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EFFECTS OF FERTILIZER SOURCES AND WEED CONTROL PRACTICES ON PHYSICAL SEED PURITY OF ORGANIC WHEAT

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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 a 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. Physical seed purity characteristics (ratios of pure seeds, other plant seeds, weed seeds, broken kernel and other materials) were determined in present study. As the average of experimental factors, a ratio of 97.89% was determined for pure seeds, 0.015% for other plant seeds, 0.84% for weed seeds, 0.59% for broken seeds (smaller than a half) and 0.66% for other materials. The highest seed purities were observed in Doğu-88 cultivar (% 98.28), hand-weeding treatment (98.06%), and inorganic fertilizer application (%98.49).

Keywords: organic wheat, organic manure, weed control, seed purity

1. INTRODUCTION

Seed has played a critical role in agricultural development since prehistoric humans domesticated the first crops. For seed to play a catalytic role, it should reach farmers in a good quality state, i.e. high genetic purity and identity, as well as high physical, physiological and health quality. In contrast to fertilizers and pesticides, farmers select and save seed to plant the next year's crop, and any off-farm seed from the formal sector should be of a better quality for farmers to invest in it. Therefore, the best production techniques need to be followed to produce good quality seed (Van Gastel et al., 2002). Quality seeds are composed of full and tough kernels of only the cultivar to be sown. They supposed to be free off any other organic or inorganic materials, seeds of weeds and other plants, broken, diseased or weak kernels. Pure seed ratio of a seed sample is expressed as the ratio of the weight of tough and full kernels to total sample weight. A quality seed should have purity close to 100% (Anonymous, 2012). Quality seeds should be used to get higher and economical yields per unit area. The seed control and certification agency is responsible for ensuring variety purity, identity and other seed quality attributes, such as physical purity, germination and health in Turkey. The official seed control and certification agency carries out inspection in the field and tests the seed in the laboratory to confirm that the seed meets the national certification standards (Anonymous, 2012). Therefore, certificated seed utilization in wheat

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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 (Şehirali, 2002). Long term use of same seeds causes some decreases in physical and biological quality of seeds (Edwards, 2006). Emergence of certified samples is always greater than 80%, but field germination rates are often below 75% in farmers' seeds (Edwards and Krenzer, 2006). Harmanşah and Tanin (1987) indicated the most significant input of the cereal production as seed and reported 25-40% yield increases with quality seeds. Ries and Everson (1970) reported higher emergence rates and powers and consequently higher initial growth rates for large size wheat seeds than the smaller ones. Chastain and Wysocki (1995) also indicated faster emergence rates for large wheat seeds.

Negative impacts of chemicals used in agricultural production practices on human, animal and environmental health has 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. Sufficient research and information are not available especially about the effects of such cultural practices on seed purity of wheat and physical characteristics of seeds. Therefore, effects of different fertilizer sources and weed control practices on purity of organic wheat seeds were investigated in this study.

2. MATERIALS AND METHODS

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 a 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. Physical seed purity characteristics (ratios of pure seeds, other plant seeds, weed seeds, broken kernel and other materials) were determined in present study. A total of 100 g wheat seed was sampled from each plot (ISTA, 1999; ISTA, 2009). Samples were divided into four groups to determine the physical purity:

- Pure seed (tough kernels and broken kernels larger than a half)
- Other plant seeds (not belonging to wheat cultivar)
- Weed seeds (not belonging to relevant cultivar)
- Tresh (broken kernels smaller than a half, soil, sand, stone, husk, straw and etc.)

Each group were weighed separately and divided by total sample weight (100 g) to determine the ratio of each group as percentage (%) (ISTA, 1999; Anonymous, 2008; ISTA, 2009). Results were expressed as the average of three cropping years.

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.

