

# Breeding and conservation of black poplar (*Populus nigra*) gene resources in Turkey

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*With black poplar in native stands threatened in Turkey, action to manage and conserve the genetic resources of this valuable species is showing promising results.*

Turkey is characterized by widely varying climatic and topographic conditions which result in a broad diversity of forest ecosystems, species and within-species variation. European black poplar (*Populus nigra*) has a wide distribution in Turkey and has been cultivated by farmers on private lands for centuries. It makes considerable contributions to both the rural and the national economy. However, with urban expansion and mismanagement of natural resources in rural areas, it is one of the most threatened tree species in native stands in Turkey – as it is also in Europe.

Turkey has approximately 130 000 ha of poplar plantations, of which 70 000 ha

are hybrid poplars and 60 000 ha consist of various clones of black poplar. Black poplar provides about 57 percent of Turkey's 3.5 million cubic metres of annual poplar wood production. Poplar wood industries – particularly furniture, packaging, particleboard, plywood and matches – have developed very quickly in recent years and mainly use the wood of hybrid poplars. On the other hand, more than 80 percent of black poplar wood (1.75 million cubic metres) is used as roundwood for rural construction and for the daily needs of rural people.

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*Black poplar plantation around agricultural fields, Yozgat, Central Anatolia region*



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**Black poplar field clone trial,  
Ankara, Central Anatolia**



In some parts of central, eastern and southeastern Turkey, black poplar is cultivated in field, roadside and riparian plantations using traditional methods. Where land is reserved for agriculture, row plantations can protect arable land and produce wood for local needs. In the main river basins, about 100 000 km of waterways are suitable for gallery plantations, i.e. one to three rows of poplars planted on both sides of the waterway (Semizoglu, 1979); some gallery plantation projects are under way supervised by the Ministry of Forestry.

Poplars are also of ecological importance as centres for biodiversity. A large number of threatened and common species are associated with or dependent on poplars, particularly in floodplain forests, which are among the most diverse ecosystems in Europe (Rotach, 2003). Thus the monitoring and conservation of the genetic resources of black poplar in riparian ecosystems is of major significance, not only for the natural control of flooding, but also because the river borders harbour great biodiversity.

This article describes efforts made in recent years in the breeding, conservation, management and utilization of black poplar genetic resources in Turkey. This work has included the establishment of clone banks and clonal trials in nurseries and fields and the identification of black poplar clones with high growth performance and adaptability to different ecological conditions. In addition, *ex situ* and *in situ* conservation programmes for black poplar have been in progress in Turkey under the framework of the European Forest Genetic

Resources Programme (EUFORGEN). Under these programmes, five previously unknown natural populations of black poplar have been identified in the Eastern Anatolia region.

#### **BIOLOGY, ECOLOGY AND DISTRIBUTION**

The natural range of European black poplar, *Populus nigra*, includes most of Western Europe (with the exception of Scandinavia, Ireland and Scotland), Ukraine, the Russian Federation, parts of North Africa and Asia Minor, and northern Islamic Republic of Iran. Black poplar usually forms local populations by colonizing open areas on alluvial soils through seeds, cuttings or root fragments. Its distribution extends from isolated trees to large blocks of pure or mixed stands. Individual trees may live up to 400 years. Almost 40 percent of black poplars are grown in line plantations along canals and stream banks and around irrigable fields.

Black poplar trees are dioecious, with separate male and female individuals. They grow fast and reach the reproductive stage at approximately ten years of age. In the early spring (early April in Turkey), male and female trees produce flowers clustered in pendulous catkins. Black poplar is wind pollinated and is

also capable of vegetative regeneration. Its seeds are disseminated by wind and water, have short viability and need specific soil and humidity conditions for germination. Regeneration is generally poor within long-established stands.

