



Editorial: The Story so Far



Stuart Knight, NIAB, CHCx3 Knowledge Hub Leader

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

UK agriculture has the huge goal of achieving Net Zero greenhouse gas emissions by 2040. As if this wasn't a sizeable challenge, farming must also become more resilient to climate change, and enhance the natural environment, whilst remaining profitable. This can only be achieved through a concerted effort, involving the many other industries that form part of food, fibre, and biomass value-chains.

CHCx3 is a four-year, £5.9M project that aims to help UK farmers target Net Zero and build resilience through diversification of arable and forage cropping, enabling new revenue sources through a carbon marketplace and supporting enhanced value-chains for industries like textiles and construction. Led by NIAB, CHCx3 is supported by a group of 22 industry and research partners. The project runs until 2027 and has been awarded funding by Defra under the Farming Futures R&D Fund: Climate Smart Farming, part of Defra's Farming Innovation Programme delivered in partnership with Innovate UK.

The research is focused on four options: rotational cover crops; annual fibre crops (industrial hemp and flax); perennial food, forage, and feed (especially herbal leys and perennial cereal); and perennial biomass crops (miscanthus, willow and poplar). In addition to evaluating potential to enhance atmospheric carbon capture, and sequestration in the soil and crop-based products, field trials will examine the effects of growing system on economic returns and environmental outcomes. Other work will optimise production and use of renewable biomaterials for textiles or construction; and develop carbon insetting/offsetting platforms.

The CHCx3 'Knowledge Hub' will provide resources to support uptake and utilisation of crops with high carbon-capture potential, with practical outputs such as crop guides, web tools and apps available to landowners, farmers and agronomists.



In this edition of Insights, CHCx3 Project Lead Lydia Smith of NIAB gives perspectives on challenges and opportunities for increased cropping diversity. Phil Howell, NIAB outlines new work on the potential for perennial cereal cropping, and Heather Oldfield, Elsoms Seeds describes field R&D supporting hemp and flax crop improvement

In 'News from the Hub' we highlight carbon capture cropping from CHCx3 and elsewhere. Our research is impossible without our host farmers, providing trials sites and practical insights. We hear from Yorkshire grower Nick Voase and also from two of our partners about their businesses and aspirations from CHCx3.

Viewpoint



Lydia Smith, NIAB, CHCx3 Project Lead

Choosing the right crops; what has driven our decisions and possible outcomes?

This project builds on the work of many others both at NIAB and our partner organisations. While the core aim and anticipated outcome of the project is to increase the total amount of CO₂ that is removed from the atmosphere into a range of products, including soil carbon, the CHCx3 group aim to directly benefit both farmers and other industry using their produce. We chose our four crop foci with the view that they can provide some exemplars that would also be relevant to other crop species and uses. Taking each in turn, the reasoning behind the choices vary, but all relate to sustainable farming and use of resources in a bio-based circular economy.

Fibre crops fell from favour in the UK for many reasons, but the main one was probably economic. Flax, was traditionally used to make linen, but the erosion of fabric manufacture to other parts of the world naturally reduced farmer interest in its cultivation. This allied to the rise in preference for cotton and synthetic fabrics contributed to its demise. Similarly, hemp was used in heavier fabric and rope. The need for such items declined and preference for alternative feedstocks was exacerbated by a tightening in the legislative framework; requiring licencing to prevent drug related issues from impacting society. But now, both are finding many new markets in sustainable products; in vital components used in buildings; in cars; in insulation; and as a replacement for plastic in its many applications; and potentially fabric again. Similarly, willow and poplar had a vital place in the UK landscape; providing fuel, building material and many other applications but were replaced by fossil fuel and alternative materials. Return to these crops (including, relative newcomer, Miscanthus) is a route to



reduced reliance on fossil fuel AND those many other applications. The third group; food/feed celebrates the many environmental rewards from increasing diversity and will be the subject of a future article. Finally, cover crop use and tillage inputs between crops potentially underpins numerous other cropping choices.

Our challenge is to build their agronomy, rotations and harvesting and pre-processing, which farmers need before taking that leap to trying inclusion in rotations, and while simultaneously understanding and building these emerging markets... “no pressure” as they say.

CHCx3 Research in Focus

Phil Howell, NIAB

Exploring the Potential for ‘Perennial Wheat’ in the UK

Cereal crops occupy more than 3 million hectares of land in the UK, accounting for about two-thirds of the arable area. Currently, all of this is annual cropping, with a requirement each year for soil tillage, resowing and often intensive weed control. These contribute to production costs, which can be high, especially for winter wheat, and to greenhouse gas emissions, and they have the potential for adverse impacts on soil health, organic matter content and biodiversity.

