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Effect of sowing date on yield of winter wheat cultivars Grom, Asr and Kuma in Khorezm region

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Abstract

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In order to determine the influence of different sowing dates on grain yield of cultivars winter wheat field experiment was set up in Khorezm region. The aim of this study was to evaluate the optimal date of sowing winter wheat according to the results obtained in practical production. For the experiment, we used three sowing dates: D_1 = 1st of October, D_2 = 10th of October, D_3 = 20th of October which were conducted in the field №119 of the Dildora-Bojimon farm of Yangibazar district of the Khorezm region. An experiment was done using winter wheat (*Triticum aestivum* L.) cultivars Grom, Asr and Kuma. The research material comprises results of farm surveys conducted in years 2014-2016. Results of three-year studies at a location in Yangibazar reviled that different sowing dates significantly affected on grain yield of cultivars winter wheat. They were in the range of 6750 kg/ha^{-1} to 6840 kg/ha^{-1} of winter wheat cultivars: Grom, Kuma and Asr during three years of experiment. The relatively highest grain yields in three years of investigations were achieved with the sowing on optimal time. Kuma produced the highest grain yield among all varieties, while, minimum grain yield was produced by Grom.

Keywords: winter wheat; Grom; Asr; Kuma; sowing date; vegetation period; yield

Introduction

Wheat (*Triticum aestivum* L.) is the world's most outstanding crop that excels all other cereals both in the area and production are known as the king of cereals (Costa et al., 2013). Winter wheat is a major grain crop in the world. Because winter wheat is one of the most popular cereal crops which is widely used in production (Khan et al., 2007; Asgar et al., 2017). Wheat is an important food crop grown during the winter season. Variation in weather conditions among and within seasons is one of the most important constraints affecting yield potential (Murungu & Madanzi, 2010).

One of the factors of agricultural management that should be controlled by farmers is the dates of sowing, which is one of the most important factors in productivity (Sun et al., 2013). Selection of appropriate sowing dates affects the growth and development, germination percentage and viscosity and cold tolerance (Schwarte et al., 2006).

The work of Yan et al. (2008), Wajid Ali Shan et al. (2006), Asgar Shirinzadeh et al. (2017), Vahid Khosravi et al. (2010) also revealed that proper sowing date brings the highest yield of winter wheat.

The sowing date is one of the more important factors that determine the yield of winter wheat. Research conducted for winter wheat on sowing dates (Green et al. 1985) has shown a trend of increasing yield as advanced sowing. On the basis of small plot experiment, the reduction in grain yield by two-week delay in sowing is 15%, while sowing delayed by four weeks results in a reduction in yield is about 30% (Podolska & Wyzińska, 2011).

Tadeusz Oleksiak (2014) has shown that delayed sowing is an important risk factor that can reduce yield, and which can be more or less significantly depended on the weather conditions and cultivation technology level during the vegetation period.

Early and timely sowing is an important element of agricultural technology that increases the probability of obtaining higher yield. Higher yields after earlier sowing time were also obtained in experiments conducted by Muhammad Tahir et al. (2009).

Sowing dates in different regions are affected by different growth conditions such as the maximum and minimum temperature, daily radiation of the sun, rainfall, growth period and genetic potential of wheat. Wheat is mainly a winter crop and needs temperature, and light for optimal growth (Baloch et al., 2010). Phenology of wheat is generally considered as the variation occurred from emergence to maturity and the influence by sowing dates and the cultivars thus the duration and stages of phenological traits are significant indicators for potential yield of the crop (Fazal et al., 2015).

The purpose of the research is to determine the effects of sowing dates on the yield of winter wheat cultivars Grom, Asr and Kuma under typical conditions of the soil of the Khorezm region.