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3. RESULTS AND DISCUSSIONS

Pure seed ratio: The difference between cultivars with regard to pure seed ratio was found to be significant. Purity ratio was calculated as 98.28% for Doğu-88 and 97.51% for Kirik. Bishaw (2004) determined an average purity ratio of 98.92% for 303 wheat varieties grown in different ecologies with different treatments and observed a pure seed ratio of between 77.18-99.99%. Sowing rate also significantly affected the pure seed ratios. The ratios were determined as 97.69, 98.06 and 97.93% respectively for 475 seeds/m^2, 475 seeds/m^2 + hand-weeding (HW) and 625 seed/m^2 treatments. Higher ratio in 475 seed/m^2+HW treatment was due to hand-weeding since the weeds were not allowed to develop seeds and therefore wheat were able to uptake more nutrient and water and yield more kernels with larger sizes. Pure seed ratios for Control, NP, Bio, Bio SR, Leonardite, OF and CM fertilizer sources were determined respectively as 97.80, 98.32, 97.06, 97.77, 97.99, 98.49 and 97.82%. The highest ratio was obtained from OF treatment and the lowest from Bio treatment. These findings may be related to the positive effects of available nutrient conditions on growth of wheat. Pure seed ratios in all treatments were above the values recommended by regulations for certificated seeds (the ratio should be >97% for certificated seeds) (Anonymous, 2008).

Ratio of other plant seeds: The difference between cultivars with regard to ratio of other plant seeds was found to be significant and the ratio was calculated as 0.012% for Doğu-88 and 0.018% for Kirik. Ratio of other plant seeds for 475 seeds/m^2, 475 seed/m^2+HW and 625 seed/m^2 treatments were found to be as 0.019, 0.011 and 0.015%, respectively. Increase in sowing rate and hand-weeding significantly decreased the ratio of other plant seeds. With regard to fertilizer sources, the ratios for control, NP, Bio, Bio SR, Leonardite, OF and CM treatments were determined respectively as 0.012, 0.000, 0.015, 0.007, 0.000, 0.001 and 0.073%. The highest ratio was obtained from CM treatment. This may be due to possible existence of undigested and unburned seeds of other plants in manure. Ratios of other plant seeds were significantly lower than the values recommended in regulations (Anonymous, 2008).

Ratio of weed seeds: The difference between cultivars with regard to ratio of weed seeds was found to be significant. The ratio was 0.92% for Kirik and 0.75% for Doğu-88. Higher yield and competitive power of Doğu-88 might have decreased the the ratio of weed seeds. With regard to sowing rates, the ratios for 475 seeds/m^2, 475 seed/m^2+HW and 625 seed/m^2 were found to be 0.97, 0.79 and 0.74%, respectively. Again, hand-weeding and denser sowing rates significantly decreased the ratio of weed seeds. With regard to fertilizer sources, the ratios for control, NP, Bio, Bio SR, Leonardite, OF and CM treatments were respectively found to be 0.91, 0.75, 0.89, 0.84 0.82, 0.47 and 1.18%. The highest weed seed ratio was obtained from CM treatment and the lowest from OF treatment. Again undigested and unburned seeds in manure might have caused to have higher weed seed ratios in manure treatment. Ratios of weed seeds were highly above the limits recommended in regulations for certificated seeds (Anonymous, 2008).

Broken seed (smaller than a half) ratio: The difference between cultivars with regard to ratio of broken seeds was found to be significant. A broken seed (smaller than a half) ratio of 0.77% was determined for Kirik and 0.42% for Doğu-88. Kernel shape and structure might have caused to have such difference. Sowing rates significantly affected the broken kernel ratio and the ratios for 475 seeds/m^2, 475 seeds/m^2+HW and 625 seeds/m^2 treatments were found to be 0.68, 0.60 and 0.50%, respectively. Increasing sowing rates decreased the ratio of broken kernel by increasing kernel size. Effects of fertilizer sources were also significant on broken kernel ratio and Control, NP, Bio, Bio SR, Leonardite, OF and CM treatments yielded broken ratios of 0.76, 0.59, 0.73, 0.48, 0.61, 0.51 and 0.48, respectively.

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Table 1. Purity ratios of two wheat cultivars with different fertilizer sources and sowing rates[1]

