The effect of different biological soil crusts on soil organic carbon in the AjiGol wetland

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ABSTRACT

The objective of this study was to investigate the role of biocrusts on the soil organic carbon characteristic in the AjiGol wetland of Golestan province (Iran). In the study area, three soil samples under the surface of biocrusts and no crust were taken at the depth of 0-2 and 2-5cm. Also, soil organic carbon factor was analyzed for all soil samples. The results showed that the presence of biocrusts compared to the no crust improved the soil quality. From the no crust to the moss biocrust, the content of organic carbon (OC) was significantly increased at two depths of soil (0-2 and 2-5cm). Therefore, the presence of biological soil crusts can increase the quality of soil as well as stability of it.

Keywords: Soil organic carbon, biological crusts, AjiGol wetland, soil stability

1. INTRODUCTION

Biological soil crusts are a combination of living, and non-living organisms (microscopic and macroscopic), their secretions, and soil particles [9]. They are often fungi, lichens, cyanobacteria, bryophytes, and algae. These organisms live within a few millimeters of the soil surface and they are a biological agent for the formation of crusts on the soil surface [3]. These biological crusts formed on the soil surface are very crucial because they cover about 12% of the earth's surface. Biological crusts are present in almost all types of soils but are more widespread in arid regions of the world where vegetation is low and plants grow relatively far apart. This is because biological crusts grow fewer than plants and thus cannot compete with vascular plants for light [3, 5].

Biological soil crusts are formed in open spaces between vascular plants and can be divided into different sequence stages based on the dominant organisms [7]. At first, single-celled organisms such as cyanobacteria or fungal spores are located in areas without vegetation and stabilize the soil with the filaments and hyphae produced [8]. After the soil is stabilized by these organisms, lichens and mosses can settle [1]. The lichens inhabit communities where competition is unlikely to be a significant factor since they are stress-tolerant organisms [2]. In addition, bacteria and fungi play an important role in the formation of biological crusts in the early stages of sequencing [11]. Furthermore, the role of biological crusts in arid and semi-arid regions is different and it depends on their degree of sequence and growth stage [3].

Assessing the organic carbon properties, is a beneficial way to find out the soil situation under the biocrusts as well as the content of soil resistance against to water and wind erosion [4]. Therefore, the objective of this study was investigating the effect of different biological soil crusts on subsoil organic carbon and soil stability in the AjiGol wetland.

2. MATERIA AND METHODS

The studied area of Ajigol Wetland is located in the south of Atrak border river and in the north of Gonbad Kavos city in Golestan province. In terms of geographical location, Ajigol Wetland with an area of about 320 hectares is located in the range of 37° 24'' N and 54° 40'' E (Fig. 1).
In order to identify different BSCs in the Ajigol region, the imaging method was used with a drone at a height of 4 meters above the ground, and the images prepared have a resolution of 10 cm and a longitudinal and transverse overlap of 75% (Fig.1). Three soil samples were taken from the depth of 0-2 and 2-5 cm below the surface of each biological crust to study the effect of biological crusts on subsoil properties. Also, to investigate the organic carbon in the soil samples, Walkley and Black [10] method was used.
Statistical Analysis: The experiment was carried out as a factorial based on a completely randomized design and was analyzed using the SAS v.9.0 software (SAS Institute, Inc., Cary, NC).

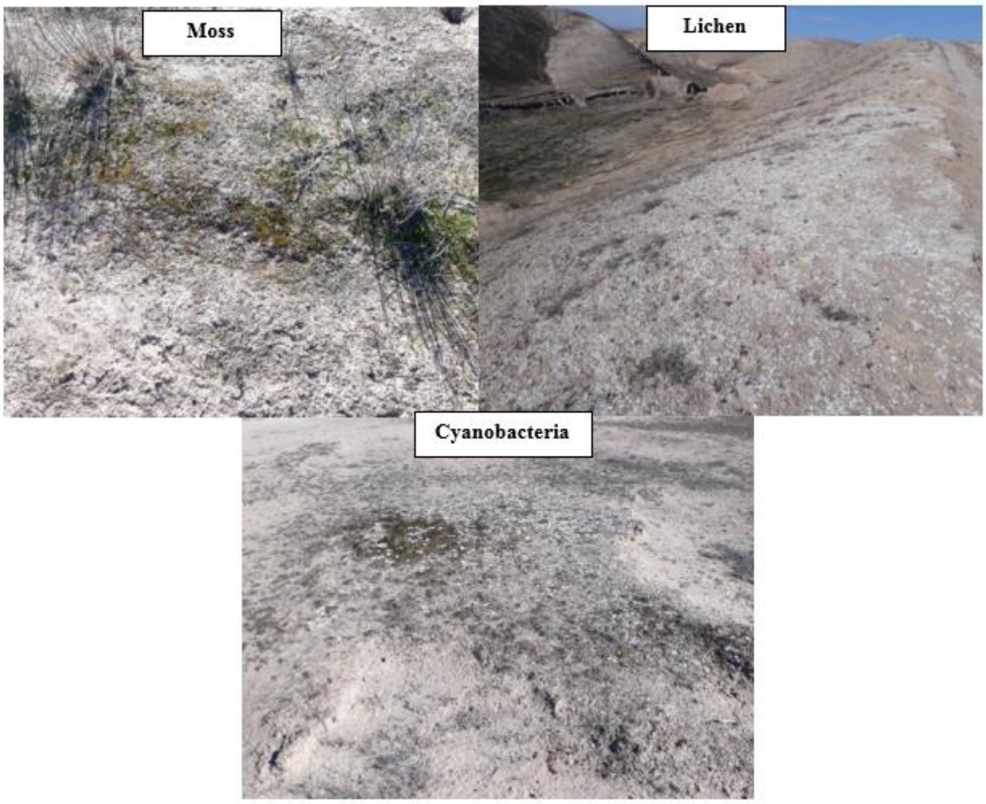
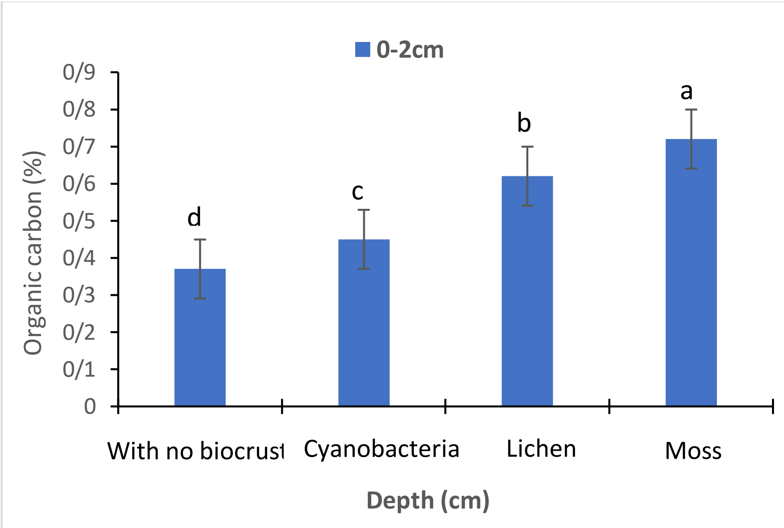


