

# SRF in Wales – Progress Report 2024



Aerial View of Brecon trial (© Crown Copyright, Forest Research)

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The Research Agency of the  
Forestry Commission

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# 1 Executive summary

This report summarises results of growth and survival to 2022 at three short rotation forestry (SRF) trial sites established in Wales. These were established across two years; in spring 2014, 14 of the 16 target species were planted while the remaining two species (coast redwood and sweet chestnut) were planted in spring 2015. The majority of species have now had nine full growing seasons.

Height growth has been lowest at the Ceredigion trial. The fastest growing trees were the two eucalypts, Tingiringi gum and cider gum and two the exotic alders, red and grey alder. Across the three trials, Tingiringi gum achieved a mean height of between 8.8 m and 9.8 m after nine growing seasons. Of the native species, common alder exhibited the fastest height growth with a mean height of 4.1 m. The growth of other native or naturalised broadleaves was relatively slow.

Survival has been generally good across all sites with most species exhibiting survival of more than 70% at all three locations. Survival was generally worst at Ceredigion, with complete failure of aspen and sycamore. Red alder survival was excellent at Radnor and very poor at Ceredigion and Brecon. The high mortality at Brecon was due to infection by *Neonectria major*.

These trials are now well established and have the potential to demonstrate the relative height growth and survival of a good range of potential SRF species across three very different sites.

## 2 Background

Short rotation forestry involves growing trees on rotations of between 10 and 20 years to produce material with a diameter at breast height (dbh) of between 10 cm and 20 cm. There is very little operational scale planting of SRF in the UK, but it is a well-established system in other countries, to produce products like biomass or wood for pulp.

In spring of 2014 a series of trials were planted to test the efficacy of SRF in a Welsh context on differing but representative site types, demonstrating best practice and examining the relative performance and potential biomass yield of a range of native and exotic trees. The trials described in this report are similar to SRF trials established in England and Scotland between 2010 and 2012. The aims of the Welsh trials, established by Forest Research (FR), working in partnership with Natural Resources Wales (NRW), are:

- to gather information on SRF through a programme of targeted research, development and monitoring; and
- to create an educational resource, demonstrating best practice and biomass potential under realistic operational conditions.

## 3 Trial locations and layout

The location of the three trials is described in Table 1 and Figure 1. Table 1 also provides information on the Forest Research experimental designation, the altitude, aspect and land use history. Table 2 describes the sites in terms of their climatic and soil conditions as generated by the Ecological Site Classification (ESC). All three sites are warm and sheltered or moderately exposed and have good levels of soil moisture and fertility.

Table 1 Location, altitude, aspect and land use history of the three trial sites.

| Site          | Altitude | Aspect | NGR      | Previous land use |
|---------------|----------|--------|----------|-------------------|
| Brecon 61     | 220-320m | NNW    | S0083170 | Grazing pasture   |
| Radnor 60     | 330-380m | NNW    | S0221648 | Re-stock          |
| Ceredigion 12 | 240-300m | NW     | S0768086 | Re-stock          |



Figure 1 Location of SRF trials in Wales

The Brecon site has a warm, and wet climate and is moderately exposed. The soils are very moist and fertility is moderate. The Radnor site has a warm, sheltered and moist climate, the soils are fresh and are of moderate fertility. At Ceredigion, the site has a warm, sheltered and drier climate, the soils have a higher level of moisture and fertility is higher, overlaying calcareous geology.

Table 2 Climatic and soil attributes of the three trial sites.

| Trial         | Accumulated Temperature <sup>1</sup> | Continentality <sup>2</sup> | Exposure (DAMS) <sup>3</sup> | Moisture Deficit <sup>4</sup> | Soil Moisture Regime | Soil Nutrient Regime |
|---------------|--------------------------------------|-----------------------------|------------------------------|-------------------------------|----------------------|----------------------|
| Brecon 61     | 1259                                 | 8                           | 13                           | 86                            | Very moist           | Medium               |
| Radnor 60     | 1299                                 | 9                           | 10                           | 95                            | Fresh                | Medium               |
| Ceredigion 12 | 1911                                 | 8                           | 12                           | 186                           | Very moist           | Carbonate            |

1. Accumulated temperature - day degrees above 5°C classed as 0-575=sub alpine, 575-1200=cool, 1200-2400=warm, 2400+=very warm.

2. Continentality: 2-5=oceanic, 5-9=neutral, 9+=continental

3. DAMS (Exposure index) - classed as 3-12=sheltered, 12-16=moderately exposed, 16-19=highly exposed, 19-22=severely exposed, 22+=too exposed for commercial forestry.

