SUMMARY OF GENETIC IMPROVEMENT OF POPLAR AND EUCALYPTS IN ITALY

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Introduction

Wood consumption has increased considerably in Italy during the past few years and has now reached approximately 12,000,000 cubic meters per annum. Unfortunately, our national production only covers 1/3 of the requirements and some 8,000,000 cubic meters of wood are imported each year. This is due pri marily to the fact that over the centuries the excessive population pressure has caused a slow but steady decrease in our forest area, now covering 5,792,000 hectares (19 percent of the total land area) of which 40 percent is under conifers and 66 percent under broadleaved coppice or mixed forests.

The production rate of these forests is rather low, due to uncontrolled fellings and to lack of cultural practices over long periods of time. The im- possibility of increasing the forest surface without prejudice to agriculture has motivated the search for new forms of production in the cultivation of quick- growing tree species. In this connection, the cultivation of poplars and eucal- ypts has acquired considerable economic importance.

Poplar cultivation is particularly, intensive in northern Italy, thought out the Po Valley, where the climate and edaphic conditions are most favorable, but little is known in the central and southern regions, where large rivers are rare and the rainfall scarce.

The annual production from poplar plantations amounts to approximately 1,500,000 cubic meters and represents 1/3 of the total national wood production. It is interesting to note that pure poplar stands account for only 20 percent of this considerable volume, while the balance is produced by riverain plantations, lines of trees bordering roads and irrigation canals, and isolated trees.

Poplar wood is used in Italy for many different purposes, About Li0 per- cent of the production is utilized by the lumber industry, 30 percent by paper mills, and the rest by the plywood and packing industries.

Necause of the particular temperature requirements of most of the species the cultivation of eucalypts is concentrated maonly along the coast of central and southern Italy and in the islands, in stations where winter temperatures

very seldom fall below zero. Eucalypts grow more rapidly in Italy than in their country of origin and because of their limited soil requirements they are successfully used for afforestation and for the establishment of shelterbelts in land reclamation areas.

Research on the genetics of popars is carried out in Italy by the Institute for the Improvement of Poplar Cultivation in Casale Monferrato, and by The Centre for Agricultural and Forestry Experimentation in Rome. The former started its activities in northern Italy over 30 years ago, while the latter was established in 1953 for the purpose of propagation, in central and southern Italy, tree species suitable for the production of cellulose and paper, and es pecially eucalypts. Both institutes are dependent on the E.N.C. C. (Ente Nazionale per la Cellulosa e per la Carta - National Agency for Cellulose and Paper), an organization which undertakes - under governmental control - varied activities in favour of pulp and paper industries.

Genetic Improvement of Poplars

Italian poplar cultivation is mainly based on natural hybrid poplars resulting from a cross between European P. nigra and American P deltoides. These hybrids have met with great success among the growers because they show pronounced characteristics of heterosis, a high growth rate, easy vegetative propagation and good technological properties. For instance, in the Po Valley a twelve-year-old poplar plantation of the clone I-214. may have a standing crop of 360 cubic meters per hectare, corresponding to a mean annual increment of 30 cubic meters.

The first studies on poplar genetics go back to 1928, when Mr. Jacometti started his research in Piedmont on types resistant to spring dieback caused by the fungus Pollacia elegans (f.p. Venturia populina). These studies were then continued and broadened Mr. Piccarolo, who is to be credited with the improvement technique at present applied in Italy. This technique has given satisfactory results and deserves description.

Each year, seed is collected from trees with good characteristics of growth, shape and, above all, resistance to pests and diseases. The seed is germinated in greenhouses. The seedlings (20 to 30 thousand) are transplanted to a nursery during the end of May and undergo a first selection at the end of the first growing season. Selection is on the basis of growth vigor, growth habit, resistance to rust and other attacks from parasites. There is no doubt that this selection can cause the elimination of plants which have grown little through accidental factors, but could eventually have shown sustained yield and good technological properties. However, for lack of large land areas in which to study all the material available, elimination of a great part of the seedlings becomes necessary.

A selection nursery is established the following season, with the selected seedlings which usually represent 2 - 3 percent of the initial number. The seedlings are dug at the end of the winter, cut back, and their roots planted with a spacing of 1.80 to 2.20 meters between rows and 0,80 meter along the row. These plants (ortets) remain in the ground for two years before they undergo a new selection.

In order to avoid taking up too much space., three cuttings (ramets) are planted between the rows according to their rooting habits. These ramets are obtained from the stem of each selected seedling. The plants, which are known as "barbatelles", remain in the ground for only one vegetative season before they are selected. They are evaluated on the basis of points assigned for

each of the following characters: diameter increase, stem form, rooting ability, resistance to pests and diseases. The plants with the highest score are again the object of vegetative propagation, while the others are eliminated. This method makes it possible to have a large number of plants with good chances of success in a short period of time and to judge their rooting ability with greater precision.

At the end of the second year, the ortets, which by then have a two-year-old stem and three-year-old root, are again selected on the basis of their dia meter increase, habit, shape and resistance to pests and diseases. At this stage, a score is again set for each of these characters. Through the comparison of the scores obtained by the ortets and their respective ramets, it is possible to single out a limited number of individuals which are set apart for selection arboreta where they remain under control for about 10 years.

At the same time, the cuttings from these individuals are distributed for experimental purposes to private planters and industries, in order to ob tain the greatest possible amount of data on the behaviour of the various types under the most varied conditions. Only a few individuals come through this test successfully and before they are registered as clones they are cultivated in comparative plantings where they undergo further technological tests. At the end of this long process, the selected clones are registered with the National Poplar Commission and distributed among the production nurseries.

