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The Effects of Different Sowing Time and Seeding Rates on Weeds in Wheat

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Keywords
Wheat, cultivar, weeds, sowing time, seeding rate

ABSTRACT

This research carried out effects of different sowing times and seeding rates of wheat on weed density. The cultivar Kirik, the most common facultative variety of Erzurum in Turkey, was used. The treatments were sowing times (Winter, Freezing and Spring sowing) and seeding rates (325, 375, 425, 475, 525, 575 and 625 viable seeds m^{-2}). The effect of different seeding rate on weed density was not significant while the effect of sowing time was considerably significant in both years. The highest weed density was observed in spring sowing in both years (2002/2003 and 2003/2004), and followed by freezing and winter sowings respectively. Dry weight of weeds showed significant differences in seeding rates and sowing time. The highest dry weight of weed was determined in the lowest seeding rate which is 325 viable seeds per m^2 while the lowest dry weight of weed was determined in seeding rate of 625 viable seeds per m^2 during the vegetation period of 2002/2003. In the vegetation period of 2003/2004, the highest dry weight of weed was also determined in seeding rate of 475 viable seeds per m^2. On the other hand, the highest dry weight of weed was found in the lowest seeding rate while the lowest dry weight was found in the highest seeding rate based on the mean of two years. There were significant differences between dry weight of weeds according to the sowing time. The highest dry weight was found in spring sowing followed by freezing and winter sowings followed this treatment, respectively.

Buğdayda Farklı Ekim Zamanı ve Ekim Sıklığının Yabancı Otlara Etkisi

Anahtar Kelimeler
Buğday, çeşit, yabancıot, ekim zamanı, ekim sıklığı

ÖZET

Erzurum'da yaygın olarak yetiştirilen alternatif karakterli Kirik buğday çeşidinin kullanıldığı araştırmada uygulama olarak ekim zamanı (kışlık, dondurma ve yazlık ekim) ve ekim sıklığı (325, 375, 425, 475, 425, 575 ve 625 tohum/m^2) kullanılmıştır. Çalışma sonucunda elde edilen verilere göre farklı ekim sıklıklarının yabancı ot yoğunluğu üzerine her iki yılda da etkisinin önemli olmadığı, ancak ekim zamanının ise yabancı ot yoğunluğu üzerine önemli derecede etkili olduğu belirlenmiştir. Her iki yılda da (2002/2003 ve 2003/2004) yabancı ot yoğunluğu en fazla yazlık ekimde görülmüş bunu sırasıyla dondurma ve kışlık ekim izlemiştir. Yabancı ot kuru ağırlığı, ekim sıklığı ve ekim zamanı açısından önemli farklılıklar göstermiştir. 2002/2003 vejetasyon döneminde yabancı ot kuru ağırlığı en fazla en düşük ekim sıklığı olan 325 adet/m^2'de tespit edilirken en düşük kuru ağırlık ise ekim sıklığı en yüksek olan 625 adet/m^2'de saptanmıştır. 2003/2004 vejetasyon döneminde en fazla yabancı ot kuru ağırlığı en düşük ekim sıklığında, en düşük ise 475 adet/m^2'de belirlenmiştir. İki vejetasyon dönemlerinin ortalamasında da en fazla yabancı ot kuru ağırlığı en düşük ekim sıklığında bulunurken, en az yabancı ot kuru ağırlığı da sık ekimde bulunmuştur. Ekim zamanına bağlı olarak yabancı ot kuru ağırlıkları arasında da önemli farkların olduğu yapılan istatistik analizler sonucunda ortaya konulmuştur. İki vejetasyon döneminde de en fazla yabancı ot kuru ağırlığı yazlık ekimde belirlenmiş olup bunu sırasıyla dondurma ve kışlık ekim takip etmiştir.

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1. INTRODUCTION

Wheat is the major crop in north-east Anatolia, Turkey, and usually grain yield is considerably lower which may be due, in part, to delayed sowings and very high seeding rates. The most common cultivar of wheat, the facultative variety Kirik, which occupies about 55 % of the total wheat-sown area in the region. This variety is generally sown in three different sowing periods. These include September, late October, and from late April to mid-May.

