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Full Length Research Paper

Investigation of the effective factors on vegetation types in the margin of Dagh Sarah Kavir

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The main objectives of this research were to study the effective factors on vegetation types, the qualitative and quantitative conditions and their relationship to soil characteristics at Ardestan County in the northern part of Isfahan province (Iran). After determining the playa area by aerial photographs and topographical maps, the key area was selected, and vegetation and soil investigations were conducted. Two line intercept with 300 m in length was established, while the plots were located from each other 20 m in distance and their sampling was carried out by random-systematic method. As a result, the various plant factors such as present plant species list, vegetation cover, canopy, litter, bare soil, rock and stone percentages were taken down. In order to study the soil factors, a profile, with 0 to 60 cm depth, excavated in the first, middle and final plots in each transect and after sampling, the soil's physical, chemical and hydraulical features were measured. For comparison of the soil's physical and chemical properties, the Duncan's multiple range test was applied. The results indicated that from the center of the playa towards the motion of the playa, gypsum, calcium, magnesium and silt levels decreased, while organic matter, sand and gravel levels increased. Hence, there is no significant difference among various types, but other factors among these types have significant difference at 5%. In respect to the afore-mentioned results, we can ascertain that in the studied vegetation types, there is a statistical difference at 5 and 1% in factors such as exchange sodium potential (ESP), clay (%), potassium, gypsum and PH, and in other factors such as electrical conductivity, $CaCO_3$ (%) calcium in ppm, magnesium (PPM), sodium absorption rate (SAR), silt (%), sand (%), elevation in m and slope (%), respectively.

Key words: Dagh Sorkh kavir, soil properties, vegetation type, salinity, Duncan's multiple-range test.

INTRODUCTION

Humans have focused on the investigation of the relationship between vegetation and soil since myriad years ago, so that prehistoric humans, by identification of these relationships utilized from them, established the first humanity civilization centers with focus on one-point and farming. Given that various factors such as climate, topography, bedrock and biological affect vegetation and soil, and that there is a special association among these factors together in a special condition, we encounter a special vegetation and soil in natural landscapes (Jafari et al., 2002). Today, excess utilization from rangeland resulted in an intense decline of rangelands that have useful potentials and gradually degraded these vital resources in terms of both quality and quantity. If prevention is considered at the initial stages of the trend, due to more stability of the soil and its slow degradation after vegetation, vegetation can be reclaimed easily with an expectation of spending less time and money. This is why a study of the relationship between vegetation and soil factors is vital, and as such, a lot of investigations are conducted in this context.

Beno (1998) in his investigations across the Arabian coast and Persian Gulf studied plants as a special

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indicator of soil characteristics. The results showed that vegetation is an indicator and representations of the soil and different vegetation types are confirmed with different soil types. Lentz et al. (1984) in Artemisia vegetation types, while studying 28 parameters from soil morphological factors, stated that, as relationship indicators between soil and vegetation, horizon texture and soil structure type can be useful in the vegetation type of discrimination. Abuziada (1980) stated that there are close correlations between vegetation distribution patterns and soil salinity and moisture, whereas Yongar et al. (1965) pointed out that the most important effective factors on halophyte plants in the United States is changes at soil salinity level, while in biotic factors, climate, topography and soil moisture have less importance. Abd El-Ghani et al. (2003), by classifying vegetation and studying the relationship between plant species and soil, found significant correlation among lime, saturated moisture percentage, pH and organic matter in some species from the family of Fabaceae, Chenopodiaceae, Poaceae and Asteraceae.

Lue et al. (2006), respectively, compared the relationship between soil factors and plant species distribution in shrub and herb stratum in Situan province, China. The results of DCCA and DCA showed that the most important factors that explain species distribution in both strata have been soil moisture, pH, organic matter and available soil moisture. Soleiman et al. (2008), applying the geographical information system (GIS), investigated the relationship between plant community and the physical features of the sub-catchment Cherat from Tellar basin in the north of Alborz hierarchical mountains. The physical factors which were considered included: pedological, meteorological and geological variables. Using remote sensing technique, eight plant communities (two rangeland types and six forest types) were recognized in the area. The results showed that climate factors have effects on vegetation type and their biological form. Vegetation types, in particular rangeland, are sensitive to soil factors. Hence, soil factors are the most important in terms of vegetation distribution in the area.

METHODS

Description of the study area

The study site, Ardestan basin, covers 11591 km^2, and is located in the northern part of Isfahan province. The northern part of the catchment is flat and is related to the kavir plain, while the southern part is a mountain. The lowest part of the area is 980 m and is located in the center of the playa, while the highest part is 2850 m elevation above sea level. Hence, vegetation and temperature varies in the north and south. The region has a typical desert climate that is dry and warm in the north and more temperate in the south. As a whole, Ardestan climate is dry and warm, and the summer and winter temperature variation is too high because of the dry nature, stone, sandy and saline soil in the north and high evaporation in south. Moreover, the area is too poor and its type is arid-steppe (Figure 1).

