

## Evaluation of growth potential of Crimean juniper (*Juniperus excelsa* Bieb.) seedlings for the first growing season under Tekir forest nursery conditions in Kahramanmaras, Turkey.

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**Abstract :** In this study, growth potential of Crimean juniper (*Juniperus excelsa* Bieb.) seedlings for the first growing season under Tekir Forest Nursery conditions in Kahramanmaras was evaluated. The height growth of Crimean juniper seedlings was relatively close to that of Lebanon cedar (*Cedrus libani* A. Rich.) seedlings produced in the same nursery, but their root collar diameters were fairly lower than that of Lebanon cedar seedlings. According to coniferous seedling standards of Turkish Standards Institute, the height growth of Crimean juniper seedlings was fairly good, but their root collar diameters were slightly small. In this respect, that 2+0 or 1+1 Crimean juniper seedlings are used in reforestation activities in the region would be more useful than 1+0 seedlings.

**Key words :** *Juniperus excelsa*, Seedling, Growth, Reforestation.

### Introduction

Crimean juniper (*Juniperus excelsa* Bieb.) is one of the major tree species of Turkey. In Turkey, it generally occurs in northern, western, central, and southern Anatolia, especially the Taurus and Anti-Taurus Mountains (Yaltirik, 1993) and is generally distributed at elevations between 500 and 2500 meters on the areas going up to the boundaries of steppe in the interior parts of the mountains, and resistant to drought and frost damages (Saatcioglu, 1969). Crimean juniper forms pure and mixed stands in Turkey and usually occurs on shallow, stony, and poor sites. Therefore, this species is very important for reforestation activities aiming at the prevention of soil erosion especially in arid sites.

However, juniper seeds have embryo dormancy and sometimes both embryo and seed coat dormancy (Saatcioglu, 1971) and germination of juniper seeds is often delayed (Young and Young, 1994). Therefore, seeds of Crimean juniper usually germinate in the second spring after sowing (Elicin, 1977; Demirci and Avsar, 2000). Likewise, germination percentage of the seeds has also been low due to probably low filled seed proportions. In this respect, Crimean juniper seedling production is very

limited in the forest nurseries, and there is very limited usage of Crimean juniper seedlings for reforestation activities.

Lebanon cedar (*Cedrus libani* A. Rich.) and black pine (*Pinus nigra* Arn. subsp. *pallasiana* (Lamb.) Holmboe) are the species largely used for reforestation activities in Turkey, and seedlings of these species have been generally used as 1+0 and 2+0, respectively in the Kahramanmaras region. According to Saatcioglu (1969), Lebanon cedar, black pine, and junipers are known as fast, moderately fast, and slow growing species, respectively. Khattak and Sheikh (1981) and Ciesla *et al.* (1998) stated that the growth of Crimean juniper trees is very slow and slow, respectively. Likewise, Eler (1988) determined that Crimean juniper grew slower in terms of diameter and height growth than Lebanon cedar and black pine. However, in Turkey, there are not sufficient studies regarding the growth of Crimean juniper seedlings under the nursery conditions having more suitable site conditions than that of its natural sites.

In this study, growth potential of Crimean juniper seedlings for the first growing season under Tekir Forest Nursery conditions was evaluated. For this, root collar diameter and

height values of 1+0 Lebanon cedar, black pine, and Crimean juniper seedlings grown at Tekir Forest Nursery in Kahramanmaras were compared. Thus, especially the possibilities of using 1+0 Crimean juniper seedlings in reforestation activities in the region were discussed.

### Materials and Methods

The study was carried out at Tekir Forest Nursery (37°53'N, 36°37'E). The nursery is located in Tekir town of Kahramanmaras province and at an elevation of 980 meters. In the nursery, soil texture is generally sandy clay loam, and soil reaction (pH) values range 7.86 to 8.20 (Kimyon *et al.*, 1994). The mean annual temperature and rainfall of Tekir are 11.2°C and 400.9 mm, respectively. These climatic data were obtained by adjusting the data of Goksun Meteorologic Station (Anonymous, 1974) that is the nearest station to Tekir.