Weed control play vital role for higher wheat yield. Wheat is a major cereal grain crop of Turkey, which meet food needs of growing human population of the country. This crop needs cool season for emergence or growth and warm season for the maturity. Whereas, most of the broad leaved weeds also make growth during the cool season and compete with wheat crop for nutrition and other inputs. The use of pure seed, proper land preparation, balanced fertilizer, seeding time, seeeding rate and proper irrigations along with weed control practices play vital role for higher wheat yield (Tunio 2001; Özçelik 2003; Bertholdsson 2005). Practices that encourage an early, vigorous start to the crop or that remove early-germinating weed seedlings give the crop a head start and allow it to compete more successfully with weeds. The critical period in which crops are most sensitive to competition varies. For example, in the case of wheat, this time is about 2-4 weeks after emergence. Early seeding is successful with cereal crops, peas and lentils, but not for other crops such as beans or buckwheat (Davies and Welsh, 2001; Beavers et al. 2004). Increasing seeding rates 20-30% above normal can increase the competitive ability of a crop. Higher rates will also result in earlier maturity (2-3 days), shorter plant height, reduced tillering and possibly higher yields (if moisture conditions are adequate), but at the same time may put the crop at a higher risk for lodging (Beavers et al. 2004). Some weeds are poisonous and some are useless plants exists on the land and compete crop plants by taking food nutrients, water, sunlight and other elements and weakens the main crop, which results in low crop yield. For achieving higher wheat production, new wheat varieties, modern methods of sowing and control of harmful insect pests and diseases are important but yield target may hardly be accessible (Roth et al. 1984; Aksoy 2003). The main reason behind it is that the growers are paying little attention to the weed control or using eradication practices of weeds, due to that yield loss may occur. This sort of loss of wheat grains due to weeds may be 15 to 25 per cent.

Akkaya and Akten (1989) noted that the optimum time of sowing for winter wheat in north-east Anatolia is between 22 August and 3 September; earlier or later sowing usually reduces over-winter survival and grain yields. However, wheat growers are obligated to sow very late in October or late April as the spring sowing due to the delay in harvesting of previous summer crops. In the other study (Çoruh and Bulut, 2008), 48 different weeds covered 43 species in 19 families were determined in the experiment area. Density of the weed changed between 1 and 181 plant/m^2 and average density of the weed was determined as 14.27 plant/m^2. The most values on density of the weed were found out *Cirsium arvense* (L.) Scop. (canada thistle) (2.64 plant/m^2), *Convolvulus arvensis* L. (field bindweed) (1.79 plant/m^2) and *Geranium tuberosum* L. (tuberous geranium) (0.58 plant/m^2) in winter sown wheat; *C. arvensis* (2.36 plant/m^2), *Lactuca serriola* L. (oil lettuce) (1.76 plant/m^2) and *C. arvense* (1.36 plant/m^2) in freze sown wheat; *Amaranthus retroflexus* L. (redroot pigweed) (5.48 plant/m^2), *Sideritis montana* L. (field iron wort) (2.12 plant/m^2) and *C. arvense* (2.06 plant/m^2), in spring sown wheat respectively.

The aim of this study was to determine the best sowing time and seeding rate which will increase production wheat, cv. Kirik their effects on weeds, and to study the effects of these factors on plant growth and production. It will be possible to make suitable suggestions with this the study about sowing time and seeding rate affecting weed density for the variety of Kirik.

2. MATERIALS AND METHODS

Location, design and treatments

The experiment was conducted on a fallow field of the Experimental Farm of Ataturk University of Erzurum (29°55'N and 41°16'E with an altitude of 1850 m) in the growing seasons of 2002–03 and 2003–04. The experimental soil was clayey loam with an organic matter content of 1.7–1.9% and pH of 7.7–7.8. Available P and K contents were 15.7–18.8 and 1790.1–1870.4 kg ha^{-1}, respectively.

Three seed sowing times were September 2nd [winter sowing (WS)], October 28th [freezing sowing (FS)], and April 28th [spring sowing (SS)] in 2002–03; 1 September (WS), 26 October (FS), and 29 April (SS) in 2003–04. Seeding rates were 325, 375, 425, 475, 525, 575 and 625 viable seeds per m^2. The experimental design was a randomized complete block desing in a split-plot configuration

with four replications. Main plots were sowing times and subplots were seeding rates.]

