

Sustainability In Arable Farming

Scottish Agronomy Objective (Mission Statement)

To produce, interpret and deliver technical information exclusively for the benefit of the members.

Achieved through an extensive trials programme on combinable crops and potatoes, over a range of climatic regions and soils, and through close links with all relevant sectors of the agricultural

Background

- Formed in 1985 as a co-operative, with 48 members.
- Run by a Board of farmer members.
- Unique delivery of independent crop advice.
- Operating in all main Scottish arable areas.
- Farmer Membership currently ~ 280.
- Most extensive trials programme in Scotland.
- Don't sell seed, chemicals or fertilisers.

What is Sustainability?

Definition - avoidance of the depletion of natural resources in order to maintain an ecological balance. The principles of sustainability refer to the three core concepts of environmental, social, and economic sustainability—sometimes broken down as "people, planet, and profits."

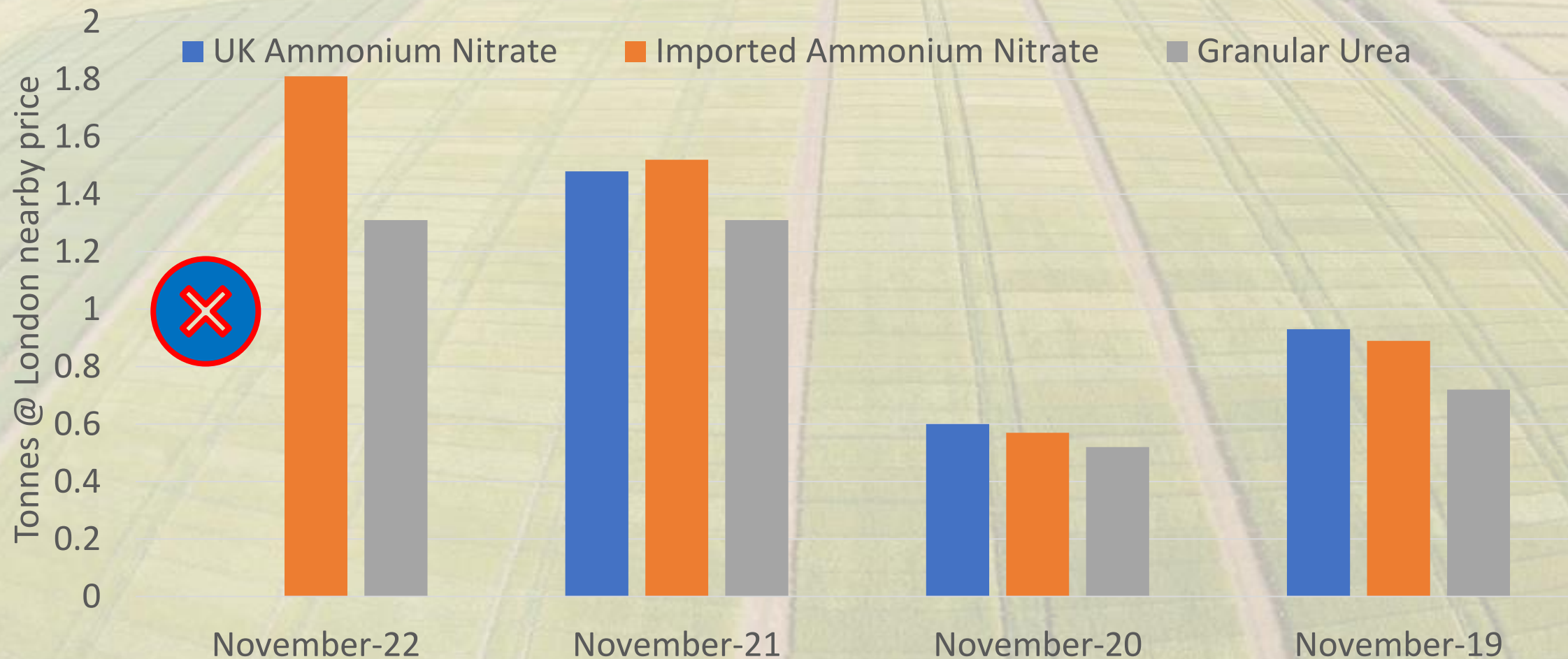
This means that in order to be considered sustainable, a business must be able to conserve natural resources, support a healthy community and workforce, and earn enough revenue to remain financially viable for the long-term.

