THE CONSERVATION OF *POPULUS NIGRA* L. AND GENE FLOW WITH CULTIVATED POPLARS IN EUROPE

Luisa Cagelli [1] **& François Lefèvre** [2]

[1)] Istituto di Sperimentazione per la Pioppicoltura, SAF/ENCC, I–15033 Casale Monferrato, Italy
[2)] I.N.R.A., Laboratoire de Recherches Forestières Mediterranéennes, F–84000 Avignon, France

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ABSTRACT

Populus nigra L. can be considered on the verge of extinction in a large part of western Europe. Its natural habitat is being gradually reduced by human activity and the gene pool is threatened by the large-scale presence of cultivated hybrids and of one ornamental cultivar, the fastigiate 'Lombardy poplar', that spontaneously hybridize with *P. nigra*.

Although cultivars of *P. nigra* are cultivated in some areas, especially in the Middle East, the main use of the species is as a parent of interspecific hybrids in breeding programmes. From an economic point of view the most important hybrid is achieved by using *P. nigra* as a pollen parent with the North American *P. deltoides* Bartr. as the seed parent, resulting in the common 'euramerican' hybrids (P. × *euramericana* (Dode) Guinier). Some varieties of black poplar are also widely used for their ornamental qualities.

The conservation of *in situ* genetic resources is limited to some restricted areas, as the riparian forests, typical habitat of *P. nigra,* have suffered considerably from urbanization and competition with human productive activities. *Ex situ* conservation activities, on the other hand, have been carried out in several European countries. A project for the coordination of efforts aimed at the conservation of *P. nigra* has been recently launched as one of four pilot projects included in the European Forest Genetic Resources Programme (EUFORGEN).

Key words: *Populus nigra*, genetic resources, *in situ* conservation, *ex situ* conservation

TAXONOMY OF THE GENUS *POPULUS* L.

The genus *Populus* L. belongs to the family *Salicaceae*; it includes thirty to forty species (according to taxonomists) distributed in the temperate and cold regions of the northern hemisphere from 20° to 70 °N latitude. *Populus* are typical pioneer species, clearly heliophilous, mostly dioecious and wind-pollinated.

The genus is generally divided into 5 sections (HOUTZAGERS 1950; FAO 1980): *Turanga, Leucoides, Leuce, Aigeiros* and *Tacamahaca* although some authors proposed the addition of new sections (ECKENWALDER 1977; KOSLA & KHURANA 1982). The taxonomy of this genus is further complicated by a high proneness to interspecific hybridization: a natural process where the natural ranges of two species overlap (BARNES & PREGITZER 1985; DICKMANN & STUART 1983; ECKENWALDER 1984a,b; KEIM *et al.* 1989; MUHLE-LARSEN 1970; RONALD *et al.* 1973a, b; ROOD *et al.* 1986), or artificial, through controlled crosses (RONALD 1982; STETTLER *et al.* 1980; WILLING & PRYOR 1976) or both, when species are introduced in culture outside their natural range (SPIES & BARNES 1981, 1982; ECKENWALDER 1982; FAO 1958; RONALD & STEEL 1974). Hybrids exist both within and across sections (RAJORA & ZSUFFA 1984; see table 1), some of them favoured by pre-treatment of pollen or stigma (STETTLER *et al.* 1980; GAGET *et al.* 1989); three- and four-way hybrids including intersectional combinations have also been obtained by using interspecific hybrids as parents (LEMOINE 1988; RAJORA & ZSUFFA 1984; RONALD 1982; ZSUFFA 1974).

The characterization of species and interspecific hybrids and studies of introgression was largely based in the past on morphological features (RONALD *et al.* 1973a; ECKENWALDER 1982, 1984a,b), which recently received new attention when computers were used both for data acquisition and for the analysis of huge data sets (BISOFFI & CAGELLI 1992; HU *et al.* 1985; ROOD *et al.* 1986). Biochemical markers are also in use: paper-chromatography (BORTITZ 1962; BOCCONE 1975; MALVOLTI *et al.* 1991) and gas-chromatography (BAIOCCHI *et al.* 1990; GREENWAY *et al.* 1991; RONALD *et al.* 1973b; RONALD & STEEL 1974) permit the discrimination of species and hybrids; isozyme analysis can discriminate within a limited set of clones (MALVOLTI *et al.* 1991; RAJORA 1989a, b, c; RAJORA & DANCIK 1992).

