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ROLE AND PERFORMANCE OF EXOTIC POPLARS IN ITALY

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SUMMARY

The most prominent role among exotic poplar species in Italian poplar culture has been played by *Populus deltoides* since the 18th century. After the fifties a thorough study of this species was possible, due to extensive seed collections; geographical variations of relevant traits were investigated and then exploited by breeding work. Anyway, *P. deltoides* found limited use as clones for large scale cultivation and was employed mainly as parent of 'Euro-american' hybrids which still represent the bulk of Italian intensive Poplar culture.

P. trichocarpa and *P. maximowiczii* have also been used in breeding work (mainly crossed with *P. deltoides*) but only to a limited extent and for local situations.

Suggestions for future germoplasm exchange and of disease-free transportation are also briefly outlined.

FOREWORD

Exotic species have played a significant part in Italian poplar culture since its beginning. As in other European Countries, the most important non-native species is *Populus deltoides* Bartr. Hybrids with *Populus nigra* L., originally obtained in France since the middle of the eighteenth century were soon imported in Italy. These hybrids, ascribable to the 'serotina' group (*P. serotina* Hartig. or *P. canadensis* Moench. forma *serotina* Rheder), backcrossed with *P. nigra*, originated that group of clones that are commonly known in Italy as 'Canadian poplars' (SEKAWIN, 1976).

Later in the 18th century, a second flow of genetic material arrived, once again from France. It included specimen of *P. deltoides*, mostly belonging to the subspecies *angulata* Ait. These individuals, vegetatively propagated and possibly crossed with *P. nigra* or hybrids, gave rise to the so called

'Carolina poplars'.

'Canadian' and 'Carolina' poplars were propagated and empirically selected by a multitude of nursery men and cultivated in Northern Italy during the 19th century. The varieties employed were far from being clones; they were perhaps mixtures of a large number of clones with similar phenotypes. They were not either genetically stable, as it was common practice to draw cuttings from the best individuals of a plantation for further propagation. The genetic diversity was particularly evident during a series of epidemics of 'spring defoliation' *Venturia populina* (Vuill.) Fabricius; a large variation in susceptibility, especially within the group of the 'Canadians', was found.

Jacometti started breeding work on poplar due to this disease. In 1929, he obtained clones such as 'I 214', 'I 488' and 'I 455' from crossings between 'Carolina' and 'Canadian' specimen.

It was only after World War II that *P. deltoides* was studied and employed in a more rational way with extensive provenance and progeny testing.

Other exotic species, which were studied and used for breeding purposes as well, but never reached the importance of *P. deltoides*, include: *P. trichocarpa* Torr. et Gray, *P. maximowiczii* Henry and *P. simonii* Carr.

POPULUS DELTOIDES

The first seed lots of *P. deltoides* reached the Poplar Research Institute (ISP) of Casale Monferrato in 1948, thanks to Prof. Scott Pauley. They came from two mother trees located along the Mississippi in the area around Stoneville. From a selection within the seedlings, two clones were released for commercial cultivation, namely 'Harvard' (= I 63/51) and 'Onda' (= I 72/51). They never obtained a great success due to greater care needed for vegetative propagation, worse resistance to windstorms and higher susceptibility to Poplar Mosaic Virus as compared to *P.x euramericana* (Dode) Guinier clones.

Prof. Scott Pauley sent more seed lots in 1951 and 1952, this time spanning a wider section of the natural area of the species (Texas, Kansas, North Dakota, Alabama, Illinois, Arizona). From Illinois (Massac County) came the seed which later originated the clone 'Lux' (= I 69/55). This clone was more successful than the two mentioned before and is at present the only *P. deltoides* clone which is commercially cultivated to some extent in Italy.

In the years that followed the flow of seed from the United States to Italy (and to the rest of Europe) increased.

In 1958 Prof. Ervedo Giordano (1959) collected seed in Rosedale and Vicksburg, in the lower course of the Mississippi river.

In 1967 the Poplar Council of America collected and sent to a great number of Institutions around the world seed from 14 different States of the U.S.A., ranging from 30.16' to 44.40' North latitude and 72.53' and 103.10' West longitude. This

collection and another one organized two years later by the P.C.A. in Oklahoma form the bulk of the breeding work carried out since the early seventies in Italy both at the Poplar Research Institute of Casale Monferrato and at the Agriculture and Forestry Experimental Centre (CSAF) of Rome (AVANZO 1974).

Clones and seed lots were also received from the 'De Dorschkamp' Institute of Wageningen (1968), from Prof. J. Jokela of the University of Illinois (1972), and from the Poplar Research Institute of Geraardsbergen (Belgium).

Quite paradoxically, in the seventies, Italy (but the situation was not very different in other European Countries) had an immense genetic capital of the North-American species to work with, but virtually nothing at all of the European *P. nigra*, the other parent of the 'euro-american' hybrids (BISOFFI et al. 1987).

