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Effects of Disturbed Soil Structure on Yield and Some Quality Factors of Wheat (*Triticum* Sp.)In The Cukurova Region in Turkey

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ABSTRACT

The effects of disturbed soil structure on yield and some quality factors such as protein, starch, ash of bread wheat (*Triticum*sp.) were examined in Cukurova Region. Yield, 1000 kernel weight, plant in m^2, protein, starch, ash, oil and gluten contents of grain samples were described in this study. Wheat plants were planted in two different experimental plots. Once, flume (small channel) which is 60 cm deep were cracked in the experimental field. Then, this flume was covered with soil after 30 days. This covered flume soil which have disturbed soil structure were used as control parcels. Other experimental parcels were planted on field which undisturbed soil that have block structur. Wheat plants were planted in two different experimental plots. The effect of disturbed soil structure on yield found to be statistically important at 0.01 levels in each bread wheat varieties. The highest yield was obtained at control parcel which disturbed soil structure of Ceyhan-99 variety as 6100.0 kg ha^{-1}. The yield was 5253.3 kg ha^{-1} in parcel 1 in which undisturbed soil structure of Adana-99 variety and increased to 5621.6 kg ha^{-1} in control parcel. Also yield was 5910.0 kg ha^{-1} in parcel 1 in which undisturbed soil structure of Ceyhan-99 variety and increased to 6100.0 kg ha^{-1} in control parcel which disturbed soil structure. Similar of disturbed soil structure were also effective on 1000 kernel weight. While 1000 kernel weight of disturbed soil of Ceyhan–99 variety was 36.16 g, the 1000 kernel weight of plot 1 which undisturbed soil structurerealized as 35.76 g. This increasing were statistically important with 0.01 levels on 1000 kernel weight in Ceyhan-99 variety but this effective was statistically insignificant in Adana-99 variety. Also disturbed soil structure was affected on the Plant m^{-2}. The effect of disturbed soil structure on the Plant m^{-2} was statistically important with 0.01 levels in Adana-99 variety and was statistically important with 0.05 levels in Ceyhan-99.

Key words: bread wheat, flume soil, disturbed soil structure, yield, 1000 kernel weight, quality.

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INTRODUCTION

Soil structure is important in agricultural lands in the contexts of restoration of disturbed lands and erosion prevention. According to these researchers the interactions of many chemical, physical and biological factors contribute to soil structure [1]. Some researchers reported that soil structure affects most characteristics and processes in the soil, such as water and gas transport, biological activity, root growth and crop production [2-5]. It is known that good soil structure is important for plant growth in soils with clay or silt and is especially important in regions subject to management. Soil structure in the surface very much depends on plant roots, organic matter, natural weathering processes, and texture of soil and drainage status. According to this mention well-structured soil encourage rooting, plant growth, airflow and drainage between the seedbed and the underlying subsoil [6]. It has shown that for the crop yield only very conservative estimation by improved soil structure. Some researchers claimed that cultivation treatments, especially deep ploughing were also highly effective in increasing grain yield [7].

Bread wheat (*Triticum*sp.) is widely produced in Cukurova region of South Turkey [8]. Thus, the study aimed to determine the effect of disturbed soil structure on yield and some quality factors such as protein, starch, ash of bread wheat (*Triticum* sp.) were examined in Cukurova Region of Turkey.

MATERIAL AND METHODS

Study area

The experiment was carried out in field of Easthern Mediterranean Agricultural Research Institute in 2010-2011 years. The Mediterranean climate with an average rainfall of 600 mm is dominating in the study area. Soils have thermic temperature with xeric moisture (9). Wheat, corn, cotton, soybean, peanut, sunflower and rapeseed are the cultivated crops in the region.

Laboratory analysis methods

Soil sample was taken from 0-30 cm depth of each experimental plot for laboratory analysis. Soils were air dried, and passed through 2 mm sieve. The pH on saturation extracts were measured using the Radiometer PHM 82 standard pH meter and a modified Walkley-Black procedure, respectively [10].The methods characterized by [11] were used to determine the available phosphorus.Organic matter was measured by using a modified Walkley-Black procedure [10]. Grain samples were taken after harvesting. Protein, stach and ash contents of grain were analyzed according to Kjeldahl method [12].

Establishing of experimental plots

In 2010 and 2011 years, experiment was established in the randomized blocks. Plots were arranged in the randomized plot desing with three replication and with two different locations. Wheat plants were planted in two different experimental plots. Once, flume (small channel) which it is 60 cm deep were cracked in the experimental field. Then, this flume was covered something over with soil after 30 days. This covered flume soil which have disturbed soil structure were make used as control parcels. Other experimental parcels were planted on field which undisturbed soil that have block structur. Wheat plants were planted in two different experimental plots. Planting was made two bread wheats (Adana–99 and Ceyhan–99) on 15 November 2010 at a seeding rate of 550 grains m^{-2}. Each plot had six rows, 5 m in length and 20 cm between rows. Applied 80 kg ha^{-1} P_2O_5 and 80 kg ha^{-1} N on soil before plowing. Then 80 kg ha^{-1} N on soil were applied in early spring.

