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Effects of soil nutrient on seedling performance of arizona cypress and medite cypress

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ABSTRACT

The present research was carried out to determine the influence of different combinations of organic matter as growing media on seed germination, survival, growth, biomass and performance of needle-leaved arizona cypress (Cupressus arizonica var arizonica *Greene) and medite cypress (C. sempervirens var. horizantalis (Mill.) Gord) seedlings in a forest nursery located in northern Iran. Seeds were sown in plastic pots as randomized completely block design (RCBD) with four replications at four different soil treatments, including: T1) nursery common soil (control), T2) control soil: cattle manure (5:1), T3) control soil: decomposed litter (5:1), T4) control soil: cattle manure: decomposed litter (5:1:1). The results after one year showed that seedlings of both species grown on T4 obtained better germination percent, survival, shoot height, collar diameter, seedling vigor index and Quality Index (QI). Greatest relative growth rate (RGR) of height and diameter were achieved on organic matter treatments. In most of the studied attributes, response of C. arizonica was better than C. sempervirens, showing the different ecological requirements of these species. From the study, it is concluded that the increased availability of soil nutrient can be useful in seedling production of both species.*

Keywords: Biomass, *Cupressus arizonica, C. sempervirens,* Organic matter, Quality index, Vigor index.

INTRODUCTION

In recent years the increasingly problems of forests degradation has been persuaded the researchers and managers to prevent the decrease of these valuable resources. One of the important solutions for restoration of the degraded areas is suitable seedling production in forest nurseries (20). In the other hands, the use of poor planting stock can reduce plantation survival and growth, increase site maintenance costs, and reduce confidence in reforestation (24). Some factors highly affect the quantitative and qualitative production of seedlings in nurseries. The physico - chemical characters of soil - media are the most important effective parameters (50, 31). Chemical fertilizers are useful for improvement of nutrition contents, soil texture, and plant tissue and higher yield production (23, 41). However, due to the environmental limitations and decrease of soil fertility in long term and also economic benefits, organic matter is a better alternative (36).

In this manner, organic matter with moisture, temperature, respiration and enzymes activity increase influence on seed germination and seedling growth. Seed germination represents an important initial phase in the life cycle of plants (19). In recent studies, combinations of types of soil in different ratios of nutrient have been evaluated for influencing the seed germination of important forest species (28, 46). The role of soil status on seed germination and subsequent growth of Deodar cedar (*Cedrus deodara* (Roxb.) G. Don f.) and Blue Pine (*Pinus wallichiana* A. B. Jacks.) under nursery conditions has been reported by Durgapal et al. (2). In study combinations of mixtures of growing media (pine bark, Sphagnum peat and paper mill sludge with sewage sludge, sewage activated sludge, municipal solid waste and inorganic fertilizer) on maritime pine tree production in a forestry nursery, Mañas et al. (38) showed that the highest values for germination percentage of Maritime Pine (*Pinus pinaster* Ait.) were obtained for 75% pine bark + fertilizer and for sewage sludge treatments. Also the best physical parameter values were obtained in seedlings grown in paper mill sludge + activated sewage sludge + peat and in paper mill sludge + activated sewage sludge + pine bark mixtures.

Also, there are many studies to indicate the effect of organic matter on increase soil fertility (16), survival and growth (29, 32), biomass (39) and seedling quality (38). Larchevêque et al. (29) by using of three rates of fresh co-composted sewage sludge and green wastes (control without compost, 20 and 40 kgm^{-2} of compost) on one-year-tree seedlings of native species Holm Oak (*Quercus ilex L.*), Aleppo Pine (*Pinus halepensis* Mill.) and Stone Pine (*Pinus pinea* L.) explained that the compost improved survival of *Q. ilex* and *P. pinea* seedlings, but had no effect on *P. halepensis* and for all species seedling length and radial growth were increased for both rates of amendment. Also, Nourshad and Ghorani (30) reported that a better treatment for diameter and height growth of Loblolly Pine (*Pinus taeda* L.) and Slash Pine (*Pinus elliottii* Engelm.) is perlit, tea wastes, decomposition manure, loam soil and forest decomposed litter (1:1:1:2:1), and for *P. pinea* tea wastes, manure and forest decomposed litter. Similar results were found in researches of Guerrero et al. (15) where they combined pine bark and sewage sludge for growing *P. pinea*, *Cupressus arizonica* and *Picea abies*. According to Kiani (8) finding, there was an increase in root and shoot dry weight of potted and bare rooted *P. taeda* seedlings where substrate was shared as soil, sand, decomposed manure (1:4:2). Findings of O´ Skarsson et al. (21) indicated that fertilizer application during two years improved survival of *Betula pube*scens, *Larix sibirica* and *Picea sitchensis* and increased annual height 7 and 15 times for *Betula alba* and *Larix sibirica*, respectively. Ravikumar et al. (45) indicated that Inoculation of Azospirillum significantly increased the shoot length by 44.85%, primary and secondary root length by 39.3% and 37.5%. Also, enhanced nutrient availability improves relative growth rate (RGR), due to larger allocation of biomass to foliage and shoot (3). Root length/Shoot height ratio (RL/SH) and Sturdiness Quotient (SQ) are important measurements for seedling survival and predict seedling performance (38). Finally, the Dickson Quality index (QI) integrates the aspects of total plant mass, the Sturdiness Quotient and (RL/SH) ratio. The QI explains plant potential for survival and growth in the field. High index values are better (47).