4. Moisture deficit - peak evaporation - precipitation (mm) classed as 0-90=wet, 90-180=moist, 180-260=slightly dry, 260+=moderately dry

## 4 Species choice and establishment

There are certain requirements of trees appropriate for short rotation forestry. These include high productivity, fast initial growth, and wood properties that suit the objectives of planting. If SRF is being established as a source of biomass, then species characteristics like low moisture content, high wood density, high calorific value and low bark content are also important. A high wood density means a smaller volume needs to be transported, while a straight stem makes storing and processing simpler. The ability to coppice is also useful, as it avoids the cost of replanting. SRF species should also be resistant to pests and diseases, abiotic damaging agents and have a low negative impact on the environment. Most tree species that meet these criteria are broadleaves like eucalypts, alders and poplars. This contrasts with conventional, longer rotation production forestry, focused on volume production where conifers are generally favoured.

As such, the tree species chosen for the SRF trials in Wales are largely broadleaves, comprising four native and twelve non-native species. The sixteen species planted are described in Table 2.

Table 3 Species included in the trials

| Common name<br>(*natives) | Scientific name               | Abbreviation |
|---------------------------|-------------------------------|--------------|
| Grand fir                 | <i>Abies grandis</i>          | GF           |
| Sycamore                  | <i>Acer pseudoplatanus</i>    | SY           |
| Italian alder             | <i>Alnus cordata</i>          | IAR          |
| Common alder*             | <i>Alnus glutinosa</i>        | CAR          |
| Red alder                 | <i>Alnus rubra</i>            | RAR          |
| Silver birch*             | <i>Betula pendula</i>         | SBI          |
| Sweet chestnut            | <i>Castanea sativa</i>        | SC           |
| Japanese cedar            | <i>Cryptomeria japonica</i>   | JCR          |
| Tingiringi gum            | <i>Eucalyptus glaucescens</i> | XEU          |
| Cider gum                 | <i>Eucalyptus gunnii</i>      | EGU          |
| Sitka spruce (VP)         | <i>Picea sitchensis</i>       | SS           |
| Aspen*                    | <i>Populus tremula</i>        | ASP          |
| Balsam poplar             | <i>Populus trichocarpa</i>    | PO           |
| Western red cedar         | <i>Thuja plicata</i>          | RC           |
| Small-leaved lime*        | <i>Tilia cordata</i>          | SLI          |
| Coast redwood             | <i>Sequoia sempervirens</i>   | RSQ          |

All sites were fenced and ground preparation and weed control were carried out prior to planting. Each species plot is 20 m × 20 m, with 10 × 10 trees planted at 2 m × 2 m spacing. Only the inner 36 trees (6 × 6) are assessed, with the surrounding two rows of trees acting as a buffer. Of the 16 species, 14 were planted in 2014, but sweet-chestnut

and coast redwood plants were not available in 2014 and were obtained and planted in spring 2015. Failed trees were replaced (“beaten up”) only at the end of the first growing season.

There were severe losses of western red cedar in the first year at Radnor and Ceredigion, and both sites had a complete beat up at the beginning of 2015. At these two sites these species have therefore had eight growing seasons rather than nine. At Brecon western red cedar losses were also very high but this trial was beaten up in the same year and so has had nine growing seasons.

## 5 Results

The results presented are from an assessment in 2022, after nine complete growing seasons for the majority of species. Mean survival for most is above 70% for 32 of the 48 site / species combinations, though across all species / survival combinations, no one site was consistently higher or lower (Figure 2). The conditions at Ceredigion were challenging for lime, hybrid poplar, sycamore, red alder and balsam poplar. An infection of *Neonectria major* devastated the red alder at Brecon and now only 7% survive. This is a known pathogen of both red alder and grey alder (*Alnus incana*) in north America.

