



Dr Lydia Smith

Land Use – The Environmental Cost of Farming
Focus at NIAB



GREATSOILS

Biological

- Feed the soil regularly through plants and OM inputs
- Move soil only when you must
- Diversify plants in space and time

KNOW YOUR SOILS; principles to improve soil health



Chemical

- Optimum pH
- Plant nutrients – right amount / right place / right time
- Textures and minerals – buffering capacity, free supply!

Physical

- Soil textures limits workability + trafficability
- Optimise water balance through drainage
- Improve soil structure – pore space

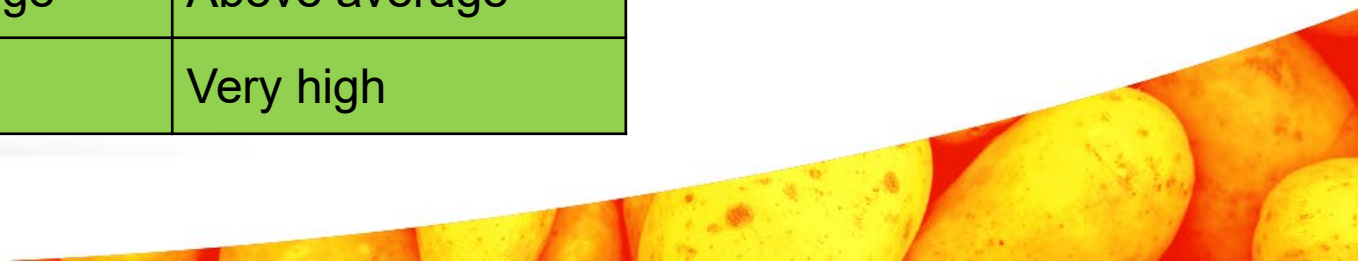
Testing ... Ranges for soil organic matter

GREATSOILS

Grassland - England – all climates (N.B. lowland)

OM %	Light	Medium	Heavy
<1			
1-2			
2-3			
3-4			
4-5	Above average		
5-6	Above average	Above average	
6-7	Above average	Above average	Above average
7-9	Very high	Above average	Above average
>9	Very high	Very high	Very high

Thanks Liz Stockdale



New, and more diverse crop choices?

- Broader crop choices and fundamental strategies to improve soils, for resilience, resource efficiency & GHG mitigation
- **High carbon capture/low GHG emission crops can help gradually build Soil Organic Matter (SOM) - twined with other strategies – e.g. cover crops**
- Reduced / zero tillage protects soil organic C levels with additional C-storage potential (highest in the first 20 yrs)
- **Scalable interventions needed to make a difference: tillage choice – especially annual crops**
- US farmers are paid for C-capture (CCs. Reduced or zero tillage). Also reduces establishment costs and thus profitability



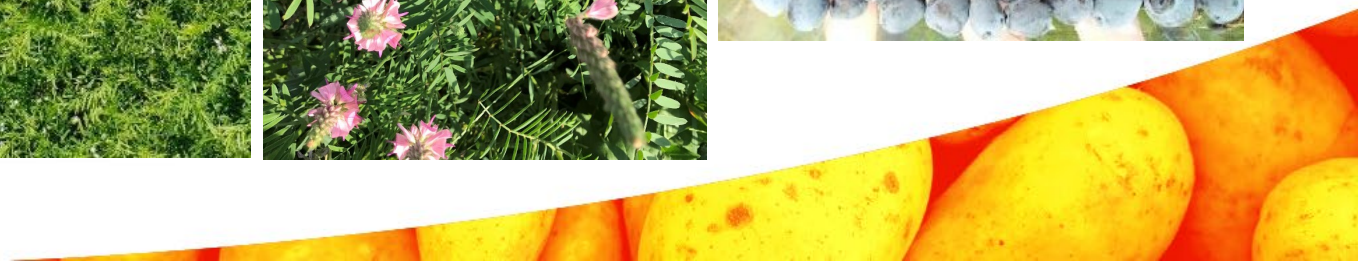
Why increase rotations & include additional diversity / break crops?

