Effect of Environmental and Management Factors on *Atriplex* Freshness and Growth (Case Study: Hossein Abad Hapeshloo, Shahriyar, Iran).

Masoomeh Abbasi Khalaki[A], Mehdi Moameri[B], Ali Tavili[C], Mohammad Jafari[D]

[A,B]Postgraduate Students, Faculty of Natural Resources, University of Tehran. Email: m_abasi6@yahoo.com
[C,D]Associate Professor, and Professor, Faculty of Natural Resources, University of Tehran.

Manuscript Received: 01/10/2011
Manuscript Accepted: 30/11/2011

Abstract. Some of arid regions problems of Iran are saline and sodic soils. In improvement and reclamation of Iranian arid rangelands, some foreign species of *Atriplex* had been imported and adapted for many years ago. The most adapted species was *Atriplex canescens*. At the present research, some environmental factors, vegetative characteristics (Na, Ca, Mg and K), soil properties (moisture, EC, pH, solute Na and K, hard pan, $CaCO_3$, $CaSO_4$, etc), topography, climate (rainfall, temperature, frost) and management characteristics (pruning, enclosure, grazing, irrigation) were studied on *Atriplex canescens* in two sites in Hossein Abad-e-Hapeshloo of Shahriyar, Tehran province, Iran. At first, field survey was done and proper sampling method was selected. Based on distance between and within furrows, one hectare reference area was selected for each of low and high freshness sites, respectively. A random-systematic sampling method was used for vegetation and soil characteristics, along three transects with a length of 100 m vertical to furrows, nine plots were established. Along each transect, three profiles were dug and samples were taken from two depths (0-30 cm and >30 cm). The wet and dried soil samples were weighted and soil moisture was estimated. Then, some physical and chemical soil properties were evaluated. Results of soil analysis showed significant diffrences between two sites for pH in lower depth, Ec in the higher depth , $CaCO_3$ and sand in the both depth, silt in the lower depth and clay in the higher depth. The amount of Ec , ESP, $CaCO_3$, clay and Na were increased in lower depth of soil, in contrast, for silt, sand and K, the higher values were obtained in the above layer. For others yraits there was no significant difference between two sites. The mean of vegetation characteristics were more in high freshness site. It was concluded that physical (soil texture) and chemical soil parameters (lime, pH and others) had significant effect on shrub freshness. Moreover, it was likely that management parameters including grazing, irrigation and environmental parameters including topography and water logging had important roles in improper growth of *Atriplex* shrubs.

Key words: Environmental and managerial factors, Freshness, Improper growth, *Atriplex canescens.*

