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Study of the relationship between soil properties and natural regeneration of *Haloxylon aphyllum* in planted areas of Ardestan

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Abstract

Present research was conducted with the aim of determination of significant effect of soil properties on natural regeneration of *Haloxylon aphyllum* and correlation coefficient and linear relation between soil variables and natural regeneration of *Haloxylon aphyllum*. Firstly, geomorphologic units were prepared in the areas under cultivation of *Haloxylon aphyllum* in Ardestan. Two cultivated lands in Heidarabad and, Shamsabad were selected for sampling. Then, random systematic sampling was carried out in each of these lands. For this propuse, Thirty quadrates to size 10 × 10 m were for sampling and offsprings resulted from regeneretion of planted *Haloxylon aphyllum* plants were counted and, further, samples were taken form the soil in some locations for me measurements on physical variables (clay, sand and silt percentages)and chemical variables (Electrical conductivity, acidity, organic carbon, nitrogen and exchangeable Sodium) . Results form such studies indicated that soil natural regeneration is significantly different in two regions of Heidarabad and Shamsabad at 1% level. Among soil physical and chemical variables, silt percentage had the highest effect compared to other variables, and also, physical variable were appeared to be effective factors on natural regeneration. There was a linear relation and negative correlation between the percentages of clay, silt, Electrical conductivity (EC), organic carbon, nitrogen and exchangeable Sodium (Na) with natural regeneration. Besides, results indicated the existence of a stright linear relation between the percentage of sand and the level of natural regeneration.

Keywords: Haloxylon aphyllum; Regeneration; Soil chemistry; Soil physics; Ardestan

1. Introduction

Haloxylon aphyllum belong to chenopodiaceae family is a resistant species in lands and arid climates. As it is cultivated in last areas and it has a high natural regeneration in companson to other desert species, and identification of the impact of relationship between soil physical and chemical variables on natural regeneration of this species can help to enhance plans in arid lands in the country.

Keeping in view the problem that destruction of environment specially in forests, decreasing the area and regeneration of forests due to some forest management schemes, are bio alerts and very important for man, so, the most important factor in the maintenance of forests, namely natural regeneration, needs to be studied.

In preliminary observations made in the areas under cultivation of *Haloxylon aphyllum* in Ardestan districts, it was found that this species has been cultivated in vast areas and expert have used this plant in various types of soils in the area regarding the fact that it has tolerance to environment harsh conditions and can prevent sand run off in deserts. Meanwhile, as the species has a high natural regeneration, it appeared as a motivative to investigate any possible relationship between natural

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regeneration of *Haloxylon aphyllum* with soil properties.

Javanshir et al. (1989), studied variations in concentrations of Ec, Esp and pH in soil where *Haloxylon aphyllum* is cultivated. Jahanbazi (1997-99) investigated the effect of a 12-year ban of usage on regeneration capacity, soil enhancement, and improvement of soil vegetation in Ardal districts of Chahar mahal va Bakhtiari Province. By taking samples of soil both inside and outside the baned area, he concluded that differences in some soil parameters such as soil particles persistency index, organic matter, and soil phosphorus content are significant between soil inside baned area and those of the soil outside that area.

Fayaz and Heidari Sharifabad (1998) in their studies on ecological characteristics province, reported low, medium and density of the plant, respectively. According to them, soils in 3 regions had sandy structure with resembling pH and Ec. Momeni moghaddam (2002) studied biodiversity, regeneration status and bulk trees in Koppeh dagh plains in Shirvan destricts. Tewary (1998) discussed the role of forests in desert management for arid areas in India. Handy and Bidoc (1998) stated that *Haloxylon* has the highest density and frequency among desert prenial plants. Current study was under taken to investigate and identity the coefficient of correlation between soil variables with natural regeneration of *Haloxylon aphyllum*. Babayov and kharin(2002) in searching ways for creating constant covering and fixing flowing sands in previous soviet unions desert concluded that vegetation kinds like *Haloxylon spp*, *Calligonum spp*, *Ephedera spp* causes development biomass of the earth in these areas. Brown(2003) studed factors maintaining plant diversity in degraded areas of northern North Kuwait That can be in natural Bushes *Haloxylon spp*. Dimeyeva (2003) experimental for improving covering destruction rangelands in western suburbs in Aralesk city. He concluded that cultivating plants like *Haloxylon spp*, *Tamarix spp* and local half bushes causes increasing plant covering in these areas. Javanshir et al (1989) in searching ecological of *Haloxylon spp*, *tamarix spp* and *Papulus spp* explained that dispersion *Haloxylon spp* as natural case in very limited and frequently as planted in sand soils or clays in mild deserts of Iran .

