Seedling Growth Differences in Ecto- and Endo-Mycorrhizae Inoculated Cedar (*Cedrus libani*) in a Nursery Experiment Conducted in Inland Part of Turkey

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Introduction

There is more than 5 million ha of socially, economically and ecologically available land area for afforestations in Turkey. The significant parts of these potential afforestation areas suffer from water deficiency during vegetation season. Data from different parts of the world suggest that mycorrhizae inoculation can significantly increase the seedling survival and growth rates.

Fig.1. Hyphae

Objective

The objective of this study is to compare the nursery performance of ecto- and endo-mycorrhizae inoculated and non-inoculated cedar seedlings' in a nursery study.

Materials

1.Site Description

The study had been conducted in Eskişehir Forest Nursery in Turkey. The nursery is located in the western part of the central Anatolia region of Turkey. The area has continental climate with less than 500 mm annual rainfall. The soil is considered alkaline. The nursery supplies the biggest part of the seedling demand for afforestation practices by Forest service.

Fig 2. The Nursery

2. Seedling Species

Two years old Cedar (Cedrus libani) seedlings grown in the nursery were utilized.

3. Mycorrhizal Mixture

Two commercial mycorrhiza mixture were used in the nursery study. The first mixture (M1) contain ecto- and endo- mycorrhizae and other ingredients. The second mixture (M1) contain endomycorrhizae and other ingredients.

Mycorrhiza %23.3			
Ecto-mycorrhiza	(propagule/gram)	Endo-mycorrhiza	(propagule/gram)
Pisolithus tinctorius	1,600,000	*Glomus intraradices*	21
Rhizopogon villosuli	80,000	*Glomus aggregatum*	20
Rhizopogon luteolus	80,000	*Glomus mosseae*	20
Rhizopogon amylopogon	80,000	*Glomus brasilianum*	1
Rhizopogon fulvigleba	80,000	*Glomus monosporum*	1
Scleroderma cepa	40,000	*Glomus deserticola*	1
Scleroderma citrinum	40,000	*Glomus clarum*	1
Laccaria bicolor	16,000	*Glomus etunicatum*	1
Laccaria laccata	16,000	*Gigaspora margarita*	1

a)

Other ingredients	
Humic acids	%28.90
Cold-water kelpt extracts	%18.00
Ascorbik acid (vitamin C)	%12.30
Amino acids	%8.50
Myo-inositol	%3.50
Surfactant	%2.5
Thiamine (Vitamin B_1)	%2.00
Aplha-tocopherol (vitamin E)	%1.00

Mycorrhiza %23.3	
Endo-mycorrihza	(propagule/gram)
Glomus intraradices	25
Glomus mosseae	24
Glomus aggregatum	24
Glomus clarum	1
Glomus monosporum	1
Glomus deserticola	1
Glomus brasilianum	1
Glomus etunicatum	1
Gigaspora margarita	1

b)

Other ingredients	
Humic acids	%28.70
Cold-water kelpt extracts	%18.00
Ascorbik acid (vitamin C)	%2.00
Amino acids	%6.00
Myo-inositol	%2.50
Surfactant	%2.50
Thiamine (Vitamin B_1)	%1.75
Aplha-tocopherol (vitamin E)	%1.00

Table 1. a) Ingredients of M1
b) Ingredients of M2

Method

A completely randomized design was used for the study. Two years old 90 Cedar seedlings grown in the nursery for afforestation stock were randomly sampled. For 30 of the seedling endo- and ecto-mychorizae was inoculated using first mycorrhizal mixture. For the next 30 of the seedling just endo-mychorizal mixture was used. For the remaining 30 seedlings no treatment was applied. For each sample, inoculation rate, shoot height, root collar diameter, root length, leaf area index, shoot dry weight, root dry weight, shoot fresh weight, root fresh weight and dickson quality index variables were measured.

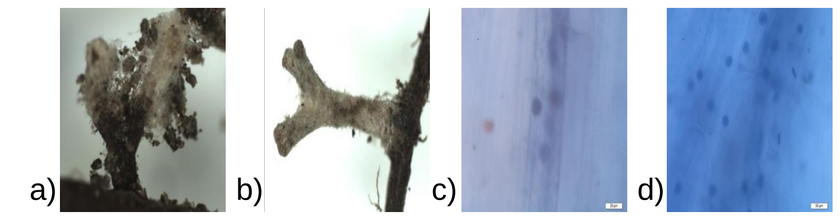
Results

1. Colonization

The root colonization was not detected in the non-inoculated plants. Inoculated plants using M1 and M2 had relatively high endomycorrhizal colonization rates (Table 2). The ectomycorrhizal colonization was not detected in inoculated plants using M2 while the inoculated plants using M1 had ectomycorrhizal colonization.

