Alternative breaks: Cover crops, living mulches and leys @ Cereals

Welcome ☺
We will start at 5pm – Please note this meeting will be recorded

@agricology @niabgroup @CFEOnline

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Agenda

- **17:00: Welcome and introduction:** Katie Bliss (Agricology)

- **17:05: Cover crops and living mulches**
  - Nathan Morris – Introduction / what have we learned?
  - George Crane – Mycorrhizal associations
  - James Alexander, Litchfield Farm – Cover crop and living mulch in practice

- **17.25: Integrating grass and multispecies / herbal Leys**
  - Lydia Smith – Overview and impact on soil health
  - Patrick McKenna – Initial insights from on farm trials

- **17.45: Reintegrating livestock and arable / livestock collaboration**
  - Emily Cooledge, Bangor University– Benefits of collaboration for arable and livestock farmers
  - James Alexander - Arable farmer perspective
  - Andrew Rouse - Sheep farmer perspective

- **18.05: Q&A and discussion**
- **18.25: Close** – Katie Bliss (Agricology) and Laura Harpham (CFE)

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Technical bit..

- Small chance of being ejected into cyberspace – log back in! ☺
- Chat box – comments and questions / personal messages
- Polls – be quick! ☺
- Questions
  - Add in chat to 'everyone' or 'raise hand' (*9 on dial in)
  - Pick up some as we go and discussion at end
  - Muted automatically – will invite to unmute (microphone icon) or *6
- We are recording

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On farm walks with farmers and researchers – focusing on key agroecological practices

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Discussions

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POLL QUESTION 1

Current use of cover crops, living mulch and leys

POLL QUESTION 2

Motivations for using a cover crop

Cover Crops and Living Mulches

Nathan Morris (NIAB)

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What is a cover crop, and what can they do?

- Range of definitions, but often:

  Cover crops are grown primarily for the purpose of protecting, improving or augmenting between periods of regular (cash) crop production.

- Benefits of cover crops ‘protecting or improving’
  - Reduce erosion, run-off & nitrate leaching
    - Retain N (& P) improve soil fertility
  - Potential benefits for soil structure, water holding capacity & porosity
    - rooting & fresh organic matter
  - Weed management, disrupt pest & disease cycles
  - Biodiversity & habitat provision
    - Greening measures
  - Grazing & forage

Cover crop definitions

- Cover crop is often used interchangeably:
  - **Cover crop**: overarching term and other terms tend to refer to specific sub-categories within this field.
  - **Catch crop**: grown to ‘catch’ the nitrogen (N) in the soil and prevent nutrient losses via run-off and leaching
  - **Green manure**: grown to improve nutrition for the following crop, through addition of fresh biomass
  - **Companion crop:** a bi-cropping approach where (generally) one crop is being taken to yield (cash crop) and the other is being used for ‘protecting or improving’ (the cover crop)
  - **Living mulch:** usually an under-sown cover crop, typically intended for weed suppression (but there are other uses)
  - **Trap and bio-fumigant crops:** usually associated with pest or weed management via metabolite production

Duration of cover crops

The duration of a cover crop typically falls into four categories:

- **Very short season covers,** often <2-3 months e.g. 'catch crops'; used to trap (for example) soil nitrogen (N) that would otherwise be lost ahead of a following crop.

- **Short season covers,** often 3-7 months: used in arable/ vegetable production scenarios, typically sown in late summer and destroyed post winter before a following crop.

- **Season long cover crops,** typically 8-12 months: tend to be used more frequently in organic rather than conventional rotations; often used for fertility building.

