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EFFECTS OF PLANTING HALOXYLON APHYLLUMON CARBON SEQUESTRATION RATE AND SOME SOIL PROPERTIESIN A ARID REGION IN IRAN

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Abstract:-
A major activity in the desert areas of Iran to control wind erosion, improving environmental conditionsespecially soil characteristics and increasing carbon sequestration in soil and plants is planting compatible and resistant species, in particularHaloxylon aphyllum. The study area,in the central Iranthat was planted with Ha.aph(in the early 1980s), reflects the environmental and management conditions of more than 800,000 hectares of aridlandsin Iranwell.5 profiles were randomly drilled at the bottom of the Haloxylon sp.shrubs and 5 profiles are in the adjacent control area without any vegetation soil sampling was carried out from 0 to 30 cm depth. Samples were transferred to the laboratory for measurement of electrical conductivity, pH, organic matter, organic carbon, lime, phosphorus, potassium, soil texture, calcium, magnesium, sodium, soil bulk density and the amount of carbon sequestration in the soil. the data from the grown area and the control were compared using independent t-student test to determine the effect of planting Haloxylon sp.on the soil characteristics of the area. The results show that planting Haloxylon sp.has increased the organic matter content of organic carbon, electrical conductivity, acidity, phosphorus and potassium, and decreased calcium carbonate, silt, calcium, magnesium and sodium in soil. Also, the comparison of the data in the control and planting area indicates a slight change in the soil texture with an increase in the percentage of sand and a decrease in the percentage of silt and clay in the planting area. Planting Haloxylon sp.increased the average amount of sequestrated carbon in soil by 28420.2 kg/ha.

Keywords:- *Aridarea, Carbon Sequestration,Haloxylon aphyllumsoil characteristic,*

INTRODUCTION

Soil erosion is the most important factor in land degradation tha tsome of its most important consequences in Iran include decreasingabout11% of Iranian forests over the period sof 40 years, the sedimentation of about 240 million cubic meters in the country's dams (equivalent to five dam with 50 million cubic meters per year), desertification in More than 100 million hectares of lands in the country, reducing the crop production capacity and increasing the concentration of greenhouse gases (Co2, Ch4, N, water vapor and N2O) into the atmosphere and induce global warming (Rouhani etal., 2005, Mojarad and Rouhani, 2010). The most important factor in land degradation in desert areas is wind erosion. The major activity that has been carried out in the desert areas of the country to combat erosion has been biologic operations or vegetation establishment, especially with Haloxylon. sp.(Karimpour Reyhan, 2005).These activities in addition to controlling erosion and improving the environmental conditions, especially the soil properties (Zehtabi an et al., 2007), the increase in carbon sequestration in the aerial and underground parts of plants and soils, thereby reducing the effects of earth warming caused by the increase of greenhouse gases specific carbon dioxide, such as the degradation of ecosystems, increased drought and floods, reduced species diversity, and eliminating of climate and ecological balance (Lal, 2004; Richards et al., 2007;Abdi et al., 2008).

So far, many studies have been carried out on the role of vegetation and soilin different habitatsin carbon stabilization and sequestration, because the type of soil and plant species are one of the most important factors in this matter (Binkley et al., 2003).Among them, Jafarian et al. (2013), in the wheat fields of Kiasar region, the potential of sequestration in plant biomasswas 1.884tons per hectare and 16.332 tons per hectare in soil. Hassan-Nejad and colleagues (2014) estimated the amount of carbon sequestration50.96 and 45.51 t / ha, respectively in cottony and Dactylis glomeratahabitats at Hezarjarib of Behshahrthat are under grazing.

Estimation of the amount of carbon sequestration of Cupressus Arizonica and Robinia sp. masses around Tehran showed that the amount of carbon sequestrationin these two masses was 78.19 and 60 tons per hectare, respectively (Hosseini and Sefidi, 2014). Rosta et al. (2013) reported the amount of carbon sequestrationat 12.78 tons per hectare in the soil of the forest bundle of Atlantica Pistaciain Firoozabad ofFars province.

Establishment vegetation, in addition to the effect on soil carbon sequestration, has an impact on soil physical and chemical properties such as electrical conductivity, acidity, texture, sodium, calcium, potassium, and phosphorus.

