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RELATIONSHIP BETWEEN GROWTH OF *NITRARIA SCHOBERI* AND SOME SOIL PROPERTIES

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ABSTRACT

A study was carried out to investigate the relationship between growth of *Nitraria schoberi* and some soil properties in Segzi plain in the eastern of Isfahan province (center of Iran). Due to its special geographic condition, Iran is a dry and semidry zone of the world. *Nitraria schoberi* is a drought-resistant shrub plants. In the study area, *Nitraria schoberi* plants were all of similar age. A total of 6 profiles were studied and from each profile depth (0-30, 30-60 and 60-90 cm), sampling was conducted. For each soil sample obtained, electrical conductivity (EC), sodium ions (Na), bicarbonate (HCO_3^-) and the percentage of gypsum, calcium carbonate and clay were measured. Plant physiological parameters including plant height and top were measured. The data thus obtained were analysed through the SPSS software. The results indicated that the electrical conductivity, sodium ions, HCO_3^- and the percentage of clay had negative effects on plant physiologic parameters whilst the percentage of calcium carbonate had a positive effect on plant physiologic parameters. However, the percentage of gypsum did not have any significant effect on the plant physiologic parameters.

Key words: Desert, physiologic parameters, *Nitraria schoberi,* Sodium, Soil**.**

INTRODUCTION

All factors existing in an ecosystem have effect on each other. In order to introduce an alien plant species to an ecosystem, especially desert ecosystems which are very tender, care must be taken. This process should be carried out based on information of all factors influencing ecosystem and the effects of each existing factor on it (Reyhan and Amiraslani, 2006).

Due to its special geographic condition, Iran is a dry and semidry zone of the world (Honarjoo *et al*., 2010). The desert ecosystems, by virtue of natural peculiarities, are distinguished by a rich variety of flora and fauna (Kapustina, 2001). In the past, the actual plains of the central of Iran were big and small lakes, which then, gradually turned to dessert and barren, this is shown by fossil of fishes and sweat water oysters that are left on the plains, and even on the higher parts of the region (Mojiri *et al*., 2011).

The surface area affected by desertification within the dry part of the world is about 4 billion ha, some 75% of the total dry-land surface area, excluding hyper-arid desert, obviously, neglecting deserts in such a populated world mean a great loss (Farshad *et al*., 2002). Desertification in Iran was recognized between the 1930s and 1960s (Amiraslani and Dragovich, 2011). One way to prevent the spread of blowing sand in a desert area is through biological fixation using compatible plant species (Honarjoo *et al*., 2010) such as *Nitraria schoberi*. *Nitraria schoberi* is a drought-resistant shrub with numerous ramifications. *Nitraria schoberi* is a halophic and suffered to high salt concentrations. Salt tolerance is the ability of plants to grow and complete their life cycle on a substrate that contains high concentrations of soluble salt, plants that can survive on high concentration of salt in the rhizosphere and grow well are called halophytes (Parida and Das, 2005).

Salinity is one of the most important stresses which is now prevalent in the world that reduces agricultural productivity and depletion of natural herb in large areas of Earth's surface (Abdolzadeh and Safari, 2004). Soil salinity is a process during which the accumulation of soluble salts in the soil surface crust, so it reached the surface of the earth as a place of their potential growth and plant loses. Moshtaghian and Esmaili Sharif (1997) investigated effects of salt stress on germination and seedling growth of *Nitraria schoberi* and found that with increasing salinity, seedlings emergence of *Nitraria schoberi* reduces. Zaremehrjardi *et al*. (2007) investigated the relationship between geopedologic characteristics and vegetation in Dagh-Finou catchment of Bandar Abbas. Correlation analysis showed a correlation between vegetation cover, slope and elevation and a negative correlation with EC. Based on the Kruskal Wallis test there was significant difference in vegetation cover between different geopedological map units. No significant relationships were found between vegetation cover and other soil properties such as pH and texture.

Honarjoo *et al*. (2010) studied the effects of soil salinity and alkalinity on growth of *Haloxylon sp.* in Segzi plain (Iran). The results showed that the effects of salinity and alkalinity of soil on growth and development of *Haloxylon sp.* are negative. Li *et al*. (2008) investigated relationship between soil characteristics and halophytic vegetation in coastal region of north China. Principle component analysis (PCA) showed that salinity, pH, moisture and available nitrogen were the major soil factors responsible for variations in the pattern of vegetation. For vegetation, primarily richness, cover, plant height, and biomass, were the main factors. The results of cluster analysis were consistent with field investigation, and canonical correlation analysis (CCA) showed results similar to PCA.

In this study the relationship between growth of *Nitraria schoberi* and some soil properties in Segzi plain (Iran) has been investigated.

MATERIALS AND METHODS

Study area: Segzi plain is located in the eastern of Isfahan province in the center of Iran and about 40 kms from the Isfahan centre (31˚ 23'N, 51˚7'E to 32˚ 55'N, 51˚ 56'E). The maximum elevation is 1640 m and the minimum elevation Above Sae Level (ASL) is 1510 m (Mojiri, 2010), The climate of the zone using the De Martonne and Gowsen methods is dry and semi-desert, respectively (Mojiri *et al*., 2011).