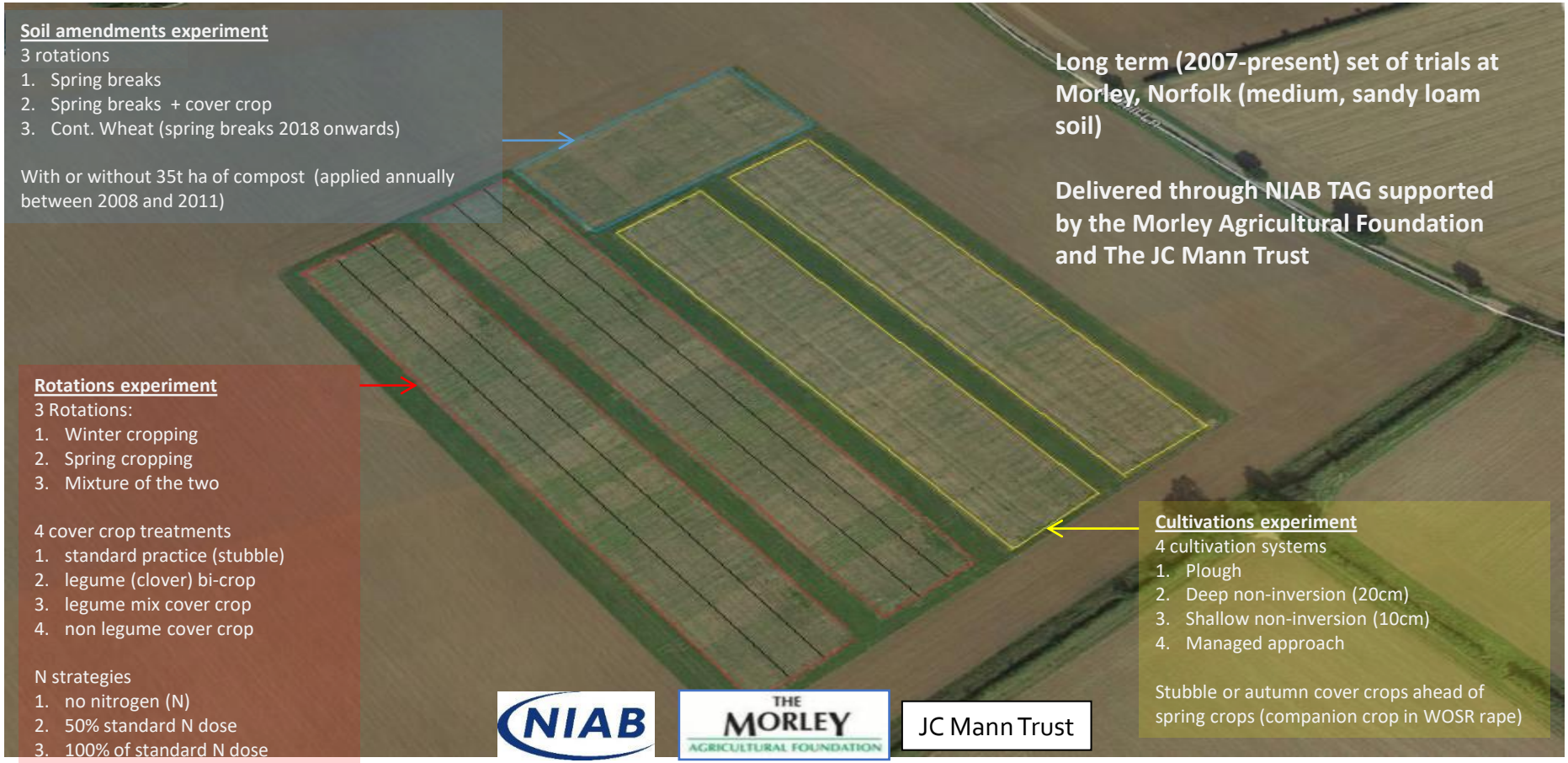
- **Longer duration cover crops,** usually >12 months: usually more strongly associated with organic practice or permanent/ perennial cropping systems.

Cover Crop Species

- Legumes
  - Vetch, clovers, peas, beans, trefoil
- Non-Legumes
  - Brassicas: Mustards, radish
  - Grasses: rye/oats
  - Others: Phacelia, buckwheat, chicory

	Brassicas	Cereals	Legumes	Other
Examples	Mustards, Radishes,	Oat, rye, rye-grass	Vetch, clovers, peas	Phacelia
Sowing	Mid Aug – early Sept	Mid Aug – Mid Sept	June – Aug	Mid Aug – Mid Sept
Qualities	Good root system, Biofumigation potential nutrient uptake	Rapid early growth & cover, Deep rooting	N fixing (modest over-winter) Fibrous root system	No rotational conflicts, good root system & nutrient uptake
Considerations	Rotational conflicts with OSR	Rotational conflicts with cereals	Rotational conflicts peas & bean; Careful drilling of small-seeded spp	Not entirely frost tolerant, needs soil moisture

The New Farming Systems (NFS) Experiments



Soil amendments experiment
3 rotations
1. Spring breaks
2. Spring breaks + cover crop
3. Cont. Wheat (spring breaks 2018 onwards)

With or without 35t ha of compost (applied annually between 2008 and 2011)

Long term (2007-present) set of trials at Morley, Norfolk (medium, sandy loam soil)

Delivered through NIAB TAG supported by the Morley Agricultural Foundation and The JC Mann Trust

Rotations experiment
3 Rotations:
1. Winter cropping
2. Spring cropping
3. Mixture of the two

4 cover crop treatments
1. standard practice (stubble)
2. legume (clover) bi-crop
3. legume mix cover crop
4. non legume cover crop

N strategies
1. no nitrogen (N)
2. 50% standard N dose
3. 100% of standard N dose

Cultivations experiment
4 cultivation systems
1. Plough
2. Deep non-inversion (20cm)
3. Shallow non-inversion (10cm)
4. Managed approach

Stubble or autumn cover crops ahead of spring crops (companion crop in WOSR rape)

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NFS Cultivation experiment

The NFS study explores the interaction between cultivation intensity in a fully replicated experiment on large plots using commercial machinery.