- Break crops & perennial species help improve soil physical structure
- Deep roots & microbial interactions can add to Soil Organic Matter by:
 - **Improved aeration & drainage; reduce erosion through wind & water**
 - **Soil aggregate stability**
 - **Microbial mineralization of organic material producing fungal networks, polysaccharides (soil aggregates) macro & micro-nutrients in soluble salts, oxides, carbonates, & metal oxyhydroxides (providing 'glue')**
- Break disease carry over + loss of genetic resistance, reduce pesticide breakdown
- More farmer choices and new diversified crop products

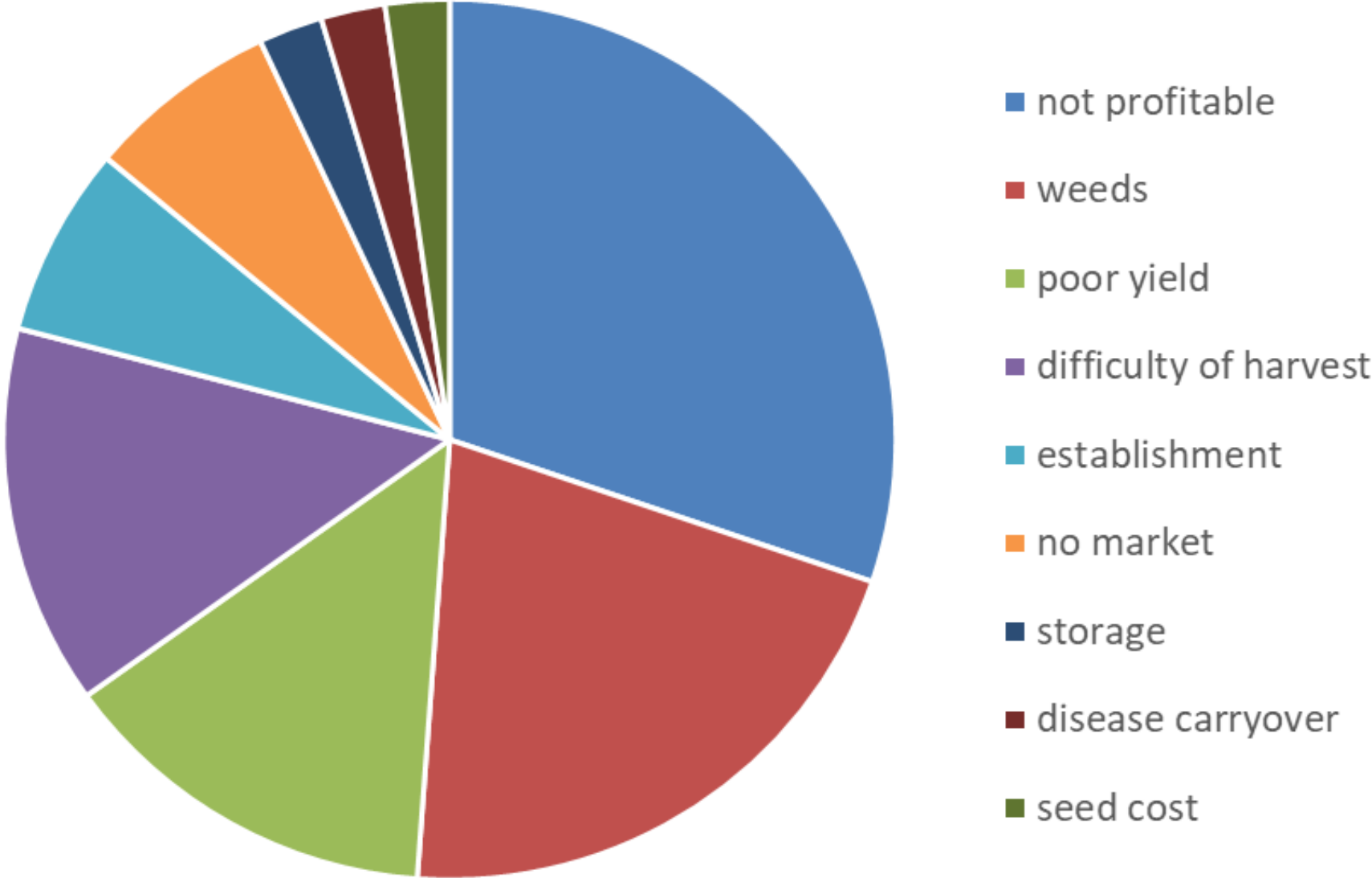


Shortlisted crops

Cereals & grains	Durum wheat, Grain maize, Rye, Triticale, Buckwheat, Quinoa
Oilseed & seeds / fibre	Ahiflower [®] , Hemp, Linseed/flax, Sunflower
Grain legumes / pulses	Soya bean, Vicia (faba) bean, Yellow pea, Chickpea, Lentil
Forage/ forage legumes	Red clover, Chicory, Festulolium, Lucerne, Ribwort plantain, Sainfoin
