

**Trees on stock farms for climate resilience Thursday 15<sup>th</sup> June. Visit to AFBI (Agri-Food and Bioscience Institute) Loughgall. Visit led by Dr. Rodrigo Olaves with colleagues.**



Agroforestry trials can play a vital role informing on farm practices. Unfortunately, funding is often short term, typically three years for a long-term crop. However one research project can stimulate one to follow on. The challenge is to keep the funding going in changing political and policy climates, something that despite difficulties AFBI Loughgall has managed to do. The presence of agroforestry trials can provide serendipity to answer questions that originally were not considered, such as on climate change and livestock or plant health. Agroforestry trials with large trees do not occur instantaneously but provide opportunities for research not possible with young agroforestry plantings and they are relatively rare. The ash trial planted in Loughgall is among the oldest researched trials in Europe. So, this is the backdrop for the Farm Woodland Forum visit to Loughgall – for some members this was their first visit for others it was a chance to witness changes that have occurred over the years stretching back to an early visit staying in Greenmount College in 1999!



The poplar trial at AFBI

The Farm Woodland Forum group visited the 1999 clonal poplar trial, the 1989 ash tree trial (both with comparable areas of grazed land), a 14-year old clonal timber cherry alley crop and clonal variety trial and a twenty year old oak trial now being used in a comparative trial for finishing bacon pigs, with open grazed paddocks. The poplar trial was originally one of several planted in Great Britain, however they outlived their original purpose after Bryant and May stopped producing matches in the UK. Despite this, poplar has potential as woodland cover in Northern Ireland. There are 4 clones in the trial planted 5 m x 12 m apart, rather than the original idea of 8 m x 8 m, to enable inter row planting, these whittled down based on poplar rust resistance from 12 Belgium clones selected for biomass. Luckily the trees were unaffected by squirrel damage on establishment, possibly due to rising polecat populations. Over the years side branches have been trimmed up twice, which is time consuming, one observation made is that trimmings can be used as fodder. Arable crops were grown in the inter rows as the trees were established, notably spring barley, and experiments were conducted on beneficial effects of growing with clover on the nitrous oxide nutrient balance. Results were compared in Spain, Italy and Northern Ireland. There was interest in growing leeks with a local grower but this didn't proceed. Later grass varieties bred at AFBI were tested in inter row plots to test for shade tolerance. The trial participated in a short rotation willow coppice inter-planting as part of the Agricrop project. Currently the trial is participating in two international trials comparing grazing within the shady alleyways and in the surrounding grassland. The EU Horizon 2020 'Undertrees' project started in 2020 and involves 12 partners in Europe, South America and Africa and AFBI are involved in measuring the balance of carbon and different greenhouse gases in a range of sites including Spain and Italy and trials in the Southern Hemisphere. Animals are identified by tags to measure emissions using a portable system to measure gas fluxes. The sheep selectively graze underneath the trees. They prefer open pasture in the morning, this may be associated with higher sugar content in the grasses. It was observed by attendees that there was more ungrazed grass underneath the trees. The 'Agromix project', involves Cranfield and Coventry University. AFBI Loughgall's contribution is to study the biophysical constraints in silvoarable and grassland trials at 6 European sites including Loughgall, researching the diversity of organisms above- and below-ground. Shotgun metagenomics are being used to identify rare bacteria and viruses that are associated with soil carbon and nitrogen cycling. There was some discussion about the future direction of research linked to the trial, as hybrid poplars do not live for ever; one clone looks as if it may have started to die. However in 2020 trees averaged 22 metres in height. Should the trial reflect on farm harvest in some way? Some members suggested that alternate trees could have been removed to allow remaining trees to increase in size – but this is too late now. Another suggestion was to remove alternate rows. Whatever the outcome, if trees are removed mixed species replanting is recommended - a lesson learnt from ash die back and *Phytophthora ramorum* (the causal organism of Sudden Oak Death) to produce Continuous Cover Forest. Every bit of a polar tree is used in England; one use highlighted was to peel timber for vegetable box production.



