

Macedonian pine

Pinus peuce

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These Technical Guidelines are intended to assist those who cherish the valuable Macedonian pine gene pool and its inheritance, through conserving valuable seed sources or use in practical forestry. The focus is on conserving the genetic diversity of the species at the European scale. The recommendations provided in this module should be regarded as a commonly agreed basis to be complemented and further developed for local, national or regional conditions. The Guidelines are based on the available knowledge of the species and on widely accepted methods for the conservation of forest genetic resources.

Biology and ecology

Macedonian pine (*Pinus peuce* Grisb.) is a tree reaching up to 30-35 m in height and up to 50-60 cm in diameter, but certain individuals may reach a height of 42 m and a diameter of 1.20 m. The tree height of this species diminishes strongly near the upper forest limit and may even obtain shrub sizes.

In stands, the crown is narrow, pyramid-like, with comparatively short and slightly ascending branches situated in whorls, of good self-pruning. Up to the age of 40-50 the bark is smooth, dark-green or green-violet, becoming plate-like fissured and grey to grey-

brown afterward. The branches are relatively thick, greenish while still young and later they become grey. The brachyblasts contain five fine needles each. These needles are grayish-green, 50-70 mm long and 1 mm wide.

The male reproductive organs are aments of a cylindrical shape, on average 13 mm long and up to 3.5 mm wide, and yellow in colour. They are situated in groups of 10-15 at the bases of growing shoots. The cones have a two-year cycle of development. In the beginning they are green or greenish-violet with their scales closed and covered with resin granules. They mature in September - October of the second year when they reach lengths of 7 -18 cm and widths of 3-4 cm. The seeds are ovate, grey-brown, from 4.7-8.9 mm long and from 3.4-6.4 mm wide.

In the beginning a *Pinus peuce* tree develops a well-formed, spindle-like, central root but its lateral root system gradually develops intensively thus penetrating deep into the soil and providing a high stability.

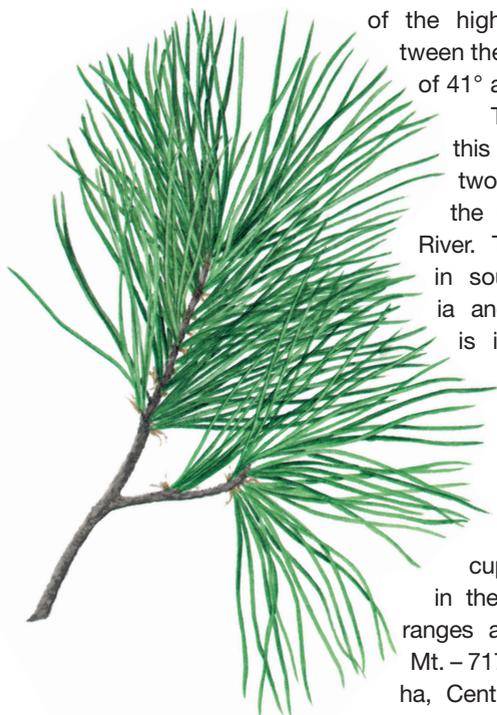


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The cold mountain climate and high air humidity are the most suitable conditions for *Pinus peuce*.

Though it occurs naturally from 800-900 m up to 2300-2400 m altitude, its optimum is most often from 1600-1900 m altitude.

Pinus peuce often occurs on mainly silicate terrains and, less often, on carbonate ones.



Distribution

Macedonian pine is a tertiary relic and endemic species of the Balkan Peninsula which A. Grisebach discovered in 1839 (Pelister, Macedonia FYR) and described in 1844 as *Pinus peuce*. This pine is the only one from the Subgenus *Strobus* native to the Balkan Peninsula. It occurs in some of the high mountains between the northern latitudes of 41° and 43°.

The natural range of this species consists of two parts separated by the valley of the Vardar River. The eastern part is in south-western Bulgaria and the western part is in Macedonia FYR, south-western Serbia, south-eastern Montenegro, eastern Albania and north-western Greece.

