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Birch and Alder - the development of a tree breeding programme and a seed supply for Irish forestry

Key external stakeholders:

Farm forest growers, commercial forestry companies, tree nurseries, COFORD & Forest Service, Department of Agriculture, Food and Fisheries

Practical implications for stakeholders:

The project is developing a sustainable supply of improved, adapted and healthy seed of birch and alder within the framework of the EU Forest Reproductive Material (FRM) regulations. The project has reached a key stage having produced improved material at the 'qualified' level of the FRM regulations.

Main results:

- Seed orchards for both birch (downy birch) and alder have been established. The clones included in the orchards have been selected on the basis of work carried out in the project.
- Grafts of downy birch, silver birch and alder plus-trees have been used to establish a living clonal archive that provides a resource for future breeding, research and conservation.

Opportunity / Benefit:

In the first instance parent material will be available to nurseries to produce and market improved planting material. And as the supply system is put in place, forestry owners can avail of improved material to increase the monetary and ecological value of their forests. The availability of improved birch planting material would enable the Forest Service to list birch as a grant-aided species providing more choice to forest owners.

Collaborating Institutions:

UCC, UCD

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1. Project background:

Two species of birch are native to Ireland; Betula *pubescens* and Betula *pendula*. Currently birch is not on the recommended species list for afforestation grants. Two factors have prevented the listing of birch as a recommended species; the poor stem quality of naturally regenerated birch and the poor survival and growth rates that has followed importation of seed from abroad. However, experience from abroad indicated that birch had improvement potential. The development of birch as commercial forestry tree species' supports government policy in the aspiration to increase forestry area in Ireland, to increase the broadleaf component of forestry in Ireland, to use more native species and to increase diversity in Irish forestry. The physiology of birch and alder means that they can be used on land that would not be suitable for oak or ash and birch has a short rotation period, about 40 years, in comparison to other native broadleaves.
The birch project began with an initial study 'Pilot project for the genetic improvement of Irish Birch' (1998 – 2000). This has been followed by a series of other COFORD funding including the current funding. The improvement of alder (*Alnus glutinosa*), a species that is on the Forest Service schedule, was initiated in 2005. In a 2007 COFORD review, alder and birch were confirmed as native species' of high potential for improvement in the Irish context.

2. Questions addressed by the project:

- Do better-quality provenances of birch and alder exist in Ireland and can they be recommended as suitable seed collection areas?
- Can superior individuals of birch and alder be identified to be used as a base population for an improvement programme?
- Do the characters of growth and stem form display heritability for cyclical and concurrent selection and improvement?
- Can superior families of birch and alder be identified in progeny trials, indicating high value parent trees to retain in the breeding populations?
- How do the selected clones respond to growing in a managed seed orchard and what is the annual seed yield?

3. The experimental studies:

The overall objective of the research is the development of a sustainable supply of improved, adapted and healthy seed of birch and alder within the framework of the EU Forest Reproductive Material (FRM) regulations. The approach to develop sources of improved planting stock has been;

- Locating the best examples of mature trees (plus-trees) of these species on which to base the improvement programme;
- Collecting scion wood from plus-trees and grafting the scion wood onto rootstock to generate clones of the plus-trees;
- Establishing clone banks to preserve the genotypes;
- Establishing seed orchards;
- Establishing progeny trials to assess the value of the trees as parents.

For birch, a survey was conducted during 1998/1999 to identify good birch stands and individual plus-trees. Good stands of mature birch were rare and often the trees were in small groups or were scattered throughout an area. Most of the stands were unmanaged and downy birch was more common than silver birch (O' Dowd, 2004). Three Breeding Seedling Orchards were established in 2001 (O' Dowd, 2004) –plants generated from the seed collected from the plus-trees were used. Seedlots from thirty-three provenances (*B. pendula* and *B. pubescens*) and 37 controlled crosses of plus-trees (*B. pubescens*) and some overseas *B. pendula* material were included. These have been evaluated for height, diameter and stem form every other year.
For alder, grafts of eighty-five plus-trees have been collected for use in an untested seed orchard. Open-

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pollinated seed from these plus-trees has been collected and a series of three progeny testing field trials have been established in 2008 and 2009. These have been evaluated for height and survival on an annual basis.
The location and collection of new material for the breeding programmes is ongoing. In spring of 2009 grafts from 16 new birch plus-trees and 26 new alder trees were successfully established.

4. Main results:

- The main result is the establishment of seed orchards for both birch (downy birch) and alder. The clones included in the orchards have been selected on the basis of work carried out in the project.
- The alder orchard is based on parents i.e. backward selection. This means that, in the future, the results from the alder progeny trials will allow the alder orchard to be modified so that only the clones that have shown good breeding values are included.
- The birch orchard is based on forward selection i.e. good trees from within the progeny trials will be selected for inclusion. At the moment, the birch orchard contains early selections and protocols to manage these indoor seed orchards are being developed.
- Grafts of downy birch, silver birch and alder plus-trees have been used to establish a living clonal archive that provides a resource for future breeding, research and conservation.
- The field trials established during the project continue to provide information as the trees mature.

Ten year old birch progeny

5. Opportunity/Benefit:

In the first instance parent material will be available to nurseries to produce and market improved planting material and as the supply system is put in place, forestry owners can avail of improved material to increase the monetary and ecological value of their forests.

The availability of improved birch planting material would enable the Forest Service to list birch as a grant-aided species providing more choice to forest owners.

The collections provide a valuable resource for future breeding, molecular and physiology research and conservation. As there is very little information about birch growth in Ireland, in particular in a plantation situation. The progeny trials provide some information about birch growth in Ireland.

6. Dissemination:

Results were also presented at demonstration visits, conferences (including Treebreedex 2010) and project reports.

Main publications:

Hemery, G., Clark, J., Aldinger, E., Claessens, H, Malvolti, M., O'Connor, E., Raftoynnis, Y., Savill, P. and Brus, R. 2010 Growing scattered broadleaved tree species in a changing climate – risks and opportunities. Forestry **83**: *65-81*

O'Dowd, N. 2004. *The improvement of Irish birch. Phase 1: Selection of individuals and populations*. COFORD, Dublin.
http://www.coford.ie/media/coford/content/publications/projectreports/Birch-improvement.pdf

Skovsgaard, J.P., O'Connor, E., Graversgaard, H.C., Hochbichler, E., Mohni, C., Nicolescu, N., Niemistö, P.,

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Pelleri, F., Spiecker, H., Stefancik, I. and Övergaard, R. 2008 *Procedures for forest experiments and demonstration plots*. COST E42, Valbro. Online Publication and COST Action E42 (Valbro) final report. http://www.valbro.uni-freiburg.de/

Popular publications:

June 2010 Project update: BIRCH/ALDER: Selection and improvement of Irish birch and alder Forestry and Wood Update 10 (6): 3 at http://www.coford.ie/publications/newsletter/newsletter-vol10/#d.en.47373

O' Connor, E. 2007 *Progress in the selection and improvement of Irish birch* COFORD Connects: Reproductive Material 10.
http://www.coford.ie/media/coford/content/publications/projectreports/cofordconnects/birch.pdf

O' Connor, E., Steer, M. and Bulfin, M. 2006 *Growth and Stem Quality Variation In Irish Birch* (Abstract). *In* Proceedings of the IUFRO Division 2 Joint Conference: Low Input Breeding and Conservation of Forest Genetic Resources: Antalya, Turkey, 9-13 October 2006. *Edited by* Fikret Isik. p 165.
Available from **http://www4.ncsu.edu/~fisik/IUFRO%20Antalya%20Conference-Proceedings.pdf**

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