

Short Rotation Forestry in Wales

Progress Report March 2019

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Front Cover shows Japanese cedar (Cryptomeria japonica) plot at the Brecon site in August 2018.

Contents

Contents	3
List of Figures	3
Executive Summary	5
Background	6
Trial Site Locations	8
Planting and establishment	9
Results	11
Work programme for 2019-20	14
Conclusions	15
References	16
Acknowledgements	16
Appendix 1: Mean height and survival charts	17

List of Figures

Figure 1: Ceredigion site in September 2018 with some of the plots showing clearly (Photo credit Dai Evans, TSU, Talybont).	6
Figure 2: Aerial image of the SRF trial site at Radnor during an NRW forestry field meeting in May 2018. Bright green plots red alder trees, and darker coloured plots of Eucalypts becoming visible at a distance. (Photo credit Dai Evans, TSU Talybont).....	7
Figure 3: Locations of the three trial sites.....	8
Figure 4: The trial site at Brecon in August 2018 with several species now visible as distinct plots.	10
Figure 5: Mean percentage survival of all species for all sites after 5 years	11
Figure 6: Mean survival of red alder across all three sites showing the severe decline at Brecon.	12
Figure 7: Severe dieback of red alder at the Brecon site in August 2018 (left), and lesions caused by <i>Neonectria major</i> (right).	12
Figure 8: Mean heights by species and site at the end of five growing seasons.....	13
Figure 9: Small-leaved lime defoliated (left) defoliated by caterpillars of buff-tip moth at the Brecon site in August 2018.	15

Figure 10: Mean heights over the first five years at the Brecon site (Y0 is height at planting), and mean % survival at year 5.	17
Figure 11: Mean heights over the first five years at the Ceredigion site (Y0 is height at planting), and mean % survival at year 5.	18
Figure 12: Mean heights over the first five years at the Radnor site (Y0 is height at planting), and mean % survival at year 5.	19

Executive Summary

This report summarises progress up to March 2019, and gives an overview of the programme for the coming year, 2019/20.

Three Short Rotation Forestry (SRF) trial sites are now established in Wales; all were planted with 14 of the 16 target species in Spring 2014, and the remaining two species (coast redwood and sweet chestnut) planted in spring 2015. The majority of species have now had four full growing seasons and trends observed at the end of year 4 are expected to continue to develop and change.

As last year, mean heights are greatest at Brecon for 15 of the 16 species, conversely 14 species recorded their lowest mean heights at Ceredigion. Cider gum had the greatest mean height with 588 cm at Brecon, closely followed by Tingiringi gum at Brecon (573 cm) and at Radnor (500 cm), and red alder at Radnor (485 cm). sycamore had the lowest mean height (44 cm at Ceredigion), with the next lowest for coast redwood at Radnor (47 cm), both were taller at Brecon (176 cm and 149 cm respectively).

Survival is generally good across all sites with most species greater than 80% at all three locations. Notable exceptions are aspen (26%), Balsam poplar (20%), and sycamore (30%) at Ceredigion. Red alder at Brecon continues to decline with survival now at 16%, compared with 92% and 98% at Ceredigion and Radnor respectively. Investigation by Forest Research Tree Health Diagnostic and Advisory Information Service has tentatively linked this to *Neonectria major* as the cause. The pathogen has not been observed on other alder species at Brecon, or on any alders at Radnor and Ceredigion. The high rate of infection and subsequent tree death may be associated with high levels of vole damage at the Brecon site in previous years.

Vegetation management is now under good control at the Brecon site though a minor amount of bracken control may still be required for smaller plants of coast redwood. Encroaching gorse and woody regen are still issues at both Radnor and Ceredigion and will require further management throughout 2019.

These sites are now well established and have hosted a number of field meetings, demonstrating their value as an educational resource. In May 2019 the Brecon site was visited as part of a Royal Forestry Society tour of the Talybont catchment, whilst the Radnor site hosted a field meeting of NRW forestry staff. As the trials continue to develop and grow this value will continue to be built upon.



Figure 1: Ceredigion site in September 2018 with some of the plots showing clearly (Photo credit Dai Evans, TSU, Talybont).