In the experimental nursery (Koloudeh, located in Amol, Mazandaran province, norther Iran), deficiency in nutrient and organic matter of soil is a problem for seedling production (4). On the other hand, the seedling morphological characteristics before planting highly affect the seedling growth during the first years after outplanting (33). Present research plans to remove above problems by adding the different combinations of organic matter in soil - media and to evaluate effect of soil status on seed germination, survival, and growth in seedlings of arizona cypress (*Cupressus arizonica* var arizonica Greene) and medite cypress (*C. sempervirens* var. horizantalis (Mill.) Gord) having a widespread application in plantations and city green areas.

MATERIALS AND METHODS

Study area:
The study was carried out in Koloudeh nursery, located in a distance of 10 kilometers far from Amol city, Mazandaran province, Iran (52° 17´ E, 36° 34´ N, 6 m a.s.l). The annual average precipitation is 830 mm, the annual average minimum temperature 6.6 °C and the annual average maximum temperature 27.2 °C.

Research method:
Seeds of Arizona Cypress (*Cupressus arizonica* var arizonica Greene) and Medite Cypress (*Cupressus sempervirens* var. horizantalis (Mill.) Gord) species with equally in size and weight were supplied from the Caspian Forests Seed Center in Mazandaran, Amol. The characteristics of seeds are shown in Table 1. Viability percentage of seed lot was determined using the Tetrazolium Chloride (TZ) staining technique. Moisture Content of the seeds was specified based on three replicate samples of approximately 10 g seeds per lot by drying seed at 103±2°C for 17±1 hours. As a measure of the cleanness of seed, pure seed was separated from impure seed and separately weighed and purity percentage obtained. To determine the number of seeds per unit weight, two or more random samples are taken from the seedlot. Four different soil treatments were supplied (Table 2). The design was set up as completely randomized block design (CRBD) with four replications for each treatment and with 20 polybags (15 cm ×15 cm × 20 cm) for each replication and a total of 320 polybags for each one of species.

Table 1. The characteristics of seeds

Species	Seed provenance	Latitude	Longitude	Mean precipitation (mm)	Viability (%)	Purity (%)	Moisture (%)	Number (per Kg)
Cupressus arizonica	Gorgan, Iran	36° 41´ N	54° 20´ E	649	26	87	13.5	128700
Cupressus sempervirens	Gorgan, Iran	36° 41´ N	54° 20´ E	649	33	97	13.1	145306

Table 2. Soil component bulk ratio used in the experiment

Treatment	Loam Soil	Sand	Bran	Cattle manure	Decomposed litter
Nursery soil (control) (T1)	3	1	1	-	-
Control soil: cattle manure (T2)	3	1	1	1	-
Control soil: decomposed litter (T3)	3	1	1	-	1
Control soil: cattle manure: decomposed litter (T4)	3	1	1	1	1

Ten seeds were sown in a polybag on March 21 (2007) with regarding to viability. Analysis of soil treatments with four replications (Table 3) were carried out at the laboratory of Tarbiat Modares University, College of Natural Resources, Noor, Iran. Seeds were dusted with fungicide (Thiram, 0.002). Seed germination began in the first of April in both of species in all the soil treatments. Germination was recorded every 3 days for 37 days. Visible radical growth was used to define germination. Germination percent was determined by using equation 1.

$$\text{Germination} = \frac{\text{number of germinating seeds}}{\text{Number of seeds initiated}} * 100 \qquad [1]$$

After completion of field germination only one seedling (best one) per polybag was maintained to record the initial growth parameters. Proper cares, including artificial watering, weed removal each 10 day (manual), and root pruning of seedlings (twice during the growth period) were carried out regularly.