Table 1. Data on the Urgench Hydrometeorology Station in the Khorezm Region for the Weather Changes in 2014-2016

Month	Year	Average temperatures (C°), at 10-days interval			Average monthly	Precipitation (мм), at 10-days interval			Total for a month
		I	II	III		I	II	III	
January	2014	2.8	3.5	1.4	2.6	14.8	15.1	1.7	31.6
	2015	1.4	–2.0	–0.2	–0.3	–	0.4	8.7	9.1
	2016	1.7	1.0	1.0	1.2	–	–	–	–
February	2014	2.2	0.0	10.3	4.2	–	–	–	–
	2015	–3.4	–3.7	4.1	–1.0	–	4.2	–	4.2
	2016	–2.1	–1.0	1.0	–1.0	–	4.0	–	4.0
March	2014	11.7	8.8	11.3	10.6	–	1.5	32.2	34.7
	2015	2.7	6.0	9.6	6.1	–	0.6	31.0	31.6
	2016	3.5	4.1	4.8	4.3	3.2	5.8	10.1	19.1
April	2014	9.8	16.7	20.5	15.7	6.8	19.7	–	26.5
	2015	10.7	17.0	16.8	14.8	3.2	9.9	3.5	16.6
	2016	9.8	18.1	16.1	11.4	4.8	10.1	2.3	15.2
May	2014	19.3	23.4	25.0	22.6	24.1	0.9	3.1	28.1
	2015	22.5	22.1	25.3	23.3	–	10.5	15.2	25.7
	2016	21.5	24.1	24.8	23.4	13.1	10.5	11.2	34.8
June	2014	27.9	26.4	28.3	27.5	3.0	21.3	–	24.3
	2015	25.5	26.7	28.0	26.7	–	4.0	–	4.0
	2016	26.8	27.0	29.0	27.6	–	4.8	–	4.8
July	2014	29.0	29.7	27.3	28.4	–	–	6.5	6.5
	2015	31.6	25.9	30.3	29.3	–	–	–	–
	2016	31.3	26.8	31.2	29.7	2.1	–	–	2.1
August	2014	27.7	26.4	24.6	26.2	–	–	–	–
	2015	28.9	23.5	25.1	25.8	–	–	–	–
	2016	27.8	24.8	26.1	26.2	1.1	1.2	–	2.3
September	2014	23.0	19.1	20.1	20.7	3.6	4.1	9.0	16.7
	2015	25.4	20.5	15.2	20.4	–	–	–	–
	2016	26.1	20.8	16.7	21.4	3.1	4.2	–	7.3
October	2014	28.1	19.8	17.2	17.0	10.5	9.8	10.5	30.8
	2015	20.1	18.1	16.5	18.2	9.1	11.8	12.5	33.4
	2016	20.1	17.8	17.1	18.3	8.1	0.5	9.5	18.1
November	2014	10.1	9.1	8.9	9.3	12.0	0.10	18.2	30.1
	2015	10.1	9.2	8.1	9.1	11.3	–	20.5	26.8
	2016	10.2	9.1	8.2	9.1	10.5	11.2	10.5	42.2
December	2014	5.8	4.5	3.1	4.4	–	10.8	10.5	21.3
	2015	6.7	4.2	2.8	4.5	–	11.8	11.0	22.8
	2016	5.1	3.1	2.3	3.4	11.8	9.1	–	20.9

Materials and Methods

A field experiment to evaluate the effect of different sowing dates on the yield of the grain of winter wheat varieties was carried out at the field №119 of the Dildora-Bojimon farm of Yangibazar district in three seasons during 2014-2016. The experiment comprised three winter wheat cultivars Grom, Asr and Kuma and three sowing dates: D1 = 1st of October, D2 = 10th of October, D3 = 20th of October in Khorezm region. The winter wheat cultivars Grom, Asr and Kuma are included in the State Register of Uzbekistan. The field experiment was comprised of four replications (control, 1/2/3/4) using a standard sub-plot size of 2×5 m², the total area of each sub-plot size is 10 m², the total test area is 1000 m², variants were placed on the three rows. The winter wheat at the rate of 250 kg/ha^{-1} on the depth of 4-5 cm was applied.

