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EFFECT OF DIFFERENT SEEDBED PREPARATION SYSTEMS ON WHEAT YIELD AND YIELD COMPONENTS IN MIDDLE ANATOLIA

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Abstract

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This research was conducted at the experimental field of Konuklar Agricultural farms of TİGEM between 2006-2009 for determination the effect of four different tillage systems on yield and yield components of bread wheat (*Triticum aestivum* L.) variety under Middle Anatolian conditions of Turkey. Conventional, reduced tillage, direct and direct seeding + herbicide were applied in the experiment. According to the results of the research, seeding systems constituted significant differences for grain yield, spike length, spikelet and kernel number per spike, kernel weight per spike, harvest index and test weight. The grain yield, plant height, spike length, spikelet per spike, kernels per spike, kernel weight per spike, spikes per m^2, harvest index, 1000 kernel weight and test weight varied from 2660.9 to 3493.3 $kg.ha^{-1}$, form 78.53 to 80.58 cm, from 7.41 to 8.42 cm, from 14.78 to 16.23, from 25.64 to 30.54, from 0.70 to 0.99 g, from 636 to 677, from 26.67 to 29.20 %, from 26.94 to 28.93 g and 72.27-74.35 kg respectively. The results revealed that direct seeding can be offered for wheat production in Middle Anatolian Region.

Key words: Direct seeding, reduced tillage, wheat, grain yield

Introduction

Tillage is one of the highest power-required processes of the agricultural production. Today, the high cost of energy forces farmers to find alternative economic tillage methods. No-till systems can (not always) produce similar or higher yields compared with conventional tillage systems. As tillage operations are not required, no-till producers do not need to purchase tillage implements. This, together with the reduced labor and tractor hours, will reduce the crop production cost (Chen et al., 2004). The main purpose of direct planting is to decrease the water and wind soil erosion and to make plant production more profitable. Therefore, the target is protection of soil. In addition, soil moisture, energy consumption, labor and protection of machinery will be effective.

Barut and Celik (2008) evaluated the direct drill and conventional tillage system in the dry farming conditions. They found wheat yield in the conventional tillage system and direct drill as 3556.7 kg ha^{-1}, 3130.0 kg ha^{-1} and 3413.3 kg ha^{-1}, 2880.0 kg ha^{-1} in the first and second years, respectively.

Aykas and Onal (1999) studied the effects of different tillage methods on yield and weeding for wheat. They obtained better grain and straw yield from reduced tillage (rotary-tiller) as 3500 kg ha^{-1} and 3470 kg ha^{-1} as compared to the conventional and zero tillage system, respectively. They recommend that proper tillage system should be carefully selected in order to achieve a better weed control.

Yalcin et al. (2005) studied tillage parameters and economic analysis of the direct seeding, minimum and the conventional tillage in wheat. They found that wheat yields were 6800 kg ha^{-1} and 7400 kg ha^{-1} for the direct seeding and minimum tillage, fuel consumption were 8.9 l ha^{-1} and58.4 l ha^{-1} for the direct seeding and the conventional tillage, respectively.

Vegetal residues on soil surface reduce water evaporation, and therefore favor water accumulation and conservation, which is very important in drought conditions (Hartfield et al., 2001). The residue cover also decreases the wind and water soil erosion (Unger et al., 1988).

This research was conducted for determination the effect of four different tillage systems on yield and yield compo-

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nents of a bread wheat variety under Middle Anatolian dry conditions of Turkey.

Materials and Methods

This study was conducted under dry conditions at the experimental field of Konuklar Agricultural farms of TİGEM located 20 km away from the city of Konya-Turkey (36º41′-39º16′ E and 31º14′-34º26′ N). The trials were conducted between 2006 and 2009 years for determination the effect of four different tillage systems on yield and yield components of bread wheat variety Gerek 79, which is the most commonly used wheat in the Middle Anatolia (Figure 1).

The relief was generally flat with average altitude of 1016 m and continental temperate climate with an average annual temperature of 10°C. According to Table 1, the coldest was 2006-2007 growing season (average 8.0°C), with the lowest total rainfall (154.0 mm). The warmest was 2008-2009 growing season (average 10.0°C), with the highest total rainfall (246.2 mm). Winters were generally poor in snow. The soil type is classified as Clay loam with a pH of 8.00.

The different tillage systems were applied in plots sown by Randomized Complete Block Design with four replicates in the beginning of October and received 7.5 kg da^{-1} N in two applications and 6.5 kg da^{-1} P_2O_5 was applied each year. Row spacing was 13 cm and seeding rate 200 kg/ha.

