Farming Connect Management Exchange

Funded through the Knowledge Transfer, Innovation and Advisory Service programme under the Welsh Government Rural Communities – Rural Development Programme 2014 - 2020

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Biochar Adventures

Ireland: August 2019

UK: September – December 2019

Finland and Sweden – September 2019

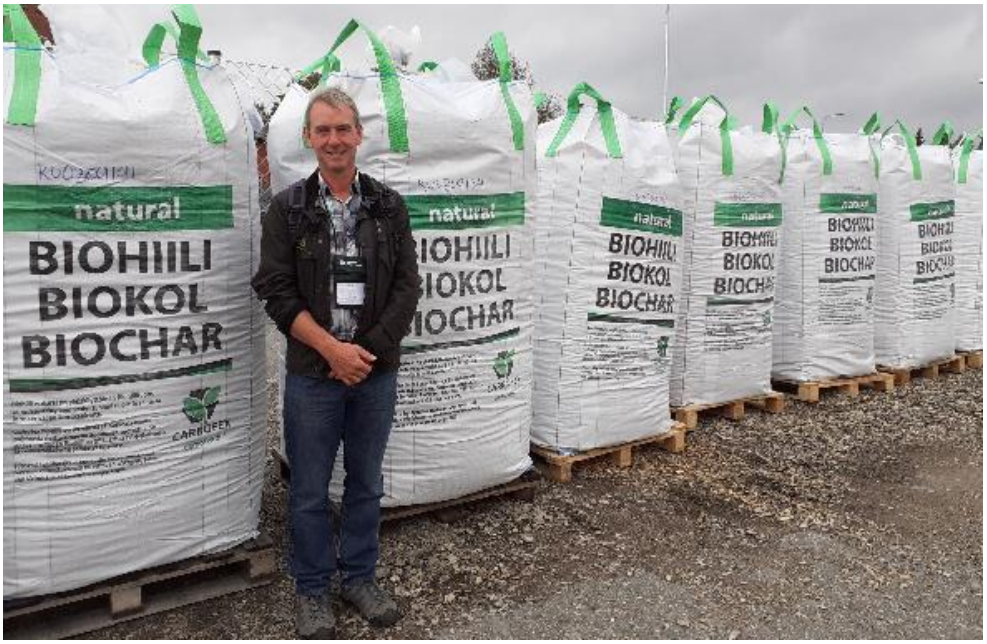

Fig 1. Biochar in Finland

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1 Background

I am the fifth-generation tenant of a 680ha farm in the mountains of mid Wales. Henfron Farm is located in the watershed area of the Elan Valley Reservoirs.

Henfron Farm is located too remotely to be connected to the electricity national grid so renewable energy (solar PV and wind) has been used for decades to reduce the reliance on a diesel generator.

Biomass heating is used to heat the farmhouse and office. I have always been passionate about renewable energy, recycling and reusing waste products.

The farm management focuses on environmental improvements with Organic, Glastir Advanced, SSSI and Woodland Creation environmental agreements. The carbon storing peat bogs and the diverse habitats are managed by a flock of Welsh Mountain sheep and a herd of Dexter cows.

2 Biochar

Biochar is produced by heating biomass materials at temperatures from 300°C to 700°C with limited quantities of oxygen present. Soil with added biochar has improved water and nutrient retention and has potential commercial usage within the market garden and other growing sectors. The carbon rich biochar resists degradation and can lock up carbon in soil for hundreds of years. A method to fight climate change that is not yet being used widely by farmers, is to increase carbon sequestration by using biochar in soil.

Fig 2. Molinia Biochar

I discovered biochar while undertaking a Welsh Government 'Nature Fund Project' to find a sustainable use for the dominant Molinia grass which grows in abundance on the Cambrian Mountains. Removing the Molinia grass improves the biodiversity, decreases fire risk and improves the habitat for golden plover.

An insulated retort is used to heat the Molinia grass, thus producing biochar. Analysis has shown that Molinia biochar has a high carbon content (over 75%) and has the potential for increasing carbon sequestration in soil (Corton, 2015).

Using an Exeter retort, I am already producing and selling biochar in small quantities to gardeners and horticulturists.