Estimated Net Margins 2023 & the cost of production

Estimated Farm 2022/23 Margins

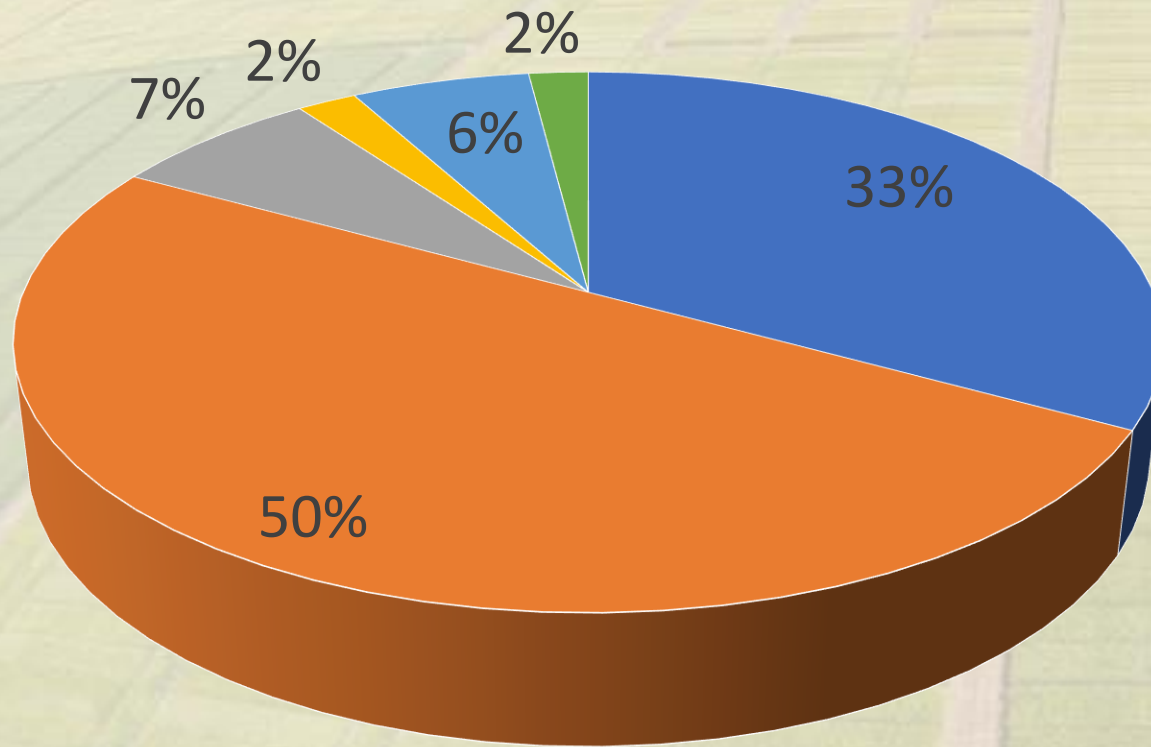
Crop	W Wheat	Continuous W Wheat	W Barley	S Barley Malt	S Barley Feed	S Oats	W Oats	Peas	Beans	WOSR	SOSR	W Linseed	Vinning Pea Let
Yield T/Ha	9.33	8.23	8.23	6.25	7.00	7.30	7.70	4.00	4.50	4.04	2.50	2.50	
£/Tonne	248	248	238	270	238	235	235	278	288	480	480	530	
Output	2314	2041	2206	1875	1897	1716	1810	1112	1296	1939	1200	1325	494
Anticipated Entitlement Value	223	223	223	223	223	223	223	223	223	223	223	223	223
Variable costs	904	1029	886	678	741	639	650	380	529	838	504	691	120
Machinery & labour costs	697	676	674	570	595	558	565	452	482	499	472	404	78
Net margin - Harvest 2023	936	559	868	850	784	742	817	504	509	826	447	453	519
Imputed Rent & Finance	153	153	153	153	153	153	153	153	153	153	153	153	153
Sundry Expenses & Overheads	128	128	128	128	128	128	128	128	128	128	128	128	128
Real Cost of Production per Tonne	178	214	197	209	199	172	165	222	237	345	414	461	
Price £/t to cover variable and machinery costs only	148	180	162	164	159	133	129	152	175	276	301	349	