For the conventional tillage system, the soil was first ploughed with three-bottom moldboard plough. After plowing, the field was harrowed with disc harrow and leveled with float. In the reduced tillage system, soil was prepared for seeding with rotary tiller-roller and drill. For the direct seeding applications, seeding was made without tillage. Only in one of direct seeding applications before seeding, Gramoxone (Paraquat) was applied as herbicide (Figure 1).

At maturity, plant height was measured from the soil surface to the top of the spikes excluding the awns. A sample of

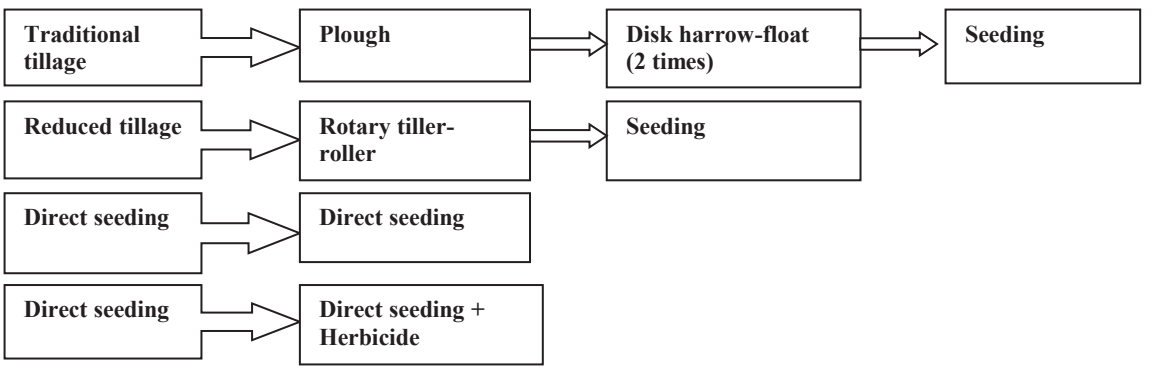

Fig. 1. Tillage systems applied in the study

Table 1
Monthly temperature and rainfall data of the experimental field

Months	Temperature, ^{0}C			Rainfall, mm		
	2006-2007	2007-2008	2008-2009	2006-2007	2007-2008	2008-2009
October	3.8	12.8	11.4	46	10	30
November	2	7.8	8.2	16	67.5	21
December	-0.7	1	0.5	0	37	0
January	-2.2	-3.8	4.6	32	6	41.4
February	-0.2	-3.2	3.6	23	20	23.9
March	5.4	9	4.5	18	22	22
April	7.7	12.9	9.5	14	11.5	32.7
May	18.3	14.5	14.4	2	17.5	48.5
June	21.1	20.9	20.3	3	9	6
July	24.3	23.2	23.2	0	0	20.7
Mean	8	9.5	10	-	-	-
Total	-	-	-	154	200.5	246.2

10 tillers was harvested randomly from each plot to measure the yield components (Genc, 1974; Tosun and Yurtman, 1973; Yagbasanlar, 1987; Yurur et al., 1987). Results were analyzed using MSTAT-C statistical software for analysis of variance. LSD test was used to compare the means of the obtained results in this research.

Results and Discussion

The variance analysis of results of investigated traits after applications of tillage systems are shown as F-tests in Table 2, the average values and LSD groups in Table 3 and the average values of the traits with significant year x tillage system interactions in Table 4.

The analysis of variance indicates that the grain yield and other traits were significantly affected by the year conditions. Tillage systems, as well as year x system interactions were non-significant with plant height, spike number/m^2 and 1000-kernel weight, but very significant with grain yield, kernel number/spike, kernel weight/spike, harvest index and test weight (Table 2).

The results presented in Table 3 and 4 show that the most favorable treatment for this crop was direct seeding application. The recorded mean grain yield of 3493.3 kg ha^{-1} was 24% and 22% higher than those registered in traditional tillage and reduced tillage, respectively. The highest mean grain yield was reached in the 2008-2009: 3364.7 kg ha^{-1}, and the lowest in the 2007-2008: 2871.9 kg ha^{-1}, mainly due to the different precipitation that occurred during the yield formation period (April - May). A similar tendency can be seen when the other traits were observed.