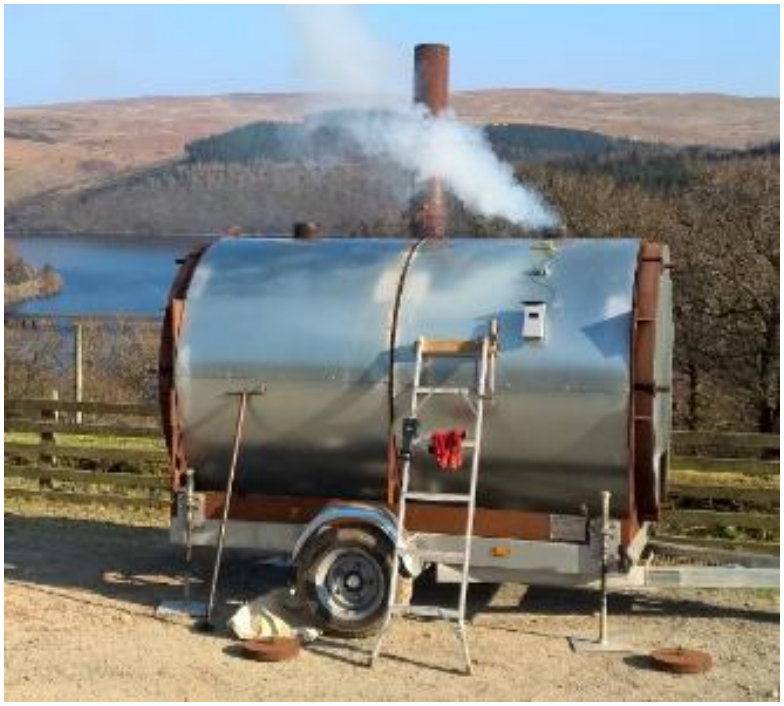


Fig 3. Exeter Biochar retort

3 Travel itinerary

3.1 Ireland

My first trip was to Ireland to attend a ‘Carbon farming and biochar’ workshop near Kilkenny. The workshop was delivered by Mr Albert Bates, a leading biochar expert from the USA and author of several biochar technical books.

The workshop started with a practical burn session using a bowl-shaped hole in the ground. This is a low-tech but useful method of producing biochar in a couple of hours using very little equipment.

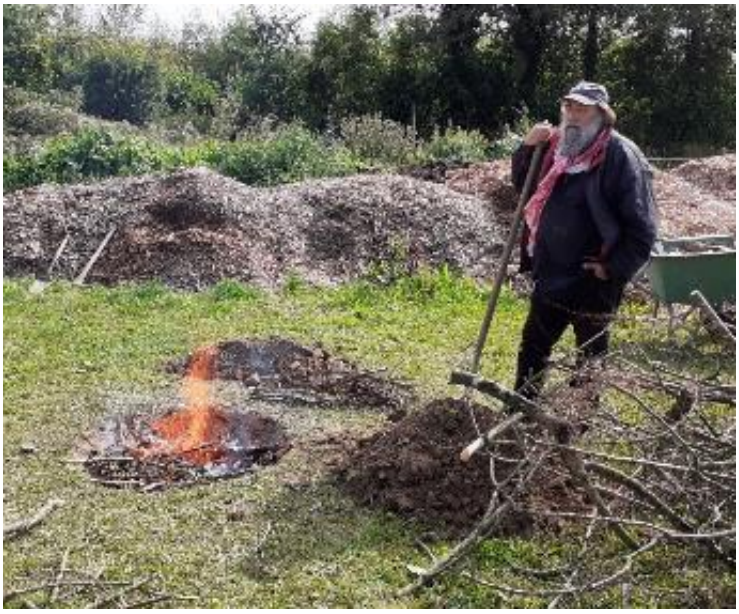


Fig 4. Albert Bates in Ireland

This practical session was followed by a technical presentation with an opportunity to ask Mr Bates questions, which led to a very interesting debate on the various uses of biochar. I became aware that leading figures in the Irish biochar industry were present. Examples of products made from biochar were distributed. These included biochar paper, soap and other building materials.

3.2 Finland

In September, I attended the 'International Biochar Initiative' annual study tour in Finland. With speakers and delegates from 18 countries, this was an unique opportunity to meet biochar experts from around the world.

