N Mineralization Potential Under Different Land Uses in Tutunculer in Artvin, Turkey

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Abstract:

This study was conducted to investigate mineralization potensial of different land uses in the area of Tutunculer in Artvin in 2011. For this purposes, soil samples were taken from surface 0-15 cm depth in young scothpine stands, scothpine and spruce stand and adjacent grassland sites with similar parent material, slope and aspect. Samples were subjected to standard incubition technique in labratory conditions (60% MSK and 25 ^{0}C). Mineralization rate different significantly among sites. Nitrification rate higher in grassland sites compared to other sides (149.46 N kg/ha 63 day^{-1}).

Key terms: nitrifications, nitrogen mineralizations, Tutunculer-Artvin.

Introduction:

Nitrogen availability in the soil which is one of the most important environmental factors of species diversity of plant communities, formation of the composition and primary production. Generally, studies have shown that the plant production and species composition of plant nutrient uptake was correlated (Kruijne et al. 1967; Vermeer and Berendse 1983; Pastor et al. 1984 and Brendse, 1990). After the application of nitrogen fertilizer is effectively changed to dominant plant species is (Persson 1981; Elberse, Van den and Dirven 1983; Tilman 1984; Vermeer 1985).

Different land use determined the amount of mineralization and type of land use to reveal the effects on net mineralization, in terms of land use change on the global scale, the amount of carbon held in the soil will help to a better understanding of the effects (Canadell 2002; Tecimen 2011). Globally, land use change in the influence of soil nitrogen and carbon cycles caused by the release of more carbon to the atmosphere is an important component to be realized (Grunzweig et al. 2003).

Nitrogen is taken from the soil which is forms of inorganic nitrojen by plants (ammonium and nitrate) and added in to the organic compounds. The amount of nitrogen in the organic matter were decomposed by litter and consumers and nitrogen back into the soil (Runge, 1983). Litter is significanlty important for supply the metabolic element for microorganisms (Enrique et al. 2008). A large number of edaphone plays important role for organic matter into the inorganic matter. Therefore, nitrogen mineralization determine the efficiency and sustainability of the ecosystem (Runge 1983; Davidson et al. 1992 and Myrold 1999).

An attempt was made to establish relationships between mineral nitrogen production and soil characteristics (organic C, total N, C/N ratio, %WHC, pH, temperature) for these communities (Runge 1983). According to Hooper and Vitousek 1997; Bergson et al. 2003 plant species in a region effects in the soil nitrogen mineralization rates which is depending on the properties of soil organic matter. Some of the parameters of the soil caused by organic matter (C/N ratio, lignin/ N ratio, phenolics compound/ N ratio and the amount of cellulose) affect the microbial activity şn soil and significantly important for nitrogen mineralization. Addition of organic matter C / N ratio, lignin/ N ratio, phenolics compound/ N ratio was found to be effective on soil properties and mineralization (Lowett et al. 2004). Plant species not only effect to nitrogen mineralization but also micro-climate change were play a role in the transformation of nitrogen in the soil (Taylor and Parkinson 1988). Therefore, the amount of nitrogen and nitrogen cycle may vary depending on the composition of the plant in different ecosystem types.

Nitrogen mineralization are discussed with different perspectives by various researchers (Knops et al. 2002; Ross et al. 2004; Guleryuz et al. 2008; Zengin et al. 2008; Arslan et al. 2010 and Guleryuz and Everest 2010) and also worked on the incubation methods. Guleryuz 1998; Guleryuz et al. 2007; 2008; 2010 and Tecimen 2011; were made using the standart incubation method in the laboratory.

In this study, determining of potential nitrogen mineralization of young scotch pine stands, old scotch pine stands, spruce and scotch pine stands and adjacent grassland area which is located in the Tutunculer region, in Artvin-Turkey (2010) and the effects on these species is intended to introduce of nitrogen mineralization.

Material and Methods

Study Area: The study site is located at in the village of Tutunculer in Artvin province, northeast Turkey, a mountain region with gentle slopes angle of the site (was range from 0 % to % 20), 850 m above sea levels and they were located on the northeastern and eastern aspect. The average age of stands were: young scotch pine stands (30 years old), old scotch pine stands (90 years old) and spruce and scotch pine stands (95 years old), respectively.

In the research area there has not been detailed soil surveys but two geological survey report is available which was held in 1974 and 1980 by provincial bank in Turkey. This report clearly shows that there may be a risk of landslides because of the area consist of split, dacitic and andesitic breccia and the slope is very high (Anonim 2005).

In general, soil types in the study area were: clay loam for young scotch pine stands, sandy clay loam for old scotch pine stands, light clay soil for spruce and scotch pine stands and sandy clay loam for grassland. İn addition to our research area does not have the appropriate weather station to examine the difference in elevation and aspect. Artvin meteorological station (600 m) which is close to the area, make a long-term observation and measurement.

Using the data from meteorological station was calculated climatic change with altitude. The climatic analyses in the Artvin meteorological station is calculated for each elevation steps (100 m) and has been interpolated to elevation of research area (850 m) and then interpolated values are given in Table-1. However, using the same method of interpolated were calculated average rainfall and temperature values in the Tutunculer region (850 m) and interpolated values are given Table-2.

Material: Our soil samples were taken from surface 0-15 cm depth in young scotch pine stands, old scotch pine stands and spruce and scotch pine stands, and adjacent grassland sites of the Tutunculer district in Artvin. Three sampling sites for each community from different areas were selected. Soil samples were taken from three sampling sites for each community. Volumetric soil samples were taken from surface 0-15 cm depth with a cylindrical cubes container of 15x15x15 cm. Soil samples were taken on 22.12.2010.