We moved on the 1989 ash trials, a comparison between grassland, ash silvopasture and mixed woodland containing ash. Originally the ash was seen as a 'bolt on' to grazing experiments rather than an integral part. Sheep performance started to decline after 12 years due to shade reduction in grass growth. Trees were thinned for the first time and the timber made £900/ha mainly from the base of trees sold for hurling sticks, the rest was sold for firewood. The trial currently has 100 trees/ha reduced from 400 trees/ha at planting. In 2018 there was drought, but the grass continues to grow under the ash trees due to a reduction in evapotranspiration. The shade provided by the trees means the grassland is not waterlogged and extends the length of the grazing season, earlier in the spring and later into the autumn. There is a 12-14 week longer grazing period under trees, 2/3 in the autumn 1/3 in the spring.



Livestock benefits from the shade in hot weather (as with the poplar trial) and this is likely to be more pronounced with climate change and hotter summers. Currently a comparative trial is being run in conjunction with INRA and University of Pisa looking at the strength and welfare of sheep as part of the Agromix project. Texel x Suffolk sheep are here for three



years, in 6 plots with 11 sheep per plot. Blood samples and hair are taken from sheep every 2 months. Cortisol is measured in sheep and cattle in different countries to measure animal welfare and pathology under trees and in the open, taking into account climate models. There was discussion about preventing bark damage by sheep – if one starts chewing bark others will follow! – Fitting ‘Virtual Fence’ collars to sheep may resolve this. This is a Norwegian innovation; boundaries such as bases of trees can be mapped in via GPS and provide an alarm if animals cross the ‘virtual fence line’, thus preventing livestock from chewing the bark. One unexpected development since the trial was the emergence of ash die back in 2012 - it possibly first appeared in 2006. Luckily the trial hasn’t been badly affected, its presence though provided opportunities, at a time when funding for agroforestry had dried up, for a funded project to look at methods of reducing the disease incidents. Out of the three treatments was of extra fertiliser a metre around the base of the trees, thinning of trees and grazing by sheep which would eat the infected plant material. The final treatment was the most significantly effective. Unlike other tree disease, where clear felling has been practised (which would remove valuable shade for animals), a more pragmatic approach is being used with ash die back. This is illustrated by a site at Johnstown Castle in County Wexford where heavily infected trees are moved but lightly infected trees are left – again a diversity of tree species are inter planted to reduce disease pressure. Some ash trees have been sent to Latvia from Ireland (where the pressure of ash tree die back is very high). Only 3% of clones appeared to express levels of tolerance; this does not vary with the tree’s age. So, a combination of close grazing and use of tolerant clones may provide some solutions to reducing the impact of the disease.



We visited the 2009 clonal timber *Prunus avium* bird cherry trials. There were a mixture of German, British and French clones planted in an alley cropping system along with an unselected wild cherry control – which was performing badly in relation to growth and habit. The best performing trees were from Silvoselect in Germany. The alleys had contained a mixture of 5 clonal willows for short rotation coppice to reduce disease pressure with either 1 or 2-metre spacing on either side. Out of these three willow clones performed well, Olaf from Sweden and two EU varieties Beagle and Endeavour. These have now been removed and the alleys could be grazed. The timber cherry trees are pruned to keep a straight stem without knots – as the trees are reluctant to shed their branches, which would cause knots.

They vary in flowering but could be a landscape feature in the spring. When considering the possibility of fruit and timber production, although they produce small fruit, and this varies between clones, discussion suggested it wasn't possible to shake them off the trees. Grazing appears to help reduce the incidence of bacterial canker.



Some warnings – when using herbicide in the spring take care – poplar can sucker and the suckers come into leaf earlier so are susceptible to spray. In addition, black fly can infest trees, but spraying can depress growth of the trees – it would be better to prune infested shoots. Next to this was a block of clonal trials in a much larger variety trial. The AFBI Agro-Forestry research platform is a 14-hectare area including experimental trials. There is funding and grants to maintain and continue research. Ireland has a huge potential for growing cherries. 34 cherry clones are being tested for suitability to grow across Ireland. Trees reach the earliest they could be harvested at 25 years or later at around 35 years of age.