Field measurements

In order to carry out an investigation, the boundary of Ardestan playa was determined by using aerial photographs with a scale of 1:120000 and topographical maps with a scale of 1:25000, then the initial investigation was conducted while the initial vegetation type-determining was exerted. The sampling site was chosen in each vegetation type as if it were an indicator of the vegetation type of character. Vegetation sampling within the site was conducted by placing it in the plot and transecting it. In whole, two transect with 300 m length were established and the vegetation types were studied separately. Afterwards, 30 plots were located and various plant factors such as present species list and vegetation canopy, litter, bare soil and rock stone percentages were taken down. In order to study the soil factors, a profile of 0 to 60 cm was excavated in the first, middle and final plots in each transect, and after sampling, soil texture, soil acidity, electrical conductivity, carbonate calcium, organic matter, gypsum, potassium, calcium and magnesium were measured. Also, ESP and SAR were computed.

RESULTS AND DISCUSSION

By considering the vegetation cover in the area, the following vegetation types, recognized from the margin of the playa towards its exterior which characterized every type based on soil and vegetation condition, are as follow:

1. The vegetation type *Salsola* sp-*Seidlitzia rosmarinus*: This is the first vegetation cover that appeared, followed by facis without vegetation. The percent of the canopy cover in Salsola sp and Seidlitzia rosmarinus is 90 and 7%, respectively, while the high percent of the area is covered by bare soil (78%). Fundamentally, the elevation of this type on average is 980 to 1000 m above sea level, while its slope is 0 to 2% and its prevailing direction is towards north. Given the results of the conducted pedological studies, the soil in this type has the maximum percent of Mg and gypsum in terms of chemical properties and it has the maximum percent of silt and minimum percent of stone and sand in comparison to other types in terms of texture. Consequently, the dominant species in this type is *Haloxylon aphyllum*.
2. The vegetation type Haloxylon aphyllum – *Salsola* sp: The percent of the canopy cover in Haloxylon aphyllum and *Salsola* sp are 15 and 10%, respectively, while the high percent of the area is covered by bare soil (63%). Fundamentally, the elevation of this type on average is 1000 to 1200 m above sea level, its slope is 2 to 5% and its prevailing direction is southward. Given the results of the conducted pedological studies, the soil in this type has the maximum level of sodium, electrical conductivity, potassium, SAR and ESP in terms of chemical properties and has the maximum percent of clay and minimum percent of stone in comparison to other types in terms of soil texture. However, the dominant species in this type are: *Salsola incanesense*, *Salicornia europae* and

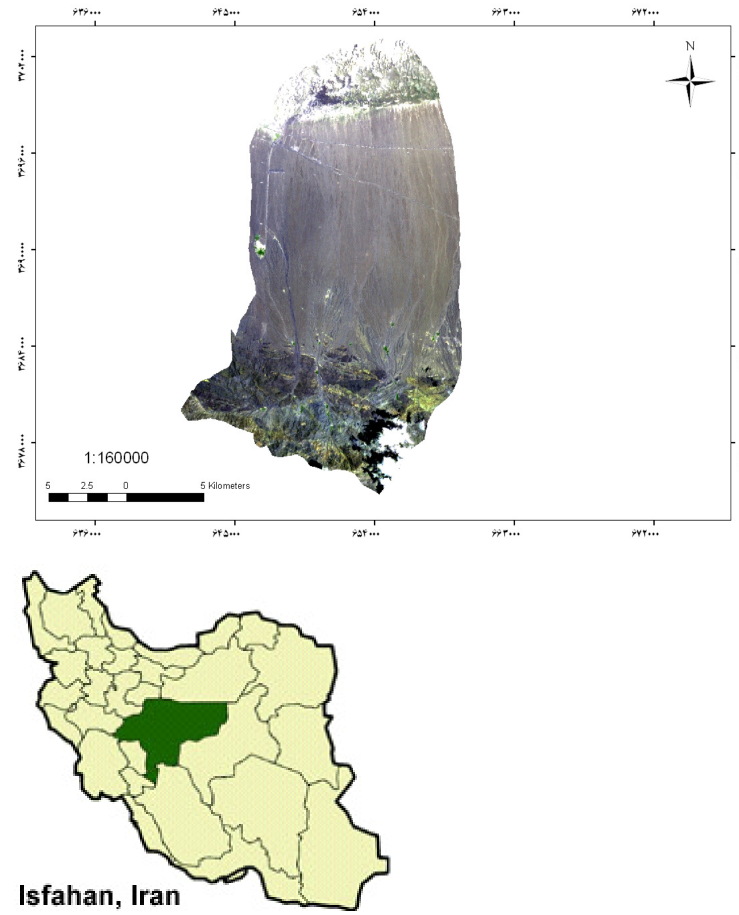

Figure 1. Geographical situation of the study area.

Lyceum depressum.

3. The vegetation type Artemisia sieberi-Onobrochyse sp.: The percent of the canopy cover in *Aremisia sieberi* and *Onobrochyse* sp are 15 and 14%, respectively, while the high percent of the area is covered by gravel. On average, its elevation limit is 1200 to 1400, its slope is 2 to 5%, and its prevailing direction is northward. Given the results of the conducted pedological studies, the soil in this type has the maximum percent of organic matter in terms of chemical properties and has the maximum percent of stone and sand in terms of soil texture. However, the dominant species in this type are: *Eryngiodes conovlvlus, Cousina ritrodes and Atriplex conescens.*

4. The vegetation type Fortuynia bungoi-petropyrum aucheri: The percent of the canopy cover in Fortuynia bungoi-petropyrum aucheri are 20 and 15%, respectively, while the high percent of the area is covered by gravel. Generally, its altitude ranges from 1400 to 1600 m, its slope from 5 to 10% and its direction towards north. Given the results of the conducted pedological studies, the soil in this type of vegetation has the minimum level of potassium and the maximum percent of organic matter and gypsum in terms of chemical properties, while it has the minimum percent of silt in terms of soil texture.