4 cultivation systems:
Plough, Deep and Shallow non-inversion and Managed
± autumn cover crops ahead of spring sown crops

Rotation	Year 1 (2008)	Year 2 (2009)	Year 3 (2010)	Year 4 (2011)	Year 5 (2012)	Year 6 (2013)	Year 7 (2014)	Year 8 (2015)	Year 9 (2016)	Year 10 (2017)	Year 11 (2018)
Winter rotation incl. spring breaks	ww	sosr	ww	sbn	ww	sbrly	wosr	ww	soats	ww	wbrly
Cover crop		✓		✓		✓			✓		

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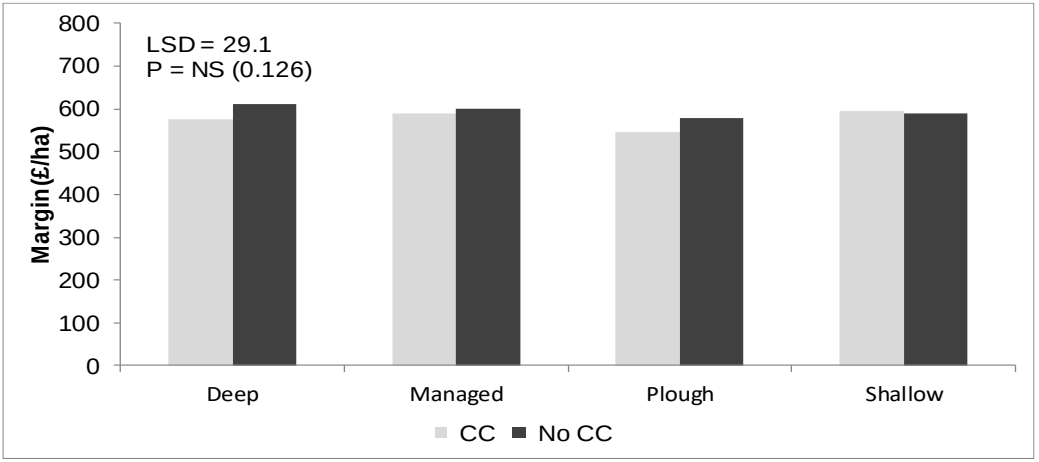
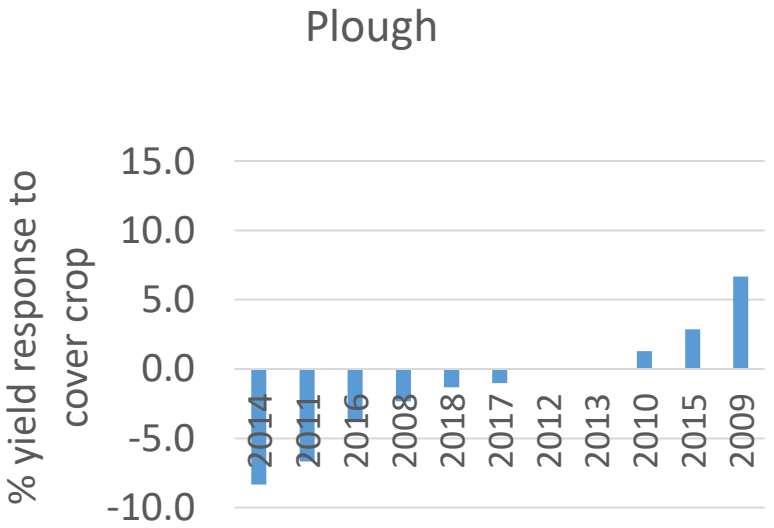
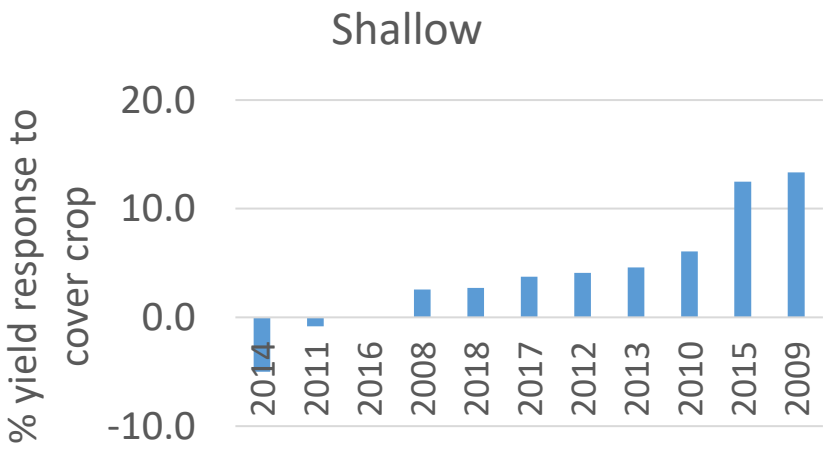
The interaction of cover crops with cultivation (2009-2018)







- The inclusion of cover crops (including the associated costs for seed and establishment c. £60-80/ha) resulted in no significant increase, or decrease in overall margin.
- Across the rotation non-inversion treatments resulted in a small increase, on average c. 4-7% in margin, compared to plough tillage; however, this is not statistically significant

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- Generally positive responses with cover crops and shallow tillage systems. Benefits less clear where plough based systems were used.