Molecular techniques are now available and several have been used with poplars: ribosomal DNA (D'OVI-

DIO *et al.* 1990, 1991; FAIVRE-RAMPANT *et al.* 1992a, b), mitochondrial DNA (BARRETT *et al.* 1992), chloroplast DNA (SMITH & SYTSMA 1990), RFLP of genomic DNA (KEIM *et al.* 1989) and RAPD (CASTIGLIONE *et al.* 1993). Ribosomal DNA polymorphisms have been suggested as suitable tools for detecting introgression of foreign germplasm into *P. nigra* (FAIVRE-RAMPANT *et al.* 1992b).

POPULUS NIGRA L. TAXONOMY

The natural range of *P. nigra* extends over Europe (mainly central and southern), western Asia and North Africa. A wide range and a clear human responsibility in the diffusion of the species makes the taxonomy of the species particularly complex: there are often different synonymous for the same variety and intermediate forms from spontaneous hybridization among varieties which are difficult to classify in an unequivocal way. We here follow the classification proposed in a review by ZSUFFA (1974):

- *P. nigra* var. *typica* L. grows in all the natural range of the species. The branches are irregularly distributed along the stem and wide spreading. Young leaves, petioles and twigs are glabrous.
- *P. nigra* var. *italica* Duroi is the oldest variety described. Although the name seems to indicate an Italian origin, its real origin is unknown. It probably derives from a spontaneous mutation of *P. nigra* occurred in central Asia. It was introduced in Italy in the 18th century and from the Po Valley it was spread all over the world (from which the English common name "Lombardy Poplar"). This variety is characterized by a fastigiate habit, closely ascending branches and dark and furrowed bark.
- *P. nigra* var. *betulifolia* (Pursh) Torr. described in France and Great Britain and *P. nigra* var. *caudina* Ten. (= *P. nigra* var. *pubescens* Parl.) described in Spain, North Africa, central and southern Italy, the Balkans and Iran present xeromorphic characteristics like pubescent twigs, petioles and young leaves.
- *P. nigra* var. *thevestina* Dode, originated in central Asia, was spread in southern Italy, North Africa, western Asia and in the Near East. It has a typically columnar habit and greyish smooth bark.
- *P. nigra* var. *neapolitana* Ten. described in North Africa, southern Italy, the Balkans, Syria and Irak presents a yellow furrowed bark, almost angular twigs and fairly large leaves. By some authors (ALLEGRI 1956; GELLINI 1975) this variety is considered a hybrid (P. × *euramericana* (Dode) Guinier).

Along with these varieties Zsuffa mentions *P. nigra* var. *sinensis,* introduced from China, and some other species considered by BUGAŁA (1967) as closely related to this species: *P. usbekistanica* Kom., distributed in central Asia, and *P. sosnowskyi* A. Grossh. growing on Caucasus.

ECOLOGY OF WILD *P. NIGRA*

P. nigra is a typical pioneer species growing in riparian mixed forests together with *P. alba* L., willows, alders, maple, elm, ash and, in more evolved forests, with oaks; in the colonization phases it follows the hygrophilous pioneer forests characterized by *Salix*. Although hygrophilous itself, it does not tolerate prolonged flooding. Heliophily and plasticity allow black poplars to settle also on poor soils and to colonize open areas on river banks. The dynamics of the populations and the different phases of colonization are directly related to the dynamics of the rivers and have been extensively described by HERPKA (1986).

Sexual maturity is generally attained at 6 to 10 years of age, but may be delayed by unfavourable environmental conditions. Flower buds differentiate at the end of the summer and flush before the sprouting of vegetative buds in late winter, early spring; the fruits ripen in late spring, early summer. Both pollen and seed are produced in abundance, and rely on wind for diffusion. Seed viability, initially high, decreases rapidly in 3 – 4 weeks in the open, although seeds can be stored at low temperature for some years (MULLER & TESSIER DU CROS 1982).

