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Note

Forest reproductive material of pedunculate oak (*Quercus robur* L) and sessile oak (*Quercus petraea* Matt Liebl) in France: problems and results

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Summary — Genetic improvement of indigenous oaks (pedunculate and sessile) is only at its beginning but a first step has been reached with the implementation of the 1966 EC directive concerning the collection and the marketing of forest reproductive material (seed and seedlings). Two difficulties of implementation are analysed: specific purity of stands and reproductive material, and validity of the regions of provenance. A conclusion is drawn after nearly 20 years of application.

***Quercus robur* / *Quercus petraea* / seed stand / region of provenance / seed / seedling**

Résumé — Les matériels forestiers de reproduction de chênes pédonculé et sessile en France : difficultés et résultats. *L'amélioration génétique des chênes indigènes (pédonculé et sessile) en est à ses débuts, mais une première étape a été franchie avec la mise en application de la directive CEE de 1966 pour la récolte et la commercialisation des matériels forestiers de reproduction (graines et plants) : 2 difficultés d'application sont analysées (pureté spécifique des peuplements et des lots de matériels forestiers de reproduction, validité des régions de provenance) et un bilan est tiré après presque 20 ans d'application de la réglementation.*

Quercus robur / Quercus petraea / *peuplement porte-graines / région de provenance / semences / plants*

INTRODUCTION

In France, the genetic improvement of pedunculate and sessile oak is just beginning with particular emphasis on its intraspecific variability. However, since 1973, France has been applying an EC directive requiring forest seed collection in 2 types of stands: selected stands (phenotypic superiority) and tested stands (superiority for 1 or several traits in comparative tests). For oaks, only the first stand type exists.

As phenotypic selection principles have recently been described by Fernandez (1991), this paper will focus on 2 particular aspects of the implementation of the regulation: specific purity and validity of the regions of provenance.

SPECIFIC PURITY

Among the 'genetic' criteria usually considered for seed stand selection, specific purity is most important, particularly in mixed stands where natural interspecific hybridization is likely to occur or where it is difficult to discriminate between species. Moreover, the regulation is very strict and imposes more than 99% purity in seedlots and seedlings. This implies that methods are necessary to identify oaks species when stands are selected and to control seedlot and seedling purity, from collection to planting.

Specific purity at the stand level

It has recently been demonstrated that artificial hybridization of sessile and pedunculate oak is possible, but that intermediate forms are rare in nature (Badeau, 1990). Morphological identification is easy (Dupouey, 1983; Sigaud, 1984; Badeau, 1990). Biochemical identification is possible (Zanetto, 1989) but, since no enzymatic system discriminates between the species, allele frequency has to be considered. Unfortunately, biochemical identification is not yet applicable in routine tests and does not reveal intermediate forms.

Therefore synthetic criteria such as crown architecture and foliage organization have to be used. Until their reliability is proven more accurately, they are provisionally applied in different geographical and ecological conditions with great care.

Mixed stands are rejected when they contain more than 5% undesirable trees belonging to the less represented species or intermediate forms. Undesirable trees in selected stands are thinned out. Unfortunately, and because of urgency, these rules were not applied when stand selection started in 1973–1975. Since many mixed stands were selected then, complete checking is needed and will be completed in less than 5 years from 1992.

Seed and seedling specific purity

A seed discrimination method can be applied with 85% confidence (Dupouey and Le Bouler, 1989) but, as it requires 2 measurements/acorn, it is difficult to use widely. Seedlings can easily be identified, but only when in leaf. Therefore, checking stand purity before selection is of the utmost importance.

VALIDITY OF REGIONS OF PROVENANCE

A region of provenance has a double notion; it reflects biological (ecotypes, ecology) and practical factors (seed and seedlings).

Although applied with some differences in the different EC countries (Fernandez, 1991), the definition is based on broad climatic and geological classes. A narrower classification based on ecotypes or phenotypes appears impossible in practice. In order to avoid seed and seedling transfer between ecologically different zones, a large number of regions have been isolated: 10 for pedunculate oak and 15 for sessile oak.