2. Materials and methods

In order to study the relation between natural regeneration of *Haloxylon aphyllum* with soil physical and chemical properties in *Haloxylon* cultivated areas of Ardestan districts.

Then, field surveys were carried out within the work quadrats in Heidarabad and Shamsabad in Ardestan districts to take experimental samples. These two areas were selected with regard to following criteria:

1- To be more than 20 years old.
2- To be close together as much as possible.
3- To have different geomorphological appearance.
4- *Haloxylon* cultivations not located in the area with cutting and deforestations.
5- These two areas should not have noticeable differences in terms of climatic conditions, slope and hight.

In each of 2 areas, 5 locations were determined, using random-systematic method in such a way that first location was selected as random and other 4 locations in a systematic way, so that the first location was located in the center and 4 other locations were selected in a way to be on two lines crossing each other and each of 4 location was 100m a way from the central location. Later, the number of offspring resulted from natural regeneration was counted within each quadrat.

Data collection was repeated 3 times in each experimental unit, so in each area, 15 quadrats were used.

Taking Soil Samples

To conduct studies on soil, samplings were carried our at 5 points in two opposite directions within each quadrate.

For this purpose, profiles as deep as 150 Cm were prepared in the soil and samples were taken from 0 – 50 , 50 – 100 and 100 – 150 Cm depths. Physical and chemical variables were studied on taken samples after wards. As physical variables, percentages of sand, silt and clay were measured and also as chemical indices, Electrical conductivity. Acidity (pH), organic carbon, nitrogen, and percentage of exchangeable Sodium were investigated.

Specifications of studied areas

1- Shamsabad-e- mughar

The area is located in the north of the village Shamsabad with geographical latitude of 52˚ , 11′ , 37″ to 52˚ , 13′ , 19″ E and longitude of 33˚ , 37′, 7″ to 33˚ , 38′ , 6″ N. The area has a hight of 960m from sea level and a slope less than 1% with sand-loamy soil texture.

Due to lack of meteorology station at the area, there is no recorded meteorological data available for that specific location, so, such, required data were calculated, using the data obtained from neighboring areas which indicated average annual temperature equal to 19.5 ˚C and annual evaporation equal to 3349 mm.

2. Heidarabad

This area is located in west of the village Heidarabad and North of Mughar with geographical latitude of 52˚, 10′, 51″ to 52˚, 12′, 11″ and longitude of 33˚,34′,57″ to 33˚,36′,12″ N. It has a hight equal to 980 m from sea level with sand-loamy soil. Due to lack of meteorology station at the area, there was no recorded meteorological data available and such data were calculated, using data obtained from neighboring areas witch revealed to be average annual temperature equal to 19.2 ˚C and annual evaporation equal to 3325 mm.

Statistical procedures

Deploying t- test, at the first the significance of difference between natural regeneration in two areas was tested. Then, linear relations of individual soil variables with the level of regeneration were studied. To final out the correlation, step by step method was followed, using MINITAB software, where regeneration was considered as dependent and other soil properties were considered as independent variables.

3. Results

Results obtained from t- test, are presented in table 1. According to these results, there is a statistically significant difference between two areas of Shamsabad and Heidarabad at 0.01 which indicates that soil properties have a significant impact on natural regeneration of *Haloxylon aphyllum*.

Table 1. t- test results of natural regeneration in two areas of Shamsabad and Heidarabad

Area	No.	Mean	SE	Sig.
Shamabad	22.866	10.246	28	0.001
Heidarabad	12.733	4.216		

Results indicated that regeneration is higher (22.866%) in Shamsabad with sand – loamy soil when compared with Heidarabad with clay – loamy soil texture and lower regeneration (12.733%).

So, according to these results, natural regeneration of *Haloxylon aphyllum* in soils with light structure is higher than in soils with heavy structure.

The results indicated the existence of a negative correlation between natural regeneration of *Haloxylon aphyllum* and light or heavy soil structure. In other words, increasing soil lightness makes it more productive and increasing its heaviness, results in less natural regeneration.

