

Seed sources, seed and seedling productions in exotic Maritime pine and Black locust in Turkish forestry

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Abstract: Exotic species, could be defined, which has distribution at outside of natural area shortly. The species introduce because of their advantages such as fast growing, resistance to arid area, and non-wood forest products to outside of natural area. In this study, seed sources, seed and seedling productions of exotic Maritime pine (*Pinus pinaster* Ait.) and Black locust (*Robinia pseudoacacia* L.) for Turkish forestry were examined based on forestry inventory of Türkiye. Maritime pine has 53.825 ha forest area of which 7% is unproductive, while area of Black locust is not detailed in inventory of Turkish forestry. Maritime pine has 5 seed stands at 479.9 ha and a seed orchard at 3.3 ha, while Black locust has only one seed stand at 61.9 ha in Türkiye. In the last decade, 57,291,346 and 109,797,738 seedlings from 9323 kg and 22392 kg seeds were produced from these seed sources in Maritime pine and Black locust, respectively.

Keywords: Afforestation, *Pinus pinaster*, Plantation, *Robinia pseudoacacia*, Silviculture

1. Introduction

Exotic forest trees could be defined as non-native tree species planted or introduced outside of their natural geographic range (Zobel and Talbert 1984) because of their advantages such as fast growing, erosion control, resistance to arid area or other biotic and abiotic factors, and non-wood forest products, balancing of supply and demand of forest products. They could have also some risks such as adaptation, low growth performance or survival at outside of their natural geographic range. However, the species are getting importance with their advantages. It is known that Türkiye is one of the richest countries for natural and exotic (i.e, *Pinus pinaster*, *P. radiata*, *Abies* sp., *Larix* sp., *Eucalyptus* sp., *Douglas* sp., *Robinia pseudoacacia*) forest trees with 23.4 million ha forest area, of which 9.5 million ha is unproductive (OGM 2026). For this forest area, seed orchards and seed stands are main generative and vegetative production material to produce improved seedlings. Some details of seed sources including exotic species in Turkish forestry are given in Table 1 (OGM 2024), while they can change for the years (Öztürk and Yıldız 2022). In these sources (Table 1), only Maritime pine (*Pinus pinaster* Ait.) has a seed orchard established at 3.3 ha as an exotic species in Türkiye (OGM 2022).

Exotic tree species are introduced outside their natural distribution ranges because of their potential advantages for forestry, including rapid growth, adaptability to adverse environmental conditions, wood production, soil improvement, erosion control, and the production of non-wood forest products (Branco et al. 2015; Koskela et al. 2014; Salmón Rivera et al. 2015). Their successful utilization in afforestation and plantation forestry depends largely on their adaptation to local ecological conditions and the availability of appropriate reproductive material (Koskela et al. 2014). In this study, seed sources, seed stands, and seed orchards are essential components of sustainable forest management (İçgen et al. 2006) because they provide a reliable supply of genetically and physiologically suitable seeds for nursery production and subsequent afforestation activities (Wambugu et al. 2023). The identification and management of appropriate seed sources are particularly important for exotic species, as their genetic resources in introduced regions are generally more limited than those of native species (Koskela et al. 2014). Seed origin may influence germination, seedling growth, survival, phenology, and adaptation to environmental stresses (Pawłowski et al. 2024); therefore, the establishment and effective utilization of suitable seed sources are critical for maintaining successful plantations. Maritime pine and Black locust (*Robinia pseudoacacia* L.) are important exotic tree species that have been introduced and cultivated in many regions outside their natural ranges. Maritime pine has considerable potential for wood production and afforestation, particularly under Mediterranean climatic conditions, owing to its relatively rapid growth and adaptation to dry environments (Fidalgo Fonseca et al. 2022). Black locust is also widely used because of its rapid early growth, nitrogen-fixing capacity, coppicing ability, tolerance of relatively poor soils, and valuable wood, and it has been utilized for timber and fuelwood production, erosion control, land rehabilitation, and other forestry purposes (Nicolescu et al. 2020; Vítková et al. 2017).