Crop management and measurements

The field was prepared by plough with depth of 20 cm, followed by surface cultivation. The facultative bread wheat cultivar Kirik (awnless, white grain) was used. Plots were sown with a six-row planter. Subplots consisted of six rows spaced 20 cm apart, with a row length of 6.0 m. Ammonium sulphate as Nitrogen source was applied to plots with an amount of 60 kg ha^{-1} and triple superphosphate as P source to plots with an amount of 50 kg ha^{-1}. Half of N and all P were applied at sowing; the second half of N was applied at the beginning of stem elongation. Weeds were controlled by hand.

Before harvest, number of weed and fresh above ground biomass were determined in by random quadrates per plot. All the plants were cut off near the soil surface and dry biomass of weed was determined separately by drying the fresh weeds at 70 C^{o} for at least 48 h for each species.

Statistical Analyses

Years and sowing times were considered as random effect, while seeding rates were considered as fixed effect. Analysis of variance was performed with the MSTAT-C (1991) software package. When 'year x treatment' interactions was not significant, data were combined over years and presented as 2-year mean values. The differences between mean values were assessed by Duncan's Multiple Range Test.

3. RESULTS AND DISCUSSION

The total annual rainfalls were 368.2 and 501.5 mm in 2002–03 and 2003–04, respectively. Monthly rainfall for the 2002–03 seasons did not differ greatly from the long-term averages, but 2003–04 seasons had more rainfall than the average (Table 1).

Winter-sown crops were well developed by freeze-up but the frozen-sown crops did not germinate by freeze-up in the fall. There was little winterkill in the 2002–03 trial for winter-sown plants. Soil moisture just prior to spring sowing was sufficient, and crops usually germinated normally in both years. In 2002–03, late freezes occurred during June, and kernel numbers per spike of the winter-sown wheat were greatly influenced. Plants did not lodge at any rate of seeding. There was no damage from pests or diseases.

Table 1. The long-term averages (LTA) and crop season values of total monthly rainfall, average monthly temperature and minimum air temperature (T_{min}) at Erzurum

	Rainfall (mm)			Temperature (°C)			T_{min} (°C)	
Month	2002–03	2003–04	LTA	2002–03	2003–04	LTA	2002–03	2003–04
September	18.1	19.3	34.4	13.6	13.8	14.3	-0.3	-1.0
October	42.9	90.9	27.9	8.9	8.8	6.2	-10.8	-14.1
November	25.6	35.1	20.5	1.3	-0.7	2.6	-11.8	-11.2
December	19.7	16.1	23.3	-12.0	-6.6	-5.1	-37.2	-25.8
January	17.7	14.3	17.3	-7.7	-9.0	-16.1	-26.2	-28.0
February	30.7	90.0	16.2	-8.2	-8.7	-3.4	-29.2	-28.6
March	32.9	33.7	55.6	-6.6	-1.7	-1.0	-28.2	-15.0
April	81.4	36.0	50.5	4.4	4.0	4.2	-22.4	-14.7
May	29.9	121.7	59.3	11.6	9.7	10.4	-7.1	-2.8
June	45.7	40.7	31.7	14.5	14.5	15.3	-1.8	0.2
July	18.5	2.4	23.6	18.9	17.9	19.9	4.4	2.8
August	5.1	1.3	8.4	20.0	19.6	19.5	5.0	4.6
Total	368.2	501.5	368.7					
Mean				4.9	5.1	5.6		

LTA from 53 years.

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Table 2. The effect of sowing times and seeding rates on weed number/m^2 of wheat