The elevated temperature and a dry-heat wave (35-45°C) around the time of flowering have a profound effect on the responses in grain yield, the number of grains, biomass, harvest index, grain protein concentration. Table 1 shows the mean of temperature at 10-days interval, mean of one-month temperature, precipitation (mm) at 10-days interval and a total of one-month precipitation during the experiment.

Above mentioned phenological monitoring and biometrical measurements would be done according to the instructions and recommendations of Crop Science Research Institute; Uzbekistan Cotton Research Institute; Andijan Research Institute of grain and leguminous plants in irrigated lands in Tashkent (2007): and Methods of field experience by B. A. Dospexov (2007).

Statistical analysis:

The data were recorded on grain yields analyzed using an SPSS (Statistical Package for Social Science) test in excel. Effects of different sowing date on biometric parameters of Grom, Kuma and Asr cultivars of winter wheat was compared by the appropriate use of LSD 0.05.

Results and Discussion

The results of the research based on different sowing dates and on selected winter wheat cultivars Grom, Asr and Kuma showed that this factor is one of the most effective factors on yield during vegetative period of crops in Khorezm region.

Date of sowing was analyzed for each year of winter wheat cultivars Grom, Asr and Kuma growth period. The different sowing dates significantly affected on grain yield of winter wheat. The grain yield of winter wheat cultivars was higher on D1 = 1st October which differed significantly from D2 = 10th October and D3 = 20th October. The results can be generalized by the statement: the earlier sowing may increase yield in three years. This is due to the practically unpredictable influence of the complex of independent weather or environment factors in a given year. Early date (D1) of year, air and soil temperature in October, extended vegetation period and created favourable conditions for growth and development of winter wheat culti-

Table 2. Results of variance analysis of studies traits on grain yield in winter wheat cultivar Grom

Replications	Sowing date	2014			average	2015			average	2016			average
		row				row				row			
		I	II	III		I	II	III		I	II	III	
1	D1	4210	4320	4010	4180	4010	4230	4060	4100	4450	4240	4450	4380
2		6310	6040	6490	6280	6210	6010	6200	6140	6500	6320	6530	6450
3		6540	6610	6620	6590	6450	6340	6470	6420	6820	6610	7030	6820
4		6320	6450	6430	6400	6310	6200	6310	6270	6510	6710	6730	6650
5		6810	6610	6700	6710	7010	6820	6660	6830	7210	6810	7020	7010
6	D2	4180	4040	4020	4080	4000	3900	4040	3980	4310	4120	4230	4220
7		6130	6000	6020	6050	5910	6010	5720	5880	6410	6230	6290	6310
8		6410	6610	6720	6580	6310	6210	6230	6260	6500	6600	6910	6670
9		6410	6230	6260	6300	6010	5820	5990	5940	6510	6400	6430	6450
10		6420	6610	6710	6580	6510	6510	6930	6650	6810	6900	6490	6730
11	D3	3910	4000	3760	3890	3910	3820	3820	3850	4180	4040	4040	4080
12		5690	5810	5870	5790	5610	5720	5740	5690	6010	5980	5950	6010
13		6310	6120	6410	6280	6210	6120	6440	6260	6510	6430	6490	6510
14		5810	5620	5910	5780	5720	5650	6150	5840	6120	5980	5760	6020
15		6610	6410	6500	6510	6430	6210	6530	6390	6700	6430	6670	6600
LSD $_{0.05}$		2110 kg/ha^{-1} 3.59%				2240 kg /ha^{-1} 3.84%				2240 kg /ha^{-1} 3.69%			

Table 3. Results of variance analysis of studies traits on grain yield in winter wheat cultivar Asr

