Original scientific paper
10.7251/AGSY1404133A

THE EFFECT OF PLANT DENSITIES AND PLANT ORIENTATION ON YIELD AND YIELD COMPONENTS IN WHEAT CULTIVARS

Hava Mirzadeh ABGARMI[1], Abbas BIABANI[2]*, Ali Rahmeni KARIZAKI[3]. Hossein Ali FALAHI[4], Azarnia[5]

[1]Master student in the agronomy Plant Production Department, in Gonbad Kavous University, Iran
[2]Faculty member of Plant Production Department, in Gonbad Kavous University, Iran
[3]Faculty member of Plant Production Department, in Gonbad Kavous University, Iran
[4]Research educator of Agricultural Research station of Gonbad Kavous
[5]Master student in the agronomy Plant Production Department, in Gonbad Kavous University, Iran
*Corresponding author: Abs346@yahoo.com

Abstract

In order to study the effect of plant density and plant orientation on yield and yield components in wheat cultivar, a factorial experiment was conducted based on randomized complete block design with three replications in research field of Gonbadkavus University in 2012. The treatments were included plant orientation (north-south, east-west, northeast-southwest and northwest-southeast), plant densities (250, 300 and 350 plant per square meter) and two cultivars (Koohdasht and line 17). The results of variance analysis indicated that the effect of density, orientation, cultivar and their interaction on number grain per square meter, thousand grain weight were significant at levels of %1 and %5, but these treatments on grain yield, biological yield and harvest index were not significantly affected. The effect of plant orientation and cultivar on grain number per spikelet and spike was significant at %1. An interaction of plant orientation, plant density and cultivar on thousand grain weight was significantly at %5. In the plant density of 350 plants per square meter the orientation of east-west and the cultivar of koohdasht had the highest number grain per square meter, number grain per spikelet and thousand grain weight.

Key words: *cultivar, density, plant orientation, wheat.*

Introduction

Wheat is one of the key strategic products. Economists believe that the increase in wheat production leads to independent on other countries; because it has essential role in providing food for people (Sarmadnia and Koochaki, 1987). Murinnen (2006) believe the progresses that has been made in recent decades can be indicated the factors affecting genetic improvement of cultivars and be effective in future genetic improvements. Wang (2010) attributed yield components of wheat multiplied by the number of spike, number of grain per spike and grain weight. Naseri et al (2012) conducted an experiment on three cultivar of wheat and they showed that cultivars had significant effect on yield, number of spike per square meter and grain number in spike. Plant density affected on all cultivars so that in density of 400 plant per square meter compare to densities of 300 and 350 plant per square meter; were obtained highest number of spike per square meter, grain number in spike and harvest index. Alavi and Shamsedin saiid (2008) conducted an experiment on sorghum and reported that the effect of plant orientation was significant because it absorbs more light on the north-south direction and also the effect of density on grain yield was significant at level of %1. Osman (1992) evaluated the effect of row space and plant orientation on barley and stated that plant orientation had little effect on yield, yield components and light interception. The aim of this study was to evaluate the effect of plant density on yield and yield

components in different plant orientation to determine the best cultivar and density with the most suitable plant orientation to achieve maximum yield.

Material and methods

This experiment was conducted in crop year 2012-2013 at research field of Gonbad kavus university located at latitude 37 degree and 16 minute north and longitude 55 and 12 minute east and the height of sea level was 45 meters. This experiment was conducted in factorial based on randomized compelet block design with three replications. The treatments consisted of two wheat cultivars (Kouhdasht and line 17) with four plant orientations (North-South, East-West, Northest-Southwest and Northwest- Southeast) and three plant densities of 250, 300 and 350 plants per square meter. The bed was Prepared by plowing in early fall and second disk was done before conducting the experiment. The experiment was rainfed and during the test, diseases, pests and weeds were controlled. In order to measure characteristics at physiological maturity stage 20 spikes from each plot were randomly selected and yield components (panicle length, number of fertile and infertile spikelet, grain number, number grain per spike, biological yield and harvest index) were measured. Removing borders, number length of harvest lines were noted for measuring of yield, dry weight was weighed by sensitive scale with an accuracy of 0.01g. The analyze of traits in this study were performed by using Excel and SAS software and average comparisons were conducted with LSD test at 0.05 level of probability.

Result and discussion

The results of the analysis of variance showed that the main effect of plant density, plant orientation, cultivar and their interaction on number grain per square meter and thousand grain weight were significant at 0.01 and 0.05 levels of probability respectively. But these treatments had no significant effect on grain yield, biological yield and harvest index (table1). The results were consistent with mozafari et al (2006) and were inconsistent with moradi et al (2012). Interaction of plant density and plant orientation on grain number per spikelet and grain number per spike was significant (table 3). Hozayn et al (2012) and Catrine et al (2010) likewise (also) reported similar results. The significant effect of treatments interaction shows that the differences between each treatment levels depends on other treatments levels. The interaction effects (orientation, density and cultivar) slicing shows that grain number per square meter in 250 (pd1), 300 (pd2) and 350 (pd3) densities were significant (table 3).

