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EFFECT OF HIGH TEMPERATURE AT DIFFERENT GROWTH STAGES OF SHORT DURATION AMAN RICE VARIETIES

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ABSTRACT

Islam MT (2022) Effect of high temperature at different growth stages of short duration aman rice varieties. *Int. J. Sustain. Crop Prod.* 17(2), 16-19.

Temperature is one of the most important environmental factors influencing crop growth, development and yield processes. Temperature is becoming the major concern for plant scientists worldwide due to the changing climate. Three short duration Aman rice varieties (Binadhan-17, Binadhan-19 and Binadhan-22) were evaluated under high temperature (36^0C) at booting and flowering stages for 3 days along with ambient temperature. Panicle length, number of filled grain panicle^{-1} and 1000-grain were similarly affected by high temperature at booting and flowering stage. High temperature (36^0C) at flowering stage produced the highest number of unfilled grain panicle^{-1}. Yield was significantly decreased with high temperature at flowering followed by booting stage. However, high temperature at flowering stage was found more detrimental. Binadhan-19 reduced less yield in high temperature compared to other varieties.

Key words: *high temperature, aman rice, short duration, booting, flowering, yield*

INTRODUCTION

Temperature is one of the most important environmental factors influencing crop growth, development, and yield processes. Temperature is becoming the major concern for plant scientists worldwide due to the changing climate. Global climate change is making high temperature a critical factor for plant growth and productivity. It is now considered to be one of the major abiotic stresses for restricting crop production, which has a favorable and in some cases unfavorable influence on the development, growth and yield of rice. Rice being a tropical and sub-tropical plant requires a fairly high temperature, ranging from 20°C to 40°C. Rice cultivation is conditioned by temperature parameters at the different phases of growth. Climate model predicts 33% rice yield decrease in 2100 (Karim *et al*. 2012). Grain filling is the final stage of growth in cereals where fertilized ovaries develop into caryopses. Grain filling in cereals depends on carbon from two sources: current assimilates transferred directly to the grain and assimilates redistributed from reserve pools in vegetative tissues either priorpost-anthesis (Schnyder 1993). Rice grain dry weight increased from fertilization to 18-24 days (Moonmoon *et al*. 2020a; Hafiz *et al*. 2015; Islam 2010; Islam *et al*. 2005b; 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). High temperature and drought stress affects growth and yield of rice (Islam 2021; Islam and Khatoon, 2019; Moonmoon *et al*. 2017; Islam *et al*. 2012; Islam *et al*. 2005c; Islam 2001). In Bangladesh, Boro rice often suffers with high temperature during its reproductive stages in April-May and Aman rice occasionally in September-October. Aman rice is rain fed cultivated during June-December. It passes through vegetative stage during August to September when rainfall is usually sufficient. The crop suffers from moisture stress when the rainfall usually ceases by the first week of October in Bangladesh. By this time, it passes through reproductive. The total rainfall in these two months is very irregular and often inadequate which fails to meet the evapotranspirational demand of Aman rice consequently develops water stress and affects translocation of assimilates and grain development in rice (Moonmoon *et al*. 2020c; Rahman *et al*. 2002). Drought stress affects plant growth and development, and ultimately reduces grain yield of rice (Moonmoon *et al*. 2020b; Moonmoon and Islam, 2017; Zohora *et al*. 2016; Islam *et al*. 2005a; Islam *et al*. 1994a; Islam *et al*. 1994b). The response of rice yield to drought varies with growth stagebeing most sensitive atbooting 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 themost 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). With all those factors above in mind, this study was carried out to assess the effect of high temperature at PI, booting and flowering stage of rice genotypes.

MATERIALS AND METHODS

The experiment was conducted at the pot yard and plant growth chamber of the Bangladesh Institute of Nuclear Agriculture (BINA), Mymensingh, Bangladesh. The soils of the experiment were collected from the field of BINA Farm. The collected soil was pulverized, inert materials, visible insect pest and plant propagules were removed. Pots were filled with top soils. The pot was 25 cm deep with 27 cm diameter at the top.

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The pots were placed at the pot yard of Crop Physiology Division, BINA, Mymensingh. Each pot contained 12 kg soil. All soils pots were fertilized with urea, TSP, MP and gypsum @ 3.08, 0.70, 1.12 and 0.707 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. 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 three six rice varieties *viz*. Binadhan-17, Binadhan-19 and Binadhan-22. The experiment was set in a two factorial RCBD with three replications in during Aman season 2021. The first factor was rice genotypes and the second factor was temperature: ambient, 36^0C at booting, and 36^0C at flowering stage of the rice varieties. Then all the plants were allowed to continue maturity. Data on yield and yield attributes were recorded at maturity. Data were analyzed statistically and DMRT was adjusted to compare the means.