Evidence of spontaneous vegetative propagation is commonly found at a juvenile stage in this species: fallen trees, broken roots and branches transported by the rivers can root very easily when partly planted in the soil; root suckers are also found. However, the relative contribution of vegetative *vs* sexual propagation to the adult stage remains undetermined.

ECOLOGICAL THREATS FOR THE SPECIES

Black poplars can be considered on the verge of extinction in a large part of Western Europe. Three are the main reasons for that:

- their habitat is often greatly disturbed by human activity either for the reduction of areas claimed by productive activities or because artificial riverside defenses prevent the natural evolution of the rivers and the consequent processes of renewal of the riparian forest;
- the widespread cultivation of the euramerican hybrids (P. × *euramericana* (Dode) Guinier), represents a risk of genetic pollution; introgression by *P. deltoides*, the female parent of the euramerican hybrid is very often observed in areas of spontaneous regeneration;

Table 1 Natural and articial hybrids among some species of the genus *Populus:* 1 – *P. alba* L.; 2 – *P. adenopoda* Maxim.; 3 – *P. davidiana* Schnei.; 4 – *P. grandidentata* Michx.; 5 – *P. sieboldii* Miq.; 6 – *P. tremula* L.; 7 – *P. tremuloides* Michx.; 8 – *P. angustifolia* James; 9 – *P. balsamifera* L.; 10 – *P. koreana* Rehd.; 11– *P. laurifolia* Ledeb.; 12 – *P. maximowiczii* Henry; 13 – *P. simonii* Carr.; 14 – *P. suaveolens* Fisch.; 15 – *P. yunnannensi* Dode; 16 – *P. trichocarpa* Torr. & Gray; 17 – *P. tristis* Fisch.; 18 – *P. deltoides* Bartr. 19 – *P. fremontii* Wats.; 20 – *P. nigra* L. (AA – artifical cross; *** – natural cross; III – intraspecific cross; NO – incompatible cross)

			Male																			
			Leuce							Tacamahaca										Aigeiros		
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Female	Leuce	1	III		AA	***	AA	***	***		AA							AA		AA		
		2		III	AA																	
		3			III																	
		4				III		AA	***											AA		
		5					III															
		6	***			AA		III	AA									AA		AA		
		7	AA					AA	III											AA		AA
	Tacamahaca	8							***	III										***	***	
		9							***	***	III							***		***		AA
		10										III		AA	AA			AA				AA
		11											III							***		***
		12										AA	AA	III	AA			AA				AA
		13													III							AA
		14														III						AA
		15															III					
		16												AA			AA	III				AA
		17																	III			
	Aigeiros	18						AA	***	***	AA			AA			AA	***		III		***
		19																***			III	
		20											AA	AA	AA			AA		NO	***	III

- *P. nigra* var. *italica*, ubiquitous as ornamental, represents another risk of genetic pollution.

Although gene exchange between species is a major event for evolution, the problem, in this case, is the fact that the genetic "pollutants" (pure exotic species, their hybrids or *P. nigra* var. *italica*) represent a very narrow genetic base spread on a very wide scale.

Another threat that could be considered is the rapid evolution of the parasitic pressure due to intensive poplar cultivation with highly resistant clones: new races of *Melampsora spp.* for example.

Table 2 *Populus nigra* clones included in the International Catalogue of Poplar Cultivars

Clone	Synonym	Origin
'ANADOLU'	TR-56/75	Turkey
'ANKUM'	NL1328	The Netherlands
'BLANC DE GARONNE'		France
'BLANQUILLO DE GRANADA'		Spain
'BORDILS'		Spain
'BRANDARIS'	NL1420	The Netherlands
'CHILE'		
'FARSI'		
'FUCINI'		Italy
'GAZY'	TR-56/52	Turkey
'HAMOUI'	Spindar, Tabrizih	
'IRRESHEIM'		Germany
'ITALICA'	Alamo Criollo, Lombardy Poplar, Peuplier d' Italy	
'JEAN POURTET'		Italy
'LOENEN'	NL1041, Terwolde (NL1749)	The Netherlands
'PONCELLA'		Spain (?)
'SARRAZIN DE SEILH'		France
'SCHOORLDAM'	NL1972	The Netherlands
'VEREECKEN'	NL1844	The Netherlands
'VERT DE GARONNE'		France
'WOLTERSON'	NL1026	The Netherlands

