Genetic improvement of Sycamore
(Acer pseudoplatanus) and
ash (Fraxinus excelsior) in Ireland

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Context for genetic improvement of broadleaves

- Afforestation-- importance
- Genetic resources available
- Genetic improvement -- Sycamore and Ash
  (Partners: Coillte & the UK)
- Development of clonal lines / varieties of Ash
Afforestation environment in Ireland

- Generous financial supports

Grants & annual Premia (Euros)

<table>
<thead>
<tr>
<th>Species</th>
<th>Establishment Grant / ha</th>
<th>Annual Premium ha /p.a. &gt; 6ha (20 yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oak</td>
<td>6920</td>
<td>559</td>
</tr>
<tr>
<td>Ash &amp; Syc</td>
<td>5199</td>
<td>522</td>
</tr>
<tr>
<td><strong>Conifer</strong></td>
<td>3573</td>
<td>464</td>
</tr>
</tbody>
</table>

Relative importance of broadleaves & conifers in Ireland

<table>
<thead>
<tr>
<th></th>
<th>% by species</th>
<th>Annual plant needs ( x 10^6)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Broadleaves</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ash</td>
<td>46</td>
<td>4.0</td>
</tr>
<tr>
<td>Oak</td>
<td>21</td>
<td>3.0</td>
</tr>
<tr>
<td>Alder</td>
<td>20</td>
<td>5.5</td>
</tr>
<tr>
<td>Sycamore</td>
<td>4</td>
<td>0.5</td>
</tr>
<tr>
<td>Beech</td>
<td>2</td>
<td>1.5</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>3.0</td>
</tr>
<tr>
<td><strong>Conifers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sitka Spruce</td>
<td>65</td>
<td>35</td>
</tr>
<tr>
<td>Others</td>
<td>35</td>
<td>18</td>
</tr>
</tbody>
</table>
3. Genetic improvement -- Sycamore and Ash

Teagasc collaboration with:
• Coillte our largest forestry semi-state company
• British and Irish Hardwood improvement programme (BIHIP) http://www.bihip.org/ species groups ash, sycamore, birch, oak chestnut, cherry

Aim:
provide genetically improved forest reproductive material for the nursery sector

Operational basis:

Ground-up approach-- participation of landowners

Establishing:
• Operational seed stands
• Conservation collections of selected material (primary grafts)
• Clonal seed orchards (regions of provenance based)
• Breeding seedling orchards (regions of provenance based)
• Testing viability of clonal material

** Genetic resources available in Ireland

<table>
<thead>
<tr>
<th>Species</th>
<th>Seed stands (ha)</th>
<th>Seed Orchards (ha)</th>
<th>Seed Orchard estimated need (ha)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Broadleaves</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ash</td>
<td>154</td>
<td>2.0</td>
<td>10</td>
</tr>
<tr>
<td>Sycamore</td>
<td>7</td>
<td>0.6</td>
<td>2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Conifers</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Picea sitchensis</em></td>
</tr>
<tr>
<td><em>Picea abies</em></td>
</tr>
<tr>
<td><em>Larix kaempferi</em></td>
</tr>
<tr>
<td><em>Larix x eurolepis</em></td>
</tr>
<tr>
<td><em>Pinus contorta</em></td>
</tr>
<tr>
<td><em>Pinus sylvestris</em></td>
</tr>
</tbody>
</table>

** COFORD ‘Sustaining and developing Ireland’s forest genetic resources’
3. Genetic improvement – Sycamore

Bolton Estate, UK
- Age 60
- Thinned 5 times
- Pruned
- Yield Class: 10-12
- Mean dbh: 60 cm
- Value
  – approx 45,000 Euro/ha

Problem:-- Grey squirrel

3. Genetic improvement – Sycamore

Aims:
- 10 seed stands (3-active)
- 150 selected trees
- Conservation collection
- 3 clonal Seed orchards

Scion collection for clonal seed orchards by shooting
Scions:
6-15 cms long
Annual growth
1.0 - 2.0 cm. per year

