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STRATEGIES FOR FINALIZING CONIFERS EXPERIMENTAL TESTS TO THE PRODUCTION OF IMPROVED REPRODUCTIVE MATERIALS

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Abstract

The paper points out the ex situ conservation problems regarding genetic resources of the most important Mediterranean Conifers studied in Italy (Pinus halepensis, P. brutia, P. eldarica, P. pinaster, P. radiata; Cedrus atlantica, C. libani, Abies nebrodensis and other species). It prospects the possibility to using some experimental plantation, which reached fully fructification as a source of certified (known origin and controlled quality) propagation material. Council Directive 1999/105/EC on the marketing of forest reproductive material is drawn considering the possibility to certify conifer seeds within the different qualitative categories. Finally the paper present the strategies to exploit appropriately experimental plantations in view of their correct management as seed orchards.

INTRODUCTION

Recent international resolutions, i.e.Vienna 2003 [9] have promoted the conservation of Forest Genetic Resources (FGR) as an integration for a Sustainable Forest Management (SFM).

Forests should be considered and protected not only for their wood value but also for their multi purpose use (renewable energy sources, soil and water resources protection, tourism and social aspects, etc.).

Regions of Provenance and Seed Stands represent the basic source of forest reproductive materials (FRM) for afforestation and reforestation activities, often performed in very hard environmental conditions.

In Italy conifers are usually reproduced through Seed Stands, but costs and organization problems make more difficult seed supplies. The mean quality could be improved and costs reduced only by using Seed Orchards, which represent the final point of improvement programs [3].

On the other hand a wide network of comparative tests exist, which could be easily used as a source of FRM [4; 6].

In the experimental plantations (Tab. 1 and Fig. 1) are preserved, approximatively:

150 provenances, namely genetic entities representative of the main stands distributed in the natural range of the different Mediterranean conifers;
500 maternal half-sib families (*P. halepensis, P. pinaster, P. radiata*);
3 clonal tests (*Pinus radiata, Cedrus atlantica* and *Abies nebrodensis*).

This material was often obtained through the collaboration among different international organizations: Food and Agriculture Organization/Silva Mediterranea (FAO), Commonwealth Scientific and Industrial Research Organisation (CSIRO), Institut National de la Recherche Agronomique (INRA), or through purchase or direct collection carried out by Centro di Sperimentazione Agricola e Forestale (CSAF, today ISP-URF) and Istituto di Sperimentazione per la Selvicoltura of Arezzo (ISSA). Often the experimental plantations were set up in cooperation with Corpo Forestale dello Stato (CFS) or other Regional and Local administration offices [6 ; 7].

Those tests are nowadays an important *ex situ* conservation network and sometime they represent important collections of endangered FGR.

Fig. 1. Territorial dislocation of conifer plantations for the production of selected seed

Table 1. Synthesis of characteristics of conifers experimental plantations (ISP/URF from n°1 to n°32; ISS from n°33 to 41)