Wheat sales to purchase 180 kg of N



Historic assumed GHG emissions from cereals and oilseeds

(source AHDB)



■ Fertiliser Production

■ Pesticides

■ Field energy use

■ Soil (including fertiliser induced emissions)

■ Crop residue management

■ Grain drying



**UN CLIMATE
CHANGE
CONFERENCE
UK 2021**

IN PARTNERSHIP WITH ITALY

Total GHG emissions for different feed wheat N responses

Example Agrecalc results for Mr Scot. Ag.

	N Input (as urea)	Sold Yield	Total emissions Kg CO ₂ e / kg of sold yield
Budget yield	200 kg/ha	10 t/ha	0.36
Scottish 10yr median yield	200 kg/ha	8.48 t/ha	0.42
RB209 response curve predicted yield reduction	150 kg/ha	8.12 t/ha	0.37
2 x predicted yield reduction	150 kg/ha	7.76 t/ha	0.38
3 x predicted yield reduction	150 kg/ha	7.40 t/ha	0.40
Agrecalc Combinable Crop Enterprises Comparator			0.39

Managed yield is king for profitability and to deliver 'low carbon' products into the supply chain

Building organic carbon Broadbalk 167 year experiment

Poulton et al. 2018

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Long term land use prior to experiment	Treatment or land use in experiment	Organic C in soil (0–23 cm or equivalent sampling depth) (t C / ha)	% C content compared to Broadbalk 'wilderness' (100% = 3.1% SOC)
Arable	WW No Inputs	24.5	31
	WW + NPK	30	38
	WW + 35 t/ha FYM Annually	78.1	98

Building organic carbon Broadbalk

59 year experiment

Poulton et al. 2018

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Long term land use prior to experiment	Treatment or land use in experiment	Organic C in soil (0–23 cm or equivalent sampling depth) (t C / ha)	% C content compared to Broadbalk 'wilderness' (100% = 3.1% SOC)
Grass	Arable	36.1	45
	Rotational grass 3yr ley, 3 yr arable	49.4	62
	Continuation of grass	73.2	92

Building organic carbon Broadbalk 22 year experiment

Poulton et al. (2018)

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Long term land use prior to experiment	Treatment or land use in experiment	Organic C in soil (0–23 cm or equivalent sampling depth) (t C / ha)	% C content compared to Broadbalk 'wilderness' (100% = 3.1% SOC)
Arable	Straw removed	53.2	67
	Chopped straw	56.1	70
	Chopped straw x 2	59.2	74
	Chopped straw x 4	61.2	77

Soil carbon sequestration in farmland is important but not infinite



For reasons of sustainability and soil health it is important to maintain Soil Organic Carbon (SOC) as high as practically possible in arable soils, but we conclude that in the vast majority of situations it is unrealistic to expect to [return to or] maintain pre-clearance values.

To maintain global SOC we consider it is more important to reduce current rates of land clearance and sustainably produce necessary food on existing agricultural land.

Powlson et al Outlook on Agriculture 2022, Vol.51 91-104

Pressure for change.....

Soil carbon: Targets and how to store it in arable fields



Farmers have a huge opportunity to help combat climate change by reducing emissions with the adoption of less intensive cultivations, as well as capturing and storing carbon in their fields.

Why mixed farmer exited pigs to focus on agroecology cropping



Shropshire arable and pig farmer Harry Heath has begun a journey into the world of agroecology in the hope it will future-proof his business, having made the difficult decision to exit the pig industry.