The results presented by Cociu et al. (2010) reveal similarly, that different tillage systems have a different effect on

Table 2
Results of the variance analysis (F- tests)

Investigated traits	A (Year)	B (tillage system)	AXB	Coefficient of variation, %
Grain yield	**	**	**	13.14
Plant height	**	ns	ns	6.4
Spike length	**	**	ns	8.7
Spikelet number/spike	**	**	ns	8.4
Kernel number/spike	**	**	**	7.5
Kernel weight/spike	**	**	**	12.7
Spike number/m2	**	ns	ns	15.6
Harvest index	**	**	**	7.7
1000-kernel weight	**	ns	ns	9.7
Test weight	**	**	**	2.4

**; *: Significant at 0.01 and 0.05 levels, respectively; ns: non-significant.

Table 3
Mean values of the investigated traits and LSD groups

Investigated traits	1	2	3	4	LSD
Grain yield, kg/ha	2660.9 b	2707.0 b	3493.3 a	3308.2 a	445.9**
Plant height, cm	80.58	79.32	80.32	78.53	ns
Spike length, cm	7.41 b	7.41 b	7.77 ab	8.42 a	0.74**
Spikelet number/spike	15.01ab	14.78 b	15.75 ab	16.23 a	1.44**
Kernel number/spike	25.36 b	27.21 b	29.64 a	30.54 a	2.28**
Kernel weight/spike, g	0.75 b	0.70 b	0.89 a	0.99 a	0.11**
Spike number/m^2	650	636	677	663	ns
Harvest index, %	27.03 b	26.67 b	28.40 ab	29.20 a	1.77*
1000-kernel weight, g	28.93	28.91	26.94	28.76	ns
Test weight, kg	72.50 b	72.27 b	74.35 a	73.05 ab	1.47*

1: Traditional tillage; 2: Reduced tillage; 3: Direct seeding; 4: Herbicide + direct seeding;
**; *: Significant at 0.01 and 0.05 levels, respectively; ns: non-significant;
Means within the same analyzed trait followed by different letters are significantly different at P<0.05 and 0.01, respectively.

grain yield of winter wheat in rotation. The average yields recorded for wheat were 4948 kg/ha with traditional tillage, 4536 kg/ha with chisel plough tillage, 4814 kg/ha with disc/sweep tillage and 5048 kg/ha with no till. The highest winter wheat grain yields were obtained with the no till variant.

The interesting results in this study are the similar and close means of traits achieved by applying the direct seeding and treated direct seeding systems. For example, the mean grain yields are 3493.3 kg ha^{-1} and 3308.2 kg ha^{-1}, respectively, demonstrating that the treatment with herbicide after harvest of the crop not affects significantly this trait.

Environmental conditions and tillage systems, which influenced positively the winter wheat grain yield, increased correspondently the other traits investigated. On the other hand, unfavorable conditions for grain yield, such as drought and high temperatures, determined lower levels of these traits (Table 4). Year x tillage system interaction (significant at $P<0.01$) indicates that lower grain yield levels are obtained with traditional tillage systems. Therefore, the relationship depends more on soil water supply.

The influences of direct seeding system on winter wheat grain yields per hectare look similar to the influences of treated direct seeding systems, demonstrating that the herbicide treatment of the field not affects significantly this trait, especially under Middle Anatolian conditions.

Year x tillage system interaction was significant ($P<0.01$) for grain yield per hectare. This interaction can be explained mainly by the important differences among the conditions of years of experimentation (Table 4). The plant height, spike number/m^2 and 1000-kernel weight of winter wheat were not significantly influenced by the tillage systems. The influence of year conditions on these traits was significant, mainly due

Table 4
Mean values of the traits with significant year x tillage system interaction and LSD groups

Traits	Aplication	1. year	2. year	3. year	LSD
Grain yield, kg/ha	1	2290.0b	2373.6b	3319.0a	445.9**
	2	2336.2b	2789.1a	2995.9a	
	3	3928.5a	2936.1b	3615.2a	
	4	3007.5b	3388.9b	3528.6a	
	Mean	2890.6b	2871.9b	3364.7a	
Kernel number/spike	1	28.40a	18.30b	29.38a	2.28**
	2	33.08a	23.18c	30.38b	
	3	32.12a	27.85c	26.94b	
	4	39.20a	21.71c	30.69b	
	Mean	33.20a	22.76c	29.35b	
Kernel weight/spike, g	1	0.78ab	0.66b	0.80a	0.11**
	2	0.71ab	0.62b	0.74a	
	3	1.07a	0.77b	0.82b	
	4	1.24a	0.72c	1.03b	
	Mean	0.95a	0.70b	0.85a	
Harvest index, %	1	25.28b	25.96b	29.85a	1.77*
	2	26.80	26.42	26.81	
	3	28.09b	25.44c	31.68a	
	4	27.66b	26.28b	33.65a	
	Mean	26.96b	26.03b	30.50a	
Test weight, kg	1	76.02a	74.62b	66.85c	1.47*
	2	76.67a	76.01a	64.14b	
	3	75.57a	74.75a	72.76b	
	4	74.85a	71.11c	73.17b	
	Mean	75.78a	74.12b	69.23c	

