INNSPUB

International Journal of Biosciences | IJB |
ISSN: 2220-6655 (Print) 2222-5234 (Online)
http://www.innspub.net
Vol. 5, No. 4, p. 256-262, 2014

RESEARCH PAPER OPEN ACCESS

Effect of delay cropping system on some agronomic characteristics of wheat (*triticum aestivum* L.) cultivars in Dorud region, Iran

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Key words: Delay cropping, wheat and sowing.

http://dx.doi.org/10.12692/ijb/5.4.256-262 Article published on August 26, 2014

Abstract

Two field experiments were laid out in order to study on effects of delaying cropping system on growth and yield components of different wheat cultivar in Iran in two years 2011 and 2012. The trial was laid out in RCBD with split plot arrangement having three replications at Dorud, Lorestan province, Iran. Five sowing dates i.e. October 31, November 15 and 30, December 15 and 30 were in main plots, whereas five wheat cultivars (Pishgam, Parsi, Bahar, Sivand and Pishtaz) were in sub plots. Results shows that the effect of year, sowing date and cultivar were significant on all parameters. Maximum number of grain per spike and HI related to 31-Oct and Sivand cultivar treatments. Sivand cultivar has the highest seed yield in two years and the Parsi cultivar has the lowest seed yield. The highest seed yield for sowing date gave at 31-Oct sowing date and the lowest seed yield gave at 30-Dec sowing date. In final results of present study showed that for achieve to highest seed yield must be sowing Sivand cultivar in 31-Oct sowing date.

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Introduction

In late planting season, temperature of soil can be expected to be below 10°C, which affects the seed germination and stand establishment. Generally wheat like other cool season crop is seeded early to take maximum period for growth and development toward maturity before the (possible) heat stress. However, mid-season seeding of winter wheat for any locality is usually most favorable, whereas late sown wheat suffers more winter injury, which produces fewer tillers and may ripen in lower grain weight and number of grains per plant (Razzaq *et al.,* 1986). The genotypic response of wheat to planting dates varies for yield contributing characters due to different genetic potential. The decline becomes prominent in the cultivars requiring more days for heading under normal planting. Increase in temperature cause shortens of headingperiod (Tashiro & Wardlaw, 1990). When optimum condition was provided by the wheat cultivar, grain filling period was higher as compared to late sown condition under high temperature stress at maturity. Similarly, cultivars matured earlier when planted late, indicating the forced maturity due to high temperature.

About 80% of the global cereal production comes from wheat, maize and rice but their yield is greatly affected by these unwanted plants. Wheat (*Triticum aestivum* L.) is the most important cereal throughout the world. It has been estimated that globally yield reduction in wheat due to weeds is 13.1% (Zadoks *et al.*, 1996) or even more in some cases which is indeed a great loss towards food self sufficiency. In wheat uniform stand establishment and early vigor are the principal determinant of crop performance (Chivasa *et al.,* 1998). Amongst the factors limiting the uniform stand establishment poor quality seed (Radford, 1983), poor seedbed preparation (Joshi, 1987), low moisture (Harris, 1996), conventional sowing (Radford, 1983), late sowing and sub-optimum temperature at sowing (Farooq *et al.,* 2008) are more important in our region. Late plantingaffects the growth, yield and quality of wheat, because earlysowing produces higher yields than late sowing due tolonger duration. Temperatures below or above normal alter plant functions and productivity. In late planted wheat, low temperature prevailing during germination substantially affects the germination and seedling emergence. Germination is a critical process, as temperature below 12°C result in poor and uneven emergence (Timmermans *etal.,* 2007). Therefore, the rate of emergence and finalemergence percentage are important factors in determine the crop potential in various temperature of wheat production.

Study on cultivation in suitable date has been investigated in Dorud region on wheat. Delay cropping studies was not enough for wheat production, therefore this study was planned to examine effect of different sowing dates on some agronomic characteristics in common wheat cultivars.