Intermediate wheatgrass (IWG; *Thinopyrum intermedium*) is a perennial grass species, from the same botanical tribe as wheat, barley and rye. Native to central/south-west Europe and western Asia, it was introduced into the western United States about 100 years ago and is used as a forage crop for grazing or cutting, although its fairly slow re-growth means it is best suited to annual harvesting.

The Land Institute, a not-for-profit research organisation based in Kansas, has spent many years developing IWG as a dual-purpose crop. Grain is sold under the trade name Kernza®, with about 1,400ha claimed to be in production in spring 2021. This sweet, nutty grain has been used in bread-making grists with wheat, as a stand-alone flour for pancakes and muffins, as a whole grain to replace rice in pilafs, and for brewing. Under US conditions, established leys can be productive as a dual purpose crop for at least five years, although grain production typically falls away after the first two, and as forage stands for at least 10 years.



A key attribute of the species is its extensive system of roots and rhizomes that can extend to two metres depth, from which the crop is able to take up water (Clément *et al.*, 2022). Like the forage legume lucerne (or alfalfa, *Medicago sativa*) IWG has the potential to increase the resilience of forage cropping systems to drought, whilst helping to improve soil structure and reduce erosion risk and build soil organic matter.

A recent Defra-funded review (Knight *et al.*, 2022) identified IWG as one of about 20 alternative cereal and grain crops that could be developed for the UK, in this case as a forage or a food crop (Kernza®). Although a current lack of UK-adapted varieties and limited agronomic knowledge mean the crop would require significant investment, its suitability to our growing conditions, favourable environmental profile, and potential to help meet productivity, sustainability and net zero objectives, mean it is of great interest for high carbon capture cropping systems.

As part of CHCx3 Work package 4 (Perennial Food, Feed and Forage Cropping) field trials containing several Kernza® cultivars have been established at two locations: NIAB, Cambridge (planted in autumn 2021) and Cotswold Seeds/Farm ED, Oxfordshire (planted in autumn 2022). These will be assessed annually for agronomic aspects including crop growth, grain yield, above and below-ground biomass, and crucially, their impacts on soil properties including organic matter content, over the duration of this 4-year project.

References

Clément, C., Sleiderink, J., Svane, S.F. et al. Comparing the deep root growth and water uptake of intermediate wheatgrass (Kernza®) to alfalfa. *Plant Soil* 472, 369–390 (2022). <https://doi.org/10.1007/s11104-021-05248-6>

Knight, S., Smith, L., Howell, P. et al. (2022) Review of opportunities for diversifying UK agriculture through investment in underutilised crops. Defra Project CH0224. <https://randd.defra.gov.uk/ProjectDetails?ProjectId=20663>



Heather Oldfield, Elsoms Seeds

*Establishing Hemp and Flax as Viable Choices
for UK Growers*



CHCx3 is a game changer for the UK carbon capture marketplace. The agronomy and carbon capture capabilities of these efficient, sustainable break crops will be evaluated. Giving growers secure, informed entry into new end user contracts, and a knowledgeable tried and tested dataset for safe entry into the carbon marketplace.

UK farmers are passionate about improving soil health, biodiversity on farm, and reducing inputs. Through the CHCx3 project we can research the best, most economically viable, management techniques of these crops, by testing and joining up the supply and value chains we can give growers confidence in an environmentally and financially sustainable break crop.

Background

Historically, fibre crops were grown at scale in the UK until approximately 70 years ago. Production and processing were exported to other countries like a lot of industries, and synthetic fibre was favoured for its consistency and cost point. With the changing weather patterns in Europe, and increased awareness of environmental footprints, natural fibres can be a part or full replacement for unsustainable materials. Manufacturers of building materials, composites for Automotive, Aerospace and Defence are actively seeking environmentally friendly alternatives. Flax and Hemp can significantly contribute to Net-Zero. Neither crop require large chemical inputs, and with the right farm contracts in place, growers can have the confidence in a long-term alternative break crop.



Objective

Our objective is to produce practically based data that will enable UK farmers to make informed decisions when choosing which crops to bring into their rotation.

Elsoms Seeds Ltd, working with the University of York, have set up a trialling network across the UK to effectively evaluate existing and potential new Hemp and Flax varieties. Our aim is to test across a range of soil types, rotations, levels of precipitation and varying cultivation and drilling techniques. The geographical spread, and trialling on a large scale, will allow us to gain practical, relevant on-farm information.

The knowledge gained in the four-year study will allow a recommended style list and agronomy guide to be available to potential commercial growers. Explaining the capabilities of the crops, linking the most appropriate traits, varieties and management to new and existing end uses. Through the network of farmers, machinery specialists, processors, and end users we will demonstrate and disseminate truly valuable information to all of those in the supply chain.