CULTIVATION OF PURE *P. NIGRA*

P. nigra, like forest trees in general, has not been subjected to high domestication as was the case of many agricultural crops. The cultivation of this species was once common in some European countries thanks to its easy vegetative propagation and fast growth. In Turkey *P. nigra* is still very widely cultivated: according to the latest inventory data it covers an area of 60,000 ha (as compared with 70,000 ha of euramerican clones) including both plot plantations and row plantations along water canals and stream banks. Black poplar clones 'ANADOLU' and 'GAZI' have been mainly cultivated in artificial plantations in Central and Eastern Anatolia. Some trials are now under way to select new clones with better growth performance and better resistance to frost damages. The wood is utilized as round wood for rural constructions and, like the euramerican wood, by the industries of plywood, furniture, packaging, particle boards and matches.

In Spain the clonal cultivars 'BORDILS', 'PONCELLA' and 'BLANQUILLO DE GRANADA' reached great popularity and large distribution at the end of the last century. Many more clones are included in the "International Catalogue of Poplar Clones", prepared by M. VIART (1992) for the International Poplar Commission (table 2); however, there is scanty information about the actual scale of cultivation. No block plantations of pure *P. nigra* are reported at present in Croatia, France, Italy and Spain, although some *P. nigra* clones are included in the National Catalogues of Forest Clones and registered for commercial use in several European countries. *P. nigra* has been generally replaced by the more productive euramerican hybrids.

Row plantations of *P. nigra* are common for windbreaks in the Rhône valley in France.

In the Netherlands *P. nigra* is still largely employed in roadside-plantation and has a limited use in plot plantations (SCHALK 1983). In the last years, however, a special programme was been developed to reintroduce this species along rivers. In Hungary *P. nigra* is used mainly in protected areas and flood-plains and covers an area of about 4. 00 ha (3% of the total poplar area).

Ornamental varieties deserves particular consideration: *P. nigra* var. *italica* is largely used for windbreaks and along roads all over the temperate regions of the world, while *P. nigra* var. *thevestina* (in particular the cv. 'HAMOUI') is widely cultivated in the Near East.

USE IN BREEDING PROGRAMMES

Like most poplar species, the European black poplar is compatible with a variety of other species: table 3 shows some possible crossing combinations.

Many are in fact the hybrids obtained with *P. nigra*: it is interesting to observe that 63% of the clones of the "world" catalogue (International Catalogue of Poplar Clones – VIART 1992) descend from this species, mainly through interspecific hybridization.

Table 3 *Populus nigra* hybrids included in the International Catalogue of Poplar Cultivars

Hybrids	Clones	Origin
P. deltoides × *P. nigra*	98 clones	
P. nigra × *P. trichocarpa*	'ANDOVER', 'ROXBURY'	USA
P. nigra × *P. laurifolia*	'FRYE', 'RUMFORD', 'STRATHGLASS'	USA
P. maximowiczii × (*P. laurifolia* × *P. nigra var. italica*)	'GENEVA', 'OXFORD'	USA
P. tacamahaca × (*P. laurifolia* × *P. nigra var. italica*)	'MAINE'	USA
P. maximowiczii × *P. nigra*	'ROCHESTER'	USA

