COMPARISON OF SOME SOIL PROPERTIES BETWEEN MAIZE CULTIVATION AREAS AND ADJACENT ALDER *[(Alnus glutinosa (L.) Gaertner Subsp. barbata (C.A.Meyer) Yalt)*] STANDS IN KESIKKÖPRÜ VILLAGE, PAZAR IN TURKEY

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Abstract

The study area is located in Kesikköprü village which is 3 km far away from Pazar. In this study, a comparison of some soil properties between maize cultivation areas and adjacent alder *[(Alnus glutinosa (L.) Gaertner subsp. barbata (C.A.Meyer) Yalt)]* stands were investigated. For this purpose two experimental blocks on two different land use types (forestland and maize cultivation area) were established. After that, 9 soil pits were dug in each block, and 36 unit soil samples were taken from different depth steps for laboratory analysis. As a result of laboratory analysis, the highest ratio of sand, permeability, porosity, root ratio and soil organic matter was measured in top soils taken from alder stands, and the highest ratio of dispersion, erosion ratio, and bulk density was measured in top soil taken from maize cultivation areas. Significant differences were determined between alder stands and maize cultivation areas.

Key words: Kesikköprü, Alder Stands, Maize Cultivation, pH, Organic Matter.

1. Introduction

The major problems of the study areas are the lack of planning in land use and deforestation. Because of these reasons, some landslide occured in the study area (Yüksek 2003). There is not enough agricultural land in Kesikköprü village, but the main means of subsistence of the people who live in the study area is agriculture (e.g: Tea cultivation, maize cultivation). All of the land in the study area are privately owned and there is no land use classification and planning. Living conditions in study area are getting difficult and the value of agricultural products is decreasing from day to day. For this reason, there is intensive pressure on forestland (alder stands). During the last 50 years, from 1950 to 2000, alder stands were destroyed by the poor people in order to create new agricultural land (Yüksek and Kalay 2002). The aim of this study is to determine variations of some properties of soil between alder stands and maize cultivation areas in Kesikköprü village, Pazar-Rize-Turkey.

2. Materials and Method

2.1. Definition of Study Area

The study area is in Kesikköprü village which is located about 3 km south west (SW) of Pazar, along with Pazar (Hemşin) watershed creek (Figure 1). It is between 40° 52' 44'' N latitude and 40° 45' 26'' E longitude. Elevation of the study area is 130 ± 30 m. The long-term annual precipitation of Pazar is 1953 mm and average annual temperature is 13.89 °C. The climate is very humid with short cold winters (Yüksek 2001).

Figure 1. Location of the study area, Kesikköprü in Pazar, Turkey

2.2. Field Methods

Two experimental blocks (80x80m) were selected with three (20X50m) replications in two different land use types. Then nine soil profiles were dug under alder stands and soil samples were taken from different depth steps (such as 0-20, 20-40 cm), and nine soil profiles were dug in maize cultivation areas and soil samples were taken from different depth steps (0-10, 10-30 cm). These soil samples were taken to the laboratory for analysis. Soils that are physically disturbed often show no visible stratification (no horizons). In this case the soil was sampled by depth. The recommended depths for sampling depend on the purpose of assessment and history of the soil's biological factors. For example, with microbial biomass, microbial activity, soil fauna and enzyme activity are most important in surface samples. It was reported that compacted soil is sampled slightly deeper than the more compacted soils (Crepin and Johnson, 1993). 0-10 cm depth steps were recommended for top soils in agriculture land and 0-20 cm depth steps were recommended for top soils in forestland (Hodges et all. 1994; Anonymous 1995). For this reason, soil samples were taken from different depth steps in the two different land use types.

2.3. Laboratory Methods (Soil Analysis)

Particle size distribution was determined on the total soil sample basis, including coarse fragments (> 2 mm), and on soil size material (< 2 mm) alone. Percentages of soil particles > 2 mm, and < 2 mm were determined by sieving and weighing.

