White poplar

Populus alba

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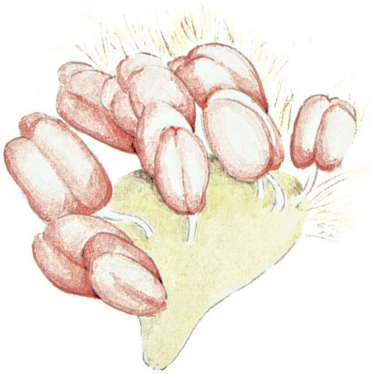
These Technical Guidelines are intended to assist those who cherish the valuable European white poplar gene pool and its inheritance, through conserving valuable seed sources or use in practical forestry. The focus is on conserving the genetic diversity of the species at the European scale. The recommendations provided in this module should be regarded as a commonly agreed basis to be complemented and further developed in 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

European white poplar, *Populus alba* L., is a pioneer tree species in riparian forest ecosystems where it forms pure or mixed stands or, also, monoclonal small groups. The species grows on fertile alluvial soils but is found also growing on sandy and dry soils as a small tree. It tolerates to a certain extent long term inundations and low levels of soil salinity. White poplar is a light demanding and dioecious species. Poplar forests are transitional stands between willow forests and oak, elm and ash forests.

White poplar is characterized by fast growth; at the age of 30-40 years it reaches the height of 20-25 m and a diameter of 50 cm. Flowering starts before or sometimes at the same time as leaf flushing (February to April). Trees mature sexually at the age of 8-10 years sometimes earlier. White poplar is a wind pollinated species and in natural conditions it regenerates through seeds and root-suckers. The rooting system is well developed with lateral roots that spread close to soil surface. When a tree is cut or dies, root suckers sprout abundantly. Under favourable conditions, one tree can cover almost a quarter of a hectare with root-suckers.

The species can also be regenerated vegetatively. Propagation material obtained from the shoots grows very fast in the beginning as compared to seed-born seedlings. The rooting capacity of the vegetative propagated material has a high level of variation, as tested in different trials and common garden study.



Distribution

White poplar has a large distribution area throughout Europe and western Asia. It is also found in northern Africa. The distribution area extends from the Mediterranean and the Middle East in the south to approximately 62° latitude in the north. The west-east distribution ranges from Portugal and Morocco to Russia, China and India.

Importance and use

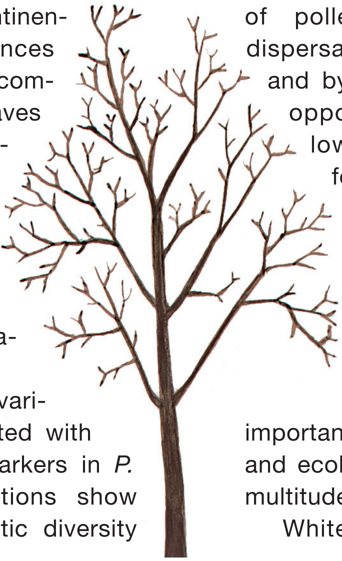
White poplar is of ecological, social and economic interest. The importance of natural poplar forests to biodiversity conservation is widely recognized. The poplar stands, forming complex ecosystems along rivers, support a wide diversity of plant communities, including many endangered species. At present, the protection and restoration of poplar stands are of major importance, not only for natural control of flooding but also because they could serve as ecological corridors for plants, animals and birds through which larger forest areas are connected.

White poplar is used in propagation and breeding programmes in several countries. The species hybridises spontaneously in Europe with *P. tremula* generating the *Populus ×canescens* hybrid, and in North America with *P. grandidentata* producing the *P. ×rouleauiana* hybrid. The latter one tolerates different climatic and pedological conditions and resists to bacterial canker caused by *Xanthomonas populi.* The recent global developments regarding climate change have promoted new interests on white poplar to explore its ability to grow under dry and saline environments. Furthermore, it is increasingly used as a model species in genomic and physiological studies.

In European countries, white poplar is planted along roads and in cities for amenity purposes. It can be planted for soil, water and air remediation in polluted industrial zones. It is used to produce veneer, boards, fruit boxes, matches and paper. The interest is highest in eastern European countries where white poplar plays an important role in the riparian forests and in some Mediterranean countries where the species is growing in harsh environmental conditions.