After determining the vegetation types, in order to compare the measured pedological and topographical characters at various types, analyses of variance (ANOVA) tests were used, and its results are shown in Table 1. In order to study the difference among vegetation types, the Duncan's multiple-range test was used, and the results are shown in Figures 2 - 17. In Table 1, there are significant differences at the level of 1 and 5% among other factors. In the light of the aforementioned results, we observe that there are significant differences among the studied types with a level of 5% in ESP, clay (%), potassium, gypsum and pH, and a significant difference with a level of 1% in EC, calcium carbonate (%), calcium ppm, magnesium ppm, sodium ppm, SAR, silt (%), sand (%), elevation (m) and slope (%).

Conclusion

According to the obtained results, the studied vegetation

Table 1. Soil characteristics and the measured trait variance of the four vegetation types.

Type of factor	Sa.sp - Se.ro	Ha.ap - Sa.sp	Ar.si - On.sp	Fo.bu – Pt.au	F
Na	2475.61	4004.78	32.02	31.21	55.221**
K	16.38	26.97	16.3	5.6	5.695*
Organic matter	18.67	18.86	18.84	19.32	2.581ns
pH	8.02	8.3	10.12	8.4	7.367*
EC	12.03	14.9	0.59	0.57	92.668**
Caso4	0.02	0.03	0	0.07	4.807*
Caco3	55	45.83	28.75	25	19.54**
Ca	3	2.97	0.43	0.3	35.726**
Mg	3.03	1	0.38	0.23	16.603**
Slope	2	5	8	20	69.886**
Elevation	1000	1100	1300	1800	33.303**
Silt	42.44	36.44	15.11	2.11	31.165**
Clay	27.07	30.4	14.07	14.4	7.766*
Sand	30.49	33.16	70.83	83.49	54.558**
SAR	1425.34	2843.68	50.11	60.44	61.364**
ESP	21.38	42.66	0.75	0.91	7.633*

* , ** and ns, significant at the level of 5% and insignificant at a level of 1%, respectively.

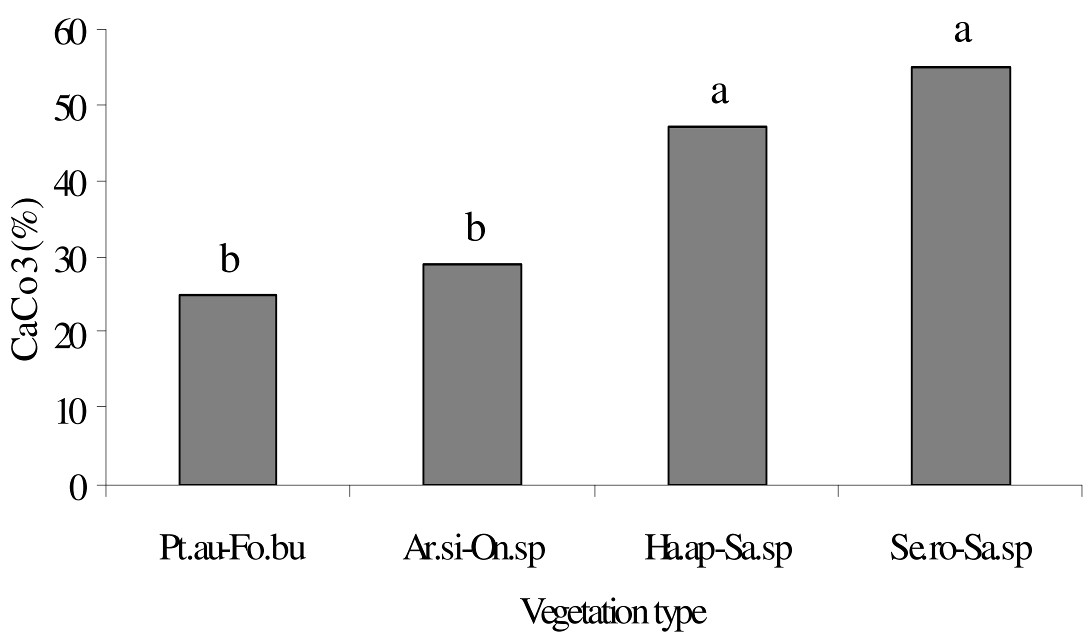

Figure 2. Comparison of slope mean in different vegetation types.

