Why use time and space to grow a bad tree on your land, if better performers are actually available. This is one basic question for all modern broadleaved UK forestry, after which "silviculture" (i.e choosing the right trees for the soil and situation and their proper care and maintenance) then becomes the principle vehicle which then kicks in to complement nurture with nature.

There are two common and quite strongly held beliefs and this talk is first of all going to query these and then add some quite simple underpinning science -

1. A fine looking tree must be the best seed collection source; yes and no, it does not necessarily guarantee it as a splendid seed source for producing equivalent or even better progeny. There are two quite obvious reasons for this – first do any of you remember the Bernard Shaw and Ellen Terry story about beauty and brains; and second, collecting from one single tree only is a very bad idea and bad practise, which is sadly too often done. It can lead to greater susceptibility to disease and, in subsequent generations, to inbreeding depression (as can collecting from too restricted a geographical area, or a very isolated population).

2. A local tree is always the best solution and it must be better than everything else; this is actually also less than half the story. Two world wars of indiscriminate overcutting have caused a scientific phenomenon called dysgenic selection – involving the repoval of all the best trees and leaving only the worst to breed with each other - and this is clearly evident now across much of our standing timber. The progeny just get worse and worse and this is described in David Boshier's leaflet in your pack.

However it is true that a good tree – we call them a "plus" or an "elite" tree - is the important first building block for better generations of trees in future and it is also true that local trees do have proven adaptability. The problem is knowing how much of these two ideas to trust. The answer lies in "testing" (measuring family – *i.e.* the progeny of a single mother tree - performances in trial plots). This is what BIHIP science is all about and what we are passionate about. The difficulty is that "testing" takes rather a long time.

Can I tell you the story of wheat breeding in the Rothamsted Research Institute in Hertfordshire ? Rothamsted was set up in 1834 by two visionary agricultural scientists in order to improve the yield of wheat - which at that time yielded an average of ½ tonne per acre. As BIHIP is now doing, it set up trial plots in order

to remove the poor performing plants and allow the remaining best to breed with each other. It is the poor performing families, which brings down your average and this is expressed in your economic return. Every year up to and continuing today, each year new trial plots of wheat were started. So that today 4 tonnes per acre is now the average yield on quite average land by the good farmer who knows what he is doing. The one snag is that with wheat you get your answers every year, while with trees you are looking at decades in order to make each small step forward.

It all takes just too long - this very simple fact has disheartened tree breeders everywhere. There is a further problem with the structure of modern research funding. Funding is always short term – two or three years usually, with milestones, deliverables and outcomes, clearly identified. There is hardly time to get trial plots established and you are finished, measured and out. The Forestry Commission have never really got started with broadleaved trees, making a policy decision to work on sitka spruce in the 1960's. Once you have started on one species, you lose it all if you drop it.

BIHIP started work in 1990, following a seminal conference held by the Royal Forestry Society at Edgbaston which some of you may have attended. I met there Peter Kanowski, a brilliant young Australian geneticist at the Oxford Forestry Institute, whose paper at the conference and his science have very much driven and inspired all BIHIP's work since then and also Peter Savill, our present Chairman who wanted to give this talk tonight and whose powerpoint pictures I am using at the end of this short introduction. OFI had a longer tradition of broadleaved forestry than any other research institution in the world and its tradition was training the foresters first of the British Empire and then of the Commonwealth gave them a great advantage. Basically they taught broadleaved forestry within the forests of India, Malaya, Burma and Africa. Their experience gave us hope and showed how it could be done. In fact all the science already had been tested on the faster growing broadleaves of the tropical forests in the Commonwealth.

The principles of testing and breeding could be combined in one operation known as the "breeding seedling orchard" (explain what this is). The first gain in any selection process is usually the biggest and 20 to 30% were not unrealistic targets and timescale could be foreshortened somewhat with ingenious science without sacrificing certainty. It is still a long process, but we were given an undisputably strong methodology and so we started out first of all with ash.