The areas occupied by *Pinus peuce* in the following mountain ranges are as follows: Pirin Mt. – 7175 ha, Rila Mt. – 6230 ha, Central Balkan Range – 193 ha, Western Phodopes – 170 ha, Vitosha Mt. – 104 ha, Slavyanka Mt. – 57 ha, Pelister Mt. – 2500 ha, Prokletije Mt. – 3531 ha and Shara Mt. – 433 ha.

Importance and use

Macedonian pine is one of the most valuable conifer species in the Balkan Peninsula. It has a wide altitudinal range, from the lower border of the submountain belt to the upper border of the subalpine forest belt. This indicates the high ecological adaptability of the species. Macedonian pine thrives in the upper mountain belt and produces high yields of wood. There it can be widely used for the improvement of low yielding stands of other species and to artificially expand the upper forest border, lowered by excessive cuttings, grazing and fires. The exceptional adaptation of Macedonian pine to the severe mountain climate conditions makes it a valuable species for afforestation on high terrain for protection against erosion.

Its wood is soft, light - with average specific gravity of 440 kg/m³, of homogenous structure, tight and durable. Pith is pale-yellowish and strongly resinous, core is reddish. *Pinus peuce* wood is highly valued in construction, furniture production, wood-carving and cooperage. It is extremely durable, as trees and logs which have been earthed up by torrential currents and have then remained in the ground for 10, 20 and even more years, are still good for usage.

The resin of *Pinus peuce* provides high quality derivatives,



Macedonian pine *Pinus peuce* Macedonian pine *Pinus peuce* Macedonian pine *Pinus peuce*

which are used in the chemical industry, optics and pharmacy. The local population use *Pinus peuce* resin to cure wounds, pectoral, skin and stomach diseases, varicose veins and other illnesses.

Genetic knowledge

Taking crown habit as a criterion, the following forms are determined:

- 1) With spindle-shaped crowns (f. *vermiculata*);
- 2) With cone-shaped crowns (f. *conica*);
- 3) With column-shaped crowns (f. *columnaris*).

According to branching habitat, three forms are distinguished: f. *horizontalis*, f. *pyramidalis* and f. *pendula*. Analogous to the other pine species the forms of *Pinus peuce* determined according to this feature, they have morphological characteristics that have resulted from continuous adaptation to particular ecological conditions.

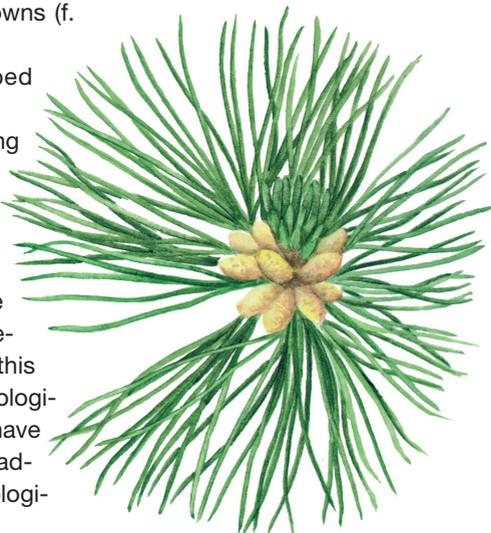
According to bark cracking, the following forms are determined: smooth-barked, scale-barked, with spruce-like-cracked bark and with longitudinally plate-like-cracked bark.

According to the coloration of the strobiles, three forms can be observed: var. *chlorocarpa*, var. *erythrocarpa* and var. *dichlora*.

According to morphology and natural range, two forms (ecotypes) are distinguished: var. *typica* (western part of Vardar River) and var. *vermiculata* (eastern part of Vardar River).

Successful inter-specific hybridization has been carried out between: *Pinus peuce* x *Pinus strobes* L., x *Pinus parviflora*

Sieb. et Zucc., x *Pinus monticola* Dougl., x *Pinus ayacahuite* Ehr., x *Pinus lambertiana* Dougl., x *Pinus excelsa* Wall., x *Pinus flexilis* James. Hybrid seedlings obtained were competitive with the control ones in growth and resistance to diseases.