Treatment	%Ectomycorrhiza	%Endomycorrhiza
M1	16	44
M2	0	85
Control	0	0

Table 2. Mean percent colonization of mycorrhizal



a) b) c) d)

Fig.3. a-b) Ectomycorrhiza c-d) Endomycorrhiza

2. Differences in Morphological Characteristics

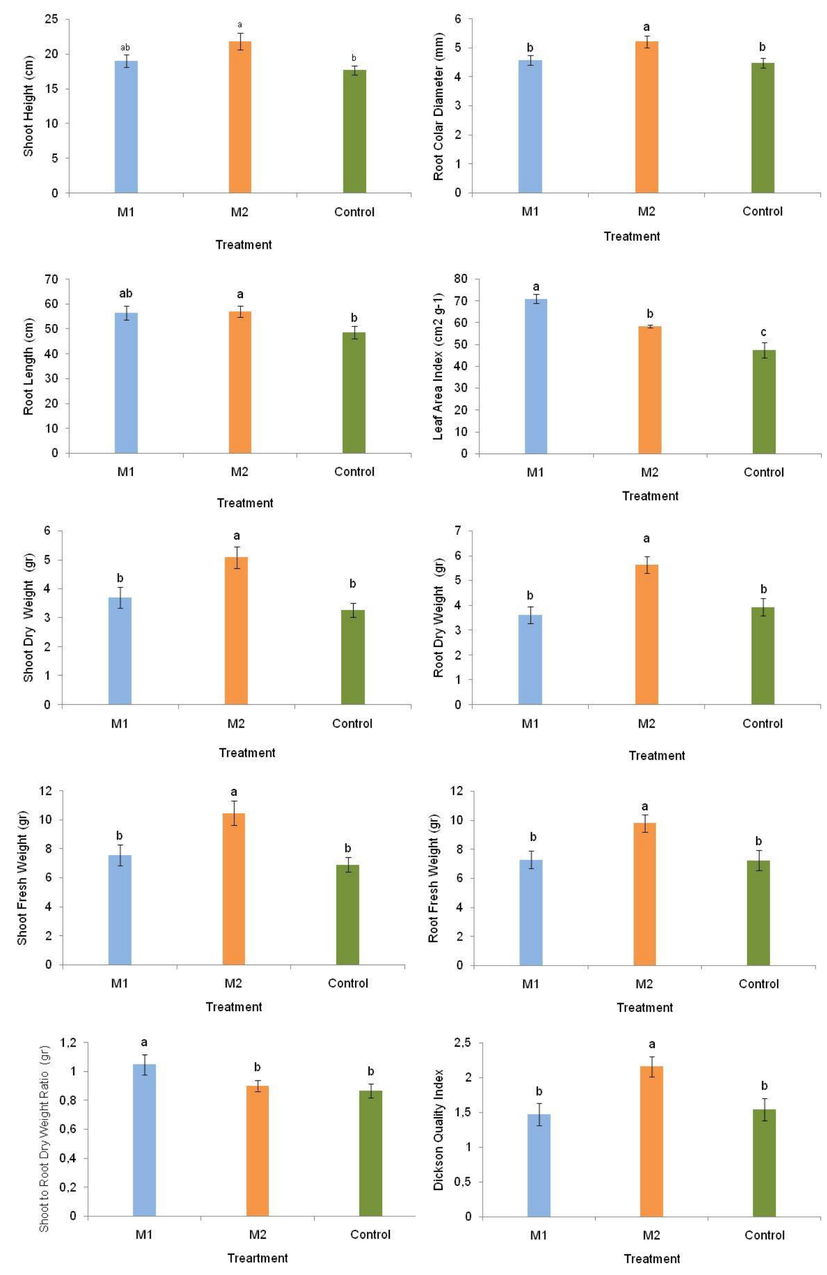


Table 3. Differences in Morphological Characteristics

Conclusions

Analysis of the data indicated that mycorrhizal differences were effective on morphological characteristics. There were statistically significant difference (p≤005) in the shoot height, root collar diameter, root length, leaf area index, shoot dry weight, root dry weight, shoot fresh weight, root fresh weight, shoot to root dry weight ratio and dickson quality index (P-values = 0.0148; 0.0104; 0.0434; <0.0001; 0.0010; 0,0001; 0.0022; 0.0051; 0.0488; 0.0032, respectively).

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