Using a clover bi-crop to build soil fertility

NFS Rotations study:

Rotations:
'winter' cropping
'spring' crops
mixture of the two

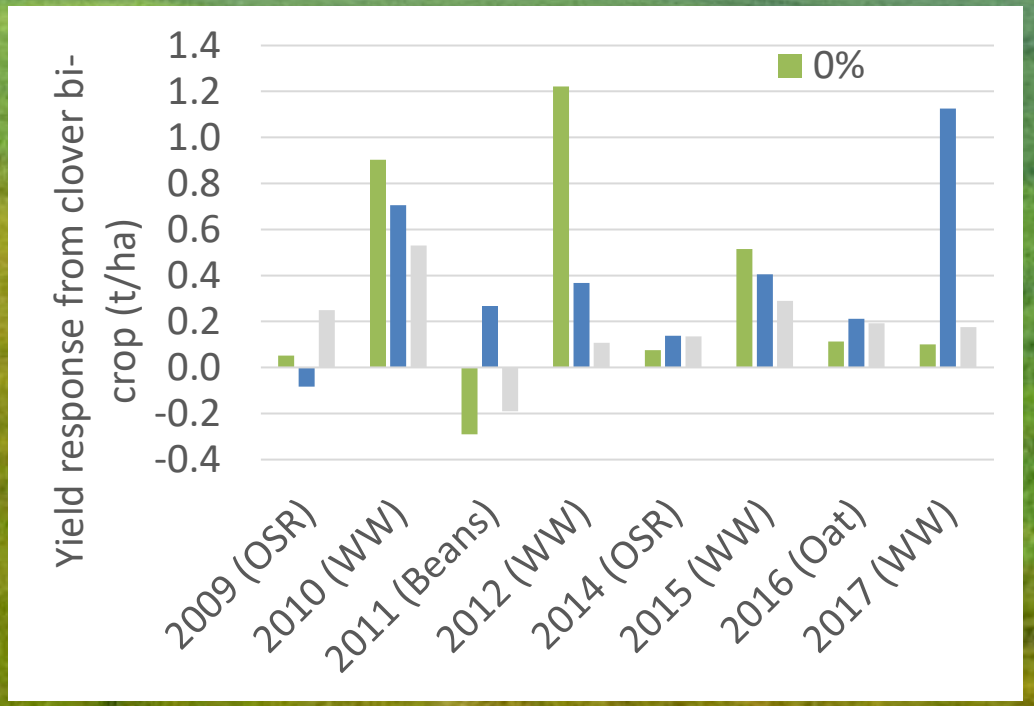
Cover crops:
standard practice
legume (clover) bi-crop
legume mix cover crop
non legume cover crop

N strategies
no nitrogen (N)
half standard N dose
full of standard N dose

NFS data has indicated:

- increases in infiltration rate from 0.8 mm/minute (standard practice) to 2.2 mm/minute (clover bi-crop system)
- reduction in bulk density from 1.17 g/cm^3 (standard practice) to 1.04 g/cm^3 (clover bi-crop system) at depths of 20cm
- opening up surface soil structure

Stobart and Morris, 2011 & 2014



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AHDB Maxi Cover Crop Project

Maximising the benefits from cover crops through species selection and crop management

- AHDB Project Report PR620

Objectives:

- Quantify effects of different cover crops on soil properties, crop rooting & yield
- Validate effects of cover crops and establishment on monitor farms
- Updated cover crop guidance & cost benefit analysis
- Knowledge exchange with growers, industry & academia

	Treatment	Seed rate
1.	Uncovered control (stubble, volunteers & weeds)	
Straights (individual species):		
2.	Oil Radish (Terranova)	10 kg/ha
3.	Spring Oats (Canyon)	50 kg/ha
4.	Rye (Inspector)	50 kg/ha
5.	Vetch (Amelia)	60 kg/ha
6.	Crimson Clover (Contea)	10 kg/ha
7.	Buckwheat (Lileja)	70 kg/ha
8.	Phacelia (Natra)	10 kg/ha
Mixes:		
9.	Spring Oats (83%) & Crimson Clover (17%) **'Mix 1'**	36 kg/ha
10.	Oilseed Radish (30%), Phacelia (20%) & Buckwheat (50%) **'Mix 2'**	20 kg/ha
11.	Spring Oats (53%) & Crimson Clover (11%) Oilseed Radish (11%), Phacelia (7%) & Buckwheat (19%); **'Mix 3'**	37.5 kg/ha

