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Effect of Cutting Time and Cutting Height on Yield and Yield Components of Ratoon Rice (Tarom Langrodi Variety)

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Abstract: In order to study the effect of cutting time and cutting height on yield and yield components of ratoon rice (*Oryza sativa* L.) Tarom langrody variety a field experiment was carried out in the field of Ghaemshahr Azad University in 2007. Experimental design was arranged in spilt plot in basis of Randomized Completely Block Design with four replications. Some agronomical traits such as numbers of effective tiller hill^{-1}, panicle number m^{-2}, total spikelet panicle^{-1}, filled spikelets percentage, 1000 grains weight, grain and biological yield and harvest index were measured. Results showed that the effect of cutting time on number of effective tiller hill^{-1}, panicle m^{-2}, percent filled spikelet panicle^{-1}, grain yield and harvest index were found statistically significant. Cutting height had a significant effect on number of tiller in hill, number of effective tiller in hill, number of panicle m^{-2}, filled spikelet panicle^{-1} percentage, grain yield and harvest index. Interaction among cutting time and cutting height on number of tiller hill^{-1}, number of effective tillers hill^{-1}, number of panicle m^{-2} percent filled spikelet panicle^{-1} were significant. According to results cutting time at physiological maturity and also cutting in 40 cm cutting height from soil surface for the best grain yield of ratoon rice were recommended.

Key words: Rice, cutting time, ratoon, yield

INTRODUCTION

Rice (*Oryza sativa* L.) is an important primary crop in the world. It is the staple food for more than two third of the world's population. One of the several ways for increasing income of rice farmers is increasing of land utility. Reharvesting or ratoon cropping is one of the most important factors for increasing rice production and income of rice farmers. Ratoon cropping of rice is the practice of obtaining a second crop from the stubble of a previously harvested (main) crop (Turner and Junes, 1993). Enhances rice grain yields without increasing land area because it provides higher resource use efficiency per unit of land area and per unit of time (Bond *et al*., 2005). Ratooning of rice may be agronomically possible in climates when the crop season is too short to produce two rice crops but factors in influencing ratoon rice yields are not well understood. Ratoon affected by some factors like variety, planting space, cutting height, pest and diseases, weed, planting date of main plant, soil fertility, Total nonstructural carbohydrates, leaf agedness, heat degree, light radiation and growth regulators. Cutting height had different effect on ratoon yield. Some ratoon characteristics that affected by cutting height are grain yield, tillering and growth period length. For increase rice ratoon grain yield cutting height must be 0-50 cm from soil surface (Turner, 2007). Pirdashti *et al*. (2006) suggested that most ratoon yield was produced at 15 cm cutting height. Some reports showed that decreased in cutting height causes delaying in ratoon grain maturity (Rahman *et al*., 2007). Ting and Liu (1996) showed that cutting height at 5 to 15 cm had not significant effect on biological yield of rice ratoon in a experiment. Jason (2006) reported that cutting at appropriate height had positive effect on ratoon yield. Ting and Liu (1996) suggested that the most ratoon yield were produced in cutting height at 5 cm. the ratoon crop matures earlier, it has been reported that days to maturity of the ratoon crops are 65% less than the main crop. It requires 50-60% less labour. Require less water inputs, water use efficiency is high and crop use 60% less water than the main crop. The production cost is lower due savings in land preparation, transplanting or direct seeding and crop maintenance during early growth (Rahman *et al*., 2007).

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For better yield of ratoon crop is possible by adopting appropriate management practices for main crop as well as to ratoon crop. These management practices include land preparation, adequate plant density and spacing, use of appropriate cultivars, water management, application adequate rate of fertilizers, appropriate height of cutting and control of diseases, insects and weeds (Wilson, 2001). Little specific information is available on the effect of many main crop management practices on ratoon crop performance. The main objective of this study was to evaluate the effect of main crop harvest cutting height and time on ratoon crop agronomic performance, yield and yield components.