Background

The demand for woody biomass is rapidly increasing, at local, national and international levels, driven by government policies that promote and incentivise the use of renewable fuels in order to help meet targets for reductions in CO₂ emissions, with additional impetus being provided by the rising price of heating oil. Within the forestry sector, biomass has provided a new market for waste wood, timber residues, thinnings, small roundwood and low grade logs; raising the value of these commodities and competing with other, more traditional, users of timber and wood fibre. In Wales, the majority of woody biomass derives from forestry and related industries whose prime objective is the production of timber products. There is little grown that is specifically targeted at biomass production.

Short rotation forestry seeks to address this by being a flexible production system, using species and methods that promote sustainable biomass yield within a relatively short time-frame. The system has not previously been tested in Wales; though there

are complimentary SRF trials in England and Scotland that were planted between 2010 -12.

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 biomass yield of a range of native and exotic trees.

The continuing aims of these trials, working in partnership with NRW, are:

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



Figure 2: Aerial image of the SRF trial site at Radnor during an NRW forestry field meeting in May 2018. Bright green plots red alder trees, and darker coloured plots of Eucalypts becoming visible at a distance. (Photo credit Dai Evans, TSU Talybont).

Trial Site Locations

All three of the proposed trial sites are now established in Wales - the names and numbers are Forest Research experiment references.

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

Site	Altitude	Aspect	NGR	History
Brecon 61	220-320m	NNW	SO083170	Grazing pasture
Radnor 60	330-380m	NNW	SO221648	Re-stock
Ceredigion 12	240-300m	NW	SO768086	Re-stock



Figure 3: Locations of the three trial sites

Planting and establishment

Species choice for SRF is driven by the need for high biomass yield over a short time-span. However, it should be borne in mind that high volume yield alone is not a clear indicator of either biomass productivity, or carbon sequestration.

Because of the relationship between wood density and biomass yield, many species have similar biomass yields despite differing growth rates, and fast growing conifers are not necessarily more productive in biomass terms than broadleaves. In addition, broadleaf production is concentrated into a smaller, more easily harvested, transported and utilised volume for the same calorific value than most conifers. All of which leads to the conclusion that fast growing broadleaves are the preferred option where sites are suitable, though conifers do have a place in more demanding situations.

With this in mind a selection of species was planned which comprised four native and twelve non-native species which incorporates both broadleaves and conifers thought likely to be suited to the sites and conditions. The following 16 species were planted at each site.

Common name (*natives)	Scientific name	Abbreviation
Grand fir	<i>Abies grandis</i>	<i>Abgr</i>
Sycamore	<i>Acer pseudoplatanus</i>	<i>Acps</i>
Italian alder	<i>Alnus cordata</i>	<i>Alco</i>
Common alder*	<i>Alnus glutinosa</i>	<i>Algl</i>
Red alder	<i>Alnus rubra</i>	<i>Alru</i>
Silver birch*	<i>Betula pendula</i>	<i>Bepe</i>
Sweet chestnut	<i>Castanea sativa</i>	<i>Casa</i>
Japanese cedar	<i>Cryptomeria japonica</i>	<i>Crja</i>
Tingiringi gum	<i>Eucalyptus glaucescens</i>	<i>Eugl</i>
Cider gum	<i>Eucalyptus gunnii</i>	<i>Eugu</i>
Sitka spruce (VP)	<i>Picea sitchensis</i>	<i>Pisi</i>
Aspen*	<i>Populus tremula</i>	<i>Ptre</i>
Balsam poplar	<i>Populus trichocarpa</i>	<i>Ptri</i>
Western red cedar	<i>Thuja plicata</i>	<i>Thpl</i>
Small-leaved lime*	<i>Tilia cordata</i>	<i>Tico</i>
Coast redwood	<i>Sequoia sempervirens</i>	<i>Sese</i>

All sites were fenced and ground preparation and weed control were carried out prior to planting. Species plots are 20 m x 20 m, containing 10 x 10 trees planted at 2 m x

2 m spacing. Assessments are carried out on a central plot of 36 trees (6 x 6), the surrounding two rows of trees acting as a buffer. Of the 16 species planned, 14 were planted in 2014. Sweet-chestnut and coast redwood plants were not available in 2014 but were sourced and planted in spring 2015. Plots were beaten up only at the end of the first growing season.

Following almost total losses of western red cedar in the first year at Radnor and Ceredigion, both sites were fully beaten up at the start of 2015. At these two sites this species has therefore had three growing seasons rather than four. Western red cedar losses were similar at Brecon but these were beaten up in the same year and have therefore had four growing seasons.