Measurements of the seedlings were carried out on 18 October 2000 by observing bud formation of the seedlings at the end of the growing season. For each tree species, 60 seedlings were randomly chosen from the seedbeds. Root collar diameter measurements were taken just above soil surface and height measurements were taken between soil surface and the top of the terminal bud. Root collar diameters and heights were measured to the nearest 0.01 and 1 mm, respectively. Seed sources and sowing dates of the species measured in the nursery are given in Table 1.

As indicated in the table, Crimean juniper and Lebanon cedar seeds were sown in the winter and seeds of black pine were sown in the spring. Crimean juniper seeds germinated in the second spring after sowing, while seeds of the other two species germinated in the first spring. Therefore, at the time of the measurement, the seedlings of three species were 1-year-old. Besides, Lebanon cedar and black pine seedbed densities were similar, but Crimean juniper seedbed density was lower than that of the other two species due to

low germination percentage of Crimean juniper seeds.

After obtaining root collar diameter and height data of 1+0 seedlings, statistical values regarding these data were found. Besides, in order to determine whether there is a statistically significant difference in root collar diameter and height values of the species, one-way analysis of variance (ANOVA) was performed. Then, Duncan's multiple range test was performed to determine different groups from each other (Kalipsiz, 1981). Statistical analysis of the data was carried out by using Statgraphics 5.0 program. In addition, the distributions of root collar diameter and height values of the species to coniferous seedling standards of Turkish Standards Institute (Anonymous, 1988) were examined.

### Results

**Root collar diameter** : Statistical values regarding the root collar diameter values of the species are given in Table 2. As seen in the table, the mean root collar diameters were 2.65, 1.90, and 1.60 mm for Lebanon cedar, Crimean juniper, and black pine seedlings, respectively.

According to the results of one-way analysis of variance (Table 2), the root collar diameter values of three species were significantly different ( $p=0.001$ ). According to the results of Duncan's multiple range test (Table 2), there was not any homogeneity ( $p=0.05$ ) in terms of the root collar diameter values among three species. In other words, the highest root collar diameter growth was in Lebanon cedar, then Crimean juniper and black pine. Root collar diameters of Lebanon cedar seedlings were fairly larger than of Crimean juniper and black pine seedlings.

On the other hand, according to coniferous seedling standards of Turkish Standards Institute (Anonymous, 1988), in terms of the root collar diameter values, 95.0% and 5.0% of Lebanon cedar seedlings were good-quality and poor-quality seedlings, respectively.

These proportions were 41.67% and 58.33% for Crimean juniper seedlings, and 5.0% and 95.0% for black pine seedlings, respectively.

**Height** : Statistical values regarding the height values of the species are given in Table 3. As seen

**Table – 1** : Seed sources and sowing dates of the species measured at Tekir Forest Nursery.

Tree species	Seed source	Sowing date
Crimean juniper	Heyiktepe (Kahramanmaras)	22 December 1998
Lebanon cedar	Heyiktepe (Kahramanmaras)	25 December 1999
Black pine	Camurlu (Goksun)	06 May 2000

**Table – 2** : Statistical values and the results of the one-way ANOVA and Duncan's multiple range test regarding the root collar diameter values of the species.

Tree species	Mean* (mm)	SD (mm)	Min. (mm)	Max. (mm)	CV (%)	F-ratio	P-value
Lebanon cedar	2.65a	0.53	1.67	4.26	20.15	107.089	0.0000
Crimean juniper	1.90b	0.39	0.95	2.90	20.30		
Black pine	1.60c	0.24	1.11	2.19	14.79		

SD : Standard deviation, CV : Coefficient of variation

\*Means followed by the different letters are significantly different ( $p=0.05$ )

**Table – 3** : Statistical values and the results of the one-way ANOVA and Duncan's multiple range test regarding the height values of the species.

