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Research Article

Studying the Relationship Between the Growth of (Gaz) Tamarix Apylla l. Shrubs with the Physico-Chemical and Microbiological Properties of Soil and Analyzing the Vegetation Cover of Tamarix Forests in Iran Desert

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Abstract

Our goal in this research is to investigate soil changes and evolution in the tamarix growing bed and determine the amount of tamarix mass for designing a tree windbreak and controlling wind erosion at Semnan University. We also investigate the effects of drought and salinity, determine the appropriate method of tamarix planting, and investigate the ecology of tamarix forest in the deserts of Semnan Province.

In general, the results of this study showed that the biomass and microbial activity of the soil increased under the canopy, which indicates the importance of the tamarix shrub in the study area. For example, the highest microbial biomass carbon was observed under the canopy compared to the open space; therefore, in order to increase the quality and health of the soil and combat soil erosion, the restoration and protection of tamarisx shrubs in the study area is necessary. For this purpose, the General Directorate of Natural Resources and Watershed Management of Semnan Province and non-governmental organizations can participate in the cultivation and restoration of this native species and other native species. Also, tamarisk shrubs or tamarix are very suitable for preventing wind erosion at Semnan University

We Considering the positive impact of the tamarix shrub on the soils of the study area by increasing organic matter in the soil, which results in improving the nutrient cycle and encouraging microbial activity and biomass, the preservation and restoration of this valuable shrub is vital. This is because one of the most important roles of the soil microbial population, especially bacteria, is the decomposition of plant residues, resulting in the mineralization of organic matter, the release of essential nutrients, and an increase in soil fertility.

Key Words: Semnan; microbial biomass; organic carbon; soil erosion; tamarix

Introduction

The tamarix tree is a tree or shrub with small, needle-shaped, and scale-like leaves. This plant grows mostly in dry places, near salty waters, in saline soils, and along rivers. The tamarix plant has different types. Some of them, like the tamarix Shahi, can be seen in different places. The tamarix plant is very resistant and grows in any desert climate. This plant grows even in high and mountainous areas.

The most suitable place for its growth and multiplication is hot and dry desert areas and salty soils. This plant is very resistant to changes in air temperature. In addition, the most suitable soil for the growth of the Gaz plant is loamy soil. Near the sea, coastal sands, and around rivers are suitable places for the growth of the Gaz plant. This plant also grows well next to streams, salty and sandy lands, wet ditches, and river beds.

Introduction to the tamarix tree and its various uses

Scientific name: Tamarix) from the Tamarisk family. Tamarisk is a salt-loving tree native to the arid regions of Eurasia and Africa and includes 55 species, of which about 35 species are found in the Middle East and 23 species are found in Iran Table 2.

About 23 species of tamarisk trees grow in Iran, the most famous of which are:

• Shahgaz, the most robust and oldest species, sometimes exceeding 15 meters.

• Korgaz (tamarix Shahi), a relatively tall but narrower type than Shahgaz

• Shorgaz (tamarix Sonbele Bland) grows on the edges of salty rivers and ravines.

• Yalqon with the scientific name Tamarix palazii, which is found around Karaj.

• Tamarix tetrander, which grows around Shiraz.

• Temis, which is seen in the northern forests of Iran.

Shahgaz, a special and famous species of Gaz in southern Iran, is an ancient tree. This tree has a long life span because its roots reach the surface water of the earth. It is said that in some tropical regions it has lived for more than a thousand years. The maximum height of this tree often reaches 10 to 15 meters. tamarix is a tree with narrow, sharp, and tightly packed leaves and a salty taste that is not even fed to animals.

Distribution range of the tamarix tree

In Iran, it grows mostly in saline lands and arid and semi-arid areas, and on the road between Tehran city and Isfahan, Kashan, Yazd, Shiraz, Kerman and Shahdad, to Zahedan and Bandar Abbas, as well as in Gotvand, Khuzestan, Bazfat, the Gav Khouni Swamp, and also in the northern regions of Khorasan from Atrak river and Bojnourd and Shirvan to Jajrud and Bahram, and the saline lands south of Karaj and Shahdasht, and also on the edge of Lake Urmia, such as Sharafkhaneh. Its minimum height in Bahram is 1100 meters and its maximum is 2200 meters on Mount Siraj in Kerman.