Vegetable & tubers	Jerusalem artichoke, Kale, Radish, Snap/snow pea, Squash, Swiss chard
Fruits nuts & vines	Apricot, Haskap, Hazelnut, Peach/Nectarine, Table grapes, Walnut



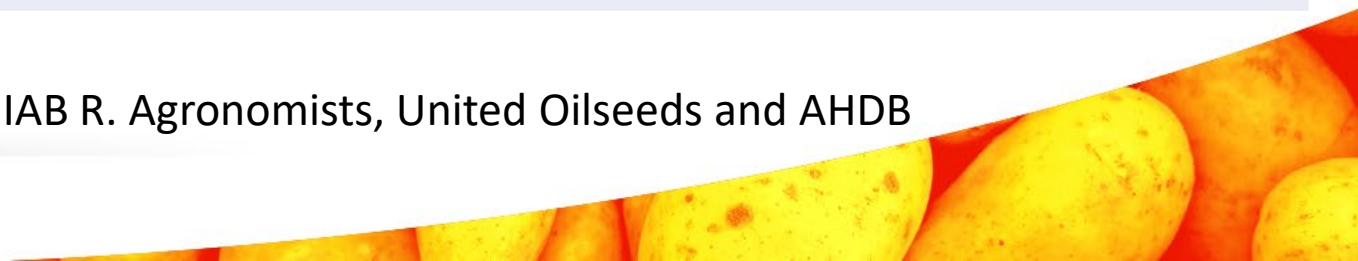
Main barriers to growing underutilised crops (% of respondents)



UK Spring crops Gross Margin 2022-3 estimated

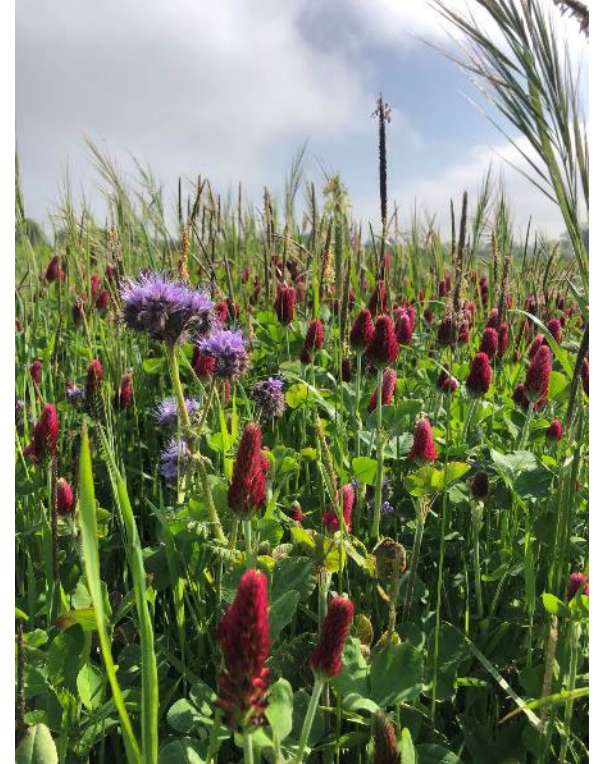
Crop	G. M. £	Issues
Linseed – spring (Linseed – winter)	720 (775)	Establishment can be patchy and a late harvest Drill date can clash with cereal drilling
Soya	800	Establishment can be late; then harvest too late
OS Rape – spring OS Rape – Winter	730 (905)	Issues with pollen beetle. Depends on cabbage stem flea beetle & N costs
Field Beans	670	Pests (bruchid beetle, nematodes) & weather-dependent
Peas	690	Establishment on heavy soil an issue
Spring wheat	625	Variable, though usually good on range of soils
Hemp	650-910	Products from stem & seeds, under ‘Industrial Hemp’ licence
Flax	750-910	Taller & more robust than linseed

