

Biochar



Biochar represents a potential way to lock up atmospheric carbon in soil for thousands of years. By storing up this carbon it can make a significant contribution to Welsh efforts to reduce climate change and in making Welsh farming systems carbon neutral. In addition to locking-up carbon, biochar may also confer many other benefits to Welsh farmers by improving soil quality and grass nutritional quality. While the benefits of incorporating biochar into soil have been proven in many places around the world there are still too few trials at the national level to enable its recommendation at the policy level.

What is biochar?

Essentially, biochar is just another name for charcoal. It is made from organic materials that are burnt in a reduced oxygen atmosphere by a process called pyrolysis. Common materials used to make biochar include waste wood, green waste, crop residues and biosolids. Unfortunately, waste paper and cardboard make poor feedstocks for making biochar. Biochar can be produced on the farm in simple pyrolysis kilns in small batches (ca. 10-100 t/year) or in large quantities in industrial pyrolysis plants (>1000 t/year). In industrial plants the byproducts (biogas and bio-oil) are normally captured and utilised for energy production. Typically, for every tonne of feedstock entering the pyrolysis process, approximately 50% is converted to biochar.



What is the nature of the problem and can biochar help?

As a nation we need to reduce our carbon footprint. One of the goals of the Welsh Government is to produce carbon neutral farming systems. This will not be achieved by a single route but requires a multi-pronged approach (e.g. reduced use of fossil fuels, improved fertiliser use efficiency, use of renewable energy, enhanced water use efficiency, improved crop varieties, better soil management etc.). In terms of improved soil management, it is crucial that we preserve, and if possible enhance, the storage of carbon in soil organic matter. Long-term trials, however, have recognised that Welsh grasslands are already close to their maximum carbon sequestration potential. If we want to keep topping up carbon in Welsh soils we must therefore find a new way of achieving this. One solution which has been proposed internationally is to apply biochar (charcoal) to soils. From the carbon dating of biochar recovered from shifting cultivation sites in the Amazon rainforest we know that biochar can survive in soils for thousands of years. As this biochar is derived from

vegetation, which itself was derived from CO₂ from the atmosphere, it is seen as a way of offsetting human CO₂ emissions. Before we apply it to soil, however, we have to know that it is safe (i.e. no risk to human and livestock health, crop production or the wider environment) especially as getting it back out of the soil would be virtually impossible. At the moment there is insufficient data from Europe to advocate its use and therefore at present biochar cannot be commercially applied to soil in Wales apart from for research purposes. Ongoing work at a number of Welsh Universities (Bangor, Swansea and Aberystwyth) and the Bangor Centre for Ecology & Hydrology, however, has indicated that biochar may have major benefits over that of just locking up carbon.



What is the current evidence from Wales?

Grassland topsoils in Wales contain approximately 100 t carbon/ha locked up in organic matter. At typical application rates, a single dose of biochar would lock up a further 10-50 t carbon/ha) therefore making a major contribution to enhancing carbon storage (and much more that can be achieved by repeatedly adding manures or composts etc). From a practical perspective the biochar can be added in a powder, pelletised or chip form, however, surface application in a powder form is not

advisable due to the potential for wind erosion and human inhalation. The biochar field trials undertaken in North Wales where biochar was ploughed into the topsoil at rates of 25 and 50 t/ha have shown no negative effects of the biochar on either fodder maize or grass production (Fig. 1). Indeed, biochar actually enhanced grass growth and foliar nitrogen content in comparison to plots not receiving biochar. Whether these positive responses persist in future years remains to be seen. Research in Wales has also shown that biochar may further reduce the environmental impact of agriculture by locking up pesticides preventing their leaching into watercourses. Whilst other studies in Europe have shown that biochar can reduce emissions of N₂O, another potent greenhouse gas released from soil, this still remains unproven in Wales. In conclusion, all the signs are positive that biochar could be used to help in the fight against climate change.

Are there any drawbacks of using biochar?

Unfortunately, one of the biggest drawbacks to the use of commercially produced biochar in Welsh agriculture is the current legislative ban on its application to land. This is likely to last until it can be proven beyond doubt that it has no negative effects on soil quality and land management. As this judgement has to incorporate the long-term effects, a decision may not be made on its use for some years to come. In addition, the source of feedstock materials for producing biochar and the cost of biochar to landowners are also currently difficult to predict. Based on current international pressure it is likely that in the future, biochar may be accountable in carbon trading schemes offering the possibility for payments to farmers for applying biochar.