Both in Casale and in Rome extensive research work on *P. deltoides* was carried out, in order to study the variations of relevant traits between and within different provenances.

Cutting rooting ability was found to increase from south to north, due to a slower loss of water (SEKAWIN 1974). As far as transplanting from nursery to plantation is concerned, winter is a better time than late autumn for the southern clones; lignification of the shoots being delayed by a longer vegetation period.

Growth rate is, as a rule, higher in the southern provenances; but, as Avanzo (1970, 1972, 1974) pointed out, that is due entirely to the longer growing period. If the growth (height in nursery) is divided by the length of the growing period, then the 'per day' increment is higher in the northern provenances.

The longer growing season of the southern provenances has negative reflections on the resistance to early frosts which can occur, in Northern Italy, as early as October. The effects of low temperatures on different provenances were studied by Cellerino (1975). He concluded that provenances over 38°N can be considered safe for Northern Italy, those under 35°N are unsuitable for the same area and those in between can be used after careful examination of historical meteorological records.

Among relevant morphological traits 'branchiness' was investigated by Avanzo (1972). He found a rather large variability but without a geographic pattern. Most of the variation was at individual level and, more interesting, the number of branches was not correlated with diameter growth.

As far as diseases are concerned, data have been collected on *Marssonina brunnea* (Ell. et Ev.) P. Magn. and *Melampsorae* sp. In both cases susceptibility increases from south to north.

Data on Poplar Mosaic Virus are not to be considered conclusive but southern provenances seem to be more susceptible than northern ones.

Among insects, resistance to *Phloeomyzus passerinii* Sign. was extensively investigated by Arru and Lapietra (1979); large differences were found both between and within provenances, Louisiana and Mississippi being the best ones.

Many other traits, such as resistance to pests, drought and

diseases other than those mentioned above, reaction to cultural practices (spacing, tillage, fertilization, pruning) and wood technological characteristics have not yet been completely investigated.

As in the recent past, *P. deltoides* is used at present more as a parent of 'euro-american' hybrids than as a source of clones to be selected and released for commercial cultivation.

Information obtained from provenance and progeny trials, as well as genotypic evaluation of individuals, have allowed a selection of parents which have been used in a large breeding program started in 1982 and aimed at the improvement of *P. nigra* and *P. deltoides* as parents of hybrids (AVANZO et al. 1985; CELLERINO 1985).

OTHER SPECIES

P. trichocarpa seed was obtained through IUFRO in 1973. Fifty seven provenances of British Columbia, Washington and Oregon were represented. It was soon evident that clones of that species would never be used in intensive culture. In the fertile bottomlands along the river Po and its tributaries they grew very herbaceous and were invariably bent or flattened even by moderate rainfalls and winds.

Another negative aspect was the very high sensibility to iron chlorosis due to high pH and lime content, common in poplar areas of northern Italy.

P. trichocarpa was then used in breeding work aimed at the selection of clones suitable for cultivation in sub-alpine regions. The best results were obtained by hybrids with *P. deltoides*, both created by controlled pollination at the ISP and raised from seed kindly provided by the Poplar Research Institute of Geraardsbergen (Belgium).

'Interamerican' hybrids from Belgium (UNAL group) and The Netherlands were also tried in intensive cultivation. Clones 'Beaupre' and 'Raspalijs' showed a good growth but proved to be quite sensible to windstorms. Anyway, available data are not conclusive and further testing is under way.

As regards diseases, almost all individuals of *P. trichocarpa* and related hybrids have showed varying degrees of susceptibility to *Melampsora* sp. Although the disease cannot be regarded at present as one of the most serious in Italy, the adaptive ability of the parasite suggests extreme caution.

On the other hand, resistance to *Marssonina*, *Venturia*, *Dothichiza* and the so called 'brown-spots', make one consider *P. trichocarpa* as one of the most interesting potential sources of useful genes.

Until recently, *P. maximowiczii* was known in Italy only through a pollen lot that Prof. Nabukiyo Takahashi of the University of Tokyo sent to the ISP in 1955. From the progeny of a *P. deltoides* mother fertilized by such pollen the hybrid clone 'Eridano' (= I 83/58) was selected: this clone has been recently registered for commercial use in Italy. It is immune from all leaf and bark diseases relevant in Italy and grows quite

fast on sandy soils. On the contrary, clayey and calcareous soils are absolutely unsuitable. It shows also rather high sensibility to windstorms.

In 1981 the ISP received cuttings of 22 clones (belonging to 8 progenies of 6 provenances in Hokkaido) from France (CTGREF Orleans). They have been propagated and tested in nursery and plantation. Their main use, anyway, will be in preliminary breeding trials in order to evaluate the potential use of this species as a parent of hybrids with *P. nigra* and *P. deltoides*.