Introduction

Some of the problems of Iran arid regions are saline and sodic soils couple with high temperature led it to difficult ecological conditions (Jafari, 1994). These limited factors, decrease of plant diversity and canopy density cause poor vegetation and decline the ability of land use. However, with correct management, ecologist could use the best from these natural resources (Henteh, 1990). For improvement and reclamation of Iranian arid rangelands, foreign species of *Atriplex* have been used during long years. The most important of them were *Atriplex canescens, Atriplex halimus* and *Atriplex lentiformis* that *A.canescens* is more important (Moghimi, 2005). *Atriplex* spp. are halophytes that complete their life cycle at high salinity levels and are able to accumulate higher concentrations of micronutrients than the required minimum (Ramos *et al*., 2004). It is suggested that *Atriplex* spp. may be more suitable for revegetation in saline soils and be a good source of productive feed (Hopkins & Nicholson, 1999). These plants could be promising, since *Atriplex* spp. has special bladders in the leaves that act as salt sinks for the removal of the excess of salt (Laeuchi & Luettge, 2002 and Hayati, 2002). *Atriplex* spp. as the most salt-tolerant within higher plants (Khan *et al*., 2000). *Atriplex canescens* is belonging to Chenopodiaceae and it is an evergreen shrub with deep and divergent root system (Ahmadi Roknabadi, 1998). In addition, it is resistant to heat, cold, alkali soils (Eskandari, 1995) and drought (Simpson, 1992). Ramos *et al*., (2004) had proposed that both K^+ and Na^+ are involved in the osmotic adjustment of plants in response to high soil salinity and they showed that Na^+ ions contribute more efficiently than K^+ ions to perform this function. Fertilization did not affect seed production in irrigated plots, but N and N+P increased seed production in dry land plots in the fourth growing season (Petersen & Ueckert, 2005). Freezing injury arises mainly from cellular dehydration due to movement of intracellular water to ice in the extracellular space, and damage to cell membranes (Uemura *et al*., 2003). Under field conditions, freezing tolerance of *A. halimus* populations seemed to be related to leaf concentrations of Na and K (Walker *et al*., 2008). Aouissat *et al*. (2009) measured the tolerance in leaf electrolyte leakage assays and assessed the visual damage after exposure to the temperatures between -5 and -25 ºC. They remarked that there was a significant correlation ($P<0.005$) between freezing tolerance and the leaf sap concentrations of Na and Na+K. Tolerance being improved markedly by the soil salinization, but no relationship was observed between tolerance and the soil salinity or minimum winter temperatures of the original sites of the populations. Sperry & Hacke (2002) reported that soil characteristics influence plant communities through water relations. Hypothetically, finer texture soils in arid climates are negatively associated with plant and soil water potentials during drought should have greater resistance of xylem to cavitation, and shallower root systems than coarse soils. Eskandari (1995) investigated the role of pedological factors in growth and establishment of *A. canescens*. He observed high density of salts in the site including dryness shrubs compared to the fresh site and also downfall of the underground water table after several years introduced as reasons of dried *Atriplex* in Isfahan, Iran. Ahmadi Roknabadi (1998) in investigation of some effective factors on dried *Atriplex* in Yazd province, Iran, reported that aggregation of sulphate ion in organs of shrubs was the most important factor for dryness shrubs. The next reason was plant poisoning because of high absorb of ESP from soil and latest reason was the presence of rats and chewing roots animals. In cultivation plans with

A.canescens, some environmental and management factors affect the shrubs freshness, for example: climate, soil, topography, vegetative characteristics, density of shrubs, grazing, pruning and irrigation. If effective factors are not considered, many costs and time will consume without achievement to proper performance. Consequently, it will cause injuries such as weakness of planted regions against wind erosion. Hence, the aim of this study was examine of the effect of some environmental and management factors on *Atriplex* freshness and growth in two adjacent and synchronic sites in Hossein Abad Hapeshloo, Shahriyar Region of Tehran province, Iran.

Materials and Methods

Hossein Abad-e-Hapeshloo of Shahriyar is located in 40 km of south of Karaj, Tehran province (50˚ 42' 17"E and 35˚ 34' 45"N). Its area is 44480 ha and it is located at an altitude of 1195 m above sea level. The highest point is Tabare zenith in north of zone with 1271 m altitude and the deepest point is bottom of Chahar Bagh river with 1160 m high. The average annual precipitation is 242 mm (Table 1, Anonymous. 2005).