cover follows the salinity and slope variations and the effective factors on soil, so that vegetation type *Salsols* sp., *Seidlitzia rosmarinus* can appear in the soil where there are high percent of gypsum, Ca and Mg; and where there is a maximum percent of silt and minimum percent of stone and sand than other types in terms of soil texture. As such, the more we move towards the mountain, the lesser the appearance of salts concentration. However, a reduction of these factors results in a vegetation type, such as Fortuynia bungoi-petropyrum aucheri. These results are confirmed with various researchers' studies as follow. Mohtashamnia et al. (2007) opined that the physiological factors with pH, gypsum, sand and phosphorous, amid an elevation of 2600 to 2700 m, and other factors like sand and calcium carbonate with an elevation of 2700 to 2800 m stratum

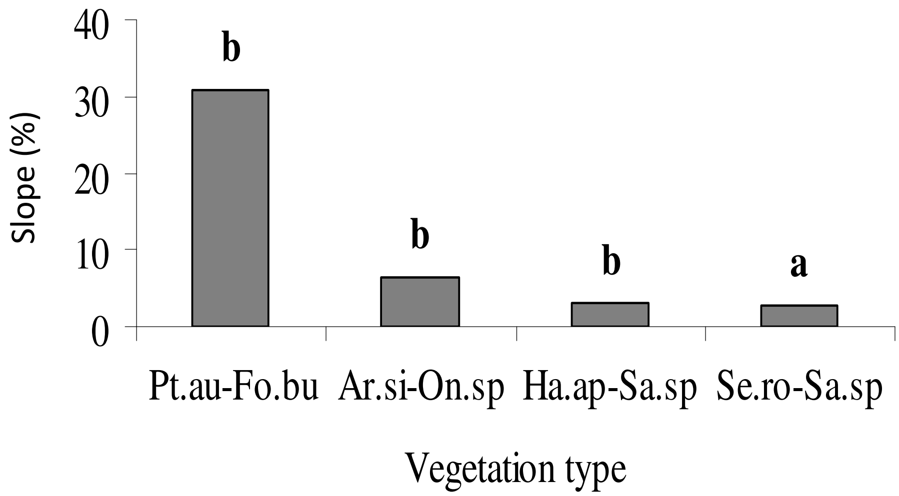

Figure 3. Comparison of elevation mean in different vegetation types.

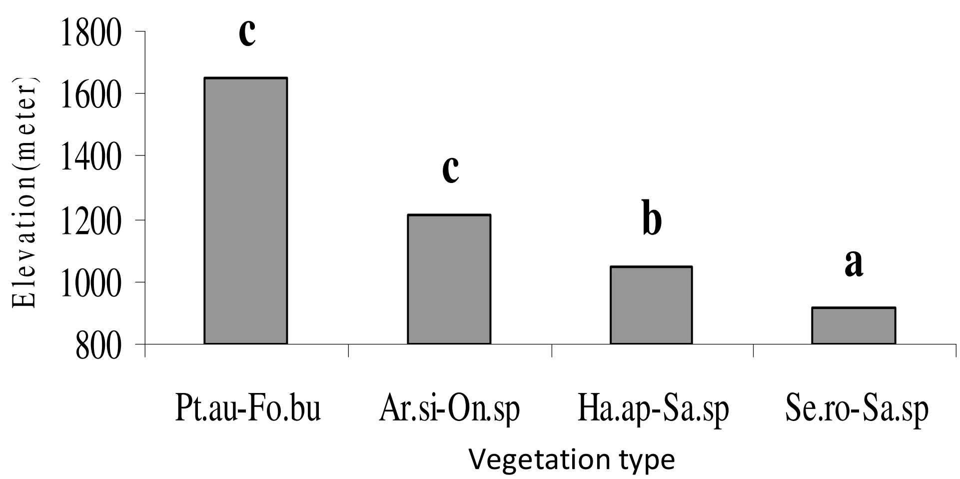

Figure 4. Comparison of acidity mean in different vegetation types.

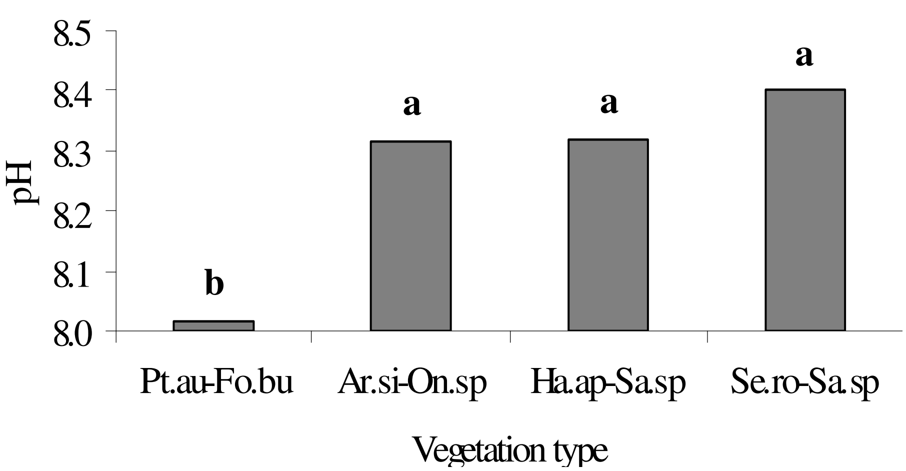

Figure 5. Comparison of EC mean in different vegetation types.