Years (Y)		2002				2003				2002-2003			
Sowing times (ST)		Winter	Freezing	Spring	Average	Winter	Freezing	Spring	Average	Winter	Freezing	Spring	Average
Seeding rates (SR)	325 seeds m^2	14.0	36.3	110.,8	53.7	16.8	16.8	25.0	19.5	15.4	26.5	67.9	36.6
	375	23.3	15.5	72.3	37.0	15.0	18.8	28.3	20.7	19.1	17.1	50.3	28.8
	425	17.8	37.5	30.0	28.4	13.5	20.0	21.3	18.3	15.6	28.8	25.6	23.3
	475	13.8	34.3	63.3	37.1	13.3	19.5	27.5	20.1	13.5	26.9	45.4	28.6
	525	18.0	26.5	56.0	33.5	12.0	11.0	22.0	15.0	15.0	18.8	39.0	24.3
	575	15.8	59.3	59.8	44.9	10.3	14.0	21.3	15.2	13.0	36.6	40.5	30.0
	625	14.0	28.8	69.8	37.5	13.5	14.3	30.8	19.5	13.8	21.5	50.3	28.5
	Average	16.6 A	34.0 B	66.0 C	38.9	13.5 B	16.3 B	25.1 A	18.3	15.1 C	25.2 B	45.6 A	28.6
Factors		F values											
Y										34.612***			
ST		17.724***				28.017***				26.353***			
SR		0.8				1.784*				0.9			
Y x ST										9.839***			
Y x SR										0.8			
ST x SR		1.2				0.7				1.253*			
Y x ST x SR										1.039*			
CV (%)		20.9				12.3				20.7			

The mean values with the same letter within variable are not significantly different (Duncan's multiple range test P < 0.05); significant at *0.05, **0.01 and ***0.001 levels.

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Table 3. The effect of sowing times and seeding rates on the weed DM (g/m^2) of wheat

Years (Y)		2002				2003				2002-2003			
Sowing times (ST)		Winter	Freezing	Spring	Average	Winter	Freezing	Spring	Average	Winter	Freezing	Spring	Average
Seeding rates (SR)	325 seeds m^2	32.1	45.7	268.4	115.4 A	26.3 E	244.5 BC	322.8 A	197.8 A	29.2 f	145.1 cd	295.6 a	156.6 A
	375	27.4	42.2	244.2	104.6 AB	18.8 E	254.0 B	319.0 A	197.3 A	23.1 f	148.1 c	281.6 a	150.9 A
	425	21.6	37.3	220.7	93.2 BC	10.3 E	171.0 D	189.0 BCD	123.4 B	15.9 f	104.2 e	204.9 b	108.3 B
	475	19.3	43.6	224.3	95.7 ABC	8.8 E	136.5 D	172.0 CD	105.8 B	14.0 f	90.1 e	198.1 b	100.7 B
	525	20.2	48.4	203.0	90.5 BC	4.8 E	173.0 CD	187.3 BCD	121.7 B	12.5 f	110.7 de	195.1 b	106.1 B
	575	23.4	30.6	221.6	91.6 BC	9.8 E	143.8 D	178.5 CD	110.7 B	16.6 f	87.2 e	200.1 b	101.3 B
	625	15.4	30.4	201.4	82.4 C	5.0 E	131.8 D	196.6 BCD	111.0 B	10.2 f	81.1 e	198.8 b	96.7 B
	Average	22.7 B	39.7 B	226.2 A	96.2	11.9 B	179.2 A	223.5 A	138.2	17.3 C	109.5 B	224.9 A	117.2
Factors		F values											
Y										45.558***			
ST		809.307***				140.291***				372.454***			
SR		4.410**				17.228***				20.694***			
Y x ST										61.528***			
Y x SR										8.356***			
ST x SR		1.851 ns				4100.833***				4.248***			
Y x ST x SR										2.1			
CV (%)		18.4				14.8				13.2			

The mean values with the same letter within variable are not significantly different (Duncan's multiple range test $P < 0.05$); significant at *0.05, **0.01 and ***0.001 levels.

In research area, the dominant weed species were *Adonis aestivalis* L., *Aethionema arabicum* (L.) Andrz. ex Schultz., *Agropyron cristatum* (L.) Gaertn., *Alyssum desertorum* Stapf, *Amaranthus graecizans* L., *Amaranthus retroflexus* L., *Anchusa arvensis* (L.) Bieb., *Bromus tectorum* L., *Centaurea depressa* Bieb., *Chenopodium album* L., *Chrispora tenella* (Pall.) DC., *Cichorium intybus* L., *Cirsium arvense* (L.) Scop., *Consolida orientalis* (J. Gay) Schröd., *Convolvulus arvensis* L., *Descurania sophia* (L.) Webb., *Euphorbia virgata* Watdst. et Ket., *Falcaria vulgaris* Bernh., *Fumaria oficinalis* L., *Geranium tuberosum* L., *Lactuca serriola* L., *Lapsana communis* L., *Malva neglecta* Wallr., *Medicago sativa* L., *Papaver dubium* L., *Polygonum aviculare* L., *Polygonum convolvulus* L., *Rumex crispus* L., *Salvia* spp., *Scleranthus annuus* L., *Secale cereale* L., *Sideritis montana* L., *Sinapis arvensis* L., *Sisymbrium altissimum* L., *Thlaspi arvense* L., *Tragopogon dubius* Scop., *Turgenia latifolia* (L.) Hoffmann, *Vicia sativa* L. and *Viola arvensis* Murr.

