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Carbon Sequestration of Mediterranean Tree Species in the Zagros Forest of Iran

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ABSTRACT

Aims: Despite the many studies on carbon stock and sequestration in Iranian forest ecosystems, the effects and role of Mediterranean species on carbon stock in Iranian forest ecosystems are not well known. To our knowledge, no information is available on the carbon sequestration of Mediterranean species in Iran. This study aimed to quantify the surface soil carbon stock of Mediterranean tree species in the Zagros forest.

Materials & Methods: To this, ten soil samples were taken under the canopy of *Cupressus sempervirens var horizontalis, Myrtus commonis*, *Quercus brantii*, and also bare lands from a depth of 0-20 cm. Soil carbon stocks were calculated in each of the studied treatments. One-way ANOVA was used to evaluate the differences among the studied species and bare land for soil physiochemical properties and carbon stock. Multiple linear regression (MLR) using the stepwise method was performed to define the most critical soil factor for soil carbon stock calculation.

Findings: Our results indicated that *Cupressus sempervirens* represent the highest significant value for soil carbon stock (237.79 t.ha^{-1}). Soil carbon stock in *Myrtus commonis* and *Quercus brantii* stands were 122.05 and 91.90 t.ha^{-1}, respectively. Significant differences between *Myrtus commonis* and *Quercus brantii* were recorded. The lowest soil carbon stock was recorded in the control site and was significantly lower (27.26 t.ha^{-1}) compared to the other treatments. Compared to the bare land and *Quercus brantii* stand, *Cupressus sempervirens* had 872.30 and 258.74 percent higher soil carbon stock, respectively. The higher soil nutrient content under the Mediterranean canopy is due to the higher soil nutrients available. Also, it might be related to the protection made for these species compared to the oak forest. Moreover, soil organic carbon and bulk density represent the best predictors of the soil carbon stock based on the multi-linear regression method.

Conclusion: Reforestation/afforestation programs using *Myrtus commonis* and *Cupressus sempervirens* should also be considered for carbon sequestration programs in the Zagros forest, where these species could be planted. Moreover, our results demonstrate that using a variety of tree species, primarily Mediterranean species, would be a proper policy for increasing soil carbon stock in the Zagros forest.

Keywords: Carbon Sequestration; Mediterranean; Nitrogen; *Quercus brantii*; Soil Properties.

CITATION LINKS

[1] Fang J., Zhu J., Wang S., Yue C., Shen H. Global warming, human-induced carbon emi ... [2] Yoro K.O., Daramola M.O. CO2 emission sources, greenhouse gases, and the global wa ... [3] Lorenz K. Carbon sequestration ... [4] Behera S ... [5] Balabandi H., Shaabanian N. Investigating the Crown Structure and Carbon Storage o ... [6] Lal R. Managing soils and ecosystems for ... [7] Lal R. Soil management ... [8] Wang X., Feng Z., ... [9] Calderón-Loor M., Cuesta F., Pinto ... [10] Sharma C.M., Baduni N.P., ... [11] Khan M.I., Sarfraz R., Kim n ... [12] Ray R.L., Griffin R.W., Fares A., Elhassan ... [13] Rastogi M., Singh S., Pathak H. Emission of carbon dioxide from soil. Curr. Sci. 2 ... [14] Moradi M., Jorfi M.R., Basiri R., Yusef Naanaei S., Heydari M. Beneficial effects ... [15] Kalayeh S.P., Moradi M., ... [16] Hosseini A. Environmental Challenges Facing Zagros Forests. Strat. Res. J. Agri. S ... [17] Iranmanesh Y., Pourhashemi M., Jahanbazi H., C ... [18] Gauquelin T., Michon G., Joffre R., Duponnois R., Genin D., Fady B., et al. Medite ... [19] Ameray A., Bergeron Y., ... [20] Safari A., Sohrabi H. e ... [21] Moradi A., Shabanian N. Land-use change in ... [22] Bremner J.M., Mulvaney C. a ... [23] Merwin H., Peech M. ... [24] Olsen S.R. Estimation of available b ... [25] Walkley A., Black I.A. An ... [26] Ruiz-Peinado R., Bravo-Oviedo A., López ... [27] Ghasemi Aghbash F. Soil ... [28] Muñoz-Rojas M, Jordán A, Zavala L, De la Rosa D, Abd-Elmabod S, Anaya-Romero M. Im ... [29] Dindaroglu T., Boran B., Babur E., ... [30] Fonseca F., de Figueiredo ... [31] Díaz-Pinés E., Rubio A., Van ... [32] Mirzaei J., Moradi M., ... [33] Forogh Nasab M., Moradi M., Moradi G., Taghizadeh-Mehrjardi R. Topsoil carbon stoc ... [34] Renna V., Martín-Gallego P., Julián F., ... [35] Avazpoor Z., Moradi M., Basiri R., ... [36] Zhou W., Han G., Liu M., Li X. Effects of soil pH and texture on soil carbon and n ... [37] Xu L., He N., Yu G. Methods of ... [38] Mosaid H., Barakat A., ... [39] Ontl T.A., Schulte L.A. Soil carbon storage. [40] L ... [41] Behmanesh S., Moradi M., Pourrezaei J., ...