1: Traditional tillage; 2: Reduced tillage; 3: Direct seeding: 4: Direct seeding + herbicide;
**; *: Significant at 0.01 and 0.05 levels, respectively;
Means within the same analyzed trait followed by different letters are significantly different at $P<0.05$ and 0.01, respectively.

to the great climatic conditions differences during yield formation period.

The results of this research show that no till system which reduce water evaporation from soil increase the grain yields. An efficient way of decreasing water evaporation from soil is to enhance soil coverage with the residue from the previous crop. This residue facilitates also water infiltration and storage (Hatfield et al., 2001).

Conclusions

Among tillage systems applied in this study, the most favorable treatment for winter wheat was direct seeding application. The recorded mean grain yield in this system was 24% and 22% higher than those registered in conventional tillage and reduced tillage, respectively. Year conditions and tillage systems had a similar influence on grain yield, spike length, spikelet number/spike, kernel number/spike, kernel weight/spike, harvest index and test weight. These results revealed that direct seeding systems can be offered for wheat production in Middle Anatolian Region.

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References

Aykas, E. and I. Onal, 1999. Effect of Different Tillage Seeding and Weed Control Methods on Plant Growth and Wheat Yield. 7. International Congress on Mechanization and Energy in Agriculture, 26-27 May, Adana, Turkey.

Barut, Z. B. and I. Celik, 2008). The effects of direct drill methods on plant growing wheat-maize rotation. Direct Seeding Workshop, Anatolia Agricultural Research Institute, Eskişehir, Turkey, December 16-17.

Chen, Y., S. Tessier and B. Irvine, 2004. Drill and crop performances as affected by different drill configurations for no-till seeding. *Soil and Tillage Research,* **77:** 147-155.

Cociu, A. I., G. V. Zaharia and N. Constantin, 2010. Tillage system effects on water use and grain yield of winter wheat, maize and soybean in rotation. *Romanian Agricultural Research*, No. 27: 69-80.

Genc, I., 1974. Yerli ve Yabancı Ekmeklik ve Makarnalık Buğday Çeşitlerinde Verim ve Verime Etkili Başlıca Karakterler Üzerine Araştırmalar. Çukurova Ün. Ziraat Fak. Yayınları 82, Adana (Tr).

Hatfield, J. L., T. J. Sauer and J. H. Prueger, 2001. Managing soils to achieve greater water use efficiency: A review. *Agron. J.,* **93**: 271-280.

Tosun, O. and N. Yurtman, 1973. Ekmeklik Buğdaylarda Verime Etkili Morfolojik ve Fizyolojik Karakterler Arasındaki İlişkiler. *Ankara Ü. Ziraat Fak. Yıllığı*, **23**: 418-434 (Tr).

Unger, P. W., D. W. Langdale and R. I. Papendick, 1988. Role of crop residues– improving water conservation and use. Cropping strategies for efficient use of water and nitrogen, vol. 51 (ed. W.L. Hargrove): 69-100. Madison, WI: American Society of Agronomy.

Yagbasanlar, T., 1987. Çukurova'nın Taban ve Kıraç Koşullarında Farklı Ekim Tarihlerinde Yetiştirilen Değişik Kökenli Yedi Triticale Çeşidinin Başlıca Tarımsal ve Kalite Özellikleri Üzerine Araştırma. Çukurova Ü. Ziraat Fak. Yayınları 82, Adana (Tr).

Yalcin, H., E. Cakir and E. Aykas, 2005. Tillage parameters and economic analysis of direct seeding, minimum and conventional tillage in wheat. *Journal of Agronomy*, **4**: 329-332.

Yurur, N., Z. M. Turan and S. Cakmakci, 1987. Bazı Ekmeklik ve Makarnalık Buğday Çeşitlerinin Bursa Koşullarında Verim ve Adaptasyon Yeteneği Üzerine Araştırmalar. Türkiye Tahıl Sempozyumu (TÜBİTAK): 59-68, Bursa, (Tr).

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