Report on the 2015 trials of the CCm carbon-capture product on the growth and productivity of crops

For:
CCm Research Ltd
Centre for Innovation and Enterprise
Begbroke Science Park
Begbroke Hill
Woodstock Road
Oxford OX5 1PF

Summary

In a replicated block trial the CCm product demonstrated a promotion of grass production virtually identical to that seen with a commercial N fertilizer. In a farm scale trial the CCm product showed useful yield benefits in three different cereal crops.

Philip John
Professor Emeritus
School of Biological Sciences
University of Reading

6 Chalfont Road
Oxford OX2 6TH
01865 552757
0786 1054464
p.john@reading.ac.uk
http://www.reading.ac.uk/biologicalsciences/about/biosci-ecoevostaff.aspx

In 2015 two trials of the CCm carbon capture product were carried out. One at the Royal Agricultural University (RAU) on established grassland at their trial site in Gloucestershire, and the other on three different cereal crops on a West Oxfordshire Farm (WOF) and at Harper Adams University trial sites in Shropshire (HA).

RAU Trials on Grassland

1. Overall the document produced by the RAU "*Report on the effect of a potential new fertiliser product on the growth and productivity of a grass crop*" (Report No: BDC/R/637, 5 November 2015) provides a clear and unambiguous demonstration of the effectiveness of the CCm product as a N fertilizer on an established grass sward.
2. The trial was organised as a randomised block design with three replicates each with five rates of CCm product application, providing the equivalent of 15, 30, 60, 90 and 120 KgN/ha. Additional replicated blocks remained either untreated or treated with a commercial fertilizer, Nitram, at the rate of 60 kgN/ha. The plots measured 8.5 x 5 m, and were treated on 28 May.
3. Chlorophyll is a sensitive indicator of the N status of a crop, and measurements made with a "point-and-shoot" technology showed that treatments with the CCm product significantly enhanced the relative chlorophyll index of the plots. There is inevitably some scatter in the data given the variability within a grass sward, but taken together the data from 7 different dates stretching from just 7 days after treatment (DAT) to 54 DAT (pp 8, 15) show a linear response between greenness and rate of application of the CCm product; the response to Nitram was no different from that of the CCm product.
4. The yield of grass was measured by weighing cuttings taken on six occasions over the 98 day period after application. There is a positive relationship between yield and the rate at which CCm product was applied (p 18) throughout the season. There is a particularly convincing linear relationship to be seen when the total dry weight of grass harvested 98 DAT (3 September) is plotted against the rate of CCm product application (p 9); again the yield obtained with Nitram falls precisely on the line obtained with the CCm product. When the CCm product was applied at the maximum rate for these trials (120 kgN/ha) it gave an almost 50% increase in accumulative yield. There is a trivial error on p 18 where FW is given for the yield on 29 June (33 DAT) when it should read DW.
5. The benefit of the applications of CCm product is seen in a very useful way from the aerial image of the trial site provided by photography from a low flying drone (pp 9, 10). The plots that appear by eye greener (p 9) and darker when the green channel is selected (p 10) are the central plots that have received CCm product at 60, 90 and 120 kgN/ha. This subjective assessment is consistent with the data presented in the graph where mean green channel pixel level is plotted against rate of application (p 10), the lightest values here being the greenest (p 11).
6. Measurements of the root mass in the first 100 mm of soil depth (p 11) indicate that there may well be a beneficial effect of the CCm product, but the variability between samples does not allow for a statistically significant conclusion. Such variability is expected in a heterogeneous medium such as an established grass sward, and again an enhanced root development might have been expected given that when the CCm product was applied above ground growth increased.
7. The CCm product supplies C as well as N. However when the top 100 mm layer of soil was sampled 127 DAT (1 October) there were no statistically significant increases in soil C and soil N with application of the CCm product (p 12).The commercial fertilizer likewise failed to increase soil C and N. There is a trivial error in Figure 10 where the vertical axis is labelled C% instead of the intended N%. Presumably the simplest reason for the lack of any increase in soil C is that in an established sward soil levels of C

would be sufficiently high not to be affected by the CCm product applications. It is known that in grassland *“soil C changes very slowly, and there is a huge pool of C within soils which can ‘mask’ the effect of any management changes. It can therefore be several years before any changes from the practices employed can be confirmed and then widely adopted “* (http://www.fcrn.org.uk/sites/default/files/FCRN_SoilCarbon_summary_0.pdf). Regarding the lack of any effect on soil N, then it may be that by the relatively late sampling date (1 October) the supplied N had been exhausted by the growth of the grass.

8. **The overall conclusion of the RAU trial (p 13)** ***“that the CCm product demonstrated a promotion of grass production in an entirely similar way to that which would have been expected from commercial products”*** **is fully justified by the results presented.**

The West Oxfordshire Farm (WOF) and Harper Adams (HA) Cereal Trials

1. The cereal trials were carried out on plots of at least 2 ha, and showed that yields were enhanced compared with Nitram applications on the same day at a similar N level as follows: winter wheat (WOF) 6.3%, (HA) 3.2%; winter barley (HA) 2.6%; spring barley (WOF) 1.4%. This trial is of limited scope, but taken together the uniformity of the positive responses indicates that the CCm product provides useful yield benefits in a variety of cereal crops; and, as a source of N, the CCm product is comparable to a commercial fertilizer, but may have additional benefits above the provision of N.

Some Pointers regarding Future Trials

1. The 2015 trials have established that the CCm product functions as a useful supplier of N to grazed grassland and to a variety of cereals. The trials were not designed to explore the extent of any other agronomic benefits that might come from its application.
2. The CCm product supplies C in the form of reduced C in organic material such as undigested fibre from anaerobic digestion processes, and inorganic C in the form of carbonate from carbon-capture.
3. There is a basis for arguing that the organic C could have a positive agronomic response. It would contribute to the soil humus with yield benefits observable under conditions where soil humus was a limiting factor: grassland normally has a high soil C content and would not be expected to benefit; while a soil that was out of condition for example due to continuous arable cropping might provide a more useful medium for demonstrating the potential benefits of the CCm product.
4. It is less obvious how the carbonate content of the CCm product might have potential agronomic benefits, other than helping to neutralise soil acidity. Carbon dioxide is known to enhance root growth including root hair growth, but this happens through the carbon dioxide captured by photosynthesis and a direct effect of carbon dioxide on root growth has not been established. Furthermore the quantitative contribution of the carbon dioxide/carbonate coming from the CCm product is not likely to be significant compared with that available from the soil itself, although that would very much depend on the pH and other physical and chemical characteristics of the soil to which it is applied.