The same can be said for *P. simonii*. The ISP and the CSAF received in 1981 seeds of 6 different Chinese provenances ranging from 34.50' to 44.30' N latitude. They were tested at nursery as well as plantation levels. Their slow growth, bushy aspect and very early spring sprouting make the species unusable for conventional poplar culture. On the other hand, *P. simonii* can be a very important source of genes in hybrids such as the chinese 'Xiaohai Poplar'. Combined with *P. nigra* or *P. deltoides* it could carry along important traits of resistance to cold and salt.

SUGGESTIONS FOR INTERNATIONAL COOPERATION

We suggest two lines of action. The first is a cooperative effort for collection and distribution of seed of still little known species or provenances. We think particularly of Asian species such as *P. yunnanensis* Dode and *P. ciliata* Wall., but also of provenances previously neglected of otherwise well known species: *P. trichocarpa* from the southern part of the natural range, for example, could be very important for the Countries of the Mediterranean area.

European Countries could reciprocate by diffusing seed of native species such as *P. nigra* and *P. alba* L.

The second line of action is the establishment of joint research project on such species or traits that might be of common interest. These should particularly address the evaluation of genetic parametres, information that is often lacking but crucial for an efficient design of breeding programmes. From a common work in different parts of the world, not only would costs be reduced by avoiding unnecessary duplications, but also information obtained and shared would have a more general value.

SAFE EXCHANGE OF MATERIAL

Intercontinental exchanges should be limited to pollen or seed which are either sufficiently safe from the risk of disease spreading or easy to disinfect before and/or after mailing. Packaging in vacuum bags is recommended.

If clones are to be exchanged this should only be through 'in vitro' cultures. Research should be made and results exchanged for the identification of one or a few universal media for these exchanges.

When it comes to transportation of clones among Countries where the same diseases occur, as is the case in Europe, less precautions are needed and a careful disinfection of cuttings both before mailing and after receiving the material seem safe enough. Anyway, the risk of spreading different strains of existing pathogens is real and quarantine is always to be recommended.

REFERENCES

- ARRU G., LAPIETRA G. (1979)
"Breeding Poplars for resistance to insect pests".
Proceedings of IUFRO Meeting of Working Parties S2-02-10 and S2-03-07 (France and Belgium, 17-22-9-1979), published in Wageningen (Netherlands), 11-17.
- AVANZO E. (1970)
"Accrèscimento in altezza del *Populus deltoides* Marsh. in vivaio, in funzione della latitudine".
Cellulosa e Carta (Roma) (3), 36-38.
- AVANZO E. (1972)
"Variabilità nell'accrescimento in altezza ed in alcune caratteristiche fogliari dei semenzali di *Populus deltoides* Bartr. in funzione della latitudine di origine".
Pubbl. Centro Sper. Agric. For. (Roma) 11, 95-117.
- AVANZO E. (1974)
"Osservazioni sulla variabilità di alcune provenienze di *Populus deltoides* Bartr. introdotte in Italia".
Informatore Botanico Italiano (Firenze) 6, (1), 94-100.
- AVANZO E., BISOFFI S., GRAS M.A., MUGHINI G. (1985)
"Breeding strategy adopted in Italy for Poplars of the *Aigeiros* section" (abstract).
Genetica Agraria 39, 308.
- BISOFFI S., GEMIGNANI G., GRAS M.A., MUGHINI G. (1987)
"Establishment of *Populus nigra* L. genetic reserves in Italy".
Genetica Agraria 41, 105-114.
- CELLERINO G.P. (1975)
"Sur la réaction de 52 familles de *Populus deltoides* Bartr. à l'infection par *Melampsora alli-populina* Kleb. dans la Vallée du Po" (résumé).
18th Session FAO/CIP/MAL75-4-2, 2pp.

CELLERINO G.P. (1978)

"Reazione di 52 famiglie di *Populus deltoides* Bartr. agli abbassamenti di temperatura precoci".

Cellulosa e Carta (Roma) , (5), 3-18.

CELLERINO G.P. (1985)

"Research on poplar tree breeding".

Commission of the European Communities, Directorate-General for Science, Research and Development, European R & D Programme "Wood as renewable raw material", Workshop of the Contact Groups I.I.A. and I.3.B., Geraardsbergen 15-17.10.1985, Proc., 84-87.

GIORDANO E. (1959)

"Il *Populus deltoides* Bartr. nel sud paese di origine".

Pubbl. Centro Sper. Agric. For. (Roma) 3, 127-180.

SEKAWIN M. (1974)

"Ancora sulla correlazione tra velocita' di disidratazione e attecchimento delle talee di pioppo".

Cellulosa e Carta (Roma) , (1), 3-11.

SEKAWIN M. (1976)

"Poplar breeding in Northern Italy, including *Populus deltoides*".

Proceedings Symposium on Eastern Cottonwood and Related Species, Greenville MS (USA), 28.9-2.10.1976, 170-175.