Effects of supplemental irrigation on the yield and yield contributing characters of BRRI dhan49 in aman season

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Abstract: A field experiment was carried out at the field laboratory of the Department of Soil Science, Bangladesh Agricultural University (BAU), Mymensingh during aman season of 2012 to study the effects of spplemental irrigation on the yield and yield contributing characters of BRRI Dhan49 in aman season. The experiment was laid out in a Randomized Complete Block Design (RCBD). The experimental field was divided into 15 plots to apply 5 treatments with 3 replications for each treatment. The treatments were T_1 (No Irrigation), T_2 (Four irrigations), T_3 (Three irrigations), T_4 (Two irrigations) and T_5 (One irrigation). Yield and yield contributing components of T. aman rice variety BRRI Dhan49 were greatly influenced by supplemental irrigation. The highest number of effective tillers hill^{-1} was found in T_2 (12.80) and the lowest number in T_1 (11.27). Numbers of non-effective tillers hill^{-1} were highest in T_1 (1.90) and lowest in T_2 (0.95). Due to application of supplemental irrigation plant height increased slightly over rainfed condition. Highest plant height was found in T_2 i.e. 88.66 cm and the lowest plant height i.e. 82.68 cm was found in T_1. Panicle length for T_1 was 21.22 cm which was the lowest and 22.66 cm for T_2 which was highest among the treatments. Highest number (130.90) of filled grains panicle^{-1}was found in T_2 and the lowest found in T_1 that was 98.80. The highest number of unfilled grain (23.85) was found in T_1 and the lowest in T_2 (15.09), In respect of Grain yield, BRRI Dhan49 gave the minimum result of 4.03 t ha^{-1} under rainfed condition while the highest yield was obtained from T_2 (5.48 t ha^{-1}). Considering straw yield, the maximum (5.99 t ha^{-1}) and the minimum (5.40 t ha^{-1}) straw yield were obtained from T_2 and T_1 respectively. The best result was noted from T_2 (11.47 t ha^{-1}) where as the lowest was counted from T_1 (9.43 t ha^{-1}) incase of biological yield. On the contrary, the highest 1000-grain weight (20.05 gm) and the lowest (19.55 gm) were noted from T_2 and T_1, respectively. From the result, it appeared that four times supplemental irrigations gave comparatively good result over other supplemental irrigation levels.
Keywords: Supplemental Irrigation, BRRI Dhan49, Yield, Yield contributing character, Rainfed condition.

Introduction

Rice *(Oryza sativa* L.) is the staple food of Bangladesh and it plays a vital role in human nutrition and diet. As a global food, rice influences largely on human nutrition and food security all over the world. Rice is most important since it provides more calories than any other cereals. In Bangladesh, food security has been and will remain a major concern because food requirement is increasing at an alarming rate due to increasing population. Projected supply and demand balance showed that the country will require 34-35 million tons of food grain by the year 2020 while the supply would be 27-33 million tons (Shahabuddin *et al.* 1999). It is needed to increase the food grain in the limited land area for the fulfillment of our demand. So it must be cultivated high yielding variety (HYV) of rice crop. It is very effective than local variety. Selection of variety and proper management of irrigation can play the important role to increase grain yield.

Rice is grown in Bangladesh under diverse ecosystems like irrigated, rainfed and deep water conditions in three distinct seasons namely aus, aman and boro. The production efficiency of rice depends on the favorable climatic conditions particularly temperature, soil moisture level and sunshine hours. Successful crop cultivation largely depends on proper water management along the greater part of the growth period of the crop. Water plays a vital role in growth, yield and nutrient uptake of rice plant. Insufficient water vigorously affects the germination of seed, cell division, tillering and nutrient uptake of the plants. Nutrients from the soil reach the surface of roots by mass flow and diffusion processes. Mass flow and diffusion processes are again positively correlated with moisture content of the soil. Movement of nutrients through the plant body is also associated with soil water contents. So, optimum supply of water is one of the most important factors in rice production. Rice plants need adequate moisture throughout of its life cycle. In tropical Asia on average a total of 1245 mm of water required for the complete growth cycle of rice. This total can be split into 40 mm for seedling nursery, 200 mm for land preparation and 1000 mm for satisfying the need during the whole growing period (Sattar, 2004).