P. nigra has many desirable characteristics that determined its inclusion as parent in several improvement programmes going on in Europe: wide adaptability to many environments and different kinds of soil, excellent rooting ability of stem cuttings, fair resistance to *Marssonina brunnea* (Ell. *et* Ev.) P. Magn., high level of resistance to bacterial canker (*Xanthomonas populi* Ridé) and mistletoe (*Viscum album* L.) (AVANZO *et al.* 1985; PICHOT & *Teissier du Cros* 1988; SALLÉ *et al.* 1991; STEENACKERS pers. comm.). P. × *euramericana* is the most common hybrid of *P. nigra*. It was the result of spontaneous hybridization occurred in Europe in the 18th century, between the American *P. deltoides* and the European *P. nigra*. These hybrids combine some favourable characteristics of the American species (fast growth, good wood quality, resistance to relevant leaf diseases) with the above-mentioned favourable traits of the European species. Their success in commercial culture was tremendous, especially in Southern Europe and P. × *euramericana* clones now represent the large majority of cultivated poplars in Italy, France, Spain and many other countries. The ease of vegetative propagation was a key factor of success and some clones were distributed worldwide. The most emblematic case is represented by the clone 'I–214' which is cultivated in Europe, Asia, North- and South-America and Oceania and is probably the single genetic entity of a superior plant with the highest biomass in the world.

For these reasons *P. nigra* is included in the breeding programmes of several European countries. The Italian programme, for example, which aims at improving *P.* × *euramericana*, is been based on a semi-reciprocal recurrent selection of the parent species (AVANZO *et al.* 1985; BISOFFI 1989), although hampered by the incompatibility of the reciprocal cross *P. nigra* (female) × *P. deltoides* (male) (MELCHIOR & SEITZ 1968).

Crosses with another American species, *P. trichocarpa,* have been made in Belgium and recently also in France. Although characterized by fast growth and resistance to *Xanthomonas populi*, the hybrids, obtained using *P. nigra* both as female and as male parent, are susceptible to other diseases (*Melampsora larici-populina* Kleb. and *Dothichiza populea* Sacc. et Br.) and display a strong tendency to produce epicormic shoots after pruning. Therefore, they have never been employed in commercial cultivation (STEENACKERS, pers. comm.).

P. nigra has also been used for crosses with some Asiatic species of the section *Tacamahaca*. Well known is the clone 'ROCHESTER' obtained by the Oxford Paper Company (USA) from a cross between *P. maximowiczii* (female) and the European black poplar. Some more were obtained both in Europe and in the United States (table 3).

Hybrids between Chinese *P. simonii* (female) and *P. nigra* are largely cultivated in China; however, the behaviour of these Euro-Asiatic hybrids in Europe is little known: neither *P. Maximowiczii* nor *P. Simonii* are of any interest for cultivation as pure species but they might bring useful characters of resistance to biological or environmental stress factors into available breeding populations (FRISON & BISOFFI 1988); exploratory breeding with selected parents of *P. nigra* and *P. deltoides* is under way at the Instituto Sperimentazione per la Pioppicoltura (ISP) of Casale Monferrato (Italy).

The conservation of genetic resources in Europe

The goals of the conservation of genetic resources are both to maintain a large gene pool in evolution that may ensure the potential for natural adaptation and to provide base material for further breeding operations.

In order to preserve the adaptability of a species the most advisable action to take would be the protection of its natural habitat (*in situ* conservation), so as to maintain the gene complexes that have evolved and that will evolve during time in response to enviromental changes. This kind of conservation, however, might not be applicable to *P. nigra* in large parts of its European range. Natural stands are often very disturbed and fragmentary and cannot be preserved from high gene flow by the establishment of large protection bands.

Moreover, a riparian forest is a very dynamic ecosystem subject to rapid sequences of evolution

Table 4 Other hybrids with *Populus nigra* in the literature

Hybrid	Author
P. × *canescens* × *P. nigra*	ZSUFFA 1974
P. tremuloides × *P. nigra*	RONALD 1982
(*P.* × *canescens* × (*P. alba* × *P. grandidentata*)) × *P nigra italica*	RONALD 1982
(*P.* × *canescens* × (*P. alba* × *P. grandidentata*)) × *P nigra* Viadri	RONALD 1982
P. nigra × *P. lasiocarpa*	RICHENS 1945 *in* RAJORA & ZSUFFA 1984
P. suaveolens × *P. nigra*	STAROVA 1977 *in* RAJORA & ZSUFFA 1984
P. balsamifera × *P. nigra*	BEATSON 1991
P. koreana × *P. nigra*	BEATSON 1991
P. nigra × *P. maximowiczii*	HEIMBURGER 1970
P. nigra × *P. simonii*	ZHAO & ZHANG, unpublished data
P. nigra × *P. nigra* hybrids	HERPKA 1960