Replications	Sowing date	2014			average	2015			average	2016			average
		row				row				row			
		I	II	III		I	II	III		I	II	III	
1	D1	3960	4130	4090	4060	4130	4010	4550	4230	4180	4310	4350	4280
2		6400	6010	6520	6310	6510	6320	6610	6480	6510	6420	7110	6680
3		6430	6510	6590	6510	6840	6610	6890	6780	6760	6640	6940	6780
4		6410	6520	6000	6310	6450	6340	6980	6590	6810	6640	6710	6720
5		6610	6480	6440	6510	6910	7050	6710	6890	7010	6610	6840	6820
6	D2	4130	3980	3890	4000	4010	3820	3900	3910	4310	3980	4340	4210
7		6410	6310	6180	6300	6130	6400	6070	6200	6410	6310	7110	6610
8		6510	6430	6500	6480	6510	6620	6370	6500	6510	6420	6900	6610
9		6430	6510	5990	6310	6510	6480	6390	6460	6510	6420	6630	6520
10		6610	6520	6400	6510	6510	6230	6800	6480	6810	6780	6840	6810
11	D3	4010	4010	3710	3910	4010	3680	3650	3780	4030	4030	4000	4010
12		6010	5980	5910	6000	6010	5810	5340	5720	6130	6210	6500	6280
13		6130	5960	5910	6000	6210	6010	6830	6350	6410	6310	6210	6310
14		6130	6040	5980	6050	6130	6040	6400	6190	6120	6410	6110	6210
15		6110	6120	6320	6150	6520	6340	6760	6540	6610	6300	6430	6480
$LSD_{0.05}$		2430 kg /ha^{-1} 4.17%				3810 kg /ha^{-1} 6.41%				3010 kg /ha^{-1} 4.94%			

Table 4. Results of variance analysis of studies traits on grain yield in winter wheat cultivar Kuma

Replications	Sowing date	2014			average	2015			average	2016			average
		row				row				row			
		I	II	III		I	II	III		I	II	III	
1	D1	4180	3980	4090	4080	4010	3820	4140	3990	4410	4320	4230	4320
2		6510	6320	6370	6400	6600	6400	6530	6510	6610	6510	6570	6560
3		6410	6610	6520	6510	6810	6540	6630	6720	6820	6610	7000	6810
4		6510	6600	6640	6580	6610	6310	6540	6520	6910	6750	6980	6880
5		7120	6910	6970	7000	6810	6680	6700	6730	7010	7210	7140	7120
6	D2	4120	3920	3960	4000	4130	4040	3860	4010	4130	4040	4430	4200
7		6510	6320	6610	6480	6450	6510	6150	6370	6800	6650	6680	6710
8		6500	6600	6700	6600	6410	6320	6290	6340	6710	6800	6890	6800
9		6450	6580	6470	6500	6010	6210	6350	6190	6820	6610	6910	6780
10		6500	6430	6360	6430	6510	6500	6430	6480	6910	6780	6740	6810
11	D3	3760	3810	3710	3760	3700	3450	3920	3690	4010	3820	4110	3980
12		5910	6000	5790	5900	5850	5650	5810	5770	6130	6320	6180	6210
13		6130	6320	6150	6200	6210	6010	6350	6190	6410	6210	6280	6300
14		6010	5950	6040	6000	6010	5920	6000	5960	6140	6080	6170	6130
15		6410	6510	6280	6400	6450	6380	6650	6490	6450	6640	6650	6580
$LSD_{0.05}$		1650 kg /ha^{-1} 2.79%				2130 kg /ha^{-1} 3.64%				1860 kg /ha^{-1} 3.03%			

vars Grom, Asr and Kuma. In all three years, the obtained yield was lower than the yield which sowing was early.

The grain yield on $D^3 = 20^{th}$ October was significantly lower than $D_1 = 1^{st}$ October and $D_2 = 10^{th}$ October. In Tables 2, 3 and 4 revealed that different wheat cultivars Grom, Asr and Kuma and different sowing dates had significant ($p > 0.05$) effect on grain yield.