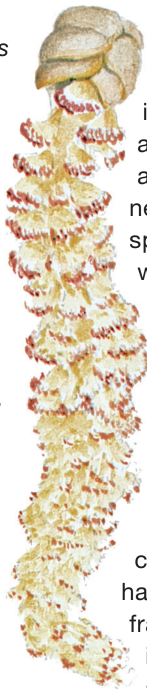
Genetic knowledge

White poplar is a species with a wide distribution range and its populations are strictly adapted for some specific traits to the local climate, generating a high level of intra-specific variation. Common garden studies for this species showed a high genetic component associated to the timing of the growth period in populations sampled on large latitudinal ranges. A moderate genetic variation among populations was also found in morphological traits like leaf size and stem form. These traits roughly follow a latitudinal gradient with large leaves and straight-stem in the northern continental provenances gradually becoming small leaves and curved-stem in the southern warmer and drier Mediterranean populations.



Genetic variability detected with molecular markers in *P. alba* populations show a high genetic diversity within population and a low genetic differentiation among populations and rivers confirming the general trend observed in other poplar species. In general, the genetic diversity tends to increase from northern to southern provenances.

Populus alba and *Populus tremula* show large areas of sympatry in their native range in Europe. The result of this overlapping is a more localized but not uncommon formation of hybrid zones in river valleys. Introgression occurs preferentially from *P. tremula* to *P. alba* via *P. tremula* pollen. This unidirectional pattern is facilitated by high levels of pollen versus seed dispersal in *P. tremula* and by great ecological opportunity in the lowland floodplain forests in proximity to *P. alba*. Natural hybrid zones have been brought recently into the ecological limelight as centers of biological dynamics, and play an important role as evolutionary and ecological hot spots for a multitude of organisms.

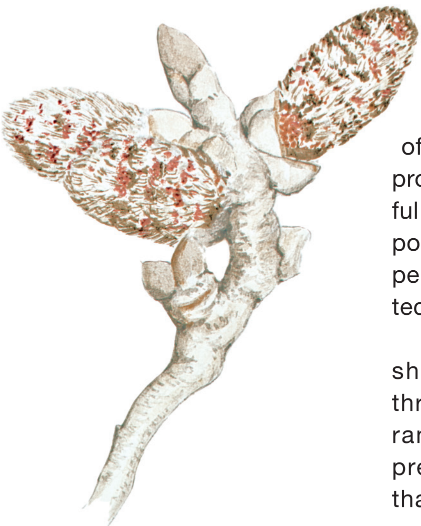


Threats to genetic diversity

White poplar is facing threats both at ecosystem and population levels. Riparian forests are one of the most threatened ecosystems in Europe. Changes in the river systems and clearance of the riparian forests to agriculture and other land uses have affected their existence negatively. As a pioneer species, regeneration of white poplar is based on the natural river dynamics. All human activities disturbing the related processes affect regeneration and survival of white poplar stands.

White poplar populations have also decreased in size and they have become increasingly fragmented, with negative impacts on gene flow along the rivers. This will ultimately reduce genetic diversity and also change the genetic structure of the populations, with possible negative effects to the survival of the species in the future.

Inappropriate use of forest reproductive material is also creating an additional threat, as white poplar is increasingly used for restoring riparian forest ecosystems. While carrying out these activities with reintroduced plant material, it is necessary to take into account the adaptability of reproductive material to the local climate and the risk of genetic erosion when using a reduced set of genotypes.



Guidelines for genetic conservation and use

As a general objective, the conservation of genetic resources should maintain the adaptation potential of species and populations. Static *ex situ* conservation is a widely applied strategy for short term conservation to preserve genotypes in *ex situ* collections or genebanks. Dynamic *in situ* conservation is preferable when the objective is long-term gene conservation and maximization of the adaptive potential of a species. This can be achieved through *in situ* conservation of native stands (including restoration of stands), long-term breeding programmes or both. Successful *in situ* conservation of white poplar in Europe primarily depends on the location and protection of its natural habitats.