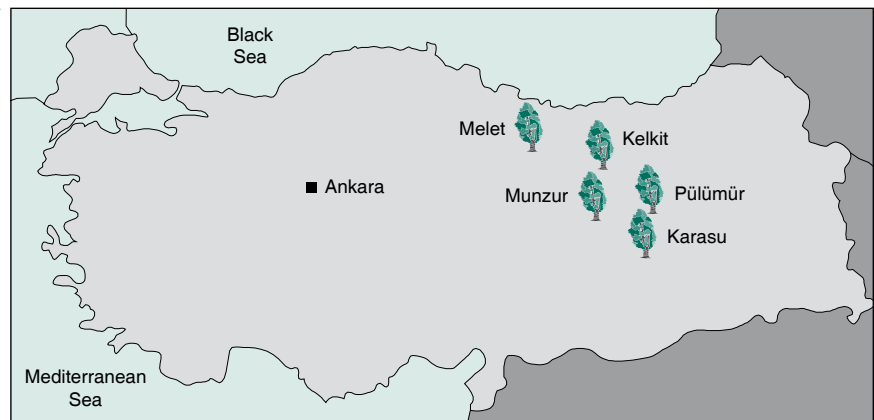
The most widely cultivated clones of black poplar in Turkey are *P. nigra* var. *italica*, used mostly in the western part of the country, and *Populus usbekistanica* var. *afghanica*, which is more widespread. Both have characteristic narrow, pyramidal crowns.

#### **SELECTION AND BREEDING**

Black poplar is used in breeding programmes in many parts of the world: 63 percent of the poplar cultivars used in forest plantations descend from black poplar. To improve the quantity and quality of wood harvested from poplar plantations in Turkey, classical breeding programmes with *Populus deltoides*, native *P. nigra* and *Populus × euramericana* are in progress for commercial release of the most productive hybrid clones. Useful traits of parents such as fast growth, desired wood quality and resistance to frost can be combined in a hybrid, and some clones are selected from intra- or interspecific crossings.

Domestic black poplar provenances are included in the breeding programme

Natural distribution of black poplar (*Populus nigra*) in Turkey



### Locations of clone banks and field trials in Turkey

Locality	Region	Clone banks and field trials
Harran	Southeastern Anatolia	Nursery clone trial First selection clone trial
Tunceli	Eastern Anatolia	First selection clone trial
Erzurum	Eastern Anatolia	Clone bank Nursery clone trial First selection clone trial
Ankara	Central Anatolia	Clone bank Nursery clone trial First selection clone trial
Kutahya	Inner Aegean	Nursery clone trial First selection clone trial Second selection clone trial
Izmit	Marmara	Clone bank

because of their adaptability to continental conditions. They are widely planted in eastern European countries for domestic use and for soil protection and afforestation in polluted industrial zones. Black poplar is hybridized with *P. deltoides* and other introduced poplar species such as *Populus maximowiczii* and *Populus trichocarpa* which provide adaptability to various soil and climate conditions, rooting ability, high resistance to bacterial canker caused by *Xanthomonas populi* and fair resistance to *Marssonina brunnea* and to poplar mosaic virus (Cagelli and Lefèvre, 1995).

*Populus nigra* × *P. nigra* hybrids and *P. deltoides* × *P. nigra* hybrids are being selected through nursery and field clone trials in Turkey. Successful clones are registered nationally and internationally by the International Poplar Commission (IPC).

### THREATS TO GENETIC RESOURCES

Three main factors threaten the genetic resources of European black poplar (Lefèvre *et al.*, 2001). First, human activities alter riparian ecosystems throughout the species' distribution area. Native poplar stands are being displaced by agriculture and floodplain areas are subject to urbanization. Regulation of floods has altered the regeneration capacity of the species and favoured the succession of poplar stands by hardwood forests. Although regeneration may be successful locally, some regions of Europe have witnessed significant reductions in native black poplar populations or their complete disappearance.

Second, the autochthonous black poplar resources have been overexploited for the use of wood and wood products and faster-growing hybrid poplars have been planted to replace them.

Finally, gene introgression (i.e. movement of genes between genetically distinct populations) from cultivated clones and other poplar species is a potential threat to the integrity of black poplar, because only a few clones are widely cultivated and these contribute markedly to the pollen and seed pools in native stands. This risk concerns not only introduced hybrids, but also pure black poplar varieties with wide distribution such as *P. nigra* var. *italica*.

