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GRAIN GROWTH AND YIELD PERFORMANCE OF BORO RICE VARIETIES UNDER DIFFERENT SOIL MOISTURE REGIMES

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ABSTRACT

Hossain MA, Islam MT, Islam MO (2014) Grain growth and yield performance of some Boro rice varieties under different soil moisture regimes. *Int. J. Expt. Agric.* 4(4), 5-8.

A pot experiment was carried out with four Boro rice varieties to observe grain growth and yield performance under different soil moisture regimes. Moisture levels *viz*., 5 cm standing water, 100% field capacity (FC) and 80% FC were maintained during booting, flowering and tillering to maturity stages separately for yield performance. Moisture levels *viz*., 100, 80 and 30% FC were also maintained from panicle emergence to maturity for grain growth pattern. Plant height, tiller number, panicle number, panicle length, number of filled grains per panicle, 1000-grain weight, total dry matter, yield and harvest index were decreased with the less soil moisture. However, varietal responses were different due to different soil moisture regimes for most of the characters and they had different degree of reduction. Binadhan-5 produced highest yield, more tillers and panicles per plant, highest 1000-grain weight and TDM and medium HI under different soil moisture regimes. Binadhan-6 showed better yield but the highest TDM and medium HI. Iratom-24 showed medium yield, TDM and the shortest panicle. BRRI dhan29 showed the highest HI but it produced lower grain yield under different soil moisture regimes. Binadhan-5 and Binadhan-6 may be used for developing suitable varieties in breeding programme for different soil moisture regimes in Bangladesh.

Key words: *boro rice, water stress, grain growth and yield*

INTRODUCTION

Rice (*Oryza sativa* L.) is the principal food crop in Bangladesh as will as for most of the people of the world and is the main source of calories of almost 40% of the world population (Hoffiman 1991). The high yielding variety of rice is usually grown under continuous submerged condition. If proper an optimum supply of water is one of the most important factors in rice production. In Bangladesh rice plants suffer from either too much or too little of water because of irregular rainfall during January to April. If care is taken, rice can also be grown equally well with occasional drying of the soil or with alternate wetting and drying conditions (Ideris and Saleque, 1982). Boro, the important rice crop of Bangladesh, covers around 42% of total rice area during the period when the total sunshine period is high. In recent years, much emphasis has been given to expand the rice cultivation in boro season provided adequate agronomic practices are followed. In fact, irrigation can tremendously increase cropping intensity and change the cropping pattern for higher and economic use of water. The only way to meet the increasing demand for water is to adopt efficient water management practices to increase water use efficiency. In efficient irrigation system will not only cause the wastage of water but may create problem of water logging, enhances leaching loss of N- fertilizer and other salts, imbalances the salt in soil and thus rendering the soil unproductive.

Farmers of this country have the tendency to maintain continuous standing water regime on soil for growing HYV rice. Most of the water is lost through evaporation, percolation, particularly in light textured permeable soils. Sharma and Rajat (1979) reported a significantly higher grain yield of 5.8 t/ha with treatment of continues 4.0cm submergence compared to 4.6 t/ha with alternate wetting and drying treatment. Singh and Mishra (1990) conducted a field experiment with 3 soil water regimes (continuous flooding, alternate flooding and drying, and continuous moist). In flooding treatments, 5-7 cm depth of floodwater was maintained up to the flowering stage through supplemental irrigation. In alternate flooding and drying regime, draining and non-floodwater was maintained up to the flowering stage through supplemental irrigation. In alternate flooding and drying regime, draining and non-flooding followed one-week flooding for 2 weeks in continuous moist regime, soil moisture level was maintained between saturation and field capacity. The highest yield was obtained under the continuous flooding regime and the lowest under the moist regime. Report of BRRI (1981) indicates that the grain yield of Boro rice (cv. BR3) was more affected than other growth components due to moisture stress.

In view of the above facts, a study was undertaken to observe the grain growth and yield performance of four Boro rice varieties under different soil moisture regimes.

MATERIALS AND METHODS

A pot experiment was conducted with four rice varieties *viz*., Binadhan-5, Binadhan-6, lratom-24 and BRRI dhan29 at Crop Physiology Division, Bangladesh Institute of Nuclear Agriculture, Mymensingh during Boro season of 2000-2001. Rice was grown in plastic pots. Each pot contained 8 kg soils collected from BINA farm. The soil was sandy loam in texture having pH 6.7. Three seedlings of 30-day old were transplanted in each pot on December 20, 2000. The seedlings were thinned to single plant per pot at 2 weeks after transplanting. Urea 576 mg. TSP 560 mg, MP 320 mg and Gypsum 66 mg per pot were applied following 90-84-60-5 kg of N-P_2O_5-