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Table 1. Some details of seed sources in Turkish forestry

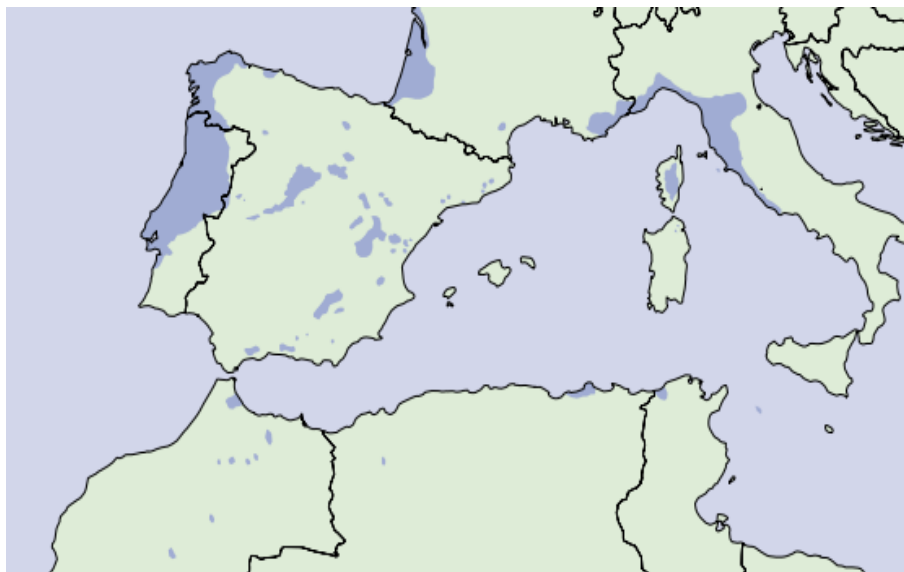
Source type	Number of species	Number of source	Total area (ha)
Seed orchard	12	189	1485,7
Seed stand	32	311	40337,9

Türkiye has considerable ecological variation and a long history of afforestation and forest rehabilitation activities, in which both native and selected exotic tree species have been used according to site conditions and management objectives (Çalışkan and Boydak 2017). Although *P. pinaster* and *R. pseudoacacia* have been used in Turkish forestry for different purposes, information integrating their forest areas, registered seed sources, seed production, and subsequent seedling production is limited. This information is important for evaluating the current reproductive-material infrastructure of these species and for determining the extent to which available seed sources support nursery production and afforestation activities. In particular, information on the number and area of seed stands and seed orchards, together with quantities of collected seeds and produced seedlings, can provide a practical basis for future planning of seed collection, seed-source management, nursery production, and the utilization of exotic species in Turkish forestry. In this study, seed sources, seed and seedling productions of exotic Maritime pine and Black locust which were used in Turkish forestry widely used in Turkish forestry for various purposes were examined based on forestry inventory of Türkiye to contribute to potential forestry purposes.

2. Maritime pine (*Pinus pinaster* Ait.)

Maritime pine (*Pinus pinaster* Ait.) is a broadly distributed conifer in the western Mediterranean Basin, in Southern Europe and Africa, and the Atlantic coast in Portugal, Spain and France together with limited island distribution in Corsica, and northern Sardinia, and a marginal stand in Pantelleria (Alía and Martín 2003, Figure 1) because of affecting present natural distribution of two main factors: a high degree of fragmentation, and human impact (Alía and Martín 2003). The species is a valuable source of timber, used in construction, furniture, and as a renewable energy source, and also resin tapped to make rosin and turpentine. Its resistance to harsh conditions also makes it a popular choice for reforestation, landscape, and preventing soil erosion practices (Alía and Martín 2003).

Maritime pine is also widely used for various purposes in Turkish forestry as an exotic pine. Maritime pine has 53.825 ha planted forest area of which 7% is unproductive in Türkiye (OGM 2026). It has five seed stands at 479.9 ha and a seed orchard at 3.3 ha (OGM 2024) in Türkiye. In the last decade, 57.291,346 seedlings from 9323 kg seeds were produced from these seed sources in Maritime pine (OGM 2026, Figures 2 and 3). As seen from the Figures 2 and 3, seed and seedlings productions changed for the years based on interval of good seed year, afforestation programme. However, there could be many biotic and abiotic factors could impact on quality and quantity of seedling production (*i.e.*, Eser 2021a,b; Eser 2025; Çetinkaya 2024, 2025; Çetinkaya et al. 2026a).