N°	Species	Kind of trials	Experimental design	Surface	Year plantation	Seed supply of	Region	Municipality	Place
1	*Abies cephalonica*	Test of proven.	ex situ conserv	0,50	1981	FAO-IUFRO	Toscana	Londa-FI	Rincine
2	*Pinus brutia, P. halepensis*	Test of proven.	random block	9,00	1975	FAO	Lazio	Roma-RM	Castel d.G.
3	*Pinus brutia, P. halepensis*	Test of proven.	random block	2,00	1976	FAO	Emilia Romagna	Modigliana-FO	Montebello
4	*Cedrus libani*	Test of proven.	split-plot	1,08	1994	INRA	Lazio	Roma-RM	Ovile
5	*Cedrus libani*	Test of proven.	split-plot	1,00	1994	INRA	Toscana	Londa-FI	Rincine
6	*Cedrus libani*	Test of proven.	split-plot	1,00	1994	INRA	Calabria	Soveria M.-CZ	Grandone
7	*Cedrus atlantica*	Test of clones	single tree plots	2,00	1991	CSAF	Toscana	Grosseto	Il Terzo
8	*Cedrus atlantica*	Test of proven.	random block	1,20	1982	DERF	Lazio	Roma-RM	Ovile
9	*Cedrus atlantica*	Test of proven.	single tree plots	0,50	1982	DERF	Lazio	Roma-RM	Ovile
10	*Cedrus atlantica*	Test of proven.	random block	2,00	1983	CSAF	Toscana	Londa-FI	Ovile
11	*Cedrus atlantica*	Test of proven.	random block	1,00	1983	CSAF	Abruzzo	Bussi sul Tirino-PE	Bussi
12	*Pinus eldarica*	test compar. species	random block	1,00	1986	CSAF	Sardegna	Domusnovas-CA	Marganai
13	*Pinus eldarica*	test of cultivation	ex situ conserv	1,00	1980	CSAF	Molise	Bonefro-CB	Bonefro
14	*Pinus eldarica*	test of cultivation	ex situ conserv	1,00	1981	CSAF	Calabria	Oriolo-CS	Oriolo-Castroregio
15	*Pinus eldarica*	test of cultivation	ex situ conserv	1,00	1981	CSAF	Abruzzo	Tufillo-CH	Tufillo
16	*Pinus eldarica*	test of cultivation	ex situ conserv	1,00	1980-81	CSAF	Campania	Ceraso-SA	Ceraso
17	*Pinus eldarica*	Test of proven.	random block	1,00	1991	CSAF	Lazio	Roma-RM	Ovile
18	*Pinus halepensis*	progeny of select. proven.	random block	1,00	1985	CSAF	Lazio	Roma-RM	Ovile
19	*Pinus halepensis*	progeny of select. proven.	random block	3,50	1989	CSAF	Calabria	Botricello-KR	Botricello
20	*Pinus pinaster*	Test of proven.	random block	0,80	1985	CSAF	Lazio	Roma-RM	Ovile
21	*Pinus pinaster*	Test of proven.	random block	3,00	1985	CSAF	Liguria	Bordighera-IM	Montenero
22	*Pinus pinaster*	Test of proven.	random block	0,90	1985	CSAF	Sardegna	Vallermosa-CA	Vallermosa
23	*Pinus pinaster*	Test of proven.	random block	1,50	1986	CSAF	Sardegna	Domusnovas-CA	Marganai
24	*Pinus pinaster*	Test of proven.	random block	1,00	1989	CFS-Pieve S. S.	Lazio	Roma-RM	Ovile
25	*Pinus radiata*	Test of clones	single tree plots	1,75	1986-93	CSAF	Lazio	Roma-RM	Vivaio ex CSAF
26	*Pinus radiata*	Test of proven.	random block	1,87	1981	CSIRO	Lazio	Roma-RM	Ovile
27	*Pinus pinaster*	progeny Cuenca	single tree plots	3,00	1993	INRA	Toscana	Grosseto	Scagliata
28	*Pinus pinaster*	progeny Cuenca	single tree plots	1,25	1993	INRA	Liguria	Bordighera-IM	Bordighera
29	*Pinus pinaster*	progeny of Sardinia proven.	single tree plots	0,90	1990	CSAF	Sardegna	Arbus-CA	Arbus
30	*Pinus pinaster*	progeny of Sardinia proven.	single tree plots	0,70	1990	CSAF	Sardegna	Domusnovas-CA	Marganai
31	*Pseudotsuga menziesii*	Test of proven.	random block	1,00	1969	IUFRO	Calabria	Decollatura	Carolea
32	*Pseudotsuga menziesii*	Test of proven.	random block	1,00	1974	IUFRO	Toscana	Londa-FI	Rincine
33	*Abies nebrodensis*	Test of clones	single tree plots	0,80	1993-94	ISSA	Toscana	Arezzo	Pomaio
34	*Abies nebrodensis*	Test of clones	single tree plots	0,80	1993-94	IUFRO	Toscana	Arezzo	Caprile
35	*Pinus brutia, P. halepensis*	Test of proven.	random block	1,00	1981-82	FAO	Sardegna	Pula-CA	Pixinamanna
36	*Pinus brutia, P. halepensis*	Test of proven.	random block	1,00	1981-83	FAO	Sardegna	Castiadas-CA	Castiadas
37	*Abies cephalonica*	Test of proven.	random block	0,52	1979	FAO	Abruzzo	Pescosansonesco-PE	Colle Soda
38	*Pinus brutia, P. halepensis*	Test of proven.	random block	0,78	1981	FAO	Molise	Guardialfiera-CB	Lentiscete
39	*Pinus brutia, P. halepensis*	Test of proven.	random block	1,00	1976	FAO	Toscana	Cecina-LI	Valle Benedetta
40	*Pseudotsuga menziesii*	Test of proven.	random block	1,00	1969	IUFRO	Toscana	Arezzo	Ponte Ranzo
41	*Abies cephalonica*	Test of proven.	random block	1,00	1970	Italy	Molise	S.Pietro Avellana - IS	Monte Capraro 91

Fig. 2. Experimental Farm Ovile, ISP/URF Research Institute, Rome

STRATEGIES FOR USING IMPROVED REPRODUCTIVE MATERIALS

These experimental plantations are the result of a complex selection program: adaptability tests, provenances comparisons, Plus trees progeny testing and clones seed orchards (Figure 2). A great part of these plantations are already producing seed; this capacity will last several years. However, the correct valorization of these plantations requires initiatives such as:

taking a census of the plantations and evaluating their productive and genetic capacities;
preparing suitable management procedures (cultural practices, fire protection precautions, floral and fructification induction, etc.);
making sure the owners act in compliance with the reproductive materials marketing rules;
promoting cooperation protocols among forest biodiversity conservation centers and private and public owners;
providing financial support for the conservation plantations and innovative research programs.

Fig. 3. Cones of *Pinus pinaster* and *Cedrus atlantica,* Ovile Farm, Rome

Current available conifer experimental plantations, finalized to the selection of best quality reproductive materials, assure the production of the seed resources required for afforestation and reforestation activities in very different ecological sites of the Mediterranean area. We are able to produce suitable material to be used in poor or semi-arid sites (*P. halepensis*, *P. eldarica*, *P. brutia*) as well as in highly productive sites (*Pinus radiata*, *Pseudotsuga menziesii*); moreover, it is possible to collect seed of high environmental and productive value species (*Cedrus atlantica*, *Pinus pinaster* resistant to *Matsucoccus feytaudi*). This concept is reinforced by the EU Directive 1999/105/CE on trading of FRM, followed by the national Decree 386/03.