News From the Hub

Improved farming techniques could limit global warming to 1.5°C

New research by Professor Jacqueline McGlade, former UN Environment chief scientist, DownForce Technologies co-founder, and carbon sequestration champion for the UKRI Sustainable Agri-food for Net Zero Network+, has suggested that using improved farming techniques to store 1% more carbon in about half of the world's agricultural soils would be sufficient to capture about 31 billion tonnes of carbon dioxide per year. According to a recent article in The Guardian, this is close to the 32 billion needed to meet the 1.5°C target limit for global warming. The estimates were based on increased uptake of practices such as improved crop rotations, cover crops and direct drilling.

Carbon capture cropping options draw interest at Groundswell

Cover crop mixes and herbal leys were amongst the carbon capture cropping options discussed by CHC_{x3} Project Lead Lydia Smith with visitors to the NIAB stand at the Groundswell event in June. Two-species cover crop combinations (phacelia + black oats or tillage radish + vetch), and an eight-species mix, were demonstrated as examples of what could be considered for the ‘multi-species winter cover crops’ action for soils under the 2023 Sustainable Farming Incentive (SFI).



Meanwhile, NIAB’s Phil Howell, CHC_{x3} Perennial Cereal lead, was on hand to discuss Kernza® as well as legume crop diversity in the form of lentils and chickpeas; with Nathan Morris, CHC_{x3} Cover Crop and Cultivations specialist, presenting outcomes from a long-term no-till soil management study in the Seminar Tent.

Value Chain Tools and Standards Survey

A value chain is the various interconnected organisation activities and processes involved in creating value (social, environmental, and economic), either through a product or when performing a service.

The Value Chain evaluation team is reviewing potential value and losses created across key CHC_{x3} ‘crop-to-product’ supply chains -

- Cotton blended textiles;
- Bio-composites – for aerospace / automotive;
- Construction materials;
- Livestock feed sector;
- Farming systems for the CHC_{x3} crops.

To help us do this, if you are involved in any of these areas, we

would like to receive your responses to this short survey – [Value](#)

[Chain Tools & Standards](#) – which will help guide our review and evaluation of the most relevant industry standards, tools, and approaches for the above sector supply chains. A summary review of the combined responses will follow in the next CHC_{x3} newsletter.

We look forward to reviewing responses by **25th September 2023**. If you would like to chat through any of this before you start the survey, please drop a line to either helen.shiels@york.ac.uk or to lukie.tolhurst@lucid-insight.com and they will be happy to answer any queries.



Biomass Connect

Our 'sister' project Biomass Connect, led by UKCEH; Centre for Ecology and Hydrology (see details at <https://www.biomassconnect.org/>) is a demonstration and knowledge sharing initiative, which aims to showcase best practice and innovations in energy/biomass crops.

The project, which shares common partners with CHCx3, is comparing biomass crop outcomes at a range of sites across the UK, including Northern Ireland. It is considering a range of crop species: such as, willow, poplar miscanthus, Eucalyptus, switch grass and hemp. Look out for common events and themes that build on synergy between the projects. Find out about the group via their webpages, and their regular newsletter; biomassconnect.org/comms-newsletter-sign-up/.

We will provide details of events here when we hear about them together with links to relevant agendas and joining information.

Envirocrops



CHCx3 is working closely with the Envirocrops project to help share our results. Envirocrops is a project led by the Agri Food and Biosciences Institute (AFBI) and is building a web app that will act as a digital consultant and provide users with all the information they need on their biomass crops journey:

Making a decision to plant based on the economics, logistics, timescales and local markets.

Best practice guidance on how to grow different crops.

A virtual directory and marketplace to find local contractors, consultants and plant material or sell your own products.

We are also exploring options within the Envirocrops project to create a trusted carbon trading platform. See [Envirocrops.com](https://envirocrops.com) for more information.

Meet the CHCx3 Partners

FarmED

FarmED is a 107-acre demonstration farm, training and event centre, and farm-to-fork cafe in the Cotswolds, with a mission to show how agroecological farming can mitigate climate change. Our mission is to encourage the transition to regenerative farming, offering the spaces and opportunity to debate, discuss and share knowledge around soil health, carbon sequestration, biodiversity, wildlife enhancement and farm to fork food production. The centre was founded ten years ago by Ian Wilkinson, owner and MD of Cotswold Seeds, and FarmED has built on Cotswold Seeds' 50-year reputation for offering specialist technical advice to UK farmers and growers around diverse forage

cropping as well as offering practical ways for farmers to make best use of scientific research to improve their agricultural operations and environmental outcomes

At the heart of the cropping at FarmED is a four-year herbal ley, grazed by livestock, in rotation with wheat and cover crops. We also grow intermediate wheatgrass. Improving soil fertility underlies all our work at FarmED and, since carbon capture is synonymous with soil health and the mitigation of climate change, we aim to ensure this vital research project will help further develop such an important field of study. Part of FarmED's mission is knowledge transfer, and our role with CHCx3 is to be one of the resources that will help disseminate the results to UK farmers and growers, guiding them towards Net Zero through diversifying their cropping.

