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Biochar as a soil amendment positively interacts with nitrogen fertiliser to improve barley yields in the UK

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Introduction: Soil organic carbon (SOC) is vital for sustainable yields, retaining water and nutrients, providing a habitat for soil biota and improving soil structure (Lorenz 2007). SOC is also a major carbon store, containing over twice the total carbon present in the atmosphere. Land Use Change and arable farming practises have already led to a marked reduction in SOC, and with the increased temperatures expected with climate change SOC is likely to fall further (Raich, Potter et al. 2002). Its loss reduces soil fertility and further exacerbates climate change.

Biochar, the use of charcoal as a soil amendment, has been proposed to increase both SOC levels and soil fertility.

Biochar has two key properties:

1. **a high affinity to nutrients and water**, reducing onsite nutrient loss and offsite pollution from nutrient leaching
2. **a long residence time.** Unlike soil amendments such as compost/manure biochar has a half life of up to several centuries (Lehmann, Gaunt et al. 2006)

The long residence time has lead to biochar's promotion for carbon sequestration, as it solves the lack of permanence problem that plagues most other (non-geological) carbon capture and storage programmes, for example afforestation. But before biochar can be widely taken up it is essential that its impacts on arable cropping are understood. To date there has been almost no work looking at the use of biochar in temperate agriculture.

Aim: To investigate the impacts of different rates of biochar on cereal growth within temperate agriculture, and specifically the interaction of biochar and nitrogen fertiliser.

Methods: In 2008 a semi-randomised block design was established using spring barley on light land with five levels of biochar (0, 5 10, 20 and 50 t/ha) and 5 levels of N (ammonium nitrate) fertiliser (0, 25, 50, 70 and 100 kgN/ha). Each biochar level was tested against each N level, giving 25 treatments. Each treatment was repeated 5 times. Other nutrients were supersaturated on all plots. Results were analysed using ANOVA in R.

Results and Conclusions: Interestingly the results showed no significant effect of yield for biochar alone, but do show a significant interaction ($p = 0.055$) between biochar and N fertiliser. Biochar appears to increase the nitrogen use efficiency. In this site the addition of 50t/ha of biochar increased the total yield by c. 30% when high levels of N were used.

A likely explanation for the lack of effect from biochar alone on yield is that one of the most important attributes of biochar – its ability to retain water – was not tested as the 2008 growing season was exceptionally wet, so water was unlikely to have been a limiting factor.

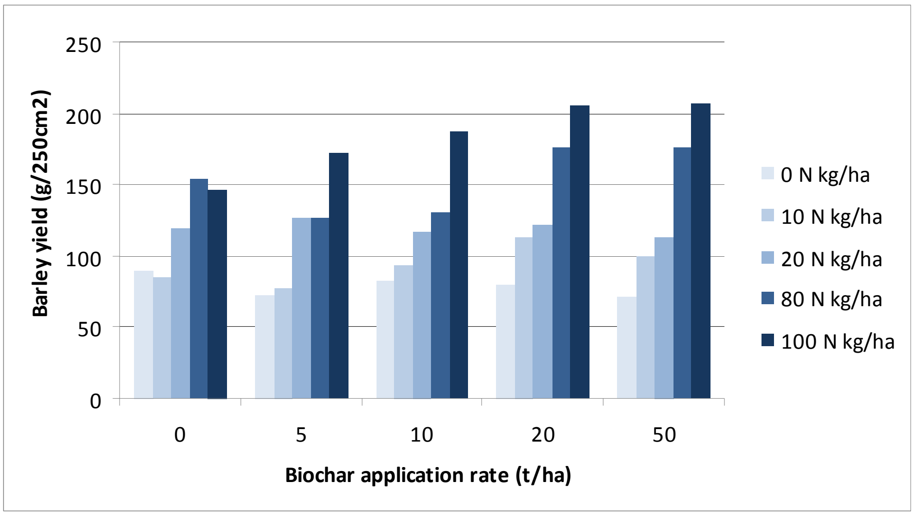

Figure 1. The effect of different levels of biochar, N fertiliser, and their interactions on barley yield

In addition to the onsite experiment, an economic model is being developed to see which price mechanisms, if any, are required to encourage farmers to use biochar as a regular soil amendment.

Conclusion: These results demonstrate that biochar can have an important role in addressing climate change through carbon sequestration and increased nitrogen use efficiency, and at the same time improving yields and food security.

It is hoped that through its high affinity to nutrients and water biochar can help to buffer climatic variability and reduce the need for fertiliser inputs. Thus biochar could both adapt agriculture to, and mitigate it from, climate change.

List of References

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