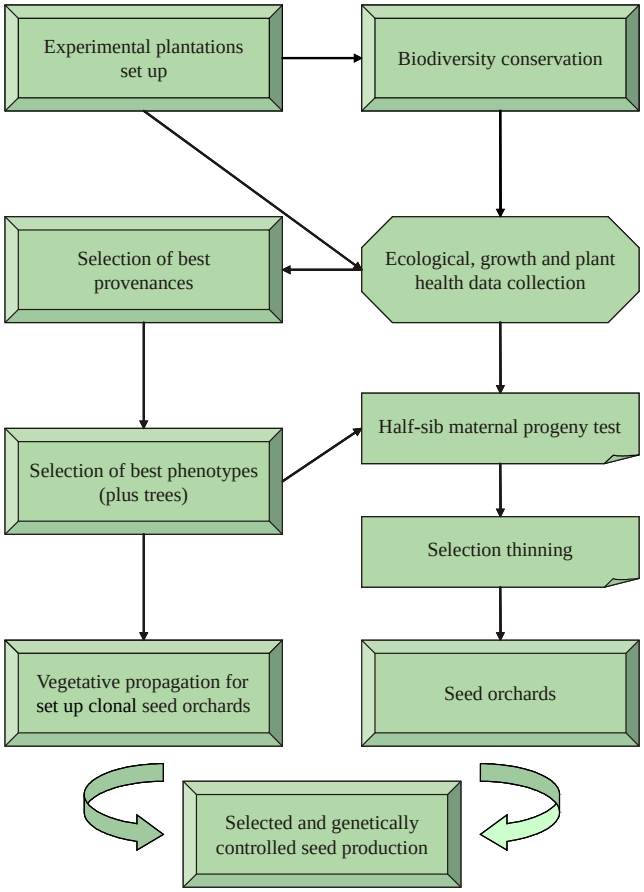

Fig. 4. Flow-chart of the selection and genetic improvement program adopted by ISP/URF

MARKETING FOREST REPRODUCTIVE MATERIAL CATEGORIES

Council Directive 1999/105/EC of 22 December 1999 [1] on the marketing of forest reproductive material, followed by the national Decree 386/03, uses following categories:

Source-identified material: "*reproductive material derived from basic material which may be either a seed source or stand located within a single region of provenance and which meets the requirements set out in Annex II"*;

Selected material: *"reproductive material derived from basic material which shall be a stand located within a single region of provenance, which has been phenotypically selected at the population level and which meets the requirements set out in Annex III"*;

Qualified material: "*reproductive material derived from basic material which shall be seed orchards, parents of families, clones or clonal mixtures, the components of which have been phenotypically selected at the individual level, and which meets the requirements set out in Annex IV. Testing need not necessarily have been undertaken or completed"*;

Tested material: *"reproductive material derived from basic material which shall consist of stands, seed orchards, parents of families, clones or clonal mixtures. The superiority of the reproductive material must have been demonstrated by comparative testing or an estimate of the superiority of the reproductive material calculated from the genetic evaluation of the components of the basic material. The material shall meet the requirements set out in Annex V"*.

Following the 1999/105/CE Directive [1], the gene resources tests can be considered also as sources of selected, qualified or controlled materials (especially the progeny tests). Many of them could be used as sources of vegetative propagation materials in order to establish Seed Orchards. A lot of tests reached the fructification age (Pines sez. *Halepensis*, *P. pinaster*, *P. radiata*, *Abies sp.*, *Cedrus sp.*) and could be easily transformed into seed orchards after evaluation and elimination of the worst materials [2; 5; 8].

Fig. 5. Test of provenances, *Cedrus atlantica*, 24 years old , Ovile Farm, Rome

DISCUSSION

The Mediterranean Conifers grow within a very difficult environment and their ecosystems are really endangered by human impact, fires, climate changes; the *ex situ* conservation could be the only possible way to protect those valuable resources. Moreover, the influence of recent European regulations as the 2080/92 increased the use of broadleaves despite the plantation of Conifers. Broadleaves have been sometime planted in wrong sites, where the local conditions would be suitable for Conifers.

The valorisation and management of conifers experimental plantations requires suitable national programs of biodiversity conservation and afforestation and reforestation promotion. Particulary important are the problems related to natural and artificial regeneration connected with biological diversity of ecosystems.

Fig. 6. Test of progeny, Cuenca provenances of *Pinus pinaster*, 12 years old , Scagliata Farm, Grosseto

It is necessary to establish and increase multi-disciplinary research networks in order to supply an adequate knowledge to decision makers concerning SFM and FGR conservation and improvement.A synergic cooperation among National, Regional and Local administrations and agencies, involving both in forestry and environmental topics, and research networks is also highly advisable.

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