In this study, due to the investigation of *Atriplex* shrubs from the viewpoint of freshness, two sites adjacent each other and the same age (planted in 2003-2004) were selected as one of them was references of weak and wither *Atriplex*, and another was referenced of freshness *Atriplex*. At the present research, some of environmental properties were studied such as vegetative characteristics (Na, Ca, Mg and K), soil properties (moisture, Ec, pH, solute Na and K, hardpan, $CaCO_3$, $CaSO_4$, etc), topography, climate (rainfall, temperature and frigid) and management characteristics (pruning, enclosure, grazing and irrigation). For sampling, the first field survey was done in and proper methods were selected for sampling. Based on clear distance of furrows and distance of between shrubs, one ha reference area was considered for sampling. To sample the vegetation and soil, random-systematic method was used along three transects with a length of 100 m perpendicular on furrows. Along each transect, nine plots were established. To evaluate the vegetation cover, ocular method was used. In order to do the vegetation experiments, green and current year branch of *Atriplex* were picked and placed into envelop then were placed into oven 70ºC for 24 hours. After drying, they were grind and Na, K, Ca and Mg were estimated. Shrub dimensions were determined before their cutting. For the study of effective soil properties on shrubs growth, along each transect three profiles (in start, medium and end points of each transect) were dug under shrubs area and samples were taken from two depths (0-30 cm and > 30 cm). The soil samples were weighted, dried and soil moisture was calculated. Some of soil effective physical and chemical characteristics were evaluated. Each of properties was examined by various methods; pH, potentiometry, soil texture, bycus hydrometer, $CaCO_3$, calcimetry, $CaSO_4$, acetone Ca and Mg, titration with EDTA, Na, K and ESP and flam photometer (Jafari Haghighi, 2003). For the investigation of topography, field survey was performed and the unevenness of the land was considered. Height and slope of each site were considered in this survey. In order to study the climate parameters, the information of nearest weather station was used (Table 1). The information of management factors such as time of planting in two studied sites, pruning, and density of shrubs, enclosure, grazing and irrigation was received from Karaj and Shahriyar natural resources office. Finally, Range management project of Hossein Abad Hapashloo region was studied in 2005 and its data were used.

The collected data were analyzed using SPSS v15.0 software. The normality and

homogeneous of data were assessed by Kolmogorov-Smirnov's and Levene's test, respectively. Independent-t test was used between two sites for assessing the significant difference of effective characteristics on shrubs freshness.

Results

Environmental Factors

Results of soil analysis showed significant diffrences between two sites for pH in the second depth, Ec in the first depth , $CaCO_3$ in the both depth, sand in the both depth, silt in the second depth and clay in the first depth. The amount of Ec, ESP, $CaCO_3$, clay and Na were increased in second depth of soil, in contrast, for silt, sand and K, the higher values were obtained in the above layer. For others investigated factors there was no significant difference between two sites (Table 2). Results of vegetation characteristics of *Atriplex canescens* in two sites showed significant differences between two sites ($P<0.01$). The higher values were obtained in the site1 (high freshness site) (Table 3).

Management Factors

Based on row and shrub distances 4x4 m, there were 625 shrubs per ha in site 1. Whereas, based on 3.5x3.5 m distance between plants a total number of 700/ ha were observed in the site2.

Since the *Atriplex* shrubs in region of Hossein Abad Hapeshloo had low age, shrubs were not changed to woody stage, as a result, no pruning, and other practice was made. Therefore, the pruning practice does not affect the improper growth of shrubs, but in future, it can be used as a useful way for managing *Atriplex* rangeland in the region.

After planting in this region for suitable establishment of shrubs, 2 year enclosure were made. The site 2 was near to road of local livestock traffic of Hossein Abad village, so local animals (particularly sheep) during pass over this site they grazed from little shrubs. But, in site 1 (high freshness) near to Tabareh Mountain, was far from the road, so in time of enclosure there was no grazing happened. It was planed later on to execute grazing timetable based on rest-rotation grazing. The timetable for entrance and existence of livestock to this region was started from April and ended in December, respectively.

The other differences between two sites were related to initial of range management plan. In both site, in the start of project the viable seeds were used. Then, seedling was produced during 3-4 months before planting in Chagho research station. The seedlings had the same age with the same original. However, in the first year, the site 1 (high freshness) was irrigated for 5 times. Whereas, site 2 where irrigated only one time. Therefore, shrubs of site 2 had little growth than site 1.