Results from the regression analysis between individual physical properties revealed that there is a significant relationship at 0.1% between the percentages of sand, silt and clay with natural regeneration of *Haloxylon aphyllum* (Table 2).

Table 2. Analysis of linear regression between soil physical variables and natural regeneration

Model		df	SS	MS	F	Sig.
sand%	Regression	1	802.54	793.129	13.0967	0.001
	Residual	28	1686.26	60.56		
	Total	29	2488.8			
clay%	Regression	1	689.7	689.698	10.734	0.003
	Residual	28	1799.1	64.254		
	Total	29	2488.8			
silt%	Regression	1	853.85	853.85	14.263	0.001
	Residual	28	1634.95	58.391		
	Total	29	2488.8			

As it can be seen in figure 1, linear regression between sand percentage and soil regeneration shows coefficient of correlation to be equal to 52.6%. Consequently, there is an increase in natural regeneration when sand percentage increases and below equation can be suggested.

Natural regeneration = 3.33247 + 0.231481 × sand%

Linear relation between regeneration and clay percentage shows coefficient of correlation equal to 52.6%. As a result increasing the soil clay percentage, will result in reduction of

natural regeneration and below equation can be suggested.

Natural regeneration = 25.5644 – 0.363956 × clay%

Linear relation between regeneration and clay percentage shows coefficient of correlation equal to 58.6% that means natural regeneration has decreased when the percentage of silt has increased and, below equation can be suggested.

Natural regeneration = 26.5811 – 0.543162 × silt%

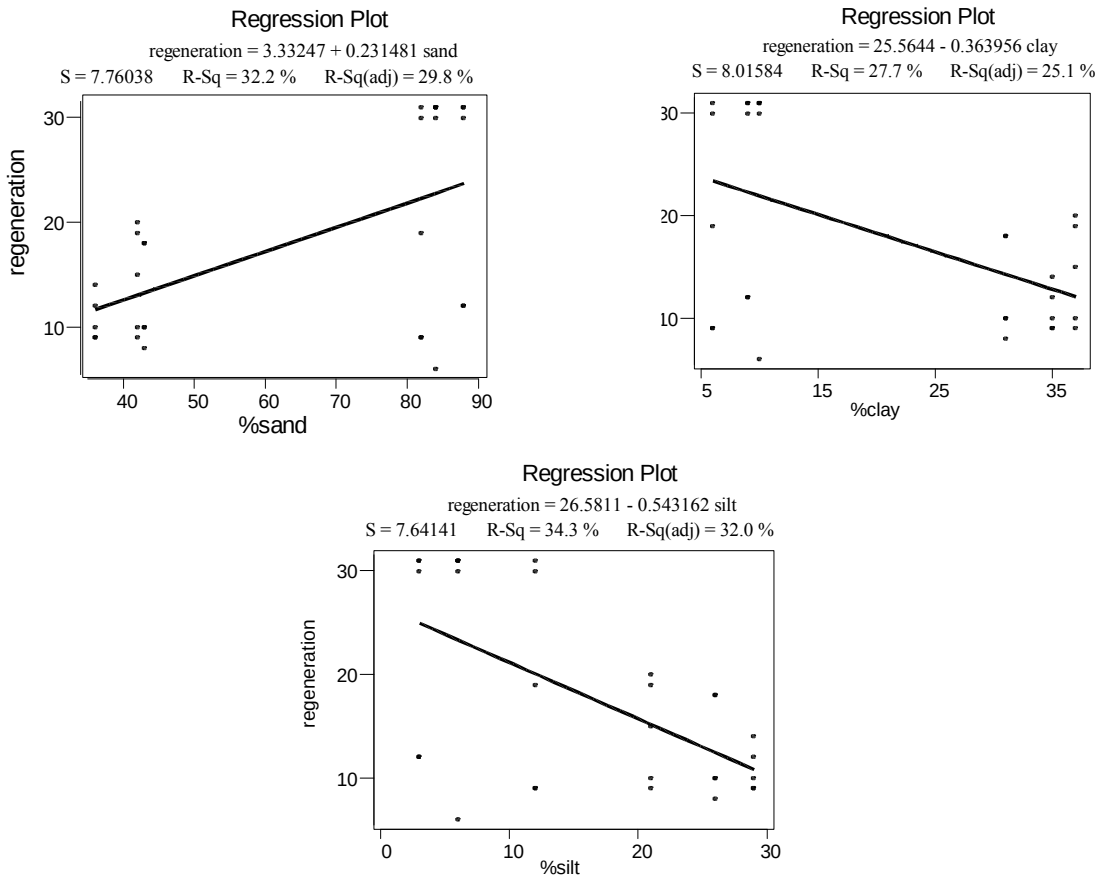

Fig. 1. Regressional relation regeneration and percentages of sand%, clay% and silt%