In an experiment recorded that grain yield reduced when sowing dates were delayed. The grain yield of the $D_3 = 20^{th}$ of October was considerably reduced.

The grain yield is an important parameter, because depending of it we can determine the quality of winter wheat.

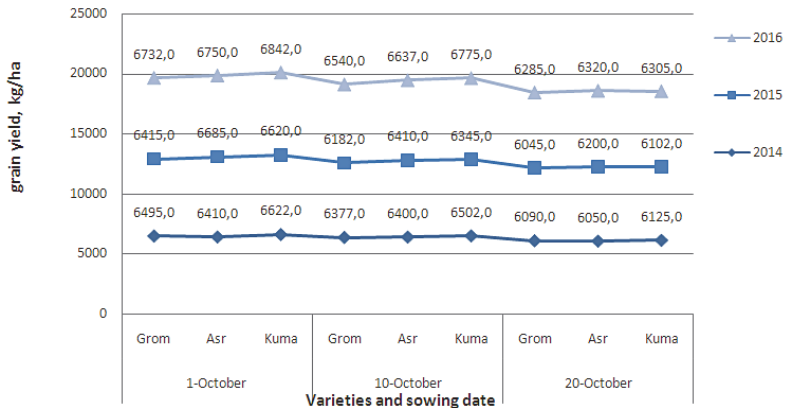

Fig. 1. Comparison of average grain yield in different sowing dates for each variety in 2015 and 2016 (i.e. average of 15 samples)

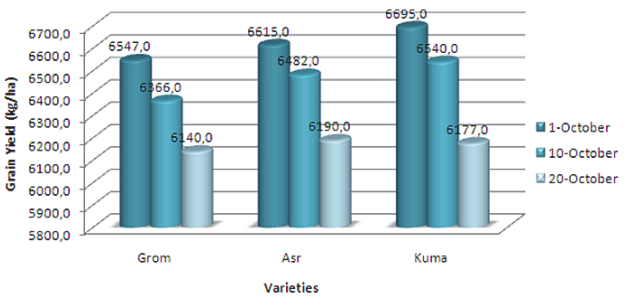

Fig. 2. Interaction sowing date and on grain yield of winter wheat cultivars in 2015 and 2016

The mean values of the date revealed that grain yield decreased as sowing delayed from D_1 = 1st October to D3 = 20th October (Fig. 1 and Fig. 2).

In Tables 2, 3 and 4 revealed that grain yields were significantly higher in 2016 (7010 kg/ha^{-1}) than in 2014 (6710 kg/ha^{-1}) and in 2015 (6830 kg/ha^{-1}) of winter wheat cultivar Grom, grain yields were significantly higher in 2015 (6890 kg/ha^{-1}) than in 2014 (6510 kg/ha^{-1}) and in 2016 (6820 kg/ha^{-1}) of winter wheat cultivar Asr and grain yields were significantly higher in 2016 (7120 kg/ha^{-1}) than in 2014 (7000 kg/ha^{-1}) and 2015 (6730 kg/ha^{-1}) of winter wheat cultivar Kuma when sowing was done on D1 = 1st October.

In Tables 2, 3 and 4 revealed that grain yields were significantly low in 2014 (6580 kg/ha^{-1}) than in 2015 (6650 kg/ha^{-1}) and in 2016 (6730 kg/ha^{-1}) of winter wheat cultivar Grom, grain yields were significantly low in 2016 (6480 kg/ha^{-1}) than in 2014 (6510 kg/ha^{-1}) and in 2016 (6810 kg/ha^{-1}) of winter wheat cultivar Asr and grain yields were significantly low in 2014 (6430 kg/ha^{-1}) than in 2016 (6810 kg/ha^{-1}) and in 2015 (6480 kg/ha^{-1}) of winter wheat cultivar Kuma when sowing was done on D_2 = 10st October.