Introduction

One of the significant risks humans face in the current century is global warming. Human activity and natural disturbances are responsible for that [1]. Global warming has become an international problem since it can directly affect the economic situation of countries. Accordingly, the Intergovernmental Panel on Climate Change (IPCC) was held in 1988 to mitigate the adverse effects of carbon emissions and climate warming. Carbon dioxide must be captured to minimize the effects of global warming on the planet because the most important sources of carbon dioxide emissions are human activities. Therefore, to prevent global warming, we must control human activities that cause carbon dioxide emissions into the atmosphere [2]. Forests are the natural and free absorbent of carbon dioxide globally. However, forest-specific policy and local management are needed for the highest carbon capture [3]. Moreover, every forest ecosystem and tree species act differently in carbon sequestration [4], highly correlated with the tree dimension [5]. Therefore, it is necessary to specify the role of each tree species in this process.

Although the forest ecosystem is inevitable in the carbon cycle, forest soil is considered the most crucial carbon reservoir in the terrestrial ecosystem. Soil can capture more than 70 percent of the organic capture of the terrestrial ecosystems [6]. Many factors control soil carbon stock, such as soil organic matter, land management [7], forest destruction [8], elevation [9], and tree species [10]. Soil is an essential section of the carbon cycle since it can either be a sink or a carbon source. Being a source or sink of carbon depends on several factors, such as nitrogen fertilizer [11], organic amendments [12], and soil biological processes [13]. Therefore, it is essential to specify the role of forest soil in carbon reservation.

The Zagros forests of Iran are known for their protection roles, not for their wood products. These forests have been under several disturbance regimes, including overgrazing [14], forest decline [15], and lack of regeneration [16]. Besides all disturbances that can negatively impact the carbon stock of this forest [17], they are essential for carbon sequestration. Zagros forest is a diverse ecosystem with many species and some rare Mediterranean species. The present study will explore soil carbon stock under the canopy of the Mediterranean species (*Cupressus sempervirens var horizontalis* and *Myrtus commonis*), *Quercus brantii*, and bare land to have a better understanding of these species' role in soil carbon stock. This information would then be helpful in forest management practices toward atmospheric carbon mitigation. Information on carbon sequestration of the Mediterranean forest is rare due to their vast distribution pattern from Africa to Europe, Middle Eastern countries, California, Australia, and Chile [18]. Forest management strategy is a crucial factor in controlling carbon sequestration. For example, fast-growing trees, different silvicultural methods, and management strategies could result in higher carbon sequestration [19]. Therefore, to achieve proper management, scientific knowledge is required about the role of every species in carbon sequestration. Through the reforestation and plantation programs in the functional selecting tree approach, managers can increase the potential of carbon sequestration in their programs. Despite the many studies on carbon stock and sequestration in forest ecosystems of Iran, the effects and role of Mediterranean species on carbon stock in forest ecosystems of Iran are not well known. It has been reported that *Quercus brantii* dieback caused aboveground carbon reduction, while ecosystem protection resulted in

