



REFORESTATION AND SOIL ORGANIC MATTER

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Abstract:

*Forests stabilize the climate in general. Plants enrich the soil by recycling the nutrients through the shedding of leaves and seeds. They also regulate the water cycle by absorbing and redistributing rainwater quite equally to every species living within its range, which is known as the economy of water. Overall, forests provide perfect habitats for life to flourish on land. Clear cutting is a controversial forestry practice in which most or all trees in an area are uniformly cut down. Clearcutting of the forests can have major negative impacts, both for humans and local flora and fauna. Some forests are clear cut in order to replace the trees species with more useful species. Today replacing of native species with non natives has increased in some forests to use a variety of wood products. In our study soil samples were collected from a virgin forest (V) and two planted forests which cultured with *Alnus subcordata* (A) and *Populus deltoids* (P) species in the north of Iran. Soil texture, electrical conductivity (EC) and pH, soil organic matter (OM), total nitrogen (N) of samples were measured and C:N ratio was estimated. Humus quality factor (K) was estimated using UV VIS spectroscopy at 400-700 nm. Soil texture of samples was similar, the highest quantity of OM was found in V sample. There was no significant difference between V and A in the amount of N but P showed the lowest amount of N. The highest and lowest values of K factor were found in V and A samples, respectively.*

Keywords: Reforestation, Organic matter, Nitrogen, K factor

INTRODUCTION

Forests provide economical, ecological, social and aesthetic services to natural systems and humans [1]. Refuges for biodiversity, hydrologic cycle, landscape, provision of food, medicinal, wood and protection of soil resources are the most benefits of forests. In addition, forests affect climate through carbon sequestration, energy, water, air pollution absorption and other chemical species with the atmosphere [2]. Clearing of forests for wood products and cultivation have altered climate. However, climate is influenced by world's forests through chemical, physical and biological processes which affects the hydrologic cycle, planetary energetic and atmospheric composition [2].

Some of the major problems in the tropics are the forest clear cutting, forest degradation and the deterioration of land productivity through human disturbance and inappropriate agricultural practices [3]. Ayanaba [4] indicated the effects of forest clearing and cropping on the carbon, nitrogen and sulfur reserves of soils under secondary lowland rain forest. He found that the soils which had been cropped for two years contained less total carbon and nitrogen than the corresponding forest soils. It is indicated that site history and management may play more important role in the changing of soil carbon and nitrogen stocks than the soil type [5]. Reforestation is the natural or intentional restocking of existing forests and woodlands that have been depleted, usually through deforestation. Reforestation can be used to improve the quality of human life by soaking up pollution and dust from the air, rebuild natural habitats and ecosystems, mitigate global warming since forests facilitate biosequestration of atmospheric carbon dioxide, and harvest for resources, particularly timber.

One of the most important component of environment is soil organic matter. Soil organic matter affects both the chemical and physical properties of the soil and its overall health. Soil properties which influenced by organic matter include: soil structure, moisture holding capacity, diversity and activity of soil organisms, which are beneficial and harmful to crop production, cation and anion exchange, nutrient availability, etc. It also influences the effects of chemical amendments, fertilizers, pesticides and herbicides [6, 7]. UV-VIS spectroscopy have been used in a wide range by soil scientists [8, 9, 10, 11]. UV VIS absorbance is used for estimating K factor which is humus quality parameter. The aim of this research was: to study the effects of replacing a virgin forest with a native and non native species on soil organic matter.

MATERIALS AND METHODS

Soil sampling was carried out from Guilan province, Iran. A virgin forest which was mostly covered with Caucasian Alder (*Alnus subcordata*), Wych Elm (*Ulmus glabra*) and Caucasian Persimmon (*Populus caspica*) was chosen. Since the Eastern Cottonwood (*Populus deltoids*) is one of the most rapid growth species which is useful for wood products, some parts of virgin forests in this area were cleared cut in order to culture this species.

