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Effect of Foliar Fertilizer as Seed Pre-treatment on Yield Components in Common Wheat (*Triticum aestivum* L.)

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Abstract: Aim of this research is to evaluate the effect of foliar fertilizer as seed pre-treatment at different concentrations and times to the yield components in the İkizce 96 common wheat (*Triticum aestivum* L) under field conditions of Central Anatolia in a split-split plot design with four replications during 1998-99 and 1999-2000 at the University of Ankara, Faculty of Agriculture, Haymana Research and Application Farm, Ankara, Turkey. According to results; plant height, spike length, number of spikes; number of spikelets; number of grain and 1000-grain weight traits showed a positive and statistically significant increasing over the control. In the study, used pre-treatments regimes resulted in improved wheat seed germination and helped to balancing the nutrients at the beginning of growth. Obtained variations in the investigated traits may be explained with the effect of pre-treatment times. Generally, a 10 minutes pre-treatment (S_1) with 1% concentration (C_1) have been showed that the optimum effect for increasing yield during the first year and all obtained data have been displayed rather stable and higher for second year in the study; but, none of all the parameters have been effected in next year. Foliar fertilizer method as a seed pre-treatment has a potential that can be apply cheap, practical, quick and helper for a healthy first development for the common wheat cultivation in Central Anatolia.

Key Words: Common wheat (*Triticum aestivum* L.), yield components, seed pre-treatment, foliar fertilizer

Ekmeklik Buğdayda (*Triticum aestivum* L.) Verim Ögelerine Tohum Ön Uygulaması Olarak Yaprak Gübresinin Etkisi

Öz: 1998-99 ve 1999-2000 yıllarında Ankara Üniversitesi Ziraat Fakültesi, Haymana Araştırma ve Uygulama Çiftliği'nde bölünen bölünmüş parseller deneme deseninde, İkizce 96 ekmeklik buğday çeşidinde ve 4 tekrarlamalı olarak düzenlenen bu araştırmanın amacı, değişik konsantrasyon ve zamanlarda tohuma ön uygulama olarak yapılan yaprak gübresinin verim ögelerine etkisini değerlendirmektir. Sonuçlara göre, bitki boyu, başak boyu, başak sayısı, başakçık sayısı, tane sayısı ve 1000 tane ağırlığı özellikleri pozitif ve istatistiksel önem düzeyinde kontrole göre pozitif yönde ve istatistiksel olarak önemli artış göstermiştir. Çalışmadaki ön uygulamalar buğday tohumunun çimlenmesini artırmış ve gelişmenin başlangıcında besin maddesi dengesinin sağlanmasına yardım etmiştir. Özelliklerdeki değişimler ön uygulama zamanlarının etkisi ile açıklanabilir. Genel olarak, %1 konsantrasyondaki (C_1), 10 dakikalık (S_1) ön uygulama birinci yılda verimi artırıcı optimum etkiyi göstermiş, ancak parametrelerin hiç biri ertesi yıl etkili olmamıştır. Tohuma ön uygulama olarak yaprak gübresi yöntemi, Orta Anadolu' daki ekmeklik buğday tarımında sağlıklı bir ilk gelişme için yardımc, hızlı, pratik ve uygulanabilir bir potansiyele sahiptir.

Anahtar Kelimeler: Ekmeklik buğday (*Triticum aestivum* L.), verim ögeleri, tohum ön uygulaması, yaprak gübresi

Introduction

The usage of the specific products and techniques can be improve growth of the seed, seedling and young plant (Anonymous 1999). One of the important from them is foliar fertilizers. They promote seedling establishment, increase the level of the yield and yield components, reduce the losses due to different diseases, pests and insects (Anonymous 1998; Ashley et al. 2002). According to oldest records, seed treatment applications were used at Egyptian and Roman periods. In the middle ages, it was used with liquid manure and chlorine salts, and, it was used with the salt water and copper products in mid-1600s and mid-1700s (Anonymous 1999). These products can be perceive one of the most important milestones in the progress of agriculture crop production (Askari et al. 1995; Anonymous 1998; Ashley et al. 2002) and plant growing. The first modern seed treatment compounds were simple inorganic chemicals, such as brine or lime solutions. The 1960s and 1970s, several groups of systemic organic chemical seed treatments were produced.