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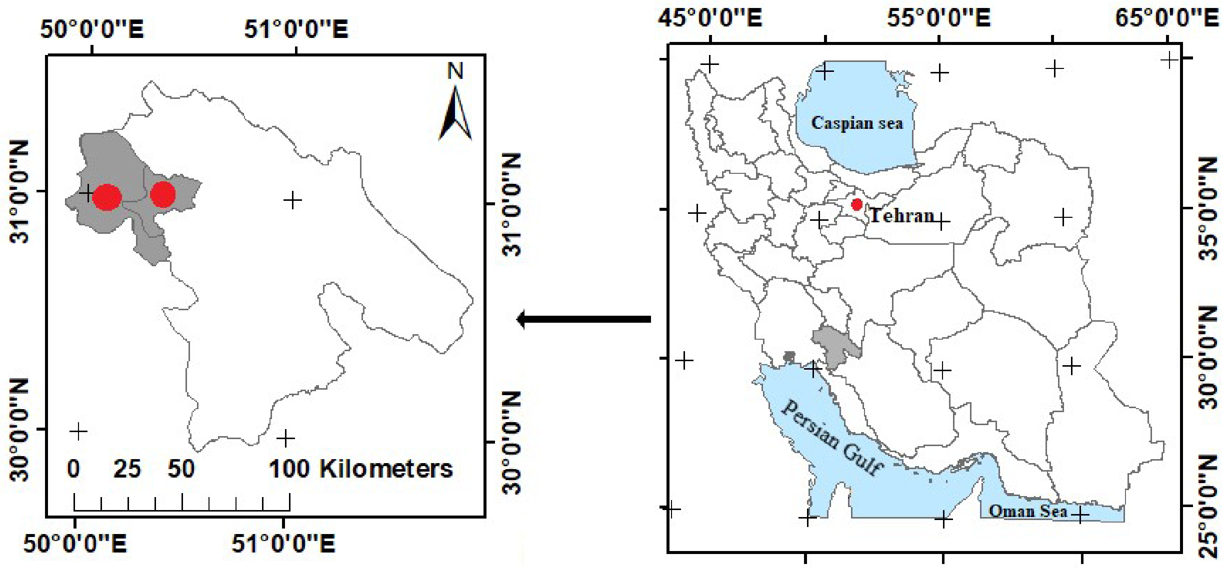

Figure 1) The location of the studied sites in Iran and Kohgiluyeh and Boyer-Ahmad Province. (Red dots are the studied sites)