Sand, silt and clay ratio in the < 2 mm fraction were then determined using Bouyoucos hydrometer method (Scheldrick and wang 1993; Yüksek 2001). Bulk density was computed for each core sample by calculating the ratio of oven-dry weigh (at 105°C) to volume (Özyuvacı 1976; Culley 1993; Yüksek 2001). Particle density was determined by the pycnometer method (Yüksek 2001). Total pore space of soils was estimated using the interaction between bulk density and particle density. Water retention was measured by subjecting saturated soil samples <2 mm to tensions of 1/3, 5 and 15 bars until equilibrated in pressure memebrane and pressure plate extractors. After that hydraulic conductivity (permeability) of soil cores was determined using a percolation rack and the constant-head soil core methods (Reynolds 1993; Yüksek 2001). Soil organic matter was determined in Walkey-Black procedure. Soil pH was determined in a 1: 1 2/5 soil water mixture using orion 420 A pH meter (Karaöz 1991; Yüksek 2001). Dispersion ratio was estimated using Middelleton's dispersion equation Colloid/Moisture equivalent ratio was measured using the interaction between clay ratio and soil moisture equivalent (C/MEG). The erosion ratio was estimated by the interaction between the dispersion ratio and colloid/moisture equivalent ratio (ER = D.R./C.M.E) (Özyuvacı, 1971).

2.4. Statistical Analysis

Data on soil properties from alder stands and maize cultivation areas were subjected to analysis of variance (ANOVA), statistically significant differences between means were identified by (Duncan's Multiple Range Test). $P<0.05$ was considered as indicating significant differences. The tests were conducted using statg (Statgraph 97) software package.

3. Results and Discussion

The highest sand ratio was found in the top soil of alder stands, and the highest clay ratio was measured in the sub soil of cultivation area, and the highest silt ratio was found in the top soil of cultivation area. According to land use types, there were significant differences between sand, clay and silt (Table 1). According to depth, sand was decreased, silt and clay were increased (Table 1, 2). While water holding capacity was increasing from top soil to sub soil in alder stands, it was decreased in maize cultivation areas. Significant differences were found between alder stands and maize cultivation areas (Table 1, 2). Yüksek (2001) reported that, there is a positive correlation between the soil's organic matter and the water holding capacity in maize soil in Pazar creek. Türüdü (1981) conducted a study comparing some soil properties between maize cultivation and adjacent *Fagus orientalis* stands. He determined that mean sand ranged from 60 to 70 %; mean clay ranged from 7.0 to 11.3 %; mean silt ranged from 23.0 to 27.7 % in *Fagus orientalis* stands; and mean sand ranged from 55.1 to 55.6 %; mean silt ranged from 27.5 to 28 %; mean clay ranged from 16.4 to 20.4 % in maize cultivation areas. And he reported approximately similar results to the findings in our study about soil water content. He reported positive correlations between soil water content and organic matter (OM) in two different land use types.

Table 1. Comparison of Some Properites of Top Soils Taken From Alder Stands and Maize Cultivation

Soil Properties	Land Use Types	N	X	Sx	F Ratio	Duncan's Multiple Range Test
Sand (%)	Alder (1) Maize (2)	9 9	69.048 59.857	4.441 3.263	5.352	1-2*
Clay (%)	1 2	9 9	15.052 20.847	2.756 2.740	4.153	1-2*
Silt (%)	1 2	9 9	15.900 19.296	1.674 2.153	4.409	1-2*
Dispersion Ratio (%)	1 2	9 9	39.716 91.575	3.347 5.656	14.256	1-2*
Colloid/ Moisture Equi.	1 2	9 9	0.831 0.873	0.169 0.174	0.654	N.S
Erosion Ratio (%)	1 2	9 9	47.79 104.90	3.421 10.512	15.104	1-2*
Water Holding Capacity (%)	1 2	9 9	43.532 45.277	3.731 3.854	0.710	N.S
Moisture Equivalent (%)	1 2	9 9	24.660 24.416	3.350 3.104	0.110	N.S
Permanent Wilting Point (%)	1 2	9 9	12.760 14.121	2.162 2.204	2.526	N.S
Available Water (%)	1 2	9 9	11.900 10.295	2.125 1.711	2.151	N.S
Bulk Density (g/cm^3)	1 2	9 9	0.964 1.110	0.046 0.196	11.912	1-2*
Particle Density (g/cm^3)	1 2	9 9	2.416 2.645	0.079 0.675	11.710	1-2*
Porosite (%)	1 2	9 9	60.099 58.030	5.451 5.386	0.916	N.S
Permeability (cm/h)	1 2	9 9	108.188 66.128	10.104 7.412	11.121	1-2*
Percentage of soil particle > 2mm	1 2	9 9	53.118 49.603	6.751 5.088	2.124	N.S
Percentage of soil particle < 2mm	1 2	9 9	45.200 49.930	6.939 6.865	0.112	N.S
Root ratio (%)	1 2	9 9	1.682 0.467	0.502 0.121	6.675	1-2*
pH	1 2	9 9	5.347 5.213	0.550 0.515	0.421	N.S
Organic matter (%)	1 2	9 9	2.932 0.855	0.324 0.094	10.721	1-2*