Temperatures at each site are monitored hourly using a single shielded TinyTag TGP-4017 temperature logger mounted 1 m above ground level which is downloaded every 6 months. Batteries and seals are replaced every other year and will be due for replacement in 2019.



Figure 4: The trial site at Brecon in August 2018 with several species now visible as distinct plots.

Results

After 5 complete growing seasons for the majority of species, mean survival for most is above 80% for 31 of the 45 site-species combinations, though no one site was consistently higher or lower than the other across all species. Sycamore, hybrid poplar, and aspen at Ceredigion were among the four site-species combinations where survival was less than 50%.

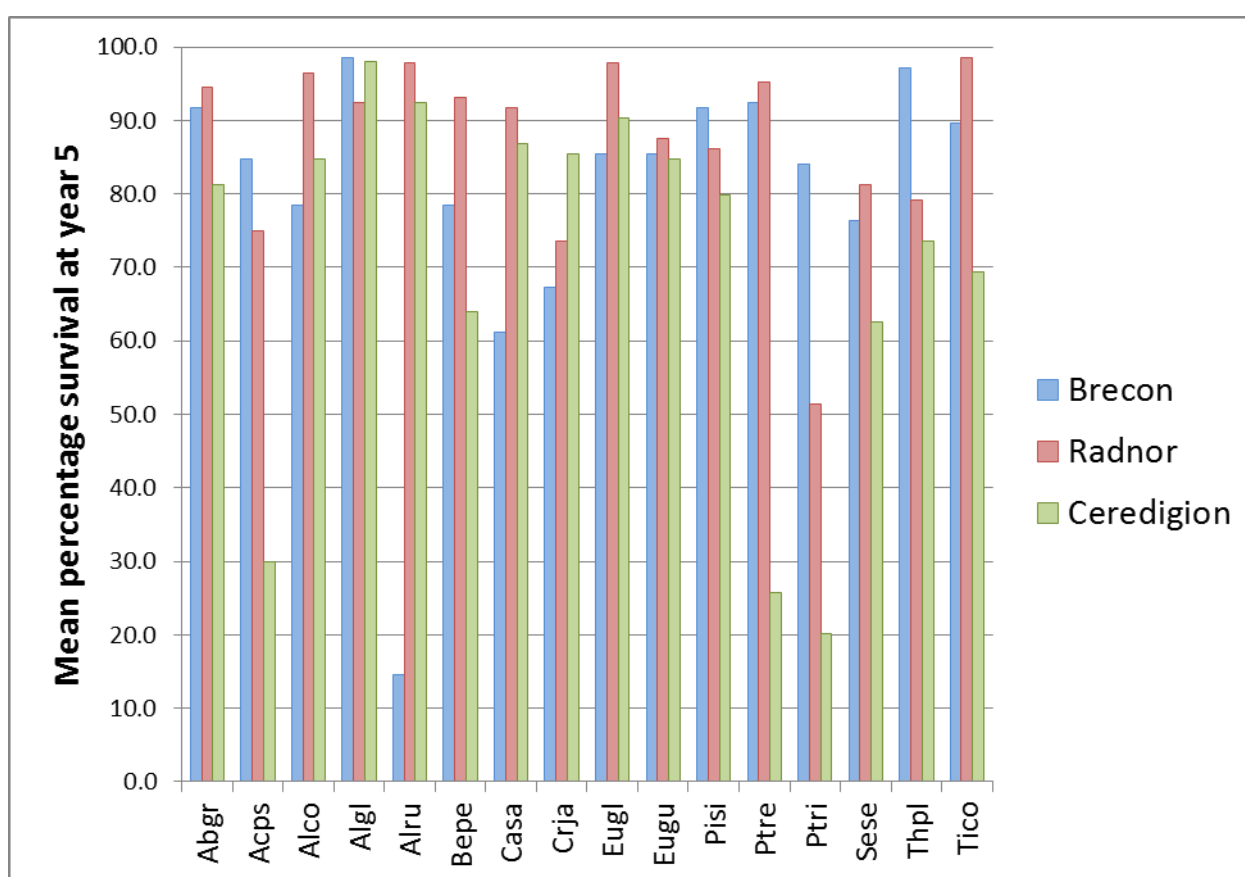


Figure 5: Mean percentage survival of all species for all sites after 5 years

As per 2017, survival of red alder was lowest at Brecon, dropping from 43% at the end of year 4 (2017) to 14.6% (figure 6). Previous tests by Forest Research's Tree Health Diagnostic Advisory Information Service were inconclusive but the continued decline prompted further testing this year. One of the pathogens present was identified as *Neonectria major*, a known pathogen of both red alder and grey alder (*Alnus incana*) in the USA. Infection by this pathogen is via either natural openings in the bark such as leaf scars or lenticels, or where wounding has occurred. Infection

begins as small dark spots which can grow into sunken lesions in the second year and in severe cases this can lead to tree death (Cootsona, 2006). Testing is ongoing and now seeks to determine if *Neonectria major* is the sole cause.