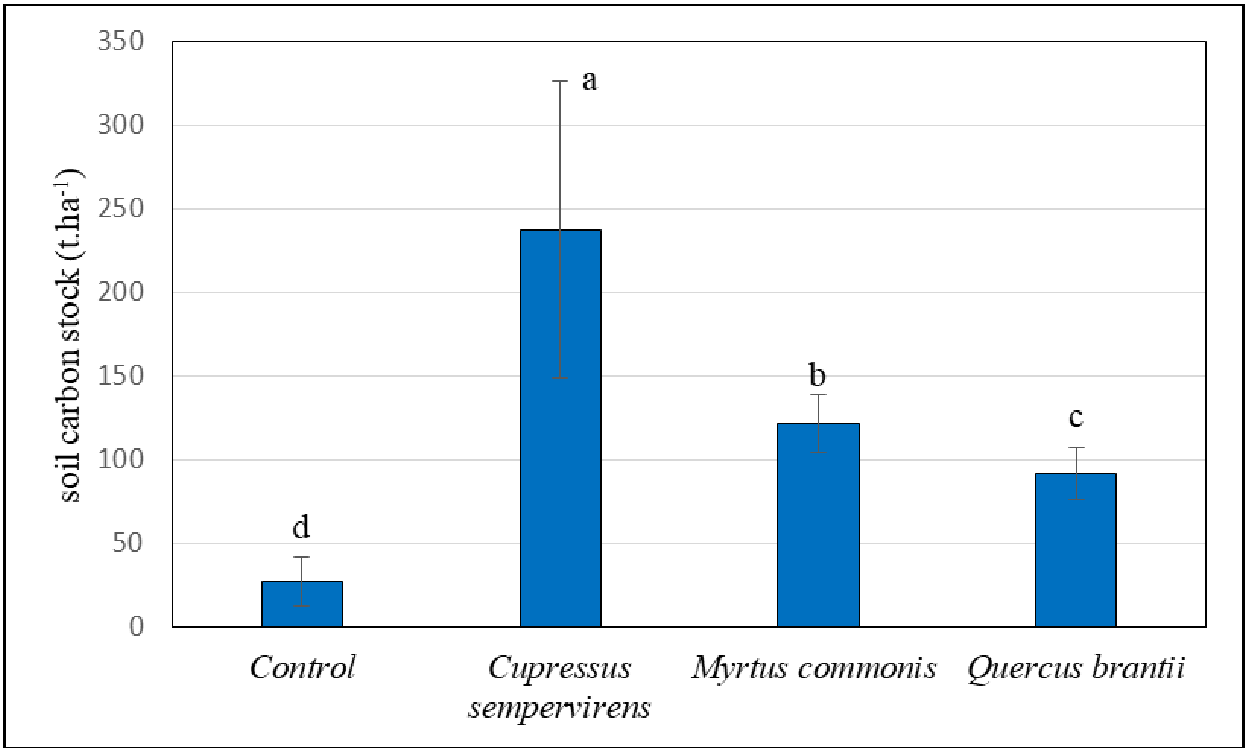

Figure 2) Soil carbon stocks among the studied treatments (values are mean ± standard deviation; different letters representing the significant differences among the treatments).

higher carbon storage in the Zagros forest of Iran [20, 21]. Hence, further research is needed on Mediterranean species and even other species to understand the effects of different tree species on soil carbon stocks. The objectives of the present study were first to quantify the effect of Mediterranean tree species on surface soil carbon stock in the Zagros forest, second to compare the carbon stock of Mediterranean species with *Quercus*

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Table 1) Results of one-way ANOVA for soil chemical and physical properties among the studied treatments.

Variable		Sum of Squares	df	Mean Square	F	Sig.
N	Between Groups	1.033	3	0.344	15.486	0.000
	Within Groups	0.801	36	0.022		
	Total	1.834	39			
OC	Between Groups	353.331	3	117.777	34.772	0.000
	Within Groups	121.936	36	3.387		
	Total	475.267	39			
K	Between Groups	262386.900	3	87462.300	17.770	0.000
	Within Groups	177187.000	36	4921.861		
	Total	439573.900	39			
P	Between Groups	1337.609	3	445.870	27.379	0.000
	Within Groups	586.260	36	16.285		
	Total	1923.869	39			
CaCo3	Between Groups	2110.508	3	703.503	7.853	0.000
	Within Groups	3225.163	36	89.588		
	Total	5335.671	39			
Clay	Between Groups	1368.275	3	456.092	21.791	0.000
	Within Groups	753.500	36	20.931		
	Total	2121.775	39			
Silt	Between Groups	270.475	3	90.158	2.718	0.059
	Within Groups	1194.300	36	33.175		
	Total	1464.775	39			
Sand	Between Groups	1197.400	3	399.133	7.866	0.000
	Within Groups	1826.600	36	50.739		
	Total	3024.000	39			
EC	Between Groups	36.852	3	12.284	48.436	0.000
	Within Groups	9.130	36	0.254		
	Total	45.982	39			
pH	Between Groups	0.267	3	0.089	12.134	0.000
	Within Groups	0.264	36	0.007		
	Total	0.531	39			
BD	Between Groups	0.075	3	0.025	21.545	0.000
	Within Groups	0.042	36	0.001		
	Total	0.117	39			
SCS	Between Groups	232688.419	3	77562.806	33.855	0.000
	Within Groups	82477.301	36	2291.036		
	Total	315165.720	39			

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brantii and bare land, and third to determine the most critical soil factor in predicting soil carbon stock. We hypothesized that Mediterranean tree species significantly increase Coil carbon compared to the *Quercus brantii* and bare lands in the Zagros forest.