Table 1.varaiance analysis of yield and yield components in density, planting orientation and wheat cultivars

Changes sources	Freedom degree	Grain number	Grain number per spikelet	Grain number per spike	Flowered spikelet per spike	Thousand grain yield	Grain yield	Biological yield	Harvest index
Replication	2	22693.06^{ns}	0.01^{ns}	1.63^{ns}	1.01^{ns}	16.43^{ns}	32347.53**	59510.59^{ns}	29.19^{ns}
Orientation	3	76434.72**	0.22^{ns}	27.09**	1.21^{ns}	14.02^{ns}	1876.84^{ns}	7609.33^{ns}	11.74ns
Density	2	60088.89**	0.04^{ns}	8.89^{ns}	1.23^{ns}	17.85^{ns}	11512.83^{ns}	29888.21^{ns}	9.39^{ns}
Cultivar	1	74112.50**	0.52**	85.59**	0.13^{ns}	211.94**	18018.35*	21889.99^{ns}	20.14^{ns}
Cultivar × orientation	3	38845.83**	0.06^{ns}	11.04^{ns}	0.01^{ns}	12.99^{ns}	7247.06^{ns}	9048.98^{ns}	15.60^{ns}
Density × orientation	6	625533.33**	0.06^{ns}	16.20*	1.18^{ns}	21.59^{ns}	4820.39^{ns}	37795.40^{ns}	7.76^{ns}
Density × cultivar	2	118516.67**	0.18**	46.72**	0.78^{ns}	10.75^{ns}	6365.66^{ns}	27417.55^{ns}	2.03^{ns}
A * b* c	6	60994.144**	0.03^{ns}	3.24^{ns}	0.89^{ns}	26.54*	4536.89^{ns}	8894.24^{ns}	7.82^{ns}
Error	46	7698.85	0.03	5.89	0.61	10.94	3731.45	23743.28	10.51
Cv	-	9.52	7.61	7.06	5.30	11.22	10.17	8.90	9.33
Cv	-	9.52	7.61	7.06	5.30	11.22	10.17	8.90	9.33

^{ns}- No significant difference, *- significant difference at 0.05 level, **- significant difference at 0.01 level

In Pd_1, the northwest-southeast plant orientation and line 17 were the best. In Pd_2 the best orientation and cultivar were northeast-southwest and line 17 respectively, and in density of Pd_3, grain number per square meter in east-west orientation and kouhdasht cultivar was the highest; these orientation and cultivar had the maximum thousand grain weight in Pd_1 but in the other densities was not observed difference in thousand grain weight. Cutting (slicing) physical of interaction between cultivar and density showed that kouhdasht cultivar produce highest number of grain per spikelet and grain number per spike in Pd_1 and Pd_2 densities but there was not any different between these traits in Pd_2 density. Slicing (Cutting) physical of interaction for plant density and orientation showed that north-south direction had maximum grain number per spike in Pd_3 density and in other densities was not observed different between plant orientations in this trait.

Conclusion

Generally the orientation of sowing effects on yield and some characteristics of plant in result of better light absorption.

Table2- slicing of interaction: sum of squares of orientation and cultivars at density levels

Density levels	Freedom degree	Grain number (m^2)	1000grain weight (gr.)
1	7	991029^{***}	335.51^{***}
2	7	378096^{***}	153.74^{ns}
3	7	329029^{***}	113.98^{ns}

slicing of interaction: sum of squares of cultivars in density levels

Density levels	Freedom degree	Grain number in spikelet (m^2)	Grain number in spike (m^2)
1	1	0.24^{***}	86.45^{***}
2	1	0.001^{ns}	6.51^{ns}
3	1	0.64^{***}	86.07^{***}

slicing of interaction: sum of squares of orientation in density levels

Density levels	Freedom degree	Grain number in spike (m^2)
1	3	28.93^{ns}
2	3	29.25^{ns}
3	3	120.26^{***}

Table3- mean comparison of grain number per square meter and 1000 grain weight at cultivars and orientation in density

density	orientation	cultivar	Grain number (m^2)	1000grain weight (gr.)
1	1	1	786.67^{h}	27.26^{defg}
1	1	2	876.67^{efgh}	32.61^{abcd}