The study tour started in the capital city, Helsinki, with a conference titled: 'Carbon Sink Trading'. Creating carbon storage is the first stage of trading, and several speakers explained the usefulness of biochar in increasing carbon sequestration in soil. In the Kaindorf region of Austria, farmers are paid to increase the carbon content of their soil (Okoregion Keindorf, 2019). Over a period of five years, farmers aim to increase the soil carbon by 1% and payments are approximately €30 per tonne. Increasing the carbon content by 1% on a 5-hectare field can increase the stored carbon by 250 tonnes.

Calculating the quantities of carbon in the soil is a complex procedure and it is essential that every stage is validated. The final stage is trading the certified carbon credits. There were several presentations explaining carbon trading schemes from several European countries.

A presentation by the Finnish Minister of the Environment and Climate Change, Krista Mikkonen, highlighted to us how Finland were on target to achieve very ambitious decarbonising targets.

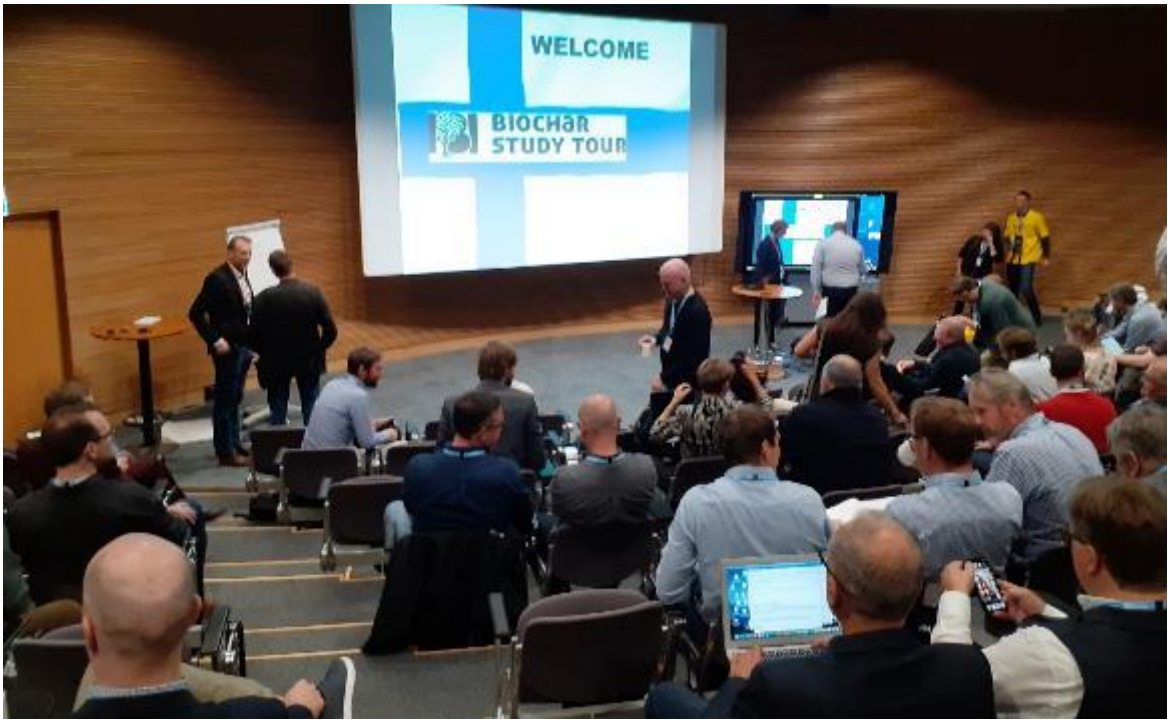


Fig 5. Biochar Study Tour, Helsinki

The study tour then moved inland to Tampere, a city which is mostly heated by a district heating scheme with a total pipe length of over 600km. The majority of the heat is generated from renewable energy sources including biochar production. The focus of the second day was 'biochar production and use'. Speakers from businesses in Finland, Sweden, Germany, Switzerland and Australia explained the challenges of making biochar efficiently and of consistent high quality. Manual methods including the practical 'hole in the ground', as seen in Ireland (page 3), were discussed alongside automated continuous flow pyrolysis retorts. Speakers included manufacturers and users of several different biochar retorts.