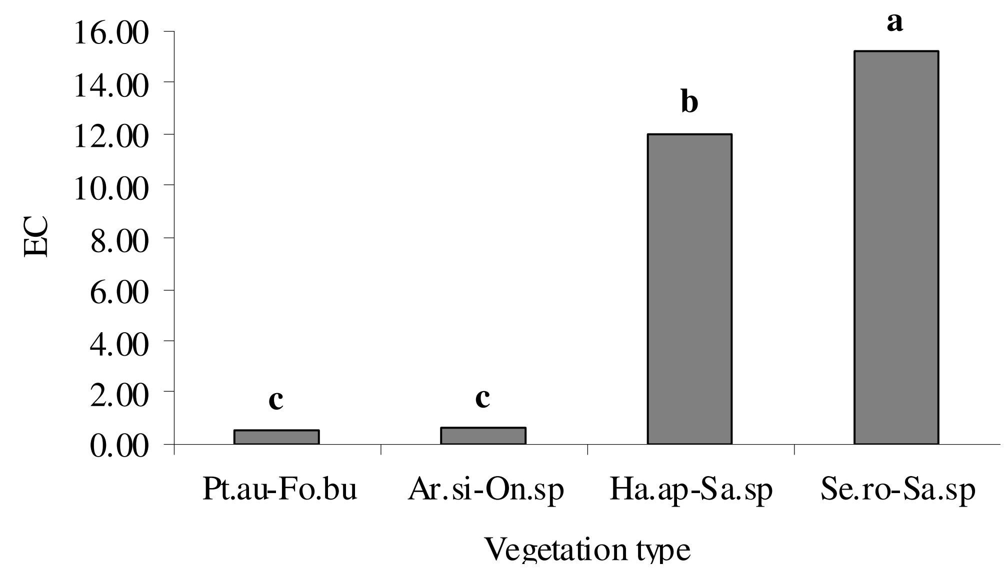

Figure 6. Comparison of gypsum mean in different vegetation types.

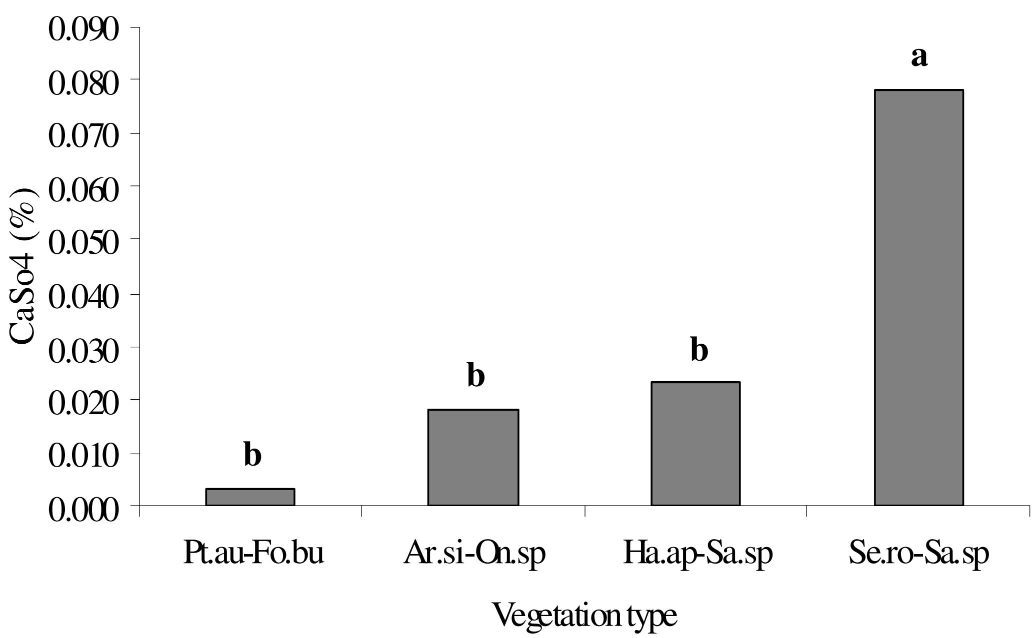

Figure 7. Comparison of calcium carbonate mean in different vegetation types.

have been effective on shaping the seventeen groups of semi-steppe rangeland plant ecology of Eghlid in Fars Province (Iran).

Jafari et al. (2003) pointed out that the percent of soil forming particles are the most effective soil characteristic factors in the vegetation type of separation ranges of Yazd Province, Nodushan, whereas Ayyad and El-Ghareeb et al. (1984), Abdel-Razik et al. (1984) and Kanival et al. (1990) showed that the most important factors, which affect saline lands and plant community distribution are three in number and they include: salinity, texture and percent of organic carbon. Beno et al. (1998), by studying the relationship of five Arabian desert plant species to soil, showed that the site of Cyprus Congelomeratus has soils with less salinity, while the site of Zygoplyllum p mandarillei has soils with more salinity. Rostampoor et al. (2009) explained that the reverse gradient of soil salinity and moisture is an important factor that shapes vegetation cover distribution in the semi-mountain area of Ghaen. Also, Khodagholi et al. (1996)