Source NIAB R. Agronomists, United Oilseeds and AHDB



Centre for High Carbon Capture Cropping (CHCx3)

- 4-year, £5.9M, multi-partner research project led by NIAB; spanning agriculture, industry and academia
- We will;
 - Help UK farmers/growers capture more carbon and build farm resilience through diversifying cropping
 - Data for insetting/offsetting emissions and offer new revenue sources in carbon markets
 - Feed into enhanced value chains for industries - e.g. **textiles, vehicles, building, construction, fibre, feed etc...**



CHCx3 Cropping Options

Research is focused on the economic and environmental potential of 4 cropping option groups and associated tillage systems



- Rotational cover crops



- Annual fibre crops (industrial hemp, flax)



- Perennial food, feed and forage cropping (including cereals and herbal leys)



- Perennial biomass crops (miscanthus, willow, poplar)

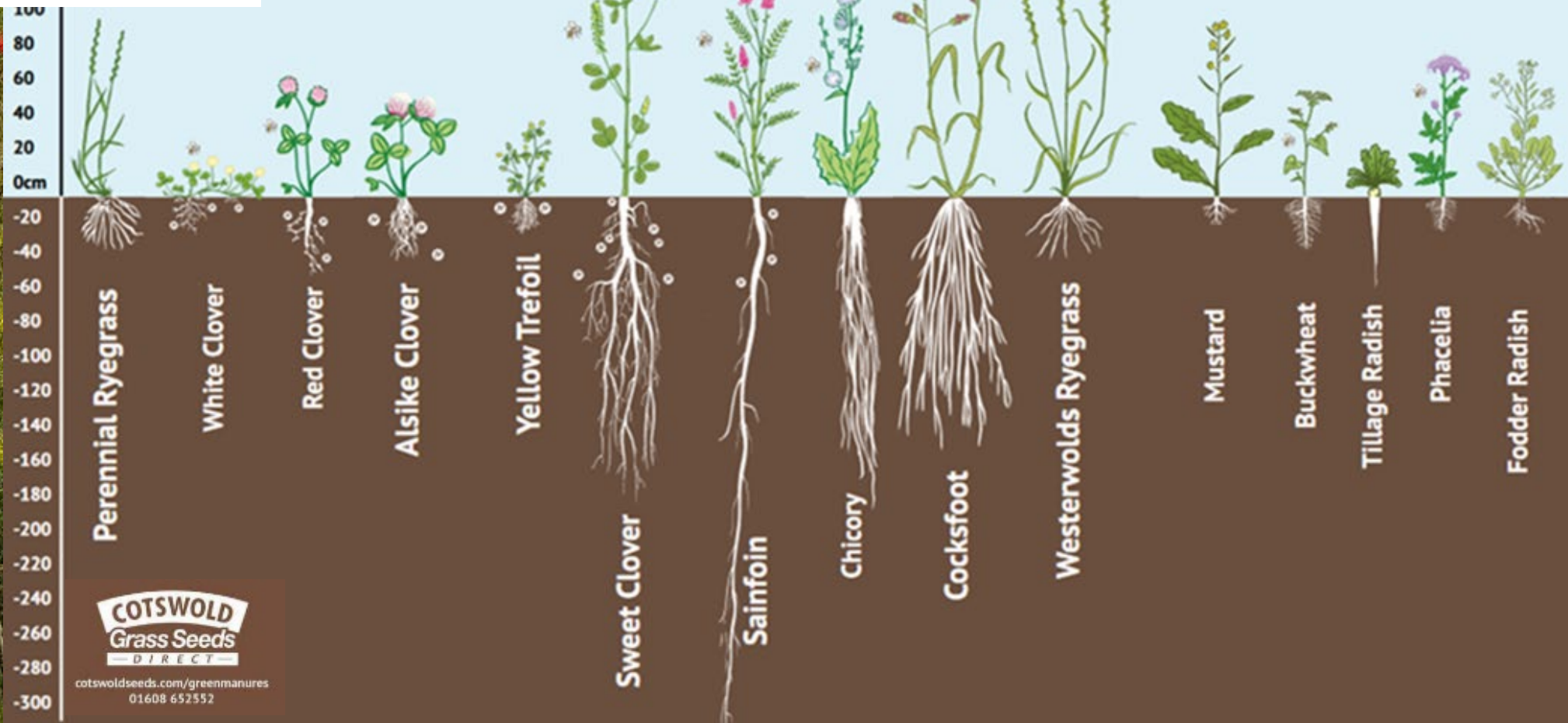
Grass/Herbal Leys - for livestock and in Arable – And Cover Crops