Water deficit at the reproductive stage has the reduction number of effective tillers, panicle length, number of spikelet panicle^{-1} and percentage of filled spikelets (BRRI, 1992). If irrigation water is not supplied on those farms, rice yields will be reduced markedly. It is disappointing to note that the most of the farmers do not usually irrigate aman rice even if the farm has access to irrigation water. This may be due to ignorance of technology and/or the higher cost of modern irrigation facilities. It was found that supplemental irrigation significantly increased rice yields over rainfed condition. Moreover, it was suggested that supplemental irrigation should be supplied precisely at the peak period of crop growth which may provide better yield of this crop (Sattar, 2003).

The present piece of research work was conducted to study the yield of T. aman rice variety cv BRRI Dhan49 grown under supplemented irrigation and rainfed condition.

Materials and Methods

Effect of supplemental irrigations on aman rice was investigated at the field laboratory of the Department of Soil Science, Bangladesh Agricultural University (BAU), Mymensingh-2202, with the rice variety BRRI Dhan49 during the period from July-December (aman season), 2012. The experimental soil has following characteristics: pH 6.57, Organic matter 1.29 %, Total N 0.11 %, Available P 11 ppm, Exchangeable K 0.14 meq./100g soil, Available S 10.41 ppm. The sprouted seeds of selected varieties were sown in the seedbed on July 8, 2012 and covered with a thin layer of fine earth. Adequate cares were taken to raise healthy seedlings. The main land preparation was done on August 10, 2012 for cultivation of T. aman rice.

Five treatments used in this experiment were T_1 = Irrigation water was not applied (Rainfed condition); T_2 = Irrigation water was applied for four times. (15th, 25th, October and 5th, 15th November); T_3= Irrigation water was applied for three times. (20th October, 5th and 20th November); T_4 = Irrigation water was applied for two times. (25th October and 15th November) and T_5 = Irrigation water was applied for only once. (30th October).

The experiment was laid out in a Randomized Complete Block Design (RCBD). The entire field was divided into 3 rows, each row again divided into 5 plots, so total field contained 15 plots to apply 5 treatments and 3 replications for each treatment. The size of the unit plot was 4.0 m x 2.5 m = 10 m^2. There was 1.0 m width and 10 cm depth drains among the rows and 50 cm width ail between two unit plots.

Recommended doses of Urea, TSP, MoP, Gypsum and Zinc Sulphate were used for sources of N, P, K, S and Zn, respectively. The full doses of all fertilizers except urea were applied as basal dose to the individual plot during final land preparation. Urea was top dressed in three (3) equal splits at 15, 30 and 45 days after transplanting (DAT).

Thirty seven day-old seedlings were uprooted carefully from the seedbed in the morning and then transplanted on the same day in the main field on August 14, 2012. The spacing was 20 cm x 20 cm and three seedlings were transplanted in each hill. The crop was harvested on 29th November, 2012. The harvested crop of each plot was bundled and tagged separately and brought to the clean threshing floor. Grains are separated from straw and their fresh weight was recorded.

The data on the yield and yield contributing components were collected and recorded from five representative hills per plot. The collected data were compiled and analyzed statistically using the analysis of variance (ANOVA) technique with the help of a computer package SPSS and mean differences were adjudged by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

Plant height: Experimental results exposed that effect of different levels of irrigation on plant height was found significant at 5% level of probability (Table 1). The highest plant height 88.66 cm (T_2) was observed under supplemental irrigated condition over the rainfed condition (T_1) 82.68 cm. The second highest plant height was observed 87.27 cm (T_3) and statistically identical with 85.77 cm (T_4).