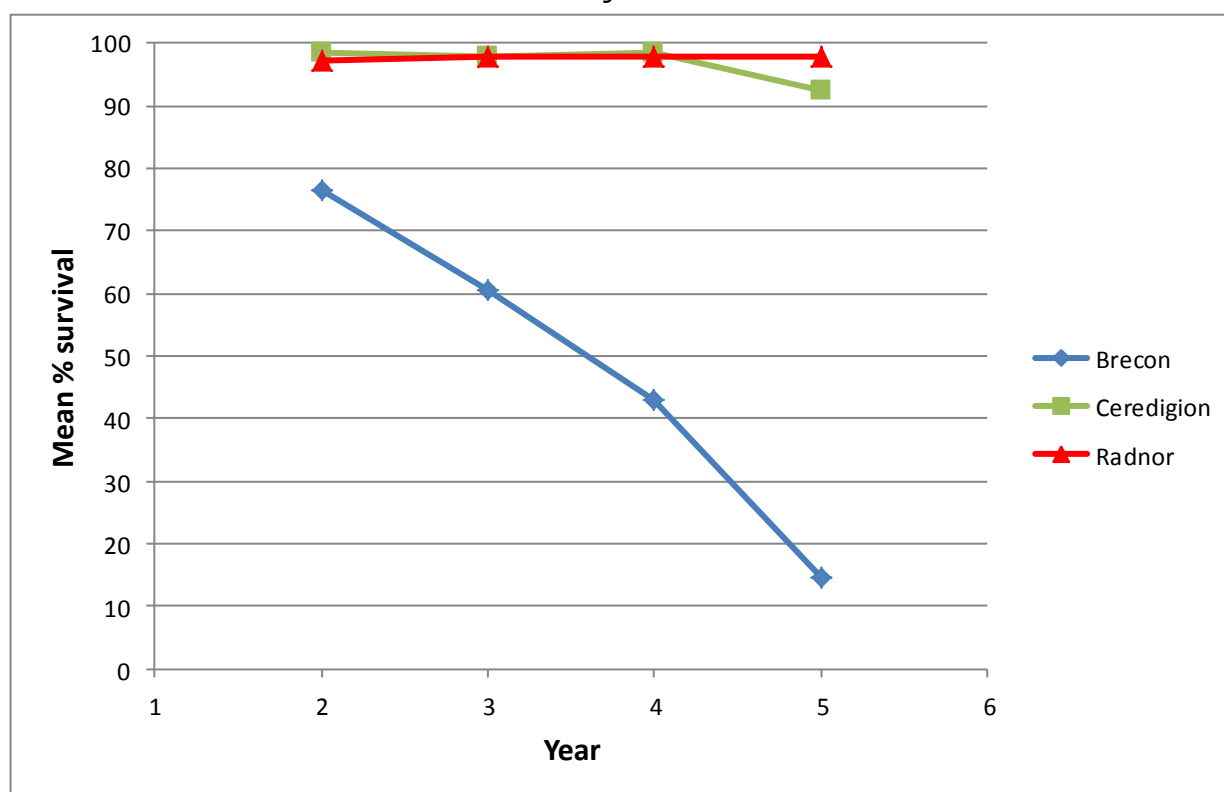


Figure 6: Mean survival of red alder across all three sites showing the severe decline at Brecon.



Figure 7: Severe dieback of red alder at the Brecon site in August 2018 (left), and lesions caused by *Neonectria major* (right).

Similar to year 4, after five growing seasons preliminary analysis suggests that 15 of the 16 species had greater mean heights at Brecon compared with Ceredigion and Radnor (Figure 8). At Radnor 14 of the 16 species were taller than trees at Ceredigion, i.e. 14 of the 16 species recorded their lowest mean height at Ceredigion.

