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Effects of Fertilizer Sources and Weed Control Practices on Biological Seed Purity of Organic Wheat

Sancar Bulut[1]* and Ali Özturk[2]

[1]Department of Plant and Animal Production, Safiye Cikrikcioglu Vocational School, Kayseri University, 38280, Talas-Kayseri, Turkey

[2]Faculty of Agriculture, Department of Field Crops, Atatürk University, 25240, Erzurum, Turkey

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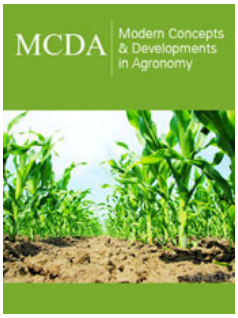

***Corresponding author:** Sancar Bulut, Department of Plant and Animal Production, Talas-Kayseri, Turkiye

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Abstract

This research was carried out in laboratories of Field Crops Department of Erciyes University Agricultural Faculty between the dates September-October 2010. Factorial experimental design with randomized blocks was used for experiments. Seeds from previous research carried out in Agricultural Research and Extension Center of Ataturk University Agricultural Faculty during the cropping seasons of 2006-07, 2007-08 and 2008-09 under dry farming conditions were used as the material of present research. In previous study, two weed cultivars (Kırik, Doğu-88), three weed control practices (475 seeds/m^2, 475 seeds/m^2 + hand weeding (HW), 625 seeds/m^2) and seven fertilizer sources [Control, standard inorganic (NP), Bio Organic (Bio), Bio Organic SR (Bio SR), Leonardite, Organic Fertilizer (OF), Cattle Manure (CM)] were included. Biological characteristics of seeds (germination rates, germination powers, emergence rates and emergence powers) were investigated in current study. As the average of treatments, germination rate was found to be as 87.8%, germination power as 93.2%, emergence rate as 68% and emergence power as 92.1%. Cropping seasons significantly affected the biological characteristics and 2006-07 cropping season had lower biological values than the others. Difference between cultivars with regard to biological characteristics was found to be significant. Weed control practices significantly affected germination power, emergence rate and emergence power values. Fertilizer sources had also significant impacts on biological characteristics. With regard to fertilizers, the lowest values were obtained from control treatment and the highest values from NP, OF and CM treatments.

Keywords: Organic wheat; Manure; Weed; Biological value; Seed

Introduction

Biological quality of a seed is usually expressed by germination rate, germination power, emergence rate and emergence power values indicating a normal plant formation of the seed under optimum conditions. High quality seeds should be used for higher and economical yields per unit area. Certificated seed utilization in wheat cultivation is at significantly low levels in Turkey and such levels should definitely be improved for the benefit of both the producers and the country. Local farmers usually reserve some of produce of the year to use as seed for the upcoming growing seasons. Long term use of same seeds causes some decreases in physical and biological quality of seeds. Therefore, uniform germination and emergence are not provided with such seeds and decreases in yields were observed due to lack of sufficient number of plants per unit area [1,2]. Emergence of certified samples was always greater than 80%, but field germination rates were often below 75% for farmer-saved sources [3]. Cultural practices have also direct or indirect impacts on seed quality. Negative impacts of chemicals used in agricultural production practices on human, animal and environmental health have increased the interest toward the organic farming day by day. Deficiency of plant nutrients and weed control are among the most significant problems experienced in organic wheat cultivation. Beside the manure, compost and green fertilizers, some other organic commercial fertilizers are also available for organic farming. Weed control can be implemented by cultural practices, mechanical or biological control, or by using resistant cultivars and dense sowing rates. Also, utilization of seeds with high germination and emergence powers will provide

early emergence and growth and consequently the plants will be able to dominate over weeds and yield loses will be prevented at certain rates. Harmanşah et al. [4] indicated the most significant input of the cereal production as seed and reported 25-40% yield increases with quality seeds. Ries et al. [5] reported higher emergence rates and powers and consequently higher initial growth rates for large size wheat seeds than the smaller ones. Chastain et al. [6] also indicated faster emergence rates for large wheat seeds. Sufficient research and information are not available especially about the effects of cultural practices on biological quality of the seeds. Therefore, effects of different fertilizer sources and weed control practices on seed biological characteristics were investigated in this study.