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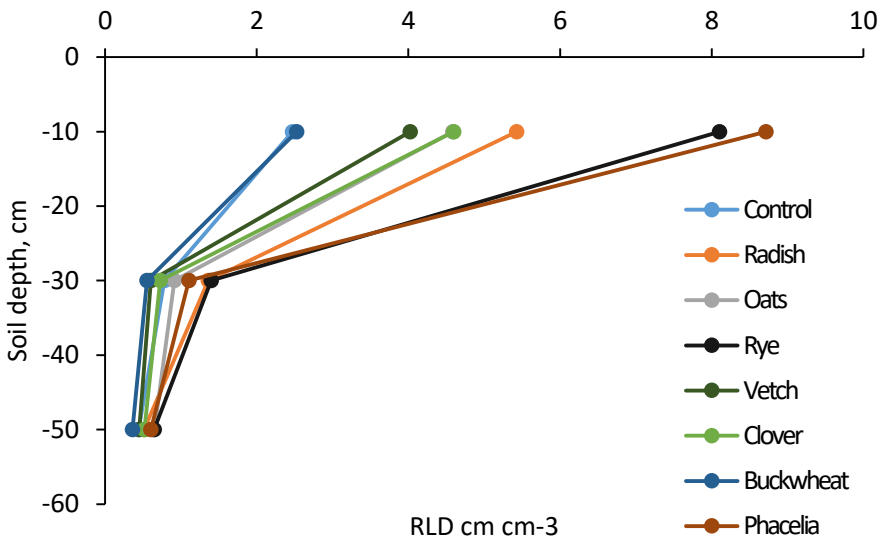
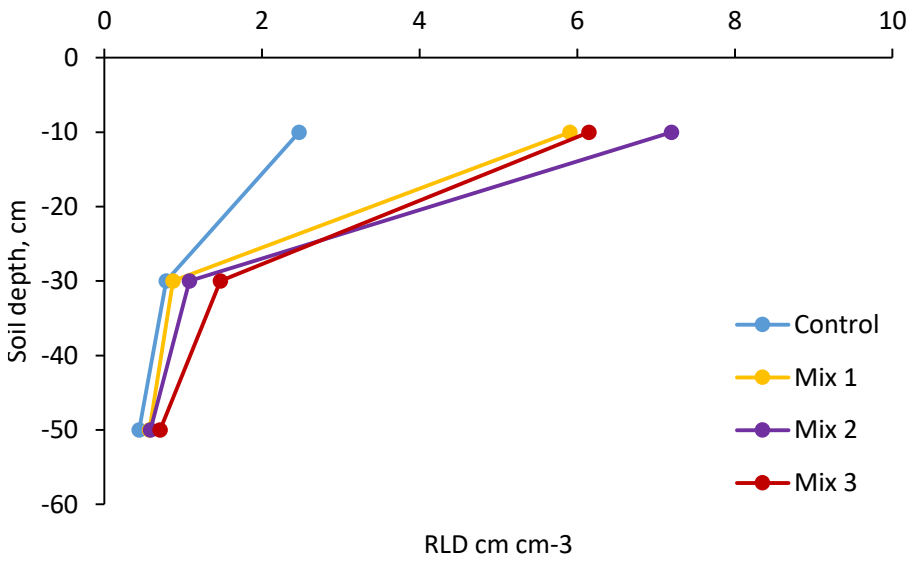
Cover crop root characteristics cross site: at CC destruction

Treatment: *F*<0.001, SED 0.41
Depth: *F*<0.001, SED 0.21
T*D: *F*<0.001, SED 0.70





Phacelia and Rye had greatest Root length density (RLD)
Phacelia slow to root in autumn, but well rooted by destruction
Mix 1 higher RLD in topsoil than single components of oats & clover

N.B. Doesn't include the radish tap root, due to nature of sampling

Cover crops: Lessons learned

- Cover crops **provide N uptake, erosion control, & soil structural benefits**
- Species choice: **Clear objectives** & considered rotational impacts
- **Establish early** (August rather than September) – to maximise growing time
- **Rooting characteristics differ** between species
- **Allow sufficient time** between destruction and cash crop establishment
- **Cover crops can recover between 25 – 50 Kg N,** up to 90 kg N
  - Can't say when the N will be released
- Some evidence that **Buckwheat scavenges P**
- Cover crops need to be **considered on a rotational basis** (possibly with several iterations of cover crops) although including the cost of seed and establishment, margins have resulted in no significant increase, or decrease in overall margin with the use of CC
- Non-tangible benefits such as **improved water quality, erosion control and enhanced biodiversity** should be considered as a wider public good