Therefore, it has been necessary to take action to conserve and manage Turkey's valuable black poplar heritage. Clone banks in nurseries and clonal field trials have been established in a range of climatic zones (see Table). Considerable progress has been made in the conservation and identification of black poplar clones with high growth performance and adaptability to different ecological conditions.

### CONSERVATION OF BLACK POPLAR IN TURKEY

#### *In situ* conservation

Conservation programmes in Turkey, undertaken within the framework of the European Forest Genetic Resources Programme (EUFORGEN), focus on *in situ* conservation.

The ultimate aim of *in situ* conservation of a species is to maintain broad genetic diversity so that the species can retain its potential to adapt to changes in the

environment. When the objective is to conserve genetic diversity and maximize the adaptive potential of the species, dynamic conservation is preferable. This can be achieved through *in situ* conservation of native stands, long-term breeding programmes or both.

Conservation work has led to the continual identification of new distribution areas, especially in Eastern Anatolia where five natural populations have been identified, in the basins of the Melet, Kelkit, Munzur, Karasu and Pülümür rivers (Toplu and Kucukosmanoglu, 2003) (see Map).

However, areas suitable for *in situ* conservation are limited because native populations of black poplar are threatened by urban expansion and poor management of rural resources. Therefore *in situ* conservation is often supplemented or replaced by *ex situ* conservation, which is being given increased emphasis.

#### Ex situ conservation

*Ex situ* conservation of black poplar in Turkey has been carried out by the Poplar and Fast-Growing Forest Trees Research Institute in Izmit since 1962. A countrywide conservation programme was started in 1990 to conserve black poplar genetic resources in *ex situ* collections. From 1990 to 1993, 310 black poplar individuals were selected in natural relict populations or aged plantations in different regions of Turkey. From this collection, 297 clones were transferred to stool beds at the experimental nurseries in Izmit and Ankara. This collection was duplicated in the nursery at Erzurum using material of 221 selected clones. In addition, 36 native clones selected in previous years (1956 to 1967) and 32 clones obtained from controlled cross-pollination were included in the collection.

These conservation activities continue. In 1995, material of 760 individuals, again selected from natural relict populations and aged plantations, was collected and established in stool beds at



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the experimental nurseries in Izmit, Erzurum and Ankara (Toplu, 1996). Individual “passport data” (accession identity number, species scientific name, institution of origin, sex, latitude, longitude and altitude of origin, geographic zone, means of conservation) have been recorded at the Poplar and Fast-Growing Forest Trees Research Institute. A large part of these clones are native and some are the result of controlled cross-pollination (*P. nigra* × *P. nigra*). During the selection of clones to be conserved, emphasis has been placed on including frost-resistant individuals.

#### CONCLUSION

Black poplars have considerable economic and social importance in Turkey, especially in rural areas. They also have an important role in poplar breeding programmes. The loss of black poplar area and genetic resources and related degradation of land affects the welfare of the Turkish people. If mismanagement of the environment continues, conservation of genetic diversity can no longer be left to nature. Therefore, the following active steps must be taken to conserve, develop and utilize the valuable black poplar heritage in Anatolia.

- Inventory activities on black poplar should be kept up continuously to

**In situ gene conservation of black poplar, Zonguldak, western Black Sea region**

**Individual selected for ex situ conservation, Kütahya, Aegean region**



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maximize the genetic base of the species.

- Black poplar individuals and stands within riparian ecosystems should be characterized and protected.
- Field surveys should identify additional *in situ* distributions of black poplar in coming years, and these areas should be included in conservation programmes.
- New areas of *ex situ* genetic resources should be established.
- Importance should be given to the control, standardization and certification of black poplar reproductive material.
- Technical information on black poplar should be disseminated to poplar growers through publications, meetings and technical excursions.
- New black poplar clones should be created through research to increase poplar wood production. ◆



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