THE BRECHFA FOREST PLOTS: RESULTS AFTER 40 YEARS

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SUMMARY

The article describes the site, the history and establishment of these forty year old forest plots in South Wales where over 90 tree species have been planted. The current status and health of all species is described and mensurational data are given for twenty-two species. Growth rates are generally high with a number of species (*Abies grandis*, *A. procera*, *Sequoia sempervirens*, *Thuja plicata*, *Tsuga heterophylla*) having estimated general yield classes of more than 20. These plots provide the first published British growth data for *A. homolepis*, *A. veitchii*, *Picea koyamai*, *P. mariana* and *Quercus canariensis*. The future of the plots is discussed and access arrangements described.

INTRODUCTION

The Brechfa Forest Garden is a collection of over ninety species plots which was set up in the 1950's in Brechfa forest, now part of the Llandovery Forest District of Forest Enterprise. The plots were established by the local staff of the time on their own initiative. The original objective appears to have been to establish an interesting collection of species that were likely to grow in this part of south-west Wales using plants that were available at the time in Forestry Commission nurseries. Although early data are scarce, an invaluable list of seed origins and establishment treatments has survived.

Staff of the Forestry Commission Research Division became aware of the plots in 1980 and took over the management in 1982 following a review of the surviving plots. Initial work consisted of clearing the rather neglected plots, opening up access paths and brashing the trees. Since 1982, plots have been assessed by research staff as funds permit while local Forest Enterprise staff develop an integrated recreational proposal for the area. A number of 'sample plots' have been established by Mensuration Branch to give more detailed information on yield of less common species. Participants at the Whole Society Meeting in May 1993 had a brief view of part of the garden (Anon, 1993). The purpose of this paper is to make the existence of these plots more widely known and to describe some of the more interesting results obtained to date.

THE SITE

Before planting the whole area was open hillside grazed by sheep. The site is about fourteen miles west of Landovery, Dyfed and the plots are arranged on either side of a ridge dividing two tributaries of the Afon Gothi, with both northerly and southerly aspects (Plate 1). The national grid reference is SN 572 368 on OS sheet 146. The plots are located at elevations of between 200 and 250 m asl. The climate is very favourable to tree growth with a mean annual rainfall of 1700 mm and accumulated day degrees (>5.6°C) of between 1375-1650. The plots lie within the 'warm-moist' climatic zone defined by the Ecological Site Classification (Pyatt, 1995). The only climatic problem in this otherwise mild area is a frost pocket in the flatter areas. The soil is generally a deep forest brown earth derived from glaciated Silurian rocks and of a low pH - 4.5-5.0. Some gleying occurs below flushes on the north face and in the flatter areas near the Afon Gorlech. Vegetation in open spaces is now dominated by dense bracken and brambles. In the flat gleyed area purple moor grass (*Molinia caerulea*) is dominant.

Most plots were planted between 1955 and 1960, although a few are of later date. The layout and size of each plot was variable depending on the number of plants that were available and the lie of the land. Most plots are between 0.05-0.15 ha allowing the establishment of volume assessment plots. At first some grouping of genera was attempted but as subsequent lots became available this was not followed. Growth or survival sometimes reflects where the species was sited. A complete list of species planted to date is given in Table 1.

Establishment was by semi pit planting though there is some evidence of turf planting in places. Initial spacing was either 1.5 m x 1.5 m or 1.8 m x 1.8 m (ie 5 foot or 6 foot). In spite of appearing a rich site now, 2 oz of superphosphate was given to each tree. This assumed need must have reflected the impoverished vegetation at time of planting after years of heavy grazing. First thinnings were started in 1983 which was rather late for some species eg western hemlock but on time for others. The most recent selective thinning was extracted by horse to minimise ground and stem damage.

RESULTS AND DISCUSSION

Ninety-three plots of different species or clones have been established in this forest garden since 1955. Two-thirds of the plots were of conifers reflecting the traditional emphasis upon such species for forestry in Britain during this century. Forty-two species are still in good health although growth may not be vigorous whereas 22 species have failed completely (Table 1). The remainder are of uncertain health but may improve with time.