RESULTS AND DISCUSSION

The results revealed that the highest plant height and number of panicle planr^{-1} were found in ambient temperature (Table 1). Panicle length, number of filled grain panicle^{-1} and 1000-grain were similarly affected by high temperature at booting and flowering stage. High temperature (36^0C) at flowering stage produced the highest number of unfilled grain panicle^{-1}. Ambient temperature showed higher seed yield. Yield was significantly decreased with high temperature at flowering followed by booting stage. Main effect of varieties showed that the varieties showed significant difference in some morphological parameters but not in yield (Table 2). Yield of Binadhan-19 reduced less in high temperature compared to other varieties (Table 3). Yield and yield attributes were significantly decreased with high temperature at booting and flowering stage and Binadhan-19 reduced less yield in high temperature compared to other varieties. The results are in conformity with many authors (Islam 2022; Islam and Arefin, 2022; Islam 2021; Saha *et al*. 2020; Haque *et al*. 2020; Hazra *et al*. 2016; Islam 2013).

Table 1. Main effect of temperature on morphological attributes and yield of rice varieties

Treatment	Plant height (cm)	Panicle plant^{-1} (no.)	Panicle length (cm)	Filled grain panicle^{-1} (no.)	Unfilled grain panicle^{-1} (no.)	1000-grain wt. (g)	Seed yield plant^{-1} (g)
T_0	98.78a	10.89a	23.84a	91.78a	67.11c	23.71a	23.65a
T_1	85.56c	8.56b	15.76b	44.56b	125.33b	22.54b	8.57b
T_2	88.89b	7.56c	15.98b	42.89b	158.64a	22.63b	7.29c

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT.

Where, T_0 = Ambient temperature, T_1= High temperature (36^0C) at booting stage and and T_2= High temperature (36^0C) at flowering stage.

Table 2. Main effect of soil moisture regimes on morphological attributes and yield of rice varieties

Variety	Plant height (cm)	Panicle plant^{-1} (no.)	Panicle length (cm)	Filled grain panicle^{-1} (no.)	Unfilled grain panicle^{-1} (no.)	1000-grain wt. (g)	Seed yield plant^{-1} (g)
V_1	99.78a	9.22a	17.73c	60.11b	142.18a	22.09b	13.42a
V_2	83.78c	9.00a	18.60b	63.00a	56.09b	22.11b	13.19a
V_3	89.67b	8.78a	19.24a	56.11c	152.82a	24.69a	12.89a

Where, V_1= Binadhan-17, V_2= Binadhan-19 and V_3= Binadhan-22

Table 3. Combined effect of temperature and rice variety on morphological attributes and yield

Variety x Temperature	Plant height (cm)	Panicle plant^{-1} (no.)	Panicle length (cm)	Filled grain panicle^{-1} (no.)	Unfilled grain panicle^{-1} (no.)	1000-grain wt. (g)	Seed yield plant^{-1} (g)
V_1T_0	107.67a	11.67a	23.80b	95.67a	69.87c	23.07c	25.71a
V_1T_1	92.33c	8.67c	14.73f	42.00e	168.00a	21.50d	7.80def
V_1T_2	99.33b	7.33e	14.67f	42.67e	188.67a	21.70d	6.77f
V_2T_0	91.67c	10.67b	19.80c	91.67b	28.33d	22.80c	22.28b
V_2T_1	82.33d	8.67c	17.47e	49.67d	33.33d	21.77d	9.35c
V_2T_2	77.33e	7.67de	18.53d	47.67d	106.60b	21.77d	7.94de
V_3T_0	97.00b	10.33b	27.93a	88.00c	103.13b	25.27a	22.96b
V_3T_1	82.00d	8.33cd	15.07f	42.00e	174.67a	24.37b	8.55cd
V_3T_2	90.00c	7.67de	14.73f	38.33f	180.67a	24.43b	7.17ef

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT.

Where, T_0 = Ambient temperature, T_1 = High temperature (36^0C) at booting stage and T_2 = High temperature (36^0C) at flowering stage, V_1= Binadhan-17, V_2= Binadhan-19 and V_3= Binadhan-22

CONCLUSION

Yield and yield attributes of the rice varieties were significantly decreased with high temperature at booting and flowering stage. However, high temperature at flowering stage was found more detrimental. Binadhan-19 reduced less yield in high temperature compared to other varieties.

REFERENCES

Hafiz MA, Islam MT, Karim MA (2015) Grain growth and yield performance of aromatic rice genotypes under different soil moisture regimes. *Int. J. Sustain. Crop Prod*. 10(2), 44-47.

Haque MS, Saha NR, Islam MT, Islam MM, Kwon SJ, Roy SK, Woo SH (2020) Screening for drought tolerance in wheat genotypes by morphological and SSR markers. *J. Crop Sci. Biotechnol*.Springerpublication.https://doi.org/10.1007/s12892-020-00036-7

Hazra P, Islam MT, Das GC (2016) Effect of high temperature on some physiological parameters of grain growth and yield of boro rice varieties. *J. Biosci. Agric. Res*. 7(1), 600-607.

Islam MT (2001) Screening of some transplanted aman rice cultivars under water stress condition. *Bangladesh J. Train. Devt*. 14(1&2), 213-220.