Table 3. Chemical characteristics mean of soil treatments, cattle decomposed manure and forest decomposed litter

Treatment	T1	T2	T3	T4	Cattle decomposed manure	Forest decomposed litter
C (%)	2.28	3.84	2.64	5.16	4.44	5.88
Organic matter (%)	3.92	6.6	4.54	8.88	7.64	10.11
N (%)	0.04	0.13	0.08	0.23	0.94	0.75
C/N	64.33	28.65	31.52	22.73	4.72	7.89
EC (dS/m)	0.19	0.27	0.26	0.22	0.22	0.24
K (mg/kg)	27.5	76	44	90.5	87.8	78
Ca (mg/kg)	35.35	36.15	39.52	49.5	57.05	45.7
Mg (mg/kg)	29	42	32	39.7	48.3	50
P (mg/kg)	11.76	14.7	25.2	50.4	26.1	23.2
pH	8.28	8.08	8.01	7.97	7.30	7.58

(T1): Nursery soil (control), (T2): Control soil: cattle manure, (T3): Control soil: decomposed litter, (T4): Control soil: cattle manure: decomposed litter.

Along the seed germination and seedling growth, fungicides were applied to soil disinfectant. Growth parameters (height and collar diameter) were measured four times (September, November, January and March). Shoot height (H) (stem) and root diameter (D) were calculated with accuracy of 0.1 cm and 0.1 mm, respectively (19) and (R/S) and (SQ) (equation 2) was assessed based on Thompson (10). The relative growth rate of height, (RGR_H, mm cm^{-1} d^{-1}) and relative growth rate of diameter, (RGR_D, µm mm^{-1} d^{-1}) was calculated by using equations 3 and 4 according to Ostos *et al*. (26).

$$SQ = \frac{H}{D} \qquad [2]$$

$$RGR = \frac{LnH_2 - LnH_1}{t_2 - t_1} \qquad [3]$$

$$RGR = \frac{LnD_2 - LnD_1}{t_2 - t_1} \qquad [4]$$

Where H_2 and H_1 are seedlings height (cm) in last and first measurement, respectively; D_2 and D_1 diameter (mm) in last and first measurement, respectively; t_2 - t_1 (days) are last and first sampling dates, respectively and Ln is natural logarithm. Twelve months after seed sowing, three seedlings were randomly chosen in each combination of treatment (species-soil). After separating root system and shoot (stem + needle), seedlings were put in oven and dried at 70 °C for 48h and then weighed (49). Survival rate following the seedlings counting was determined in March 2008. Seedling quality index (QI) (1), vigor index and total dry biomass increment (%) (6, 19) were calculated by using formula 5, 6 and 7, as follows:

$$\text{The seedling quality index (QI)} = \frac{\text{Total seedling dry weight}}{[\text{height (cm)/diameter (mm) + shoot dry weight (g)/root dry weight (g)}]} \quad [5]$$

$$\text{Vigor index} = \text{Germination (\%)} \times \text{Seedling total length} \quad [6]$$

$$\text{Total dry biomass increment (\%)} = \frac{\text{Total dry weight of the treatment - Total dry weight of the control treatment}}{\text{Total dry weight of the control treatment}} \times 100 \quad [7]$$

The total nitrogen soil was estimated using the Micro-Kjeldhal method (34). The total phosphorous soil was determined by Vanado-Molybdate phosphoric yellow colorimetric procedure. Potassium, calcium and magnesium soil were determined using an atomic absorption spectrophotometer after wet digestion of a 1 g sample with triple acid mixture (10 ml of $HNO3$, 4 ml of $HClO4$, and 1 ml of HCl) (34) .