stages and heliophilous pioneer species such as poplars tend to be quickly replaced. For this reasons the protec tion of restricted ecological zones, even with appropriate silvicultural management that ensure the survival of the species, might not be enough. Secondary genetic resources (*ex situ* conservation) are also necessary. Although at the moment *ex situ* programmes are mainly static, in the future it would be better a "dynamic *ex situ* conservation".

Many European countries already started independent programmes of conservation of genetic resources of black poplar some years ago, mainly in consideration of its use as a parent species in poplar breeding. In recent years, however, the public concern about *P. nigra* as an endangered indigenous species has increased (ARBEZ 1993; WHITE 1993).

Unfortunately our countries in general lack exhaustive inventories of the remaining stands of *P. nigra* and detailed information on the status of preservation of these existing natural resources.

In situ conservation is limited to some particular situations: Bulgaria is involved in an international project for the protection of the riparian zones of the Danube. Croatia is going to start a plan for the preservation of the natural mixed forest with black poplar (covering about 10,000 ha). Hungary initiated a programme of gene preservation of native species in 1992; at the moment 8 stands (about 60 ha) on private land are protected. Portugal created an "ecological exhibition stand" which won so much renown that a bill for the conservation of that species was issued. In Italy no protection systems exist for *in situ* preservation: some Regional Natural Parks or Natural Reserves have been created along the main rivers of Northern Italy and areas with *P. nigra* are included, but no specific measure for the preservation of this species has been taken. The only indirect reference is some restriction to the cultivation of poplar hybrids.

Ex situ conservation, on the contrary, is more common in Europe. In Italy the first collection of spontaneous *P. nigra* specimens started before 1980 in central Italy, and was supplemented in 1981–83 by a large collection covering the whole national territory; distance from areas of large-scale poplar culture, old age, safety distance between sampled trees and an even sex-ratio were the guidelines of sampling (BISOFFI *et al.* 1987). In 1988 a thorough survey of the distribution of spontaneous poplar in the Region Lombardy was financed by the Regional Government (ANONYMOUS 1989; MALINVERNO 1992). About 400 genotypes are now in collection in stool-beds, clonal banks and arboreta at the Istituto di Sperimentazione per la Pioppicoltura of Casale Monferrato.

In France a first comprehensive collection started in the beginning of the 1970's and continued later. Seed of *P. nigra* was collected only in the areas where the risk of genetic pollution was reduced to the minimum (narrow valleys on the Alps, Massif Central and the Pyrenees) while vegetative propagation of spontaneous trees by stem cuttings was carried out in other areas. In some stands (Loire and Durance Valley) the sampling was more numerous to evaluate the variability within stand. All the material collected, at present 360 clones and 75 progenies, is now preserved in clonal banks and arboreta. A national inventory is planned for both single individuals and "evolute stands" (irregular native stands including sexually mature trees).

In Turkey about 500 clones were sampled at national level. Hungary started an inventory of *P. nigra* population some years ago: 150 clones propagated from isolated trees or from selected trees in native stands are now in collection. Croatia, recently involved in a programme of conservation of black poplar, has selected and propagated 36 genotypes. In the UK an inventory of the existing *P. nigra* specimens and a collection of propagation material were recently started, with a press

Table 5 Synthetic review of national activities in Europe involving *Populus nigra*

Country	Conservation		Research		
	ex situ	*in situ*	selection	diversity	
				P. nigra	*Populus*
Belgium	*		*		
Bulgaria	*	Danube	*		
Croatia	*	*	*		
France	*		*	*	*
Germany	*				*
Greece	*				
Hungary	*	8 populations	*		
Italy	*		*	*	*
Netherlands	*		*		
Portugal	*	Mondego	*		
Slovakia	*		*		
Spain	*		*		
Turkey	*		*		
UK	*			*	

campaign that involved the public, strongly concerned about the conservation of native trees, in the survey.