The highlight of the trip for me was visiting 'Carbofex', an innovative business owned by entrepreneur Sampo Turkiainen. Carbofex have built and successfully operate the largest continuously operating biochar plant in Europe. The plant produces over 1,000 tonnes of biochar, 600 tonnes of pyrolysis oil and generate up to 7,000 MWh of heat every year from waste wood woodchip. The wood chips are heated at 600–700°C for 5–10 minutes. With a carbon content of over 90%, the biochar is of very high quality.

The Carbofex biochar is sold for use as:

- Removal of nutrients (phosphorous, nitrogen) from industrial and municipal effluents, ponds and lakes
- Growing media
- Building – biochar concrete building materials, vacuum insulation.

Fig 6. Logs ready for chipping and processing into biochar

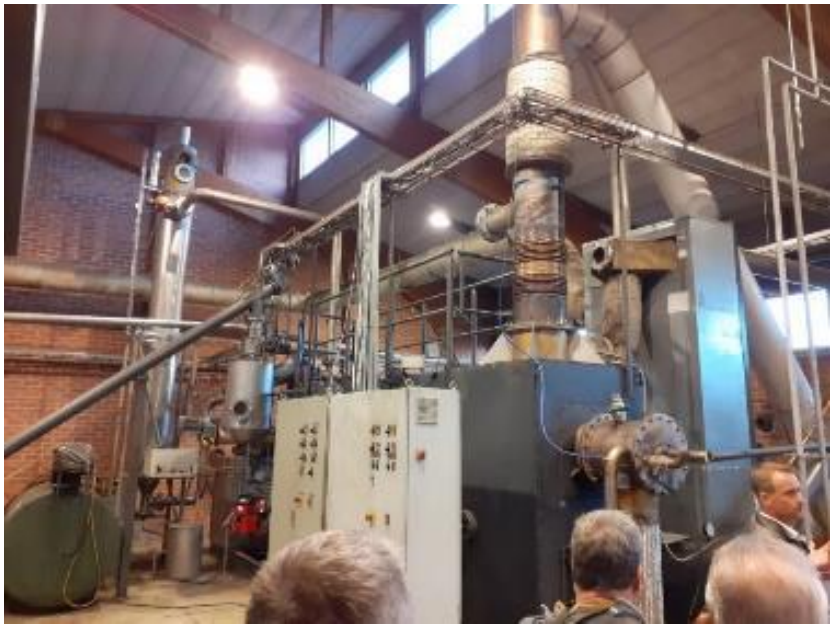


Fig 7. Carbofex Pyrolysis Retort

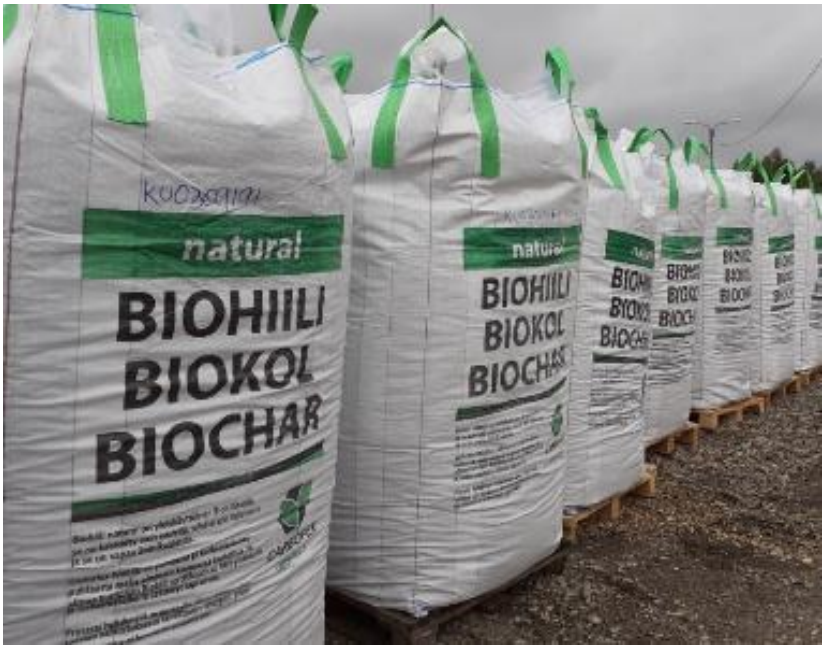
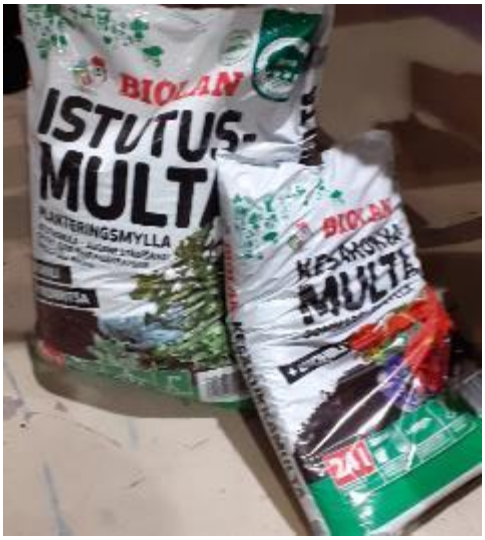