Material and Method

This research was carried out in laboratories of Field Crops Department of Erciyes University Agricultural Faculty between the dates September-October 2010. Factorial experimental design with randomized blocks was used for experiments. Seeds from previous research carried out in Agricultural Research and Extension Center of Ataturk University Agricultural Faculty during the cropping seasons of 2006-07, 2007-08 and 2008-09 under dry farming conditions were used as the material of present research. In previous study, two weed cultivars (Kırik, Doğu-88), three weed control practices (475 seeds/m^2, 475 seeds/m^2 + hand weeding (HW), 625 seeds/m^2) and seven fertilizer sources [Control, standard inorganic (NP), Bio Organic (Bio), Bio Organic SR (Bio SR), Leonardite, Organic Fertilizer (OF), Cattle Manure (CM)] were included. A total of 800 healthy seeds were selected from seed samples of each treatment combination. For germination and emergence characteristics, seed samples passed through germination and emergence tests in Petri dishes and germination boxes in a growing chamber with 20 °C inside temperature. Tests were carried out in 4 replications (100 seeds for each replication) [7].

Before the germination and emergence tests, seeds were subjected to surface sterilizations for 5 minutes with 10% sodium hypochlorite. Following the sterilization, seeds were washed through distilled water 3 times [8]. Tough and similar seeds were tried to be selected. Germination tests were carried out in sterilized Petri dishes (9cm diameter). A total of 100 seeds were placed in-between two filter papers with equal spacing and 12ml distillated water was added into each Petri dish [8]. At the ends of 4^{th} day, normally germinated seeds were counted, removed and percent (%) germination rate was calculated by dividing the number of germinated seeds to initial number of seeds [7]. Non-germinated seeds were again placed in-between filter papers, moistened with sufficient water and germination counts were repeated at the end of 8^{th} day. The number of germinated seeds at the end of 8^{th} day was added to germinated number of seeds at the end of 4^{th} day and the total number was divided to initial number of seeds to calculate germination power. Emergence tests were carried out in pre-cleaned germination boxes (60 x 100 x 15cm). Sterilized sand was placed into boxes and 100 seeds were buried with 1cm spacing into 3cm depth in rows with 10cm spacing. Water was added to each box until the saturate level of the sand [9]. At the end of 4^{th} day, normally germinated and emerged seeds over the sand were counted and removed from the boxes with their roots. The number of emerged seed was divided to initial number of seeds to determine percent (5) emergence rate. Water was added to dried boxes to moisten the boxes and counting was repeated at the end of 8^{th} day. As it was in germination rate, total of 4^{th} and 8^{th} days was divided to initial number of seeds to get percent (%) emergence power [7].

Analysis of variance was performed by using MSTAT-C statistical software. Least Significant Difference (LSD) test was performed to evaluate the differences among means. Results were expressed as the average of cropping seasons.

Result and Discussion

Germination rate (%)

Differences between weed control practices with regard to germination rate were not found to be significant (Table 1). However, the differences between cultivars were significant. Kırık had 1% more germination rate than Doğu-88. Contrary to current findings, Kırtok et al. [8] and Dumlupınar et al. [10] indicated significant differences between wheat cultivars with regard to germination rates. With regard to fertilizer sources of current study, germination rates for control, NP, Bio, Bio SR, Leonardite, OF and CM treatments were respectively found to be 82.7, 93.0, 84.0, 84.4, 85.3, 92.4 and 92.7%. The highest germination rates were obtained from NP, CM and OF treatments and the lowest rates from control treatment (Table 1). These findings may be related to the positive effects of available nutrient conditions on growth of wheat. Germination rates in all treatments were above the allowable limits recommended by regulations for certificated seeds (% 85) [11].

Germination power (%)

The difference between cultivars with regard to germination power was not significant (Table 1). Germination power for 475 seed/m^2, 475 seed/m^2+HW and 625 seed/m^2 treatments were found to be 92.7, 93.9 and 93.1%, respectively. While sowing rates were not significantly affecting germination powers, hand-weeding significantly increased the germination power. That might be due to increased kernel size in research plots.

Germination powers for Control, NP, Bio, Bio SR, Leonardite, OF and CM treatments were respectively determined as 90.1, 96.6, 91.4, 91.0, 92.2, 95.8 and 95.6% (Table 1). The highest germination power was observed in NP treatment, and it was followed by OF and CM treatments. Such findings might be due to larger kernels of more proper nutrient conditions. Kurama et al. [12] carried out research to investigate the effects of natural zeolite and different fertilizer sources on germination power of wheat seeds and reported the highest germination power for NP treatment. Germination powers of all treatments were highly above the limits recommended in regulations for certificated seeds [11].

Emergence rate (%)

The difference between cultivars with regard to emergence rate was not significant. Emergence rates of 475 seed/m^2, 475 seed/m^2+HW and 625 seed/m^2 treatments were 68.4, 68.6 and 66.9%,

respectively. While hand-weeding was not significantly affecting emergence rates, increasing sowing rates significantly affected emergence rates. That might be due to decrease in kernel size of high sowing rates [13]. Emergence rates for Control, NP, Bio, Bio SR, Leonardite, OF and CM treatments were respectively found to be 56.2, 81.4, 59.6, 60.9, 64.2, 77.4 and 76.2% (Table 1). The highest emergence rate was observed in NP treatment, and it was followed by OF and CM treatments. The lowest emergence rate on the other hand was obtained from control treatment without fertilizer application.