Islam MT (2010) Photosynthesis, conductance, transpiration, water use efficiency and grain growth of high yielding rice varieties under water stress. *Int. J. Expt. Agric*. 1(2), 1-4.

Islam MT (2013) Photosynthesis, chlorophyll stability and grain growth of aromatic rice genotypes under high temperature stress. *Bangladesh J. Nuclear Agric*. 27 & 28: 9-14.

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

Islam MT (2022) Effect of high temperature on photosynthesis, stomatal conductance, transpiration, and yield of boro rice varieties under different soil moisture regimes. *Bangladesh J. Nuclear Agric*. 36(1), 65-72.

Islam MT, Arefin KS (2022) Photosynthesis, chlorophyll flouroscence, stomatal conductance, transpiration, water use efficiency and yield of aman rice genotypes under high temperature at different growth stages. *Int. J. Sustain. Crop Prod*. 17(1): 22-26.

Islam MT, Gretzmacher R (2001) Grain growth pattern and yield performance of some transplanted aman rice cultivars in relation to moisture stress. *Bangladesh J. Nuclear Agric*. 16&17: 21-28.

Islam MT, Hossain MA, Islam MT (2005a) Effect of soil moisture on morpho-physiological and yield attributes of boro rice genotypes. J. *Bangladesh Soc. Agric. Sci. Technol*., 2 (3&4), 81-84.

Islam MT, Islam MN, Hossain MA, Karim MA (2012) Effects of water stress on morpho-physiological characters and yield of rice genotypes. *Int. J. Sustain. Crop Prod*., 7(1), 6-11.

Islam MT, Islam MT, Salam MA (1994b) Growth and yield performance of some rice genotypes under different soil moisture regimes. *Bangladesh J. Train. Devt*., 7(2), 57-62.

Islam MT, Khan MEH, Islam MT (2005b) Grain growth pattern and yield attributes of boro rice genotypes under soil moisture stress. *J. Bangladesh Soc. Agric. Sci. Technol*., 2(3&4), 25-28.

Islam MT, Khatoon M (2019) Effect of different temperature levels on germination, root and shoot development of rice varieties. *Int. J. Expt. Agric*. 9(2), 11-12.

Islam MT, Salam MA, Kauser M (1994a) Effect of water stress at different growth stages of rice on yield components and yield. *Progress. Agric*., 5(2), 151-156.

Islam Z, Islam MT, Islam MO (2005c) Effect of soil moisture on dry matter production and yield of bororiceunder pot culture conditions. *Bangladesh J. Crop Sci*., 16(1), 37-43.

Jeng TL, Tseng TH, Wang CS, Chen CL, Sung JM (2006) Yield and grain uniformity in contrasting rice genotypes suitable for different growth environments. *Field Crops Res*., 99: 59-66.

Karim MR, Ishikawa M, Ikeda M, Islam MT (2012) Climate change model predicts 33% rice yield decrease in2100 in Bangladesh. *Agron. Sustain. Dev*., DOI 10.1007/s13593-012-0096-7

Moonmoon S, Fakir MSA, Islam MT (2017) Effect of drought stress on grain dry weight, photosynthesis and chlorophyll in six rice genotypes. *Sch J Agric Vet Sci*., 4(1), 13-17.

Moonmoon S, Fakir MSA, Islam MT (2020a) Assimilation of grain on yield and yield attributes of rice (*Oryza sativa* L.) genotypes under drought stress. *Fourrages*. 241(3), 85-98.

Moonmoon S, Fakir MSA, Islam MT (2020b) Effect of drought on morphology and dry matter partitioning at panicle stage in rice genotypes. *Fourrages*. 242(6), 19-30.

Moonmoon S, Fakir MSA, Islam MT (2020c) Modulation of morpho-physiology in rice at early tillering stage under drought stress. Role of photosynthates. *Fourrages*. 242(4), 19-37.

Moonmoon S, Islam MT (2017) Effect of drought stress at different growth stages on yield and yield components of six rice (*Oryza sativa* L.) genotypes. *Fundam Appl Agric*., 2(3), 285-289.

Rahman MT, Islam MT, Islam MO (2002) Effect of water stress at different growth stages on yield and yield contributing characters of transplanted aman rice. *Pakistan J. Biol. Sci*., 5(2), 169-172.

Saha NR, Islam MT, Islam MM, Haque MS (2020) Morpho-molecular screening of wheat genotypes for heat tolerance. *African J. Biotechnol*. 19(2), 71-83.

Schnyder H (1993) The role of carbohydrate storage and redistribution in the source-sink relations of wheat and barley during grain filling-a review. *New Phytologist*. 123: 233-245.

Singh S, Singh TN, Chauhan JS (2010) Productivity of hybrid rice. 1. Vernubility to water stress of reproductive development and inhibition of RuBisCO enzyme in upper leaves as major constraints to yield. *J. New Seeds*. 11(4), 328-355.

Zohora FT, Islam MT, Baten MA (2016) Drought tolerance of NERICA rice mutants. *Int. J. Sustain. Crop Prod*., 11(1), 4-8.