Data analysis:

Data were statistically analyzed using SPSS software program (Ver.15 for Windows). Distribution was tested for normality by Kolmogorov - Smirnov, and homogeneity of variances tested by Levene test. One - Way - ANOVA was used to determination the effect of soil treatments on germination, survival, growth indices and biomass. Wherever the treatment effect was significant, Duncan multiple range test (p = 0.05) was carried out to compare the means. Growth indices as well as biomass of seedlings between two species in the same soil treatment were analyzed by t-test. Pearson correlation was conducted for finding the relationship between determined indices in *C. arizonica* and *C. sempervirens* seedlings.

RESULTS

Generally, there was a positive significant correlation among elements concentrations of N, P and K with all determined growth indices except root length. The same correlation was between Mg and diameter and quality index (QI) of arizona cypress seedlings (Table 4). The significant correlation was found among elements concentrations of N and K with all determined indices except root length and seedling dry biomass increment (%) of medite cypress seedlings. There was not a significant correlation between P with root length, root dry weight and seedling dry biomass increment (%). Also Mg element was only correlated with diameter. Element Ca was not significantly correlated with all indices under study in both species (Table 4).

Table 4. Correlation coefficients of Pearson (r) between nutrient content of soil with seed germination and seedling characteristics of *C. arizonica* and C. *sempervirens* seedlings

Parameters	*C. arizonica*					*C. sempervirens*				
	N (%)	P	K	Ca	Mg	N (%)	P	K	Ca	Mg
		Concentration (mg/kg)					Concentration (mg/kg)			
Germination (%)	0.674**	0.605*	0.585*	0.158^{ns}	0.48^{ns}	0.691**	0.615*	0.391^{ns}	0.124^{ns}	0.365^{ns}
Survival (%)	0.712**	0.502*	0.748**	0.178^{ns}	0.534*	0.595*	0.65**	0.581*	0.264^{ns}	0.458^{ns}
Shoot height (SH) (cm)	0.617*	0.667**	0.619*	0.294^{ns}	0.29^{ns}	0.649**	0.671**	0.556*	0.189^{ns}	0.497^{ns}
Diameter (D) (mm)	0.782**	0.557*	0.825**	0.252^{ns}	0.522*	0.812**	0.658**	0.764**	0.179^{ns}	0.692**
Root length (RL) (cm)	0.08^{ns}	0.19^{ns}	0.057^{ns}	0.045^{ns}	-.017^{ns}	0.222^{ns}	-.079^{ns}	0.308^{ns}	0.011^{ns}	0.245^{ns}
Vigor Index	0.67**	0.725**	0.609*	0.301^{ns}	0.402^{ns}	0.792**	0.623**	0.747**	0.136^{ns}	0.688^{ns}
S, shoot dry weight (g)	0.767**	0.717**	0.774**	0.32^{ns}	0.467^{ns}	0.544*	0.62*	0.512*	0.369^{ns}	0.309^{ns}
R, root dry weight (g)	0.728**	0.678**	0.738**	0.252^{ns}	0.491^{ns}	0.54*	0.484^{ns}	0.565*	0.472^{ns}	0.185^{ns}
Quality index (QI)	0.832**	0.69**	0.854**	0.281^{ns}	0.582*	0.661**	0.569*	0.68**	0.477^{ns}	0.334^{ns}
Seedling dry biomass increment (%)	0.671**	0.5*	0.717**	0.132^{ns}	0.417^{ns}	0.275^{ns}	0.383^{ns}	0.292^{ns}	0.011^{ns}	0.256^{ns}

** Significant at the 0.05 level; ** Correlation is significant at the 0.01 level; ns: no significant*

Table 5. Analysis of variance for effect of soil treatment on germination, survival and growth indices of *C. arizonica* and *C. sempervirens* seedlings

	C. arizonica		*C. sempervirens*	
	F	*P-values*	F	*P-values*
Germination (%)	7.181	0.005*	24.214	0.000*
Survival (%)	15.27	0.000*	6.823	0.006*
Shoot height (SH) (cm)	4.62	0.023*	5.48	0.013*
Diameter (D) (mm)	25.50	0.000*	38.95	0.000*
Root length (RL) (cm)	0.07	0.975^{ns}	0.73	0.549^{ns}
Length total seedling (cm)	1.53	0.257^{ns}	12.27	0.001*
SQ	0.20	0.895^{ns}	0.51	0.678^{ns}
RL/SH	1.93	0.177^{ns}	1.59	0.242^{ns}
Vigor index	4.83	0.02*	24.41	0.000*

