

THE BRITISH AND IRISH HARDWOODS IMPROVEMENT PROGRAMME (BIHIP)

Jeffery Burley, Peter Savill, Gabriel Hemery and John Davis
(Chairman, Committee Member, Secretary and Treasurer, BIHIP)

Summary

The British and Irish Hardwoods Improvement Programme (BIHIP) is an informal but active collaboration among many organizations and individuals concerned with the evaluation, improvement, and conservation of hardwoods for commercial and ecological purposes. BIHIP has seven Species Groups dealing with the selection and testing of populations and individual trees from throughout their ranges in Britain and Ireland on a range of sites. Comparative trials and breeding seedling orchards have been established.

History of the programme

The British Hardwoods Improvement Programme (BHIP) owes its origin to the Royal Forestry Society's symposium on Tree Breeding and Improvement, held at Edgbaston in 1991 where John Davis, of Woodland Improvement and Conservation, and Peter Kanowski and Peter Savill, of the Oxford Forestry Institute, agreed to initiate some work on improving ash (Savill, 1998). From that beginning BHIP developed into a voluntary association of landowners, nursery managers, professional and technical foresters, researchers, academics and others who are actively attempting to improve the quality and performance of hardwood species of economic importance in Britain and Ireland. It expanded to include members from Ireland and changed its name accordingly.

Administration

As a relatively young and voluntary association BIHIP does not have major financial resources, nor heavy administrative machinery. Members cover the cost of meetings and the Committee seeks support for collaborative research projects from governmental and non-governmental organizations including the Department for Environment, Food and Rural Affairs, the Forestry Commission and the Woodland Heritage charitable trust. Support for the Secretariat is provided by the Northmoor Trust at Little Wittenham, near Oxford. The small number of voluntary Committee members are elected by the full BIHIP membership.

Aims of the programme

The aims of BIHIP are to:

- promote research into provenance testing, selection, and breeding;
- support the establishment of field trials;
- develop technologies to aid the rapid multiplication of improved material;
- promote the use of improved material;
- undertake education, publicity, fund raising and lobbying to further the above aims.

The nature of Species Groups

BIHIP is organized into collaborative Species Groups covering seven major hardwood tree species of economic importance in Britain and Ireland: ash, cherry, oak, silver birch, sweet chestnut, sycamore and walnut. Each of these species presents different opportunities, potential, and problems that the Groups aim to address. Each Species Group is normally made up of a landowner as chairman, a researcher as secretary, and members with the best expertise that can be brought together for the rapid development of an appropriate programme. All Species Groups and other interested people meet together for individual meetings at various times and locations. The entire membership of BIHIP assembles at an Annual General Meeting, usually in November, to hear progress reports on the Groups' work, to visit field experiments, and to discuss opportunities for future collaborative work and financing. BIHIP also collaborates closely with the Royal Forestry Society of England and Wales in organizing collaborative work, meetings, and publications.

Participants

BIHIP includes the following participants representing commerce and research:

- COFORD (Ireland)
- Coillte (Ireland)
- Forestry Commission (Edinburgh, Scotland)
- Horticulture Research International (Maidstone, Kent)
- Imperial College of London (University of London at Wye, Kent)
- Institute of Ecology and Resource Management (Edinburgh University, Scotland)
- National School of Forestry (Central Lancashire University, Newton Rigg, Lancashire)
- Oxford Forestry Institute (Oxford University, Oxford)
- Northern Ireland Forestry Service (Belfast, Northern Ireland)
- Northmoor Trust (Little Wittenham, Oxfordshire)
- Woodland Heritage (Buckinghamshire)
- Woodland Improvement and Conservation Ltd. (Gloucestershire)
- Landowners, nursery managers and professional and technical foresters across Britain and Ireland

Activities of the Species Groups

The following information is extracted from the reports on the Species Groups in the BIHIP web-site: <http://www.bihip.com>

Ash — *Fraxinus excelsior*

Ash was recorded as the third most common broadleaved species in the last Census of Woodlands and Trees, and today it is the second most widely planted broadleaved tree in Britain. The attraction of ash is that it is native, produces valuable timber on short rotations, and grows well on nutrient rich sites over much of lowland Britain. However, those trees planted are often of poorly adapted or from foreign stock. BIHIP hopes to address this problem by providing the forester with superior planting stock of local provenance.