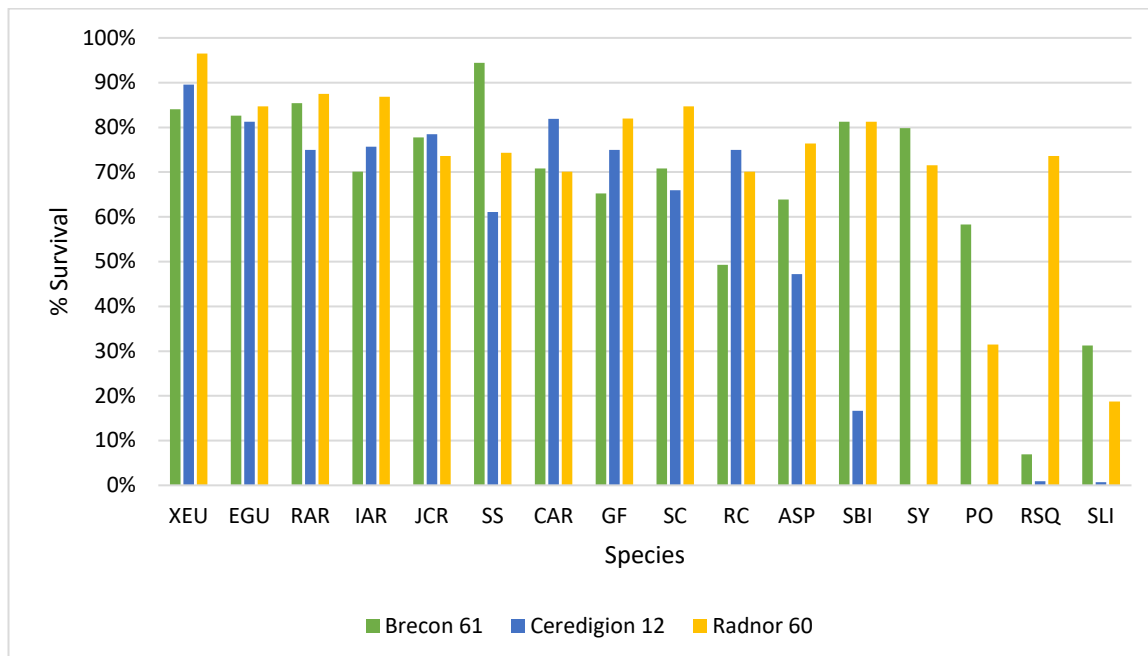


Figure 2 Mean plot survival for sixteen potential SRF species at three trials in Wales. For an explanation of species abbreviations see Table 2.

Height growth across the trials varies but it was consistently poorest at Ceredigion (Figure 3). In general height growth has been most rapid in the eucalypts and red alder (Figure



3). This is to be expected; eucalypts and alders are two genera known for their rapid, early growth and were tested in early trials for short rotation coppice. Trees of Tingiringi gum have grown in height by almost 1 m per year.

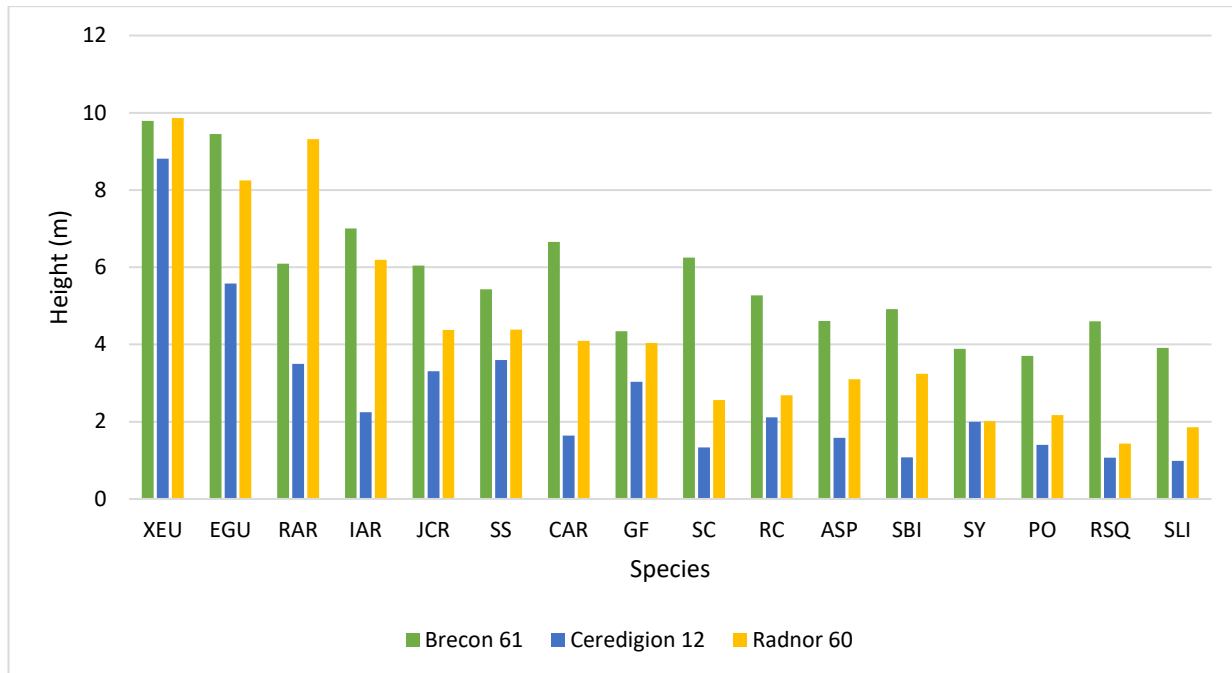


Figure 3 Mean plot heights for sixteen potential SRF species at three trials in Wales. For an explanation of species abbreviations see Table 2.