Material & Methods

Study Site

Kohgiluyeh and Boyer-Ahmad Province was selected for the study site since it has the *Cupressus sempervirens var horizontal* and *Myrtus common* as the Mediterranean species (Figure 1). Soil samples for *Cupressus sempervirens var horizontalis* and *Myrtus commonis* were collected in Tange Sulak and Lendeh. Lendeh site was used to take *Myrtus commonis* soil samples, and Tange Sulak was selected to take a soil samples of *Cupressus sempervirens var horizontalis*. Tange Sulak was located at 50°11′ and 50°17′ (latitudes) and 30°35′ and 30°37′ (longitudes). The elevation was 350 a.s.l., and precipitation ranged from 400-600 mm. The maximum temperature was 38 °C. This site is covered by *Quercus brantii*, Acer *monspessulanum*, *Pistacia* sp, and *Daphne* sp. In contrast, the sampling site in Lendeh was at 50° 29′ and 31° 0′ (latitudes) and 50° 28′ and 31°2′ (longitudes). The precipitation and temperature were 750 mm and 25 °C, respectively. The elevation was 1100 m a.s.l. This site is covered by *Quercus brantii*, *Pistacia khinjuk*, and *Ficus* sp.

Sampling Laboratory Analysis

Ten soil samples were taken from 0-20 cm depth under the canopy of the studied species (*Cupressus sempervirens var horizontalis, Myrtus commonis*, and *Quercus brantii*). Moreover, ten soil samples were also collected from the bare land, with no trees, for the control site [14]. In total, 40 soil samples were taken and moved to the laboratory for further analysis.

Kajeldal technique [22] and flame photometer [23] were applied for potassium. The method described by Olsen et al. [24] was used for soil phosphorous. Moreover, soil organic matter was calculated using the Walkley and Black [25] method. Soil pH (deionized water suspension of 1:2.5) and electrical conductivity (deionized water suspension of 1:5) were also measured. Besides, soil texture and bulk density were calculated. Equation [1] was used for soil carbon stock calculation.

$$OC = 10000 * OC\% * BD * E \qquad \text{Eq. (1)}$$

Where OC is the carbon stock ($t.ha^{-1}$), OC% is organic carbon, BD is bulk density ($gr.cm^{-3}$), and E represents the soil depth (cm).

Statistical Analysis

Before any analysis, all the data were subjected to the homogeneity of variance test using the Kolmogorov–Smirnov test. One-way ANOVA was used to evaluate the differences in soil physicochemical properties among the studied species and bare land. Significant differences in soil carbon stock were evaluated using one-way ANOVA. If a significant difference was observed, the least significant difference (LSD) was used to compare the means between treatments. Multiple linear regression (MLR) using the stepwise method was performed to define the most critical soil factor for soil carbon stock calculation. These analyses were performed in SPSS (v. 18) for Windows. Finally, principal component analysis (PCA) was performed to identify the most critical soil properties correlated with the studied species. PCA was performed using PC-ORD version 5.

Findings

Soil Physicochemical Properties

Our result indicated that the studied species significantly affect soil properties (Table 1). The least soil nitrogen and organic carbon belonged to the control site, significantly

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Table 2) Soil physicochemical properties in the studied sites (values are mean ± standard deviation; different letters represent the significant differences among the treatments for each studied soil factor).