Mycorrhizal associations in cover crops

George Crane, NIAB

Cover Crops and Living mulch in practice

James Alexander, Litchfield Farm

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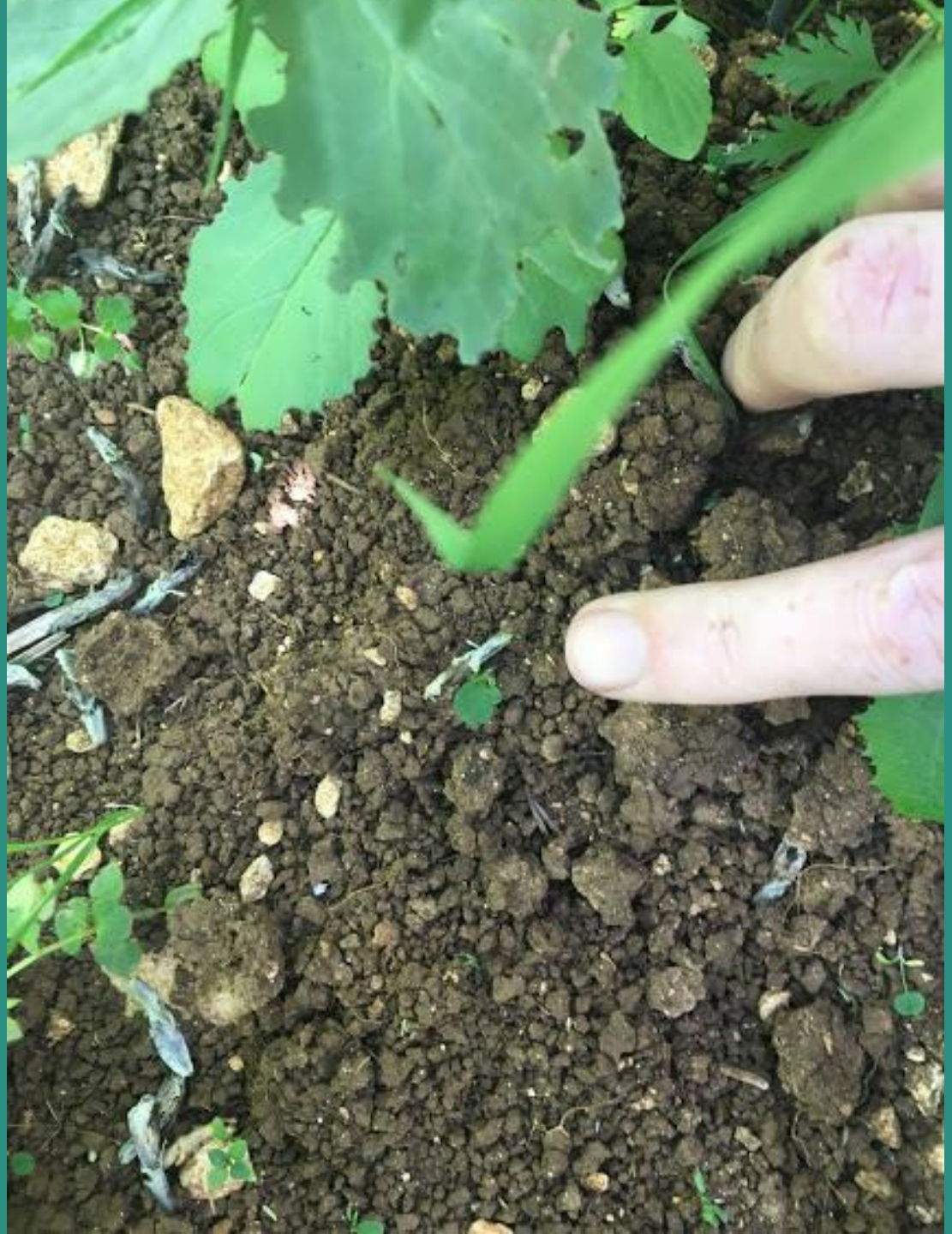
Mustard, oats and oil radish

Buckwheat and dock control?

Roller crimper in vetch and rye, 2018

Crimped vetch and rye, 2018

Twice crimped vetch and rye, 2018



White clover

living mulch..

Pea cover

POLL QUESTION 3

Duration of cover crop

POLL QUESTION 4

Integration of a ley

Grass and herbal leys

Lydia Smith @ NIAB Innovation Farm

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Grass clover ley

Simple herbal ley

Grazing vs mowing

Biomass assessments at Duxford

POLL QUESTION 5

Coming out of a ley

POLL QUESTION 6

Duration of a ley

Emily Cooledge – Bangor University

Reintroducing livestock into arable rotations

- Soil degradation costs England and Wales £0.9-1.2 billion annually[1]
- Disconnect between arable and livestock farming systems.
- Leys can help improve soil quality – but can we go one step further by integrating livestock?
- Australia's 'Grain and Graze' program or Brazil's integrated crop-livestock systems.

[1]Graves et al. (2015). The total costs of soil degradation in England and Wales. Ecological Economics. Vol: 119. PP: 339-413.

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What are the benefits for arable farmers?

- Livestock excreta can increase soil organic matter content.
- Reduce agrochemical inputs.
- Disrupt pest lifecycles.
- Improve biodiversity.
- Grazing livestock can deplete weed seedbanks.
- However, avoiding **overgrazing** is key!

Herbal ley at NIAB Duxford (E.Cooledge, 2019)

What are the benefits for livestock farmers?

- Access to ‘clean’ grazing pasture.
- Key plant species, e.g. chicory or sainfoin, contain high concentrations of plant secondary metabolites (PSMs).
- PSMs can:
  - Reduce parasite burden.
  - Reduce enteric CH_4 emissions.
  - Reduce livestock excreta N_2O emissions.
  - Increase livestock productivity.

