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Full Length Research Paper

The effect of planting date and seedling age on yield and yield components of rice (*Oryza sativa* L.) varieties in North of Iran

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In order to study the effects of seedling age and planting date on yield and yield components of rice (*Oryza sativa*), a field experiment was carried out in the field of Qaemshahr Azad University. Experimental design was arranged in split split plot in basis of Randomized Completely Block design with four replications. Planting date in three levels (23 May and 12 June) were allocated in the main plots and seedling age in two levels (25,35 day) were allocated in sub-plots and two rice cultivars (Mahali Tarom, Hashemi Tarom) were allocated in the sub-sub plots. Some agronomical traits such as total tiller number, fertile tiller number, panicle number per m^2, total spikelet per panicle, total sterile spikelet per panicle, 1000 grains weight, plant height, biologic yield, grain yield and harvest index were measured. Results showed that the effect of planting date on plant height, total sterile spikelet per panicle, 1000 grains weight, total tiller number, panicle number per m2, grain yield and harvest index was significant at 0.01 probability level. Also planting date had a significant effect on fertile tiller number at 0.05 probability levels. Seedling had a significant effect on fertile tiller at 0.05 probability level. When date of planting is delayed grain yield decreases because the 1000 grains weight decreases and total strile spikelet per panicle increases. In the Mahali Tarom total spikelet per panicle and total sterile spikelet per panicle are more than Hashemi Tarom.

Key words: *Oryza sativa*, planting date, seedling age, grain yield and yield components.

INTRODUCTION

Rice is the most important crop at the global level, as it is used as a staple food in most countries of the world (Dowling et al., 1998). Rice is the principle food crop of Iran, feeding almost hundred percent of its population. Rice scientists are engaged in developing new high yielding varieties and management practices to increase the productivity per unit land area per unit time. Achieving a sustainable increase in rice production can improve global food security and contribute to poverty alleviation. The reason for such low yield is mainly associated with cultural technologies (Barari, 2005). Transplanting rice in the optimum period of time is critical to achieve high grain yield. However, optimum rice planting dates are regional and vary with location and genotypes (Bruns and Abbas, 2006; Sha and Linscombe, 2005). BRRI and Yoshida reported that rice plants require a particular temperature for its phonological affair such as panicle initiation; flowering, panicle exertions from flag leaf sheath and maturity and these are very much influenced by the planting dates during Iran season. Rice seeded before the window of optimum dates usually has slow germination and emergence, poor stand establishment, and increased damages from soil borne seedling diseases under cold condition, as well as lose seeds to

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Table 1. Mean squares of agronomical traits of rice (*Oryza sativa*).

Source of variation	DF	Total tiller	Fertile tiller	Panicle m-2	Spikelet per panicle	Sterile pikelet per panicle	1000 Grain weight	Plant height	Grain yield	Biological yield	Harvest index at
Replication	3	0.65	0.94	1386.64	78.35	12.34	0.23	40.21	1805.24	67584.46	42.91
Transplanting date	2	27.00**	19.41*	7882.14**	12.38	560.31**	25.05**	589.68**	49768.31*	52086.27	495.02**
Error (a)	6	2.25	2.64	39.70	62.07	7.21	1.34	23.77	6697.28	65564.71	32.39
Seedling age	1	12.79*	1.54	188.02	116.09	12.17	1.12	8.52	77.52	10295.68	83.42
TD * SA	2	17.07*	18.99**	44.77	160.66	14.85	0.45	7.46	31187.77**	37852.93	81.89
Error (b)	9	2.29	1.45	71.79	63.60	3.62	0.24	10.37	2455.68	39073.29	52.80
Cultivar	1	5.24	5.49*	825.02*	1377.62**	29.84**	29.73**	120.17*	1813.02	13838.02	4.35
TD * CV	2	1.47	0.66	30.77	0.67	24.91**	0.56	20.97	12359.89**	8093.89	36.57
SA * CV	1	0.64	0.73	462.52	139.98	3.34	0.75	12.29	21547.68**	1530.02	71.83
TD * SA * CV	2	0.17	0.07	29.64	11.45	7.40	0.18	53.11	1093.68	7433.39	8.00
Error ©	18	1.34	1.16	106.45	52.18	3.80	0.53	15.48	2103.36	34053.43	24.83
% C.V	-	7.34	7.38	3.46	7.07	23.93	3.06	2.65	10.15	16.16	12.33

SA = Seedling age, TD = transplanting date, CV = cultivar, *, ** significant at 0.05 and 0.01 probability level.

birds (black birds, ducks, and geese) that are more concentrated in the early season (Linscombe et al., 1999).

Planting rice after the optimum dates can result in higher disease and insect incidence, tropical storm-related lodging, and possible cold damage during heading and the grain filling period resulting in low yields (Groth and Lee, 2003; Thompson et al., 1994).