New wheat variety could have regenerative appeal

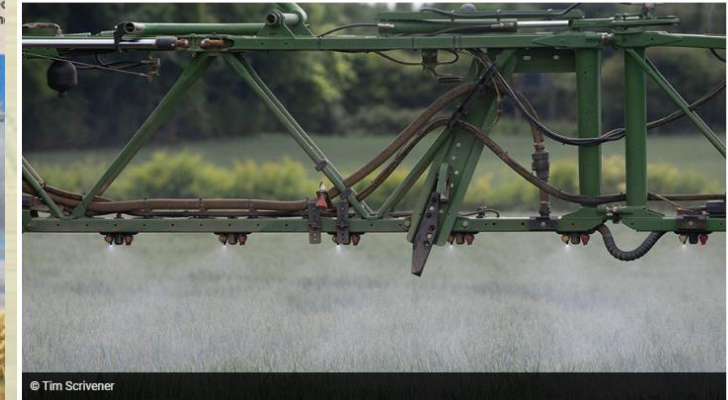
The agroecology mindset

[DOWNLOAD PDF](#)



[Hutchinsons](#) has launched a new bespoke agroecology service for its farmer customers, linked to its Helix innovation network. *CPM* attends the launch at the Shropshire farm and asks what the term actually means.

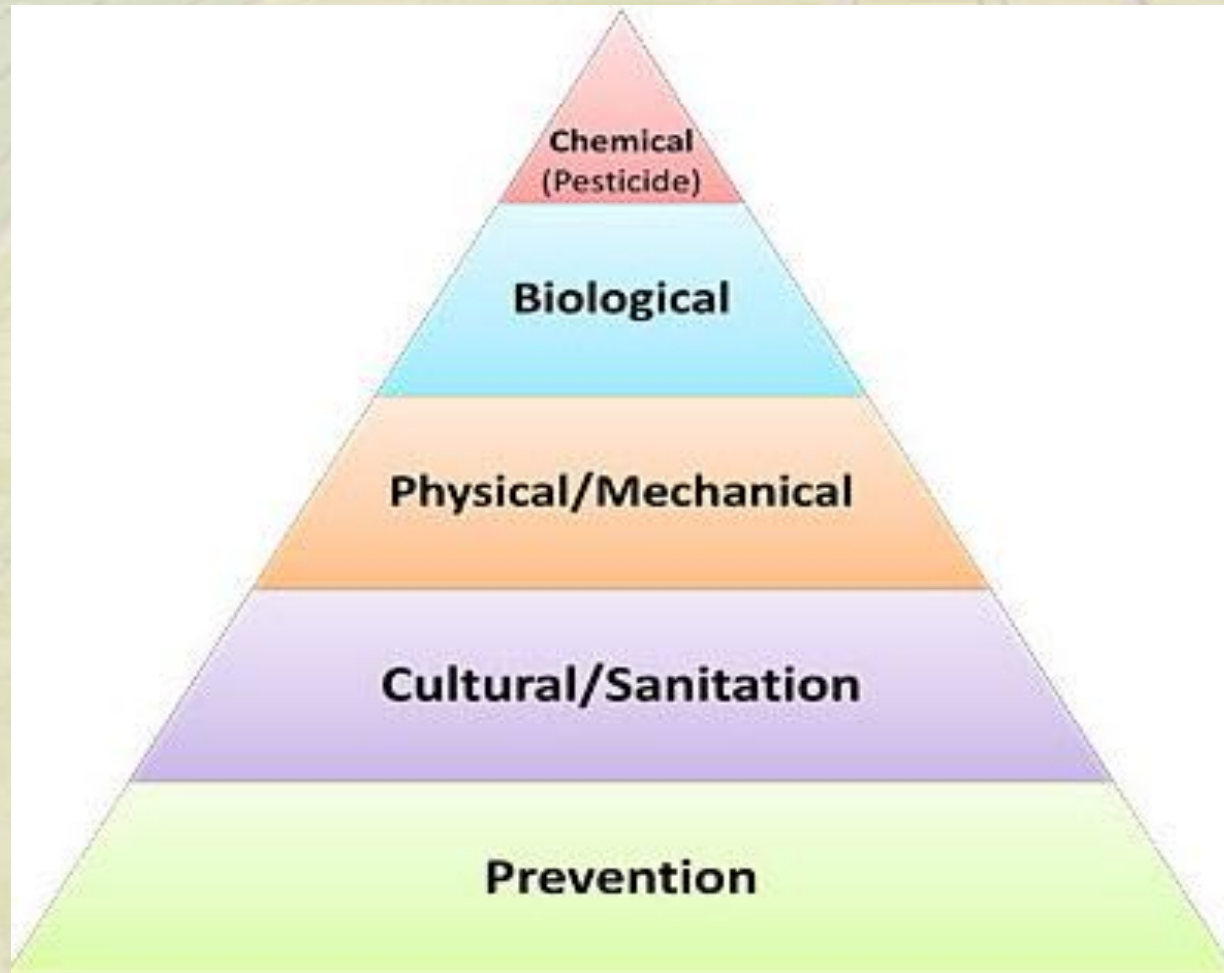
Can microbes replace chemicals for crop protection?