Industrial uses of the tree

The tamarix tree has many benefits and is used in industrial products, construction, and also has high therapeutic properties. Some of them are as follows: It can be used in supplementary paste for mixing with high-quality pastes. It is possible to use Gaz wood chips mixed with other wood chips or pure in the production of particleboard.

The thick and long trunks of tamarix are used for use in the roofs of stables and pens (especially in mountainous areas), scaffolding for hair trees, at the entrances of rooms and doors of houses, and their purchase and sale is used among rural residents. The use of Gaz is suitable for industrial uses, and in the cultivation of forest stands with Gaz, it is also possible to improve the quality of wood. Similarly, the use of Gaz wood chips in the production of particleboard, whether mixed with other species or pure, seems appropriate if its crushing is economical on a commercial production scale.

Medicinal uses of the tamarix tree (keyrodin 2009)

1. Its nature is warm and dry.

2. To relieve chronic coughs, mix the bark of this plant with cinnamon and drink it as a brew.

3. To relieve stomach pain due to cold, brew 4 grams of the bark of the plant and sweeten it with sugar and drink it.

4. Gargling the infusion of this plant is beneficial for the teeth.

5. To relieve toothache, pound the bark of the gaz tree, mix it with vinegar and gargle.

6. Gargling the pounded bark of this plant with vinegar eliminates the smell of stench and pus from the gums.

7. To eliminate bad breath, pound the bark of this plant softly, dip a wick in it and place it in the nose.

8. To treat hemorrhoids, mix the bark of this tree with cinnamon and drink it as a brew.

9. The infusion of the bark of this tree with cinnamon eliminates excessive sperm secretion.

10. Use the infusion of this plant to remove bloody mucus from the chest.

11. The bark of this tree is harmful to the spleen and liver and should be consumed with chewing gum.

12. To treat diarrhea, brew 8 grams of the bark of this tree in 300 cc of boiling water and drink three glasses a day.

13. Pregnant women should avoid eating the gaz plant.

14. A decoction of the bark of this plant is useful for controlling jaundice.

The gaz tree can also have other uses and capabilities, for example, in areas that are now devoid of life and property, the large presence of this tree can reduce the size of deserts and, in a sense, eliminate desertification. The gaz tree is also an effective tool in stabilizing and keeping the soil together and preventing their transfer.

In Iran, it grows mostly in saline lands and arid and semi-arid areas, and on the road between Tehran and Isfahan, Kashan, Yazd, Shiraz, Kerman and Shahdad, to Zahedan and Bandar Abbas, as well as in Gotvand, Khuzestan, Bazfat, the Gav Khouni Swamp, and also in the northern regions of Khorasan from Atrak and Bojnourd and Shirvan to Jajrud and Bahram, and the saline lands south of Karaj and Shahdasht, and also on the edge of Lake Urmia, such as Sharafkhaneh. Its minimum altitude in Bahram is 1100 meters and its maximum is 2200 meters on Mount Siraj, Kerman.

Background and Objective: Gaz shrub, as one of the most important plants in arid and semi-arid areas, can have a great impact on the activity of the soil microbial community and in this way, by making the nutrient cycle more efficient, it can increase soil fertility. Also, this shrub, as a natural and adaptive vegetation cover in the study area, plays an important role in soil protection and controlling wind erosion. The aim of this study was to investigate the effect of natural azalea shrubs on the microbial activities and biomass of desert soils in the Farrokh Abad region of Dehloran County, Ilam Province.

Materials and Methods: Plan experimental show in figure 1 and 2. All soil microbial activity measurement by Asgharzadeh, methods 2010 . In order to investigate the biological properties of the soil, sampling of the surface soil (0-5 cm depth) under the azalea shrub canopy and the open space was carried out using a systematic random method. The total number of soil samples was 62, of which 31 samples were from under the canopy and 31 samples were outside the azalea shrub canopy. After collecting the soil samples and transferring them to the laboratory, soil biological analyses including microbial biomass carbon and nitrogen,(Nelson 1986). basal respiration, substrate-induced respiration, microbial yield, metabolic yield, and soil organic carbon were performed on the samples. Statistical analyses such as one-way analysis of variance and correlation coefficient were performed with SAS 9.1 software. The t-test was used to compare the average of the biological properties of the soil. Soil microbial respiration and biomass analysis bt Anderson et al. method 1982 and 1990.all soil enzymes activity concluded by kheyrodin hamid methodes 2014.