Therefore, in the present study, theeffect of planting Haloxylon sp.on these characteristics has been studied, until inaddition to studying the effect of planting Haloxylon sp.on the amount of carbon sequstration ratein the soil, based on its effect, we can determine whether planting Haloxylon sphas beena suitable method for improving the nvironmental conditions of this areaor not? So far, many studies have been carried out on the effects of planting Haloxylon sp.on soil properties that have produced different results in different regions.

Jafari et al. (2003) reported the effects of planting Haloxylon sp.on increasing organic matter, potassium, phosphorus, nitrogen, electrical conductivity and soil acidity in Hussein Abad area of Qom, while the sodium content of the soil did not significantly change as a result of planting. Planting Haloxylon sp.in Kalpush plain of North Khorasan have increased electrical conductivity and soil acidity, while significant changes in texture, saturation moisture, and amount of organic matter have not been observed (Jafari and NikNahand, 2012).Nosrati et al. (2016) reported an increase in electrical conductivity, acidity and soil lime, soil texture changes and no organic matter variation as a result of planting Haloxylon sp.in Roshtkhar district of Khorasan azavi .Mohammadi et al. (2014)stated that thein crease of electrical conductivity and soil acidity are considered as the results of planting Haloxylon sp.in Abbas Abad area of Mashhad.planting Haloxylon sp. has reduced acidity and increased organic matter, electrical conductivity, phosphorus, potassium, calcium, sodium, and magnesium in the Neyatak area of Sistan (Farahi et al., 2014).Mahdavi Ardakani et al. (2011)stated anincrease in soil phosphorus and reduce of electrical conductivity. Also,Bazrafshan(2011) showed to reduce acidity of soil, Jafari and Erfanzadeh (2005), to reduce soil phosphorus, Mlambo & Nyathi Mapaure (2005) and Khedri et al. (2011) pointed to an increase in the amount of sodium in the soil due to planting Haloxylon sp.

Materials and Methods

The studied area description

The study area is located in the southeastern part of Semnan city, including lands planting Haloxylon sp.in the east and northeast of Ala village and between Ala Industrial Park and agricultural lands, which planting Haloxylon sp.has been over 4oyears old.The mean annual rainfall of the area is about 144.2mm, the average annual temperature is 18°C, the average wind speed is 4 m/s, the wind direction ispredominantly northwest and north, and the climate is arid.

Research method

The indicator area was specified using the Google Earth satellite imagery and field explorations in the region .In this case, 5 profiles were randomly drilled at the bottom of the Haloxylon sp. shrubs and 5 profiles are in the adjacent control area without any vegetation. Depending on the condition of the soil horizons and the presence of hard layer in the soil, the depth of rooting maximum of the Haloxylon sp.in the soil, and therefore, the most planting Haloxylon aphylumeffect on the soil, soil sampling was carried out from 0 to 30 cm depth. Samples were transferred to the

laboratory for measurement of electrical conductivity, pH, organic matter, organic carbon, lime, phosphorus, potassium, soil texture, calcium, magnesium, sodium and soil bulk density. After measuring the characteristics, the data from the grown area and the control were compared using independent t-student test to determine the effect of planting Haloxylon sp.on the soil characteristics of the area. Also, in order to determine the amount of carbon sequestration in the soil of planting area, the relation (1) was used.

Relation (1):
$Cc=1000 \times C\ (\%) \times BD \times E$

Where Cc is the amount of carbon sequestration in soil in kilograms per hectare, E is the depth of soil in cm, BD is the bulk density of the soil, and C is the Soil organic carbon percentage.

Results

There is a significant difference between the planting Haloxylon sp.and the control area in all variables, except for the percentage of sand, clay content and bulkdensity.Differences in percentage of silt in 5% and other variables were significant at 1% level. The results (Table

1) show that planting Haloxylon sp.has increased the organic matter content of organic carbon, electrical conductivity, acidity, phosphorus and potassium, and decreased calcium carbonate, silt, calcium, magnesium and sodium in soil. Also, the comparison of the data in the control and planting area indicates a slight change in thesoil texture with an increase in the percentage of sand and a decrease in the percentage of siltand clay in the planting area.

