Methods

This field lab will investigate these effects and measure the impact on both dairy and beef cattle, and the resultant manure. An initial trial has already looked at the effects on a small group of cows to see if there are any noticeable differences on ammonia production when feeding for a week. The farmer produced his own biochar from native hard and soft woods sourced from his tree surgery business. These woods were pyrolysed in his Exeter Retort, ground to less that 2 mm and bagged into 20 g bags. From the 14th May 2018, the farmer fed 9 heifers 1 bag of biochar every morning for 7 mornings. Manure samples were collected on the 14th (prior to feeding) and every morning thereafter for 9 days, placed in a plastic bag, tied and labelled. It was not noted which cows' samples were collected from. The researcher had collected all samples by day 10.

The samples were stored in a fridge (4°C) until analysis. Four methods of analysis were undertaken; dry weights, ammonia volatilisation and ammonium and nitrate content to establish if the addition of biochar to diet had any effect on these parameters.

Analysis

Dry weights: These were established for all samples by drying in an oven at (80^{o}C) for 24 hours until weight stabilised.

Ammonia volatilisation analysis: 40 g of all samples (4 replicates) were placed in a 250 ml bottles with an acid trap placed in the screw top and sealed. The acid trap comprised of polyurethane foam pre-soaked in a solution of 10% phosphoric acid and glycerol. The acid traps captured any ammonia volatilised off the sample for a period of 24 hours and then 1 week. The foam acid traps where then removed and placed in 100 ml of 2 molar potassium chloride (KCl) solution and shaken for 1 hour. The extract was then filtered through Whatman. No.1 filter paper and analysed in a continuous flow analyser (FOSS Fiastar).

Ammonium content analysis: 20 g of all samples (4 replicates) were placed in 250 ml bottles along with 100ml of 2M KCL. This was then shaken for 1 hour and the extractant filtered through Whatman. No.1. This was then analysed for ammonium in the continuous flow analyser.

Nitrate content analysis: As above but analysed for nitrate in the continuous flow analyser.

Initial results and further trial methods

The results of this trial have given a good indication of the practicalities of the bigger trial. But it was considered that not enough time was given to allow the biochar to have any measurable effect on dry weights, ammonia content and ammonia volatilisation of the manure. It is thought that with a longer feeding / trial period an increasing amount and duration of biochar in the cows' stomach it might act to adsorb ammonium and therefore limit ammonia production from cow pats. This has been suggested in previous research – see background document for full references (Udall, Rayns and Charlesworth; 2017; Shackley et al, 2009).

This longer trial will look at ammonia volatilisation, manure ammonium levels, dry weights and worm burden (using Faecal egg counts).

There are 4 farms taking part which include both beef and dairy. The beef farmer will use a similar methodology to the initial trial, with samples taken from 4 cows twice a week. One dairy farm is able to split his herd on a permanent basis for the winter, and this would allow National Milk Records data to be analysed to see if there are any milk quality and animal health benefits from the use of biochar in the diets. The samples from the dairy herd will be bulked. The manures could then be used to assess the effect of biochar treatment in a controlled trial on grass growth in plot or pot or both. The same analysis will be carried out using the same laboratory methods as the previous one-week trial.

The full trials will begin when cattle have been housed in autumn 2018. Findings from the pilot trial indicated that trial will need to run for at least 56 days to allow for dietary changes to be taken into account.

Samples will be collected every 2 days (or as agreed with farmer). The researcher will then collect these samples and store, as appropriate, until able to perform lab-based analysis. Farmers will assess the cattle for worm burden, using a FECPAK, as agreed with farmer. In Spring 2019 lab-based analysis for ammonia volatilisation on stored samples will be performed.

INNOVATIVE FARMERS
PART OF THE DUCHY FUTURE FARMING PROGRAMME

Innovative Farmers is part of the Duchy Future Farming Programme, funded by the Prince of Wales's Charitable Foundation through the sales of Waitrose Duchy Organic products. The network is backed by a team from LEAF (Linking Environment and Farming), Innovation for Agriculture, the Organic Research Centre and the Soil