Central to activity at FarmED is a multi-award-winning eco-conference barn and cafe, where we will host the CHCx3 consortium, offering space for visitors to meet in large and small gatherings, hear from other partners, or just get together and talk over a cup of coffee.



Northern Ireland Hemp Association

In 2019, Varin Marshall and a small group of like-minded hemp advocates set up the Northern Ireland Hemp Association. Initially established as a non-profit membership organisation, helping with licence applications, access to EU-listed seed cultivars and local agri contractors, current activities include:

Networking and connecting, with the aim of educating the farming community, industry and the general public about the benefits of hemp and what it can do for our ever-changing environment;

- Developing a network of farmers and businesses to assist in the growth of all aspects of the emerging industry;
- Liaising with local authorities to ensure that hemp farmers and businesses are aware of the legislation and standards within the industry;
- Offering solutions and consultation to the wider community that meet both industry and consumer needs.

Since conception, the Association has been involved in linking many businesses, academia representatives, hemp industry associations and cooperatives, agri-industry experts from government to construction and engineering, carbon sequestration to food and drink, manufacturing and processing and many others, establishing an infrastructure for the growth and development of the industrial hemp industry across Ireland at local and national level. We both establish connections and work on R&D projects with a range of academic, industry and authority partners.

Being involved in the CHCx3 project means we can continue to establish new connections and engage with a range of stakeholders and interested businesses within Northern and Southern Ireland further strengthening our much-needed unique and intricate trade relationships and economic gateways within the EU. The Association and our members are very proud of the opportunity to help develop and be involved in the creation of a platform for future carbon sequestration and soil data collection. With over 20 businesses involved in this project it also allows us to work and trade closer with our counterparts in England and Scotland; further expanding economic and academic partnerships and opportunities across the UK, Ireland and further afield.



In the Field



Nick Voase

K.J. Voase Ltd Yorkshire



Nick has been growing hemp commercially for over two decades and is certainly one of the country's leading experts, both in terms of cropping and the attendant on-farm processing. In the early days, he was supplying Hemcore Ltd, near Southwold, but this company was wound up in 2011. After which, he supplied Yorkshire-based Harrison Spinks, furniture and bedmakers. Now he supplies a broad range of other customers in this growing market, including Indinature Ltd; a natural fibre and construction company based in Scotland. In the last few years, he has extended his remit to flax so that he can supply both Harrison Spinks and others with this second fibre crop. "This year I have 110 hectares of hemp, 100 of wheat and 20 of flax; some of which is contributing to the CHCx3 project crop trials" says Nick.

He has either bought or personally made all of the necessary machinery needed for drilling, harvesting and pre-processing these crops. When asked whether this has been an issue for getting going with these new crops he said; "yes, but now that I am up and running, it is possible to run the decortication and fibre cleaning machines 12 months of the year and to work with neighbouring farmers that are not yet up to speed".

Get Involved

Contact us at chcx3@niab.com

Visit our web page [Centre for High Carbon Capture Cropping](https://www.chcx3.com)

Find out more from one of the CHCx3 Partners:

NIAB, Biorenewables Development Centre, British Hemp Alliance, Cambond, Cotswold Seeds, Crops for Energy, Dark Green Carbon, 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 Hemp-crete, University of York, Unyte Hemp.

Forthcoming Events in Autumn/Winter 2023-24

We will be hosting a free, three-part webinar series with guest speakers from within the project and experts in the field on the following dates as well as other events hosted by our partners. We will send out email invites to the webinars confirming dates and times shortly.

Event	Host	Location	Date	Time
Herbal Ley course	FarmED	FarmED, Station Rd, Shipton -under-Wychwood, Chipping Norton, OX7 6BJ	2nd November 2023	10:00 16:30
Agri-Tech week: Crops to products; building those value-chains	NIAB	Sophi Taylor Building, NIAB, Park Farm, Villa Road, Histon, Cambridge, CB24 9NZ	Friday 10th November 2023	10:00—14:30
Cover Crops webinar	CHCx3, NIAB	Online	22nd November 2023	16:00—17:00
Fibre Crops webinar	CHCx3, NIAB	Online	13th December 2023	16:00—17:00
Biomass Crops webinar	CHCx3, NIAB	Online	Date to be confirmed	16:00—17:00
Cover crop field trials demonstration and workshop	NIAB	NIAB. Morley Business Centre, Deopham Road, Morley, Wymondham, Norfolk, NR18 9DF	February 2024, date to be confirmed	10:30—14:30

Acknowledgements

This project is funded by Defra under the Farming Futures R&D Fund: Climate Smart Farming. It forms part of Defra's Farming Innovation Programme, delivered in partnership with Innovate UK.