**Figure 1.** Distribution range of maritime pine (Alía and Martín 2003)

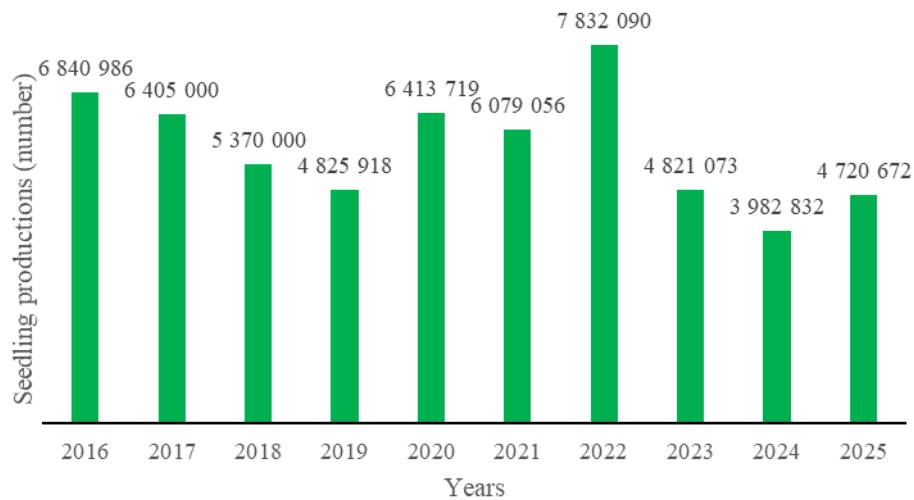


Figure 2. Seedling productions of maritime pine for the last decade

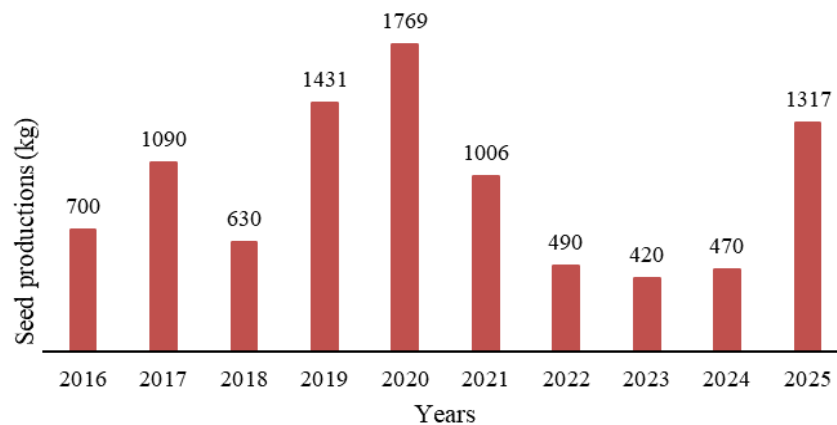


Figure 3. Seed productions of maritime pine for the last decade

3. Black locust (*Robinia pseudoacacia* L.)

Black locust (*Robinia pseudoacacia* L.) introduced to Europe in the seventeenth century is a fast-growing deciduous tree native to North America. It is now found naturally in most of the continent, from Italy to southern Norway, and is one of the most common non-native species in Europe (Puchalka et al. 2021). Black locust is of high economic importance in both North America and Europe. Black locust is hardy and extremely tolerant to different types of soil, a light-demanding, pioneer species, able to grow under harsh conditions. The tree grows at altitudes from sea level up to 1 600 m, reaching

heights of 12-30 m, and is characterized by its deeply furrowed bark and fragrant white flowers in late spring, which are a valuable source of nectar for bees (Puchalka et al. 2021).

Black locust is also an exotic forest tree widely used in Turkish forestry. The species has only one seed stands at 61.9 ha in Türkiye (OGM 2024, Figure 4). In the last decade, 109.797,738 seedlings and 22392 kg seeds which changed for the years were produced from the seed source of Black locust (OGM 2026, Figures 5 and 6). There could be many biotic and abiotic factors could impact on quantity of seed productions in forest tree species (i.e., Eser 2024; Çetinkaya et al. 2026b).



