CENTRE FOR HIGH CARBON CAPTURE CROPPING

INSIGHTS

The newsletter of the Centre of High Carbon Capture Cropping **January 2024**

Editorial: Gaining momentum

Stuart Knight, NIAB, CHCx3 Knowledge Hub Leader

Welcome to the second edition of CHCx3 Insights, the newsletter of the Centre for High Carbon Capture Cropping, or 'CHCx3' for short.

On 20 September 2023, the Prime Minister recommitted the UK to achieving Net Zero by 2050. Meanwhile, the goal for UK Farming is still to reach this milestone ten years earlier. Huge strides are required over the next two decades to reduce net greenhouse gas emissions and increase carbon capture. Not to mention maintaining the productive, profitable, and resilient cropping systems needed to supply enough food, feed, forage, fibre, and biomass, whilst continuing to reduce the negative and enhance the positive impacts that farming can have on the environment.

Since our project started in April, the CHCx3 Partners have been busy in the lab, in the field, and in the workshop, exploring the potential for rotational cover crops, annual fibre crops, herbal leys and perennial cereals, and perennial biomass crops, to help accelerate progress to Net Zero.

We have also been growing our community of growers, agronomists, scientists, plant breeders, crop processors, product manufacturers, and environment and policy stakeholders, all with an interest in high carbon capture cropping. If you are interested in getting more involved in CHCx3 research, events, or have a suggestion as to how else we can support carbon capture cropping, please do get in touch. Our contact details are provided on the last page of this newsletter.

In this edition of Insights, Professor Peter Ball of the University of York gives his viewpoint on the opportunity to exploit innovative thinking across agrifood and biorenewables value chains. NIAB's Dr Nathan Morris outlines new field studies to investigate how rotational cover crops could increase soil organic carbon and growing system resilience, and Ian Wilkinson of Cotswold Seeds describes field trials evaluating the benefits of multi-species herbal leys for crop productivity and carbon capture. In 'News from the Hub' we highlight new developments in carbon capture cropping from CHCx3 and elsewhere. We hear from Cambridgeshire farmer Luke Palmer on how he is exploring new cropping options to enhance carbon capture, and from the Biorenewables Development Centre and Unyte Hemp on the work they are leading on Value Chains and Industrial Hemp respectively within the Project.

Viewpoint

Peter Ball, University of York

Opportunity for suppliers, growers and processors to exploit value across supply chains

The CHCx3 project is a unique and timely opportunity to exploit the innovative thinking in our agrifood supply chains to maximise value for business and environmental benefit. Most in the agricultural and industrial systems now see environmental impact reduction as a business opportunity rather than a trade-off. The next stage of this journey is to exploit the leading thinking of the CHCx3 partners to demonstrate more widely that we can move beyond achieving impact reduction to engaging in profitable, net positive, regenerative behaviours. Lydia Smith and Heather Oldfield both put this at the forefront of their introductions in the last newsletter talking about atmospheric CO2 reduction, sustainable farming and health improvement in the widest sense, including profitability.

The unique opportunity is brought about by our current partners and by who subsequently engages with us. Having the diversity of those across the entire value chain is essential. We need the diverse mix to be able to address the 'wicked problems' that we are faced with. In academia we might call this interdisciplinarity. It's easier to call it common sense. By looking at things as a bigger picture or 'system', we can see how we can improve overall quickly together, rather than incrementally individually . We need to understand the needs and ambitions of all those from seed suppliers through to growers through to processors and, say, builders to become transformative.

I'm working with the Biorenewables Development Centre (BDC) in York in the Crop and Process Development Team. Here we consider the entire life cycle and in doing so capture the value chain. We prefer the term value chain to supply chain as the name supply chain can imply a simplistic, transactional interaction. Value chain can capture the bigger picture and brings the focus on value, whether it's value to our businesses or the environment. There is often more value that individual businesses can capture than initially meets the eye.