Urine collection lamb grazing herbal ley at Loddington, Leicestershire (E.Cooledge, 2019)

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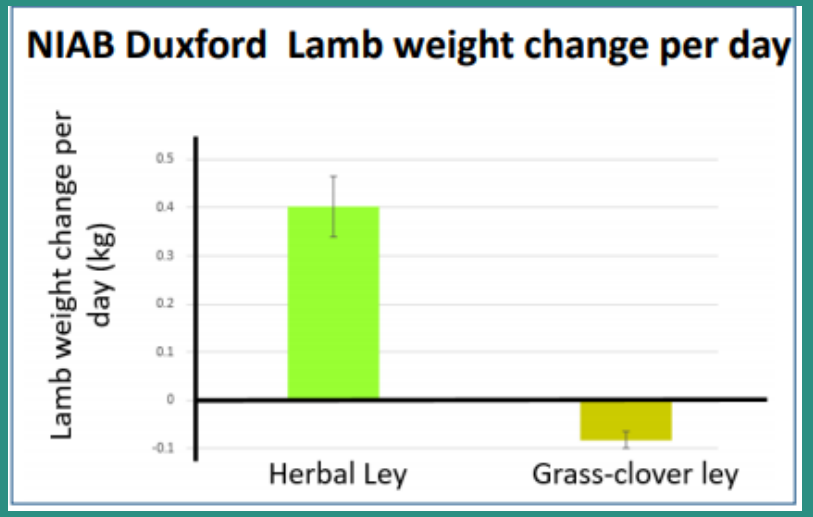
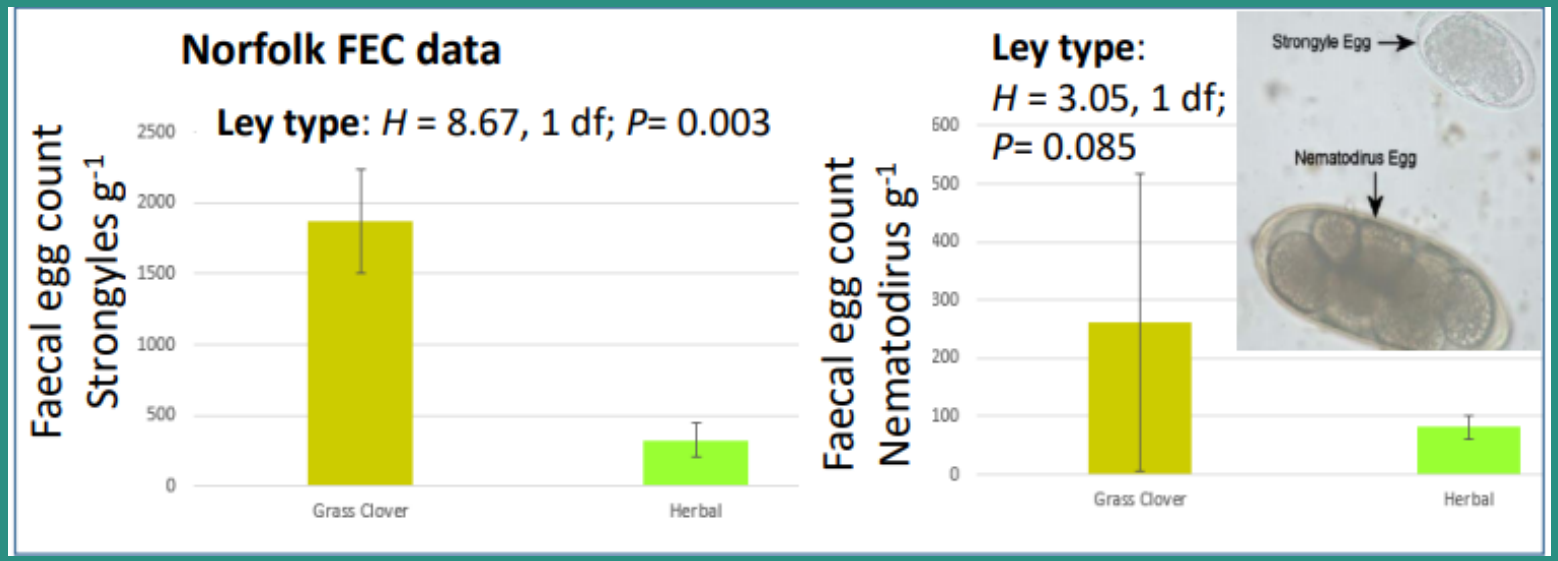
SARIC Research Project: Preliminary Data

- Sainfoin, chicory, and birdsfoot trefoil have anthelminthic properties.
- Two categories of helminth:
  - Strongyles: (hookworm, scour worm, small intestinal worm etc).
  - Nematodirus: (*Nematodirus battus*).