To this end, the Ash Group has the following targets:

1. To select 500 superior individuals on a regional basis across Great Britain and Ireland, to fall in line with guidelines issued by the Forestry Commission.
2. To collect reproductive material from the selected trees in the form of either seed for progeny trials, or scion material for the development of a clone bank for gene conservation.

Ash has a reputation for being site sensitive, requiring base-rich, freely draining soils. It is highly susceptible to forking, partly due to the ash bud moth (*Prays fraxinella*), but increasing evidence points to early flushing and subsequent late frost as being a significant cause of damage. While growth and vigour are important elements of any improvement programme, research into the time of flushing and the degree to which this is genetically controlled are essential to the ash programme.

The Ash Group of the BIHIP started work in 1991 and has six Breeding Seedling Orchards (BSOs) under its management. The orchards have been measured for growth and vigour several times. The Group is currently looking for approximately 500 superior trees to be included in the next stage of progeny testing. Ash is a dioecious species - a complete sexual mix-up. Individuals can be male, female, hermaphrodite, or any set of combinations in between.

Silver birch — *Betula pendula*

Although birch was previously frequently planted for amenity and conservation reasons, there was apparently little thought given to the origin of the plants used or to the potential quality of any timber that might be produced. The Birch Group was founded in 1997 to address these problems and the Group set itself two main objectives:

1. To determine the extent of adaptive genetic variation in silver birch in Britain. A comprehensive series of provenance trials with 25 populations planted in four sites in England, Scotland and Wales will establish 'transfer rules', identify any superior populations, and demonstrate the efficacy of proposed seed collection zones in this species. In addition, basic environmental relationships and the genetic structure of the species could be studied in these collections.
2. To initiate a breeding programme for improving the quality of the species. Based on defined regions within Britain, selected superior phenotypes are installed in polyhouse seed orchards to rapidly provide 'improved' seed for commercial use. The technique, based on Finnish practice, was demonstrated for a collection of 'plus' trees from NW Scotland by Forest Research at Roslin. Particular attention needs to be paid to improving stem quality, as well as growth rates.

Wild cherry — *Prunus avium*

Wild cherry is also known as the Gean or Mazzard tree. It is an attractive native species with a high quality timber, short rotation time, and resistance to squirrel damage. As it is a light-demanding tree, it frequently can be found

occurring as single trees or small groups in lowland woodlands, particularly on the woodland edges. Cherry is often reproduced vegetatively by suckering, so clumps of cherry frequently consist of identical trees or a low number of genetically distinct individuals. It is one of the first trees to flower in the spring and the fruits are eaten by many small mammals and birds. Its attractive nature and its ability to grow well in many soil types and pH ranges have made cherry a common species in farm woodlands. Cherry timber is used for cabinet making, furniture, panelling, and decorative joinery. The demand for wild cherry timber is high, though top quality timber can be hard to find and very expensive. As a result, the majority of the cherry used in the UK is actually imported Black Cherry (*Prunus serotina*) from North America.

Currently, the majority of wild cherry seedlings planted in the UK are of continental origin and are of unknown quality and uncertain adaptability. Many have characteristics similar to sweet cherry which have been bred to produce large fruited, heavily cropping trees with a wide, open and broad branching habit for ease of picking. Trees selected and bred for timber production will have quite different characteristics, including light branching and vigorous apical growth. Timber trees also tend to be much less susceptible to bacterial canker, therefore ensuring that trees are of a timber type that is suitable for forestry purposes.