Table 1. Effects of different levels of irrigation water on the yield contributing characters of T. aman rice variety BRRI Dhan49

Treatments	Plant height (cm)	No. of Effective tillers hill^{-1}	No of non Effective tillers hill^{-1}	Panicle length (cm)	No. of filled grain	No. of unfilled grain	1000 grain wt. (g)
T_1	82.68 c	11.27 b	1.900 a	21.22 c	98.80 d	23.85 a	19.55 b
T_2	88.66 a	12.80 a	0.950 d	22.66 a	130.9 a	15.09 e	20.05 a
T_3	87.27 ab	11.87 b	1.200 c	22.28 ab	121.8 ab	16.89 d	19.73 b
T_4	85.77 abc	11.67 b	1.410 b	22.27 ab	116.1 bc	18.91 c	19.70 b
T_5	84.45 bc	11.60 b	1.730 a	21.79 bc	107.3 cd	20.19 b	19.67 b
$LSD_{0.05}$	3.60	0.719	0.188	0.792	9.21	1.22	0.252
Level of sign	*	**	**	**	**	**	**
SE	1.05	0.26	0.056	0.25	2.82	0.374	0.08
CV%	2.23	3.22	6.78	1.91	4.26	3.41	0.69

Number of effective tillers hill^{-1}: As a result of four time's supplemental irrigation treatments to aman rice, the number of effective tillers hill^{-1} influenced appreciably at 1% level of significance (Table 1). The highest number of effective tiller hill^{-1} was 12.80 in case of treatment two (T_2) and the lowest number of tiller hill^{-1} was 11.27 in case of treatment one (T_1). The same result was found by Islam and Gretzmacher (2000). The second highest number of effective tillers hill^{-1} was observed in T_3. Number of effective tillers hill^{-1} may be arranged in order of decreasing fromT_2> T_3> T_4> T_5>T_1. It was found that the number of effective tillers hill^{-1} increased with the increasing number of irrigation water supply.

Number of non-effective tillers hill^{-1}**:** Supplemental irrigation to the T. aman rice on the number of non-effective tillers hill^{-1} influenced notably (Table 4.1). Supplemental irrigation treatments to aman rice, the number of effective tillers hill^{-1} influenced appreciably at 1% level of significance (Table 1). The lowest number of non-effective tillers hill^{-1} was 0.95 obtained in Supplemental irrigated plots (T_2) where as in the control plot the number of non-effective tillers hill^{-1} was heigher 1.90, (T_1), (Fig. 4.3). Number of non-effective tillers hill^{-1} gradually increases from treatment two (T_2) to treatment five (T_5). The result was accorded with TaoLong *et al*. (2004). The non-effective tillers hill^{-1} T_1 (1.90) and T_5 (1.73) produced the highest number of non-effective tiller hill^{-1} were statistically similar and sequence for rest of the treatments are T_4>T_3>T_2.

Panicle length: From the experimental results (Table 1) it was found that the effects of supplemental irrigation to the aman rice from panicle initiation to grain filling stage, the panicle length was statistically significant at 1% level of probability. Panicle length was increased with increase of each irrigation under supplemental irrigated plots over rainfed condition. The panicle length 22.66 cm was observed in treatment two (T_2) compared to control 21.22 cm (T_1) i.e. panicle length was increased in supplemental irrigated plots over rainfed condition. This result was supported by Islam *et al.* (1994).

Number of filled grains panicle^{-1}: From the experimental results (Table 1) it was observed that the effect of supplemental irrigation to the T. aman rice on the number of filled grains panicle^{-1} was statistically significant at 1%

level of probability. The highest number of filled grains panicle^{-1} (130.90) was observed in supplemental irrigated plots of T_2 compared to rainfed condition 98.80 (T_1). The second highest number of filled grains panicle^{-1} was 121.80 (T_3), then the 3rd and 4th highest number of filled grains panicle^{-1} was 116.10 (T_4) and 107.3 (T_5), (Fig.4.5). Yang *et al.* (1994) reported that water deficit at the reproductive stage has the reduction number of spikelet panicle^{-1}.

