Comparing of yield and yield components of rice hybrid in different irrigation regimes and nitrogen levels

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Abstract: In order to investigating the effect of different irrigation regimes and nitrogen fertilizer on yield and yield components of hybrid rice a biennial experiment was conducted at rice research institute of Iran during crop season 2008-9. experiment was arranged in split plot based on completely randomized block design with 3 replications in which water regimes were main factor included Continuous Submergence and Alternative Submergence conditions (irrigation intervals of 5, 8 and 11days) and nitrogen fertilizer levels were sub factor included 0, 90, 120 and 150 kg/ha. Grain yield in I1 to I4 were 7342, 7079, 7159 and 5168 kg/ha in 2008 and 4372, 4343, 4674 and 4208 kg/ha in 2009 respectively. Number of grains per panicle in I1 to I4 was 304,307,311 and 272 in 2008 and 183,180,181 and 179 in 2009 respectively. Weight of 1000 grain in I1 to I4 was 22.4, 22.2, 21.8 and 21.1 g in 2008 and was 22.8, 23, 23.1 and 23.2 g in 2009 respectively. Unfilled grain in I1 to I4 was 27.1, 32.9, 30.3 and 39.2 percentage in 2008 and was 55.2, 48.4, 50.4 and 46.8 percentage in 2009 respectively. Mean grain yield in irrigation regimes in 2009 compare to 2008 decreased 34% because mean number of grains per panicle in 2009 compare to 2008 decreased 40% and mean unfilled grain percentage increased 56%.
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1. Introduction

Increased efficiency in the use of water is essential for future food security in Asia where rice production has to be increased by 70% of the present amount by the year 2025.decreasing water availability for agriculture threatens the productivity of the irrigated rice ecosystem and ways must be sought to save water and increase the water productivity of rice (Guerra et al., 1998). Conventional water management in lowland rice aims at keeping the fields continuously submerged. Water inputs can be reduced and water productivity increased by introducing periods of none submerged conditions of several days (Bouman and Tuong, 2001).

Panicles with a low percentage of sterile flowers permit the application of higher doses of nitrogen and produce better yields (Yoshida, 1981). Rice grain yield was recorded highest in case the N application ranged between 90-250 kg per ha (Bali et al., 1995).

Worldwide, freshwater availability for irrigation is decreasing because of increasing competition from urban and industrial development, degrading irrigation infra-structure, and degrading water quality (Molden, 2007).

Zhong and Huang (2002) report that grain yield and dry matter increased when application of nitrogen fertilizer increased.

Nitrogen is normally a key factor in achieving optimum lowland rice grain yields (Fageria et al., 1997). It is worth mentioning utilization especially usage of nitrogen fertilizer is very significant factor in growth of rice. When nitrogen fertilizer used in tillering, paddy yield increased (Bacon, 1989).

2. Material and Methods

In order to investigating the effect of different regimes of irrigation and nitrogen fertilizer on yield of hybrid rice an experiment was conducted at rice research institute of Iran during crop season 2008-9. experiment was arranged in split plot based on completely randomized block design with 3 replications in which water regimes were main factor included continuous submergence and alternately submergence (irrigation intervals of 5, 8 and 11days) and nitrogen fertilizer levels were sub factor included 0, 90, 120 and 150 kg/ha. For all treatments, drainage basins have been mounted from which waste water belonging to each replicate treatments were exited. Each experimental plot had 15 lines with five meter in length and the planting method was considered to be 25×25 cm. The nursery construction took place in April and transplanting to the field happened in early may. In order to use fertilizer, based on the soil test and instructions of the technicians the rice investigation organization the amount of P and K was calculated and

applied to every plot. The amount of irrigation water applied was monitored at each plot from transplanting till maturity, by using flow meters installed in the irrigation pipes. Yield was measured with $6m^2$ harvesting of every plot. The mean daily temperature during the growing season (May-Sep) was 26 and 23.6 in 2008 and 2009, respectively.

Total rainfall during the growing season (May-Sep) was 236mm (50 mm in flowering to harvest) and 157mm (108mm in flowering to harvest) in 2008 and 2009, respectively.

Total sunshine hours in flowering to harvest was 256 and 173 h in 2008 and 2009, respectively. The yield and yield components were analyzed by using MSTATC software. The Duncan's multiple range tests was used to compare the means at 5% of significant.