A relative weakness of the collection is that a number of species are represented by material either of unknown provenance or that was derived from seed collections in small plots elsewhere in Britain. The latter may have been subject to cross-pollination by other species eg the plot of *Abies cephalonica* has some trees which appear morphologically close to *Abies alba*. In such cases, the species performance should be considered as indicative rather than conclusive. In some cases, the provenance records are inadequate even where the identity numbers conform to those cited in official records (Anon., 1965). Thus the *Pinus radiata* quoted from Austria, the *Pinus banksiana* from New York, the *Abies concolor* var *lowiana* from Montana reflect the business location of the seed merchant from whom the seed was purchased rather than the natural distribution of the species.

Nevertheless, after 40 years growth some general trends are apparent although these are based upon single plots located in varying parts of the garden. Conifer species that are adapted to wet moist climatic conditions (eg various *Abies* species, some *Picea* species, western hemlock etc) have generally grown well whereas those more characteristic of drier climates (eg most pine species, cedars) have either failed completely or are in poor health.

The generally poor performance of the pine species agrees with other reports from Wales (eg Danby, 1993) although the healthy plots of *P. peuce* and *P. strobus* show that there may be some pine species which may be worth considering on a wider scale in Wales. The healthy growth of *Pinus peuce* in wetter parts of Britain has been reported elsewhere (Lines, 1985). *Pinus strobus* has fallen out of favour in this century because of the risks from *Cronartium ribicola*, but Chard (1962) felt that this high yielding pine merited further consideration provided the tree was planted in mixture and/or stands were well thinned. The disappointing performance of both lodgepole pine plots reflects unsuitable provenances due to susceptibility to windthrow and/or low vigour (see Lines, 1996).

The more limited range of broadleaved species planted to date show variable results. Most *Acers*, birches, oaks, beech and *Nothofagus obliqua* have shown reasonable growth even if the form of the trees is not of the best. Others such as alders, ash, walnut and limes have either failed or only grown poorly. It is debatable whether some of these failures may reflect a poor choice of seed source since the provenances are either unknown or from continental Europe. Recent work by Worrell (1992) has indicated that British seed sources are generally better than imported ones for a range of native tree species.

The growth of the most productive and/or interesting species has been assessed at intervals since 1982 and the most recent data are given in Table 2. Greatest attention has been given to conifer species plots. Yield classes have been derived by examination of the most appropriate tables in Hamilton and Christie (1971). It is unfortunate that no Sitka spruce was included in the early plantings so that direct comparisons with the standard forest species in this area of Wales are not possible. However, operational plantings on similar sites in nearby forests suggest yield classes of 14-16 can be reliably obtained with this species. The fertile growing conditions at Brechfa are underlined by the high yield classes recorded for most species. Five species have estimated yield classes over 20 and a further 10 of more than 14. Seven species (*Abies grandis*, *A. procera*, *Pseudotsuga menziesii*, *Sequoia sempervirens*, *Sequoiadendron giganteum*, *Thuja plicata*, and *Tsuga heterophylla*) are growing at rates in excess of that expected from Sitka spruce in this area and a number of others are growing at least at equivalent rates. The results for four out of the seven fast-growing species (*Abies grandis*, *A. procera*, *Thuja plicata* and *Tsuga heterophylla*) are in general agreement with a previous survey of plantations of these species throughout Britain (Aldhous and Low, 1974). These authors found that these four species produced higher volumes than Sitka spruce on better quality sites (such as Brechfa) but that this advantage was offset by an anticipated loss in timber quality.

In Table 3 a comparison in drawn between the yield classes of various plots at Brechfa and other published British or Welsh data. For the better-known species (ie *Abies grandis*, *A. procera*, *Chamaecyparis lawsoniana*, *Picea abies*, *Pinus contorta*, *Pseudotsuga menziesii*, *Sequoia sempervirens*, *Thuja plicata*, *Tsuga heterophylla*) the growth rates are generally similar to those previously reported. The high productivity that can be obtained on fertile sites in Wales from some of these species (eg *Sequoia sempervirens*) is clear. As far as the lesser-known species are concerned, these data are either the first published information for Britain or there is at best information from one or two other plots. In a number of cases (*A. nordmanniana*, *P.omorika*) growth rates are higher than in previous reports. The figures indicate the wide range of species that could be planted on sheltered fertile sites in this part of Wales.