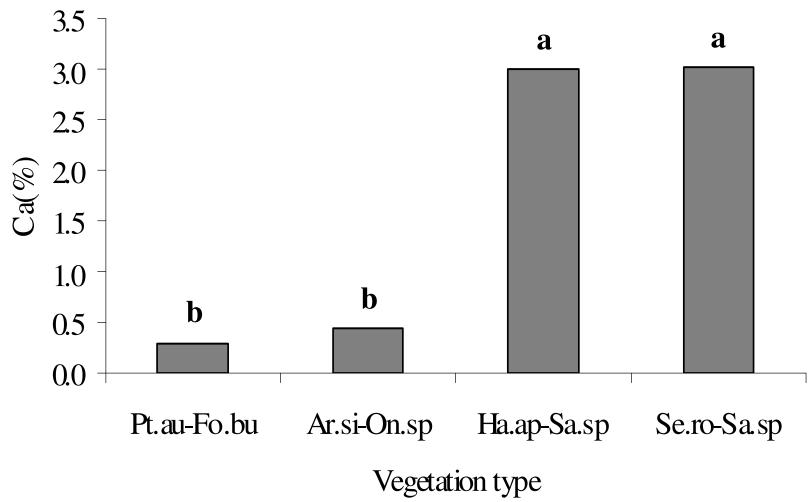

Figure 8. Comparison of calcium mean in different vegetation types.

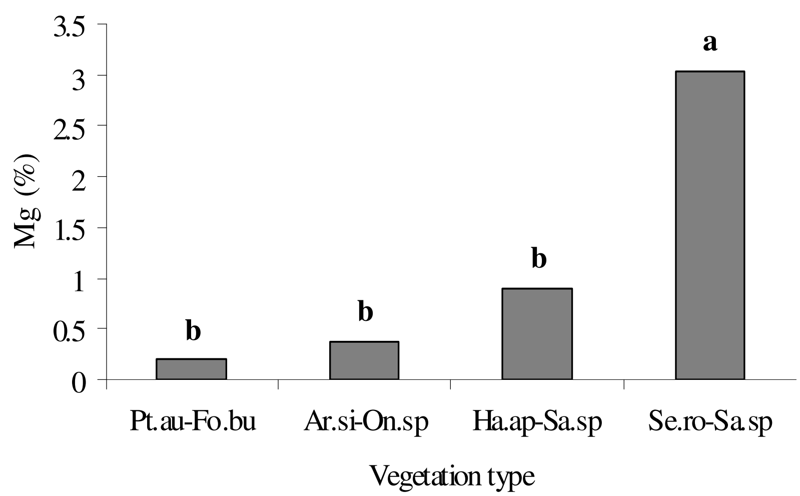

Figure 9. Comparison of magnesium mean in different vegetation types.

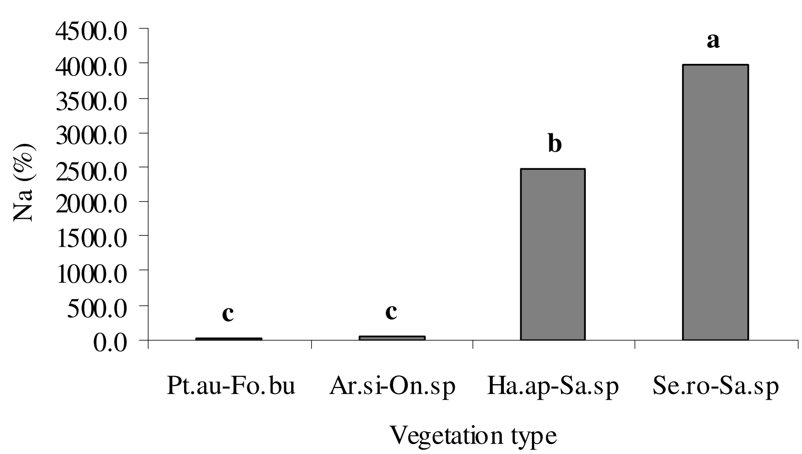

Figure 10. Comparison of sodium mean in different vegetation types.

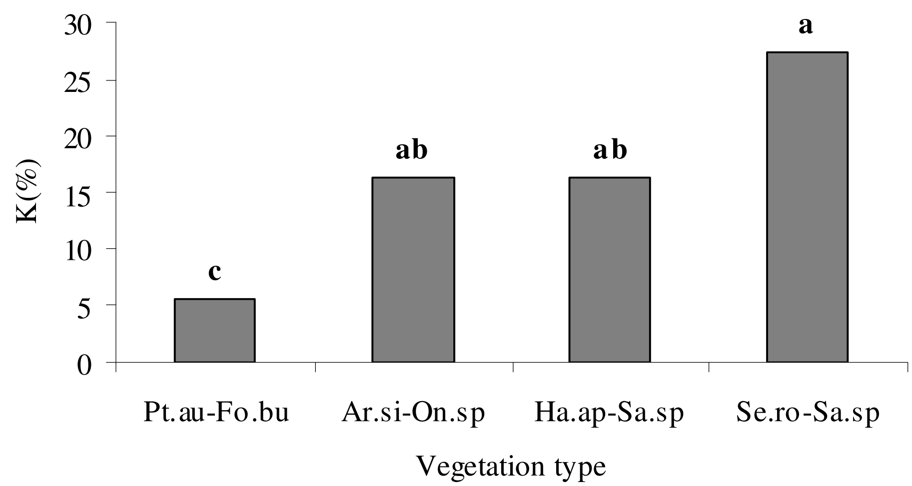

Figure 11. Comparison of potassium mean in different vegetation types.