MATERIALS AND METHODS

The experiment was conducted at the field of Ghaemshahr Azad University, Iran (52°22' N, 36°28' E, altitude 28 m) in 2007. This experiment was laid out in split plot in basis of Randomized Completely Block Design with four replications. The soil total N and organic carbon contents were low. The available P and exchangeable K contents are medium (Table 1). The plot size was 15 m^2. Main factor was cutting time in two levels (T_1: the physiological maturity and T_2: 10 days after the physiological maturity) and minor factor was cutting height from the soil surface in five levels (H_1: ground cutting, H_2: 10, H_3: 20, H_4: 30 and H_5: 40 cm). All plots were fertilized with 100 kg P_2O_5 ha^{-1} and 100 kg K_2O ha^{-1} before transplanting. The applied nitrogenous fertilizer was 50 kg N ha^{-1} urea in ratoon crop. Recommended agronomic all practices were followed and crop was harvested. Six hills (excluding border hills) were randomly selected from each plot for measure yield components. Grain yield was determined from harvest area of 5 m^2 adjusting to 14% moisture content. All statistical tests were done using the Statically Analysis System (SAS, 1996) and mean valves were compared by Duncan Multiple Range test (DMRT).

Table 1: Physical and chemical properties of the top soil in the experimental field at Ghaemshahr Azad University

Soil parameters	Values
pH	7.500
Organic carbon (%)	0.730
Total N (%)	0.071
P available (mg kg^{-1})	9.800
K exchangeable ($cmol^{(+)}$ kg^{-1})	0.240
Textural class	Loam

RESULTS AND DISCUSSION

Cutting height: Results showed that cutting height had significant effect on number of tillers per hill and filled spikeletes percentage at 1% probability level also number of effective tillers $hill^{-1}$, number of panicle m^{-2} and grain yield were influenced significantly by cutting height at 5% probability level. Most number of tillers $hill^{-1}$, number of effective tillers $hill^{-1}$ and grain yield were obtained in H_5 cutting height. Most number of panicle m^{-2} (120.8) and filled spikelets percentage (79.82) were obtained in H_3 and H_4 cutting height, respectively. Pirdashti *et al*. (2006) showed that the highest number of tiller $hill^{-1}$, highest number of effective tillers $hill^{-1}$ and panicle m^{-2} were produced in 40 cm from soil surface cutting height. Cutting height had not significant effect on number of spikelet $panicle^{-1}$, 1000 grain weight, grain and biological yield and harvest index.

Cutting time: The cutting time had a significant effect on number of effective tillers $hill^{-1}$, panicle m^{-2}, percent of filled spikekets, grain yield and harvest index at 0.01 probability level (Table 2). The highest number of effective tillers hill (8.66), panicle m^{-2} (138.6), percent of filling spikelets (82.59), grain yield (1294.1 kg ha^{-1}) and harvest index (30.5) were obtained in harvesting physiological maturity (Table 3). This was perhaps due to decreased to delay cutting time and decreased in temperature cause reduce in yield and component yield. Cutting time had not significant effect on number of tillers $hill^{-1}$, number spikelets per panicle, 1000 grain weight and biological yields. Results of this study are in agreement with those Thuamkham (2003) were obtained.

Interaction of cutting time and cutting height: Effect of cutting time and cutting height on yield and components yield are presented in Table 4. The highest number of tillers (17.33) and effective tillers $hill^{-1}$ (10.23),

Table 2: Mean squares of yield and yield components in ratoon rice (Tarom Langrodi Variety)

SOV	df	No. of tillers $hill^{-1}$	No. of effective tillers $hill^{-1}$	No. of panicle (m^{-2})	No. of spikelets $panicle^{-1}$	Filled spikelets (%)	1000 grain weight (g)	Grain yield	Biological yield	Harvest index
Rep	3	4.641	1.060	271.445	1.24	6.590	1.143	62023.80	49749.70	12.80
Cutting time	1	134.023	132.741**	33976.400**	22.60	1918.400**	1.540	2654690.80**	14137877.80	774.10**
Error (a)	2	13.452	0.600	153.870	224.39	14.072	0.320	103802.30	1722450.50	2.04
Cutting height	4	18.021**	6.019*	1540.340*	39.57	160.880**	1.271	108479.80*	662313.40	25.63
CT×CH	4	14.266**	6.256*	1601.940*	69.50	13.921**	1.144	77198.80	106229.30	74.20
Error(b)	16	3.397	2.420	523.030	87.22	2.992	1.831	52307.30	921478.30	26.15
CV		16.130	21.790	21.790	25.23	2.320	5.690	22.36	18.79	20.12

df: Degree of freedom, CT: Cutting time, CH: Cutting height * and **: Significant at 5 and 1% a probability levels, respectively

Table 3: Effects of cutting time and cutting height on the yield and yield components in ratoon rice (Tarom Langrodi Variety)