A composite sampling was done from A horizon (0-20 cm) of the virgin forest and a 15 years old planted forests which were cultured with Caucasian Alder and Eastern Cottonwood in the same area. Soil samples were air dried and ground to pass through a 2-mm sieve for further analysis. Soil texture was determined using pipette method. The electrical conductivity (EC) and pH were measured using standard methods. The percentage of soil organic matter (OM) and nitrogen (N) and C:N ratio were measured in soil samples according to wet oxidation and Kjeldahl methods, respectively. Two grams of soil samples were extracted with 20 ml of 0.5% NaOH and two grams with 20 ml of 1% NaF. The absorbance capacity of recent extracts were measured using VIS spectra at 400-700 nm and the humus quality factor (K) was estimated [12]. Data were analyzed using SAS statistical software and Duncan's Multiple Range Test was used to separate the means ($p < 0.05$).

RESULTS

Physical and chemical properties of samples including: percentage of sand, silt and clay, soil texture, EC, pH, OM, N and C:N ratio were shown in the Table 1.

Table 1: The physico-chemical properties of soil samples

| Forest type | V | A | P |
|-----------------------------|------------|------------|------------|
| Sand (%) | 20.29 | 17.77 | 15.73 |
| Silt (%) | 57.26 | 63.09 | 64.04 |
| Clay (%) | 22.44 | 19.14 | 20.24 |
| Soil Texture | Silty loam | Silty loam | Silty loam |
| EC (μscm^{-1}) | 2.01 | 1.61 | 0.84 |
| pH | 7.39 | 7.52 | 7.52 |
| OM (%) | * a 5.65 | b 4.68 | c 3.32 |
| N (%) | a 0.12 | a 0.10 | b 0.05 |
| C:N | a 28.1 | a 27.43 | a 35.9 |

* Values followed by the same letter are not significantly different at $P < 0.05$ according to a one-way ANOVA

The soil texture of all samples was silty loam. EC values of samples were in the range of 0.84-2.01 and pH were placed in a narrow range of 7.39 to 7.52 (Table 1). The highest and lowest amounts of OM and N were found in V and P samples, respectively (Figure 1 and 2).

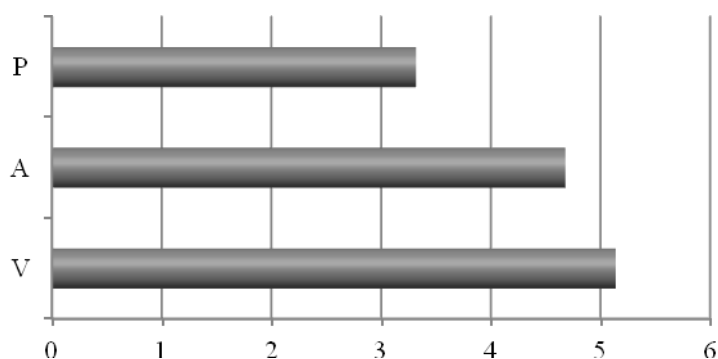


Figure 1: The percentage of organic matter in the samples

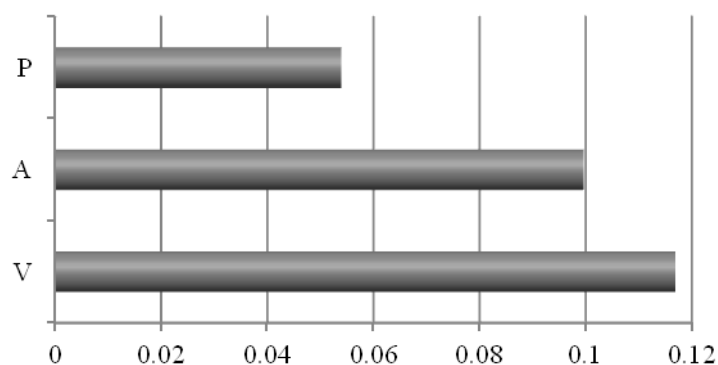


Figure 2: The percentage of N in the samples

Statistically there was no significant difference of C:N ratio between samples (Table 1) but in the figure P showed the highest value of this parameter (Figure 3).