After lunch we went to see a 20-year old oak trial now repurposed for a finishing trial for 21-week old male Hampshire bacon pigs. Groups of 6 pigs spend 12 weeks in paddocks under oak trees thinned to 200 trees per hectare to suit the pig production system. This project funded by DEARA (The Department of Agriculture and Rural Affairs) and DAFM (Department

of Agriculture, Food and Marine), harnesses expertise in agroforestry, forestry, animal science and welfare to investigate the economics and environmental benefits of indoor and outdoor pig production either in grass paddocks or under agroforestry conditions. It appears Waitrose are the only supermarket that use outdoor finishing for pigs. There are 4 plots under the oak trees with 6 pigs per plot 32 x 30.5 metres; these are divided into three with their own drinkers and arks. The pigs spend 4 weeks in each of three adjacent fenced paddocks before being moved on to the next paddock. For the animals health biosecurity is in place and human contact is minimized. Pigs are fed daily an appropriate diet for their stage of growth. Previous to this the pigs are born inside and conditioned to withstand electric fences at 6 weeks of age. The females of the litter are being trialled under indoor conditions.



The pigs outdoors do not have their tails docked as they are less stressed and do not tail bite. Interestingly the pigs do not touch ash seedlings (unlike sheep) and also leave nettles alone. As a comparison other groups of pigs are being finished on similar open grassland paddocks, here they do have a small area of artificial shade and a very wet wallow to cool them down. In addition, groups of pigs are being compared in their 12-week summer finishing period with those finished in winter (Oct/Nov/Dec) when plant growth is slower. The land in the paddocks is grazed by the first batch. The later batch of pigs could benefit in the agroforestry plots from any crop of acorns produced. The original oak trial was influenced by American 'Root Production Methods' research where faster growing trees from larger acorns of white oak were raised in bottomless containers and they identified early flowering and fruiting varieties with high yields. There also appears to be some genetic control for early masting (acorn production) in the Loughgall trials; however, it isn't completely predictable which years will be masting years.





On our return we passed a randomized plot of seedling family groups of field maples which showed remarkable variation in growth – this is part of a ‘Plus Tree’ trial planted in different parts of the UK to select trees for timber production and cross pollinate the best trees. Possibly with a trial plan it would be possible to see family similarities in tree growth.

**Greenmount College Farm - Hedge management and promoting biodiversity and comparing tree guards on grassland farms** *(Bryan Irvine and Nicola Warden)*



Demonstration of different intervals of hedge trimming.

The land is very different here. It is fertile and not well drained, and has been used for long term grazing. It has low biodiversity, typical of many farms, having hedges cut yearly and very few trees - largely ash trees. The college has made significant progress to increase on-farm biodiversity here, and this has risen to 8% (The EU recommend a minimum of 10%); one action has been to plant flower rich strips around minimum till cultivated fields. Hedge management has changed on the farm to increase biodiversity. Internal hedges are now cut

every three years but some hedges are being assessed after 4 years between cuttings. External roadside hedges are cut on the roadside yearly, but the internal sides are not cut for 3-4 years – particularly if livestock are grazing as the livestock browse the hedge. The aim of cutting hedges within the farm in a 1/3 yearly rotation is that you break the cycle of boom and bust flowering and fruiting – basically there are always areas of hedge in flower and fruit each year. In addition, where there are gaps in existing hedgerows; these are being planted with young trees and protected from browsing livestock. Where there are no gaps, hawthorn and blackthorn saplings are being left uncut and allowed to grow into flowering trees. There is a hedge in one of the fields, which visually demonstrates the impact of different hedge cutting regimes for 3-5 years to see how the hedges grow and how they need to be managed.



**Tree guard trial** - The site was established to mimic the agroforestry specification of the agro-environment scheme that was available to farmers at the time; the scheme provided £4 per tree of establishment grant. Five types of guards were used with appropriate stakes and these including geotextile tree guards and two different kinds of tubes made from flimsy plastic (these were the only ones cheap enough to be covered by the grant). The plastic tube guards can fill up with water, drilling holes in them was time consuming but let air in. Cactus guard keep sheep out but they cost £25 a guard. One of the problems is the affect the rough edges at the top of the guards had on damaging the trees. There was discussion about producing a wider shaped guard to prevent damage. To increase the height and width of the guard, two cactus guards could be folded and tied together instead of one guard; this would allow the tree to sway without being damaged on the rough edges of the guard. Unfortunately, sheep can eat the trees through the guards that were made from chicken wire with 3 posts. Five-year old willow poles from Loughgall have also been driven into the ground and these are successfully growing, although the branches are in some cases lax and leaning, raising questions about pruning them back. An unforeseen result of the trial work is the growth of rushes in the moist ground, which were not present before hand.



