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RESEARCH ARTICLE

EFFECTS OF PLANTING DATE AND PLANT DENSITY ON YIELD AND YIELD COMPONENTS OF HULLESS BARLEY

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ABSTRACT

An experiment was conducted on research farm in Gorgan University of Agricultural Sciences and Natural Resources during the crop year of 2005-2006to study the effects of planting date and density on yield and yield components of hulless barley. An experiment was carried out as factorial by using the randomized complete block design with four replications. The examined factors were included three levels of planting date in 27 NoV, 23DeC, 2Feb and density was at three levels of 200, 300 and 400 plants per square meter. The results showed that the effect of planting date on yield and yield components was significant and the number of spike per square meters and the number of grain in spike and the weight of thousand grain decreased through the delay in planting, and the number of spike per square meters increased through adding the density, ut the number of grains in spike and the weight of thousand grains decreased. Also, the yield decreased through reducing the density and delaying in planting.

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INTRODUCTION

The nutritional value of hulless barley is higher than the ordinary barley. Its crude protein compared to normal barley is more 1 to 2 percent. Producers of barley prefer the hulless barley than the ordinary barley due to higher amount of lysine (Salehi, 2006). Planting the hulless barley has been growing to feed poultry during the last two decades in Europe and in the world because of the above benefits. The best planting date of crop plants is important in such a way that the agenda is set according to it and the more products to be earned (Yazdi Samadi, 1993). Salehi and colleagues (2006) showed that the different planting dates have a significant effect on yield and yield components, especially the number of clusters per unit area of hulless barley. Means of density is to plant a certain amount of seed per unit area of land; it is expected that the result of this action almost gives a certain number of plants per unit area. The number of plants per unit area is also called plant density per unit area (Khajehpour 2003). Through the effect of different densities on hulless barley, Asgarzadeh *et al*. (2007) stated that biological yield and harvest index increased significantly by increasing density of seed yield, and this is due to the increase in leaf area index and number of spikes with increasing density per unit area. Danayi and Ayeneh (2001), Salehi and colleagues (2006) reported the increase of yield in hulless barley along with increasing the density.

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MATERIALS AND METHODS

This experiment was conducted as a factorial in a randomized complete block design with four replications in 2005-2006 at research farm in Gorgan University of Agriculture and Natural Resources (latitude 37 degrees and 45 northern minutes and longitude 54 degrees and 30 eastern minutes, and height of 120 m above sea level).Treatments included three plant dates of 27 NoV, 23 DeC, 2 Feb and density was at three levels of 200,300, and 400 plants per square meter.

There was no irrigation due to the implementation of the project as rainfed; the tissue type of farm soil was also based on the results obtained in the soil science laboratory of Silty Clay Loam. According to fertilizer recommendation of soil science laboratory, 160 kg per hectar triple super phosphate, 160 kg per hectare potassium sulfate, and 150 kg per hectare urea fertilizer was given to land by hand.

It should be noted that the urea fertilizer was given to land in three steps (before planting, tillering and head emergence) with 50 kg per hectare at any stage, and phosphate triple and potassium sulphate before planting. The number of 20 plants from each plot was harvested to determine the grain yield components in physiological maturity step and the number of spikes per square meter, the number of grains per spike and the weight of thousand grain were determined. An area equivalent to one square meter from two center line of each plot, that was remained intact from the beginning to this purpose, were harvested in step maturity (when the plants were completely yellow), and grain yield per unit area was identified after transferring to the laboratory. The SAS software was used to analyze the test data and the Excel software for drawing diagrams. Comparison of averages of each trait was conducted by using the LSD test at the probability of 0/05.

Table 1. Max temperature, min temperature, radiation and sum of rain in growth season in Gorgan

Radiation($_{mj/m2}$)	Rain($_{mm}$)	Min temp(c^{0})	Max temp(c^{0})	Month
13/06	41/1	7/4	17/9	Nov
11/3	141/2	2/1	10/8	Dec
8/3	51/5	3/4	12/5	Jan
9/1	27/7	6/4	18/2	Feb
8/7	31/8	9/9	20	Mar
10/1	48/4	14/7	23/1	Apr
19/4	5/9	19/4	32/8	May

Table 2. Analysis of variance of yield and yield component

S.O.V	Fd	Number of spikelet per m2	Number of seed in spiklet	1000grain weight	Yield
Replication	3	2824^{ns}	1/2^{ns}	13/7**	80834^{ns}
Planting Date	2	39675**	40**	95/9**	19279330**
Plant density	2	1259233**	12**	46/9**	9132562**
Planting date×Plant density	4	24406**	1/3^{ns}	1/3^{ns}	193764^{ns}
Error	24	2/3	0/79	3/4	143435
CV		52/5	5/3	5/2	8/8

Ns, **, *: non-significant and significant, respectively, at the level of 1 per cent and five per cent

Table 3. Mean comparison of yield and yield components for different planting date and plant density

Treatment	Number of spikelet per m2	Number of seed in spiklet	1000grain Weight(gr)	Yield (kg/ha)
27Nov	1079/3^{a}	18/66^{a}	38/58^{a}	**5518/10**^{a}
23Dec	1037/5^{b}	16/83^{b}	35/61^{b}	**4315/83**^{b}
2Feb	965/6^{c}	15/00^{c}	32/93^{c}	**2984/16**^{c}
200Pl/m2	674/9 ^{a}	17/83a	37/86^{a}	**3330/43**^{a}
300Pl/m2	1095/5^{b}	16/83^{b}	35/29^{b}	**4435/36**^{b}
400Pl/m2	1312^{c}	15/83^{c}	33/97^{c}	**5052/29**^{c}

Means with similar letters in each column are not significantly different at the %5 level of probability. (Lsd)

RESULTS AND DISCUSSION

Yield components

Effect of planting date was significant on all yield components (Table 2).With the delay in planting the number of spikes per square meters, the number of grains per spike and thousand grain weight decreased significantly (Table 3).Increasing the yield components on earlier planting dates can be mainly attributed to increase during the growing season and the greater use of environmental factors. Also, pollination time in earlier planting dates copes with the more suitable temperatures that lead to increase the number of grains per spike and the weight of thousand grain. The effect of density on yield components was significant (Table 2).The number of spikes per square meter increased by adding the density, but the number of grains per spike and the weight of thousand grains decreased (Table 3).The reason of reducing the number of grains per spike and the weight of thousand grain through increasing the density can be attributed to increase the competition among plants for receiving the light and decrease the photosynthesis under high compression condition.

Yield

The effect of planting date on yield was significant and different planting dates had a significant differences in terms of yield (Table 2). Amount of yield decreased through the delay in planting, thus planting date of 27Nov had the highest yield with an average yield of 5518 kg per hectare and planting date of 2feb had the lowest yield with 2984 kg per hectare (Table 3).

The reason for this issue can be considered because of the more all yield components in early planting dates that is the same with the results of Salehi *et al*. (2006) in hulless barley, Ravari *et al*. (2002) in barley, and Donald and Eghball (1999) in wheat. As well as, absorption rate of solar radiation reduce with the delay in planting and this issue also is effective on the yield reduction due to delay in planting (Stapper and Fisher, 1990). The effect of density on yield was significant (Table 2) and the yield rate was increased significantly by increasing the density (Table 3), which is accordance with the results of Salehi and colleagues (2006) in hulless barley, and that of Tompkins *et al*. (1991) in wheat. The interaction between planting date and density was significant only on the number of spikes per square meter. The number of spike per square meter increased significantly in all planting dates with

increasing of density (Table 3).While the number of grains per spike and the weight of thousand grain decreased by increasing the density.

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