Fig .1. The image of the SBCs of the Aji Gol area prepared by using a drone

3. RESULT AND DISCUSSION

The results of the OC content in the soils below the surface of the biocrust and with no biocrust at the depths of 0-2 and 2-5cm are provided in Fig. 2. The highest OC content was observed in the soil covered with moss biocrust at a depth of 2-5 cm, which had a significant difference ($p<0.05$) with other cyanobacteria and lichen biocrusts. The lowest amount of organic carbon was observed in the soil below the surface of no crust at a depth of 0-2cm. On the other hand, with the increase of soil depth, the amount of OC content increased in the soil covered with biocrusts and without them, and the intensity of this reduction is higher in the case of biocrusts compared with the no crust. Biocrust increases soil OC content by maintaining the soil and also through carbon deposition over time.



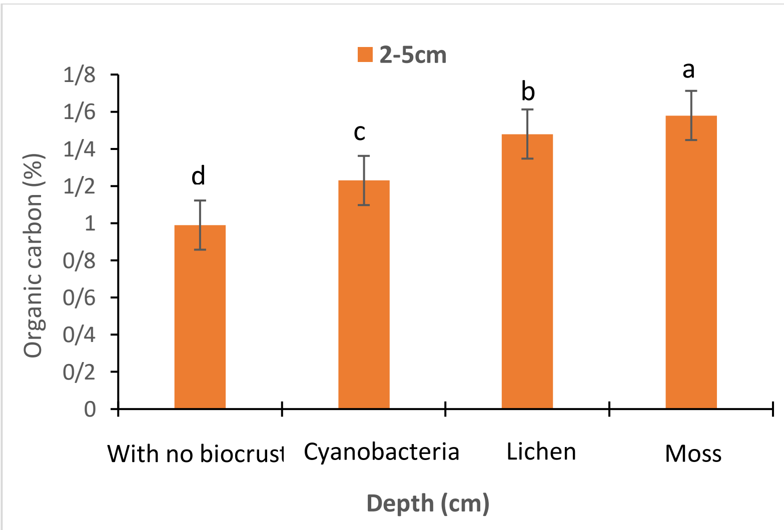


Fig.2. The effect of biological crusts and no crust on subsoil organic carbon at two depths (0-2 and 2-5cm)

According to pervious studied, the distribution of moss biocrust on the soil surface causes the accumulation and increases of the activity of micro-organisms by providing carbon materials. It seems that the main activity of these micro-organisms is in the subsoil. The carbon within the soil microbial biomass a few centimeters near the soil surface can be 100 times more than its value 100 centimeters deep in the soil. This is particularly the case for agricultural lands and pastures that usually have a shallow root system. Although it constitutes only 5% of the total soil organic carbon, it is known as the most active nutrient storage part in the soil and plays a significant role in the soil organic carbon cycle [6]. Conversion of natural ecosystems to fields or their destruction causes soil organic carbon depletion. Also, these changes decrease the carbon content of microbial biomass, increase decomposition, reduce vegetation and increase soil erosion.

4. CONCLUSION

The study of soils with biocrusts showed that the presence of biocrusts on the soil surface improved the quality of the soil. These biocrusts were mainly effective down to the depth of 5 cm. Soil quality was greatly affected in soils covered with moss biocrusts. organic carbon content increased with development of biological soil crusts This increase in the soil quality is mainly related to the suitable development and evolution of the biocrusts in the region. In general, it can be stated that the soil covered with a dense cover of biocrusts has been less affected by soil erosion compared to the biocrust-free soils.

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