The coefficients of heritability in the narrow sense and the genetic gain from the selection by individuals were established in 13 representative populations of Macedonian pine from Pirin Mt., Rila Mt. and the Central Balkan Range.

Based on the needle terpene profile some *Pinus peuce* populations from Serbia and Montenegro are more similar to those from Greece and Kosovo.



Source Pinus peuce Macedonian pine

Threats to genetic diversity

Macedonian pine is generally considered to belong to the group of species which almost do not suffer from insect pests and fungus diseases. However, this statement exaggerates its generally good health status. In fact, this pine is more resistant to such factors, as compared with the other conifer species. A substantial reason for this resistance is the severe climatic conditions in the high parts of the mountains where it is spread, as these conditions do not favour the development of a number of diseases and pests. Another reason is the high resinousness/resin content of its wood, buds and cones which is also a limiting factor because of the resin's toxic properties.

The insects which attack *Pinus peuce* are bark beetles *Ips amitinus* Eichh. and *Ips sexdentatus* Boen., which impact mainly felled stems, *Pityogenes chalcographus* L., *Pityogenes bidentatus* Hrbst., *Pityogenes bistridentatus* Eichh. and *Pityogenes quadridens* Htg. which attack mainly young trees. *Pissodes notatus* Fabr. and *Pissodes pini* L. are secondary pests which impact the lower parts of the stems. *Hylobius abietes* L. is a mass pest which attacks mainly seedlings by gnawing their bark but it also feeds on needles. Availability of *Myelophilus minor* Hartm. and *Myelophilus piniperda* L. has been reported

on the mountains of Pelister and Kozyak. Considerable resistance to *Pissodes strobi* Peck has been reported.

Wood is damaged by *Acanthocinus aedilis* L. and *Monochamus galloprovincialis* Ol., which make galleries mainly in felled stems.

The fungus diseases of *Pinus peuce*, even though less numerous than the insect pests, deliver more impact but of comparatively low degree. Macedonian pine is attacked by *Heterobasidium annosum* (Fr.) Bref., *Phaeolus schweinitzii* (Fr.) Par., *Cenangium ferruginosum* Fr., *Armillaria mellea* (Vahl.) Karst., *Trametes pini* Fr., *Polyporus* sp., *Stereum* sp. and others. Considerable resistance to *Cronartium ribicola* J.C. Fisch. has been reported.

With respect to air pollution, *Pinus peuce* growing in forest plantations and parks in different parts of Europe has been categorized by different authors as resistant to slightly resistant, the opinion about its relative resistance being the dominant one. According to the scale of gas resistance under acute impact of sulphur dioxide, *Pinus peuce* is related to the species of outward, slightly visible damage but of decreased productivity.

Guidelines for genetic conservation and use

This species forms as pure, so mixed stands most often occur with *Picea abies* (L.) Karst., *Pinus sylvestris* L., *Pinus mugo* Turra and less often with *Abies alba* Mill., *Pinus nigra* Arn., *Pinus heldreichii* Christ., *Fagus sylvatica* L. and other species.