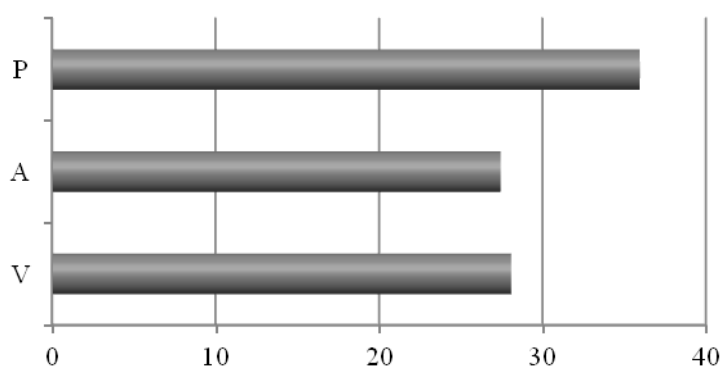


Figure 3: The C:N ratio of the samples

The highest and lowest value of K factor were found in V and A samples, respectively (Figure 4).

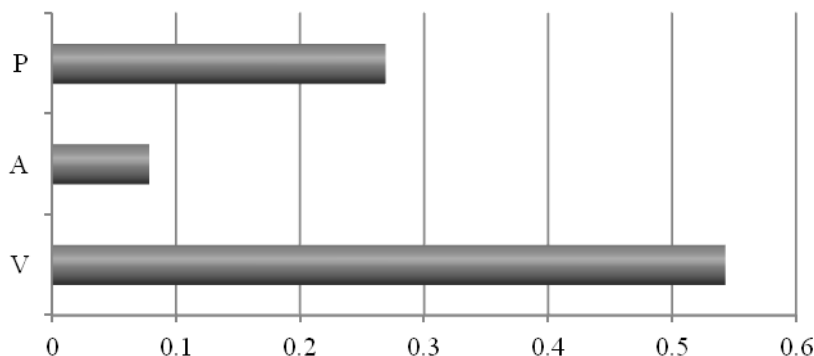


Figure 4: The K factor value of the samples

DISCUSSION

In order to reach the aim of this research all samples were collected from the same area so the soil texture of them was similar. Virgin forest contained the highest values of OM and N (Table 1). The virgin forest covered with a variety of old and native species, both the age and species kind influence the quantity of OM in the soil. In another hand soil microbial phase and its relationship with plants and itself in the soil strongly affected by vegetation type, age, solid phase stability etc. In the V sample because of long term activities of soil microbial phase in a stable environment with native and old species as well as balance of input and output organic matter, the amount of OM was more than the other samples.

There was no significant difference between V and A samples in N parameter (Table 1). However *A. subcordata* is the most native species of the virgin forest and it was confirmed that *Alnus* spp. is able to fix the atmospheric nitrogen (N_2) and increases it in the soil by symbiosis relationship with *Frankia* [13, 14]. Taleshi et al. [15] studied the effect of Alder vegetation on the restoration of forest soil and indicated that's positive role on increasing the amount of soil nitrogen because of their capability of nitrogen fixation.



K factor is a qualitative parameter of humus. In the measurement of this factor, raw and acidic humus fractions tend to dissolve primarily in NaOH solution, while the high-quality humus fractions of larger molecules enter into NaF solution more easily [16]. The highest value of K factor was found in V and the lowest in A samples (Figure 4). The amount of humus fraction with high quality in the soil organic matter of V sample was highest which is related to its vegetation, different types of input and output organic matter produced by microbial phase in the soil, more stable environment condition in this sample etc. But in the A sample because of high rate of nitrogen fixation and less amount of organic matter as well as low diversity of input organic matter, huge amount of organic matter is decomposed by microbial phase to simple fraction with low quality.

CONCLUSION

The virgin forest sample contained maximum amounts of organic matter and nitrogen and highest value of humus quality factor. The organic matter and nitrogen quantity of reforested samples with *A. subcordata*, the most native species of the sampling area was much more similar to virgin forest. But the humus quality of this sample was lowest because of imbalance condition of its environment. In order to restore the cleared forests, it is better to use the most native species than non-native.

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