Table 1. Climatic characteristics of Hossein abad Hapeshloo

Annual mean	Statistical period							Parameters
	2005	2004	2003	2002	2001	2000	1999	
242.0	300	270	268	262	173.5	240	181.5	Precipitation (mm)
55.00	61	60	54	57	44	64	45	Freezing weather (day)
9.30	8.3	9.5	9.0	9.5	9.9	9.4	9.4	Minimum temperature (°C)
21.76	21.8	21.7	21.2	21.8	22.5	21.5	21.8	Maximum temperature (°C)
45.28	47.64	45.5	47.33	44.58	43.67	44	44.25	Relative moisture (%)

Table 2. T-test Results of soil characteristics comparison between high (site 1) and low (site 2) freshness site

Characteristics	Soil depth	Treatment		Df	T	Sig
		High freshness (site 1) Means ± SD	Low freshness (site 2) Means ± SD			
pH	The first depth	7.32 ± 0.81	8.39 ± 0.03	16	0.95	ns
	The second depth	8.24 ± 0.05	8.00 ± 0.07	16	2.82	**
Ec (ds/m)	The first depth	0.24 ± 0.06	0.25 ± 0.02	16	2.34	*
	The second depth	0.31 ± 0.02	0.29 ± 0.02	16	0.36	ns
$CaCO_3$ (%)	The first depth	8.72 ± 0.18	11.75 ± 0.75	16	3.93	**
	The second depth	10.16 ± 0.92	15.53 ± 0.79	16	4.44	**
$CaSO_4$ (%)	The first depth	0.46.0 ± 0.0	0.46.0 ± 0.0	16	1.81	ns
	The second depth	0.46.0 ± 0.0	0.47.0 ± 0.0	16	1.00	ns
Silt (%)	The first depth	18.95 ± 1.55	22.22 ± 0.40	16	2.03	ns
	The second depth	15.40 ± 0.58	21.33 ± 1.41	16	3.88	**
Clay (%)	The first depth	18.29 ± 1.29	30.22 ± 1.45	16	5.69	**
	The second depth	31.40 ± 3.38	39.55 ± 2.47	16	1.95	ns
Sand (%)	The first depth	62.75 ± 1.44	47.55 ± 1.82	16	6.54	**
	The second depth	53.20 ± 3.28	39.11 ± 2.26	16	3.53	**
ESP (%)	The first depth	9.47 ± 2.22	5.47 ± 1.58	16	1.47	ns
	The second depth	15.84 ± 4.16	7.59 ± 1.83	16	1.82	ns
Moisture (%)	The first depth	2.94 ± 0.02	3.00 ± 0.03	16	1.40	ns
	The second depth	3.16 ± 0.16	3.00 ± 0.03	16	0.94	ns
Na (ppm)	The first depth	49.35 ± 8.41	38.70 ± 5.50	16	1.06	ns
	The second depth	56.60 ± 7.06	43.32 ± 7.11	16	1.32	ns
K (ppm)	The first depth	17.44 ± 2.83	10.64 ± 2.59	16	1.77	ns
	The second depth	15.06 ± 4.25	6.00 ± 2.46	16	1.84	ns
Ca (ppm)	The first depth	40.00 ± 10.24	17.78 ± 1.90	16	1.50	ns
	The second depth	17.78 ± 1.90	24.89 ± 3.64	16	1.73	ns
Mg (ppm)	The first depth	10.67 ± 1.63	14.67 ± 3.40	16	1.06	ns
	The second depth	14.67 ± 3.40	8.89 ± 1.86	16	0.37	ns

*: $P < 0.05$, **: $P < 0.01$, ns: No significant different

Table 3. Compare of *Atriplex* vegetative factors in two perused sites

Parameters	High freshness (site 1)	Low freshness (site 2)	Sig
Canopy length (cm)	107.78 ± 6.65	43.70 ± 3.33	**
Canopy width (cm)	113.33 ± 8.41	41.11 ± 3.19	**
Shrub height (cm)	83.89 ± 3.72	44.81 ± 3.04	**
Canopy cover (%)	13.00 ± 1.11	3.00 ± 0.36	**