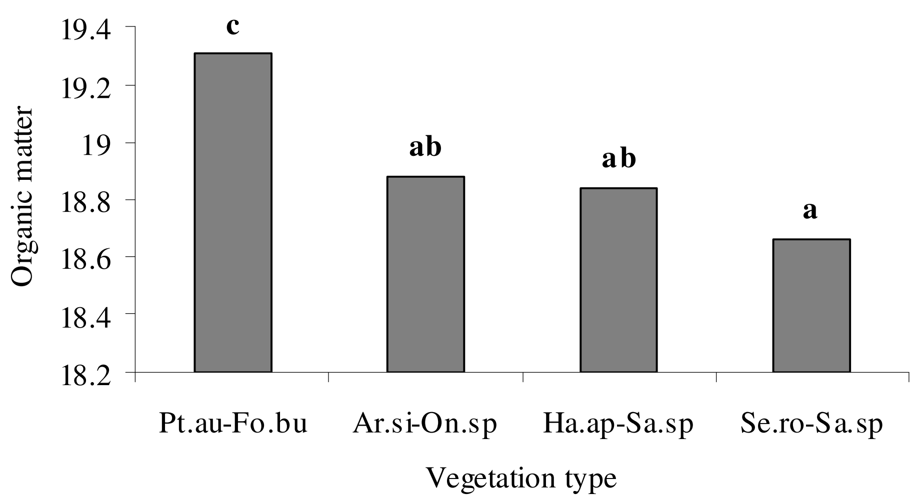

Figure 12. Comparison of silt mean in different vegetation types.

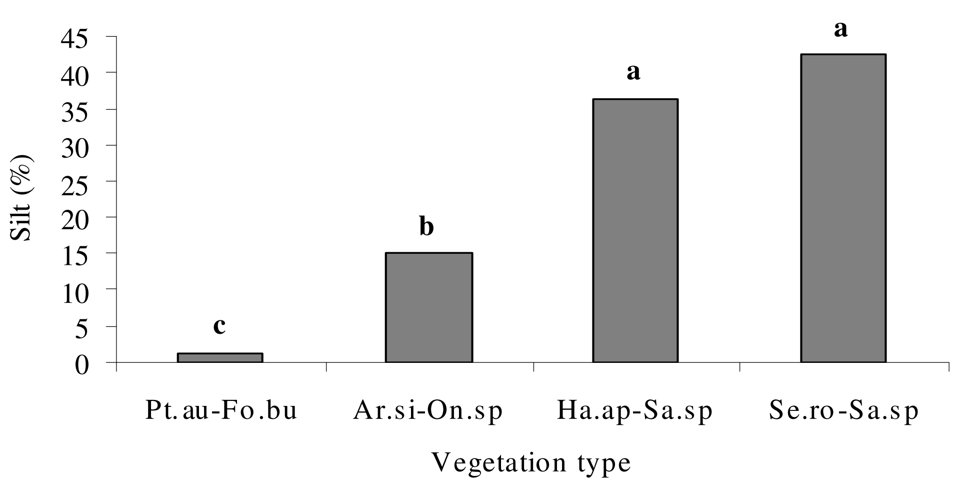

Figure 13. Comparison of organic matters mean in different vegetation types.

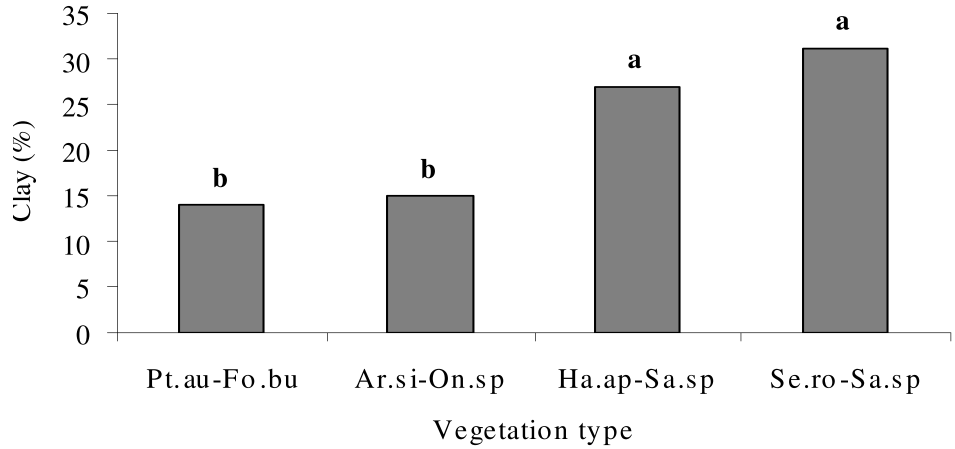

Figure 14. Comparison of clay mean in different vegetation types.