Treatments	Pure seed (tough kernels and broken kernels larger than a half) (%)	Other plant seeds (not belonging to wheat cultivar) (%)	Weed seeds (not belonging to relevant cultivar) (%)	Thresh	
				Seed and seed pieces (broken smaller than a half) (%)	Other (soil, sand, stone, husk, straw and etc.) (%)
Years					
2006-07	97.98 b	0.015 b	0.81 b	0.57 b	0.63 b
2007-08	97.50 c	0.022 a	0.97 a	0.69 a	0.80 a
2008-09	98.19 a	0.008 c	0.73 c	0.52 c	0.55 c
LSD	0.10	0.003	0.064	0.050	0.054
Average	97.89	0.015	0.84	0.59	0.66
Cultivars					
Doğu-88	98.28 a	0.018 a	0.75 b	0.42 b	0.53 b
Kırik	97.51 b	0.012 b	0.92 a	0.77 a	0.79 a
Sowing rates (seed/m^2)					
475	97.69 c	0.019 a	0.97 a	0.68 a	0.63 b
475+HW	98.06 a	0.011 c	0.79 b	0.60 b	0.54 c
625	97.93 b	0.015 b	0.74 b	0.50 c	0.81 a
LSD	0.10	0.003	0.064	0.050	0.054
Fertilizers					
Control	97.80 d	0.012 bc	0.91 b	0.76 a	1.00 a
NP	98.32 b	0.000 c	0.75 c	0.59 b	0.54 d
Bio	97.06 e	0.015 b	0.89 b	0.73 a	0.68 c
Bio SR	97.77 d	0.007 bc	0.84 bc	0.48 c	0.53 d
Leonardite	97.99 c	0.000 c	0.82 bc	0.61 b	0.58 d
OF	98.49 a	0.001 c	0.47 d	0.51 c	0.44 e
CM	97.82 d	0.073 a	1.18 a	0.48 c	0.85 b
LSD	0.16	0.014	0.098	0.076	0.082
Variation Sources					
Year (Y)	154.58**	21.08**	50.15**	43.79**	76.41**
Cultivar (C)	556.37**	12.92**	65.02**	484.29**	245.64**
Rate (R)	43.49**	7.82**	46.53**	43.09**	89.28**
Fertilizer (F)	112.50**	132.53**	61.43**	30.62**	78.96**
Y x C	2.06	6.19**	0.53	1.07	0.96
Y x R	0.01	2.16	0.06	0.01	0.01
Y x F	0.01	5.15**	0.05	0.01	0.01
C x R	0.97	0.93	21.19**	6.04**	83.02**
C x F	34.63**	21.60**	42.03**	56.19**	21.81**
R x F	1.18	17.66**	11.45**	14.37**	9.90**
Y x C x R	0.01	0.32	0.04	0.01	0.01
Y x C x F	0.01	6.94**	0.05	0.01	0.01
Y x R x F	0.01	3.55**	0.04	0.01	0.01
C x R x F	3.13**	27.36**	15.44**	6.16**	11.46**
Y x C x R x F	0.01	5.10**	0.05	0.01	0.01
Variation Coefficient (%)	0.38	9.83	7.26	9.65	8.83

[1] Averages indicated with the same letter are not different. * indicate F values of 0.05, ** indicate F values of 0.01

Ratio of other materials: The difference between cultivars with regard to ratio of materials other than seed was found to be significant. The ratio was 0.79% for Kirik and 0.53% for Doğu-88. Weed control practices had significant effects on the ratio of other materials. Te ratios for 475 seed/m^2,

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475 seeds/m^2+HW and 625 seed/m^2 treatments were found to be 0.63, 0.54 and 0.81%, respectively. Hand-weeding herein again decreased the ratio of other materials. With regard to fertilizer sources, the ratios for Control, NP, Bio, Bio SR, Leonardite, OF and CM treatments were found to be 1.00, 0.54, 0.68, 0.53, 0.58, 0.44 and 0.85%, respectively. The lowest ratios were observed in OF and NP treatments and highest in Control and CM treatments. The ratios in all treatments were below the allowable limits (Anonymous, 2008).

4. CONCLUSIONS

More available conditions in 2006-07 and 2008-09 cropping seasons than that of 2007-08 for wheat growth increased the purity of wheat seeds of these seasons. Plant deaths due to winter effect in second cropping season caused to have higher weed development and consequently higher weed seed ratios, other plant seed ratios and trash ratios in experimental plots. Averages of cropping seasons were 97.89% for pure seed ratio, 0.015% for ratio of other plant seeds, 0.84% for ratio of weed seeds, 0.59% for ratio of broken seeds and 0.66% for ratio of other materials. The highest seed purity (98.28%) as the average of sowing rates and fertilizer sources was observed in Doğu-88; the highest purity (98.06%) as the average of cultivars and fertilizer sources was observed in 475 seed/m^2 + HW treatment; the highest purity (98.49%) as the average of cultivars and weed control practices was observed in OF treatment. Seed samples had yielded allowable ratios for entire factors except for weed seed ratio.

5. ACKNOWLEDGEMENTS

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