Materials and mhetods

experimental design

A field experiment was laid out in order to study effect of different date sowing on some agronomic characteristics of different common wheat (*triticum aestivum* L.) cultivars at Dorud region, Iran in 2011 and 2012 years. The soil type was a clay loam, pH of 7.92 and EC = 0.63 ds m^{-1}. The Dorud region has a continental semi-arid climate with annual precipitation of 372 mm. About 50% of this falls during the wheat and barley growing period. The experimental design was a split-plot with three replications in both two years. There were six rows in each plot for any cultivarsd; rows were 6 m long with 1.2 m width.

Treatments

Treatments in main plots were including two year (Y_1 and Y_2), five date of sowing consist of October 31 (A_1), November 15 (A_2), November 30 (A_3), December15 (A_4) and December 30 (A_5) and treatments in sub plots were including five cultivars consist of Pishgam (B_1), Pishtaz (B_2), Parsi (B_3), Sivand (B_4) and Bahar(B_5). At maturity, two outer rows for each plot, 50 cm from each end of the plots, were left as borders and the middle 1 m^2 of the two central rows were harvested. Each sample was oven dried at 80C and grain yield measured. Then yield components of

cultivars were determined.

Statistical analysis

Data were analyzed with MSTAT-C and SPSS statistical softwares.

Results

Plant height

Results of combined analysis showed that the effect of year, sowing date, cultivar and interaction between sowing date and cultivar on the plant height were significant (table 1). The comparison of the mean values of the plant height for cultivars showed that Pishgam, Sivand and Bahar cultivar has the highest (74cm) and the Parsi cultivar had the lowest plant height (67cm) (table 2). The comparison of the mean values of the plant height for date of sowing showed that 31-Oct sowing date had the highest (81cm) of it (table 2).

Number spike per m²

Results of combined analysis showed that the effect of year, sowing date and cultivars on the number of spike per m² were significant (table 1). The comparison of the mean values of the number of spike per m² for cultivars showed that Sivand cultivar had the highest (931) and the Pishgam cultivar had the lowest number of spike per m² (769) (table 2). The comparison of the mean values of the number of spike per m² for date of sowing showed that 31-Oct sowing date had the highest (1037) and 30-Dec sowing date had the lowest (630) of it (table 2).

Table 1. Combined analysis of variance (mean squares) for yield components of wheat cultivars in different sowing dates.

		MS						
S.O.V	df	Plant height	number of spike per m²	number of grains per spike	1000 grain weight	Grain yield	Biomass	HI
Year (Y)	1	2161.4**	2957.4**	587.27**	626.28**	11.07**	122.21**	257.9**
R	4	21.58	621.2	8.5	4.26	0.65	4	6.69
Sowing date (A)	4	2111.87**	910544**	827.82**	845.1**	106.4**	965.76**	508.97**
Y*A	4	5.87	2904	2.29	2.24	0.2	2.65	1.42
Error-a	16	8.77	16518	7.2	2.65	0.42	1.5	8.24
Cultivar(B)	4	277.42**	224950.7**	180.2**	262.25**	47.49**	807.51**	262.64**
Y*B	4	0.77	577.2	0.5	1.01	0.12	2.2	0.97
A*B	16	22.27	15094	12.4	11.21**	1.22**	49.7**	22.08**
Y*A*B	16	0.06	77.2	0.04	0.02	0.004	0.14	0.09
Error-b	80	7.2	16415	9.59	2.8	0.46	1.99	7.82
Total	149	86.72	44794.3	28.59	29.82	4.7	55.26	24.62
CV(%)		4	15.2	8.2	5	12.1	8.2	9.5

ns: Non-significant, * and **: Significant at 5% and 1% probability levels, respectively.

Number of grain per spike

Results of combined analysis showed that the effect of year, sowing date and cultivars on the number of grains per spike were significant (table 1). The comparison of the mean values of the number of grain per spike for cultivars showed that Sivand cultivar had the highest (41) and the Pishtaz cultivar had the lowest number of grains per spike (37) (table 2). The comparison of the mean values of the number of grain per spike for date of sowing showed that 31-Oct sowing date had the highest (44) and 30-Dec sowing date had the lowest (31) of it (table 2).