**: $P< 0.01$

Discussion and Conclusion

Results of physical characteristics of soil showed significant differences between site 1 and site2 for clay percentage in the first depth and its values were higher in low freshness (site 2). This means that the soil texture of site 2 is heavier than that in site 1. This causes the decrease of soil pore and plants obtain less water subsequently, therefore shrubs growth will diminish. In agreement with our result, Jafari *et al*. (2008) reported that available water for plants depend on the soil texture. It is less in clay soils in comparison to loamy and sandy soils. Hence, plant growth in clay soils is slower than sandy soils. Ekhtesasi & Barzegari (1993) mentioned that *Atriplex* root is limited in soils with heavy texture, even sometimes water unbalance between aerial parts and roots leads to the plant's dryness. Results showed that in lower depth silt percentage in site 2 (low freshness) was more than site 1. Jafari & Sarmadian (2003) reported that by increasing of silt amount, the soil

permeability declines and this could be one of the reasons of weak growth of shrubs in site 2. According to the results of this study, sand percentage in site 1 (high freshness) was more than site 2. This showed that soil of site 1 has a light texture. Sadeghi (1991) showed that *Atriplex canescens* is established and grows successfully in loamy and loamy-sandy soils than clay and sandy soils.

Significant diffrences between two sites for pH in the second depth, EC in the first depth. The values of pH ranged from 7.32 to 8.39 and values of Ec ranged from 0.24 to 0.31 ds/m. These results agree with the findings of Moor *et al*. (2006) who demonstrated that proper pH and Ec for *Atriplex canescens* prosperous growth are 6-8.5 (neutral to alkali soils) and <25 ds/m, respectively. Likewise, Nord (1971) showed that *Atriplex* spp. grows in alkaline soils with pH 7-8.5. Also, Moghimi (2005) mentioned that appropriate Ec for *Atriplex* growth is <20 mmhous/cm. So, pH and EC of studied region soil are proper and these factors don't threaten the establishment and freshness of *Atriplex* shrubs.

According to results of $CaCO_3$ percent, there was significant diffrences between two sites for $CaCO_3$ in the both depth. This substance had higher values in the site2 (weak freshness site). Land slope in this site 2 was very slow and it was approximately flat. Accordingly, it had water logging. Therefore, water and $CaCO_3$ react together and form hardpan for depth> 80 cm. This hardpan does not permit the leaking of root into soil and causes the improper growth of shrubs. Confirming this theory, Zare Chahouki (2001) showed that relation of $CaCO_3$ with plants were direct and sometimes are indirect. He remarks that in some regions, equable amount of $CaCO_3$ in soil leads to more species diversity because $CaCO_3$ enhances the soil biological activities. However, if soil $CaCO_3$ amount increases, hardpan will be made and nutritive materials will face the problem of being absorbed by plants. Hayati (2002) introduced the presence of hardpan in Lamerd, Fars province, Iran as one of the reason of seedling dryness in *Atriplex canescens*. Zandi Esfahani (2005) showed that hardpan beginning from depth to surface is an important factor to prevent *Haloxylon* root expansion vertically.

Results of vegetative studies of *Atriplex* showed that Canopy cover and shrub height in site 1 (strong site) were more than site 2. Probability, one of effective factors on shrub freshness is loam-sandy texture of the soil in site 1. Ogle & John (2001) mentioned that the best soil for *Atriplex* prosperous growth is deep loam to sand soil with rapid drainage. Moreover, Alizadeh (1995) and Naseri (1997) reported that *Atriplex* height in soils with light texture is more than soils with heavy texture because water maintenance capacity in heavy texture of soils is high. Results of soil analysis showed higher values for K, in the above layer in site1. It is likely that raise of K concentration had caused more activity of enzymes and protein synthesis, it subsequently, led to the growth increase and the best performance of shrubs in site1.