While D_2 = 10st October sowing recorded minimum grain yield in 2015 (6390 kg/ha^{-1}) than in 2014 (6510 kg/ha^{-1}) and in 2016 (6600 kg/ha^{-1}) of winter wheat cultivar Grom, in 2014 (6150 kg/ha^{-1}) than in 2015 (6540 kg/ha^{-1}) and in 2016 (6480 kg/ha^{-1}) of winter wheat cultivar Asr and in 2014 (6400 kg/ha^{-1}) than in 2015 (6450 kg/ha^{-1}) and in 2016 (6580 kg/ha^{-1}) of winter wheat cultivar Kuma in Tables 2, 3 and 4.

The data presented in Fig. 2 indicated that highest average of grain 6700 kg/ha^{-1} was obtained of winter wheat cultivar Kuma, 6620 kg/ha^{-1} was obtained of winter wheat cultivar Asr and 6550 kg/ha^{-1} was obtained of winter wheat cultivar Grom when sowing was done on the D_1 = 1th of October for three years in the experiment, low average of grain 6540 kg/ha^{-1} was obtained of winter wheat cultivar Kuma, 6480 kg/ha^{-1} was obtained of winter wheat cultivar Asr, 6370 kg/ha^{-1} was obtained of winter wheat cultivar Grom when sowing was done on the D_2 = 10th of October for three years in the experiment and minimum average of grain 6180 kg/ha^{-1} was obtained of winter wheat cultivar Kuma, 6190 kg/ha^{-1} was obtained of winter wheat cultivar Asr, 6140 kg/ha^{-1} was obtained of winter wheat cultivar Grom when sowing was done on the D_3 = 20th of October for three years in the experiment. All varieties revealed similar results on the D_3 = 20th of October.

Kuma produced the highest grain yield among all varieties, while minimum grain yield was produced by Grom.

Conclusion

The analysis showed a significant decrease of yield as a result of delayed sowing. The delayed sowing date is an important risk factor that can reduce yield and whose occurrence and value depend on weather conditions during the vegetation period.

The research has confirmed that yield from the late sown

fields was significantly lower than from the other sowing dates.

High yield obtained from the crops sown very early prove that correct and complete agricultural technology can compensate the increased yield due to early date of sowing.

The yield after early sowing usually was higher than the yield from fields sown in time defined as optimal.

It could be assumed that the gradual climatic changes in Khorezm region, the progress of breeding, the new released improved varieties, and changes in production technology may require reanalyzing the sowing time recommendations for winter wheat, and possibly for other winter crops. It can, therefore, be concluded that delayed sowing is an important risk factor that can reduce yield, and which can be more or less significantly depended on the weather conditions and cultivation technology level during the vegetation period.

Early and timely sowing is an important element of agricultural technology that increases the probability of obtaining higher yield. In three years, maximum average of grain yield 6700 kg/ha^{-1} was obtained of winter wheat cultivar Kuma, 6620 kg/ha^{-1} was obtained of winter wheat cultivar Asr and 6550 kg/ha^{-1} was obtained of winter wheat cultivar Grom when sowing was done on the $D_1 = 1^{th}$ of October for three years in the experiment, low average of grain 6540 kg/ha^{-1} was obtained of winter wheat cultivar Kuma, 6480 kg/ha^{-1} was obtained of winter wheat cultivar Asr, 6370 kg/ha^{-1} was obtained of winter wheat cultivar Grom when sowing was done on the $D_2 = 10^{th}$ of October for three years in the experiment and minimum average of grain 6180 kg/ha^{-1} was obtained of winter wheat cultivar Kuma, 6190 kg/ha^{-1} was obtained of winter wheat cultivar Asr, 6140 kg/ha^{-1} was obtained of winter wheat cultivar Grom when sowing was done on the $D_3 = 20^{th}$ of October in a field experiment at location in Yangibazar district of the Khorezm region. All varieties revealed similar results on the $D_3 = 20^{th}$ of October.

Kuma produced the highest grain yield among all varieties, while minimum grain yield was produced by Grom.

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