The results obtained with this selection method are satisfactory and have brought about the identification of several clones (such as, I-154, I-214, I-262, I-455, I-476, I-488) which are very frequently cultivated in Italy and abroad. In fact, clone I-154 occupies over 10,000 hectares in the delta of the Parana River in Argentina, and clone I-214 has shown a high degree of adapta-bility in countries of the Mediterranean region, such as Syria and Turkey, as well as in those of Central Europe (Belgium, France, Netherlands).

Artificial hybridizations have so far been undertaken on a rather lim-ited scale and have concentrated mainly on poplars of the Section Leuce. Suc-cessful crossings have been carried out in Casale Monferrato between selected P. alba % P. tremula, P. alba x P. tremuloides, P. alba x P.grandi dentata . The crossing technique is similar to that usually applied in Europe and con-sists in pollinating the female branches obtained from selected trees and side -grafted on one-year old greenhouse plants. The pollen is collected from the flowering branches of male plants in water culture. Artificial hybridizations will undoubtedly have ever greater importance in the creation of new types of poplars suited to the difficult surroundings of Central and Southern Italy.

The research program of the Centre in Rome includes a series of cross-ings between selected spontaneous Italian poplars and various forms of P. del-toides from the United States, particularly from the southern States. For this purpose, the author collected seeds and cuttings of this species in Mississippi, Louisiana, Illinois, Iowa, and Vermont, in 1958 during a study tour on the veg-etative conditions of Populus deltoides. These have been propagated in nurseries in Rome. There are at present some 30,000 cuttings of P. deltoides available which will undergo selection during the next few years.

In addition, the Centre in Rome has started two other lines of research intended to favor the culture of poplar in central-southern Italy, namely the improvement of P. tremula and the establishment of the Populetum Mediterraneum.

On the mountains of the central and southern Apennines, there are a great number of areas abandoned by agriculture where it would be possible to expand poplar cultivation, Before the introduction of new types, an effort

has been made to propagate spontaneous P. tremula. This species has a moderate growth rate, but good technological characteristics and, above all, a remarkable degree of adaptability to poor soils. Research has led to the identification and collection of rooted sprouts of a few individuals that are outstanding for their form and rapidity of growth. It is interesting to note that the greater part of the P. tremula populations are made up of only female plants, while the male individuals are almost non-existent. This makes it difficult to collect fertile seed.

The centre has undertaken the establishment of a Populetum with the collaboration of FAO, where natural or cultivated poplars from the countries of the Mediterranean Basin are collected. This arboretum is intended to allow direct comparison between the various clones, including the study of the botanical and technological characteristics, as a basis for a broader improvement program. So far, the arboretum consists of many types of P. alba and P. nigra received from Iraq, Spain, Syria and Turkey.

Genetic Improvement of Eucalypts

Eucalypts were introduced into Italy as ornamental trees towards the end of the eighteenth century, but their spread only started at the beginning of the present century, when it was believed that the essential oil contained in their leaves had therapeutic value against malaria. Their rapid growth and their adaptability to dry areas, make eucalypts particularly well suited to the conditions prevailing in southern Italy where, since the end of the last World War, more than 15,000 hectares were afforested with E. camaldulensis gomphocephala, E. globulus and E. trabuti.

In order to expand these cultivations, 60 new species were introduced into Italy in 1953 and are now being tested by the Centre in Rome. A drastic selection has resulted from the exceptionally cold winter of 1955-56 when temperatures below 0°C. were registered for 20 consecutive days. Nevertheless, certain species belonging to the Snowgum group showed good resistance to the cold. Among these, the following seem rather promising: E. bridgesiana, E. dalrympleana, L. rubida, E. stellulata and E. viminalis. Unfortunately, E. camaldulensis, E. globulus and E. trabuti, which are the most common in Italy, show great variability within the species and are therefore unsuitable for industrial utilization.

With a view to obtaining more morphologically uniform plants, a collection has been started of E. trabuti seeds from selected plants in the shelterbelts around Rome. This selection will be progressively extended to other species but concrete results can only be expected when seed orchards have been established. In this connection, one of the main obstacles is the fact that up to the present time no method has been found to root cuttings from adult trees. Vegetative propagation of eucalypts has given satisfactory results only from cuttings and grafts obtained from young trees (1- to 2-year-old). Studies are now in progress to improve the propagation of stem cuttings by the mist method.

Natural hybrids are now being sought among the species already acclimatized in Italy. The following forms have been singled out so far: E. maideni x E. camaldulensis, E. viminalis x E. camaldulensis, E. viminalis x E. globulus. These hybrids are of particular interest as E. camaldulensis shows a high degree of adaptability to difficult soils, Although the others are less hardy, they possess better technological characteristics. Tests are being carried out on the collection and preservation of pollen to effect artificial crossings among these species.

Conclusion

This brief review makes it apparent that there is still much work to be done for the improvement of poplars and eucalypts.

In the case of poplars the problem is no longer the creation of highly productive and easily adaptable clones, but mostly the improvement of the technological characteristics. To this end, greater importance will have to be given to artificial hybridization in order to reduce loss of time and material.

The improvement of eucalypts has only just begun, but satisfactory results can be expected before too long. In fact, eucalypts can produce viable seed at the age of 3 to 5 years, which is not the case with many other forest species. This characteristic facilitates selection, as various generations can be compared in a relatively short time.

In the research to identify the eucalypt species best suited to ecological conditions in Italy, due attention should be paid to the collection of seeds from plants which grow outside the Australian territory, as for example in California and Brazil, as they often produce trees of great adaptability to the countries into which they are introduced.

If the present collaboration between American and European research workers continues to be as satisfactory as it has been so far, new and promising vistas will be opened to poplar and eucalypt cultivation on both continents.