Table 1. Student t-test for comparison of sampleand control averages

Parameters	Bulk density	Na	Mg	Ca	Clay	Silt	Sand	K	P	CaCO3	OM	OC	PH	EC
Samples mean	1.578	423.1	63.7	172.8	27.2	27.8	46.28	267.5	2.09	19.28	1.5	0.87	7.3	73
Controls mean	1.576	780.1	269.1	442.6	27.8	31.8	42.34	193.8	1.65	20.49	0.48	0.27	6.82	36.5
t	^{ns}0.031	-**870.1	-*313.6	**-317.5	^{ns}-1.38	*-2.5	^{ns}1.98	**112.3	**5.5	**-26.9	**15.2	**15.1	**3.7	**60

***and ns show significationat the level of 5%, 1% and not significant, respectively**

Table 2: Calculation of carbonsequestrationrate in soils in plantingand controlareas

Sample number	1	2	3	4	5	Mean
Sample amount (kg/ha)	42132.6	40035	41185.1	40712.4	41860.4	41185.1
Control amount (kg/ha)	12292.8	12765.6	13238.4	13238.4	12292.8	12765.6

The results of calculating the carbon sequestration rate according to (1)relation, in table (2), show that planting Haloxylon sp.increased the average of soil carbon sequestration from 12762.6 kg/ha in non-vegetation areas to 41185.1 kg/ha inplanting area.In general, planting Haloxylon sp.increased the average amount of sequestrated carbon in soil by 28420.2 kg/ha.

Discussion and conclusion

Based on the results, planting Haloxylon sp.increases the electrical conductivity and alkalinity of the soil.This could be due to the falling Haloxylon sp.remainson the soil, as well as the transfer of salts from depths to soil surface by its roots. Nik Nahad (2002), Jafari et al (2003), Jafari et al (2005), and Mohammadi et al. (2014) achieved similar results. The amount of soil lime in planting areas has decreased significantly compared to the control areas, which may be due to its absorption by the plant. Nosrati et al. (2016) reported a different result.

Also, the reduction of sodium, magnesium and calcium in the planting area compared to the control areas may be due to the absorption of these elements by the Haloxylon sp. Jafari et al. (2003) and Jafari et al. (2007) pointed to similar results. The soil texture of the region does not show significant change due to the effect of planting Haloxylon sp. This result can be expected due to the warm and dry climate, low rainfall, high temperatures and, consequently, low levels of microorganisms and their activities for organic matter decomposition and the limitation of soil pedogenes is in the region.Also, for the same reasons, the bulk density of the soil in the planting and control area is not significantly different. Jafari and Nik. Nahad (2012) have found similar results in their research .

The reason for increasing the amount of organic matter and soil carbon is that there is no vegetation in the control area. Any vegetation can reduce the amount of Co2 in the atmosphere by absorbing it to carry out the process

of photosynthesis and reduce the negative effects of its increase as the most important greenhouse gas. With the return of plant residues to the soil (especially Haloxylon sp.roots that are larger than its aerial parts) and theirde composition over time, the carbon stored in the plant organs enters the soil and sequestrated. The results of Jafari et al. (2007), Joneidi et al. (2011), Su et al. (2010) and Ahmadi et al. (2014) also confirm this.

Of course, in the case that vegetation was present in the region prior to planting Haloxylonsp., sometimes planting Haloxylon sp.leads to a decrease in organic matter and soil carbon, due to the effect of Haloxylon sp.allopathyon other species, as well as its competition with other species and their elimination due to the greater resistance of the Haloxylon sp.to the difficult conditions of the environment in arid and Its broad horizontal and vertical rooting, it makes it difficult for other species to survive. In such a situation, after the removal of other species, it is observed that the amount of carbon sequestration by of Haloxylon sp.is less than that of other species that had been present in the region prior to planting Haloxylon sp. Therefore, if planting Haloxylon sp. is to increase the amount of carbon sequestration in the soil, then the vegetation cover type in the region should be considered (Shakeri et al., 2004; Abbasi et al., 2012and Dehghani Bidgoli, 2017).

Also, phosphorus and potassium elements, which indicate the fertility of soils, increase as organic soils increase. Jafari et al. (2003), Jafari et al. (2007) and Joneidi et al. (2011) also showed that planting Haloxylon sp.increased potassium and phosphorus elements.

planting Haloxylon sp.By increasing the amount of some soil parameters, such as electrical conductivity and alkalinity, causes getting worse the soil conditions in the area and by increasing the parameters such as organic matter, organic carbon, phosphorus and potassium, increased soil fertility and improved its conditions. Considering that no vegetation was present in the region prior to planting Haloxylon sp.and this action controlled the wind erosion and significantly increased the amount of carbon sequestration in the soil, it seems that its positive effects are far more than its negative effects and a good action has been taken in the region.

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