The Cherry Group held its first meeting at Woodland Improvement and Conservation Ltd, Gloucestershire on 17th July 1997. The cherry improvement programme is the most advanced of the BIHIP species groups because since 1989 the Department for Environment, Food and Rural Affairs (DEFRA, formerly MAFF) has funded a genetic improvement programme at Horticulture Research International (HRI). This work is now jointly funded by DEFRA and the Forestry Commission. The group supports HRI's ongoing programme of research by helping in the location and collection of 'plus' trees, the selection of sites for trials and seed orchards, the selection of trees from the breeding programme, and the promotion of cherry as a valuable timber and amenity tree. In addition, the cherry group would like to see research undertaken on the silviculture of cherry and aspects of timber quality.

Oak: Penduculate — *Quercus robur* and Sessile — *Q. petraea*

Oak trees form a crucial feature of our landscapes, provide vital wildlife habitats, and are a potentially valuable timber resource. The commercial forester's goal of better returns on shorter rotations has particular appeal for all growers of broadleaves where the difference in price between firewood and veneer timber can be 100-fold, and the time between seed and harvest makes planting an act of faith. Although silviculture can help, it has long been recognized that improving the quality of the planting stock could hold potentially massive benefits for the countryside.

The Oak Group is working to provide improved planting stock to ensure we leave quality oak trees to help sustain the countryside and the rural economy for our successors; it was formed to initiate and support research into the improvement of oak by selective breeding. The objective was to identify two hundred 'elite' oak trees selected for their excellent phenotypic characters: straight trunks, lighter branching, superior vigour, and timber quality. Work at the Oxford Forestry Institute had also identified a link between large spring vessel sizes in the wood, and the presence of shake. All trees 'selected' were therefore

microscopically assessed and of these, 100 trees were rejected as having large vessels. Acorns from the remaining 100 superior mother trees were collected over three years and seedlings were raised at Forest Research's nursery at Roslin. The nursery stock was planted in eight 1-2 hectare breeding seedling orchards across Great Britain and Ireland during the winter of 2002/03.

The orchards will be managed (over 50 years) to exclude any obviously inferior lines and the resulting 'improved' acorns will become available for multiplication and release to the nursery trade. It is hoped that the seed orchards should begin to produce acorns in 20 years. Similar projects using tropical hardwood species have yielded 30% increases in average growth rates. Comparable results can be expected with oak. More details of the work of the Oak Group are given in the second BIHIP presentation to the International Oak Society meeting (Savill, Burley and Hemery, 2003)

Sweet chestnut — *Castanea sativa*

Although originally introduced from southern Europe, sweet chestnut is usually considered an 'honorary native' in southern England where it is still the most important commercial coppice crop. The timber is naturally durable, with little sapwood, and requires no preservatives for outdoor use. Its suitability for furniture and other purposes is similar to that of oak, but in large diameters it can be susceptible to timber defects, especially ring shake and spiral grain.

Climate and management changes, together with biotic factors (such as the fungal diseases *Phytophthora* spp. and *Cryphonectria* spp.), pose potential threats to the species. At the same time, genetic variation in domesticated plant material may have diminished, both through breeding and selection (primarily in orchards for edible nuts) and silvicultural intensification.

The Sweet Chestnut Group was formed in June, 1999 with the objective of developing a programme for the genetic conservation and improvement of sweet chestnut in Britain and Ireland. The Group's overall aim is to set up strategies of integrated conservation and utilization that minimize these risks. Its primary objective is to establish both seedling and clonal orchards of chestnut from superior trees, but in the longer term, to investigate a number of research themes including genetic variation, flowering, ecology, defects, and economics.

Sycamore — *Acer pseudoplatanus*

There are thought to be 66,600 ha of sycamore planted across Great Britain, representing about 3% of the total woodland cover. Sycamore grows on a wide range of sites and has similar ecological requirements as ash, but is more frost hardy and less demanding.

This naturalized exotic has considerable economic potential, being one of the fastest growing broadleaves in the UK and Ireland, and because it produces a desirable white timber with little discernible figure or grain. In addition, some individual trees exhibit wavy grain timber, which is prized for making musical instruments and for producing veneer. This is highly valued, but whether this characteristic is determined by the tree's genetic composition, by environmental factors, or both, is not known.