One recent CHCx3 event I really enjoyed was during Agri-Tech week in November 2023. The crops to products and building value-chains event brought different businesses together to showcase how we can create data informed, net positive, regenerative and profitable opportunities within new value chains. The hemp value chain workshop that immediately followed showed the collaborative opportunities as well as challenges to overcome. Win-win opportunities for business and environment will continue to come from this project in the months and years ahead.

CHCx3 Research in Focus

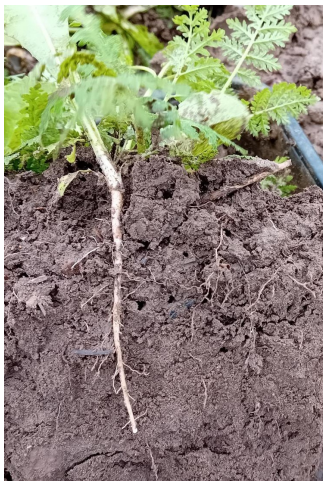
Nathan Morris, NIAB

Utilising cover crops to improve soil health and increase carbon capture

Cover crops are grown primarily for the purpose of 'protecting or improving' soils between periods of regular crop production. An AHDB review defined that there are four main types of use including; improving soil fertility, improving soil structure, managing weeds and pests and environmental management (White et al, 2016). The most appropriate cover crop species/management will depend on what the grower wants to achieve from the cover crop. A 38-month AHDB project characterised the performance of a range of cover crop species, providing new data on the depth of rooting and rooting density from different cover crop species and mixes (Bhogal et al., 2020). Findings from this report found that the rye cover crop produced the greatest amount of roots, both early in the season and at destruction. Phacelia roots were slower to develop, but by destruction had a high root mass particularly in the topsoil. Phacelia was also found to have a high specific root length, or SRL, (length of root in metres per unit of root biomass in grams), suggesting it explored more of the soil for a given root biomass.

Many of the benefits from the inclusion of cover crops, are likely to come after repeated cycles of using cover crops, particularly around improvements in soil structure and increasing the soil organic matter in the soil. Therefore, The New Farming Systems (NFS) project was set up in 2007 and is on-going with support from The Morley Agricultural Foundation (TMAF) and the JC Mann Trust. The NFS experiment is located in Morley, Norfolk on a medium sandy loam soil. It is a fully replicated randomised design exploring novel approaches to cover cropping across rotations.

As part of CHCx3 Work package 2 (Cover crops and cultivations) field trials containing a number of cover crop mixes have been established at NIAB, Morley (established into the long-running New Farming Systems study in autumn 2023). At Morley, cover crop mixes chosen include ribgrass (plantain), chicory and phacelia to aid soil structuring with their deep root system. A more diverse, legume mix containing six species (buckwheat, black oats, yellow trefoil, lucerne, vetch and forage pea) will look at building fertility and enhancing soil health. Finally, a white clover has been re-established to be intercropped with combinable crops to aid soil health and build fertility. These will be assessed for agronomic aspects including crop establishment and grain yield, as well as above and below-ground biomass and the impacts on soil structure e.g. bulk density and VESS, and soil organic matter (and therefore carbon) content, over the duration of the 4-year project.



References

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- White, C.A., Holmes, H.F., Morris, N.L. and Stobart, R.M. (2016) A review of the benefits, optimal crop management practices and knowledge gaps associated with different cover crop species. AHDB Research Review No. 90.

Jed Soleiman, Cotswold Seeds

Breaking ground: The quest to understand the carbon potential of herbal leys

On a crisp winter morning, myself and some members of the Cotswold Seeds and FarmED team bundled up in layers to embark on the first step of our research journey to understand the possible contribution of herbal ley systems to carbon sequestration and storage. Herbal leys have been chosen due to their extensive root systems. Assisted by Rachel and Jade, we delved (literally) into the depths of our research plots; the herbal leys at FarmED in Oxfordshire and at Hinxton in Cambridgeshire. Despite the muddy terrain, spirits were high as we navigated through the challenges of the chilly day ahead.