There are two main categories of seed treatments: i) protectants (contact on the seed surface) and ii) systemics (within the plant).From them; i) protectants help control pathogens that reside on the seed surface; however, ii) systemics seed treatments are mostly used for controlling the seed-borne fungi diseases (FAO 2005; Anonim 2005). Research findings show that seed treatments are effective on the agronomic responses of the plants yield and yield components.

It was assumed that pre-treatments, increases permeability of seed membranes, enhancing the soil nutrients uptake efficiency by creating a zone of high fertilizer concentration accessible to developing and relevant physiological processes in used common wheat (Simon and Meany 1965; Marcus et al. 1966; Mory et al. 1972; Dobrzanska et al. 1973).

The main goal of this study is to find out effect of the foliar fertilizer as seed pre - treatment application in

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common wheat cultivar (namely, Ikizce 96) for selected agronomic traits under the Central Anatolian conditions.

Materials and Methods

A common wheat cultivar 'İkizce 96' was used and it was sown in a split-split block design with four replications during the 1998-99 and 1999-2000 at the University of Ankara, Faculty of Agriculture, Haymana Research and Application Farm, Ankara, Turkey. The foliar fertilizer concentrations were arranged as main plots and pre-treatment times were arranged as sub-plots, also. Main plots were divided into three sub-plots that each one consisted of eight rows with 1.0 m lengthened and 0.20 m spaced. Sowing and harvesting procedures were done manually during 1st week of October and 4th week of July in each year. The soils of the experimental site are dark brown colour in characterisitcs with pH=5.7, lime level ($CaCO_3$) of 23.7%, changeable potassium rate of 0.028% and organic matter level of 1.33%. Plant height and spike length (cm), excluding awns; number of spike and spikelets; number of grain; 1000-grain weights (g) were determined at the maturity from 30 tagged plants according to the Tosun and Yurtman (1973).

Used foliar fertilizer was provided from OMEX-K Madencilik Product, Konya-Turkey. It was prepared in 1%, 3% and 5% concentrations according to Purvis et al. (1966) and Kacar (1977) with 10, 20 and 30 minutes, respectively. Its formulation was 20% N, 20% P_2O_5, 8% K_2O, 80 mg/l each of Bo (EDTA) and Mo (EDTA), 8 mg/l Co (EDTA), 1.75 mg/l Fe (EDTA), 0.90 mg/l Zn (EDTA), 625 mg/l each of Cu (EDTA) and Mn (EDTA), Chlorate <30 mg/l, inert material 26% with specific weight of 1.44 g/cm^3 at 18 ^{o}C and ph=5.0 (at solution in 10%). Significances, correlation coefficients and mean values were compared by Analysis of Variance using MSTAT-C (1998) statistical software and all comparisons were made using least significant difference (LSD) test according to Steel and Torrie (1980).

Results and Discussion

Obtained data are presented in Table 1 and Figure 1. Concentrations, pre-treatment times and their interactions were not found statistically significance, so result of the statistical analysis determined data were not given. Generally, wide variations were found for all examined traits as (79.90-105.40 cm) for plant height; (7.10-9.65 cm) for spike length; (3.00-6.00) for the number of spikes; (29.00-35.00) for the number of spikelets; (26.00-47.00) for the number of grains and (32.00-40.80 g) for the 1000-grain weight (Table 1). We observe that stages of the food reserves mobilization prove to be statistically different at the various concentrations and pre-treatment times (Table 1) in relation to precipitation or soil moisture. 2nd year of the experiment were received much more rain than the 1st year (Figure 1).

Precipitation originated variation was directly reflected to the yield and yield components of the İkizce 96 common wheat. From the start of germination to the exposure of the first leaf to sun light, growing is completely dependent on reserve carbohydrates in the endosperm, more than half of which is utilized by seminal roots (Williams 1960) and was affected by pre-treatment fertilizer concentrations that influenced growth and development of wheat. Observed variations among the yield contributed traits of Ikizce 96 wheat are assumed to be due to the differences water availability, pre-treatment times and concentrations. On the other hand, reduced yield during the first year is assumed to be due to poor availability and/or insufficiency of water. This effect was indicated in lower yield during 1st year and increased yield but more in 2nd year. These findings in accordance and verified with Palm (1993).