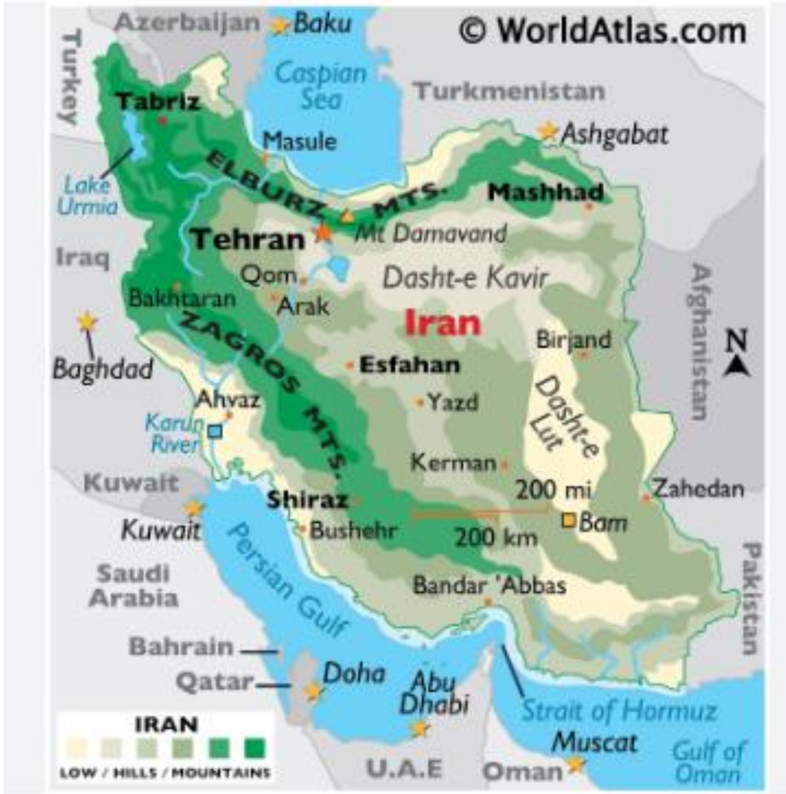


Figure 1: shows a image of map in Iran.

Figure 2: shows a satellite image of the city of Semnan in Iran.

Results:

The results showed in table 1 and 2 and figure 3. The result demonstrated that there was a significant difference at the 1% level between the biological characteristics of the soil under the canopy of the azalea shrubs and the open space. The highest amount of soil organic carbon (16.2%) was observed under the azalea canopy compared to the open space. Microbial biomass carbon (654 mg carbon/kg) and microbial biomass nitrogen (79 mg nitrogen/kg) were significantly higher under the azalea shrubs than outside the canopy. Also, the basal and stimulated respiration rates were significantly higher under the azalea shrubs than outside the canopy ($p<0.01$). Basal respiration under the azalea canopy showed a positive correlation with metabolic gain (qCO_2), while this parameter showed a negative correlation with soil organic carbon. Conclusion: In general, the results of this study showed that the biomass and microbial activity of the soil under the canopy increased, which indicates the importance of azalea shrubs in the study area. For example, the highest microbial biomass carbon was observed under the tamarix canopy compared to the open space the result was similar result Yang et al. 2025. Therefore, in order to increase the quality and health of the soil and combat soil erosion, it is necessary to restore and protect the Gaz shrub in the study area. For this purpose, the General Directorate of Natural Resources and Watershed Management of Ilam Province and non-governmental organizations can participate in the cultivation and restoration of this native species and other native species (kheyrodin 2016).

Standard error	Standard deviation	Variation coefficient	Variation range	Mean	Maximum	Minimum	Soil properties
0.82	5.15	22.04	18.20	23.35	30.80	12.60	Basal respiration (mg CO_2-C $g^{-1}d^{-1}$)
1.37	8.53	22.23	34.65	39.38	59.40	24.75	Induced respiration (mg CO_2-C $g^{-1}d^{-1}$)
20.82	130.03	21.00	470.73	619.10	856.10	37.385	Microbial biomass C (mg C kg^{-1})
2.71	16.92	23.63	71.30	71.10	97.22	25.93	Microbial biomass N (mg C kg^{-1})
0.65	4.03	10.01	15.27	4.02	17.68	1.00	Microbial quotient (%)
1.24	7.76	20.23	30.20	38.36	55.89	25.70	Metabolic quotient (mgCO_2-C g^{-1}MBC hr^{-1})
0.22	1.36	76.44	5.25	1.78	5.36	0.10	Organic carbon (%)