To ensure scientific rigour and robustness, we conducted the same battery of tests at both sites. The first order of business was baseline soil sampling. Armed with augers and plastic trays, we hammered down to 90cm, sectioning and pooling many soil samples into 0-30, 30-60, and 60-90cm increments. This approach ensured that our samples were not just accurate but also representative of these different depths. As the soil clung to our boots, we also performed bulk density sampling at 0-30 and 30-60cm depths, capturing further nuances of the physio-chemical soil composition.

In pursuit of the most comprehensive understanding possible only using relatively simple tools, we expanded our baseline to include VESS scoring, aiming to unravel the intricate details of the soil structure. Worm counts added a further biological layer to our investigation, offering an initial glimpse into this hidden ecosystem. Understanding that the key to reliable results lies in strategic, repeated sampling, we repeated each of these measurements at various locations within the field. This approach ensures that our results are not only accurate but also representative of the heterogenous nature of soil.

Armed with a treasure trove of freshly collected soil samples, we eagerly sent them off to the laboratory at Yara Analytical Services for testing. The analyses promise to yield valuable insights into the soil's composition and health with comparable tests across all field sites.

What's at stake? The results from these tests will play a pivotal role in understanding the unlocking of possible carbon capture within herbal ley systems. By performing these tests at the beginning of the experiment, we can compare these results with samples taken later to accurately test and account for change to interpret the impact of the leys on the soil system. As we await the first results and the end of winter for the leys to take off, our journey into this promising novel system has just begun. Stay tuned for results that could hopefully pave the way for a more regenerative and resilient agricultural future.

News From the Hub

Cover Crops in the US

According to a recent article reported by the Independent (2 November 2023), many farmers in the US are wary of planting cover crops as they fear growing them will reduce the yield and profitability of the following crop. This is despite cover crops being identified as their number one option to improve soil health, enhance the environment and tackle climate change. A study published in November 2022 in the journal Global Change Biology used satellite data to analyse maize and soybean yields from over 90,000 fields across six states in the US Corn Belt. The researchers estimated the yield loss from using cover crops for 3 years or more at 5.5% for maize and 3.5% for soybean. The size of yield loss was affected by several factors, but for both crops was larger for fields where spring rainfall was lower. However, it was noted that the most frequently used cover crop rye (due to its lower cost and suitability to a wide range of soils) was especially prone to reducing yields. The study concluded that cover crop management needed to be improved to reduce the yield impact and encourage more widespread uptake, with the associated benefits for water quality, erosion reduction and carbon capture in the soil.

Research shows Miscanthus stabilises flooded soils

The low input, carbon negative crop Miscanthus is hailed a robust diversification option for an arable or mixed enterprise. Research shows that it not only thrives on waterlogged land, but it also helps to stabilise flooded soils.

Results of a study from the Institute of Biological Environmental and Rural Sciences (IBERS) at Aberystwyth University in 2019 concluded that Miscanthus can grow well in waterlogged and flood-prone areas. It also provides much needed soil stability, and crop yield is not affected by excess water.

According to the leading author in the study, Dr Jason Kam, crop quality is not compromised by flooding. “There is no significant difference in yield and other physiological development. Observed height and tiller number have no differences between winter flooded and non-flooded ground. “Because of Miscanthus’ perennial nature, annual planting is not needed. This therefore reduces soil disturbance to a minimum,” he says. “The structure of Miscanthus rhizome and root helps to stabilise soils, making it more resilient against flood-caused soil erosion,” adds Jason.