Unfortunately, the validity of these regions has not yet been evaluated. Isozymes only partly solve the question. So far, France has been divided into 4 main units, some of them being contradictory in terms of sessile oak regions of provenance (Zanetto, 1989). This preliminary result in based on a sample of only 30 stands, while regions of provenance altogether represent 130 stands. Furthermore, as isozymes are considered neutral, they cannot reflect ecotypic diversity. Non-neutral genetic markers, like DNA, may provide a more precise discrimination. For the time being, it appears that genetic diversity can only be assessed through a multiple site provenance network which will clarify the homogeneity of the regions of provenance; these findings will lead to the upgrading of some selected stands in the tested category.

RESULTS

Twenty years of application of the EC regulation has resulted in several positive aspects. 4,000 of the 2.1 million hectares of pedunculate oak and 11,000 of the 1.6 million hectares of sessile oak have been selected. These stands are grouped into regions of provenance and are listed in the national forest basic material inventory (CEMAGREF, 1991a).

Since 1989, all seed collection has come entirely from selected stands, except when acorn production is particularly scarce (table I). Nationally, the annual requirement for seedlings represents 4.5 million pedunculate oak seedlings and 6.8 million sessile oak seedlings. These are essentially covered by French collections. Imports are limited while exports of sessile oak to other EC countries are important.

The main limitation to the application of the EC regulations is that they are only concerned with seed collection and the seed and seedling trades. Use of genetic material in reforestation is uncontrolled but foresters receive advice from CEMAGREF, the government body in charge of stand selection, thanks to its new version of the handbook on forest reproductive material (CEMAGREF, 1991b).

CONCLUSION

If after 20 years, people have become used to the EC regulations, several aspects still need to be amended so as to make their application more certain, especially the control of synthetic morphological markers, and the development of a technique that could cheaply and reliably identify the species of acorns.

Control of the integrity of provenance regions should lead to success but one must keep in mind that this notion – which is primarily a pragmatic one – aims at avoiding both unwise genetic transfers and consequent enormous adaptation mistakes. The cost of the necessary research should not exceed the possible benefits to be achieved through the implementation of the EC regulation.

Table I. Acorn collection since 1985 (CEMAGREF; 1988–1992).

Parameter	*Species*	*1985*	*1986*	*1987*	*1988*	*1989*	*1990*
Total collection (tons)	*Quercus robur*	36	27	116	161	139	20
Selected collection (%)		34	39	43	99	100	100
Total collection (tons)	*Quercus petraea*	88	367	405	286	422	111
Selected collection (%)		49	73	69	93	100	100

REFERENCES

Badeau V (1990) Étude de la variabilité morphologique des chênes en Lorraine. DEA, Thesis, Université de Nancy I et INRA

CEMAGREF (1988, 1989, 1990, 1991, 1992) Récoltes et flux de graines, campagnes 1986/1987 à 1990/1991. Division amélioration génétique et pépinières forestières, Nogent-sur-Vernisson

CEMAGREF (1991a) *Répertoire National des Matériels de Base Français des Essences Forestières.* 3rd ed. Division amélioration génétique et pépinières forestières, Nogent-sur-Vernisson, pp 106

CEMAGREF (1991b) *Amélioration des Essences Forestières, Matériels Contrôlés et Sélectionnés : Conseils d'Utilisation.* Ministère de l'Agriculture et de la Forêt, pp 90

Dupouey JL (1983) Analyse multivariable de quelques caractères morphologiques de populations de chênes (*Quercus robur* L et *Quercus petraea* (Matt) Liebl) du Hurepoix. *Ann Sci For* 40, 265-282

Dupouey JL, Le Bouler H (1989) Discrimination morphologique des glands de chênes sessile (*Quercus petraea* (Matt) Liebl) et pédonculé (*Quercus robur* L). *Ann Sci For* 46, 167-194

Fernandez R (1991) Selected forest reproductive material in France: critical analysis and results. Meeting of the IUFRO working party S2.02.21, Gmunden and Vienna, pp 8

Sigaud P (1984) Les chênes du Berry. ENITEF thesis, Nogent-sur-Vernisson

Zanetto A (1989) Polymorphisme enzymatique du chêne sessile. DEA, Thesis, INRA Bordeaux