In the Netherlands existing collections include about 80 clones, German collections include about 59 clones, while Spain has made a collection only in some restricted areas (about 110 clones). Bulgaria and Greece, instead, have a very small collection. Detailed information is not available for other countries.

Present activities for the conservation of *P. nigra* are summarized in table 5.

As mentioned above, many countries are interested in *P. nigra* for its use in hybridization: almost all the nations are now evaluating the variability of their collections as regards the characters useful for breeding. All the genotypes included in the Italian collection were evaluated in nursery tests in three different localities: growth-related data (height and diameter), morphological traits (leaf shape, stem form and branchiness), phenology and resistance to principal diseases (*Marssonina, Melampsora, Dothichiza*) and insects (*Phloeomyzus passerinii* Sign.) were considered. A high variability among clones but a stable performance across sites was detected for growth and branchiness. A study on the behaviour of *P. nigra* coming from various sources towards *Melampsora allii-populina* Kleb. and *Melampsora larici-populina* Kleb. showed a high variability among individuals within provenances, but limited differences among provenances (CELLERINO *et al.* 1986).

Genetic diversity was also studied in France and Italy by means of biochemical markers (LEGIONNET, unpublished; MALVOLTI & BENEDETTELLI 1993): preliminary results of the isozyme analysis show a high level of within-stand genetic diversity (LEGIONNET, pers. comm.).

International coordination (EUFORGEN)

One of the six Resolutions proposed by the first Ministerial Conference on the Protection of Forests in Europe, held in Strasbourg in 1990, regards the conservation of genetic resources of European forest species. Resolution 2 invited the signatory countries to develop a forest-gene conservation policy, possibly through the establishment of international cooperation programmes.

FAO and IPGRI proposed a European Forestry Genetic Resources Programme (EUFORGEN) which was approved by a second Conference held in Helsinki in 1993 (IBPGR/FAO 1993; ARBEZ & LEFÈVRE 1993). This programme consists of four pilot networks on the species considered threatened in their genetic diversity according to a preliminary survey on the present status of the European forests genetic resources made by FAO and IBPGR.

One of the pilot networks regards *P. nigra* under the coordination of the authors of this paper. At the moment 14 countries have been involved: Belgium, Bulgaria, Croatia, France, Germany, Greece, Hungary, Italy, the Netherlands, Portugal, Slovakia, Spain, Turkey and the United Kingdom, although some of them have yet to formalize their membership of EUFORGEN with a financial contribution. Network meetings were held in Viterbo (Italy) May 1993 and in Izmit (Turkey) October 1994; a third one is planned in Casale Monferrato (Italy) September 1995. Present activities concern: the constitution of a European data-base for the *ex situ*

collections, the edition of identification sheet and guidelines for collecting material, the survey of different *ex situ* and *in situ* solutions locally used for *P. nigra,* and literature reviews.

PROPOSALS

Further studies are necessary in order to get a better knowledge of the remaining natural stands of *P. nigra,* the biology of the species, and the structuration of genetic diversity. This might guide a strategy of "dynamic *ex situ* conservation" for the long run, favouring flowering and the recombination between genotypes in order to cope "naturally" with the evolution of environmental conditions and parasitic populations.

The collection of new germplasm must be made taking into consideration the preliminary results obtained from the studies on variability: the high level of within-stand genetic diversity seems to show that a within-stand sampling might be more cost-efficient as compared to the sampling of isolated trees.

In the short run only *ex situ* conservation seems to be readily feasible. National reserves should be extended and "core collections", representative of their diversity, should be kept in several contrasted environments.

International coordination and exchanges of reproductive materials are imperative in consideration of the widespread natural range of black poplar. Collaboration from non-European countries is also to be sought after.

A special effort must also be put in the improvement of poplar image in the public perception. A negative attitude towards poplars in general by organized "ecologists" has been noticed in several countries where intensive poplar culture is widespread; and this attitude tends to be stuck also to autochtonous species. In extreme but emblematic cases the very existence of native poplar species is sometimes denied (France).

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