Trees have built in genetic preferences, which you can't argue with ! We chose seven major species which we considered were the main hardwood trees species from which landowners would gain most benefit first of all. These are oak, ash, sweet chestnut, birch, wild cherry, sycamore and walnut. There are things that trees can do and what they cannot however desirable. I shall take you quickly through our current species. "Vigour" is under strong genetic control in ash, sweet chestnut, sycamore and walnut; "branching" (heavy or light) is under strong genetic control in oak, wild cherry and birch; "form" is under genetic control (fluting etc) in all of these species; late and early flushing times are under strong genetic control in most species. In other words you cannot breed (I call it "select out") a vigorous oak tree which will grow faster, but you can select one for apical dominance and reduced and better branching. Oak and sweet chestnut suffer from a well know and very common condition known as "shake" which makes the timber unusable. However there is a strong correlation between large vessel size, early flushing and shake. If this is so, late flushing which is under strong genetic control and small vessel size become a more desirable feature. None of this is genetic engineering – it is simple selection as has been done for millenia in agricultural crops.

The "breeding seedling orchard" is a brilliant concept because it overcomes the worst feature of collecting seed from single trees. This is difficult enough to avoid when seed falls naturally, but with "tree climbing" I know of few good examples and plenty of bad examples, even among seed merchants. This is the reason why Woodland Improvement does almost all its own seed collection. The BSO brings you seed already pre-mixed from known families, which are being continuously tested and compared with each other. The worst performers are rogued out after pretty serious mathematical analysis, so that only the best are left to cross breed and this produces progeny which can be better than the sum of the sum of the individual parents We now have over 20 BSO's and trials across all the seven species under BIHIP's supervision.

So where is BIHIP now, current programmes are shown in your folder and what challenges now face us ? Results are now coming through from our present trials and the testing momentum is becoming a regular discipline. Last week I spent an exciting few hours at our Ash BSO in Newent, with Graham Taylor and David Boshier, the best silvicultural and the foremost genetic experts in the UK respectively, marking which trees should be removed so that the improved interbreeding could commence after what seemed like 15 very short years. It was a wonderfully exhilarating moment. Now we are longing to get out the improved seed, test it in progeny trials against standard controls so that we can genuinely measure the improvements in vigour and form that we are looking for

and build further dynamism into a continuous process as the wheat breeders have shown us how to do.

We do know what we are doing, and our work is respected across the UK and Ireland. We literally have all the best people on board, we know each other well and are candid about issues and ways forward. We now know how to select "plus" trees across the species and our database is growing as we add yearly so that all counties have a representative sample. We are hoping to extend horizontally what we have learnt to do by species – vertically. So our programme this year, will we hope take on a county or group of counties assessment. Glos will be first, but we would like to move across South Wales, if RFS members are keen that we should. This will cost about £25,000 and we are hopeful that our recent approval for landfill eligibility through Entrust will enable us to complete the UK database in this way. At the same time we are finding ways to induce early flowering using scion material from the tree tops, taking approx 10 years off the testing process, and we are wanting to get at least 100 seed orchards established over the next 5 to 10 years, so that the edging forward of bankable progress and the elimination of poor performance and avoidable diseases and defects can become main stream.

A final word on climate change. It is 100% certain that our climate will be different as the century progresses through various stages of global warming. These seven species have a huge role to play both in mitigation and in the vital natural process of carbon sequestration. It is increasingly clear that drier summers and wetter winters, combined with extreme weather events such as we witnessed 2 years ago in the Severn basin, trees will become ever more important parts of our strategies for containment. In particular it is clear that our sequestration processes in our temperate maritime Atlantic climate will have a unique advantage over elsewhere. A Yield Class 12 sycamore will retain more carbon than its cousins in the tropical rainforests because our woodlands do not release carbon to anything like the extent of the tropical rainforest, where decaying matter neutralises their greater growth potential (and respiration rates are much higher), by a factor which researchers are now trying to determine and which may be as much as tenfold.

I want to finish before opening up for what will I hope become a lively discussion by taking you through some of the slides which Peter Savill most kindly prepared for me and which will cover pictorially and figuratively sone of the concepts which I have navigated across tonight.

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