Sampling: Three sampling sites for each three community from different areas were selected. Soil samples were taken from three sampling sites for each community (a total of nine samples). Soil samples were taken from 15 cm depth with a container size of 15x15x15 cm and has 225 cm^2 area. The soil samples were dried naturally in the air and then put into polyethylen bags and arhived. For each sample, roots and stones are placed into plastic bags and labelled. Soil samples were sifted through with a standard 2 mm stainless steel sieve and then dried in air. The soil core was seperated from their stone and plant parts with a standard 4 mm sieve and put into nylon bags with label, and then weighed by precisely scale (Nuve FN 400) and (Cas Computing Scale) as gram (g).

Soil Analyses: First of all, soil moisture (%) was determined. The sample is weighed as received in the laboratory and again after drying in an oven for 24 hours at 105 C. The differences between the initial and final weight values show that the water content of the soil and calculated dry weight ratio of humidity. The maximum water holding capacity was determined as the difference in weight between dried before and after artificial wetting,

Soil pH was determined by a combination glass electrode in H2O (soil-solution ratio 1:2,5) and were measured with İnolab pH level I pH (Gulcur 1974). Organic matter contents of the soils were determined according to the wet digestion method described by Kalra and Maynard (1991) (modified Walkley- Black method) (Gulcur 1974). Micro-distillation method is used in the determination of mineral nitrogen (Bremner and Keeney 1965; Gerlach 1973 and Guleryuz 1992). Kjeldhal wet digestion method was used for the determination of total nitrogen (Steubing 1965).

Standart Incubatıon and Mineral Nitrogen Production: The 100 g of air-dried soil were put into two polyethylene bags and humidified with distilled water to reach 60 % Water-Holding Capacity (WHC). Samples were then placed into an incubator set at 25 C for nine weeks (63 days). The mineral nitrogen analyses were made in the 21st, 42nd and 63rd days of incubation. The mineral nitrogen analyses by the micro-distillation method (Bremner and Keeney 1965; Gerlach 1973).

Calculation of Nitrogen Mineralization rates: Mineral nitrogen was analyzed at three times during 63 days of incubation: at the 21st, at the 42nd and at the 63rd day. Incubation period was divided into two main periods: 21- days (between the initial and the 21st day) and 42nd days (between the 21st day and the 63rd day). Net mineral nitrogen accumulations were calculated between 42nd days and 21st days and also were calculated between 63rd days and 21st days. Differences were used to calculate the net mineral nitrogen production for each period. Net mineral nitrogen production was then expressed as nitrogen mineralization rates.

Statistical Analyses: The differences among the samples regarding to the mineral nitrogen values and the net mineralization were tested by analyses of variance.The significance among means was determined using the Tukey test. Also, correlation between net mineral nitrogen productivity at the and of 63 days and some soil factors (pH, WHC, % C, % N and % C/ N) was tested. All of the tests were performed at the significance level of a= 0.05, with Statistica Version 6.0 (Stat Soft Inc. 1984-1995) and SPSS 16.0 packet program.

Conclusion And Discussion: Values of pH, the maximum of water holding capacity (WHC), organic substance (% and kg/ha), total nitrogen (% and kg/ha) in the researched areas soil are given in Table 1.

Table 1. The organic C, total N, WHC (%) and pH means of the Scotch pine, Spruce and Scotch pine and Grassland

Topluluk	Scotch pine	Spruce and scotch pine	Grassland
pH	4,88±0,32	4,87±0,55	4,86±0,15
WHC (%)	147,03±12,65	119,5±12,68	94,31±3,46
Total N (%)	0,10±0,03	0,32±0,004	0,15±0,04
Total N (kg/ha)	905,99±285,39	2388±799	1122±225
Organic C (%)	3,37±0,74	5,42±0,91	6,95±0,41
Kg/ha	31085±3231	38134±4076	52726±5524

All of the research area's solid shows acidic character. In terms of this characteristic they resemble each other. The lowest pH value analysed areas in grasslands, the highest value were found in pine areas but there is no difference between these values.

When the maximum water holding capacity of analysed soils values were studied the highest value was measured in pine areas, the lowest value was measured in grasslands.

The soil samples which are subject to nitrojen mineralization varies shows distinctness according to the group vegetation in terms of the value of total nitrojen. The highest value was found in pine and spruce mixture areas, and the lowest value was found in the pine areas.

In comparison to the soil of study areas in terms of organic substance is observed that the maximum value is occurred in grasslands.

The results of the solids incubation 21st, 42nd and 63rd days that were collected from young scotch pine, scoth pine and spruce mixture with beside areas of the grasslands area were given in Table 2.

Table 2. net nitrogen mineralization accumulation for 21.42 and 63 days

	21st Day		42nd Day		63rd Day	
	NH_4	NO_3	NH_4	NO_3	NH_4	NO_3
Young scotch pine	9,16	10,73	44,32	17,51	120,97	44,32
Spruce Scotch pine	6,51	9,34	6,04	35,77	69,21	30,4
Grassland	6,63	7,09	31,14	64,08	110,31	149,46

During all the whole periods the high valuein terms of efficiency of ammonium was determined in the area of young scotch pine. This case is thought to be due to the high water holding capacity (WHC) of scoth pine areas.

All periods except the 21st day the highest values of nitrate in terms of efficiency in was grasslands. Because the WHC of soil is low that can be explained by the presence of oxygen. Tufekcioglu and Kucuk (2004) have showed that soil respiration of grasslands is higher in higher. This case is parallesism to our study.

As a result, effect of soil pH, WHC, total nitrogen, organic substance and temperature is known on nitrogen mineralization. The effect of WHC is seen as more on our study.

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