Table 1: Show statistics of the resultes

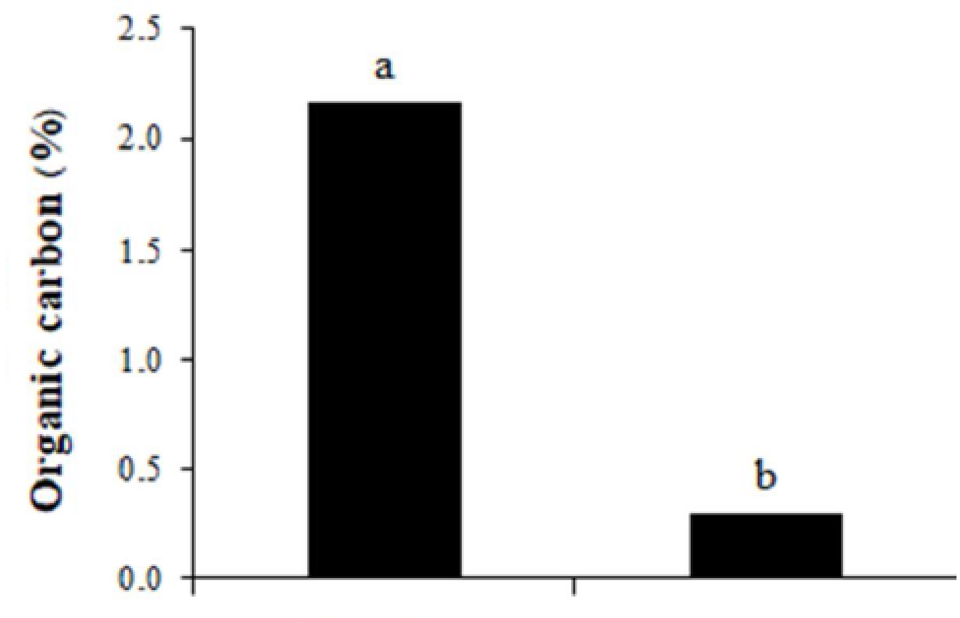


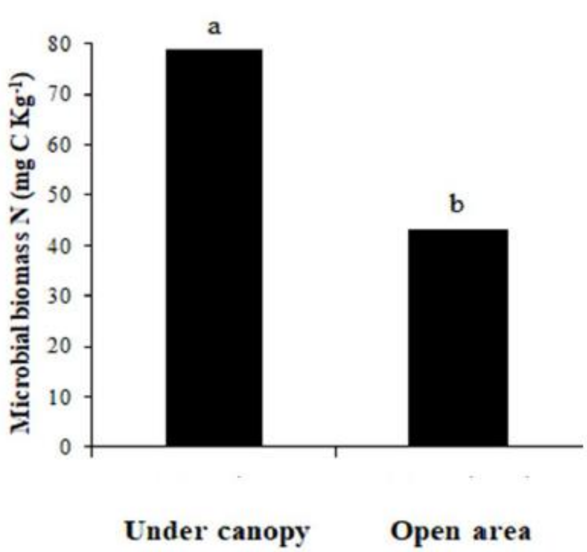
Figure 3: Soil organic carbon status under and outside the canopy of the azalea shrub.

Discussion

Climatic conditions are among the factors affecting the establishment of vegetation in arid and desert areas. In these areas, fertile and fertile soils also play an important role in the emergence and development of vegetation and forest cover (34). Rangeland plants favorably change the microclimate around them. For example, they can increase the moisture retention capacity and water permeability of the soil, accelerate the nutrient cycle, and modulate temperature and wind speed (6 and 28). Accordingly, considering the climatic conditions in desert areas, it is essential to understand the relationship between soil characteristics and the natural plant species of the area, and by understanding and planting the most suitable species, we can have the greatest success in restoring vegetation.

