

Changes in Chemical Soil Characteristics in Confronting with Fire and Its Severity

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Introduction: Amongst different habitats, fire is an ecological factor and determinant that affects many physico-chemical soil factors. In addition, among natural disturbances, fire plays an important role in plant diversity conservation and in some areas around the world, the presence of some plant species depends on natural fire. The extension of fire influences on soil is related to the fire severity. In fact, fire severity encompasses of two characteristics: extension and time of burning. On the other hand, fire extension and burning time are affected by humidity, air temperature, wind speed, topographical characteristics. Despite high frequency of fire in natural habitats and high level of fire effectiveness on soil parameters, study of fire impacts on soil characteristics were rarely reported in Iran. In addition, most previous studies were conducted in forest habitats, ignoring the severity of fire on soil.

Materials and Methods: In order to investigate the effect of fire severity on some soil physico-chemical characteristics, Yeylagh Dasht area (rangeland habitats) was selected in southern-east of national Golestan Park with three different plant covers, viz. grass, shrub and cushion. Many fires occurring have been reported in this park in each year. For the current study, we tried to select the habitats in which the fire was occurred at least one year before. A control area without burning with similar ecological parameters was also selected adjacent to the burnt area. In fact unburnt area was isolated by a road from burnt area, unable to extend the fire into unburnt area due to the road. Fire had been occurred in the burnt area in September, 2014. Soil samples with 15 replications in burnt area and 15 replications in unburnt were collected within a depth of 0-5 cm and then transported to the soil laboratory to measure some qualitative soil characteristics i.e. soil organic matter (SOM), particulate organic matter (POM), total nitrogen (TN) and aggregate stability (AS). All statistical analyses were done by R software. Before ANOVAs (one and two-ways) and unpaired t-test, we tested data for normal distribution by Shapiro-Wilk test and homogeneity of variance by Flinger Test.

Results and Discussion: The results of two-way ANOVA showed that the main effect of fire on soil was not significant while the main effect of fire severity and the interaction of fire and fire severity on SOM and POM were significant (Table 1). The results of one-way ANOVA showed that the content of SOM was significantly different between three different treatments in unburnt area (control area) while there were no significant differences between the three treatments (three fire severities) in burning areas. Therefore it can be discussed that the kind of vegetation (grassland, shrub or cushion) could affect SOM while the fire increased the spatial homogeneity of SOM. The same pattern of SOM was occurred for POM in burnt and unburnt areas. However, the results of unpaired t-test showed that POM was drastically decreased after high and intermediate fire severities. Aggregate stability and POM were significantly decreased in the intermediate and high severities of fire (cushion and shrub plant cover). Fire in the intermediate and high severities increased TN (Figure 1). We concluded that fire occurring by plants might be decreased POM and AS significantly. In addition, mineralization probable increased TN after burning. We also compared soil characteristics among three fire severities in burnt area and in unburnt area separately.

Table 1- The results of two-way ANOVA and main effects of fire and fire severity, and interactions

Parameter	Fire	Fire Severity	Fire × Fire Severity
	F-Value	F-Value	F-Value
Organic Matter	0.66	6.25**	5.69**
Particulate Organic Matter	1.87	10.42***	6.40**
Total Nitrogen	14.95***	3.18	4.38*
Soil Aggregate Stability	2.20	0.92	1.38

0.001 ***, 0.01 **, 0.05 * :Significant Code

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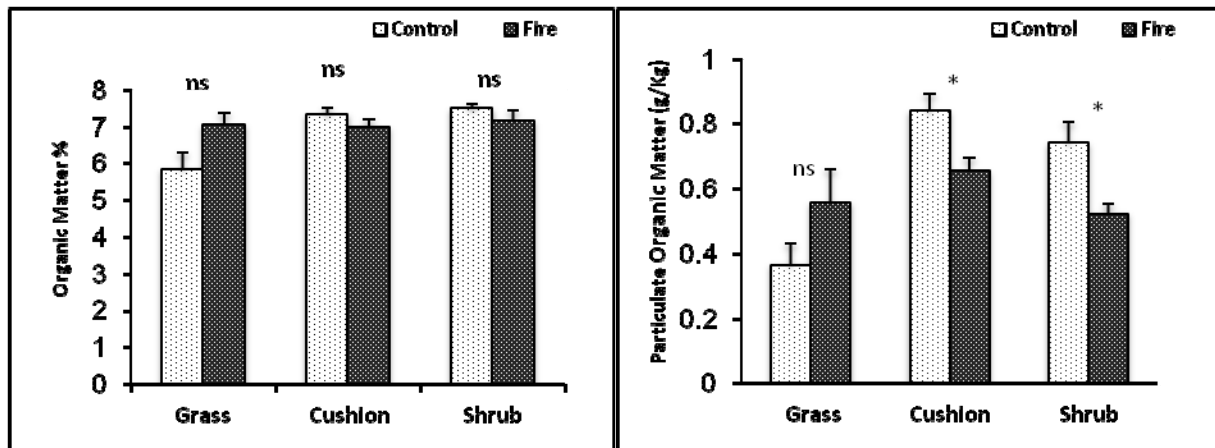


Figure 1- variation of soil parameters (organic matter and particulate organic matter) in different fire severities between burnt and unburnt areas (*: significant differences, ns: not significant differences)

Conclusion: This study showed that the variation of soil characteristic was mainly affected by different fire severities. Therefore, we emphasized that fire severity should be considered in the studies of the impact of fire on soil in different habitats. Fire can decrease the spatial heterogeneity of soil parameters among different sites. We showed that soil POM is a characteristic more sensitive than total SOM in confronting with fire.

Keywords: Golestan National Park, Particulate Organic Matter, Natural Fire, Soil Aggregate Stability