Figure 4. Seed stand of black locust in Isparta

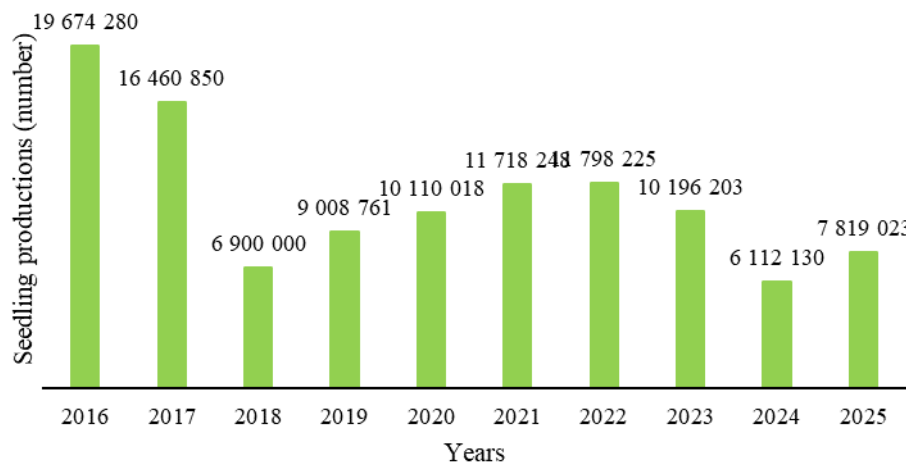


Figure 5. Seedling productions of black locust for the last decade

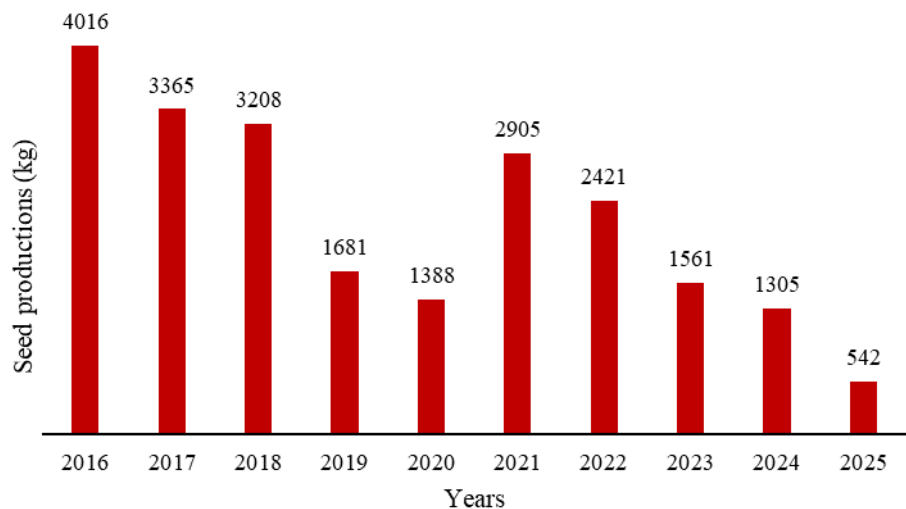


Figure 6. Seed productions of black locust for the last decade

4. Conclusions

This study evaluated the seed sources and seed and seedling production of maritime pine and black locust, which are used as exotic species in Turkish forestry. Although both species have an established importance in forestry practices in Türkiye, their seed-source infrastructures differ in extent and structure. While maritime pine has a more developed seed-source structure, black locust relies on a limited number of registered seed sources, yet draws attention with its high level of seedling production and demand. Therefore, the number and area of seed sources, their geographical distribution, genetic structure, seed and seedling quality, and adaptation to planting sites should be evaluated together. The plantation performance of seedlings obtained from different seed sources should be considered together with seedling quality; the effects of differences among seed sources on field success should be investigated through provenance trials and long-term field experiments.

Annual inventorial data indicated importance of the species for Turkish forestry, plantation performances from different seed sources of the species should be examined together with seedling quality. Selection and establishment of the seed sources should be also supported by genomic selection.