Microbial-based products in agriculture have over-promised and under-delivered. However, the first high-performing microbes may only be two to three years away and by the end of the decade there will be many more.

In 2021, [PepsiCo](#) announced that by 2030 they will work with the farmers in their supply chain to establish regenerative agriculture practices across their approximately 7 million acres.

Integrated Pest Management (IPM)



New challenges require new services



Scottish Agronomy Arable Business Groups, facilitated by Gavin Dick (ex-AHDB) & Julie Clarke of AHDB

NOVEMBER 12, 2022

www.thescottishfarmer.co.uk

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ARABLE

Could carbon auditing play a major role for Scottish agricultural businesses?

IN our latest column from Scottish Agronomy, Stevie Gray, takes a measured look at the role that carbon auditing might play in future funding and why it's important to get on that first rung of the ladder with using it as a benchmark.



STEVIE GRAY at Scottish Agronomy

UNTIL recently, it's unlikely many of Scotland's farmers would have been able to tell you what a carbon audit was. As even smaller number and almost exclusively livestock farmers, many have actually undertaken the process of evaluating their carbon emissions from within their own business.

Yet, as we head into the colder, wetter and sparser months of the year, many of Scotland's food producing businesses will be getting up to undertake a carbon audit for the first time, using one of the many PAS 2050 certified carbon calculators available – whether that's the Farm Carbon Calculator, Cool Farm Tool, Tristram AgTech Sandy, or AgriCalc.

The National Test Programme (NTP) was announced by the Scottish Government in October 2021, with the stated aim of supporting farmers to learn about how their operation impacts on climate and nature.

Running alongside the Agricultural Bill Consultation, the Scottish Government is looking to both of these to guide it in its frames new legislation from 2026 and the role it can play in its commitment to reach net zero by 2045.

To help achieve this latter ambition, the Scottish Government intends its implementation 'voluntary' requirements on at least half of all funding support to Scottish farmers by 2025.

As such, farmers will be expected to deliver on targeted outcomes for biodiversity gains and low emissions production with an evidence-based approach, using the NTP as a baseline and making the most of emerging information science, technology and tools.

So far, only Track 1 of the

and as part of the service we will be supporting members to submit their carbon audit and to access the funding.

The process of carrying out a carbon audit is fairly straightforward, while the data required ranges in complexity depending on the size of the business and the enterprises included in the audit. For many growers, the most time-consuming part of the process will be finding the data from within their own recording system.

When the report is complete, it will provide a summary of the emissions of the business and its enterprises, expressed as kg or tonnes of CO₂ equivalent. Whilst this provides an interesting starting point for farmers on their journey to understanding the potential impact of their business on the environment, the data will be of far more value to long-term planning and policy making.

Reducing agricultural greenhouse gas emissions is a key target when it comes to net zero and to facilitate this requires baseline figures to be in place.

The result of a carbon audit currently has no consequences to growers, be it a good or bad score, and the £500 funding will still be available, and the access to soil sampling will be facilitated.

When it comes to the recommendations on how to lower the CO₂ emissions based on the completed report, some growers may find the topics discussed familiar. This is because the best way to reduce the calculated carbon footprint of a crop is to increase the yield and improve nutrient use efficiency.

Conversations with our members are regularly about better product choice, rates, and timings, choosing the correct variety and appropriately managing it through the season, improving soil structure and alternative lower input crops, and are inevitably the headlines at our annual trials results meetings.

It is considered sustainable, a business must be able to conserve natural resources, support a healthy community and, moreover, and earn enough revenue to remain financially viable for the long-term.

The greater influencing factors of the carbon calculators are what many growers consider to be the best management practices in farming. So, whilst a



CARBON AUDITING might have an impact on where farmers go with their tillage plans in the future

carbon audit will be new to many and may indicate a direction for travel on how to improve your emissions for future, the practices of good sustainable farming will not be.