1000 grain weight

Results of combined analysis showed that the effect of year, sowing date, cultivar and interaction between sowing date and cultivar on the 1000 grain weight were significant (table 1). The comparison of the mean values of the 1000 grain weight for date of sowing showed that 31-Oct sowing date had the highest (44g) of it and 30-Dec has the lowest (32g). The comparison of the mean values of the 1000 grain for cultivars showed that Sivand cultivar had the highest (44g) and the Pishtaz cultivar had the lowest 1000 grain (37g) (table 2).

Grain yield

Various wheat cultivars showed difference among the grain yield of wheat on different sowing date (Table 1). Results of combined analysis showed that the effect of year, sowing date, cultivar and interaction

between sowing date and cultivar on the grain yield were significant (table 1). The comparison of the mean values for grain yield shows that Sivand cultivar has the highest seed yield (7.1 ton/ha) and the Parsi cultivar has the lowest seed yield (3.6 ton/ha) and the difference was significant (table 2). Sivand cultivr was the best among all the cultivars for seed yield. The results were in line with Ansari *et al.* (1989), Khan *et al.* (1989), Sandhu *et al.*, (1978), and Tunio *et al.*, (1995). The comparison of the mean values of the grain yield for date of sowing showed that 31-Oct sowing date had the highest (7.3 ton/ha) of it and 30-Dec has the lowest (2/73 ton/ha).

Table 2. Simple mean comparisons for for yield components of wheat cultivars in different sowing dates.

Treatments	Plant height	number of spike per m²	number of grains per spike	1000 grain weight	Grain yield	Biomass	HI
Year(Y)							
Y1	75.95	886	29.6	40.8	5	18	30
Y2	68.26	797.2	25.6	36.8	4.9	16	27
Sowing date (A)							
A1	81.26^{a}	1027^{a}	44.1^{a}	44^{a}	7.3^{a}	23.4^{a}	34.6^{a}
A2	78.1^{b}	994.7^{a}	41.6^{b}	42^{b}	6.6^{b}	22.2^{a}	32^{b}
A3	72.5^{c}	826^{b}	27^{c}	39^{c}	5.2^{c}	17.3^{c}	29.2^{c}
A4	67.2^{d}	719^{c}	22.8^{d}	35^{d}	4^{d}	13.5^{d}	26.6^{d}
A5	60.5^{e}	620^{d}	21^{e}	32^{e}	2.7^{e}	10^{e}	24.2^{e}
Cultivar(B)							
B1	72.4^{a}	729^{c}	29^{b}	38^{c}	5.09^{b}	17.1^{b}	25^{d}
B2	71.6^{b}	855^{b}	27^{c}	37^{c}	5.05^{b}	14.9^{c}	31^{b}
B3	67.1^{c}	778^{c}	25^{d}	34^{d}	3.6^{c}	11.4^{d}	29.2^{c}
B4	74.5^{a}	961^{a}	41^{a}	44^{a}	7.1^{a}	25.5^{a}	33.6^{a}
B5	74.1^{a}	874^{b}	25.7^{cd}	39^{b}	5.04^{b}	17.4^{b}	26.5^{d}

Means by the uncommon letter in each column are significantly different ($p<0.05$).October 31 (A_1), November 15 (A_2), November 30 (A_3), December15 (A_4) and December 30 (A_5) and treatments in sub plots were including five cultivars consist of Pishgam (B_1), Pishtaz (B_2), Parsi (B_3), Sivand (B_4) and Bahar(B_5).

Biomass yield

Results showed that the effect of year, sowing date, cultivar and interaction between sowing date and cultivar on the biomass yield were significant (table 1). The comparison of the mean values of the biomass yield for date of sowing showed that 31-Oct sowing date had the highest (23 ton/ha) of it and 30-Dec has the lowest (10.5 ton/ha). Sivand cultivar has the highest biomass yield (24 ton/ha) and the Parsi cultivar has the lowest biomass yield (11 ton/ha) and the difference was significant.

Table 3. Correlation matrix of mean productivity, for for yield components of wheat cultivars in different sowing dates.

	Biomass	number of spike per m²	number of grains per spike	1000 grain weight	Grain yield	HI	Plant height
Biomass	1	0.26*	-0.2	0.46**	0.86**	-**0.56	0.1
number of spike per m²		1	0.17	0.09	0.59**	0.24**	0.2
number of grains per spike			1	-0.19	0.62**	-0.02	-0.05
1000 grain weight				1	0.84**	0.68**	-0.1
Grain yield					1	0.77**	0.42**
HI						1	0.18
Plant height							1

* and **:Significant at 5 and 1% probability levels, respectively.