Fig 8. Biochar ready to be loaded and distributed

Several farm-scale biochar producers attended the conference displaying various products.

The following growth boxes are sold with a compost and biochar mix with seeds ready planted (mostly herbs).


Fig 9 and 10. Biochar and compost 'growth boxes'



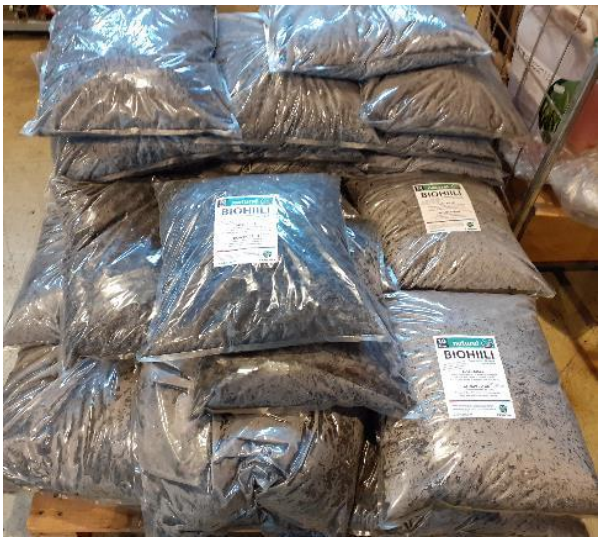


Fig 11 and 12. Biochar-based composts

The third day focused on the urban uses of biochar. The speakers discussed many different uses for biochar, including:

- Humidity bricks and plaster
- Temperature insulation
- Carbon fertiliser/compost, substitute for peat in potting soil
- Water treatment in fish farming
- Decontamination of soil and natural water
- Soil additive for soil remediation
- A barrier preventing pesticides getting into surface water
- Treating pond and lake water
- Waste water and sewage treatment
- Active carbon filter
- Composting toilets
- Cosmetics
- Treatment of drinking water
- Filtration
- Exhaust filter
- Controlling emissions
- Blocking radiation
- Animal feed

The city of Tampere has historically been a paper mill town. Biochar is being used to filter the effluent leaking from old paper mill dump sites, filtering the dirty, contaminated water. The dirty water has to soak through a deep layer of biochar which will be renewed every few years as necessary.