The conservation units should be distributed throughout the distribution range of the species, preferably including more than one conservation site per river-system. A preliminary assessment of the genetic diversity among adult trees in the candidate populations is recommended to conserve a high amount of diversity and a low number of clonal duplicates. Particular attention must be paid to all practices that have an impact on flowering habit and the regeneration process, which determine the effective population size. Conditions for seed-set and seedling establishment should be optimized. The number of flowering and seeding trees provides a practical approach to assess the effective size of a given population. At least 50 fructifying and unrelated trees are required to keep genetic variation at a satisfactory level within a population. If natural regeneration does not occur successfully in some of the units, then supplemental planting with seedlings from appropriate sources might be carried out.

For restored populations, introgression with unwanted genetic material can be limited by creating a “buffer zone” around the population consisting of local male trees. Active management and evaluation of the restored populations are highly recommended and should include replacement of poorly flowering individuals, corrective thinning, new additions to and from the genebanks, and removal of unsuitable individuals.

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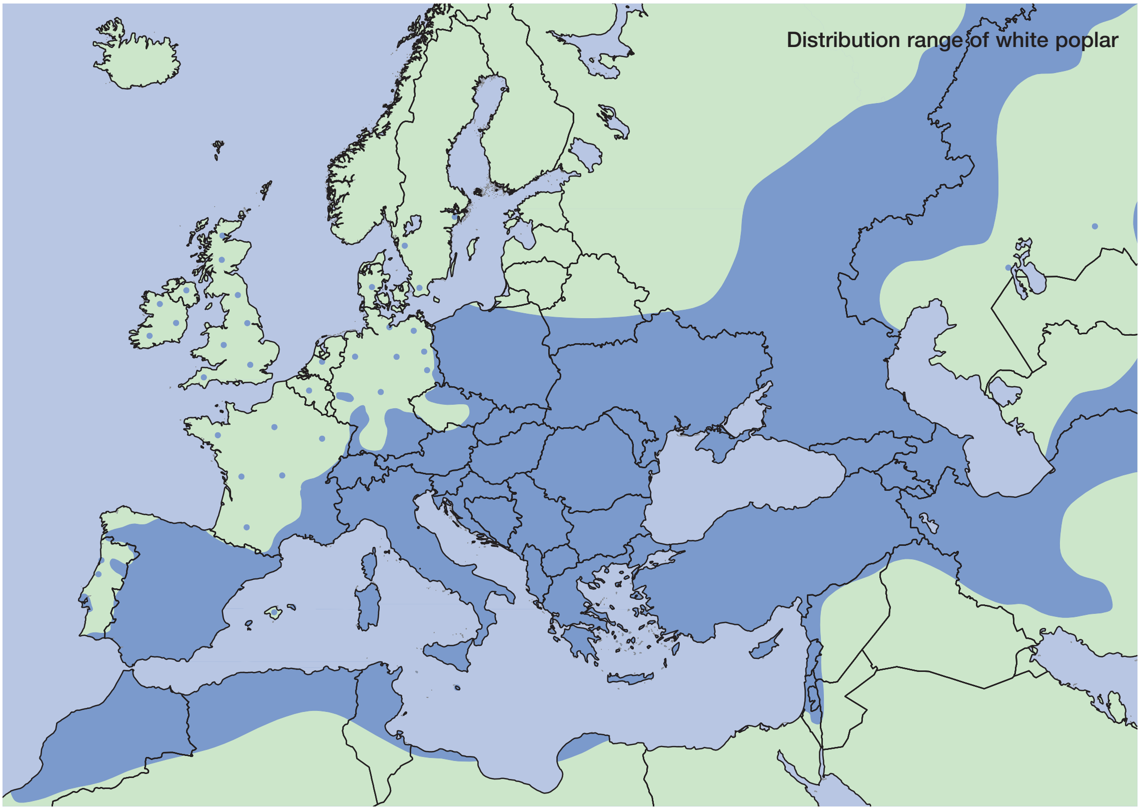

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EUFORGEN

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

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The distribution map is based on: Caudullo, G., Welk, E., San-Miguel-Ayanz, J., 2017. Chorological maps for the main European woody species. Data in Brief 12, 662-666. https://doi.org/10.1016/j.dib.2017.05.007

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