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James Alexander

James Alexander

Andrew Rouse,

Flying stock at

Duxford

POLL QUESTION 7

Livestock integration

POLL QUESTION 8

Distance for clean grazing

Your questions and comments

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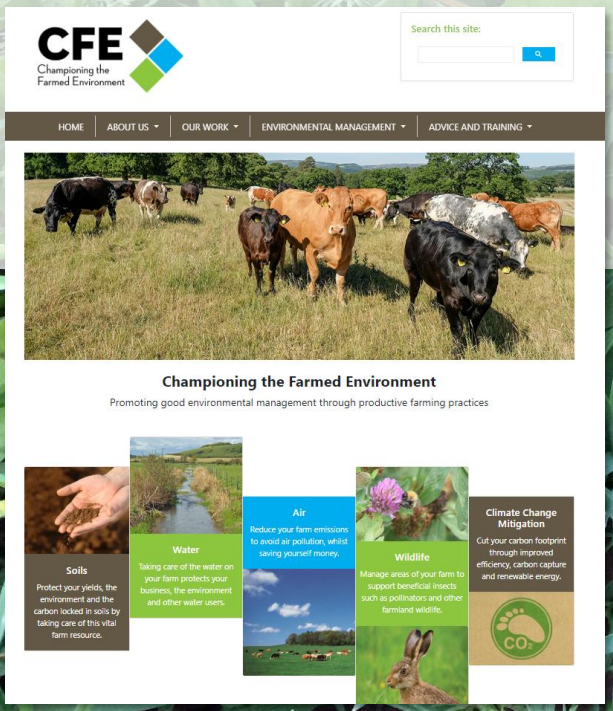
Promoting good environmental management through productive farming practices



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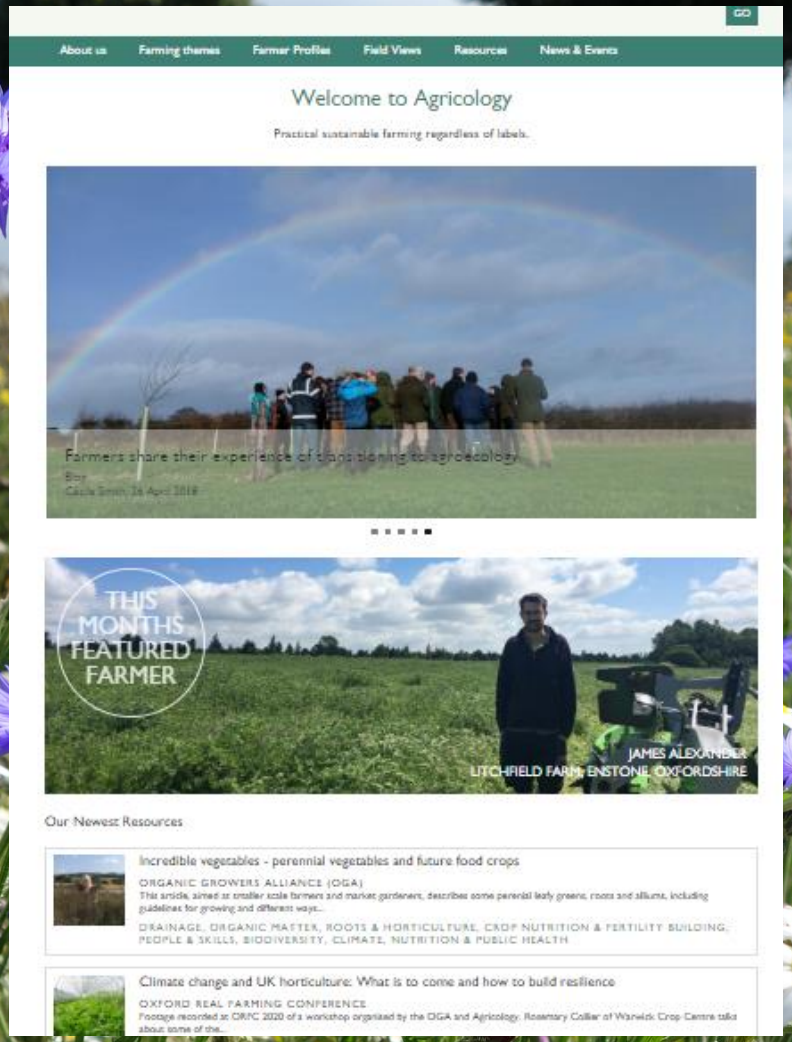

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VIRTUAL EVENTS

Soil health and function in arable farming systems

16 June 2020
Online event - Webinar
FIELD DAY

Virtual Field Day (LEAF) Integrated Pest Management in Arable

23 June 2020
Online Event - Webinar
FIELD DAY

NFU virtual organic farm walk: Challenges of Net Zero

23 June 2020
Online event - Webinar
FIELD DAY

PFLA Webinar: Talking Soil - Nicole Masters in conversation with Tim Williams

24 June 2020
Online event - Webinar
FIELD DAY

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LEAF
LINKING ENVIRONMENT AND FARMING

- **Non-Chemical approaches: Cereals LIVE:** 10th June @ 1pm
- **IPM in arable** (LEAF): 23rd June
- **Climate Change resilient systems** (CFE): late June TBC
- **Environmental seed mixes** (CFE): late June TBC
- **Hedges for wildlife and carbon** (CFE): 2nd July
- **National Organic Combinable Crops** (NOCC): 7th July
- **NOCC** - Q&A with John Pawsey: 9th July (TBC)
- **NOCC** - Land sharing vs Land sparing discussion: 14th July

Thank you! ☺

Stay safe and hope to see you soon!

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