Transplanting of healthy seedlings of optimum age ensures better rice yield. When seedlings are transplanted at the right time, tillering and growth proceed normally. However, when seedlings stay longer in seed nursery bed, primary tiller buds on the lower nodes of the main culm often degenerate. Primary tiller buds of 4^{th} to 7^{th} nodes are held inside when seedlings are planted at 7^{th} leaf age (Matsuo and Hoshikawa, 1993). Age of seedling at the time of transplanting is an important factor for uniform stand establishment of rice (Paddalia, 1981). On the other hand, if the age of seedlings is more than optimum, the seedlings produce less tillers due to reduce vegetative period and thereby results in poor yield. Thus, to improve yield and quality of fine rice, optimum age of seedling for transplanting needs investigations. Selection of suitable planting date and seedling age are the most important factors for maximizing rice production.

MATERIALS AND METHODS

The experiment was conducted at field of Qaemshahr Azad University in north of Iran (36°28' N and 52°53' E, 115 m above sea level). This experiment was laid out in split-split plot in basis of Randomized Completely Block design with four replications. transplanting date in there levels (3, 23 May and 12 June) were allocated in the main plots and seedling age in two levels (25, 35 day) were allocated in sub-plots and two rice cultivars (Mahali Tarom, Hashemi Tarom) were allocated in the sub-sub plots. The plot size was kept at 4 × 2.5 m and with spacing of 25 cm hill to hill and row to row. Nitrogen fertilizer in the form of urea was applied at the rate of 150 kg N ha^{-1} in two split doses. Half of nitrogen fertilizer was applied before transplanting while the remaining quantity applied as top dressing in the maximum tillering stage. Standards cultural practices were carried out until the plant was matured. Four hills (excluding border hills) were randomly selected from each plot for measuring total tiller number. Six hills (excluding border hills) were randomly selected from each plot prior to harvest for measuring yield components. Grain yield was determined from harvest area of 4 m^2 adjusting to 14% moisture content. All statistical tests were done using the Statically Analysis System (SAS, Institute, 1996) and mean values were compared by Duncan Multiple Range Test (DMRT).

RESULTS AND DISCUSSION

Effect of transplanting date

The transplanting date had a significant effect on

Table 2. Mean comparision of agronomical traits of rice (*Oryza sativa*).

Treatment	Total tiller	Fertile tiller	Panicle m-2	Spikelet per panicle	Sterile spikelet per panicle	1000 grain weight	plant height	grain yield	biological yield	Harvest index at
Transplanting date										
3 May	15.8b	15.0a	290.2b	102.2a	4.3b	24.6a	144.9b	481.18a	1101.4a	43.7a
23 May	14.5b	13.3b	281.3c	103.2a	5.3b	24.4a	144.6b	487.00a	1116.6a	43.6a
12 Jun	17.1a	15.4a	323.4a	101.5a	15.0a	22.4b	155.3a	387.62b	1206.9a	34.0b
Seedling age										
25 day	16.3a	14.8a	296.3a	100.7a	8.7a	23.6a	148.7a	450.66a	1188.0a	39.1a
35 day	15.3b	14.4a	300.3a	103.8a	7.6a	23.9a	147.9a	453.20a	1095.3a	41.7a
Cultivar										
Mahali Tarom	15.5a	14.3b	294.1b	107.6a	8.9a	23.0b	149.9a	445.79a	1124.7a	40.7a
Hashemi Tarom	16.1a	14.9a	302.4a	96.9b	7.4b	24.6a	146.7b	458.08a	1158.6a	40.1a

Means with similar letter(s) in each column are not significantly different at the 0.05 probability level according to Duncan's multiple range test.

plant height, total strile spikelet per panicle, 1000 grains weight, total tiller number, panicle number per m^2, grain yield and harvest index at 0.01 probability level; also transplanting date had significant effect on fertile tiller number at 0.05 probability level (Table 1). The highest strile spikelet number per panicle (15) was obtained in 12 June transplanting date (Table 2). These findings are in conformity with those of Ahmad et al. (1996) and Yoshida (1981).

The highest plant height (155.3) was obtained in 12 June transplanting date (Table 2). These findings are in conformity with those of Gines et al. (1987). The lowest 1000 grains weight (22.4 g) was obtained in 12 June transplanting date. The lowest grains yield (387.62 $g.m^2$) was obtained in 12 June transplanting date (Table 2). Noorbakhshian (2003) showed that the late transplanting date decreased grain yield. These findings are in conformity with those of Sabeti (2006) and Pirdashti (2003).