The weeds and their densities listed above differe damong the applications. During the 2002/2003 vegetation period, in winter sowing, *P. aviculare* (3.43 plant/m^2), *L. serriola* (2.93), *A. aestivalis* (2.54), *D. sophia* (1.14), *P. dubium* (1.04); during 2003/2004 vegetation period, *P. dubium* (2.79), *C. arvense* (2.71), *C. arvensis* (1.50), *Viola* sp. (1.32), *A. aestivalis* (1.11); during 2002/2003, in freezing sowing, *P. aviculare* (14.07), *P. convolvulus* (7.25), *A. aestivalis* (4.32), *L. serriola* (2.79), *C. album* (1.04); during 2003/2004 vegetation period, *P. dubium* (6.00), *C. arvensis* (2.75), *D. sophia* (1.18); during 2002/2003 vegetation period in spring sowing, *A. retroflexus* (44.04), *C. arvense* (11.96), *P. convolvulus* (3.96), *A. graecizans* (2.46); during 2003/2004 vegetation period, *P. dubium* (8.93), *C. arvensis* (5.29), *P. aviculare* (4.39), *L. serriola* (1.39), *C. arvense* (1.00) were determined as widespread species.

The effect of different seeding rate on weed density was not significant while the effect of sowing time was considerably significant in both years. The highest weed density was observed in spring sowing in both years (2002/2003 and 2003/2004), and followed by freezing and winter sowing, respectively (Table 2).

Dry weight of weeds showed significant differences between seeding rate and sowing time. The highest dry weight of weed was determined in the lowest seeding rate with 325 viable seeds per m^2 while the lowest dry weight was determined in the highest seeding rate having 625 viable seeds per m^2 in the vegetation period of 2002/2003. In the vegetation period of 2003/2004, the highest dry weight of weed was also determined in the lowest seeding rate having 475 viable seeds m^2. On the other hand, the highest dry weight of weed was found in the lowest seeding rate while the lowest dry weight was found in the more seeding rate in the mean of two years. Asbil et al. (2006) reported that seeding rate decreased weed biomass and the highest wheat grain yield was obtained from two times increased seeding rate. Ibrahim et al. (1986) also determined that the effect of sowing time on dry weight of weed was not significant but the lowest dry weight of weed obtained from the wheat sowed in November and the other sowed in October and December followed this, respectively.

Based on statistical analyzes, it was determined that there are significant differences between dry weight of weeds according to the sowing time (Table 3). The highest dry weight was found in spring sowing in two vegetation periods, and freezing and winter sowings followed this treatment, respectively. Accordingly, Rasmussen (2004) found that the weed biomass in normal sowing time in wheat was more than in late sowing time. Late sowing decreased the 40% of weed biomass. The winter sowing was determined to be advantageous for both weed density and dry weight of weed (Çoruh and Bulut, 2008). Ozturk et al. (2006) and also reported that the best yield was obtained from winter sowing in the Kirik variety in Erzurum ecological conditions.

4. CONCLUSION

According to the result of this research, the optimum sowing time is the winter sowing for facultative wheat cv. Kırik in Erzurum dry land conditions. If wheat was not be able to be sown as winter sowing, depending on environmental condition, the second choose would be freezing sowing. Seeding rate of 525 seeds m^{-2} (200 kg ha^{-1}) would be appropriate for the winter sowing, 575 seeds m^{-2} (220 kg ha^{-1}) appropriate for the freezing sowing and spring sowing for optimum weed control. Growth and yield of wheat are affected by the environment and can be regulated by sowing time and seeding rate

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