It should be noted that the growth rates reported here may not represent the maximum attainable from the best provenances for each species. For example, *Abies grandis* is represented by material derived from east of the Cascade Mountains which is less productive than sources from north coastal Washington (Samuel, 1996). This may explain why growth rates for *Abies grandis* and *Abies procera* are so similar at Brechfa, since there is appreciably less variation within the Washington zone of the latter species (C. J. A. Samuel, pers. comm.). A further example of poor growth due to the wrong provenance choice is in Norway spruce where the Austrian seed source has shown much slower growth than might be achieved with fast growing origins from the Carpathian mountains in Eastern Europe (Lines, 1987).

The growth data should not be considered without ignoring potential disease risks whether from fungal, insect or climatic causes. Thus some of the species are relatively susceptible to *Fomes* (eg western hemlock, western red cedar) while others may be sensitive to frost (*Sequoia sempervirens*). Anybody wishing to consider the use of these species on a wider scale would be well advised to consult the relevant specialists in the Forestry Commission Research Division.

THE FUTURE

The value of the Brechfa plots is above all as a living demonstration of a wide range of tree species growing side by side under forest conditions in Wales. The main aim is to retain each plot until biological rotation and to collect appropriate data on growth, yield and other aspects (eg soil changes) that may be helpful for foresters now and in the future. Greater emphasis will be given to collecting data from the broadleaved plots. A subsidiary objective is to replace some of the failed plots by other species, particularly broadleaves, that could be expected to grow well in this area. Achieving this target will depend upon the finances available. The plots can serve as an educational resource for successive generations of foresters as well as for interested members of the public. In an era where there is an increasing interest in the wider aspects of forestry such as biodiversity, species diversity, landscape design, the information from these plots can be a helpful reminder of the need to select species that are ecologically adapted to the differing climatic regions in Britain.

ACCESS

Public access at present is by walking via the path from the recreation area at Abergorlech. Vehicle access is limited but possible up a forest road alongside the Afon Gothi which was dubbed the 'Burma Road' by the forest staff who built it. Permission must be obtained from the Llandovery Forest District Office (telephone 01550 720394). The number of visitors is specialised and small at present but when the Forest District recreation work is completed more visitors are expected.

Acknowledgements

To the staff who had the original foresight to plant these plots, to Steve Corcoran who undertook the resurvey in 1983, to David Paterson who encouraged this work and to Rob Donaldson and Alan Fletcher who commented on the draft. We are grateful to Mensuration branch at Alice Holt for providing the data in Table 2a.

References

Aldhous, J. R. and Low, A. J. (1974). The potential of western Hemlock, western red cedar, grand fir and noble fir in Britain. *Forestry Commission Bulletin* **49**. HMSO, London.

Anon. (1965). Seed Identification Numbers. *Forestry Commission Research Branch Paper* **29**, 370pp.

Anon. (1993). Report of Whole Society meeting 1993: South-West Wales. *Quarterly Journal of Forestry* **87**, 276-283.

Chard, R. (1962). Silviculture of Weymouth pine. *Forestry* **35**, 1-10.

Corcoran S. J. (1988). Brechfa Forest Garden - work Programme. Forestry Commission Internal Paper.

Danby, N. P. (1993). The use of pines in Wales. *Quarterly Journal of Forestry* **87**, 26-36.

Hamilton, G. J. and Christie, J. M. (1971). *Forest management tables*. Forestry Commission Booklet **34**. HMSO, London.

Lines, R. (1985). The Macedonian pine (*Pinus peuce* Grisebach) in the Balkans and Great Britain. *Forestry* **58**, 27-40.

Lines, R. (1987). Choice of seed origins for the main forest species in Britain. *Forestry Commission Bulletin* **66**. HMSO, London.

Lines, R. (1996). Experiments on lodgepole pine seed origins in Britain. *Forestry Commission Technical Paper* **10**. Forestry Commission, Edinburgh.

Pyatt, D. G. (1995). An ecological site classification for forestry in Great Britain. *Forestry Commission Research Information Note* **260**. Forestry Commission, Edinburgh.

Samuel, C. J. A. (1996). The influence of seed origin on the growth of grand fir in Britain. *Forestry Commission Research Information Note*, **280**. Forestry Commission, Edinburgh.

Worrell, R. (1992). A comparison between European Continental and British provenances of some British native trees: growth, survival and stem form. *Forestry* **65**, 253-280.

