



GROWERS STORY

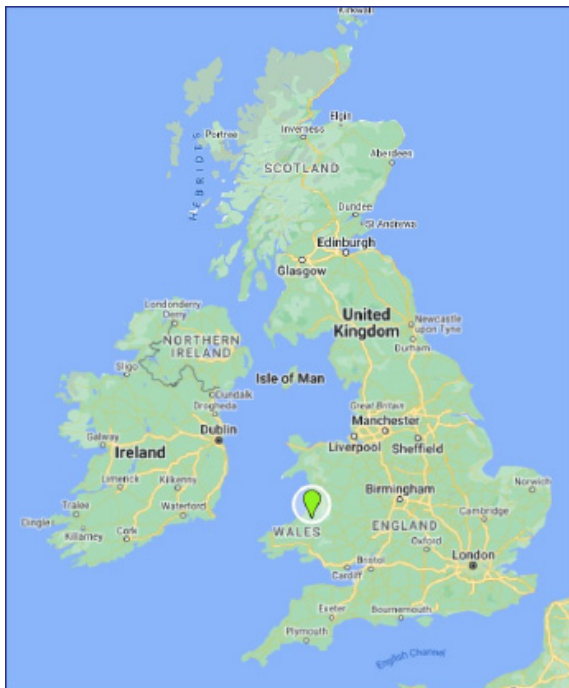
Eucalyptus and the Frost Challenge:

A Tale from Tanllan Farm, Llangeitho



David and Susan Bodsworth's Experiment with Eucalyptus on a Welsh Upland Farm

In a bid to explore biomass production for household heating and as a potential revenue stream, David and Susan Bodsworth of Tanllan Farm, Llangeitho, are keen to share their experiences with the farming community.



The farm primarily operating as a pasture-based farm with a flock of breeding ewes and cattle is located near the village of Llangeitho, sitting at an elevation of approximately 200 meters above sea level, nestled in the shadow of the Mynydd Bach hills, just 11 miles east of the coast. The soil texture was identified as acid loam and clay soil, and tests conducted

through Farming Connect, revealed that while the P and K indices were acceptable, the pH levels were lower than ideal. Most Eucalyptus grow well on a range of soils, within the pH range of 4.5 to 7.5, with most species preferring fertile and free draining soils. The soil was poorly drained, which prevented machinery access throughout most of the year.

David and Susan invited the Biomass Connect team to come and inspect their eucalyptus plantations. Unfortunately, a large proportion of which had died during the previous winter of 2022/23.



The Eucalyptus species that were planted were chosen by David and Susan with direction from Bryan Elliott of Eucalyptus Renewables. These species are suited to short rotation forestry (SRF) due to fast growth rate and high biomass yield, which can exceed that of other native species. The various species selected were targeted for specific locations on the farm due to owner objectives and ground constraints. When planted in favourable locations growth rate can be up to 2-3 m



per year and can be harvested through thinning and clear-felling from 6 years onward. Based on an 10–15-year rotation, data from UK trials identified yields in the range of 20-30 m³ ha/year and that is the equivalent to 10-15 oven dry tonnes per hectare per year.

In 2018 and 2019, David and Susan procured a range of eucalyptus species to plant on the farm, including a variety from Tasmania, believed to be more frost-resistant.

The Eucalyptus trees were planted in the spring as plug seedlings (small container grown saplings) into a hole made using a

large diameter auger bit on a cordless drill. They were then protected with mesh guards and staked, following best practice guidance from the supplier. The trees were planted at the suggested short rotational forestry (SRF) density of 2500 per hectare in 2 x 2.5 metre blocks. This spacing was to allow tree development and for mechanical flail access for ground cover management. The primary objective of close spacing is to achieve canopy closure as soon as possible to create a microclimate that helps to develop a protected forest zone against climatic events.

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As part of their overall plan to plant trees on less productive agricultural land and for minimal intervention, they only conducted mechanical strimming between the rows in the first year to suppress the surrounding vegetation. The trees were then left to grow without further management.

At the time of the visit, October 2023, the Eucalyptus had been in the ground for 3 to 4 years, exhibiting varying heights between 1 and 4 meters and up to 15 centimetres in diameter at breast height (a standard method of expressing the diameter of the trunk).

“We established this plantation of Eucalyptus in 2018 and it grew remarkably well in the first four years. This last winter in 2022/2023, we had a -18 °C frost overnight, but we had a week of -10°C and nearly all of the eucalyptus have died”.



In January 2023, the region experienced an extremely cold spell, with temperatures plummeting for a week to -10°C at night and down to -18°C for a single night. David believes that this extreme cold weather affected 60-70% of the eucalyptus trees which succumbed to the frost. Vertical cracks and bark peel were visible on the affected trees, leading David to speculate that something similar to frost heave, that is the separation of the of the bark from the woody stem was the culprit. This hampered nutrient and water circulation and ultimately caused tree death.