Statistical Analysis

The experimentations were designed as randomized block with 3 replications. Statistical analysis were made according to this experimentation design. Variance Analysis was used to interpret the data of randomized blocks. The data were evaluated according to the variance analyze in statistic program and LSD test was used for the differences among averages.

RESULTS AND DISCUSSIONS

Some physical and chemical characteristics of soils

Some physical and chemical characteristics of experiment plots' soils were presented in Table-1 and 2. The pH values of experiment plots of Adana-99 variety ranged from 7.9 to 8.2. Also the pH values of experiment plots of Ceyhan-99 variety ranged from 7.7 to 8.1. It is shown that organic matter contents are very low. Organic matter contents of experiment plots of Adana–99 variety ranged from 0.50 % to 2.05 %. Also organic matter contents of experiment plots of Ceyhan–99 variety ranged from 0.44 % to 1.31 %. Electrical conductivity of soil samples of experiment plots of Adana–99 and Ceyhan–99 varieties ranged from 0.25 to 0.56 mmohscm^{-1}and 0.30 to 1.09 mmohscm^{-1}. Extractable P_2O_5 content of soils experiment plots of Adana–99 variety ranged from 18.0 to 61.2 kg ha^{-1}. Also extractable P_2O_5 content of soils experiment plots of Ceyhan–99 variety ranged from 23.4 to 59.4 kg ha^{-1}. It is known that excessive phosphorus in soils interacts with extractable some microelements [13-15]. Plant available P levels seem to be low not high and there should not be an interaction between P and micro nutrients. Extractable K_2O content of soils experiment plots of Adana–99 and Ceyhan–99 varieties ranged from 405.0 to 708.7 kg ha^{-1} and 405.0 to 540.0 kg ha^{-1} respectively. Total nitrogen contents of experiment plots of Adana–99 and Ceyhan–99 varieties ranged from 0.030 % to 0.123 % and 0.027 % to 0.067 %respectively.

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Table-1.Some physical and chemical charecteristic of soils of experimental plots.

Soil samples of plots	Organic matter %		pH 1/1		Electritical conductivity EC mmohscm^{-1}	
	Adana-99 variety	Ceyhan-99 variety	Adana-99 variety	Ceyhan-99 variety	Adana-99 variety	Ceyhan-99 variety
Control	0.63	0.67	8.1	7.7	0.35	0.30
1	1.34	0.82	8.1	8.1	0.30	1.09
2	2.05	1.31	8.1	8.1	0.25	1.00
3	0.93	1.03	8.2	7.8	0.55	0.38
4	1.23	0.55	8.1	8.0	0.56	0.50
5	0.50	0.44	7.9	8.0	0.25	0.33

Table-2.Some physical and chemical charecteristic of soils of experimental plots.

Soil samples of plots	Extractable P_2O_5kg ha^{-1}		Extractable K_2Okg ha^{-1}		Total Nitrogen %	
	Adana-99 variety	Ceyhan-99 variety	Adana-99 variety	Ceyhan-99 variety	Adana-99 variety	Ceyhan-99 variety
Control	48.6	36.0	708.7	540.0	0.038	0.040
1	19.8	25.2	405.0	405.0	0.080	0.049
2	18.0	25.2	472.5	540.0	0.123	0.067
3	48.6	23.4	708.7	472.5	0.055	0.061
4	28.8	45.0	472.5	540.0	0.074	0.033
5	61.2	59.4	675.0	540.0	0.030	0.027

The effects of disturbed soil structure on yield and 1000 kernel weight

Crop yield, 1000 kernel weight and some productivity factors of each wheat variety were given Table–3. The field experiment revealed that disturbed soil structuresignificantly increased yield and some productivity factors, such as 1000 kernel weight, plant m^{-2} of bread wheat. While the crop yield of control plot for Adana–99 variety was 5621.6 kg ha^{-1}, the crop yield of plot no 1 which undisturbed soil structurerealized as 5253.3 kg ha^{-1}. The crop yield of plot no 2 which undisturbed soil structure was found 5076.6 kg ha^{-1} in the second plot and 5380.0 in the third plot and 4841.6 in fourth plot. The crop yield of control plot of disturbed soil structure of Adana–99 variety higher than other all plots which undisturbed soil structure. The effect of disturbed soil structure on yield found to be statistically important at 0.01 levels.

Similar results were obtained for crop yield of Ceyhan-99 variety. The highest yield was obtained at control parcel which disturbed soil structure of Ceyhan-99 variety. The crop yield in control plot which disturbed soil structure of Ceyhan-99 were found as 6100.0 kg ha^{-1}; 5910.0 kg ha^{-1}; 5956.6 kg ha^{-1} and 5448.3 kg ha^{-1} , first, second, third and fourth plots which undisturbed soil structurerespectively. Also the effect of disturbed soil structure of Ceyhan-99 variety on yield found to be statistically important at 0.01 levels (Table-3).