The time of introduction of sycamore to Britain and Ireland is uncertain. It is thought to have been introduced to Britain some time between the Roman occupation and 1550, although it has become established strongly only over the

last 200 years. Recently it has acquired a reputation as being an invasive species, yet it thrives best when there is disturbance and evidence seems to support the view that it cannot dominate woodlands for long periods as it has difficulty regenerating under its own canopy.

Little work has been undertaken in the UK or Ireland towards improving sycamore. In the UK five provenance trials testing local and continental European origins showed that there was little difference in growth between the local and continental origins. This has encouraged selecting superior trees or stands to be focussed on local populations.

In May, 2003 the Sycamore Group held its inaugural meeting in Edinburgh. In order to increase the availability of quality genetic material for those wanting to plant sycamore, the Sycamore Group set out to expand the current number of registered seed stands (in Britain there are currently only two registered seed stands). This will improve the supply of seed from stands of better-than-average quality and give rapid results. In the longer term plus trees will also be selected. These will be used to produce seed orchards using grafted stock. Such orchards could produce seed within 5-6 years and be commercially productive within 10 years. There are no such orchards in the UK, but Coillte has established one in Ireland.

Walnut: Common — *Juglans regia* and Black — *J. nigra*

The common or English walnut (*Juglans regia*) is one of the ancient introductions to Britain, but today there are probably fewer trees than at any time since the late sixteenth or early seventeenth centuries.

Black walnut (*Juglans nigra*) was introduced to Britain from North America in 1656 and planted for its valuable timber. The species is potentially the provider of high quality timber on a relatively short rotation, and is consistently in great demand by end-users. During 2000 alone, UK imports of this valuable timber rose by 51%.

At present both species are often overlooked by British foresters because of their reputation as being site demanding, usually of poor form, and vulnerable to frost. No research has effectively addressed these problems in Britain, and although the UK Forestry Commission in 1986-87 planted a series of black walnut provenance experiments, these tested a limited range of material. Since then walnut-tree breeding in North America and mainland Europe has advanced considerably, making available new and improved stock for testing in Britain. Selecting desirable, straight stemmed and finely branched trees to suit the climatic conditions of the UK should encourage a revival of interest.

Walnut is perhaps the finest and most valuable hardwood species, and is seen as a tree that could regain the place it had centuries ago as the provider of high quality timber on relatively short rotations. The wood is used for making quality furniture and producing highly figured veneers, usually from burrs, which are used for cabinet-making and decorative panels. Phenotypes for timber or nut production are generally viewed as incompatible because good phenotypes for timber (e.g. long and straight stemmed, finely branched) have deliberately been selected against. Short-boled, spreading and branched trees were sought for high nut productivity and ease of harvesting. Additionally, some phenotypes in Britain may originate from ancient introductions, taken from environments unsuitable for widespread introduction to the British climate.

BIHIP's walnut research is led by Horticulture Research International and the Northmoor Trust. Initially research concentrated on the common walnut, but more recently it has expanded to include black walnut. The walnut trials at the Northmoor Trust's estate in south Oxfordshire include one of the largest collections of walnut (*Juglans regia*) genotypes found worldwide, incorporated in a tree improvement programme and various silvicultural trials. Many of the several trials now underway are planted both with the Northmoor Trust and on independent sites across southern England.

Further information about BIHIP and the work of its individual Species Groups can be found at the website is <http://www.bihip.com> or by communication with the Secretary, Gabriel.Hemery@northmoortrust.co.uk

References

- Savill, P. (1998). British Hardwoods Improvement Programme. *Quarterly Journal of Forestry* 92 (3) 217-22.
- Savill, P. Burley, J. and Hemery, G. (2003). Improving oak: the first steps towards a breeding programme. *Invited paper, International Oak Society meeting, Winchester, UK.*