For Na, higher values for were obtained in the lower ayer of site1. Heidari Sharifabad (2001) remarked that Na concentration creates most changes of plant mineral nourish in outside of root and inside of plant. Likewise, K ion contributes in decrease of osmotic potential for the plant water balance in root point. Na ion causes the reduction of suction of K ion and diminution of plant growth. For climate studies, Jafari (2006) reported that *Atriplex* has a good growth in annual precipitation rather than 150 mm. Moreover, Ogel & John (2001) showed that *Atriplex* grows in weather that its annual precipitation is 200-300 mm. According to the results, freezing period of this region starts from November reaching the peak in January

and ends in April. Moghimi (2005) expressed that vegetative growth of *Atriplex canescens* begin in the middle of March, flowering in 1 June producing seeds from late of October and the seed fall period starts from late of December until the early April of next year. This period coincides with plant winter dormancy; hence, it does not affect the improper growth of *Atriplex*. Aouissat *et al*. (2009) investigated the freezing tolerance of *Atriplex halimus* and *Atriplex canescens* in Algeria in relation to plant provenance and leaf cation concentrations. They reported that tolerance was determined in leaf electrolyte leakage assays and visual damage was assessed after exposure to temperatures between -5 and -25ºC.

Peimanifard *et al*. (1994) mentioned that *Atriplex* could tolerate -20 to +40°C of temperature range. Therefore, climate of Hossein Abad region was compatible for *Atriplex* growth. As a result, in present study, the runoff of Tabare Mountain (site1) flowed to flat (site 2) and because of heavy texture of site 2, runoff cannot penetrate into the soil creating the water logging under shrubs. Researches of Gibbs & Greenway (2003) and Armstrong (1979) showed that plant roots in water logging involved the shortage of Oxygen and ATP. Likewise, Voesenek *et al*. (2006) reported that water logging leads to the decrease of gas balance between leaves and atmosphere. Jafari *et al*. (2008) remarked that water logging in halophytes causes the water deficiency in roots and the reduction of root growth and photosynthesis that leads to the plant death. The results of plant density showed that in site1 and 2, number of shrubs was 625 and 700 per ha, respectively. Azarnivand and Zare Chahuoki (2008) remarked that for monoculture, number of *Atriplex canescens* was 500 to 1000 shrub/ha. So, in present study region based on habitat condition, plant density was lower. Likewise, Agha *et al*. (2009) represented that fresh root and dry weights of *Atriplex stocksii* were higher at low shrub density and low salinity, however under high salinity, density had no effect. The site2 was near to road of local livestock traffic of Hossein Abad village this site was grazed by livestock. Cibils *et al*. (2003) expressed that shrub fecundity is critical to long term persistence of Fourwing saltbush (*Atriplex canescens*) populations at their research site in Colorado. They studied the impact of cattle browsing on fecundity-related variables in Furrow saltbush. Protection from cattle browsing was significantly associated with floral phenotype shifts toward femaleness occurring mostly in monecious shrubs (1% and 13% of grazed and protected shrubs, respectively).

The results showed that shrubs of sites 1 and 2 were irrigated during 5 and 1 periods, respectively. It is likely that this is one of main reasons of improper growth of the shrubs after establishment of seedlings in site 2. Nadjafi Shabankareh (2001) reported that no irrigation after planting in spite of proper establishment of species in first year cultivation was dryness and incompatible factors for *Atriplex* spp. in Sarkhoun Banbar Abbas region. Moreover, Watson *et al*. (1995) remarked that supplementary irrigation for seedling establishment is necessary. Hayati (2002) represented that irrigation practice in planting after seedling establishment is not performed and it means that plants can absorb water from soil not irrigation. Simpson (1992) expressed that cultivation of permanent *Atriplex* spp. in habitats with high precipitation was performed in areas in which irrigation is possible. In general, the results showed that some factors, could affected in low freshness (site 2). Although it seems that because of multiplicity of the effective soil characteristics, soil has more effect on the freshness of shrubs. Among the effective soil characteristics, both the physical parameters (soil texture) and chemical

parameters (lime, pH and others) affected the freshness. Moreover, it is likely that management parameters including grazing and irrigation and environmental parameters including topography and water logging have an important role in the improper growth of *Atriplex* shrubs.