TABLE 1

LIST OF SPECIES AND PROVENANCE PLANTED IN THE BRECHFA FOREST PLOTS: 1955-PRESENT: CURRENT STATUS AND HEALTH

Species	Year	Provenance	Stocking	Health	Other Comments
Abies					
amabilis	1959	Washington	Full	Good	Rectangular plot
balsamea	1960	Unknown	Low	Poor	Landslide in plot
cephalonica	1957	Inverary, Argyll	Good	Average	Not impresive
concolor	1958	Colorado	Failed	Most died in eighties	-
concolor var. *lowiana*	1958	Montana [not natural range]	Fair	Failing	Poor crowns
delavayi	1959	Benmore, Argyll	Low	Good	Slow, attractive
fraseri	1961	Crarae, Argyll	Low	Good	Very slow
grandis	1957	Kittitas County, Washington	Full	Excellent	Some stem cracking
homolepis	1959	Nagano, Japan	Good	Fair	-
koreana	1961	Unknown	Low	Fair	Slow, attractive flowers
lasiocarpa	1960	Oakridge, Oregon	Fair	Good, past damage	Attractive colour
nordmanniana	1958	SW Germany	Fair	Average	-
procera	1957	Washington	Full	Good	Some stem cracking
veitchii	1958	Japan	Full	Average	-
Acer					
pennsylvanicum	1960	Unknown	Low	Past stem damage	Seeding into forest
platanoides	1957	Northumberland	Fair	Good	Rather thin
pseudoplatanus	1957	Slebech, Dyfed	Fair	Fair	Poorer than *A. platanoides*
saccharinum	1959	Tennessee	Fair	Average	Poor form
Aesculus					
hippocastanum	1958	Unknown	Low	Average	Poor for age
Alnus					
glutinosa	1968	Unknown	Very low	Poor, failing	S. slope, too dry
rubra	1958	Unknown	Very low	Failed	Attacked by *Chionaspis salicis*

Species	Year	Provenance	Stocking	Health	Other Comments
Betula					
lenta	1959	Pennsylvania	Fair	Healthy	Poor form
maximowicziana	1957	Nagano, Japan	Average	Fair	Snow damaged
pendula	1959	Unknown	Average	Fair	Rough form, snow damage
Castanea					
sativa	1957	France	Fair	Good after early frosting	Growth and form improved
Cedrus					
deodara	1958	Northern Italy	Fair	Annual dieback	Weak crowns
libani	1958	Italy	Failed	Failing by 1968	Last tree died 1990
Chamecyparis					
lawsoniana	1957	Monmouth	Full	Snow damaged	Multi-forked, tall
Cryptomeria					
japonica	1959	Japan	Full	Good	Basal sweep; from seed
Cupressocyparis					
leylandii	1965	Clone 11?	Full	Good	Good form in plots
Cupressus					
macrocarpa	1968	Unknown	Low	Unhealthy, from frost?	Multi-leadered
Davidia					
villmoriniana	1958	Unknown	Failed	-	-
Eucalyptus					
debeuzvillei	1986	Australia	Low	Good, but leaning from snow	-
Fagus					
sylvatica	1957	Unknown	Full	Good	Poor form, forking

TABLE 3

COMPARISON OF YIELD CLASS (GYC) IN SPECIES PLOTS AT BRECHFA WITH OTHER PUBLISHED WELSH OR BRITISH DATA

Species	GYC	
	Brechfa	**Other**
Abies		
amabilis	22	14[1]
grandis	24	24:14-30[2]
homolepis	14	-
nordmanniana	16	12[1]
procera	28	18[2]:14-22
veitchii	12	-
Chamaecyparis		
lawsoniana	20	20:18-22
Cryptomeria		
japonica	20	20[1]
Cupressocyparis		
leylandii	16	-
Picea		
abies	18	18[2]:14-22
koyamai	18	-
mariana	10	-
omorika	16	12[1]
Pinus		
contorta (South Coastal)	16	8-10[3]
contorta (Lower Frazer Valley)	10	8-10[3]
peuce	14	6-12[3]
strobus	16	14[1]
Pseudotsuga		
menziesii	26	18:12-22[2]
Quercus		
canariensis	6	-
Sequoia		
sempervirens	30	20-30[1]
Sequoiadendron		
giganteum	18	14[1]
Thuja		
plicata	22	20[2]:12-26
Tsuga		
heterophylla	24	20[2]:14-26

Sources:
1. MacDonald *et al.*, 1957;
2. Aldhous and Low, 1974;
3. Danby, 1993

Notes:
1. In 'other' columns, the average and the range of GYC is given if data from more than one plot are available.