Plant height was ranged between 79.90±3.69 (C_1S_1 1%-10 min.) to 84.33±2.35 (C_3S_3 5%-30 min) during the 1st (Table 1). Similarly, (C_1S_1 1%-10 min.) was resulted in maximum increase of spike length; but, grain number was not during the 1st year while maximum number of spike and 1000-grain weight was achieved with (C_3S_2 5%-20 min.). Maximum spikelet number of 32.00±1.23 was achieved through (C_3S_2 5%-20 min.) and it was found statistically close to the value obtained from (C_1S_1 1%-10 min.) or (C_2S_3 3%-30 min.). Maximum plant height (105.40±3.27 cm), spike length (9.65±0.59 cm), number of spikelets (35.00±1.85) and number of grains (47.00±3.21) were obtained through treatment (C_3S_1 5%-10 min.). The highest 1000-grain weight (40.80±2.94 g) was achieved in (C_1S_1 1%-10 min.). 1000-grain weight (g) on (C_3S_1 5%-10 min) is inferior to one obtained with (C_1S_1 1%-10 min) and others. Minimum positive correlation coefficient was found between number of spike and number of grains ($r=0.041$, $P<0.05$) and the maximum positive correlation coefficient was found between number of spikelets and number of grains ($r=0.717$, $P<0.01$) during 1998-99. Nevertheless, the correlation coefficient values were ranged between ($r=-0.086$, $P<0.05$) and ($r=0.817$, $P<0.01$) for spike number and 1000-grain weight and spike number, during 1999-2000, respectively. The results suggest that increase of one variable will result in increase at second variable.

External factors affecting plant growth include total precipitation and developments during changes from vegetative to generative stage during March and April (Figure 1). Foliar fertilizers should be applied when the plant is not in water stress, neither too wet nor too dry and are best applied when the plant is cool and filled with water (Askari et al. 1995). Climate records displayed that obtained annual precipitation and its distribution to the vegetation period had been caused a "the trigger effect" for investigated agronomical traits (Figure 1). In addition, It was presumed that application time and concentration of the used foliar fertilizer during generative stage resulted in increased 1000-grain weight (g). This finding shows similarity to the Asker et al. 1995.

Table 1. Mean values±standard errors of the plant height (cm), spike length (cm), number of spike, number of spikelet, number of grain and 1000 grain weight (g) of the seeds in common wheat cultivar (İkizce 96) applied with a foliar fertilizer during 1998-2000.