References

Agha, F., Gul, B., Khan, M. A., 2009. Seasonal variation in productivity of *Atriplex stocksii* from a coastal marsh along the Arabian Sea coast. Pak. J. Bot. **41(3):** 1053-1068.

Ahmadi Roknabadi, M. R., 1998. Study of effective factors on dried *Atriplex lentiformis* plants in Chah Afzal (Ardakan- Yazd), MSc Thesis of Range Management. Tarbiat Modarres university. 97p. (In Persian).

Alizaheh, A., 1995. Relationship of water and soil and plant, Mashhad press. 735p. (In Persian).

Anonymous. 2005. Natural Resource office of Shahriyar Range management project of Hossein Abad Hapashloo Region.

Aouissat, M., Walker, D. J., Belkhodja, M., Fares, S., Correal, E., 2009. Freezing tolerance in Algerian population of *Atriplex halimus* and *Atriplex canescens*, *Spanish Jour. Agricultural Research*. **7(3):** 672- 679.

Armstrong, W. 1979. Aeration in higher plants, J. Advances in Botanical Research., **7:** 225- 332.

Azarnivand, H., Zare Chahouki, M. A. 2008. Range Improvement. University of Tehran Press. 354 p. (In Persian).

Cibils A. F., Swift, D.M., Hart, R. H., 2003. Changes in shrub fecundity in fourwing saltbush browsed by cattle. *Jour. Range Mana*. **56:** 39-46.

Ekhtesasi, M. R., Barzegari, G. R. 1993. Introduction on ecological requirements of *Atriplex canescens*, *Atriplex lentiformis* and *Atriplex halimus* for establishment of artificial pastures and economic production in Iran, Proceeding of the first national range & range management seminar in Iran. Pp. 447-459. (In Persian).

Eskandari, Z. 1995. Study of pedologic factors on growth and establishment of *Atriplex* in Habib Abad-E- Esfahan, Pajouhesh Sazandegi. **29:** 16-21. (In Persian).

Gibbs, J., Greenway, H. 2003. Mechanisms of anoxia tolerance in plants. I. Growth, survival and anaerobic catabolism, *Jour. Functional Plant Biology*. **30:** 1-47.

Hayati, J., 2002. Investigation and evaluation implement of de-desertification project in Lamerd, MSc Thesis of Range Management, University of Tehran. 111p. (In Persian).

Heidari Sharif Abad, H. 2001. Plants and Salinity, Research Institute of Forest and Rangelands. 199p. (In Persian).

Henteh, A., 1990. Study of planting methods of *Atriplex canescens* in summary range in Mohammad Lou-E-Karaj, MSc Thesis of Range Management, University of Tehran. 142p.

Hopkins, D. L., Nicholson, A., 1999. Halophytes as a wether lambs grazed on saltbush (*A.numularia*) plus supplements or Lucerne (*Medicago sativa*). *Meat Sci.* **51:** 91-95.

Jafari Haghighi, M. 2003. Soil analysis methods. Nedaye Zoha Press. 236p. (In Persian).

Jafari, M., 1994. Formation of salinity and Halophytes, Research Institute of Forest and Rangelands. (In Persian).

Jafari, M., 2006. Reclamation of Arid lands. University of Tehran Press. 247p. (In Persian).

Jafari, M., Javadi, M. R., Hamedanian, F., Ghorbani, M. 2008. Salt land Pastures,

University of Tehran Press. 269p. (In Persian).

Jafari, M., Sarmadian, F. 2003. Fundamental of Soil Science and Soil Taxonomy, University of Tehran Press. 788p. (In Persian).