K_2O-S fertilizer ha^{-1} respectively. The whole amount of TSP, MP and Gypsum were mixed with the soil as basal does during pot preparation. The Urea of a pot was applied in three installments equally to the soils at 7 days, 21 days and at maximum tilling stage, respectively after transplanting. Cultural practices were done whenever it needed. The pots were kept to field capacity until the initiation of water regime treatments with the supply of water. The pot experiment was arranged in 2 factors completely randomized design with 3 replicated pots. The total pot grown plants were divided into 2 groups. Three water regime treatments *viz*., 5cm standing water, 100% field capacity (FC) and 80% FC were imposed at booting and flowering stage for all varieties and continued till maturity in one group for morphological studies. Those treatments were also imposed in another group from tillering to maturity for yield and yield attributes. Three water regimes *viz*., 100% field capacity (FC) 80% FC and 30% FC were imposed at flowering stage for all varieties and continued till maturity for grain growth studies. Twenty grains from 3 selected panicles were sampled at 0, 3, 6, 9, 12, 15, 18, 21 and 24 days after fertilizations, oven dried and weighed. Amount of water in pot soil at 100% FC was determined and 100% and 80% of measured level was maintained for 100% and 80% FC, respectively. Amount of water to be added to maintain the desired water level was measured by weighing the pots at alternate days. The rice plants were harvested at maturity for measurement of yield and yield components. The data were analyzed statistically following two and three factor experimental design of CRD by MSTAT computer packages (Freed 1992).

RESULTS AND DISCUSSION

Results showed that plant height, tiller and leaf numbers, leaf area per plant, root, leaf, stem weight and total dry matter per plant were significantly affected by different soil moisture levels (Table 1). Those parameters were reduced more at 80% FC. It indicates that water stress might develop at 100% FC and 80% FC due to evapotranspiration which inhibit cell division/cell enlargement. This result agrees with Islam (2001) and Rahman *et al*. (2002). Binadhan-5 and Binadhan-6 showed better performance in most of the parameters compared to other varieties.

Yield and yield attributes were significantly reduced by soil moisture stress and 80% FC had more reduction in all the parameters except number of unfilled grains per panicle which was increased at 80% FC (Table 2 & 3). This result agrees with RRDI (1999) report stated that water stress at or before panicle initiation reduced panicle number and all stresses regardless of crop stage significantly reduced panicle number. This might be due to the fact that moisture stress reduced the number of cell division and or reduced the length of the individual cell. Increased sterility in rice under water stress was also reported by 0'Toole and Moya (1981), Rahman and Yoshida (1985). Binadhan-5 and Binadhan-6 also showed better yield performance compared to other varieties.

Grain dry weight and water content in grain significantly decreased due to 80% FC and 30% FC from panicle emergence to maturity compared to that of 100% FC (Table 4). The highest dry weight of individual grain was found in 100% FC (16.00mg) followed by 80% FC (14.14mg) and 30% FC (8.72mg). The highest dry weight of individual grain was found in Binadhan-5 (13.24mg) and it was statistically similar with Iratom24 (13.14 mg). Binadhan-6 showed the least grain dry weight (12.54 mg). BRRI dhan29 was medium in grain dry matter accumulation under water stress treatments. Varieties did not show difference in water content in grain under different soil moisture regimes. Grain dry weight increment was steady up to 21 days. After 21 days, grain dry weight was not increased significantly (Table 4). These findings agree with Islam and Gretzmacher (2001) and Islam (2010).

Table 1. Effect of different soil moisture regimes on rice varieties at booting and flowering stages

Treatment	Plant height (cm)	Tillers /plant (No.)	Leaves /plant (No.)	Leaf area /plant (cm^2)	*D.M. of leaves /plant (g)	*D.M. of roots/ plant (g)	*D.M. of stems/ plant (g)	**T.D.M. /plant (g)
5 cm water	88.7a	35.1a	153a	2237a	11.1a	42.1a	24.7a	77.9a
100% FC	85.1b	33.5a	150a	2175a	11.0a	36.1b	19.9b	64.9b
80% FC	71.7c	28.5b	132b	1883b	9.6b	31.8c	18.5b	60.1c
Varieties								
Binadhan-5	88.6a	32.8ab	155a	2503a	11.0a	37.1a	18.9b	67.4b
Binadhan-6	84.2b	30.1b	153a	2255b	10.7ab	38.0a	18.8b	67.4b
Iratom-24	75.8d	33.5a	143ab	1922c	10.4ab	33.7b	20.1b	64.3b
BRRI dhan29	78.8c	33.2a	150a	1712d	10.2ab	37.8a	23.7a	71.4a
Harvest								
Flowering	76.6b	34.7a	162a	2346a	11.4a	33.9b	20.2ab	65.6b
Booting stage	87.1a	30.0b	128b	1850b	9.7b	39.3a	22.5a	69.7a

Common letter(s) in a column do not differ significantly at 5% level of significance analyzed by DMRT

*DM = Dry matter

**TDM = Total dry matter

Table 2. Effect of different soil moisture regimes on some agronomic and physiological parameters of four Boro rice varieties at maturity