Number of unfilled grains panicle^{-1}: From the experimental results (Table 1) it was conspicuous that the effect of supplemental irrigation on the number of un-filled grains panicle^{-1} was statistically significant at 1% level of probability. Un-filled grains panicle^{-1} was decreased in irrigated plots compared to control. The number of unfilled grains panicle^{-1} 15.09 was observed in supplemental irrigated plot T_2 which was markedly lower than plot T_1 in rainfed condition 23.85. The second highest number of unfilled grains panicle^{-1} was 20.05 (T_5). So comparative sequence number of unfilled grains panicle^{-1} is T_1> T_5> T_4> T_3>T_2. TaoLong *et al.* (2004) was obtained parallel result.

Thousand (1000) Grain Weight: Experimental result showed that the weight of 1000 grain was slightly increased under supplemental irrigated plots over rainfed condition (Table 1). The weight of 1000 grain is 20.05 gm which was observed in supplemental irrigation plots (T_2) compared to control 19.55 gm (T_1). The second highest 1000 grain weight was observed in (T_3) 19.73 which are statistically identical with T_4 (19.70), T_5 (19.67) and T_1 (19.55). Similarly results were reported by Reddy and Hokkeri (1979).

Grain yield: Experimental results revealed that the effect of supplemental irrigation to the aman rice on the grain yield was statistically significant at 1% level of probability (Table 2).The grain yield of 5.483 t ha^{-1} was found in supplemental irrigated plots of T_2 compared to control 4.030 t ha^{-1} (T_1). Grain yield of T_2 (5.483 t ha^{-1}) and T_3 (5.370 t ha^{-1}) were statistically similar and significant over other treatments. T_1 (4.030 t ha^{-1}) produced lowest amount of grain and T_5 produced 5.120 t ha^{-1} grain which is statistically identical with T_1.The comparative sequence of treatments for grain yield were found as T_2> T_3> T_4>T_5>T_1. Similar findings were observed by Spanu *et al.* (2004) who indicated that grain yields were satisfactory both in quantity and quality under well watered conditions.

Straw yield: Results indicated that the effect of supplemental irrigation to the T. aman rice on the straw yield statistically significant (Table 2). It was observed that straw yield was increased under supplemental irrigation plots over control. Straw yield of 5.99 t ha^{-1} was observed in supplemental irrigation plots of T_2 compared to controls (T_1) 5.403 t ha^{-1} i.e. the straw yield was increased gradually by different levels of supplemental irrigation plots over control. The second highest straw yield was 5.91 t ha^{-1} (T_3). Straw yield varies slightly due to irrigation and comparative sequence of treatments for straw yield were found as T_2> T_3> T_4>T_5>T_1.

Table 2. Effects of different levels of irrigation water on the grain yield, straw yield and Biological yield of T. aman rice variety BRRI Dhan49

Treatments	Grain yield (t ha^{-1})	Straw yield (t ha^{-1})	Biological yield (t ha^{-1})
T_1	4.030 b	5.403 b	9.43 b
T_2	5.483 a	5.99 a	11.47 a
T_3	5.370 a	5.917 a	11.29 a
T_4	5.290 a	5.863 a	11.15 a
T_5	5.120 a	5.787 a	10.91 a
$LSD_{0.05}$	0.741	0.326	0.746
Level of sign	**	**	**
SE	0.26	0.10	0.365
CV%	7.77	2.97	3.66

** = Significant at 1% level of probability , * = Significant at 5% level of probability.

Biological yield: Result exposed that the effect of supplemental irrigation to the aman rice on the biological yield was statistically significant 1% level of probability (Table 2). It was observed that the biological yield was increased under supplemental irrigated conditioned plots over rainfed condition. The biological yield of 11.47 t ha^{-1} was secured in supplemental irrigated plots (T_2) compared to control 9.433 t ha^{-1} (T_1). Again, incase of biological yield T_2 (11.47 t ha^{-1}) and T_3 (11.29 t ha^{-1}) were statistically similar and significant over other treatments. The comparative sequence of treatments for biological yield were found as T_2> T_3> T_4>T_5>T_1. Islam *et al.* (1994a) reported that moisture stress resulted in reduced total dry matter.

The overall results indicate that the yield contributing components and yields of aman rice (BRRI Dhan49) were significantly influenced by different levels of supplemental irrigation. From above discussion it can be concluded that 4 times irrigation gave the best result over all the supplemental irrigation treatments.

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