Treatments	No. of tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of panicle (m^{-2})	No. of spikelets panicle^{-1}	Filled spikelets (%)	1000 grain weight (g)	Grain yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (%)
Cutting time									
T_1	13.54a	8.660a	138.60a	37.74a	82.59a	23.55a	1294.1a	3597a	30.50a
T_2	9.31a	4.450a	71.30b	36.00a	66.60b	24.01a	699.2b	2824a	25.34b
Cutting height									
H_1	8.83b	5.303b	84.8b	39.07a	67.05	24.22a	1028.9ab	2826ab	26.52a
H_2	11.31a	5.660b	90.59b	33.44a	72.90	23.23a	985.5ab	3004a	26.50a
H_3	11.02ab	7.510a	120.80a	35.30a	74.15	23.55a	828.6b	2444b	24.00a
H_4	12.60a	7.170a	114.30a	36.97a	79.82	23.47a	943.5ab	2879ab	25.55a
H_5	13.36a	7.740a	114.90a	39.56a	79.07	23.33a	1196.8a	3370a	27.53a

Means with similar letter(s) in each column are not significantly different at the 0.05 probability level according to Duncans Multiple Rang test, T_1: Physiological maturity, T_2: 10 day after physiological maturity, H_1: Ground cutting, H_2: 10 cm cutting height of soil surface, H_3: 20 cm cutting height of soil surface, H_4: 30 cm cutting height of soil surface, H_5: 40 cm cutting height of soil surface

Table 4: Interaction effects of cutting time and cutting height on the yield and yield components in ratoon rice (Tarom Langrodi Variety)

Treatments	No. of tillers hill^{-1}	No. of effective tillers hill^{-1}	No. of panicle (m^{-2})	No. of spikelets panicle^{-1}	Filled spikelets (%)	1000 grain weight (g)	Grain yield (kg ha^{-1})	Biological yield (kg ha^{-1})	Harvest index (%)
T_1H_1	12.03bcd	9.23a	146.10a	38.14a	72.40cc	24.22a	1378.00ab	3667ab	31.40ab
T_1H_2	9.34de	6.22bc	99.50b	35.14a	81.83bb	23.32a	963.30cd	3610ab	25.07abc
T_1H_3	14.82	8.92	142.70a	36.61a	88.87a	23.60a	1365.00ab	2944abc	31.53ab
T_1H_4	14.15abc	8.80ab	140.90a	37.70a	82.20a	23.51a	1343.00ab	3595ab	32.93a
T_1H_5	17.33a	10.23a	163.70a	38.70a	72.40c	23.40a	1587.00a	4171a	31.40ab
T_2H_1	9.38de	4.08cd	64.80bc	37.50a	61.70e	24.14a	691.70def	2044cdef	21.57cde
T_2H_2	9.99de	5.87c	94.19b	35.50a	63.97de	23.78a	759.80de	2399cde	21.50cde
T_2H_3	8.33e	4.38cd	70.19bc	35.50a	65.63d	23.78a	693.90def	1944cdef	22.93bc
T_2H_4	7.79e	2.40d	38.45c	36.80a	70.77c	23.81a	543.70efg	2164bcde	23.50def
T_2H_5	11.05cde	5.55c	88.80b	38.90a	70.93c	23.78a	806.90de	2570bcd	22.80cd

T_1: Physiological maturity, T_2: 10 day after physiological maturity, H_1: Ground cutting H_2: 10 cm cutting height of soil surface, H_3: 20 cm cutting height of soil surface, H_4: 30 cm cutting height of soil surface, H_5: 40 cm cutting height of soil surface, Means with similar letter(s) in each column are not significantly different at the 0.05 probability level according to Duncans Multiple Range test

panicle m^{-2} (163.7) were obtained in first cutting time (physiological maturity) in case of cutting height of 40 cm (Table 4). Some reports stated that the highest number of tillers hill^{-1} and panicle m^{-2} were obtained in physiological maturity in cutting height of 40 cm. The highest percent filled spikelets (88.87) and the lowest (61.70) were found in third cutting height in ground cutting height and second cutting time (20 day after physiological maturity) in cutting height of ground cutting, respectively (Table 4). Grain yield was not influenced significantly by interaction of cutting time and height. However the mean values showed that the highest grain yield (1587 kg ha^{-1}) was observed in first cutting time in cutting height of 40 cm. The least grain yield (691.7 kg ha^{-1}) was produced in two cutting time in for cutting height 30 cm.

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