Conc.-Time (%) -	(Min.)	Plant Height (cm) 1998-1999	Plant Height (cm) 1999-2000	Spike Length (cm) 1998-1999	Spike Length (cm) 1999-2000	Number of Spike 1998-1999	Number of Spike 1999-2000	Number of Spikelet 1998-1999	Number of Spikelet 1999-2000	Number of Grain 1998-1999	Number of Grain 1999-2000	1000 Grain Weight (g) 1998-1999	1000 Grain Weight (g) 1999-2000
	So	81.15±2.00 c	98.70±1.40 b	7.21±1.41 d	8.33±0.25 e	3.00±0.35 b	4.05±1.25 c	29.00±1.00 c	32.00±0.50 c	26.00±1.35 f	35.40±3.80 g	35.40±2.70 d	36.44±3.20 c
	S_1	79.90±3.69 e	99.70±2.37 c	8.25±2.69 a	9.02±0.51 d	3.00±0.77 b	4.00±0.60 c	31.00±0.95 b	34.00±1.84 b	33.00±1.91 a	38.00±2.70 f	38.76±4.80 b	40.80±2.94 a
C_1	S_2	82.60±2.06 b	105.40±3.27 a	7.70±0.44 c	9.48±0.77 a	4.00±0.77 a	5.00±1.00 b	30.00±0.73 b	34.00±2.41 b	30.00±1.30 d	43.00±4.73 b	34.29±2.70 e	39.15±4.29 b
	S_3	84.20±3.31 a	100.01±3.19 b	8.23±0.74 a	8.93±0.51 e	4.00±1.16 a	4.00±0.60 c	32.00±0.77 a	32.00±1.95 c	33.00±1.62 a	42.00±3.80 c	39.09±5.00 a	36.58±3.30 c
	S_1	82.00±2.35 b	100.90±3.92 b	7.10±0.65 d	9.27±0.61 c	4.00±0.93 a	5.00±0.71 b	31.00±1.00 b	33.00±1.70 d	31.00±2.42 c	41.00±4.06 d	33.92±4.63 f	39.05±3.88 b
C_2	S_2	83.45±4.01 a	102.47±3.04 a	7.68±0.60 b	9.02±0.59 d	3.00±0.89 b	5.00±0.73 b	31.00±0.98 b	33.00±1.64 d	30.00±1.94 d	41.00±4.76 d	32.00±4.87g	39.81±4.25 b
	S_3	81.73±3.70 c	102.02±3.06 a	7.90±0.80 a	9.30±0.58 b	4.00±0.85 a	5.00±0.83 b	31.00±1.33 b	33.00±1.24 d	31.00±2.83 c	41.00±3.23 d	40.86±5.01a	37.93±3.05 b
	S_1	80.33±2.42 d	105.03±3.79 a	7.33±0.43 c	9.65±0.59 a	3.00±0.60 b	6.00±0.73 a	31.00±0.90 b	35.00±1.85 a	29.00±1.44 e	47.00±3.21 a	39.17±3.80 a	38.03±2.62 b
C_3	S_2	82.43±2.42 b	99.76±2.88 b	7.60±0.40 b	9.17±0.73 d	3.00±0.57 b	5.00±0.61 b	32.00±1.23 a	34.00±2.74 b	32.00±1.10 b	40.00±3.96 e	35.45±3.60 d	37.93±3.90 b
	S_3	84.33±2.35 a	103.78±2.35 a	7.60±0.55 b	9.20±0.60 b	3.00±0.70 b	5.00±0.81 b	31.00±1.08 b	33.00±2.50 d	31.00±1.75 c	43.00±3.28 b	36.25±3.77 c	37.68±2.93 b

S_0 = Control; S_1= 10 minutes; S_2=20 minutes; S_3=30 minutes; Conc.: Concentration; C_1= 1%; C_2= 3%; C_3= 5%;
Means followed by the same letter(s) within a column are not significantly different and significant change at 0.05% and 0.01 % probability levels, using a LSD test