Soil properties	Control	*Cupressus sempervirens*	*Myrtus commonis*	*Quercus brantii*
N (%)	0.15±0.23c	0.58±0.15a	0.30±0.05b	0.24±0.08cb
OC (%)	1.03±0.53c	9.20±9.20a	4.34±4.32b	3.43±3.43b
K (mg.kg^{-1})	170.00±55.92b	383.30±68.18a	339.50±86.54a	331.40±66.48a
P (mg.kg^{-1})	4.15±2.24c	6.05±4.75cb	19.16±4.29a	9.37±4.37b
$CaCo_3$ (%)	47.64±7.92a	29.02±6.90b	42.80±5.62a	34.12±14.70b
Clay (%)	33.70±6.01a	34.70±2.90a	19.90±4.06c	29.40±4.74b
Silt (%)	37.50±7.12b	43.80±4.28a	43.30±6.00a	39.70±5.25ab
Sand (%)	28.80±7.68b	21.50±3.97c	36.80±7.64a	30.90±8.34ab
EC (dS.m^{-1})	1.12±0.15c	3.48±0.93a	1.24±0.31c	1.48±0.14c
pH	7.16±0.05b	7.12±0.04b	7.31±.4a	7.10±0.04b
BD (gr.cm^{-3})	1.31±0.03bc	1.29±0.01c	1.40±0.04a	1.33±0.03b

lower than other studied species (Table 2). However, the higher significant soil nitrogen and organic carbon were recorded in the *Cupressus sempervirens* stands. Although soil nitrogen in *Myrtus commonis* and *Quercus brantii* stands has no significant differences, they were significantly lower than *Cupressus sempervirens* stands and higher than the control site. Studied tree species showed significantly higher soil potassium content than the control site. Nevertheless, no significant differences were observed for soil potassium among the *Cupressus sempervirens*, *Myrtus commonis*, and *Quercus brantii*. The higher soil phosphorous belonged to *Myrtus commonis*, then *Quercus brantii* and *Cupressus sempervirens*. The least significant soil calcium carbonate was recorded in the *Cupressus sempervirens* and *Quercus brantii* stands. Soil pH under the canopy of *Myrtus commonis* is recorded as the highest significant value compared to the other treatments. Soil bulk density also indicated that its higher values belonged to *Myrtus commonis* stand. No significant differences were recorded in soil bulk density under the canopy of the *Cupressus sempervirens* and control site. The highest electrical conductivity belonged to the *Cupressus sempervirens*, significantly higher than the other treatments (Table 2).

The significantly higher soil clay content was recorded in *Cupressus sempervirens*, *Quercus brantii*, and *Myrtus commonis*. However, the lowest and highest soil sand values belonged to the *Cupressus sempervirens* and *Myrtus commonis* stands, respectively (Table 2).

Soil Carbon Stock and Multi-Linear Regression

Soil carbon stock revealed significant differences among the treatments (Figure 2). Our result indicated that *Cupressus sempervirens* represents the highest significant value for soil carbon stock (Figure 2). The mean soil carbon stock in *Cupressus*

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sempervirens stand was 237.79 $t.ha^{-1}$. Soil carbon stock in *Myrtus commonis* and *Quercus brantii* stands were 122.05 and 91.90 $t.ha^{-1}$, respectively. Significant differences between *Myrtus commonis* and *Quercus brantii* were recorded (Figure 2). The most minor soil carbon stock was recorded in the control site and was significantly lower (27.26 $t.ha^{-1}$) compared to the other treatments (Figure 2). Our result indicated that soil bulk density and organic carbon are the most crucial soil physiochemical factors in soil carbon stock calculation. These two factors were selected based on the stepwise method (Table 3).

Table 3) Soil carbon stock estimation using multi-linear regression for the studied species.

	Multi-linear Regression Equation	R^2	Sig.
Soil carbon stock		0.99	0.000

where SCS is soil carbon stock ($t.ha^{-1}$), BD is bulk density ($gr.cm^{-3}$), and OC is organic carbon (%).

Principal Component Analysis (PCA) for Studied Treatments

The result of the principal component analysis indicated that the first and the second axes represented 35.26 and 27.75 percent of the variance, respectively (Table 4). PCA analysis showed that organic carbon, soil carbon stock, soil nitrogen, electrical conductivity, silt, potassium, and clay are significantly correlated with the positive side of the first axis. In contrast, soil $CaCo_3$, silt, bulk density, and pH were correlated with the negative side of the first axis (Table 5). Soil clay was correlated with the positive side of the second axis, and soil bulk density, phosphorous, sand, potassium, pH, soil carbon stock, and organic carbon were correlated with the negative side of the second axis (Table 5).