3. Results

The effect of irrigation regime on Grain yield, Biomass, Harvest index, Number of grains per panicle, Weight of 1000 grain, unfilled grain percentage was significant and no significant on Number of tiller, Length of panicle and Plant height in 2008 (table 1).

Irrigation regime had no significant effect on all of plant characteristics in 2009 (table 2).

The effect of nitrogen levels on Grain yield, Biomass, Number of tiller, Number of grains per panicle, Weight of 1000 grain, unfilled grain percentage, Length of panicle and Plant height was significant and no significant on Harvest index in 2008 and 2009 (table 1 and 2).

Grain yield in I1 to I4 were 7342, 7079, 7159 and 5168 kg/ha in 2008 and 4372, 4343, 4674 and 4208 kg/ha in 2009 respectively (Table 3, 4).

Grain yield in N1 to N4 were 3471, 4588, 4783 and 4755kg/ha in 2008 and 3471, 4588, 4783and 4755 kg/ha in 2009 respectively (Table 3, 4).

Biomass in I1 to I4 were 13245, 12647, 12698 and 11641 kg/ha in 2008 and 12155, 12919, 11939 and 12350 kg/ha in 2009 respectively (Table 3, 4).

Biomass in N1 to N4 were 9873, 12685, 13284 and 14389kg/ha in 2008 and 10095, 11455, 13386and 14427 kg/ha in 2009 respectively (Table 3, 4).

Harvest index in I1 to I4 were 51, 53, 53 and 42 percentage in 2008 and 48, 48, 49 and 49 percentages in 2009 respectively (Table 3, 4).

Harvest index in N1 to N4 were 50, 49, 52 and 48 percentage in 2008 and 48, 49, 49 and 49 percentages in 2009 respectively (Table 3, 4).

Number of tiller in I1 to I4 was 245,252,250 and 228 in 2008 and 276,278,276 and 272 in 2009 respectively (Table 3, 4).

Number of tiller in N1 to N4 was 209,240,249 and 277 in 2008 and 236,272,284and 307 in 2009 respectively (Table 3, 4).

Number of grains per panicle in I1 to I4 was 304,307,311 and 272 in 2008 and 183,180,181 and 179 in 2009 respectively (Table 3, 4).

Number of grains per panicle in N1 to N4 was 282,291,305 and 316 in 2008 and 165,174,190 and 196 in 2009 respectively (Table 3, 4).

Weight of 1000 grain in I1 to I4 was 22.4, 22.2, 21.8 and 21.1 g in 2008 and was 22.8, 23, 23.1 and 23.2 g in 2009 respectively(Table 3, 4).

Weight of 1000 grain in N1 to N4 was 21, 21.9, 22.4 and 22.2 g in 2008 and was 22.5, 23.1, 23.1and 23.3 g in 2009 respectively (Table 3, 4).

Unfilled grain in I1 to I4 was 27.1, 32.9, 30.3 and 39.2 percentage in 2008 and was 55.2, 48.4, 50.4 and 46.8 in 2009 respectively (Table 3, 4).

Unfilled grain in N1 to N4 was 37.5, 31.1, 32 and 29 percentage in 2008 and was 49.1, 44.4, 47.2 and 60.1 in 2009 respectively (Table 3, 4).

Length of panicle in I1 to I4 was 29.4, 31.1, 30.5 and 29.6 cm in 2008 and was 25.6, 25.8, 26.2 and 25.2 cm in 2009 respectively (Table 3, 4).

Length of panicle in N1 to N4 was 29.1, 30.3, 30.3 and 30.9 cm in 2008 and was 24, 26, 26 and 27 cm in 2009 respectively(Table 3, 4).

Plant height in I1 to I4 was 105.8, 107.6, 107 and 106.7 cm in 2008 and was 92, 94, 91 and 92 cm in 2009 respectively (Table 3, 4).

Plant height in N1 to N4 was 100.8, 106.7, 109.2 and 110.4 cm in 2008 and was 86, 94, 94 and 96 cm in 2009 respectively(Table 3, 4).