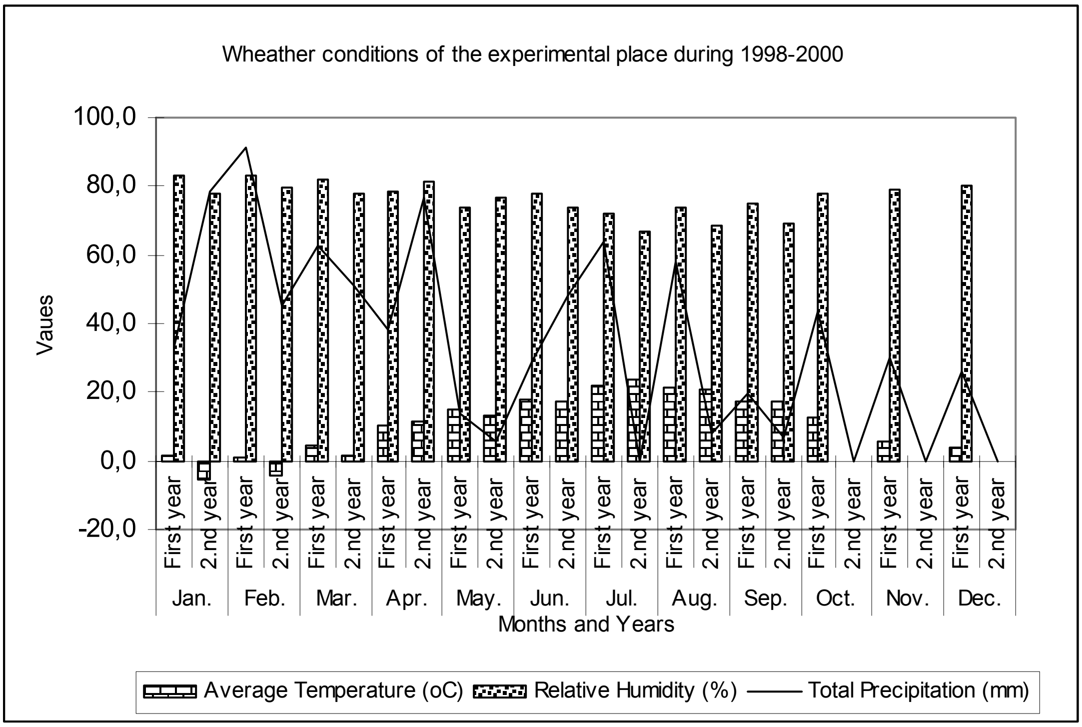

Figure 1. Weather conditions of the experimental place during 1998-2000

Source: Republic of Turkey, Prime Ministry of General Directory of Meteorology, Ankara, Turkey
(Note= 2nd year of the meteorological data could not provided for October, November and December)

Reduced precipitation was received during 1998-99 compared to 1999-2000. Variation in results could not be explained explicitly except that less rain might have acted negatively poor development of root biomass and nutrient absorption from soil. Reduction of the precipitation about 50% in April 1999 played a dominant role on efficiency of investigated yield components. Measurable agronomic characters such as plant height and spike length were not affected from the pre-treatment times and concentrations in this experiment (Table 1). These data suggest that relevant applications resulted in simulation of growth process and this ended up in plant structure and yield (Muhammad et al. 2002). Results explain that why wheat plants having the highest ratios for the related yield components at (C_2S_3 3%) and (C_3S_3 5%) in each year, without water limitation (except of spike number). These are in accordance with the findings of Smocek and Hlavat (1984); Wei et al. (1996); Zhao (1991).

Conclusions

We conclude that 10 minutes pre-treatment (S_1) with 1% concentration (C_1) was optimum for increasing yield during the 1st year of experiment and all obtained data have been rather stable and higher for 2nd year. However, we conclude that increased spike length (cm), spikelet number and grain number reduced the grain weight. Observed variations in the examined traits may be explained with the effect of pre-treatment times. Especially, treatment times might be the causative agent for the obtained variations. They were acted and done as a supplementary effect on the examined traits.

Plant height was mainly affected from the seed pre-treatments due to the application time increasing in both years. Spike length was affected from the decreasing of the foliar fertilizer concentration in every year. Number of spike was affected decreasing in the foliar fertilizer concentration and application time, but this effect was happened very strongly in second year. In each years of the experiment, number of spikelet was showed increasing for the foliar fertilizer concentration, and 1000-grain weight which affected from the application time. Water deficit during the first year of the experiment was resulted in poor utilization of the used nutrients for different physiological reactions in common wheat. In addition, practices (concentrations and application times) were also affected on the cell division in a positive way and all relevant physiological activities

(Evans et al. 1980; Palm 1993) and increased chlorophyll production and synthesis. With the activation of these processes were increased the emergence of primary roots. With this stimulation, occurred positive effect may have been converted into the first development. Increasing chlorophyll production and synthesis in the cells of leaves most exposed to direct sunlight. This increase in water “flow” automatically brings more fertilizing elements into the plant via the vascular system.

Water stress in plants is one of the main factors that limit the crop production level. It affects directly, cell growth, expansion and division, enzyme level, photosynthetic activity etc. in plants. Also, our work illustrates that plant functions can be chemically manipulated by seed pre-treatments with a suit foliar fertilizer. This application has a vigorous potential that would be able to cheap and applicable process. Quick seedling emergence and even stands are essential and important to maximizing the yield of common wheat especially under the Central Anatolian conditions.

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