- Soil degradation costs England + Wales ~ £0.9 - £1.2 billion/annum most due to soil compaction + lost organic matter
- Introducing temporary grasslands (leys) into arable crop rotations can help alleviate soil degradation – maybe complex leys are even more impactful

Herbal leys, Grass Leys and Cover Crops

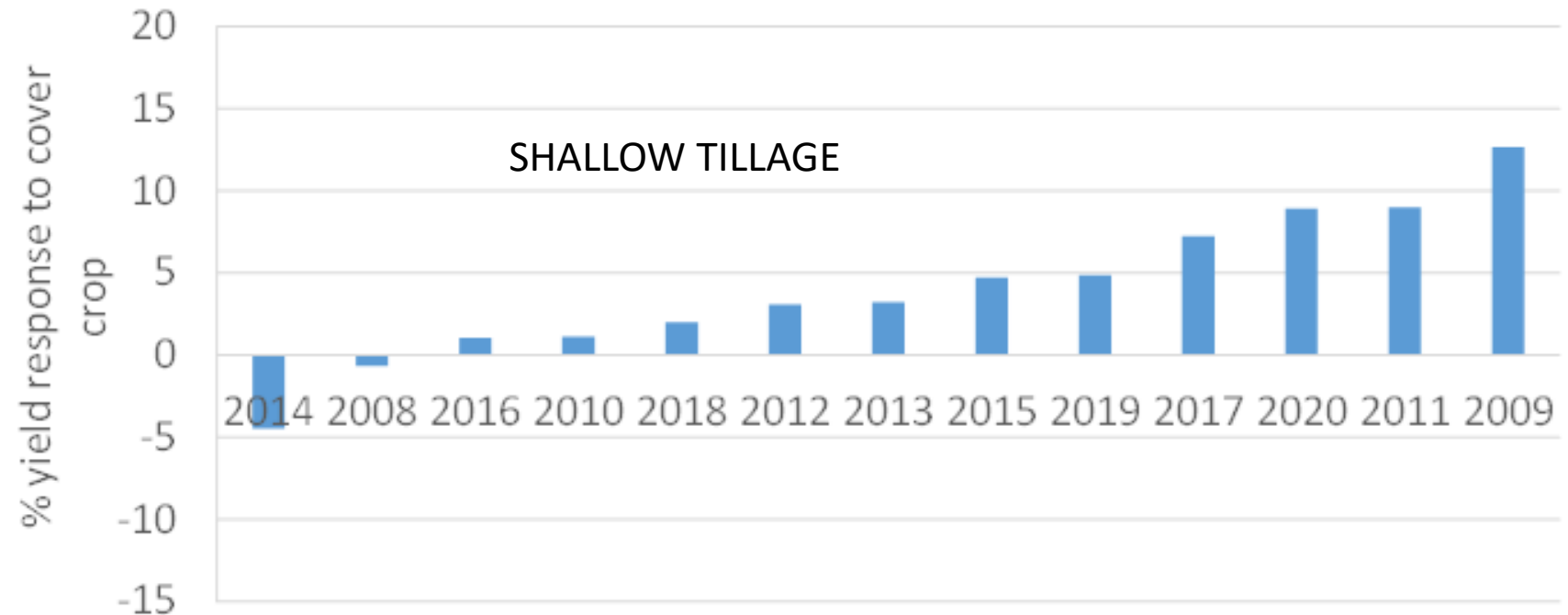
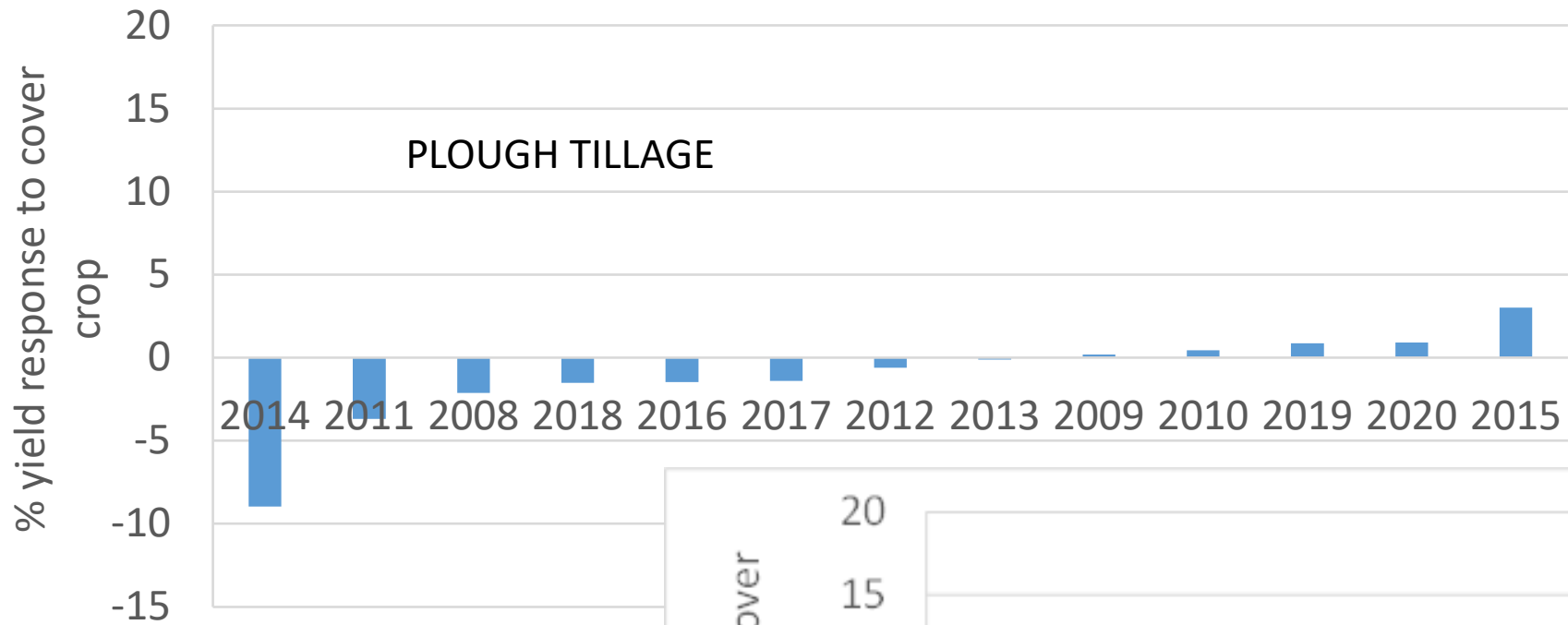
Conventional ryegrass
white/ red clover ley