The tallest trees were those of cider gum at Brecon with a mean height of 588 cm, followed by Tingiringi gum at 573 cm, also at Brecon, and Tingiringi gum at Radnor at 500cm. Red alder was the tallest non-Eucalypt with 485 cm at Radnor, followed by common alder (389.7 cm) and Italian alder at Brecon (322 cm) (Figure 8).

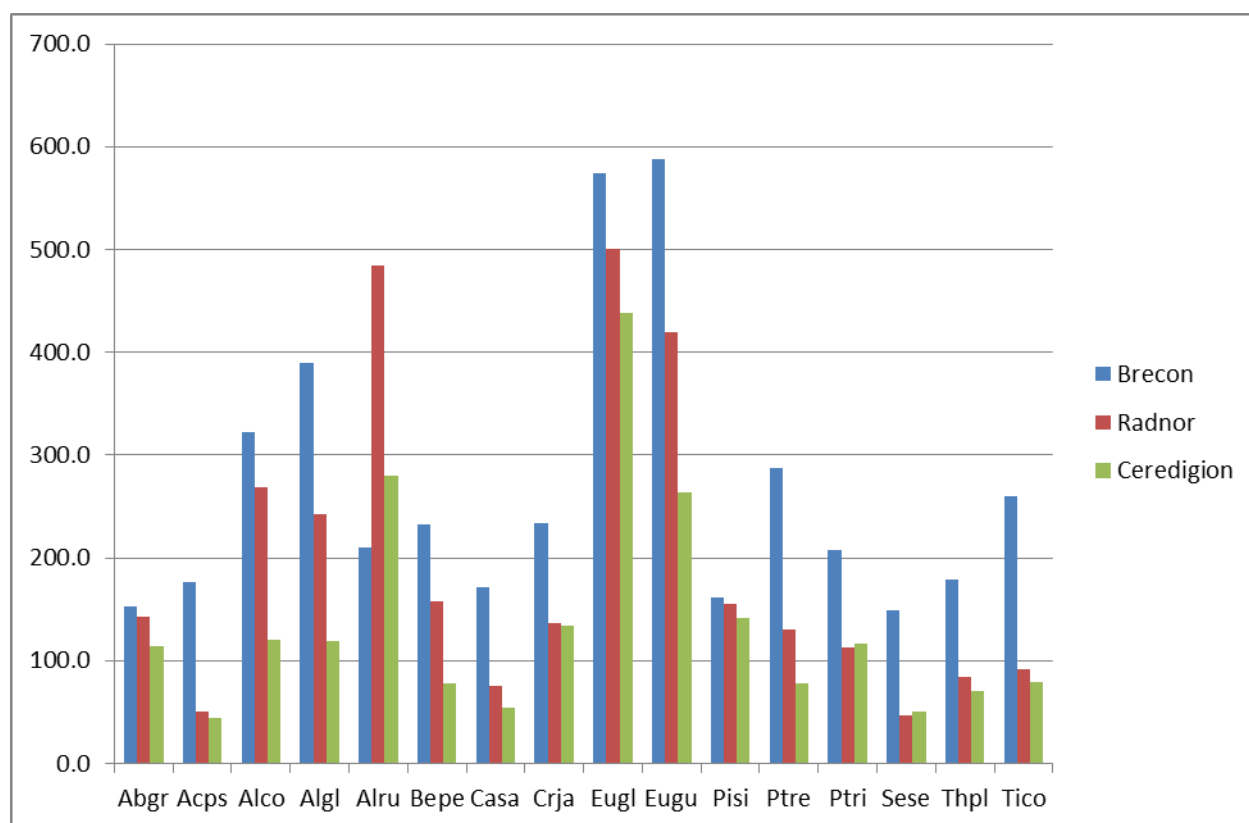


Figure 8: Mean heights by species and site at the end of five growing seasons.

Conifers have performed reasonably well, the tallest being Japanese cedar (234 cm), western red cedar (178 cm), and Sitka spruce (161 cm) at Brecon. In terms of mean height Sitka spruce is the most consistent species, with mean heights of 141 cm at Ceredigion, 154 cm at Radnor, and 161 cm at Brecon.

Work programme for 2019-20

Assessments

Height and survival assessments will be made of the central 36 trees in each plot at the end of the growing season after full dormancy. The experiment plan also calls for the measurement of DbH once >90% of the trees exceed 2.5m height, a condition which will be met by cider gum, Tingiringi gum and possibly red alder at the end of the 2019 growing season. Capturing this information would allow an estimate of biomass production of some species to be calculated. Provision will need to be made to carry out these assessments in addition to height measurements.