Fixing Australia's approach to soil carbon credits

A group of agricultural and soil scientists from Universities across Australia have challenged the way in which credits are being awarded for soil carbon sequestration under the Australian carbon credit units scheme. Carbon credits are an important part of Australia's plan to achieve Net Zero by 2050. According to an article published on The Conversation (29 September 2023), credits are being awarded for net increases in soil organic carbon associated with seasonal conditions, for example following a wet season and good plant growth, rather than management changes. Sequestration rates may therefore be overinflated, and recorded increases could be reversed in warmer, drier seasons as carbon is lost. The article calls for data to be made available by the scheme regulator to enable the calculation method to be verified, and for it to be revised such that only increases due to crop/land management are credited, citing Verra in the international voluntary carbon market as an example of a methodology that seeks to minimise credited increases associated with rainfall.

Barriers to industrial hemp use

For many years, the NFU has lobbied for better regulation and promotion of industrial hemp as a versatile non-food break crop which remains unfairly stigmatised and held back by the disproportionate administrative burden of Home Office licensing, last reviewed in 2009. Hemp-based building, construction and manufacturing products as well as packaging, protein and food products, could all contribute towards improved productivity in arable rotations as well as the bio-economy, helping to move UK agriculture down the path to net zero. The NFU strongly supports opportunities for farmers to supply a variety of bio-based materials that capture carbon and/or displace fossil-fuel alternatives – whether derived from livestock (wool, leather) or crops (hemp, flax, straw bales). Hemp offers a good low-input break crop alternative to legumes or oilseed rape; fast-growing, it quickly forms a dense canopy which suppresses weeds. However, UK processors and off-takers have come and gone, and the total planted area in Britain remains modest. Every few years, there appears to be a softening of regulatory attitudes towards industrial fibre hemp but our principal ask is for a simpler, streamlined and fit-for-purpose licensing scheme, administered by government officials who understand farmers' needs.

Meet the CHCx3 Partners

Jamie Bartley, Unyte Hemp

Lead partner for the CHCx3 Fibre Crops workstream

Unyte Hemp, a trailblazing company in sustainable construction, is making significant strides in revolutionising the building industry with eco-friendly materials. Central to their mission is leveraging hemp, a renewable resource with considerable ecological and economic benefits. This commitment aligns with circular economy principles and sustainability, underpinning their innovative approach to construction.

A key component of Unyte Hemp's strategy is the development of hemp-based materials. Notably, their hempcrete, a bio-composite made from hemp's woody fibres and a lime-based binder, stands out for its thermal insulation, humidity regulation, and fire resistance. This material's production not only reduces the carbon footprint but also contributes to carbon sequestration, harnessing hemp's natural ability to absorb CO2.

Significantly, Unyte Hemp is advancing in scaling the UK supply chain through their venture, Unyte Bio-construct. This initiative aims to expand the availability and use of hemp-based construction materials, enhancing the industry's capacity for sustainable building practices. Unyte Bio-construct represents a critical step in increasing the reach and impact of hemp in construction, contributing substantially to the sector's sustainability.

Furthermore, Unyte Hemp champions the use of hemp in retrofitting projects, a key strategy in reducing the carbon footprint of existing structures. By integrating hemp materials in retrofitting, they not only improve buildings' energy efficiency but also drive forward the goal of net-zero emissions.

In summary, Unyte Hemp's innovative approach and the development of Unyte Bio-construct are pivotal in transforming the construction industry. Their efforts contribute immensely to the global movement towards sustainable development and the pursuit of net-zero objectives. As a partner, Unyte Hemp offers invaluable expertise and a shared vision for a more sustainable future in construction.