## 6 Discussion and Conclusion

The impressive growth of the eucalypts reflects their ability to grow throughout the year, provided temperatures are sufficiently high in comparison with other genera which have a more defined growing season. While survival of eucalypts has been excellent in the Welsh trials, there was complete mortality due to cold winters soon after planting in all but one trial in England (in the extreme southwest) and all trials in Scotland. The two species of eucalypts tested in the trials in Wales coppice and experience has shown that resprouting can occur after a damaging cold event and also means that replanting is not required for second and third rotations.

Alders have also performed well, except for the red alder, which at Brecon was attacked by *Neonectria major* and where survival at Ceredigion was very poor. The infection by *Neonectria* at Brecon appears to be an isolated incident and this species has not been infected by this pathogen in other trials in Wales, England or Scotland. However, red alder is known to be susceptible to spring frosts as budburst is early in UK conditions (Cannell *et al.* 1987) and this may be the reason for the very poor survival at Ceredigion as in 2020 spring temperatures, through to May were very low for a protracted period (Figure 4). The

ability of alders to fix nitrogen through an associate is an attractive characteristic if considering amelioration of poor soils or for their use as a nurse species.

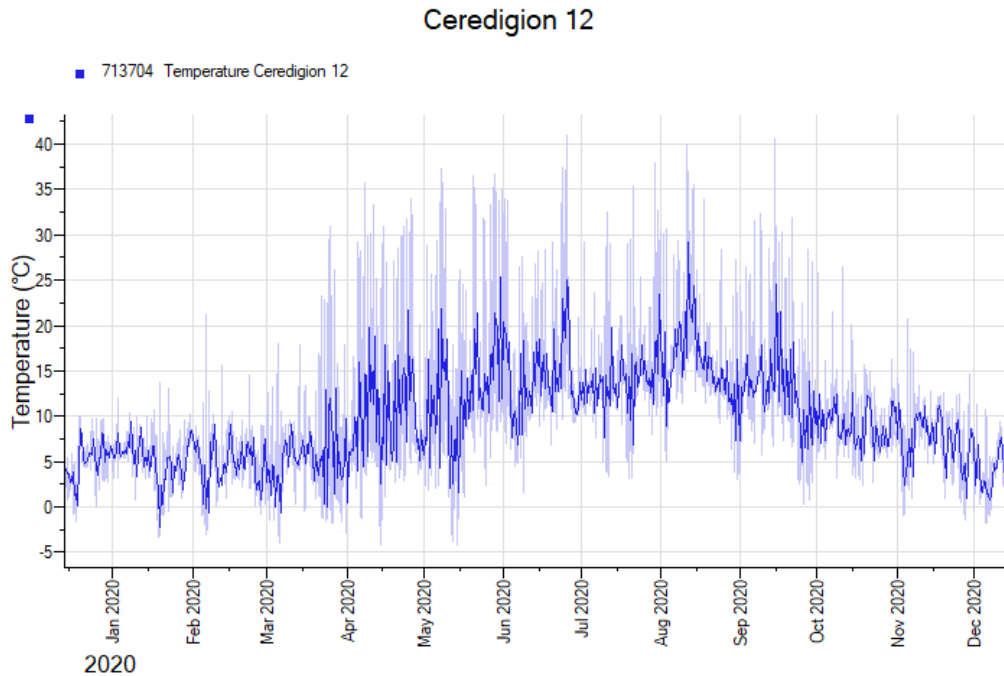


Figure 4 Temperature in 2020 at Ceredigion 12. Note below freezing temperatures occurred until mid-May.

Poplars are a genus associated with SRF but neither aspen nor balsam poplar have proven to be particularly rapid growing in Wales and survival of balsam poplar has been disappointing. Aspen may have potential for plantings requiring a native species and benefits from suckering from the roots, obviating the need for replanting.

Conifers are generally more productive than broadleaves over longer rotations and the four conifer species have grown relatively slowly compared with some of the most productive broadleaves, as predicted.

## 7 Acknowledgements

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## 8 References

Cannell, M.G.R., Murray, M.B. and Sheppard, L.J., 1987. Frost hardiness of red alder (*Alnus rubra*) provenances in Britain. *Forestry: An International Journal of Forest Research*, 60(1), pp.57-67.

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