Some researchers reported that disturbed soil structure with deep ploughingeffected on plant growing and grain yield [7].

The 1000 kernel weight of control plot which disturbed soil structure showed increases both for each variety. While 1000 kernel weight of control plot of Adana–99 variety was 35.21 g, the 1000 kernel weight of plot 1, undisturbed soil structure,realized as 34.86 g. Also while 1000 kernel weight of control plot of Ceyhan–99 variety was 36.16 g, the 1000 kernel weight of plot 1 which undisturbed soil structurerealized as 35.76 g. The effect of disturbed soil structure on 1000 kernel weight found to be statistically important at 0.01 levels for Ceyhan–99 variety. This effect for Adana-99 variety was found as statistically insignificant.

Similar results were obtained for plant m^{-2} of Adana-99 and Ceyhan-99 varieties. While plant m^{-2} of plot 1 of Adana–99 variety was 120.33, the plant m^{-2} of control plot was 131.00. Also while plant m^{-2} of plot 1 of Ceyhan–99 variety was 126.33, the plant m^{-2} of control plot was 135.66. The effect of disturbed soil structure of Adana-99 and Ceyhan-99 varieties on plant m^{-2} were found statistically important at 0.01 levels and 0.05 levels respectively (Table-3).

Table-3. Crop yield and some productivity factors

Experimental plots	Crop yield kg ha^{-1}		1000 Kernel weight g		Plant m^{-2}	
	Adana-99 variety	Ceyhan-99 variety	Adana-99 variety	Ceyhan-99 variety	Adana-99 variety	Ceyhan-99 variety
Control	5621.6	6100.0	35.21	36.16	131.00	135.66
1	5253.3	5910.0	34.86	35.76	120.33	126.33
2	5076.6	5956.6	35.65	35.03	116.83	118.00
3	5380.0	5448.3	35.71	36.91	127.66	134.00
4	4841.6	4713.3	35.30	35.70	126.83	129.83
5	4666.6	4998.3	34.26	34.18	127.33	127.33
CV	8.39	11.89	2.73	3.53	7.52	7.65
	Significant (P < 0.01)	Significant (P < 0.01)	insignificant	Significant (P < 0.01)	Significant (P < 0.01)	Significant (P < 0.05)

The effects of disturbed soil structure on some quality properties.

Results of some quality properties of grain samples experimental plots were presented in table-4. The protein contents of experimental plots of Adana-99 were varied from 9.9 % to 10.93 %, and for Ceyhan-99 variety it changed from 10.25 % to 11.89 %. The effect of disturbed soil structure on protein content was found statistically important at 0.01 levels for each variety. Some researchers claimed that wheat protein content and baking quality highly depend on genetic background and environmental factors. It is known that especially drought and heat stress affect protein content of wheat grain, during the grain filling period and nitrogen availability [16, 17].

The starch contents of experimental plots of Adana-99 were varied from 67.81 % to 68.76 %, and for Ceyhan-99 variety it changed from 67.22 % to 68.00 %. The effects of disturbed soil structure on starch contents were found statistically insignificant for each variety.

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The ash content of experimental plots of Adana-99 variety was varied from 0.351 % to 0.361 %. Also, ash content of experimental plots of Ceyhan-99 variety was ranged from 0.360 % to 0.373 %. The effect of disturbed soil structure on ash content wasn't found statistically important for each variety (Table–4). The ash content refers to the mineral contents of plants or foods. Also it is determined by burning a given quantity of foods under prescribed conditions and measuring the residue. The mineral content especially depends on some factors, such as the variety of wheat, the terrain, the fertilization and climatic conditions. The greater portion of minerals found in grain of wheat is contained in the germ and husk, the least amount in the endosperm of grain. Consequently, if grains of wheat and foods contain a greater number of bran particles, it has more elevated ash content [18, 19].

Table-4. Contents of protein, starch and ash of wheat grain samples

Grain samples of plots	Protein %		Starch %		Ash %	
	Adana-99 variety	Ceyhan-99 variety	Adana-99 variety	Ceyhan-99 variety	Adana-99 variety	Ceyhan-99 variety
Control	10.49	10.25	68.05	67.67	0.361	0.370
1	10.41	11.89	67.81	67.54	0.353	0.363
2	10.06	11.04	68.19	67.81	0.351	0.360
3	10.00	10.57	68.76	67.22	0.353	0.373
4	10.93	10.43	68.20	67.74	0.356	0.373
5	9.9	10.45	68.25	68.00	0.351	0.361
CV	4.74	6.12	1.04	1.26	1.8	2.52
	Significant (P < 0.01)	Significant (P < 0.01)	insignificant	insignificant	insignificant	insignificant

CONCLUSION

It has shownthat disturbed soil structuresignificantly increased yield, 1000 kernel weight and plant m^{-2} of bread wheat. The effect of disturbed soil structure on yield found to be statistically important at 0.01 levels for each wheat variety. Also the effect of disturbed soil structure of Adana-99 and Ceyhan-99 varieties on plant m^{-2} were found statistically important at 0.01 levels and 0.05 levels respectively.

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