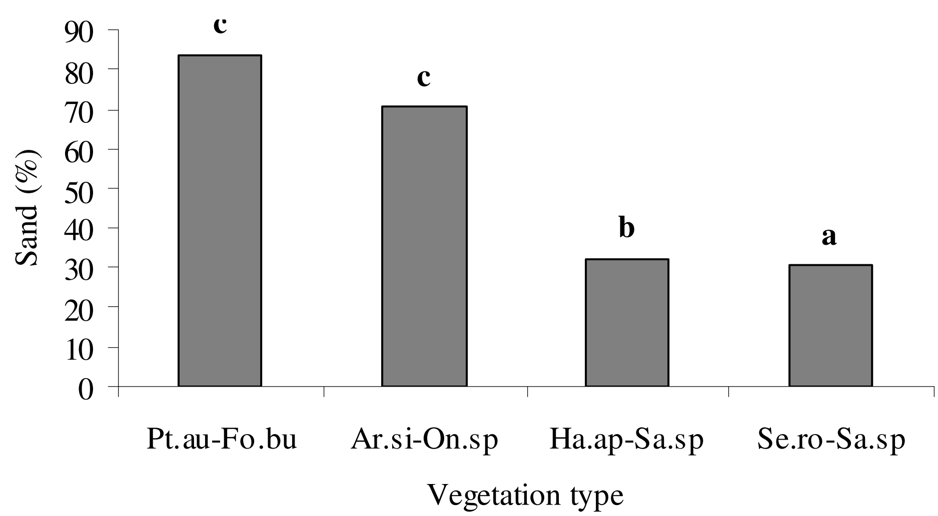

Figure 15. Comparison of sand mean in different vegetation types.

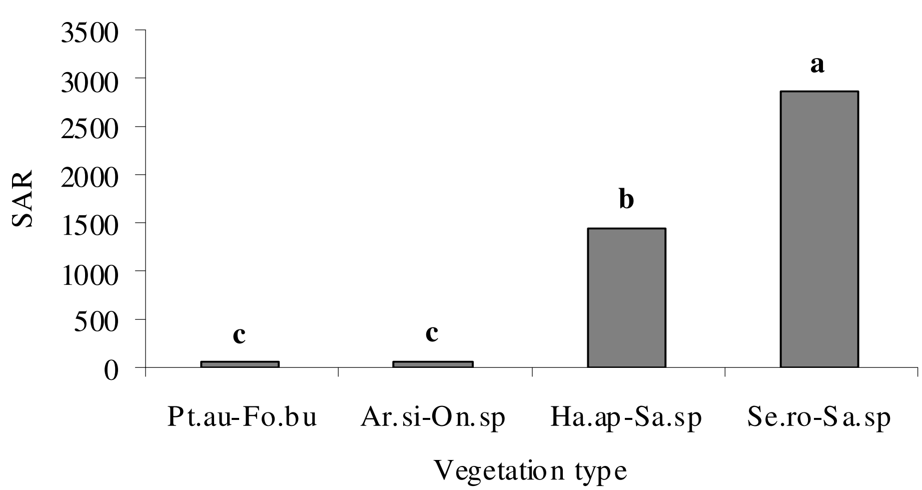

Figure 16. Comparison of SAR mean in different vegetation types.

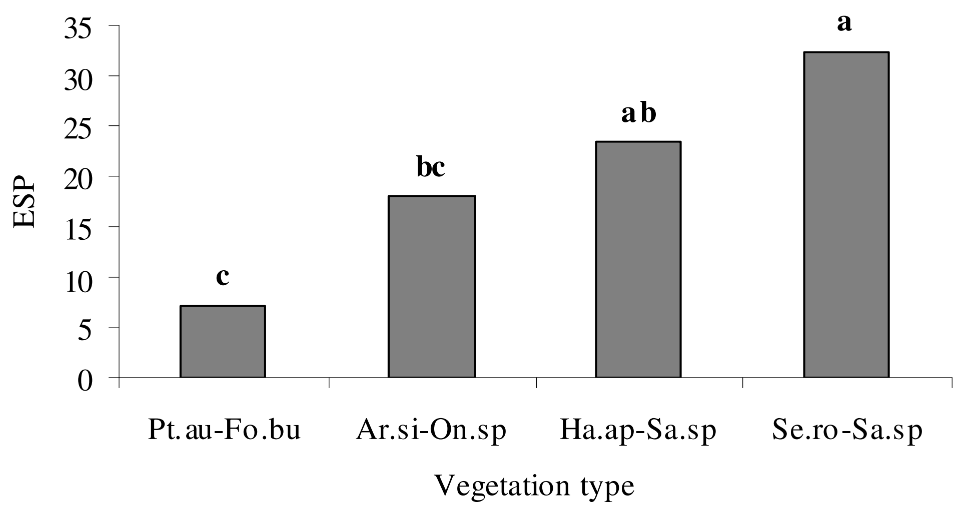

Figure 17. Comparison of ESP mean in different vegetation types.

and Hoveizeh et al. (1997) maintained that salinity is one of the most important factors that determine the vegetation community in the playa's unit at the southern part of Salt Kavir Lake. As we observed, the role of salinity pointed out by researchers in plant species distribution is confirmed by the results of this investigation. Also, this investigation results are confirmed with the results of Zohran et al. (1992) who reported that saline land vegetation cover distribution on Egypt Mediterranean beach distribution has close correlation with the level of organic matter, EC, soil moisture, calcium carbonate and soil texture.

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