* *Signifiant différences (P < 0.05)* (*^{ns}): Non signifiant différences (P > 0.05)*

Table 6. Germination, survival and growth traits and vigor index of one-year old potted seedlings of both species produced in four growing soil media

	C. arizonica				*C. sempervirens*			
	(T1)	(T2)	(T3)	(T4)	(T1)	(T2)	(T3)	(T4)
Germination (%)	19.13 (1.2)b	21.88 (0.55)a	22.88 (0.55)a	24 (0.61)a	22.25 (1.03)c	28.38 (0.69)b	29.75 (0.25)ab	31.13 (0.97)a
Survival (%)	79.38 (2.2)b	92.5 (1.33)a	91.25 (1.25)a	93.75 (0.81)a	79.38 (1.75)b	91.25 (1.25)a	91.25 (0.81)a	94.38 (1.13)a
Shoot height (SH) cm)	17.91 (2.46)b	28.35 (2.18)a	27.5 (0.94)a	30.51 (3.91)a	16.71 (1.6)b	21.53 (2.51)ab	23.74 (1.87)a	27 (1.11)a
Diameter (D) (mm)	3.06 (0.18)b	4.59 (0.18)a	4.34 (0.17)a	4.82 (0.12)a	3.04 (0.08)c	4.41 (0.16)b	4.52 (0.08)b	4.93 (0.18)a
Root length (RL) (cm)	21.07 (4.49)	20.4 (2.56)	20.21 (3.71)	22.17 (1.98)	23.46 (3)	27.7 (2.04)	25.41 (0.99)	25.68 (1.38)
Length total seedling (cm)	38.98 (4.56)	48.74 (4.35)	47.71 (3.71)	52.68 (5.8)	40.16 (1.64)	49.2 (1.77)	49.15 (1.67)	52.68 (0.83)
SQ	5.81 (0.51)	6.24 (0.63)	6.37 (0.39)	6.29 (0.7)	5.46 (0.39)	4.86 (0.45)	5.28 (0.5)	5.48 (0.17)
RL/SH	1.25 (0.34)	0.72 (0.06)	0.74 (0.14)	0.74 (0.05)	1.49 (0.3)	1.35 (0.19)	1.09 (0.1)	0.96 (0.08)
Vigor index	744.53 (96.6)b	1060.95 (74.76)a	1086.07 (60.84)a	1263.39 (141.12)a	890.36 (34.2)c	1399.68 (84.39)b	1463.06 (59.03)ab	1641.38 (72.35)a

Values in parenthesis are standard error.
Within the same column the means followed by different letters are statistically different (P < 0.05), according to Duncan test.
(T1): Nursery soil (control), (T2): Control soil: cattle manure, (T3): Control soil: decomposed litter, (T4): Control soil: cattle manure: decomposed litter.

Both species significantly (p<0.05) varied in germination, survival, shoot height (SH) (cm), diameter (D) (mm) and vigor index in different soil treatments (Table 5).

Generally, most of these characters had greater rate in soils consisting organic matter (Table 6). Furthermore, relative growth rates (RGR) of height and diameter showed decreasing process in during time for each soil treatment. The greatest RGR_H in each measurement time belonged to 2 and 4 treatments in both species and the lowest amount was observed in control treatment (Fig. 1). The greatest RGR_D allocated to *C. sempervirens* species in control treatment but it declined duration time (Fig. 2).