Harvest index (HI)

Results of combined analysis showed that the effect of year, sowing date, cultivar and interaction between

sowing date and cultivar on the HI were significant (table 1). Results showed that the effect of cultivars on HI was significant only (Table 1). The comparison of the mean values of the HI for cultivars showed that Sivand cultivar had the highest (35%) and the Pishgam cultivar had the lowest HI(25%) (Figure6). The comparison of the mean values of the HI for date of sowing showed that 31-Oct sowing date had the highest (34%) of it and 30-Dec has the lowest (24%) (table 1).

Simple correlation between treats

The correlation matrix (Table 3), indicated strong and significant ($p<0.01$) correlation of grain yield with plat height (r=0.42), number of spike per plant (r=0.59) , number of grain per spike (r=0.63), 1000 grain weight (r=0.84), harvest index (r=0.77) and biomass yield (r=0.86). These results were agreement with the previously reported ones (ICARDA, 1993). Such results indicated that selection for these traitswould lead to the increase in grain yield (El-Gizawy and Mehasen, 2004).

Conclusion

Combined analysis showed that the highest seed yield gave at 31-Dec sowing date and the lowest seed yield gave at 30-Dec sowing date and difference was significant. The decrease in seed yield was closely associated with lower 1000- seed weight with late sown crops, as was reported by Darwinkel *et al*, (1977). The date from sowing to anthesis was longer in the late sown crop, as compared to the earliest sown, presumably due to relatively lower temperatures during anthesis of the late sown crop. Green *et al.* (1985) stated that crops sown at different dates pass through each developmental stage under different environmental conditions. Thus, the late sown crops in this study passed through cooler temperatures, and were associated with late flowering. Ishag and Mohamed (1995) reported that phasic development stages of wheat are affected by genetic and environmental factors. Sowing date had a great effect on the duration of grain filling. Late sown crops (early and mid- August) were severely affected by frost damage during the second and third weeks of November in both seasons and at the two sites.

The analysis of variance in shows that the effects of sowing sowing date × cultivar was significant (table 1). Interaction effect of sowing date and cultivars on seed yield of wheat shows that the highest seed yield gave at 31-oct sowing date in all cultivars and difference of it between other sowing dates was significant. Sivand cultivar has high seed yield in all sowing dates. Sivand cultivar gave highest and lowest seed yield in 31-Oct and 30-Des respectively. These results suggest that cultivars should be chosen to suit the seasonal break, which may vary from October to December. Under late sowing, early germination and seedling growth are very important for better stand establishment of wheat crop. This might be due to the ability to tolerate low temperature during the germination. Benjamin (1990); Stewart *et al.* (1990) reported that low temperature during the germination and early seedling has detrimental effect on the crop establishment and productivity. Tillering starts after the completion of the germination and reaches to the maximum at the end of the vegetative growth stage. Maximum number of productive tillers contributes to the highest yield. However, for late sown condition, Bahar and Pishgam cultivars produced more productive tillers due to better germination and stand establishment as compared to other cultivars those had poor stand establishment. Poor emergence and stand establishment result in fewer fertile tillers (Farooq *et al.*, 2008). The pattern of the tillering is affected by the sowing dates due to change in temperature and contribution of tillers to grain yield is maximum during the early planted crop and decreased with delayed planting.

The early sowing resulted in better development of the grains due to longer growing period. As timey planted wheat had more time for the dry matter accumulation to produce the higher seed yield (Spink *et al.*, 2000; Shahzad*et al.*, 2002). It can be concluded that early sowing in October November is optimum at elevations of seed yield of wheat cultivars. However, at the higher elevation, the sowing date can

be extended to the latest week of October. Sivand cultivar gave highest yield for sowing dates but Pishgam cultivar was better for sowing in 15-Nev and Bahar cultivar was better for sowing in 15-Dec. However, for gave of highest seed yield we should sowing these cultivars in those dates.

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