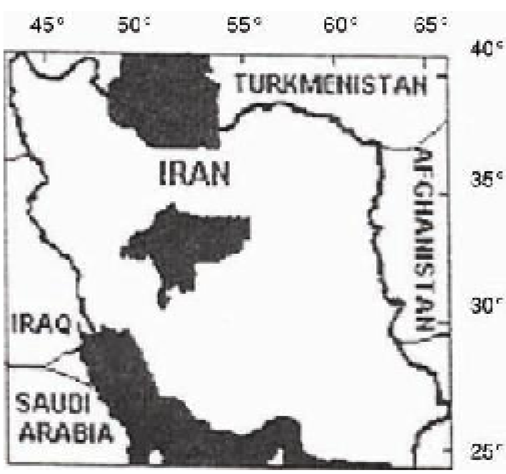

Fig 1. Isfahan province in the center of Iran

Field Operations: Based on the status of vegetation in the region, a total of 6 profiles were studied in 2010. Then each depth different profiles (0-30, 30-60 and 60-90 cm) was sampled. Soil samples were air dried in a green house at a temperature between 25ºC and 30ºC and sifted through a 2-mm mesh sieve for preparation of soil samples (Makoi and Verplancke, 2010). In the study area all the *Nitraria schoberi* plants were of the same age. Plant physiologic parameters, including plant height and top were measured.

Analytical methods: Electrical conductivity (EC) was measured on saturation extracts, bicarbonate (HCO_3^-) was measured by titration method, the percentage of calcium carbonate ($CaCO_3$) and the percentage of gypsum ($CaSO_4$) were determined (Richards, 1954). The percentage of clay was determined by the Bouyoucos hydrometer method (Gee and Bauder, 1986). Sodium ion was measured by Flamephotometry (Zarinkafsh, 1993). After preparing the data, the SPSS software was used to analyse and compare the statistics and averages.

RESULTS AND DISCUSSION

Soil properties and plant parameters are shown in Table 1. Pearson correlation between soil properties and plant physiologic parameters are shown in Table 2.

First depth (0 – 30 cm): Minimum EC (dS/m) equal to 31.96 was recorded in profile 3, and maximum EC equal to 195.48 was found in profile 5. Minimum Na (me/l) equal to 502.23 was recorded in profile 3, and maximum Na equal to 3945.23 was found in profile 5. Minimum HCO_3^- (me/l) equal to 9.9 was recorded in profile 4, and maximum HCO_3^- equal to 10.6 was found in profile 5. Minimum $CaSO_4$ (%) equal to 23.5 was determined in profile 3, and maximum $CaSO_4$ equal to 43.4 was determined in profile 6.

Second depth (30 – 60 cm): Minimum EC (dS/m) equal to 18.10 was recorded in profile 3, and maximum EC equal to 41.04 was found in profile 5. Minimum Na (me/l) equal to 252.17 was recorded in profile 4, and maximum Na equal to 846.37 was found in profile 5. Minimum HCO_3^- (me/l) equal to 9.7 was found in profile 4 and 6, and maximum HCO_3^- equal to 10.1 was recorded in profile 2. Minimum $CaSO_4$ (%) equal to 23.9 was determined in profile 3, and maximum $CaSO_4$ equal to 49.2 was determined in profile 2.

Third depth (60 – 90 cm): Minimum EC (dS/m) equal to 15.34 was recorded in profile 3, and maximum EC equal to 42.82 was found in profile 5. Minimum Na (me/l) equal to 72.93 was found in profile 6, and maximum Na equal to 802.89 was found in profile 5. Minimum HCO_3^- (me/l) equal to 9.3 was recorded in profile 4, and maximum HCO_3^- equal to 10.9 was recorded in profile 1. Minimum $CaSO_4$ (%) equal to 27.3 was determined in profile 3, and maximum $CaSO_4$ equal to 50.1 was determined in profile 6.

Vegetation status in profile 6 is better than other profiles.

According to Table 2, EC in the third (60-90 cm) depth, the sodium ions in the second (30-60 cm) and third depths, HCO_3^- in the second and third depths and the percentage of clay in the second depth had negative effects on plant physiologic parameters. The percentage of calcium carbonate in the third depth had a positive effect on plant physiologic parameters. The percentage of gypsum did not have any significant effect on plant physiologic parameters.

Index 1, 2 and 3 show first, second and third depth from the soil surface, respectively.

Electrical Conductivity (EC): According to Table 2, EC in the third (60-90 cm) depth had a negative effect on plant physiologic parameters.

In investigating the effect of soil properties on plant parameters Reyhan (2005) and Honarjoo *et al*. (2010) found the same results about the negative effect of EC on plant parameters.

The plants in saline environments are faced with two main elements. The first element is the high salts in soil solution which decrease the soil osmotic potential and also water absorption and so make water shortage. The second element is the lot of sodium ions and chloride ions which reduce the absorption essential ions such as potassium, calcium and nitrate (Abdolzadeh and Safari, 2004).