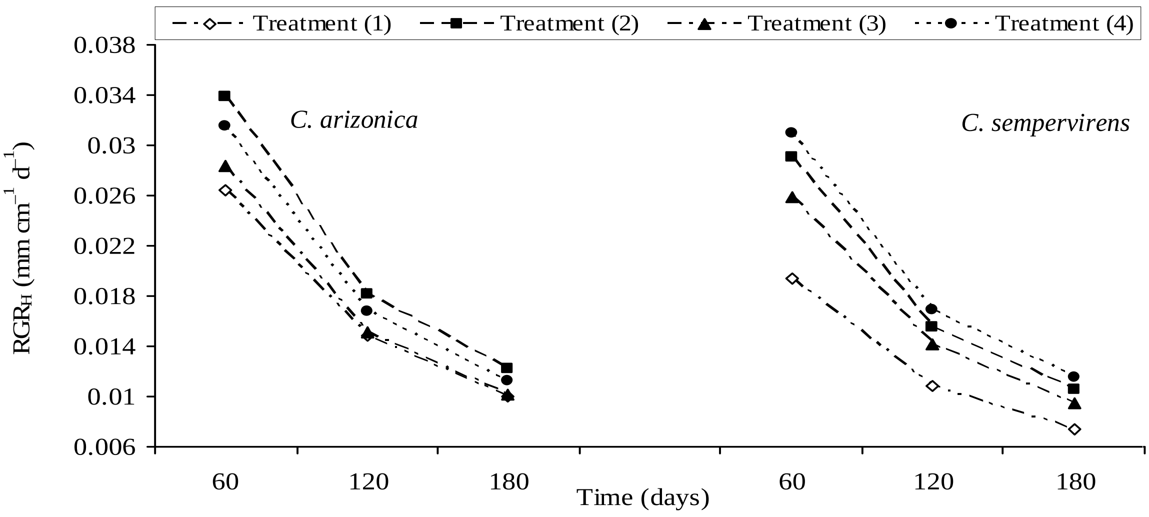

Fig. 1. Relative growth rate of height (RGR_H, mm cm^{-1} d^{-1}) for investigated species in different growing media

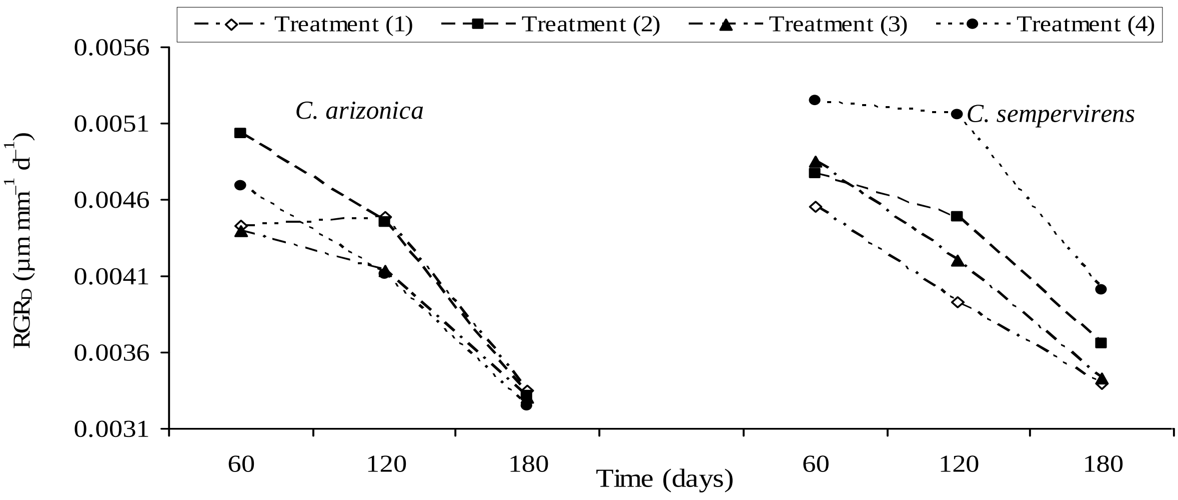

Fig. 2. Relative growth rate of diameter (RGR_D, µm mm^{-1} d^{-1}) for investigated species in different growing media

Soil treatment affected *S*, shoot dry weight (g), R, root dry weight (g), total dry weight (g), R/S and Quality Index (QI) of *C. arizonica* and Quality Index (QI) of *C. sempervirens* (Table 7). Whereas most of parameters in *C. arizonica* had the highest values on soil treatment 4 and the lowest values on soil control (Table 8). In *C. sempervirens* increase of organic matter raised the Quality index (QI).