Table 1: Seed germination rates of two wheat cultivars with different fertilizer sources and sowing rates.

Note: Averages indicated with the same letter are not different. * Indicate F values of 0.05, ** indicate F values of 0.01.

Treatments	Germination Rate (%)	Germination Power (%)	Emergence Rate (%)	Emergence Power (%)
Years				
2006-07	85.2b	91.5b	66.3c	90.7c
2007-08	88.9a	94.1a	69.5a	92.1b
2008-09	89.3a	94.2a	68.2b	93.5a
LSD	0.52	0.48	1.20	0.42
Average	87.8	93.2	68.0	92.1
Cultivars				
Doğu-88	87.4b	93.2	68.0	92.3a
Kırik	88.1a	93.3	68.0	91.8b
Sowing rates (seed/m^2)				
475	87.7	92.7b	68.4a	92.1a
475+HW	87.9	93.9a	68.6a	92.5a
625	87.7	93.1b	66.9b	91.6b
LSD	-	0.48	1.20	0.42
Fertilizers				
Control	82.7d	90.1e	56.2e	90.4c
NP	93.0a	96.6a	81.4a	94.5a
Bio	84.0c	91.4d	59.6d	90.8c
Bio SR	84.4c	91.0d	60.9d	90.5c
Leonardite	85.3b	92.2c	64.2c	90.8c
OF	92.4a	95.8b	77.4b	94.1ab
CM	92.7a	95.6b	76.2b	93.5b
LSD	0.80	0.73	1.84	0.64
Variation Sources				
Year (Y)	248.24**	133.07**	24.65**	147.94**
Cultivar (C)	19.57**	1.19	0.03	15.96**
Rate (R)	1.04	22.25**	8.30**	14.79**
Fertilizer (F)	460.93**	179.15**	405.93**	111.65**
Y x C	18.41**	7.53**	0.66	5.88**
Y x R	1.81	3.29*	5.29**	5.09**
Y x F	5.21**	1.71	5.96**	4.26**
C x R	30.59**	5.98**	28.34**	6.70**
C x F	13.25**	3.81**	3.72**	6.30**
R x F	9.17**	11.86**	7.18**	5.26**
Y x C x R	0.98	0.47	0.33	4.81**
Y x C x F	6.25**	2.23*	2.81**	1.46
Y x R x F	6.46**	1.73*	1.90**	2.74**
C x R x F	8.65**	3.85**	2.96**	8.70**
Y x C x R x F	4.95**	1.91**	2.59**	2.85**
Variation Coefficient (%)	1.81	1.56	5.41	1.38

Emergence power (%)

The difference between cultivars with regard to emergence power was found to be significant (Table 1). Emergence power was found to be 92.2% for Doğu-88 and 91.8% for Kırik. Weed control practices significantly affected the emergence power and the value was 92.1% for 475 seed/m^2, 92.5% for 475 seed/m^2+HW and 91.6% for 625 seed/m^2 treatments (Table 1). Increasing sowing rates decreased the kernel sizes and consequently the emergence power. Hand-weeding allowed plants to uptake more nutrients and water, increased kernel fill and leaf area periods and consequently 1000 kernel weight (kernel size) [13]. Fertilizer sources had significant effects on emergence power and the values for Control, NP, Bio, Bio SR, Leonardite, OF and CM treatments were respectively found to be 90.4, 94.5, 90.8, 90.5, 90.8, 94.1 and 93.5%. The highest emergence powers were obtained from NP, OF and CM treatments but the differences among these fertilizers with regard to emergence power were not significant. The seed with more available nutrient conditions had higher emergence power values than the others.

Biological values decreased with the aging of seeds, therefore seeds of 2006-07 cropping year had lower biological values than the seeds of 2007-08 and 2008-09 cropping years. As the average of cropping years, germination rate was determined as 87.8%, germination power as 93.2%, emergence rate as 68.0 and emergence power as 92.1. The differences between cultivars were significant with regard to germination rate and emergence power and were not significant with regard to germination power and emergence rate. Weed control practices significantly affected germination power, emergence rate and power and the highest values were observed in hand-weeding treatments. Fertilizer sources also significantly affected the biological characteristics of seeds. While the lowest values were observed in control treatment without fertilizer, the highest values were seen in mineral NP, OF and CM treatments.

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