Table 1. Analysis of variance in plant parameters in 2008

S. O. V	df	Yield	biomass	Weight of 1000 grain	Length of panicle	unfilled grain	Plant Height	Number of tiller	number of grains per panicle	Harvest Index
I	3	12452331**	5364477.1*	3.8**	7.1 ns	316.8**	6.9 ns	1464.8 ns	3974.2*	333.7**
N	3	11838173**	44436179.4**	5.1**	6.6*	159.3**	218.7**	9429.3**	2746.9**	33.6 ns
I×N	9	1211276*	4554914.2*	.051**	4.1*	38.7*	16.2 ns	986 ns	322.1 ns	43.1 ns
Cv (%)		10.59	10.93	.47	4.3	10.67	3.74	17.47	6.55	9.48

Table 2. Analysis of variance in plant parameters in 2009

	Weight of 1000 grain (g)	Length of panicle(cm)	Unfilled grain (%)	Plant Height (cm)	Number of tiller	number of grains per panicle	biomass (kg/ha)	Yield (kg/ha)	Harvest Index (%)
Irrigation									
Continue submerge	22.4 a	29.4a	27.1c	105.8a	245a	304a	13245a	7342a	51a
5 day interval	22.2 b	31.1a	32.9b	107.6a	252a	307a	12647ab	7079a	53a
8 day interval	21.8c	30.5a	30.3bc	107a	250a	311a	12698ab	7159a	53a
11 day interval	21.1d	29.6a	39.2a	106.7a	228a	272b	11641b	5168b	42 b
Nitrogen									
N1	21d	29.1b	37.5a	100.8c	209b	282c	9873c	3471b	50a
N2	21.9c	30.3a	31.1b	106.7b	240ab	291bc	12685b	4588a	49a
N3	22.4 a	30.3a	32b	109.2ab	249a	305ab	13284ab	4783a	52a
N4	22.2 b	30.9a	29b	110.4a	277a	316a	14389a	4755a	48a

Table 3. Effects of irrigation management and nitrogen levels plant parameters of rice in 2008

S. O. V	df	Yield	biomass	Weight of 1000 grain	Length of panicle	unfilled grain	Plant Height	Number of tiller	number of grains per panicle	Harvest Index
I	3	ns	ns	ns	ns	ns	ns	ns	ns	ns
N	3	468361**	67839329**	1.37**	13.9**	566**	220**	45**	2465**	ns
I×N	9	ns	ns	ns	ns	ns	ns	ns	421*	ns
Cv (%)		11.5	16	1.02	2.7	21.5	8.57	8.6	6.45	2.5

Table 4. Effects of irrigation management and nitrogen levels plant parameters of rice in 2009

	Weight of 1000 grain (g)	Length of panicle (cm)	Unfilled grain (%)	Plant Height (cm)	Number of tiller	number of grains per panicle	biomass (kg/ha)	Yield (kg/ha)	Harvest Index (%)
Irrigation									
Continue submerge	22.8a	25.6a	55.2a	92a	276a	183a	12155a	4372a	48a
5 day interval	23a	25.8a	48.4a	94a	278a	180a	12919a	4343a	48a
8 day interval	23.1a	26.2a	50.4a	91a	276a	181a	11939a	4674a	49a
11 day interval	23.2a	25.2a	46.8a	92a	272a	179a	12350a	4208a	49 a
Nitrogen									
N1	22.5c	24c	49.1b	86c	236d	165b	10095c	3471b	48a
N2	23.1b	26b	44.4b	94b	272c	174b	11455b	4588a	49a
N3	23.1b	26b	47.2b	94b	284b	190a	13386a	4783a	49a
N4	23.3a	27a	60.1a	96a	307a	196a	14427a	4755a	49a

4. Discussions

Mean grain yield in irrigation regimes in 2009 compare to 2008 decreased 34% because mean number of grains per panicle in 2009 compare to 2008 decreased 40% and mean unfilled grain percentage increased 56%.

Numbers of grains per panicle and unfilled grain percentage were two important yield components and have direct effect on increasing of grain yield.

The mean daily temperature during the growing season (May-Sep) was 26 and 23.6 in 2008 and 2009, respectively.

Total rainfall during the growing season (May-Sep) was 236mm (50 mm in flowering to harvest) and 157mm (108mm in flowering to harvest) in 2008 and 2009, respectively.

Total sunshine hours in flowering to harvest was 256 and 173 h in 2008 and 2009, respectively.

Mean daily temperature during the growing season (May-Sep) and Total sunshine hours in flowering to harvest in 2009 were lower than 2008, therefore mean number of grains per panicle decreased and mean unfilled grain percentage increased.

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