Binadhan-5, Binadhan-10 and Binadhan-14 were grown in pots each of 8 kg soil in ambient temperature and those were kept at 38°C at flowering stage for 24 hours under different soil moisture levels (80% FC, 100% FC and 2 inches standing water) in plant growth chamber. Then all the plants were again continued to maturity under sufficient soil moisture in ambient condition. The experiment was conducted in CRD with three replications. Data on photosynthetic parameters, yield and yield attributes were recorded. The results revealed that under high temperature photosynthesis, transpiration rate and yield significantly decreased but water use efficiency increased at 80% FC. Transpiration rate maintained T leaf of 33-34°C during T air of 38°C. Binadhan-5 and Binadhan-10 maintained lower leaf temperature than Binadhan-14. Better yield was found in 100% FC and standing water of 2 inches compared to 80% FC. So, maintain 100% FC or standing water of 2 inches at flowering stage of rice can reduce high temperature effect.

Key words: *high temperature, high soil moisture, photosynthesis, water use efficiency, rice*

INTRODUCTION

Changing climate rises air temperature due to increasing concentration of CO_2 and other atmospheric greenhouse gases. The rise in atmospheric temperature causes detrimental effects on growth, yield, and quality of the crop varieties by affecting their phenology, physiology, and yield components. Climate model predicts 33% rice yield decrease in 2100 (Karim *et al*. 2012). Boro rice is transplanted in January-February and usually faces high temperature (36-39°C) at its reproductive stage in April-May. Flowering stage of rice is very critical for high temperature. High temperature may cause drying of pollen and stigma and ceasing pollen tube development for fertilization. As a result, unfilled grains are produced. Rice grain dry weight increased from fertilization to 18-21 days and water stress decreased the rate of accumulation and finally produced decreased grain weight under water stress (Moonmoon *et al*. 2020a; Hafiz *et al*. 2015; Islam 2010; Islam and Gretzmacher, 2001). The yield of rice is an integrated result of various processes including canopy photosynthesis, conversion of assimilates to biomass, and partitioning of assimilates to grains (Jeng *et al*. 2006). Drought stress affects plant growth and development, and ultimately reduces grain yield of rice (Moonmoon *et al*. 2020b; Moonmoon *et al*. 2017; Islam *et al*. 2005a; Zohora *et al*. 2016; Islam *et al*. 1994b). The response of rice yield to drought varies with growth stage being most sensitive at booting followed by flowering and or grain filling stage (Islam *et al*. 1994a). The early reproductive growth period, encompassing tetrad-formation stage of miosis (i.e., about 10-15 d prior to heading), was found to be the most sensitive and critical to water deficit resulting in up to 59% grain sterility that caused similar magnitude of yield reduction. As the grain formation progressed further, the early period of grain-filling was found to be more vulnerable to water stress than the late-milk stages (Singh *et al*. 2010). For stress condition, reproductive stages are critical than vegetative stages and booting to early grain filling stages are more critical (Islam *et al*. 2005b; Moonmoon and Islam, 2017; Rahman *et al*. 2002). So, the experiment was conducted to estimate proper soil moisture level at flowering stage of boro rice varieties to reduce high temperature effect.

MATERIALS AND METHODS

The experiment was conducted at the pot yard of the Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh, Bangladesh. The experimental site falls under the AEZ (Agro-Ecological-Zone)-9 (Old Brahmaputtra Floodplain) of Bangladesh and situated at latitude 24.75°N and longitude of 90.50°E. The soils of the experiment were collected from the field of BINA Farm. The top soil was non-calcareous DarkGrey Floodplain with loamy texture belonging to the AEZ Old Brahmaputtra Floodplain. The collected soil was pulverized, inert materials, visible insect pest and plant propagules were removed. Pots are filled with top soils. The soil moisture stresses were calculated based on field capacity (FC). Gravimetric Method determined FC. Each pot contained 8 kg soil. All soils pots were fertilized with urea, TSP, MP and gypsum @ 2.05, 0.47, 0.75 and 0.47 g pot^{-1}, respectively. All TSP, MP, Gypsum and one-third of the urea were applied as basal dose. The remaining two-thirds of the urea were applied in two equal splits in each pot at 25 and 45 days after transplanting (DAT). One seedling was transplanted in a puddle pot. For gap filling there were extra seedlings preserved. All necessary intercultural operations, mainly weeding, and irrigation was done as and when necessary. The pot experiment was conducted with Binadhan-5, Binadhan-10 and Binadhan-14. The experiment was set in a two factorial CRD with three replications during December 2019-May 2020. The first factor was rice genotypes and the second factor was irrigations: 80% FC, 100% FC and standing water of 2 inches in pot soil. Plants are grown in ambient temperature and during flowering stage those were kept in plant growth chamber at 38^{0}C for 24 hrs under different soil moisture levels (80% FC, 100% FC and standing water of 2 inches). Then all the plants were allowed to complete the maturity in ambient temperature. Data on photosynthesis, transpiration, water use efficiency (WUE), leaf temperature and grain yield were recorded. Data were analyzed statistically.