Graft viability of Primary grafts of selected sycamores - 2008

![Graft viability chart showing 97 viable genotypes and 91 viable grafts.](image)
Graft viability of Secondary grafts of selected sycamores

<table>
<thead>
<tr>
<th>Scions</th>
<th>Genotypes</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. grafted</td>
<td>No. viable</td>
</tr>
<tr>
<td>282</td>
<td>118</td>
</tr>
<tr>
<td>No. genotypes</td>
<td>No. viable</td>
</tr>
<tr>
<td>47</td>
<td>44</td>
</tr>
</tbody>
</table>

One year old grafted plants

Conservation collection

Material is being bulked up to generate Seed Orchards
3. Genetic improvement – Ash

Aims:

-- Testing European provenances
-- Establishment of sufficient Seed Orchards (10 ha)
-- Development of vegetative propagation methods
  produce material for testing and development of polyclonal varieties

Ash- --Testing European provenances

-- Material grown from 36 European regions (provenances)
-- sites in Ireland (replicated in UK, Germany, France, Belgium, Italy)
--- Identify good & bad provenances
-- influences of environmental / climate effects
36 European ash provenances (core of 30 provenances)
- Rootrainer grown plants
- Planted May 2005 & 2007 (2 sites)
- 108 plants / provenance (36 trees/plot) of 3 replications
- Height & stem diameter taken after planting
- Trees are well established

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**Ash -- Development of vegetative propagation methods – large scale**
-- material for testing and
-- ash variety development

**Initiation of cultures 2008:**

<table>
<thead>
<tr>
<th>No. Clones initiated</th>
<th>No. viable at first culture</th>
<th>No. viable at 2nd culture</th>
<th>No. clones micropropagating</th>
</tr>
</thead>
<tbody>
<tr>
<td>44</td>
<td>44</td>
<td>26</td>
<td>12</td>
</tr>
</tbody>
</table>

** buds collected from grafted plants for micropropagation**
Viable ash shoot cultures

Medium: (mg/L)
M9 = MS : BA 5.5; TDZ 0.55, IBA 0.2
QRC = WPM with 3.0 g/L charcoal.

Micropropagation cycle
Spontaneous Rooting
-- indicates rejuvenation

Weaning of micropropagated ash
Planted as stoolbeds / hedges

Cutting production in hedges
Hedges of ash clones at Teagasc, Kinsealy

Propagating ash from cuttings from hedges of micropropagated plants

Warm bench 20°C+ plastic
**Rooting in cuttings from micropropagated ash**

Rooting
2 -3wks.

3 months

Plants grown in Rootrainers

**Rooting in cuttings from hedges**

3 successive crops in May, June & July

![Bar graph showing rooting percentage for different clones and months.](chart.png)
Rooting in cuttings from hedges of ash
12 clones

- Selected Ash clone
- Rooting (%)
- 1/54
- 77/27
- JK 47
- I/54
- F5
- M 72
- T1/27
- R 29
- 77/5
- 51/12
- M 72

400 rooted / m²:
: 4 cutting crops / yr = 1600 rooted / yr / m²

400 rooted / m²:
: 4 cutting crops / yr = 1600 rooted / yr / m²

glasshouse of 200 m² = 320,000 rooted ash plants / yr.
Conclusions:

- More research needed to improve the culture initiation stage for ash
- Clonal seeds orchards of ash and sycamore are planned
- Vegetative propagation system for ash is viable
- Field testing of ash clones indicates conformity
- Clonal field trials are planned
Thanks to:
Coillte
British & Irish Hardwood Improvement Programme (BIHIP)
European colleagues EC- former projects
COFORD (national funds)

Colleagues:
John Mc Namara
Sean Egan
P. Doody
Improving culture initiation:
- Flushing stage is most responsive
- Summer dormant buds not responsive
- Stimulation of secondary flushing by defoliation

Cutting propagation of ash:
- Stoolbeds
- 3 crops of cuttings / year
- High rooting rates