References

- Alía R, Martín S (2003). EUFORGEN Technical Guidelines for genetic conservation and use for Maritime pine (*Pinus pinaster*). International Plant Genetic Resources Institute, Rome, Italy.
- Branco M, Brockerhoff EG, Castagneyrol B, Orazio C, Jactel H (2015). Host range expansion of native insects to exotic trees increases with area of introduction and the presence of congeneric native trees. *Journal of Applied Ecology* 52:69–77.
- Çalışkan S, Boydak M (2017). Afforestation of arid and semiarid ecosystems in Turkey. In *Turkish Journal of Agriculture and Forestry* 41:317-330.
- Çetinkaya D (2024). Effects of humic substance application on the development of Anatolian black pine seedlings. *Theoretical and Applied Forestry* 4: 1-5.
- Çetinkaya D (2025). Impact of ash waste material on morphological traits of Kurrajong (*Brachychiton populneus* Schott.) and Scots pine (*Pinus sylvestris* L.) seedlings. *Pakistan Journal of Agricultural Sciences* 62(2):197-204.
- Çetinkaya D, Çetinkaya Z, Bilir N (2026a). Biopriming with plant growth-promoting bacteria enhances germination and stress tolerance of *Pinus nigra* seeds under drought and salinity stress. *Front. For. Glob. Change* 9:1905933.
- Çetinkaya D, Oktan E, Bilir N (2026b). Conversion loss among strobili, conelets, and cones and its impact on effective population size: a case study in *Cedrus libani*. *Front. For. Glob. Change* 9:1840736.
- Eser Y (2021a). Influence of transplanting on seedling morphology and quality in Taurus cedar. *Artvin Çoruh University Journal of Forestry Faculty* 22(1):67-72.
- Eser Y (2021b). Morphological characteristics of containerized and bare-root seedlings in *Juniperus excelsa* and *J. foetidissima*. *Fresenius Environmental Bulletin* 30:8351-8355.
- Eser Y (2024). Variation in cone production of Anatolian Black pine [*Pinus nigra* Arnold. subsp. *pallasiana* (Lamb.) Holmboe] over habitat classes. *Biol Bull Russ Acad Sci*. 51:121-127
- Eser Y (2025). Height and diameter performances in afforestation of Taurus cedar and Crimean juniper seedlings: A case study from southern Turkey. *Reforesta* 21:54- 58.
- Fidalgo Fonseca T, Cristina Gonçalves A, Lousada J (2022). Maritime pine, Its biological and silvicultural traits for the basis of natural resources: An overview. In *Conifers - recent advances*. IntechOpen, 102860
- İçgen Y, Kaya Z, Çengel B, Velioglu E, Öztürk H, Önde S (2006). Potential impact of forest management and tree improvement on genetic diversity of Turkish red pine (*Pinus brutia* Ten.) plantations in Turkey. *Forest Ecology and Management* 225:328–336.
- Koskela J, Vinceti B, Dvorak W, Bush D, Dawson IK, Loo J, Kjaer ED, Navarro C, Padolina C, Bordács S, Jamnadass R, Graudal L, Ramamonjisoa L (2014). Utilization and transfer of forest genetic resources: A global review. *Forest Ecology and Management* 333:22-34.
- Nicolescu VN, Rédei K, Mason WL, et al. (2020). Ecology, growth and management of black locust (*Robinia pseudoacacia* L.), a non-native species integrated into European forests. In *Journal of Forestry Research* 31:1081-1101.
- OGM (2024). Genetic resources. General Directorate of Forestry, Ankara. [<http://www.ogm.gov.tr/tr/haberler>].
- OGM (2026). Forestry Statistics-2025. General Directorate of Forestry, Ankara. [<http://www.ogm.gov.tr/ekutuphane/Sayfalar/Istatistikler>].
- Öztürk YO, Yıldız MC (2022). Seed orchard and seed stands of Turkish forestry. *Theoretical and Applied Forestry* 1:22-25.
- Pawłowski TA, Suszka J, Mucha J, Zadworny M, Alipour S, Kurpisz B, Chmielarz P, Jagodziński AM, Chmura DJ (2024). Climate legacy in seed and seedling traits of European beech populations. *Frontiers in Plant Science*, 15,1355328
- Puchalka R, Dyderski MK, Vítková M, Sádlo J, Klisz M, Netsvetov M, Prokopuk Y, Matisons R, Mionskowski M, Wojda T, Koprowski M (2021). Black locust (*Robinia pseudoacacia* L.) range contraction and expansion in Europe under changing climate. *Global Change Biology* 27(8):1587-1600.
- Salmón Rivera B, Barrette M, Thiffault N (2015). Issues and perspectives on the use of exotic species in the sustainable management of Canadian forests. *Reforesta* 1:261-280.
- Vítková M, Müllerová J, Sádlo J, Pergl J, Pyšek P (2017). Black locust (*Robinia pseudoacacia*) beloved and despised: A story of an invasive tree in Central Europe. In *Forest Ecology and Management* 384:287-302.
- Wambugu PW, Nyamongo DO, Kirwa EC (2023). Role of seed banks in supporting ecosystem and biodiversity conservation and restoration. In *Diversity*, 15, 5080896.
- Zobel BJ, Talbert J (1984). *Applied Forest Tree Improvement*. New York: John Wiley.