Treatment	Plant height (cm)	Tillers /plant (no.)	Panicles /plant (no.)	Length of panicle (cm)	Filled grains/panicle (no.)	Unfilled grains/ panicle (no.)	1000-grain weight (g)	Yield/ plant (g)	*T.D.M. /plant (g)	Harvest index
5 cm water	93.9a	27.9ab	22.7a	20.2a	89.7a	10.1c	21.0a	42.1a	79.0a	52.2a
100% FC	88.7b	23.0c	18.1b	17.4b	65.9b	22.0b	15.3b	29.9b	66.3b	40.3b
80% FC	73.3c	20.9d	12.2c	11.1c	35.5c	35.6a	10.2c	9.9c	65.1b	24.4c
Varieties										
Binadhan-5	94.1a	32.3a	25.1a	19.8a	77.5a	19.8b	19.1a	31.1a	70.9b	37.2a
Binadhan-6	94.3a	23.1c	17.6c	18.3a	69.4b	21.1a	18.0b	28.5b	75.1a	34.1c
Iratom-24	77.0b	24.6b	19.7b	17.1b	61.5c	18.7b	18.6b	27.5b	72.1b	36.1ab
BRRI dhan29	75.8b	24.3b	18.1bc	18.1a	67.4b	20.1b	16.5c	26.3c	96.9c	38.7a

Common letter(s) in a column do not differ significantly at 5% level of significance analyzed by DMRT
*TDM = Total dry matter

Table 3. Effect of different soil moisture regimes on some agronomic and physiological parameters of four Boro rice varieties at maturity

Varieties	Treatment	Plant height (cm)	Tillers /plant (no.)	Panicles /plant (no.)	Length of panicle (cm)	Filled grains /panicle (no.)	Unfilled grains/ panicle (no.)	1000-grain weight (g)	Yield/ plant (g)	*T.D.M. / plant (g)	Harvest index
Binadhan-5	5 cm water	102.0a	33.6a	30.0a	22.6a	92.3a	12.0c	24.1a	75.9ab	50.0a	48.7b
	100% FC	99.6a	25.0bc	20.3b	15.3b	73.0c	19.3b	15.5c	65.8cd	35.6d	39.6cd
	80% FC	80.7c	20.3c	15.0e	11.4c	47.3e	28.3a	11.6d	59.1ef	20.0e	24.3e
Binadhan-6	100% FC	99.3a	24.3bc	15.6cde	14.3b	65.0b	20.6b	14.2c	59.8ef	20.0e	35.0d
	80% FC	80.3c	17.0d	12.0e	10.3cd	38.0e	31.6a	10.8d	48.8f	13.0e	23.0e
	5 cm water	82.0bc	26.0bc	21.3b	20.3a	73.6c	10.3c	22.5b	75.7ab	46.6b	50.3a
Iratom-24	100% FC	78.6c	24.6bc	15.6bc	14.3b	55.0de	17.0bc	15.9c	70.2b	25.6c	45.0bc
	80% FC	70.3d	20.3c	10.3bcd	9.3d	26.0f	29.0a	10.4d	65.5cd	12.3e	24.3dc
BRRI dhan29	5 cm water	88.3b	28.6ab	22.6b	20.6a	82.6b	24.3ab	21.1b	81.9a	45.3a	50.6a
	100% FC	77.3cd	22.6c	19.0bc	15.0b	60.6d	21.3b	15.5c	69.5cd	25.3c	41.6cd
	80% FC	62.0e	21.0c	13.6de	11.0c	41.0e	39.6a	11.1d	66.9cd	12.3e	26.1d

Common letter(s) within the column do not differ significantly at 5% level of significance analyzed by DMRT

*TDM=Total dry matter

Table 4. Grain growth patterns of some Boro rice varieties under different soil moisture regimes at 2 days intervals after panicle emergence to maturity

Treatment	Dry weight/grain(mg)	Water content/grain (mg)
100% FC	16.00 a	5.53 a
80% FC	14.14 b	4.59 b
30% FC	8.72 c	3.16 c
Varieties		
Binadhan-5	13.24 a	4.32 a
Binadhan-6	12.54 b	4.37 a
Iratom-24	13.14 a	4.41 a
BRRI dhan29	12.90 ab	4.62 a
Harvests (days)		
0	5.38 g	2.79 c
3	7.90 f	3.71 d
6	9.44 e	4.79 abc
9	12.63 d	5.02 ab
12	13.63 c	5.03 a
15	16.29 b	4.98 ab
18	18.67 b	4.71 c
21	20.60 a	4.63 c
24	20.21 a	4.35 c

Common letter(s) in a column do not differ significantly at 5% level of significance analyzed by DMRT
Treatments: Means over 9 harvests and 4 varieties of 4 replications
Harvests: Means over 3 treatments and 4 varieties of 4 replications
Varieties: Means of 4 replications over 3 treatments and 9 harvests

CONCLUSION

Yield and yield attributes of Boro rice varieties were affected by soil moisture 80% FC at booting and flowering stages. So, 100% FC should be maintained at these two stages to obtain good yield in Boro rice.

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