Given the appearance of *Neonectria major* on the red alder at Brecon at least one inspection of all alder plots on all three sites should be made to check for symptoms. If symptoms are observed samples will be taken and sent to THDAIS at Alice Holt for confirmation. A site walk of all plots at each site looking for signs of disease or pests is recommended, preferably carried out in August. For example, defoliation of individual trees of aspen and hybrid poplar was seen in the first year or two of the trials, and of small-leaved lime by buff-tip moth larvae in August 2018 (fig 9).



Figure 9: Small-leaved lime defoliated (left) defoliated by caterpillars of buff-tip moth at the Brecon site in August 2018.

Hourly maximum and minimum temperature measurements will continue to be gathered automatically using the TinyTag loggers and batteries and moisture seals will need to be replaced in 2019.

Vegetation management

In the majority of cases species plots are now well established at Brecon and no further vegetation management within individual species plots should be required except to remove woody regen if and when it appears. A very limited amount of bracken control may still be required where individual plants are still relatively small, such as coast redwood.

Gorse continues to be a problem at Radnor, though operations by local NRW staff have been invaluable. Many species plots are now of a size where gorse shouldn't be too much of a problem but species such as coast redwood, western red cedar and sycamore will still need to be kept clear.

As in previous years grass remains the main problem in some plots, particularly coast redwood where trees are still small and in danger of being choked. Gorse is starting to appear, as is regen of both western hemlock and Sitka spruce. Prompt action to tackle the gorse in particular should prevent it becoming a major problem.

Conclusions

These trials are now well established and starting to yield interesting and informative results. Tinglewood gum, cedar gum and red alder (the latter with the exception of trees at Brecon) are clear leaders in terms of height gain on all sites. More traditional conifer species such as Sitka spruce and grand fir have both been relatively slow to start in comparison but are now putting on good growth.

On the whole balsam poplar, sycamore and aspen continue to be disappointing with low survival and poor growth. Western red cedar at Ceredigion and Radnor is likewise very poor, but at Brecon trees are now growing well. Deaths of red alders at Brecon, previously attributed to vole damage have been tentatively linked to the pathogen *Neonectria major* and continued vigilance for the appearance of similar symptoms in other alders on the site, and at Ceredigion and Radnor is essential.

Vegetation management will continue to reduce in the coming year but for smaller trees such as coast redwood some light management may still be required. However, the majority of species trees are now well enough established and the only requirement may be to manage woody regeneration.

Importantly, all three sites are now at a stage where they provide a valuable educational resource and could host practitioners, researchers and policy makers and this is something that should be encouraged.

References

Cootsona, C. 2006. Identification and distribution of *Neonectria* major causing cankers on red alder (*Alnus rubra*). MS Thesis, University of Washington.

Acknowledgements

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We would like to thank Lyn Ackroyd, Dai Evans, David Reynolds, and Kate Sparrow of the Forest Research Technical Services Unit at Talybont for their work monitoring and assessing these trials.