PCA analysis could separate the studied treatments into four groups (Figure 3). *Cupressus sempervirens* plots were located on the positive side of the first axis, where soil nitrogen, organic carbon, and soil carbon stock were higher. *Myrtus commonis* plots were located on the negative side of the second axis, where bulk density, phosphorous, sand, and pH were higher. Control plots are located on the negative side of the first axis, where soil calcium carbonate is higher. Finally, *Quercus brantii* plots are located at the center of the diagram (Figure 3).

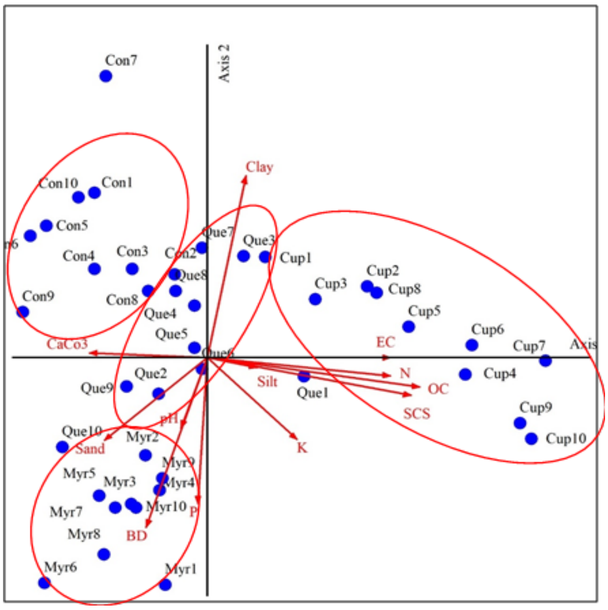

Figure 3) PCA analysis for the studied species and control site (Con: control; Que: *Quercus brantii* brantti; *Myrtus commonis*; Cup: *Cupressus sempervirens*; EC: electrical conductivity; N: nitrogen; OC: organic carbon; SCS: soil carbon stock; K: potassium; BD: bulk density; P: phosphorous).

Table 4) Principal component analysis's Eigenvalues, variance, and Broken-Stick Eigenvalue.

Axis	Broken-Stick Eigenvalue	Commutative Variance	Variance	Eigenvalues
1	3.103	40.76	40.76	4.89
2	2.103	68.05	27.29	2.27

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Table 5) The correlation coefficient between studied soil properties in the PCA and axes 1 and 2.

Variables	Axis 1	Axis 2
N	0.837**	-0.270
OC	0.901**	-0.342*
K	0.586**	-0.565**
P	-0.191	-0.756**
$CaCo_3$	-0.672**	0.136
Clay	0.386*	0.845**
Silt	0.436**	-0.196
Sand	-0.626**	-0.571**
EC	0.836**	-0.012
pH	-0.319*	-0.527**
BD	-0.485**	-0.818**
SCS	0.884**	-0.386*

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Discussion

Soil Carbon Stock

Our results show that Mediterranean species in the Zagros forest represent a high potential for soil carbon stock accumulation. *Cupressus sempervirens* and *Myrtus commonis* showed a significantly higher soil carbon stock than the *Quercus brantii* and bare land. Compared to the bare land and *Quercus brantii* stand, *Cupressus sempervirens* had 872.30 and 258.74 percent higher soil carbon stock, respectively. Like the other studies on Mediterranean needle-leaved tree species [26, 27], our study emphasizes the importance of the *Cupressus sempervirens* as a needle-leaved tree species in the Zagros forest for a carbon sequestration program. Due to the deforestation activity in the Mediterranean zone that leads to soil carbon losses [28], reforestation and plantation with *Cupressus sempervirens* can be a suitable species for soil carbon stock programs. *Myrtus commonis*, another Mediterranean species, had 447.72 percent higher soil carbon stock than bare land. At the same time, *Cupressus sempervirens* showed a soil carbon stock of 194.83 percent higher *than that of Myrtus commonis*.