■ Stevie Gray is an agronomist at Scottish Agronomy, a farmer-owned cooperative offering independent agronomy advice based on the findings from its 20,000-plus trials plots in Scotland and over 35 years of experience in the field.

For more about membership or for a 30-day free trial, see www.thescottishfarmer.co.uk

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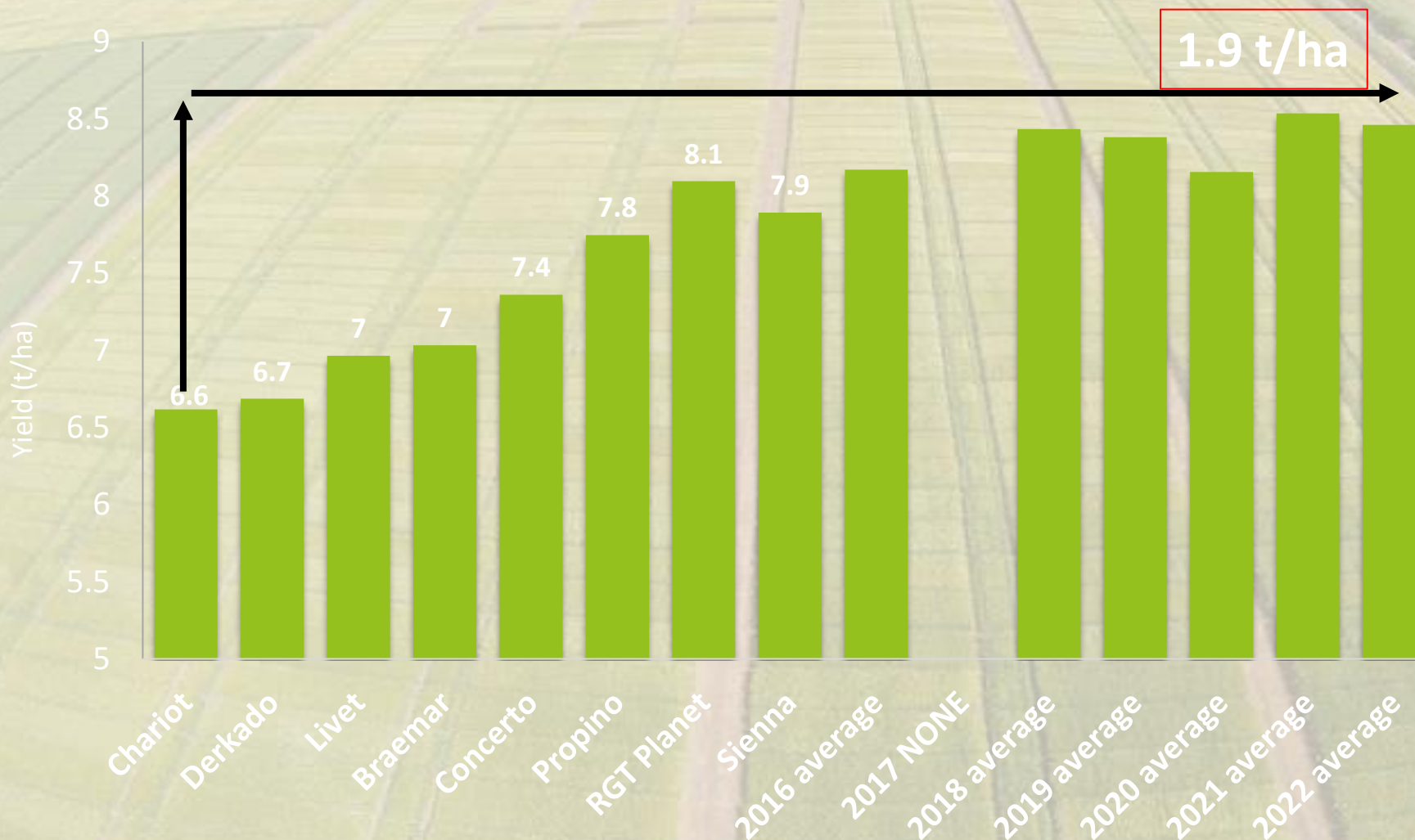
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Spring Barley yield progression

(RL trials over 30 years)

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Research on alternative fertiliser types



Use of less inorganic fertiliser and a switch to abated nitrogen fertiliser such as the low carbon calcium ammonium nitrate produced by Yara as a result of 90% reductions in the first stage of nitric acid production resulting in approximately 40% reduction overall – ***Decarbonising UK Cereal Production, Dr Nigel Davies***

CCm Technologies innovative CO2 capture to fertiliser process transforms currently variable digestate outputs into predictable NPK organo mineral fertilisers. CCm's pelletised fertiliser product ensures that digestate feedstocks can be transported and delivered to land in a much more efficient manner, using conventional farming equipment.