Tamarix stricta	Tamarix jordanis
Tamarix leptopetala	Tamarix karelinii
Tamarix aphylla	Tamarix kasakhorum
Tamarix hispida	Tamarix kermanensis
Tamarix gallica	Tamarix komarovii
Tamarix ramosissima	Tamarix korolkowii
Tamarix chinensis	Tamarix kotschyi
Tamarix parviflora	Tamarix kutchensis
Tamarix senegalensis	Tamarix laxa
Tamarix africana	Tamarix leptostachya
Tamarix alii	Tamarix litwinowii
Tamarix amplexicaulis	Tamarix macrocarpa
Tamarix androssowii	Tamarix mascatensis
Tamarix aralensis	Tamarix meyeri
Tamarix aravensis	Tamarix mongolica
Tamarix arceuthoides	Tamarix negevensis
Tamarix aucheriana	Tamarix nilotica
Tamarix austromongolica	Tamarix octandra
Tamarix baluchistanica	Tamarix pakistanica
Tamarix boveana	Tamarix palaestina
Tamarix brachystachys	Tamarix passerinoides
Tamarix canariensis	Tamarix pycnocarpa
Tamarix dalmatica	Tamarix sachensis
Tamarix dioica	Tamarix salina
Tamarix dubia	Tamarix sarenensis
Tamarix duezenlii	Tamarix smyrnensis
Tamarix elongata	Tamarix sultanii
Tamarix ericoides	Tamarix szowitsiana
Tamarix eversmannii	Tamarix taklamakanensis
Tamarix florida	Tamarix tarimensis
Tamarix gansuensis	Tamarix tenuissima
Tamarix gennessarensis	Tamarix tetragyna
Tamarix gracilis	Tamarix tetrandra
Tamarix hampeana	Tamarix jintaensis
Tamarix hohenackeri	Tamarix usneoides

Table 2: Different Tamarix in Iran desert



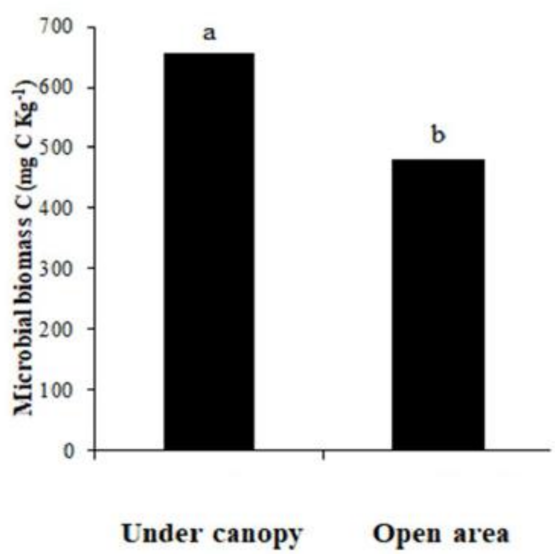


Figure 4: Microbial biomass carbon (a) and soil microbial biomass nitrogen (b) under and outside the canopy of agave shrub.

Organic carbon	Metabolic quotient	Microbial quotient	Microbial biomass N	Microbial biomass C	Induced respiration	Basal respiration	Biological property
-0.364**	0.491**	0.211 ns	0.194 ns	0.053 ns	0.056 ns	1	Basal respiration
0.071 ns	0.216 ns	0.048 ns	-0.061 ns	-0.066 ns	1	0.561 ns	Induced respiration
-0.270 ns	-0.754**	0.122 ns	0.487**	1	0.073 ns	0.286 ns	Microbial biomass C
-0.414 ns	-0.244 ns	0.079 ns	1	0.395 ns	0.182 ns	0.278 ns	Microbial biomass N
-0.510**	0.017 ns	1	-0.432 ns	-0.009 ns	-0.375 ns	-0.156 ns	Microbial quotient
0.046 ns	1	-0.276 ns	0.085 ns	-0.784*	0.243 ns	0.173 ns	Metabolic quotient
1	-0.278 ns	-0.558 ns	0.316 ns	0.421 ns	0.137 ns	-0.323 ns	Organic carbon

Table 3: Correlation coefficients between soil biological properties under canopy (white color) and open area (gray color).

* and ** are significant at 5 and 1% probability levels and ns not significant, respectively.

Figure 4, concluded that the highest microbial biomass of carbon and nitrogen (654 and 79 mg/kg soil, respectively) was obtained in the soil under the canopy of the azalea shrub, which was 64.82% higher in 36 and 01% compared to the soil outside the canopy, respectively. In addition The highest microbial yield (qmic) was obtained in the soil under the canopy cover (11.2%), and the open space soil had the lowest microbial yield (2%) at 16%.. The highest metabolic efficiency was observed in the soil under the canopy cover at 40 mg (qCO_2) per gram of microbial biomass carbon per hour of CO_2. Little research has been conducted in arid regions on the microbial fraction (qmic). Microbial efficiency indicates the state of soil organic matter after the addition of organic matter.

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