“The best growing trees that we had were *E. nitens*, and they have died completely. The method of death that I think the eucalyptus has suffered is frost to the main stem.”

There is evidence from some research studies in support of David’s speculation on frost damage in Eucalyptus in

Cumbria. This highlighted cell damage, reduced photosynthesis ability, dehydration and frozen roots which decreased water uptake as consequences of freezing conditions.

Eucalyptus are evergreen trees and can continue to grow through the winter if conditions are suitable. Eucalyptus trees, if they experience a gradual reduction in temperature over a period of time, will harden, a process that allows the tree to accumulate proteins and sugars in the cells that act as an anti freeze (inhibit ice crystals forming) and therefore reducing damage. Low temperatures and unseasonal temperature fluxes are the main limiting factor to Eucalyptus growth, but these can be mitigated by proper species selection and silvicultural management. *E. nitens*, for example, displays exceptionally fast growth rate but is more susceptible to frost, this restricts its growth range to southern Britain. Species such as *E. glaucescens* and *E. gunnii* are more cold-tolerant.

It was also noted that a number of trees that appeared to have died, had started producing shoots from the base of the tree. Eucalyptus trees have the capacity to produce buds over the protected surviving cambial layers. These shoots are triggered in response to serious damage such as frost or fire, allowing the regeneration of the tree, as long the roots are not too badly affected.

The temperature was higher than average

that winter, which encouraged the young trees to come out of dormancy and had become vulnerable to the plunging cold temperatures. The specific scenario was set with an early winter cold spell at the end of November and into December followed by around six weeks or so of warmer spring-like conditions until the deep cold spell at the end of January 2023. There was a serious impact on all non-deciduous trees through the winter of 2022-23.



Although [climate change](#)^[1] in the UK suggests wetter and warmer winters and fewer frost days, the [atmospheric blocking](#)^[2] patterns which are responsible for some of the extreme weather such as the cold snaps seen in early 2023 may increase with climate change.

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The Bodsworths' story at Tanllan Farm highlights some of the challenges faced by farmers seeking to diversify into biomass production. David commented that although the Eucalyptus tree has a great potential for producing biomass, perhaps the location of his site was not entirely suitable.

Eucalyptus species and provenance must be selected and matched appropriately on a site-by-site basis. Overcoming the challenges of growing Eucalyptus in this region requires the need for careful site selection, water availability, likelihood of unseasonal frosts, soil type, light levels, agronomy, silviculture, and variety choice in light of local climatic conditions.

“Eucalyptus is a great tree in the right place!”. Where the Eucalyptus have died, we are trialling black locust and Paulownia. Because of the ground conditions, some are growing well and some are not doing well. We are trying to find the right tree for the right place!”

Further Eucalyptus information can be found on www.biomassconnect.org.

There are also case studies from other Eucalyptus growers which can be accessed by visiting UK Eucalyptus silviculture in 2022

Their openness to sharing their experiences serves as a valuable lesson for the broader farming community, encouraging discussions on the viability of Eucalyptus and similar species in the UK.



Top tips

Best practice guidelines to ensure a good establishment which will aid a productive plantation.

Choice of species and site selection

- ▶ The duration and timing of cold spells are significant factors on the impact of the survival capacity of cold-tolerant Eucalyptus trees. A choice will need to be made regarding the balance between growth potential and cold tolerance.
- ▶ *Eucalyptus nitens* is particularly productive, but less cold tolerant to both extreme temperatures and out of season frosts. Other less productive Eucalyptus tree species for example *E. glaucescens* and *E. gunnii*, originating from more extreme mountainous provenances with greater cold tolerance characteristics, are less effected by fluctuating temperatures, so the selection of targeted species for specific sites is important.

Establishment

- ▶ With Forestry (and SRF) establishment and silviculture it is imperative to follow best practice guidance to alleviate any stress related issues that impede trees to develop to their best potential.
- ▶ A healthy consistent canopy closure the primary objective. The capacity of a relatively uniform stand of trees that has achieved canopy closure, is worth quite a few degrees of protection in any sort of climatic event, whether it be drought, wind or cold temperatures. (Any sort of) trees have evolved to struggle through our enforced establishment phases in a pioneer environment such as a new plantation, often an open field habitat, until they manage some sort of microclimate and effectively develop a continuous protective cover.
- ▶ As trees are being grown with specific expected outcomes, it is important to follow up the investment of establishment with timely post-planting interventions through weeding and ground cover management to allow the trees to respond to growth opportunities.
- ▶ At Tanllan Farm the trees were struggling to survive against grass competition throughout their establishment phase with inconsistent growth opportunities due to a lack of weeding and basic maintenance. Their capacity to survive any sort of climatic cold event was curtailed with a lack of post-plant weeding intervention and subsequently, a varied stand of trees with a canopy full of gaps.

References

1: <https://link.springer.com/article/10.1007/s10584-021-03100-5>

2: <https://link.springer.com/article/10.1007/s00024-023-03297-9>

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