Effect of seedling age

Seedling age had significant effect on total tiller number at 0.05 probability level (Table 1). The highest tiller number (16.29) was obtained at 25 day seedling age (Table 2). Seedling age had no significant effect on fertile tiller number, total spikelet per panicle, sterile spikelet per panicle, 1000 grains weight and grain yield (Table 1). These findings are in conformity with those of Chandra and Manna (1988), Ali and Rahman (1992) and Paul (1994), who stated that the seedling age, had non-significant effect on grain yield. The highest spikelet number per panicle (103.83) was obtained in 35 day seedling. The highest grain yield (453.20 $g.m^2$) was obtained in transplanting at 35 day seedling (Table 2). Alam et al. (2002) showed that the least tiller number was produced in seedling of 21 day. In this research, the least total tiller number was obtained in seedling of 25 day.

Interaction of seedling age and transplanting date

The highest grain yield (527.37 $g.m^2$) was observed in the first transplanting date with 25 day seedling. The least grain yield (346.50 $g.m^2$) was produced in third transplanting date with 25 day seedling. Process changes of temperature, rainfall, day change and growth stages are set in Figure 1. Confert of flowering period in third transplanting date with low temperature and rainy days increased strile spikelet number per panicle and decreased 1000 grains weight. These two components reduced yield on third planting date.

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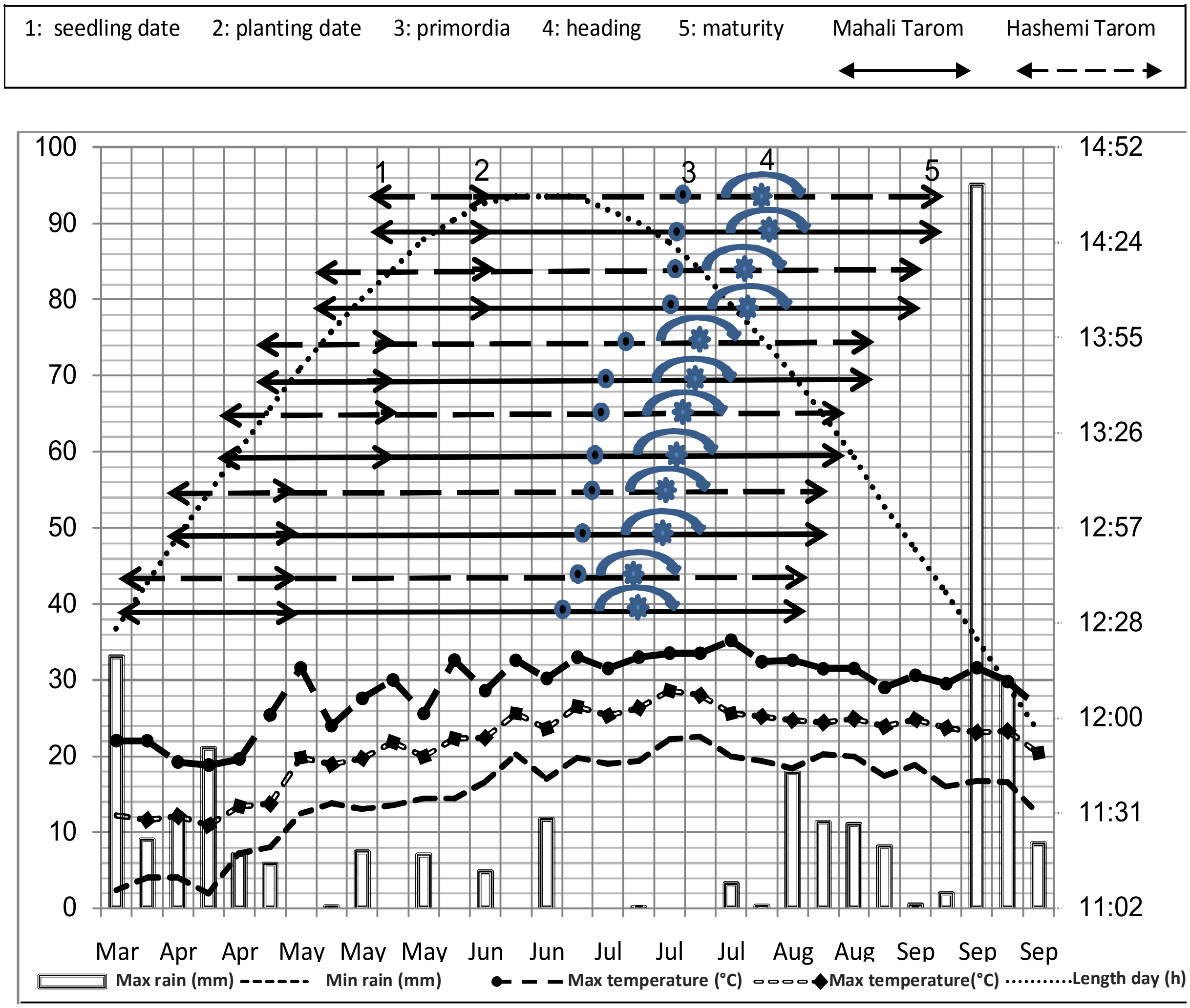

Figure 1. Process changes of temperature, rainfall, day change and growth stages.

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