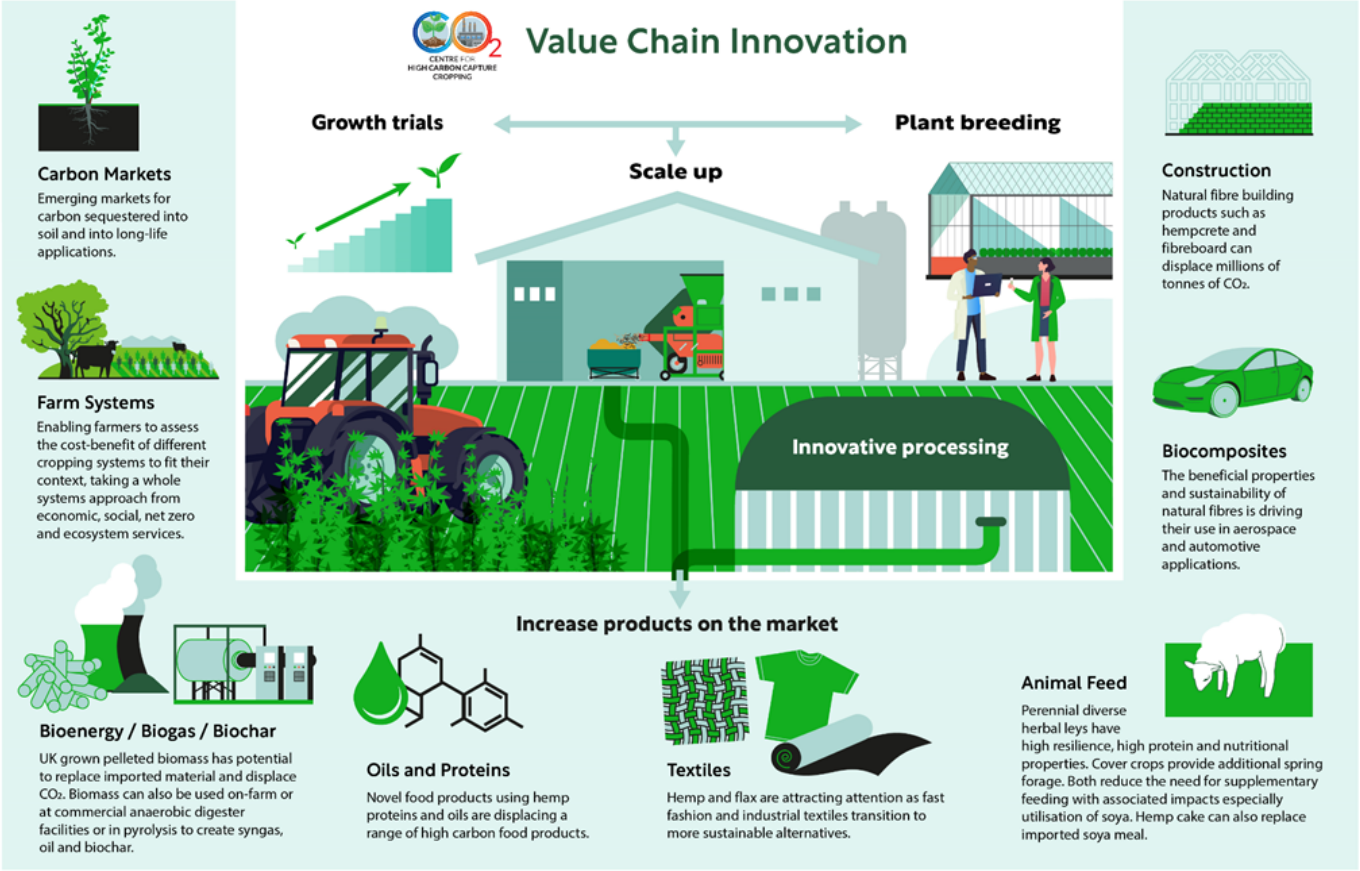
Biorenewables Development Centre

Lead partner for the CHCx3 Value Chain Mapping and Evaluation workstream

The Biorenewables Development Centre - a subsidiary of the University of York - is an open-access Research, Development and Demonstration centre working at the interface between academia and industry to develop, scale-up and help commercialise high-value biobased products and processes.

Covering a broad spectrum of biorefining processes and technologies - from feedstock assessment to product evaluation, the multidisciplinary team of biologists, chemists and innovation advisors specialise in making the most out of biorenewable materials. The BDC's strength lies in advancing laboratory scale processing to pilot-scale to demonstrate commercial viability at a scale from 1-100 litre or 1-100kg. Businesses can also access support with market research and customer discovery to establish value across their supply chains, as well as connections to build collaborations within the wider bioeconomy.