Dindaroglu et al. [29] reported the significant importance of the Mediterranean forest in soil carbon stock compared to the other land uses, which aligns with our findings. This suggests that using a tree composition program with Mediterranean species in the Zagros forest increases the soil carbon stock value. This result aligns with other studies claiming to use Mediterranean tree species to increase carbon stock [30, 31]. Moreover, the variability of soil carbon stocks between Mediterranean species might be indicated by the environmental heterogeneity that caused different soil carbon stocks [31].

Soil Chemical Properties

There are several factors affecting soil carbon stock, including tree species [32], soil properties [33], and soil nitrogen [27]. Our result indicated that different tree species caused different soil chemical properties. This might be the reason for soil carbon stock differences among the studied species. Higher soil nitrogen and organic carbon were recorded under the canopy of the *Cupressus sempervirens*, where the highest soil carbon stock is recorded. Mediterranean species provide higher soil nitrogen and organic carbon to the soil. This could result in higher soil carbon stocks than the *Quercus brantii* and bare land. Unlike the study of Renna et al. [34], who mentioned no significant differences between Mediterranean oak species afforestation and arable lands, our study showed that studied Mediterranean tree species significantly increased soil carbon stock compared to the Brant oak.

Tree species could change soil chemical properties through the litter [1, 35]. The present study also showed different soil chemical properties under the canopy of the Mediterranean species and *Quercus brantii* that led to changes in soil nutrients and carbon stock [1]. The minimum soil

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pH is recorded on bare land and under the canopy of the *Cupressus sempervirens*. Moreover, the minimum soil calcium carbonate is recorded under the canopy of the *Cupressus sempervirens*. This indicates the importance of the soil pH for not only soil calcium carbonate change but also soil carbon stocks [36]. Moreover, Multi-linear regression indicated that the best soil factors for predicting soil carbon stock are soil bulk density and organic carbon [37]. This finding aligns with the finding of Mosaid et al., who mentioned soil bulk density as a critical factor in predicting soil carbon stock [38].

Soil Physical Properties

Not only soil chemical properties but soil texture play a significant role in soil carbon stock [39]. Higher values of fine soil particles (clay and silt) lead to higher soil carbon stock [40] recorded in our studied sites. *Cupressus sempervirens* indicated the higher significant soil carbon pool, where we can record the higher soil clay and silt content. The significant positive effects of clay and silt on soil carbon stocks are also stated in the study of Iranmanesh and Sadeghi [17].

Principal Component Analysis (PCA)

Based on the principal component analysis, soil nitrogen, electrical conductivity, organic carbon, and soil carbon stock were correlated with the first axis where the *Cupressus sempervirens* plots are located. Phosphorous, bulk density, sand, and pH were higher in the *Myrtus commonis* plots and PCA showed those plots with higher soil factors. This diagram represents the *Cupressus sempervirens* as the highest soil carbon stock with higher soil nutrients. In contrast, *Myrtus commonis* represents a higher soil sand and bulk density with higher soil phosphorous and pH. Soil nutrition losses and the degradation of forest resources are the main challenges in the forests of Iran [14, 41]. *Myrtus commonis* and *Cupressus sempervirens* are among the protected species in the forest resources of Iran. Maybe this protection resulted in better soil quality compared to the *Quercus brantii*. The better soil conditions also resulted in higher soil carbon stock content. This shows the value of the forest protection program for increasing soil carbon stock.

Conclusion

Mediterranean tree species significantly increase the soil carbon stock in the Zagros forest of Iran. This finding proves our hypothesis that Mediterranean tree species are essential for increasing soil carbon stock. The higher soil nutrient content under the Mediterranean canopy is due to the higher soil nutrients available. Also, it might be related to the protection made for these species compared to the oak forest. Moreover, soil organic carbon and bulk density represent the best predictor of the soil carbon stock based on the multi-linear regression method. Additionally, reforestation/afforestation programs by *Myrtus commonis* and *Cupressus sempervirens* should be considered for a carbon sequestration program in the Zagros forest, where these species could be planted. Besides, our results revealed that Mediterranean tree species would be a proper policy for increasing soil carbon stock in the Zagros forest.

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Conflicts of Interest

The authors declare no conflict of interest.

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