Investigation on the relation between natural regeneration and its chemical properties

Results obtained from regressional analysis between the level of productivity and chemical properties indicated that there is a significant relationship between regeneration and factors such as Electrical conductivity, carbon, nitrogen, and Sodium percentages at 1% level.

Further, the result shows lack of significant relationship between soil acidity and natural regeneration (table 3).

In this regard, linear relation between these variables and natural regeneration were studied

According to figure 2, regressional relation between Electrical conductivity (EC) and natural regeneration shows that coefficient of correlation is 52.8%. Consequently, increasing the EC, productivity increases significantly and below equation can be suggested:

Natural regeneration = 25.8191 – 0.925279 × Ec

Regressional relation between organic carbon percentage and natural regeneration showed a coefficient of correlation to be equal to 55.6%, and increasing carbon percentage result in reduction of regeneration and blow equation can be suggested:

Natural regeneration = 31.171 – 29.8238 × carbon %

Regressional relation between soil nitrogen percentage and natural regeneration showed a coefficient of correlation to be equal to 56.5%, where increasing nitrogen content results in significant reduction in natural regeneration and below equation can be suggested: one by one.

Table 3. Result analysis of linear regression between soil chemical variable sand regeneration

Model		df	SS	MS	F	Sig.
Ec	Regression	1	693.96	693.959	10.8259	0.003
	Residual	28	1794.84	64.101		
	Total	29	2488.8			
pH	Regression	1	26.13	26.1333	0.29713	0.59
	Residual	28	2462.67	87.9524		
	Total	29	2488.8			
Organic carbon	Regression	1	759.75	769.752	12.5378	0.001
	Residual	28	1719.05	61.395		
	Total	29	2488.8			
nitrogen%	Regression	1	793.13	793.129	13.0967	0.001
	Residual	28	1695.67	60.56		
	Total	29	2488.8			

Natural regeneration = 34.0118 – 374.118 × organic nitrogen

Regressional relation between soil exchangeable Sodium (Na) and natural regeneration revealed coefficient of correlation equal to 48.2% and as a result increasing the exchangeable Na results in significant reduction in natural regeneration and below equation can be suggested:

Natural regeneration = 26.9954 – 0.698381 × ESP %

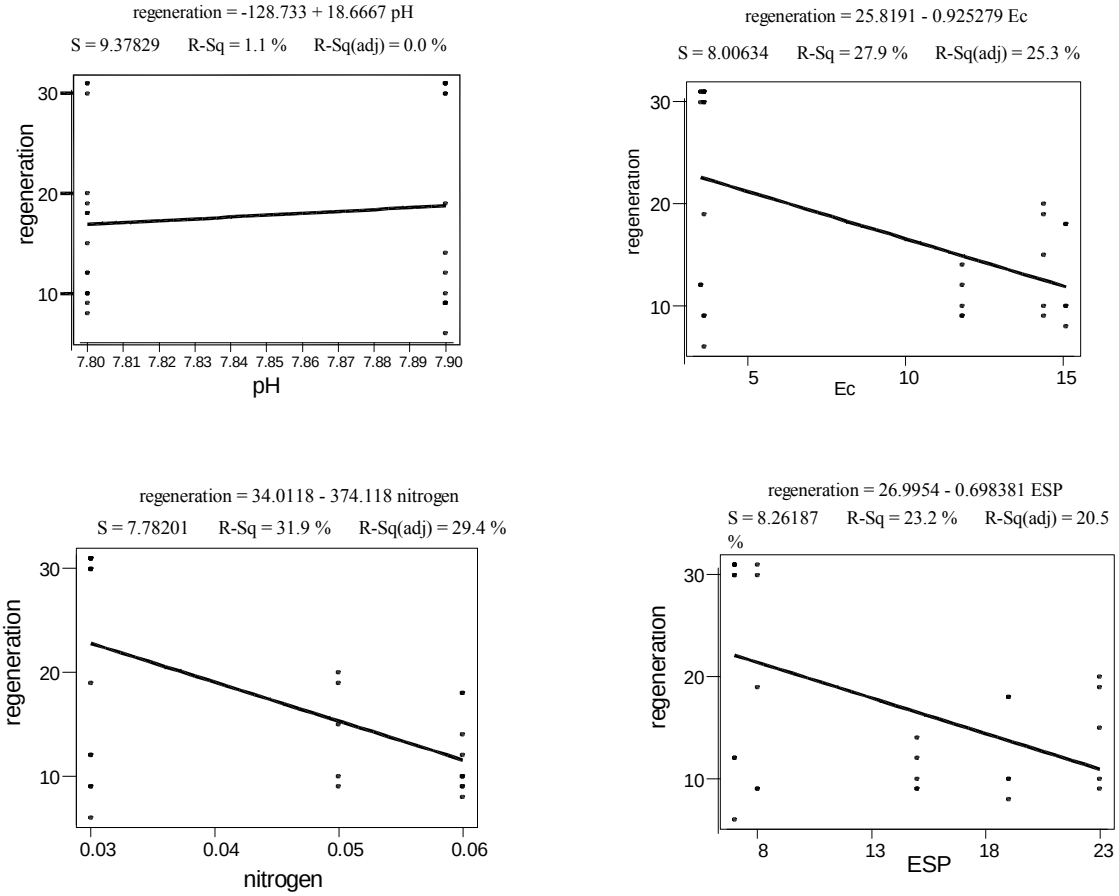

Fig. 2. Regressional relationship between regeneration with EC, C%, ESP and N

4. Discussion and conclusion

Results obtained from the analysis of natural regeneration indicated that two areas of Shamsabad and Heidarabad are significantly different at 1% level and on the basis of these results, it can be concluded that whatever the soil lightness increases, it would be more productive. In this regard, Hangafarin (1927) had justly understood that *Haloxylon aphyllum* trees can grow vigorously in deep sandy light soils as well as on sandy hills, but it's growth is

reduced in heavy clay soils. Bakhshi (2005) inspected study on the effect Haloxylon plantation on understorey coverage in area Aardertan explained that there are more plant covering in comparing with reference area. Also soil in this area has effect on Haloxylon plant.

Sabeti (1976) had mentioned deserts and saline sandy stepps as the suitable habitats of *Haloxylon*. Aharanjani (1977) stated that light soil is favorable for Haloxylon aphyllum and it grows up particularly on sandy hills their margins.

Results indicated that there is a reverse significant linear relation between natural regeneration with the percentages of clay, silt, organic carbon, nitrogen, exchangeable Sodium and Electrical conductivity and one can be conclude that natural regeneration reduces with increasing of any of any of these variables.

Mokhtari (2002) The relationship between plant age and selected soil properties with the growth of *Haloxylon persicum* in Abozeidabad region , Kashan resulted that physical properties of soil like texture, and chemical properties ike salinity and alkaline have the most effect on plant parameters in *Haloxylon spp* plant. Ajmal khan and ungar (1996) studied the impact of salinity (EC) and temperature on the germination of *Haloxylon* and concluded that highest percentage of germination happens with distilled water, and that *Haloxylon* seeds can still germinate with saline water but percentage of germination reduces as salinity increases and a significant straight linear relation exists between the percentage of sand and natural regeneration. Amani and Parvizi (1996) inspections on natural regeneration in Kashan observated that understorey coverage the young masses of *Haloxylon spp* plant , there are natural regeneration. Moqtader (2001) A survey plants ecological to used for fixing flowing sands in Kerman district, various stages on the effect soil parameters in dispersion for this plants determination to used statistical laws.

MINITAB software was used for inestigation on the most effects of soil physical and chemical variables on natural regeneration. In this method, natural regeneration was considered as dependent variables and other properties of soil were considered as independent variables. Results revealed that the silt percentage has the highest significant difference (at 5%) level among all soil chemical and physical variables. So it can be concluded that soil percentage has the highest impact on the natural regeneration of *Haloxylon spp*.