As a partner in the CHCx3 project, the BDC leads the value chain mapping and evaluation work with specialist guidance from Professor Peter Ball, University of York's School of Business and Society, and from Lukie Tolhurst, associate at Lucid Insight, author of the UK Grown Report for High-Value Biorenewables. Together they will map and evaluate the supply chain opportunities and challenges across the four crop-to-product value chains. They will also develop guidance on Life Cycle Assessment (LCA) to measure and evaluate the carbon emissions and wider environmental impacts of the value streams.



Research partners at the University of York's Centre for Novel Agricultural Products and seed supply partners at Elsoms are undertaking research trials to improve the genomics of hemp seed and fibre crops to bring further processing benefits to develop enhanced single and dual crop industrial hemp varieties.

Project partners, the University of York and the Biorenewables Development Centre are both part of the BioYorkshire initiative with bold ambitions to transform York and North Yorkshire into a national centre of excellence for manufacturing and research in the Bioeconomy. BioYorkshire will accelerate the translation and application of research discoveries into full-scale biotechnology applications. It will include a world class science base to deliver the profitable bio-based production of chemicals, materials, and fuels. The project will also support net-zero food production, farming and wider land use practices. The programme - an innovative public-private partnership includes Fera Science, Askham Bryan College and a range of private sector partners.

In the Field

Luke Palmer

FC Palmers & Sons

Luke has been working on the FC Palmer & Sons Farm since 2000. The farm is located north of Cambridge on the Fens with organic soil. When his father purchased the farm in 1989, it was 1000 acres (400 ha). Since taking over the farm, the business has "massively diversified" says Luke. The farm is now 4,000 acres (1,600ha), with a varied crop rotation including wheat, barley, beans, peas, potatoes and sugar beet. . To increase resilience, there are 250 acres of solar panels and some of the land is rented out to other growers.

In the first year of the project, Luke grew six varieties of industrial hemp. For 2024, the fibre crop trial on Luke's land is increasing to 30 acres of industrial hemp and 8 acres of flax. Luke wants to understand the historic synergy between fibre crops and the Fens as they were previously grown in large numbers. Luke adds that he is "looking for a different crop to grow on the Fens to spread the risk to his farm". Luke joined the project to understand how we can "mitigate the CO2 being released from the Fens through different cropping options". Furthermore, as a part of the UK Flux Tower Network Luke has a Greenhouse Gas Flux tower on the field where we are conducting the hemp and flax trial.

Get Involved

Contact us at **chcx3@niab.com**

Visit our web pages **Carboncapturecropping.com**

Find out more from one of the CHCx3 Partners:

NIAB, Biorenewables Development Centre, British Hemp Alliance, Cotswold Seeds, Crops for Energy, Elsoms Seeds, Energy Crops Consultancy, English Fine Cottons, FarmED, F C Palmer & Sons, National Farmers Union of England & Wales (NFU), Natural Building Systems, Northern Ireland Hemp Association, Rothamsted Research, Scottish Hemp Association, Terravesta, UK Hempcrete, University of York, Unyte Hemp.

Forthcoming Events

Date and Time	Event	Location
8th February 2024 12.00 - 13.00	Biomass Crops webinar	Zoom webinar
1st May 2024 10.30—14.30	Herbay ley demo day. Booking link to follow.	FarmED, Honeydale Farm, Station Road, Shipton under Wychwood, OX7 6BJ

To sign up for one of our free CHCx3 events go to https://www.niab.com/event-hub/book-your-place or email us at chcx3@niab.com

Catch up on our previous Cover Crop webinar, Fibre Crops webinar and the Crops to Products event that was part of Agri-tech week by clicking on the links!

Acknowledgements

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