Tree Species	Mean* (cm)	SD (cm)	Min. (cm)	Max. (cm)	CV (%)	F-ratio	P-value
Lebanon cedar	10.75a	2.48	4.50	17.40	23.06	223.805	0.0000
Crimean juniper	9.76b	2.21	4.10	17.30	22.61		
Black pine	3.65c	0.94	2.00	6.40	25.81		

SD : Standard deviation, CV : Coefficient of variation

\*Means followed by the different letters are significantly different ( $p=0.05$ ).

in the Table, the mean heights were 10.75, 9.76, and 3.65 cm for Lebanon cedar, Crimean juniper, and black pine seedlings, respectively.

According to the results of one-way analysis of variance (Table 3), the height values of three species were significantly different ( $p=0.001$ ). According to the results of Duncan's multiple range test (Table 3), there was not any homogeneity ( $p=0.05$ ) in terms of the height values among three species. In other words, the highest height growth was in Lebanon cedar, then Crimean juniper and black pine. However, the height values of Lebanon cedar and Crimean juniper seedlings were relatively close to each

other, but the height values of black pine were different.

On the other hand, according to coniferous seedling standards of Turkish Standards Institute (Anonymous, 1988), in terms of the height values, 90.0%, 8.33%, and 1.67% of Lebanon cedar seedlings were the best-quality, good-quality, and poor-quality seedlings, respectively. These proportions were 3.33%, 5.0%, and 91.67% for black pine seedlings, respectively. 100.0% of Crimean juniper seedlings were the best-quality seedlings.

## Discussion

In a study carried out on 1-year-old, 60 Crimean juniper seedlings on 17 December 1996 at Tekir Forest Nursery, the mean height was found to be 13.1 cm (Demirci and Avsar, 2000). In another study carried out on 1-year-old, 30 seedlings for each tree species in September and October 1999 in the same nursery, it was reported that the mean heights were 12.0, 11.8, and 6.2 cm for Crimean juniper, Lebanon cedar, and black pine, respectively (Akbaba, 2000). These results also indicate that Crimean juniper seedlings have a height growth potential close to that of Lebanon cedar seedlings for the first growing season under Tekir Forest Nursery conditions.

In fact, Gokmen (1970) stated that junipers grow fast for early years after establishment, and then their growth decreases. Eler and Cetin (1994) also stated that Crimean juniper seedlings grew fairly well under the nursery conditions. Eler and Karakus (1994) observed that Crimean juniper seedlings grown under the nursery conditions had better height growth than the natural seedlings of which growth was very slow. This most probably results from being more suitable of the nursery site conditions such as water, nutrient, and soil depth, etc.

On the other hand, considering the height/root collar diameter (mm/mm) ratio, this ratio was found to be 51.37, 40.57, and 22.81 for Crimean juniper, Lebanon cedar, and black pine, respectively. Although Crimean juniper seedlings had lower seedbed density than that of the other two species, it was observed that Crimean juniper seedlings could not produce large diameter seedlings. In fact, the studies regarding *Picea orientalis* (Eyuboglu *et al.*, 1984) and *Pinus brutia* (Keskin, 1992) revealed that low seedbed density affected root collar diameter positively, while seedbed density did not affect seedling height.

According to coniferous seedling standards of Turkish Standards Institute (Anonymous, 1988), in terms of height growth, all of the 1+0 Crimean juniper seedlings measured in the study are the best-quality seedlings. It has been suggested that the root

collar diameters of coniferous seedlings to be used should be at least 2 mm (Anonymous, 1988). 58.33% of Crimean juniper seedlings have the root collar diameters that are lower than this value. Therefore, even height growth of 1+0 Crimean juniper seedlings grown at Tekir Forest Nursery is good; it is possible to say that the root collar diameters of these seedlings are insufficient for reforestation activities. Likewise, Khattak and Sheikh (1981) reported that although 1-year-old Crimean juniper seedlings can be outplanted, 2-year-old stock is sturdier and better able to stand the rigours of field planting. Urgenc (1986) also emphasized that small diameter seedlings are more sensitive to high temperatures on the soil surface than large diameter seedlings. Therefore, that 2+0 or 1+1 Crimean juniper seedlings are used in reforestation activities in the region would be more useful than 1+0 seedlings. However, these evaluations should also be supported by field tests.

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