Some Potential Cover Crops



Yield response (%) using cover crops in a long-term cultivation study

Nathan Morris NIAB



THE MORLEY AGRICULTURAL FOUNDATION

JC Mann Trust



Soil pore structure

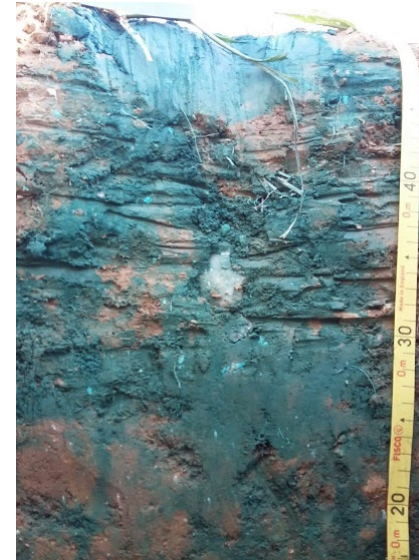
Herbal ley



Grass-clover ley



Arable

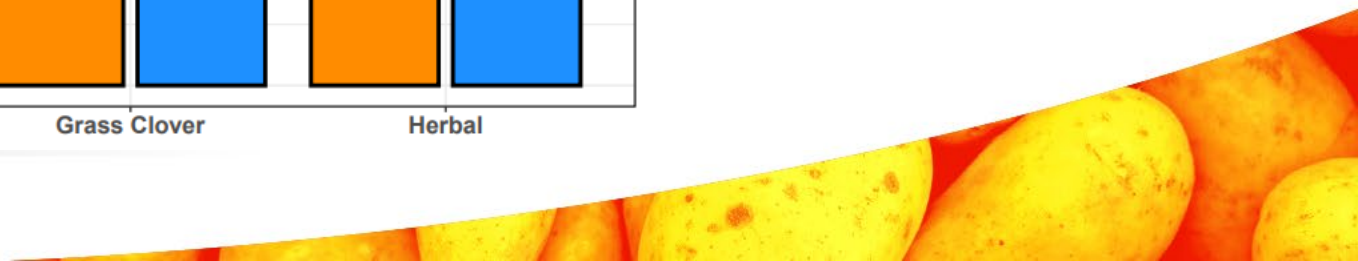
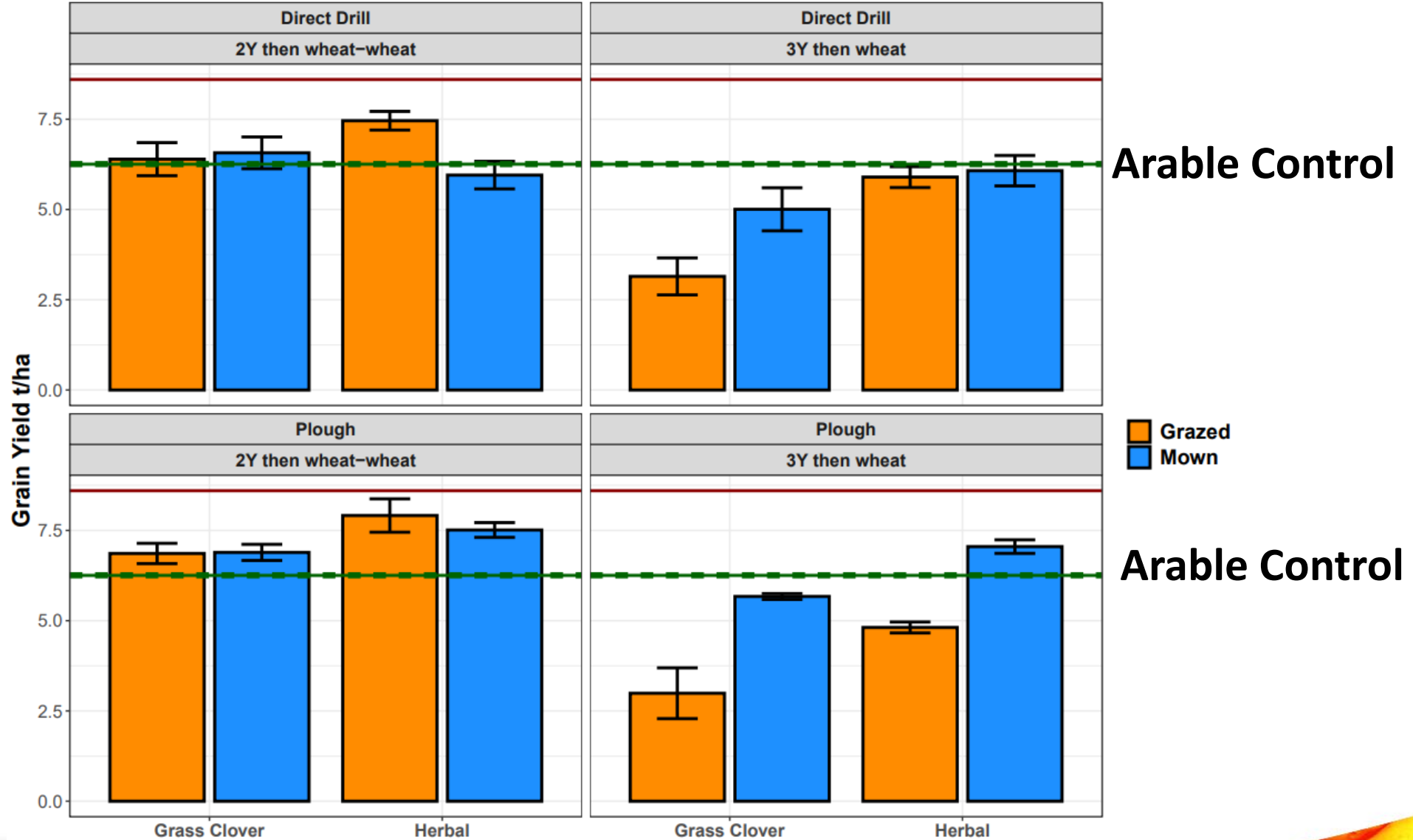