Research on alternative nutrient sources – not always successful



Encera™ is a nitrogen-fixing solution that allows you to take control of nitrogen utilisation on your farm. Applied in-furrow or as a foliar spray, Encera enables cells throughout the plant, including foliage and roots, to fix their own nitrogen and fill the nitrogen gap between crop required and crop available nitrogen.

Works perfectly in a glasshouse.

Unfortunately, after 3 years of research, confirmed that we could **not** repeat glasshouse results in the field.

Beans in Scotland

Results from autumn sown bean comparison at Cornceres 2022:

Variety	Yield (0.94 Ha Plots)
Tundra (W)	7.72 tonnes
Fuego (S)	7.47 tonnes
LG Raptor (S)	6.86 tonnes
LG Raptor (S)	6.55 tonnes

Cover Crops

- Can be used to retain fertility in rotation
- Can improve soil structure and drainage
- Can provide a habitat for wildlife
- Can provide IPM pest control – ie Oil Radish for PCN/FLN Control
- Beware of unintended consequences – Cruciferous inclusions increasing clubroot risk or Phacelia increasing FLN
- Plan ahead – establish what you want to achieve by using a cover crop, as you would with any other crop.:



Alternative cereal options - Winter Rye

- Reduced Input Cereal option – Winter Wheat Output at Winter Oat Input Levels.
- Much better utilisation of water than wheat.
- Higher output at lower N levels.
- Beware of Ergot risk if growing as a grain crop.

Biodiversity Credits – a different outlook



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PLANET

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BUSINESS**

**FARM FOR
NATURE**

Earn over **£27,000**
for every hectare of
habitat creation

With the continued economic volatility and reduction in funding, farmers are looking for new ways to diversify their business and build long-term resilience.

Environment Bank is enabling farmers to generate additional income through Biodiversity Net Gain. We are leasing parcels of land, typically low-yielding and upwards of 10 hectares, which we contract back to the farmer to create a biologically diverse Habitat Bank.

Our ecologists will work with you to develop a management plan to ensure the best possible outcomes for nature, and undertake all reporting and monitoring for the 30 year term.

Our model removes all risk and liability from the farmer. We cover all habitat creation costs and legal fees and guarantee secured annual payments that start immediately on lease completion.



Pepsico Positive Agriculture Outcome Fund –PEABIO Project



PARTRIDGE mix at Balgonie in 2018



Tramline mix at Balgonie in 2020



YEN Zero – An opportunity for growers

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YEN Zero, a new network focusing on reducing the carbon costs of cropping. Yield Enhancement Network (YEN) members can currently compare the characteristics of their crops and fields, such as soil type, yield, quality and nutrition, to those of their peers. With funding from Innovate UK, YEN Zero will take this one step further and enable the benchmarking of crop greenhouse gas (GHG) intensities. It will bring together organisations and individuals interested in calculating, comparing, understanding and reducing their carbon footprints.



Other areas of interest:

- New net zero Green Fertilisers
- Tillage practice – i.e. reduced or zero till systems
- Use of green compost to increase soil organic matter
- The benefits of precision farming

Denmark – November 2022

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- Carbon footprint numbers on invoice of product sales to ease carbon calculator input
- Soldier fly proteins as alternate protein source
- Grass protein extraction – BioRefine
- No methane cow feed additive (reduce cow methane by 40%)
- Plant Breeding - looking at CRISPR technology – gene editing
- Green ammonium Green Hydrogen – Power to X



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Nigel Davies



DECARBONISING UK CEREAL PRODUCTION

Dr Nigel Davies, BSc, PhD, FIFST, Dipl Brew,
Hon Assoc Professor, Nottingham University, Maltdoctor Ltd

