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THE INFLUENCE OF CONSTRUCTIONS ON SOIL C:N RATIO

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Abstract

It is well known that the construction sector is constantly growing, bringing a negative impact on the environment. Therefore, the purpose of this study is to assess the impact of construction materials on the content of Carbon and Nitrogen in soil. These two chemical elements, especially the Carbon:Nitrogen (C:N) ratio, are extremely important in organic matter and are among the most important in terms of soil structure, especially because they could provide information leading to characterization of the soil. Carbon in soil plays an essential role as food source for soil micro-organisms and as bacteria metabolite, while Nitrogen is an important nutrient for crop production.
In this study, the C:N ratio was calculated in the case of soil samples taken from an area in full development, in Bucharest, where demolition of buildings took place recently. This ratio was compared with the one determined in the soil samples from the immediate surroundings, where vegetation grows.
The obtained results indicated that the C:N ratio was lower in the case of soil samples taken from an area in full development compared with the one determined in the soil samples from the immediate surroundings, which indicates that construction materials influence the Carbon and Nitrogen content of the soil.

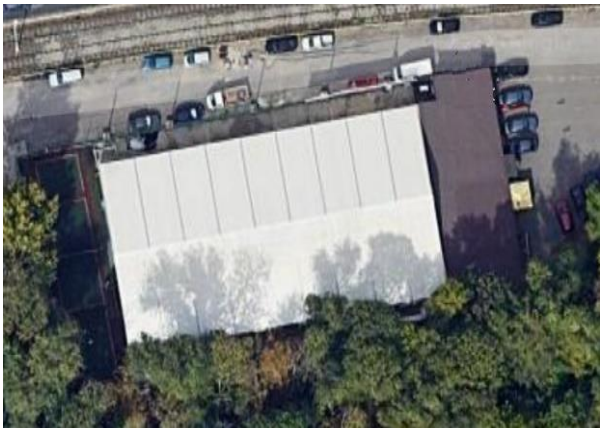
Key words: *buildings, Carbon:Nitrogen (C:N) ratio, construction materials, soil*

INTRODUCTION

The environment is constantly changing according to the growing desire for modernization. The topic of this study was selected to reveal that the world that overbuilding at the national level has a negative impact not only on nature, but also on the soil itself. The main purpose of this study was to identify the impact of construction and building materials on the carbon and nitrogen content of the soil.
The carbon and nitrogen content of the soil was evaluated according to this issue, especially the C:N ratio (the mathematical ratio used to find the connection between carbon and nitrogen), and it refers to the mass of carbon relative to the mass of nitrogen in a sample (Brust, 2019). A microorganism present in the soil needs carbon and nitrogen to survive, namely a C:N ratio of 24:1 (16 parts of carbon are used for energy and 8 parts for survival (USDA NRCS, 2011)). An optimal C:N ratio in the soil of 24:1 (Howell, 2005) influences the soil-protecting layer covering the soil, but the vegetation type affects this ratio (Rowe et al., 2006).
This ratio could be seen as an indicator for soil quality, humidity and organic matter content (Swangjang, 2015). More, it is useful even in the ecosystem nitrogen status investigation.
The soil organic matter is a basic substance which indicate the relationship between soil and carbon storage and could be seen as the sum of living and dead organic matter in the soil, including plant residues and microorganisms.

MATERIALS AND METHODS

Soil samples were collected from a crowded area in Bucharest, which is currently under development (Ghencea area). In this study, soil samples collected from areas where the building was recently demolished (Figure 1) and soil samples that were taken from approximately 10-15 meters away from the initial sampling site, where vegetation grows (Figure 2) were compared to find the calculated C: N ratio in both cases.



a)

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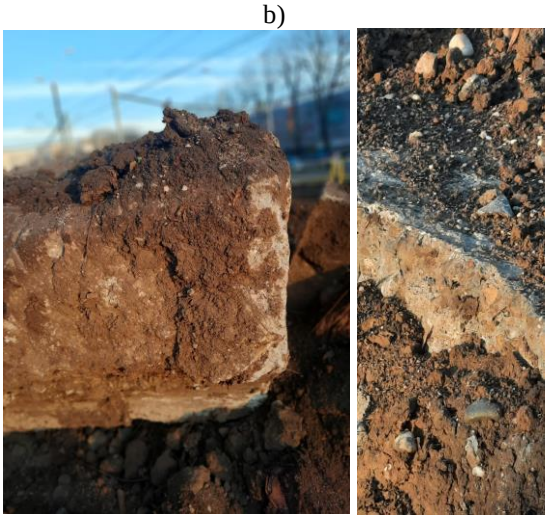

c)

Figure 1. a) Building before demolition; b) Building after demolition; c) Demolished building soil sample prelevation place.

Analysis of C and N content was performed in the Laboratory of Agrochemistry, Research Center for Studies of Food Quality and Agricultural Products, University of Agronomic Sciences and Veterinary Medicine of Bucharest.

Figure 2. Immediate surroundings where vegetation grows soil sample prelevation place

Soil samples were dried at room temperature, ground with a soil grinder, and passed through a sieve (250 micrometers) (Figure 3). The samples were kept in a dry environment. To determine the total nitrogen and carbon content, 5-10 mg of soil sample were used.