Table 7. Analysis of variance affected by soil treatment for biomass parameters in *C. arizonica* and *C. sempervirens* seedlings

		S, shoot dry weight (g)	R, root dry weight (g)	Total dry weight (g)	R/S	Quality Index (QI)	Total dry biomass increment (%)
C. arizonica	F	8.12	6.84	7.86	3.56	17.66	4.62
	P-values	0.003*	0.006*	0.004*	0.047*	0.000*	0.023*
C. sempervirens	F	2.78	2.89	3.42	0.15	5.68	0.64
	P-values	0.086^{ns}	0.079^{ns}	0.052^{ns}	0.926^{ns}	0.012*	0.600^{ns}

* *Signifiant (P < 0.05); (ns): Non signifiant*

Table 8. Biomass traits in one-year old potted *C. arizonica* and *C.sempervirens* seedlings produced in four growing soil media

	C. arizonica				*C. sempervirens*			
	(T1)	(T2)	(T3)	(T4)	(T1)	(T2)	(T3)	(T4)
S, shoot dry weight (g)	1.51 (0.27)c	5.32 (0.74)ab	4.1 (0.47)b	6.34 (1.14)a	1.57 (0.36)	2.36 (0.58)	2.57 (0.35)	3.17 (0.2)
R, root dry weight (g)	0.63 (0.12)b	1.89 (0.26)a	1.46 (0.18)a	2.07 (0.35)a	0.78 (0.16)	1.25 (0.19)	1.31 (0.22)	1.59 (0.21)
Total dry weight (g)	2.13 (0.39)b	7.21 (1)a	5.54 (0.64)a	8.41 (1.49)a	2.35 (0.48)	3.61 (0.75)	3.89 (0.48)	4.76 (0.37)
R/S	0.41 (0.03)a	0.36 (0.01)ab	0.36 (0.01)ab	0.33 (0.01)b	0.56 (0.09)	0.57 (0.07)	0.53 (0.08)	0.5 (0.05)
Quality index (QI)	0.26 (0.04)c	0.78 (0.06)ab	0.6 (0.06)b	0.88 (0.09)a	0.32 (0.07)b	0.52 (0.06)a	0.52 (0.04)a	0.63 (0.05)a
Total dry biomass increment (%)	0	2.76 (0.9)a	1.8 (0.6)ab	3.2 (0.8)a	0	1.3 (1.2)	1.3 (1)	1.5 (0.7)

Within the same column the means followed by different letters are statistically different (P < 0.05), according to Duncan test. (T1): Nursery soil (control), (T2): Control soil: cattle manure, (T3): Control soil: decomposed litter, (T4): Control soil: cattle manure: decomposed litter. Values in parenthesis are standard error.

DISCUSSION

In this study, high correlation was observed among some nutritional elements as N and P in both species with seed germination and followed improvement growth indices. Similar instances were also found by Durgapal et al. (2) whereas combination of soil organic matter improved the seed germination and subsequent growth of *Cedrus deodara* and *Pinus wallichiana* under nursery conditions. In the other hand, one of the early events during seed germination is mobilization of seed reserves due to enzymes activity because it supplies substrates for functioning of different metabolic processes, including respiration and various anabolic pathways, which are essential for growth of embryonic axes (37). Similar instances were also found by Sheikh and Abdul Matin (5) on Shisham (*Dalbergia sissoo* Roxb.) seed germination. The highest germination percentage resulted in cow-dung mixture soil medium might be due to it helps to develop and maintain good soil structure and porosity, water holding capacity, aeration, permeability and contribute in raising Cation Exchange Capacity (CEC) of the soil.

High correlation among some nutritional elements as N, P and K soil with survival and growth indices in present study for both species may be due to positive effect of soil nutritional elements on improvement of growth and biomass seedling (24). This finding on seedling is in line with Puértolas et al. (22) on *Pinus* spp., Navarro et al. (42) on *Abies pinsapo* and Luis et al. (48) on *Pinus canariensis*. Also, Trubat et al. (40) showed that survival was highly dependent on the species and the nutritional conditions. Since in our study no significant correlation was detected between Ca and Mg concentration and survival, our data suggest that the role of Ca and Mg may be less important than that of other variables. In fact, increased organic matter in soil as plant hormone - like activity is caused plant stimulation for nutrient absorption, enzymatic and metabolism activity increase in plant and has an influence on protein synthesis and performance better (11). So, the changing rate of nutrient and resource availability is caused higher absorption of C by plant and can have a significant influence on the photosynthetic efficiency of needles (43).