Table 2. Comparison of Some Properites of Sub-Soils Taken From Alder Stands and Maize Cultivation

Soil Properties	Land Use Types	N	X	Sx	F Ratio	Duncan's Multiple Range Test
Sand (%)	Alder (1) Maize (2)	9 9	67.466 60.890	3.648 5.211	6.152	1-2*
Clay (%)	1 2	9 9	15.347 22.539	1.944 2.154	7.612	1-2*
Silt (%)	1 2	9 9	17.187 16.571	1.219 1.101	1.212	N.S
Dispersion Ratio (%)	1 2	9 9	51.224 106.860	6.710 9.126	14.157	1-2*
Colloid/ Moisture Equi.	1 2	9 9	0.858 0.984	0.130 0.171	0.162	N.S
Erosion Ratio (%)	1 2	9 9	59.700 108.590	6.841 12.126	16.624	1-2*
Water Holding Capacity (%)	1 2	9 9	45.423 35.960	2.736 3.127	8.426	1-2*
Moisture Equivalent (%)	1 2	9 9	24.233 23.537	1.193 1.454	0.744	N.S
Permanent Wilting Point (%)	1 2	9 9	10.960 10.928	1.182 1.120	0.324	N.S
Available Water (%)	1 2	9 9	13.273 12.609	1.321 1.189	0.621	N.S
Bulk Density (g/cm^3)	1 2	9 9	0.993 1.222	0.136 0.214	9.624	1-2*
Particle Density (g/cm^3)	1 2	9 9	2.450 2.702	0.604 0.710	6.122	1-2*
Porosity (%)	1 2	9 9	59.460 54.770	7.181 5.610	1.224	N.S
Permeability (cm/h)	1 2	9 9	104.10 36.205	12.866 4.054	15.055	1-2*
Percentage of soil particle > 2mm	1 2	9 9	61.130 48.063	6.481 5.324	8.621	1-2*
Percentage of soil particle < 2mm	1 2	9 9	38.135 51.721	2.586 5.206	6.812	1-2*
Root ratio (%)	1 2	9 9	0.735 0.212	0.076 0.032	11.624	1-2*
pH	1 2	9 9	5.010 4.878	1.014 0.912	1.212	N.S
Organic matter (%)	1 2	9 9	2.063 0.443	0.491 0.095	12.928	1-2*

X: Average; S_X: Standart Deviation; N: Number of Samples; *: Significant at 5 % level; N.S: Non Significant

The highest permeability was determined in the top soil of alder stands and the lowest permeability was found in the sub soil of maize cultivation. Significant differences were determined between maize cultivation and alder stands (Table 1, 2). The highest bulk and particle densities were found in the sub-soils of maize cultivation and the lowest bulk and particle densities were determined in the top-soil of alder stands. The variations of means are significantly important according to land use types (Table 1, 2). It is known that OM improves the physical properties of soil. The higher ratio of OM, which was measured in alder stands, can affect the decreasing ratio of bulk and particle densities. According to Hudson (1994), soil high in OM content have significantly higher avaliable water content (AWC) then soils of similar texture that contain less OM. Also, there was a significantly positive correlation between soil OM content and estimated AWC in all textural groups (sand, silt loam and silty clay loam). As organic matter increased, the volume of water held by the soil of field capacity increased much more rapidly then the volume of water held at wilting point (PWP), resulting in increase in AWC. It was reported by Pritchett and Fisher (1987), soils in organic matter have lower bulk densities then soils low in this component. Soils that are loose porous have weights per unit volume (bulk densities), while those that are compacted have high values. Continued cultivation tends to reduce aggregation in most soils through mechanical rupturing of aggregates and by reduction in organic matter. The amount and nature of soil organic matter and activity of soil flora and fauna influence pore volume. Pore volume is reduced by compaction. Pore volume of forest soils is naturally greater than that of similar soil used for agricultural purposes, because continuous cropping results in a reduction in OM in pore spaces.

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4. References

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