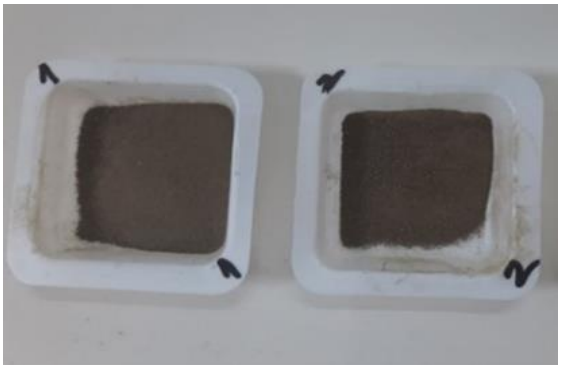

Figure 3. Soil sample: demolished building (left) and immediate surroundings with vegetation (right)

The soil analysis was performed using the CHNS (Carbon/Hydrogen/Nitrogen/Sulf) elemental analyzer (EuroVector EA3100 Elemental Analyzer). Acetanilide EDTA was used as standard reference material. All determinations were performed in triplicate.

RESULTS AND DISCUSSIONS

Soil organic matter could be considered an indicator of soil fertility in natural and managed ecosystems, due to C, N and P contents that are important for plant growth. Soil organic matter is a useful resource which plays an important role in environment and economy management.

Thus, this organic matter could be considered an entire ecosystem at the microscopic level.
Analyses performed to determine the carbon and nitrogen content of the soil samples collected from both studied sites showed a higher carbon content than nitrogen, as expected (Figure 4). Figure 5 reveals a higher mass expressed as micrograms of Carbon content, and a lower mass expressed as micrograms of Nitrogen content, respectively.

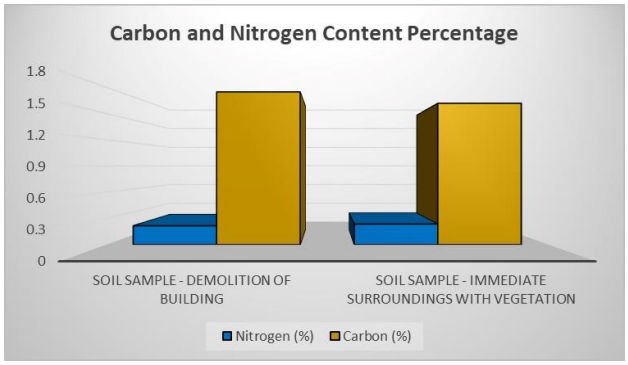

Figure 4. Carbon and Nitrogen Content Percentage

From the analysis of the obtained data it can be seen that the impact of the construction on the fertility of the soil below it is major, a conclusion underlined by the low nitrogen content.

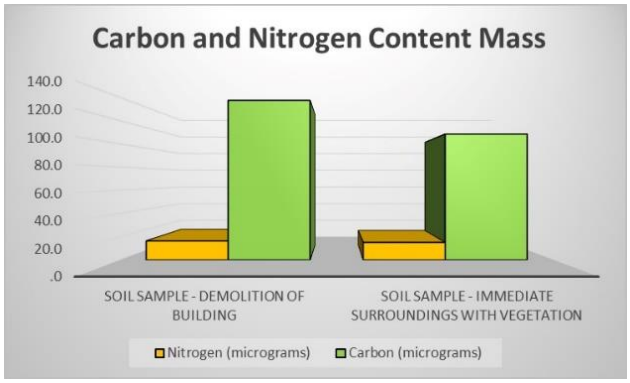

Figure 5. Carbon and Nitrogen Content Mass

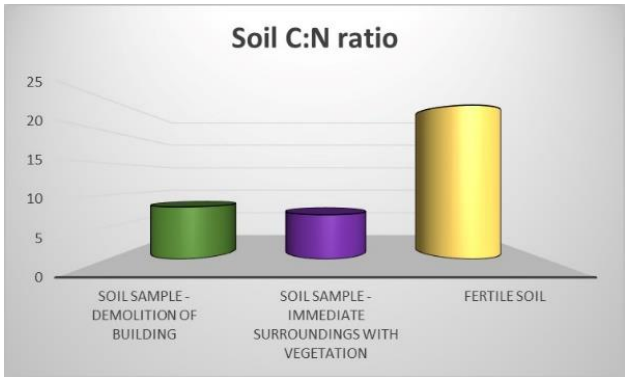

Figure 6. Soil C:N ratio

Figure 6 shows the C:N ratio from the collected samples comparatively to the optimum ratio found in a fertile soil. As can be seen, the C:N ratio in the soil is slightly higher in the case of the soil samples under the demolished building, compared to the values obtained in the case of the samples from the immediate surroundings where vegetation grows. The observed difference (8: 1 versus 7: 1), in contradiction to what one would have expected, can be explained by the fact that under the concrete construction there are several building materials (sand, cement, etc.) that come with a higher intake of carbon stored in the soil, while in the case of soil in the immediate surroundings where vegetation grows, nitrogen is absorbed by plants, leading to a decrease in soil nitrogen content. Moreover, the low values obtained for the C:N ratio even in the areas with vegetation, located at a distance of 10-15 m from the demolition site, confirm the fact that the constructions have a negative impact on the soil, including on that from surroundings.
To these low values contributes also the level of pollution of the crowded area taken into study. It is known that soil organic carbon has an essential role in stabilizing atmospheric CO2 concentration (Zhou et al., 2019).

CONCLUSIONS

In both cases of the sites studied, the value of the C: N ratio was considerably lower than in the optimal case of a fertile soil, when it reaches the threshold of 24: 1, which undoubtedly shows the negative impact of building materials on essential soil compounds. More, as could be seen, in the analysed soil samples, the content of carbon was higher than nitrogen content, which is in accordance with the ratio in organic matter. In conclusion, understanding the C: N ratio of soil to the various building materials applied to it is important for managing a future crop and the nutrient cycle required for it.

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