Photosynthetic efficiency is also dependent on the amount of incident light. Light availability can interact with soil resource availability in influencing seedling physiology and growth (43). Similarly, Kaakenin et al. (44) reported significant correlation ($p<0.05$) between organic matter of soil with growth and biomass in norway spruce (*Picea abies* (L.) H. Karst) seedlings whereas the increase of nutrient content of plant tissue (NPK) increased the growth and biomass. Shadanpour et al. (17) studied the effect of cow manure vermicompost on the growth of Marigold. The largest stem diameter, flower size, shoot fresh and dry weight were related to mixture of 60% v/v vermicompost with 30% v/v sand plus 10% v/v soil, but the highest plant height obtained at 60% peat plus 40% perlite. Cow manure vermicompost was better than peat in many attributes of plant growth and compost effect also was better than peat. On the other hand, organic matters are effective in make favorable conditions for plant performance as suitable aeration and water content regime (35).

In this study non significant correlation were observed in soil Ca content in both species with growth indices and biomass that is probably due to, Ca is not as mobile as Mg in plants and thus it is being accumulated in older plant tissues (9). Significant correlation Mg with diameter and Quality index exhibited that probably seedlings need to this element that is higher than Ca. Root length is effective in absorption of Mg (7), But in the present study there is no significant correlation between soil organic matter and root length; therefore, the lack of Mg correlation with measured indices could be explained.

Non - significant correlation between root length (cm) and soil organic matter may be due to sufficient nutrient in root zone preventing the development of root system (18, 25). Also, a less nutrient availability could comparatively enhance root growth (26). However, environmental factors such nutrient may affect the growth and physiology of roots, but seem to more heavily influence growth of older seedlings (13). Also it was thought to be due to microbial presence or its activity in the growth media during one year period. In contrast, in previous studies carried out on Holm Oak (*Quercus ilex L.*) *and* Stone Pine (*Pinus pinea L.*) (29) organic fertilization increased root growth because of nutrient supply. It seems that difference with findings of the present research is probably due to two years period of examination. Also, the absence of growth may be associated with the environmental conditions with cold weather.

Generally, organic matter with improvement of the physical, chemical and biological properties of soils such as acceleration of microorganism's microbial processes and of absorbable nutrient for plants enhances soil aeration, influences on seed germination and seedling growth and provides suitable conditions for seedling production (36). In the present, RL/SH and SQ ratios under nutrient supply of soil conditions for both species was not significant. It is probably so that the organic matter can increase water and nutrient absorption and return carbon and nutrient contents to a balance more favorable for storage (14). Also the 'functional equilibrium' between root and shoot growth varies widely between species and is strongly modified by internal and external factors (26). Also, a high RL/SH value can indicate low foliage development and therefore negatively influence the photosynthesis process within the plant (38).

RGR is ecologically important because it is one of the primary variables influencing on plant structure. Environmental factors can provoke changes in RGR (12). It seems that in our study RGR development is due to suitable light and nutrient availability affecting on growth and larger allocation of biomass in seedlings (3). So clearly, in this survey the environmental factors as soil, species and time in RGR_H are more effective than those in RGR_D. This response is normal, because seedlings in primary growing stages are benefited from higher growth in height than in diameter (46). The greatest relative growth rate obtained in organic matter treatments shows that organic matters affect the physiological potential of growth. The patterns with RGR and nutrient supply are the same as reported previously by Ostos et al. (26). Larger seedlings generally have a greater photosynthetic active surface in terms of needle biomass. Thus, they have a higher net carbon gain through a higher photosynthetic surface. Enhanced carbon gain increases root biomass which may increase the survival rate. Increase in biomass is due to accumulation of nutrient proportionally more intense in the first phases of plant life (27). In *C. arizonica*, total dry biomass increment (%) in organic matter treatments, and its significant correlation with N, P and K elements indicates that soil nutrient has an important role in plant dry biomass production (19). The maximum value in both species for QI is in control soil: cattle manure: decomposed litter treatment (T4). This implies that the plant experiences high development, while the aerial and radical parts are balanced (24). Plants developed in organic matter treatments had the greatest values for QI in other studies (47, 38). This suggests good potential for survival and growth in the field.

In general, from the present investigation it can be concluded that germination, survival, growth and biomass of *C. arizonica* and *C. sempervirens* were enhanced by using the organic matter treatments. This indicates that organic matter can be a suitable growth medium component, depending amount of cattle manure and decomposed litter, the plant growing requirement, and the specific physical characteristics desired in the growth media. This is while, that other organic components like, homestead - organic wastes, agricultural wastes, bio - fertilizers, sugarcane wastes, pine bark, and coconut fiber may advance the quality and quantity of seedling production.

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