RESULTS AND DISCUSSION

The results revealed that under high temperature photosynthesis, transpiration rate and yield significantly decreased but water use efficiency at 80% FC (Fig. A, Fig B, Fig. C and Fig. D). Transpiration rate maintained T leaf of 33-35°C during T air of 38°C. Binadhan-5 and Binadhan-10 maintained lower leaf temperature (Fig. E). The results agree with many researchers (Islam 2021; Moonmoon *et al*. 2020b; Moonmoon *et al*. 2020c; Hazra *et al*. 2016; Islam 2013; Islam *et al*. 2012; Islam 2011; Islam *et al*. 2005c and Islam 2001). Better yield was found in 100% FC and standing water of 2 inches compared to 80% FC. So, maintain 100% FC or standing water of 2 inches at flowering stage of rice can reduce high temperature effect.

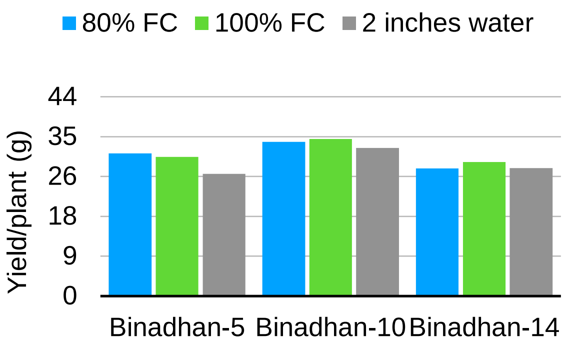

Fig. A

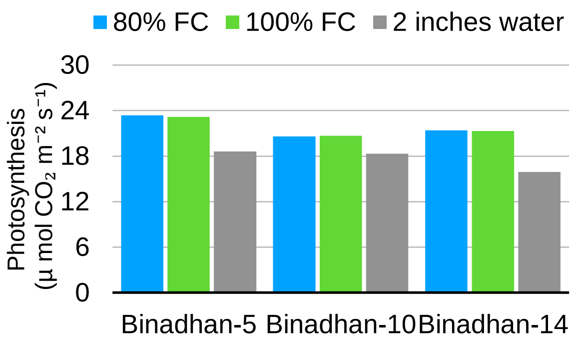

Fig. B

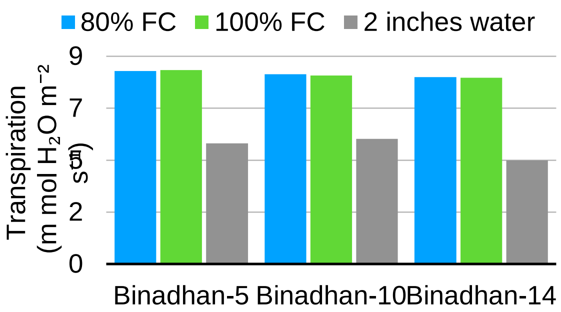

Fig. C

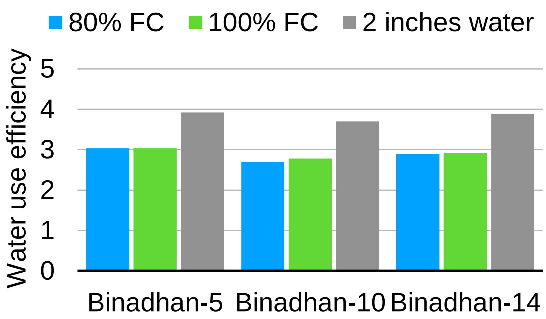

Fig. D

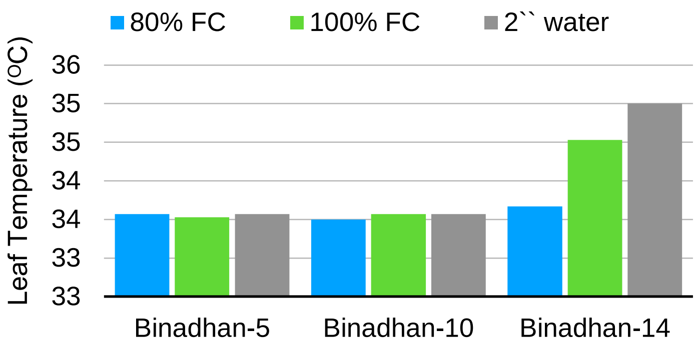

Fig. E

Figures show yield (Fig. A), photosynthetic rate (Fig. B), transpiration rate (Fig. C), water use efficiency (Fig. D) and leaf temperature (Fig. E) of 3 rice varieties under 3 soil moisture level.

CONCLUSION

Maintain soil moisture at 100% field capacity level or standing water of 2 inches can reduce the high-temperature effect of boro rice varieties at the flowering stage.

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