1	2	1	933.33^{defg}	24.08^{g}
1	2	2	946.67^{cdefg}	34.52^{ab}
1	3	1	1083.33^{bc}	25.18^{efg}
1	3	2	870^{tgh}	32.43^{bcd}
1	4	1	1473.33^{a}	28.49^{cdefg}
1	4	2	866.67^{gh}	25.10^{fg}
2	1	1	823.33^{gh}	32.47^{abcdef}
2	1	2	830^{fgh}	34.05^{abcd}
2	2	1	873.33^{defgh}	26.62^{g}
2	2	2	786.67^{h}	29.08^{defg}
2	3	1	1213.33^{a}	28.56^{efg}
2	3	2	843.33^{efgh}	32.23^{cdef}
2	4	1	873.33^{cdefgh}	27.80^{fg}
2	4	2	900^{bcdefgh}	32.42^{bcdef}
3	1	1	776.67^{h}	25.31^{g}
3	1	2	913.33^{cdefgh}	29.64^{bcdefg}
3	2	1	800^{fgh}	29.61^{cdefg}
3	2	2	1166.67^{a}	28.26^{efg}
3	3	1	870^{efgh}	29.35^{defg}
3	3	2	796.67^{gh}	33.65^{abcdef}
3	4	1	940^{bcdefg}	28.25^{fg}
3	4	2	880^{defgh}	30.17^{abcdefg}

Table3- mean comparison of grain number per square meter and 1000grain weight at cultivars and orientation in density

density	orientation	cultivar	Grain number(m2)	1000grain weight
1	1	1	786.67^{h}	27.26^{defg}
1	1	2	876.67^{efgh}	32.61^{abcd}
1	2	1	933.33^{defg}	24.08^{g}
1	2	2	946.67^{cdefg}	34.52^{ab}
1	3	1	1083.33^{bc}	25.18^{efg}
1	3	2	870^{tgh}	32.43^{bcd}
1	4	1	1473.33^{a}	28.49^{cdefg}
1	4	2	866.67^{gh}	25.10^{fg}
2	1	1	823.33^{gh}	32.47^{abcdef}
2	1	2	830^{fgh}	34.05^{abcd}
2	2	1	873.33^{defgh}	26.62^{g}
2	2	2	786.67^{h}	29.08^{defg}
2	3	1	1213.33^{a}	28.56^{efg}
2	3	2	843.33^{efgh}	32.23^{cdef}
2	4	1	873.33^{cdefgh}	27.80^{fg}
2	4	2	900^{bcdefgh}	32.42^{bcdef}

3	1	1	776.67^{h}	25.31^{g}
3	1	2	913.33^{cdefgh}	29.64^{bcdefg}
3	2	1	800^{fgh}	29.61^{cdefg}
3	2	2	1166.67^{a}	28.26^{efg}
3	3	1	870^{efgh}	29.35^{defg}
3	3	2	796.67^{gh}	33.65^{abcdef}
3	4	1	940^{bcdefg}	28.25^{fg}
3	4	2	880^{defgh}	$30.17^{abcdefg}$

References

Sarmadnia, GH. And Koochaki, A. 1987. Physiological aspects of dry land farm. (translated) Mashhad Jahad Daneshgahi Publication. Pp 77.

Alavi, N. Shams Aldin Saiid, M. 2008. Effect of orientation and densities planting on forage and grain yield of sorghum in Bam. Agriculture and natural resources science. 45:91-97.

Mozafari, A. Siadat, A. Hashemi Dezfooli, A. 2006. The Study of plant density effect on morghological and physiological traits of four durum cultivars under rain fed condition in Sarable region of Ilam. Science research in agriculture. 2: 47-56.

Catherine, p. d., Borger, A. H., and Shahab, P. 2010. Manipulating crop row orientation to suppress weeds and increase crop yield. Weed Science. 58: 174- 178.

Hozayn, M., Tarek, A. E., Ghafar, E. S., Sharara, A. 2012. Implication of crop row orientation and row spacing for controlling weeds and increasing yield in wheat. Field crop research. 6: 422- 427.

Moraditochaee, M., Motamed, M. K., Azarpour, E., and Khosravi Danesh, R. 2012. Effect of nitrogen fertilizer and plant density management in corn farming. Agriculture and biological science. 7: 133- 137.

Murrinen, S., and Peltonen- Sainio, P. 2006. Radiation use efficiency of modern and old spring cereal cultivars and its response to nitrogen in northern growing conditions. Field crop research. 96: 363- 373.

Naseri, R., Soleymanifard, A., Khoshkhabar, H., Mirzaei, A., and Nazaralizadeh, K. 2012. Effect of plant density on grain yield, yield components and associated traits on three durum wheat cultivars in western Iran. Agriculture and crop science. 4: 79- 85.

Ottman, M. J. 1992. Row spacing and direction effect on yield, water use, tillering and light interception of one-irrigation barley. Forage and grain. 74: 47- 52.

Rahmati, H. 2012.Effect of plant density and nitrogen rates on morphological characteristics grain maize.

Wang, L., Chen, F. Zhang, F., and Mi, G. 2010. Two strategies for achieving higher yield under phosphorus deficiency in winter wheat grown in field conditions. Field crop research. 118: 36- 42.