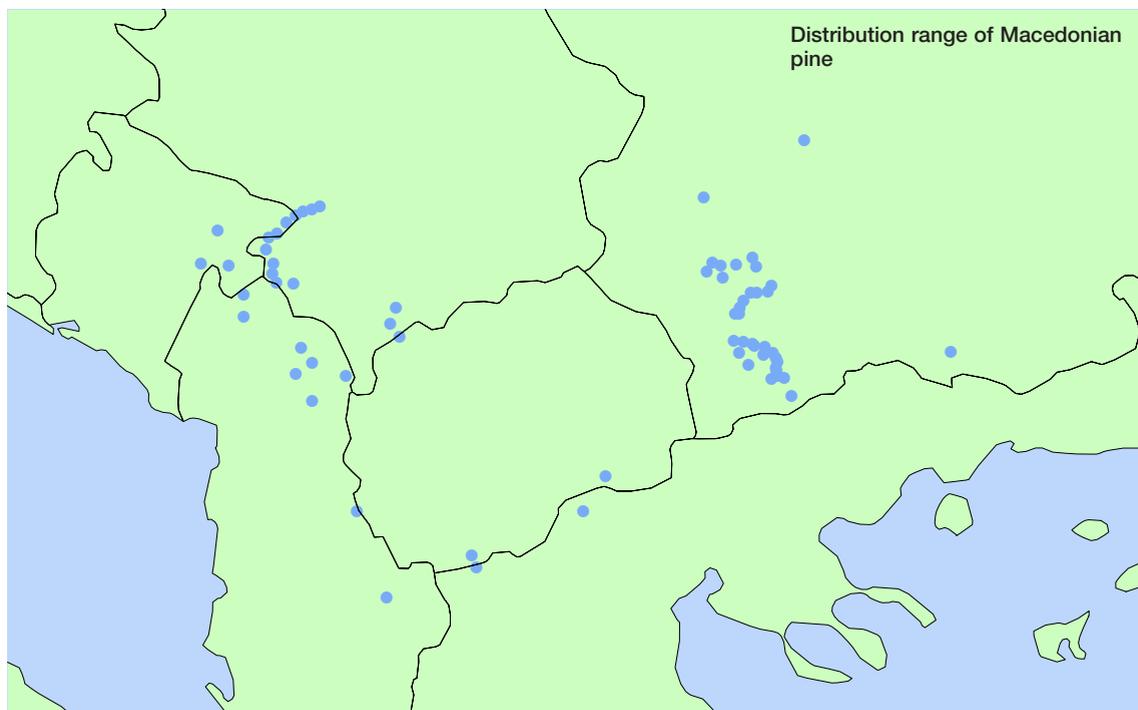
The contrasting bio-ecological peculiarities of *Pinus peuce* and *Picea abies*, of *Pinus peuce* and *Abies alba* and some other species have been combined very well in mixed, two-storeyed stands. That is why striving to establish such stands is reasonable from both the biological and ecological points of view.

The natural regeneration of *Pinus peuce* depends on a number of factors such as altitude, type of forest, rate and periodicity of seeding, crown closure, relief, application of corresponding felling, etc. The state of most of the *Pinus peuce* forests requires the processes of regeneration to be directed by foresters with a view to preserving, taking care of and propagating this species.

The *in situ* conservation method includes mainly the national and nature parks, reserves, seed stands and plus trees. By the *ex situ* method the genetic resources of Macedonian pine are preserved mainly through



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provenance testing plantations, progeny trial plantations, seed orchards and genebanks for seeds. Assessing the advantages of the two methods for conservation of genetic resources, *in situ* seems to be more reliable. The autochthonous populations of *Pinus peuce* in Pirin Mt., Pelister Mt. and Prokletije Mt. present valuable genetic resources for the introduction of this species in

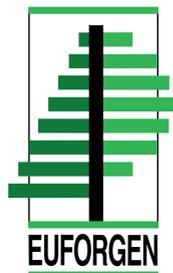
many countries of the Northern Hemisphere.

The area of Macedonian pine seed stands in Bulgaria is 693 ha and that of the seed orchards 10 ha, in Macedonia FYR - respectively 110 ha and 6 ha and in Serbia and Montenegro 10 ha of seed stands.

The high grade stands in which trees with spindle-shaped crowns and shallow-scaled

bark fissuring prevail should be preferred for the purposes of breeding. The existence of two edaphotypes – silicate and carbonate – should be taken into consideration.

While selecting plus and candidate elite trees, individuals with narrow crown, fine and short branches of first order disposed approximately perpendicular to the stem should be selected.



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This series of Technical Guidelines and distribution maps were produced by members of the EUFORGEN Networks. The objective is to identify minimum requirements for long-term genetic conservation in Europe, in order to reduce the overall conservation cost and to improve quality standards in each country.

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