Appendix 1: Mean height and survival charts

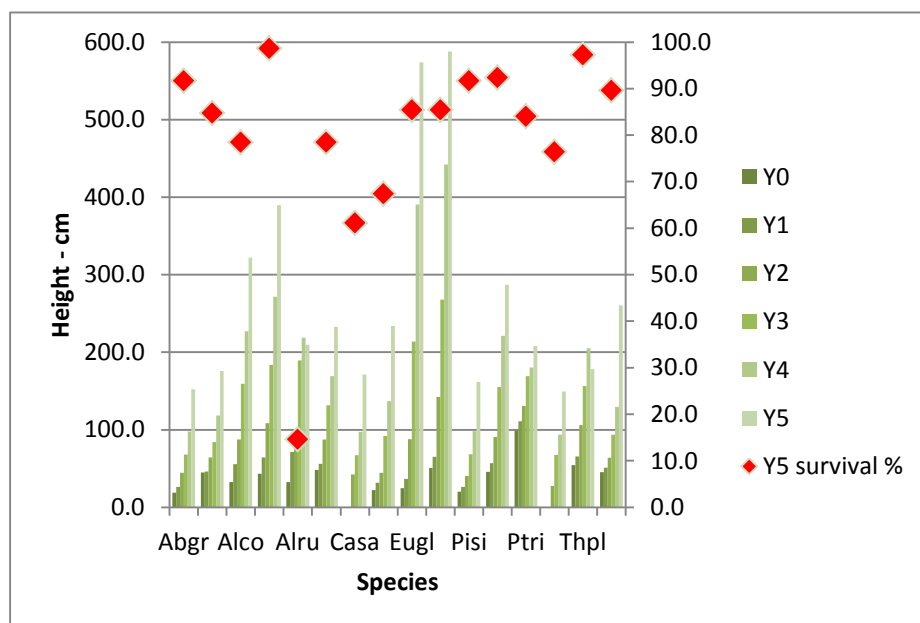


Figure 10: Mean heights over the first five years at the Brecon site (Y0 is height at planting), and mean % survival at year 5.

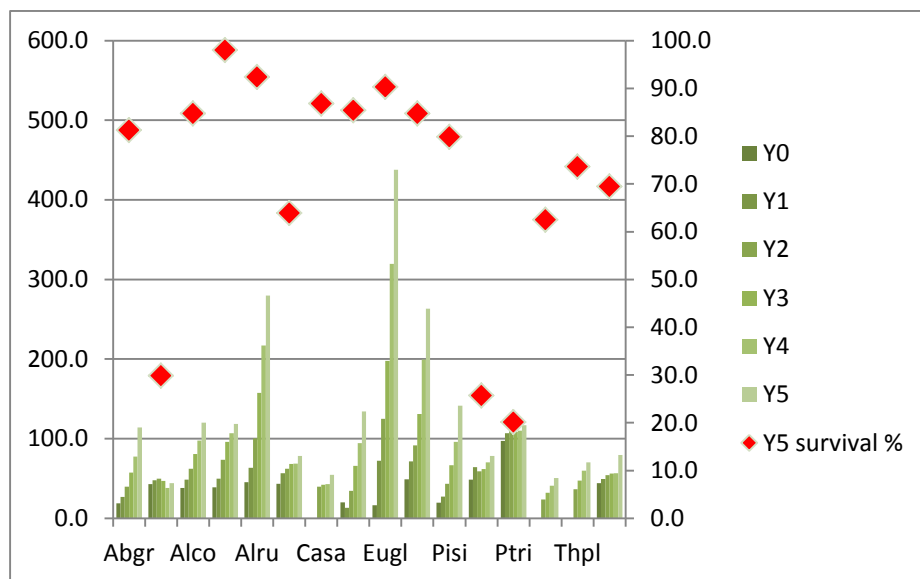


Figure 11: Mean heights over the first five years at the Ceredigion site (Y0 is height at planting), and mean % survival at year 5.

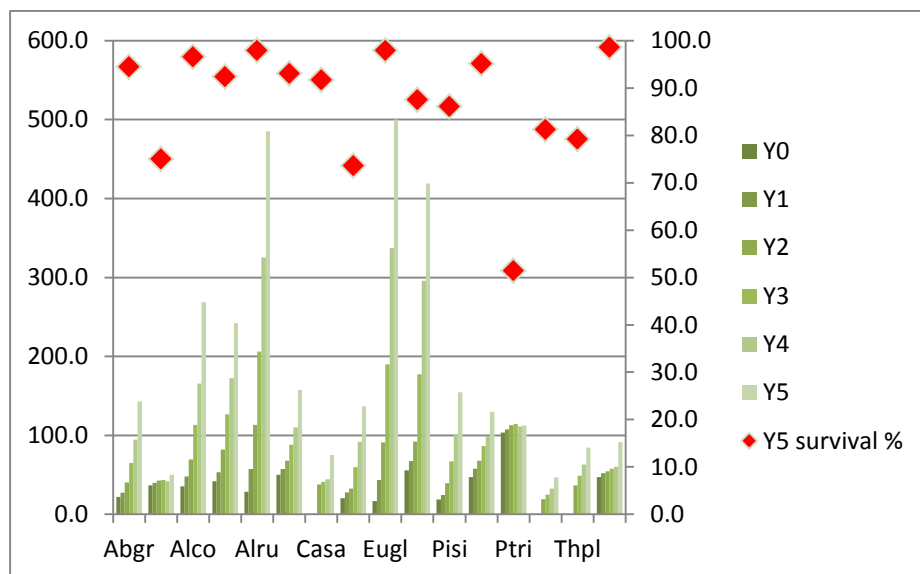


Figure 12: Mean heights over the first five years at the Radnor site (Y0 is height at planting), and mean % survival at year 5.