Among the soil physical properties, silt percentage and among the chemical properties, Electrical conductivity had the highest impact on natural regeneration and according to obtaines results physical properties has more importamt than chemical properties.

Arabzadeh (1995) in his study on the status of *Haloxylon* cultivations in Kerman stated that in fixed rainfall and density, growth and development of *Haloxylon* follows the soil texture conditions and finally the effect of soil variables on natural regeneration can be ranked as following: Silt % > sand % > clay % > EC > Acidity > carbon% > nitrogen % > exchangeable Sodium (Na) %

References

Arabzadeh, N .1995. A Study on the effect of Different procedures of Trim for reluvariances & obtaining wood of The cultivating of *Haloxylon* In The Surrounding of Kerman, Master thesis of forestation, Gorgan Universityof Agricultural Sciences and Natural Resources, 153 pp.

Amani, M and A, Parvizi. 1996. Haloxylon spp, Research organization in forest and range lands, 118 pp.

Aharanjani, B. 1997.The cultivation of *Haloxylon* in Iran, Jornal of Sonboleh, 93:11-17.

Ajmal Khan. M and Irwin A. ungar. 1996. Influence of salinity and Temperature on the Germiation of *Haloxylon* recurvum Bunge ex. Boiss. Annals of Botany. 78(5): 547- 551.

Babaev.A,N.Kharin.2002.Combating Desertification in USSR.Arid zone Foresty.Unasilva.168:128-134.

Brown. G. 2003. Factors maintaining plant diversity in degraded areas of northern Kuwait . Journal of Arid Environments. 54(1) : 183-194 .

Bakhshi, J. 2005, A Study on the Effect *Haloxylon* Plantation on Understories Vegetation and Soil Properties for Arid zon Management propose in Ardestan , Isfahan, Master thesis Proposal, Gorgan Univercity of Agricultural Sciences and Natural Resources, 98 pp.

Dimeyeva. L. 2003. Restoration of the Aral sea coastal rangelands. African Journal of Range & forage science. 20(2): 157- 175.

Fayaz, M and Heidari sharif abad, H. 1998. The study on Some Ecological characteristices of *Haloxylon persicum* on desert plain of Sistan and Baluchestan. Journal of Pajouhesh & Sazandegi, 39:42-46.

Hang Afarin, H.1972. *Haloxylon*, Forests and Rangeland Organization of Country, 40pp.

Heneidy. s.z, L.M. Bidak. 1998. Diversity of the Wadi vegetation in Matrouh. Region, Egypt. Union Arab Biol. 6(B): 13-28.

Jahanbazi Goojani, H. 2002. investigated the effect of a 12-year ban of usage on regeneration capacity, soil enhancement, and improvement of soil vegetation in Ardal districts of Chahar mahal va Bakhtiari Province, Chahar mahal va Bakhtiari Province Natural Research & Agricultural Research Centcenter. 142 pp.

Javanshir, K. Dastmalchi, H and Emarati, A. 2001.The Ecological Study on *Haloxylon*, *Pennisetum* and *Tamarix* Spacies in Iran deserts, A collection of The second National Congress Essays on Removing Desert And Different Procedures of Doing It, pp 1-12.

Momeni Moghaddam, T. 2002. The study on Ecological & Forestation characteristics of *Haloxylon* of Natural

Habitat of Juniper within The Hillsides of Koppeh Dagh Shirvan, Master thesis of forestation, University of Tarbiat Modarres, 145pp.

Mokhtari, K. 2002. The relationship between plant age and selected soil properties with the growth of haloxylon persicum in Abozeidabad region , Kashan. Master thesis Proposal, University of Isfahan Industrial, 90pp. *81*

Moqtader, H,R. 2001. A survey plants ecological to used for fixing flowing sands in Kerman district, Industrial and scientific researching organization of Iran, Kerman, 204pp.

Sabeti, H. 1976. Forests, Trees and Shrubes of Iran, Agricultural Researches & Natural Resources, Agricultural Ministry and natural Resurses Organiztion, 81 pp.

Tewari.J.C.1998.Plantation Foresty and Succes of Various Tree Species in Arid Tropices. http: \\www.aoi.com.auacotanc .

Zafariqbal.M, M.shafia. 1996 .Plant communities on the sandy Areas of Karachi university Campus. Journal of Islamic Academy of sciences.9 (3): 1-9.