Sodium ions (Na): According to Table 2, sodium ions in the second (30-60 cm) and third depths had a negative effect on plant physiologic parameters.

Fig. 2: *Nitraria schoberi* in profile 6

In investigating the effect of soil salinity and alkalinity properties on plant physiologic parameters, Honarjoo *et al*. (2010) and Mojiri (2010) found the same results about the negative effect of sodium on plant physiologic parameters.

Soil sodium increases soil reaction, encourages low uptake in some types of micronutrients and destroys the physical properties of soils, thereby reducing soil permeability and growth of plants (Honarjoo *et al*., 2010).

Table-1. Characteristics selected profiles and plant parameters

Profile	Depth (cm)	EC (dS m^{-1})	Na (me L^{-1})	HCO_3^- (me L^{-1})	$CaCO_3$ (%)	$CaSO_4$ (%)	Clay (%)	Plant Physiological Parameters Height (cm)	Top (cm)
	0-30	48.06	876.72	10.1	11.1	38.8	15.41		
Profile 1	30-60	39.00	755.32	10.0	10.0	46.9	22.50	0*	0
	60-90	38.28	593.09	10.9	8.0	49.0	27.04		
	0-30	76.55	1312.03	10.5	8.4	37.4	9.60		
Profile 2	30-60	34.43	692.28	10.1	12.2	49.2	14.54	0	0
	60-90	35.39	675.66	10.2	11.4	50.1	15.82		
	0-30	31.96	502.23	10.2	9.8	23.5	10.52		
Profile 3	30-60	18.10	354.54	10.0	11.3	23.9	14.53	49	198
	60-90	15.34	278.80	9.8	9.0	27.3	16.83		
	0-30	45.37	924.02	9.9	16.1	27.6	9.85		
Profile 4	30-60	27.50	252.17	9.7	28.0	26.2	12.50	54	218
	60-90	21.50	297.82	9.3	13.3	29.4	16.70		
	0-30	195.48	3945.23	10.6	7.0	36.9	29.75		
Profile 5	30-60	41.04	846.37	10.0	7.0	34.6	27.51	0	0
	60-90	42.82	802.89	10.2	10.9	35.1	28.41		
	0-30	37.39	720.86	10.0	12.0	43.4	19.56		
Profile 6	30-60	25.93	389.59	9.7	18.5	46.8	23.67	86	477
	60-90	24.08	72.93	9.6	23.7	36.6	25.41		

*0 = *Nitraria schoberi* cultivated did not have any growth in these profiles

Bicarbonate (HCO_3^-): According to Table 2, HCO_3^- in second and third depth had a negative effect on plant physiologic parameters.

In investigating the effect of soil properties on growth of *Haloxylon sp.* Zandi *et al*. (2007) that found the same results about the negative effect of HCO_3^- on plant physiologic parameters.

Table-2. Pearson correlation (r) between soil properties and plant parameters

Soil Properties	Plant Physiological Parameters	
	Height	Top
EC_1	-0.536	-0.482
EC_2	-0.586	-0.451
EC_3	-0.955**	-0.913**
Na_1	-0.527	-0.481
Na_2	-0.865*	-0.762*
Na_3	-0.916*	-0.847*
$HCO3_1$	-0.713	-0.662
$HCO3_2$	-0.829*	-0.818*
$HCO3_3$	-0.793*	-0.716
$CaCO3_1$	0.602	0.524
$CaCO3_2$	0.654	0.581
$CaCO3_3$	0.759*	0.854*
$CaSO4_1$	-0.122	-0.064
$CaSO4_2$	-0.268	-0.101
$CaSO4_3$	-0.616	-0.499
$Clay_1$	-0.608	-0.581
$Clay_2$	-0.731*	-0.684
$Clay_3$	-0.554	-0.485

* & ** significance at level of five and one percent, respectively.

The Percentage of Calcium Carbonate ($CaCO_3$): According to Table 2, the percentage of calcium carbonate in the third depth had a positive effect on plant physiologic parameters. Calcium carbonate causes the creation of appropriate soil structure and induces changes to soil acidity (Jafari *et al*., 2006).

The Percentage of Gypsum ($CaSO_4$): According to Table 2, the percentage of gypsum did not have any significant effect on plant physiologic parameters.

The Percentage of Clay: According to Table 2, the percentage of clay in the second depth had a negative effect on plant physiologic parameters.

In investigating the effect of soil properties on plant physiologic parameters, Mojiri (2010) obtained similar results about the negative effect of the percentage of clay on plant physiologic parameters. If soil texture is lighter, root penetration into the deep soil is easier.

Conclusion: One way to prevent the spread of blowing sand in a desert area is through biological fixation using compatible plant species such as *Nitraria schoberi*.

Electrical conductivity in the third depth, the sodium ions and HCO_3^- in the second and third depths and the percentage of clay in the second depth had negative effects on plant parameters. However, the percentage of calcium carbonate in the third depth had a positive effect on plant physiologic parameters.

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