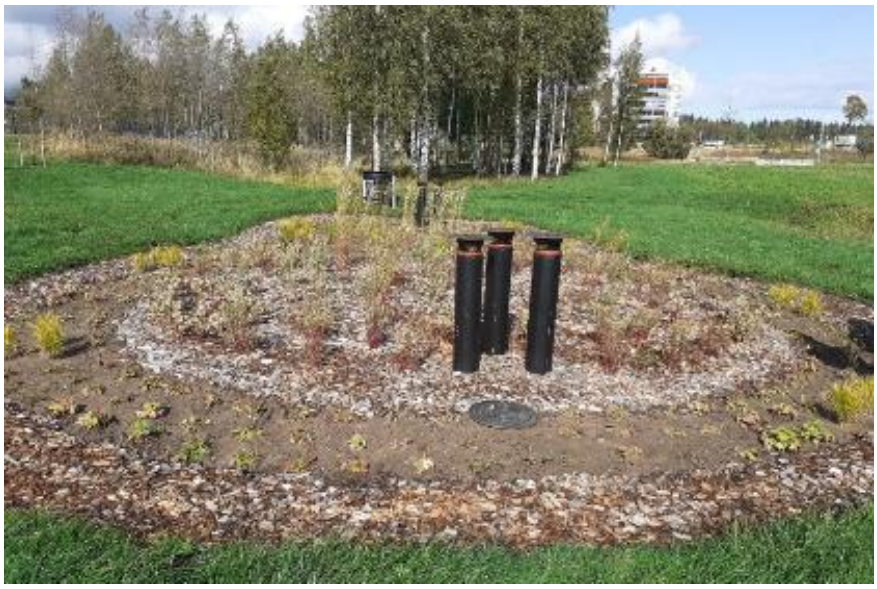


Fig 13. Underground biochar *filter*

3.3 Stockholm

The Stockholm biochar project has focused on converting waste biomass into biochar to use with urban trees. Trees are planted with a biochar mix which increased their survival rates. The underground biochar also filtered the groundwater before it entered water courses.

Fig 14. Stockholm biochar project

3.4 UK

Bangor

In September 2019, I attended the 'Regional development and integration of unused biomass wastes as resources for circular products and economic transformation' (REDIRECT) final conference near Bangor. The conference title was 'Biochar and Biomass Resource use for Resilient Rural Communities'. The EU funded REDIRECT project incorporated partners from 5 European countries: Germany, France, Belgium, Ireland and the UK (Interreg, 2019).

There was a very interesting programme of speakers, demonstrations and workshops. Various biomass materials from several European countries had been processed into biochar with the analysis explained by excellent presentations.

The following image is from one of the presentations.

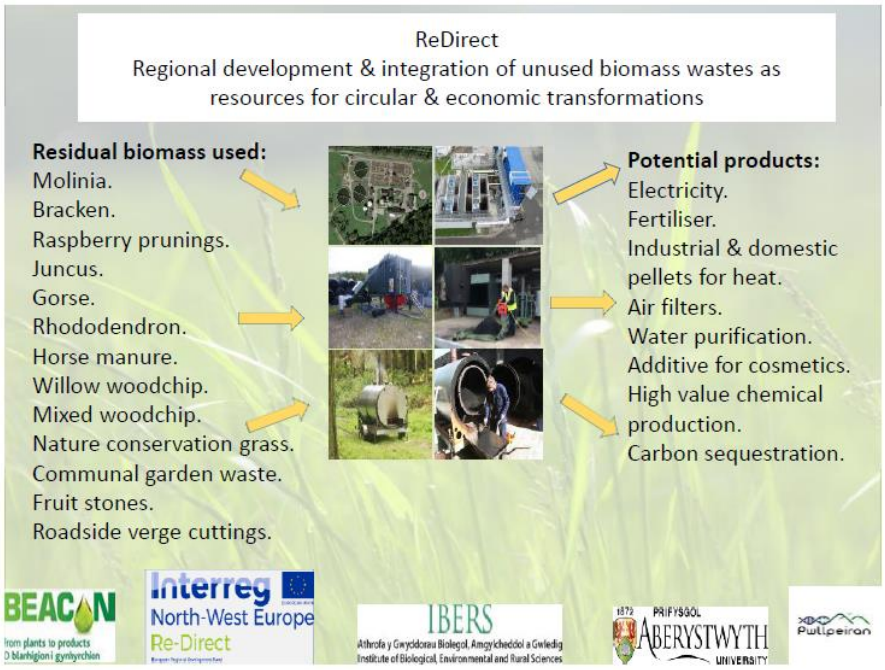


Fig 15. (Roberts, 2019)

The speakers were from Baden Baden, Duisburg-Essen University and the University of Kassel in Germany, the Institute of Biological, Environmental & Rural Sciences (IBERS), Aberystwyth University and the Cwm Harry Land Trust.

Abergavenny

In October 2019, I attended a 'Biochar for soil and health' event in Abergavenny. Donna Udall (Centre for Agroecology, Water and Resilience, Coventry University) expertly explained the complexities, challenges and opportunities associated with biochar. Donna then described a project that was recently completed where cows had biochar included in their diets.

This was followed by a talk from Richard Copley, the farmer who made the biochar and completed the trials. Cattle from his herd were split into two herds. Cows in one herd were fed 300g of biochar per day for 28 days; whilst the others had no change to their diet. Manure samples were collected and analysed from the two herds every other day throughout the trial.