Khan, M. A., Ungar, I. A., Showalter, A.M. 2000. Effects of salinity on growth, water relations and ion accumulation of the subtropical perennial halophyte, *Atriplex griffithii* var. stocksii. Ann. Bot. **85:** 225-232.

Laeuchi, A., Luettge, U. 2002. Salinity, Kluwer Academic Publishers, Dordrecht, Neth., p. 341.

Moghimi, J., 2005. Introduction some of important rangeland species for improvement of Iranian rangelands, Arvan press, Tehran, Iran. 669p (In Persian).

Moor, G., Sanford, P., Wiley, P. 2006. Perennial pastures for Western Australia, Department of Agriculture and Food Western Australia. Bulletin 4690, Perth.

Najafi Shabankare, K., 2001. Comparing of compatibility *Atriplex* spp. And effect of irrigation period on their establishment. *Jour. Pajouhesh & Sazandegi*. **51:** 36-40 (In Persian).

Naseri, A. 1997. Study of mutual effect of *Atriplex canescens* and environment in Kerman province, MSc Thesis of Range Management, University of Tehran., 76p.

Nord, E., Hartless, P. F & Nettleton,W.D.1971. Effects of several factors on saltbush stablishment in California. *Jour. range manag*. **24:** 216-222.

Ogle, D. G., John, L. St. 2001. Fourwing Saltbush, *Atriplex canescens* (Pursh) Nutt. USDA NRCS Idaho State Office & Aberdeen Plant Materials Center.

Peimani Fard, B., Malekpour, B., Faezipour, M. 1994. Introduction of important rangeland plants and guidance of their planting for different regions of Iran, Research Institute of Forest and Rangelands. **24:** 79p. (In Persian).

Petersen, J. L., Ueckert, D. N. 2005. Fourwing saltbush seed yield and quality: irrigation, fertilization and ecotype effects, *Jour. Rangeland Ecol Manage*. **58:** 299-307.

Ramos, J., Lopez, M. J., Benlloch, M., (2004). Effect of NaCl and KCl salts on the growth and solute accumulation of the halophyte *Atriplex nummularia*. *Jour. Plant and Soil*., 259, 163–168.

Sadeghi, N., 1991. *Atriplex canescens*: growth and establishment, Quarterly Periodical of Agriculture and Animal, **10:** 123-130. (In Persian).

Simpson, I., 1992. Rangeland management in western New South Wales. Regional Advisory leader, Goulburn. Pp. 144.

Sperry, J. S. and U. G. Hacke., 2002. Desert shrub water relations with respect to soil characteristics and plant functional type. *Jour. Functional Ecology* **16:** 367–378.

Uemura M., Warren G., Steponkus P.L. 2003. Freezing susceptibility in the sfr4 mutant of Arabidopsis is due to low sugar content and is manifested by loss of osmotic responsiveness. Plant Physiol., **131:** 1800-1807.

Voesenek, L., Colmer, T. D. Pierik, R. Millenaar F. F., Peeters, A. J. M. 2006. How plants cope with complete submergence, The New Physiologist. **170:** 213-226.

Walker D. J., Romero P., De Hoyosa., Correal, E., 2008. Seasonal changes in cold tolerance, water relations and accumulation of cations and compatible solutes in *Atriplex halimus* L. *Env Exp Bot.* **64:** 217-224.

Watson M. E., Raundy B. A., Smilh S.

E., Munda B., 1995. Water requirements for establishing native *Atriplex* species during summer in southern Arizona. General Technical Report. International Research Station. USDA, Forest Service. **315:** 119- 125.

Zandi Esfahan, E., 2005. Relationship of edaphic factors with growth of *Haloxylon* (Case study: Sagzi Esfahan), MSc Thesis of Range Management, University of Tehran. 108p. (In Persian).

Zare chahoki, M. A., 2001. Study of relationships between some species with some soil physico-chemical characteristics in Poshtkooh-e-Yazd, MSc Thesis of Range Management, University of Tehran. 110 p. (In Persian).