Emily Cooledge



Duxford 2022 Yield Data

All ley treatments received 110 kg N ha and 20 kg P2O5 ha. Arable control received 220 kg N ha and 40 kg P2O5 ha



Flax - Fibre

Flax in 2023

Andrew Stevenson, ES Growers



Heather Oldfield
Elsoms Seeds



Hemp – fibre & Shiv

2023 cultivation and harvest



Luke Palmer
Cambridgeshire



Good and poor soil structure – impact of hemp roots



Products now and in development

FLAX

- Fabric – a range of qualities and types - linens
- Woven textiles with carbon fibre
- Combined with resins for multiple car parts
- Aerospace components
- Replacement for glass fibre
- Sports equipment; e.g. tennis racquet, bicycle and surf-boards
- Sports boats hull build e.g. catamarans (e.g. 'Outremer')
- Food - oil

European Alliance for flax linen & hemp; >10,000 companies across 16 European countries. All links in the value chain represented: farmers, scutchers, spinners, knitters, weavers, traders, also producers and processors

HEMP

- Hempcrete and hemp plaster render
- Hemp 'foam' for building
- Loft insulation felt
- Combined with resins for multiple car parts
- Briquettes for burning
- Bio-plastics
- Paper and card
- Fabric
- Food; milk, hemp protein, seed, in breakfast cereal, in pasta, snack bars, etc.
- Animal feed and bedding
- Cosmetics, as a component in: shampoo, soap, sunscreen, moisture lotion, perfume, etc
- In beds with flax





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@Innovationfarm1

@NIABGroup

@lydiamjsmith

E-mail Lydia.smith@niab.com