The results showed that the cows that were fed biochar excreted less nitrate in their manure than those that were not fed biochar. This suggested that the cows that were fed biochar had more efficient digestion, although more trials were planned to clarify the exact reasons (Innovative Farmers, 2019).

Lincoln

In November 2019, I travelled to Lincoln to visit Richard Copley on his farm. Richard uses an Exeter Retort (the same as mine) to process waste wood into biochar, which he then processes through a grinder to make it small enough to feed to his cows (Copley, 2019).

In December, Richard travelled to Wales to see my Biochar processing set-up. As Richard also used an Exeter retort, his advice on my procedures was invaluable. Richard also taught me how to estimate the carbon content of biochar by biting and chewing small quantities.

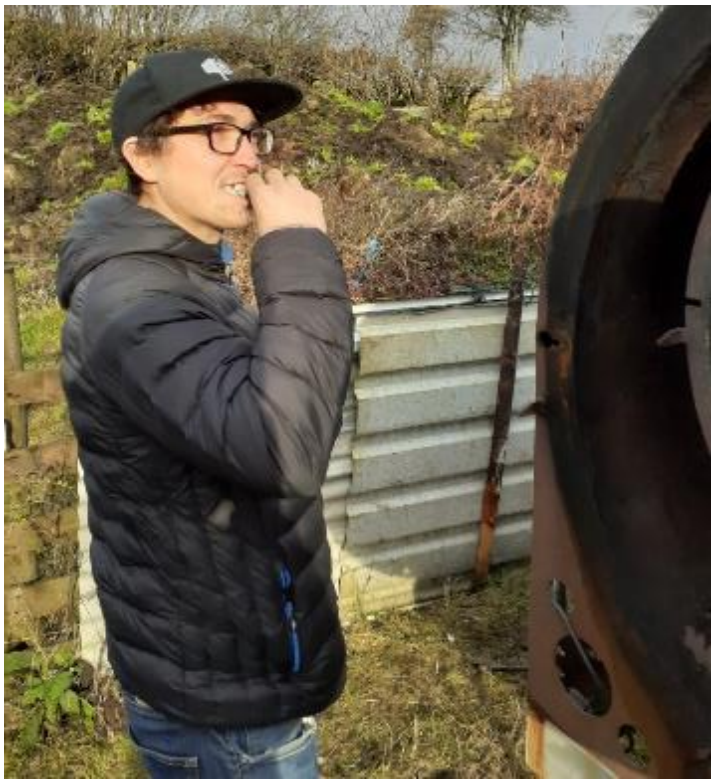


Fig 16. Richard Copley tasting my Biochar!

4 Key Messages to the industry

Biochar has been proven by academics worldwide to be a useful method of increasing carbon sequestration as it resists degradation and can lock up carbon in soil for thousands of years.

Governments are currently focusing on reducing carbon emissions and increasing carbon sequestration, which is mentioned in the recent post-Brexit agriculture scheme consultations. With the right policies and financial incentives, the use of biochar is likely to become more widespread in agriculture, primarily as a method of increasing carbon sequestration.

Agriculture in Wales has a range of waste products which could be utilised for processing into biochar. As well as making biochar for on-farm use, farmers are perfectly placed to produce biochar for use in urban areas.

Although biochar has proven benefits in increasing horticultural and crop yields, it may not be cost effective to use on grassland to increase yield. The organic matter is normally higher on grazed land than cropping land due to the grazing/manuring effect of grazing animals. Waste from grazed farms could be processed into biochar and sold to horticultural farms and possibly mixed with composted animal manure. This is already happening in parts of Europe.

Another potential opportunity for livestock farmers is including biochar in the diet of farm animals. Research studies across Europe have proven beneficial effects in the growth of animals as it possibly improves their digestion. There is research in the early stages at IBERS to measure the methane emissions of sheep which have been fed biochar. Biochar fed to animals would ultimately be passed to the manure and onto the land, creating a carbon cascade effect.

The Management Exchange travel experience has highlighted to me how farmers could do more to utilise waste biomass materials. Farms in Wales could be more self-sufficient in bedding and fuel etc by exploiting the lower quality resources growing on their land.

5 References

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