

Intercropping in Arable Systems

Welcome 😊



We will start at 11.30

@agricology

@IFarmers

@plantteams

AGRICOLOGY
SUSTAINABLE PRACTICAL FARMING



ORGANIC
RESEARCH CENTRE

INNOVATIVE
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PART OF THE DUCKY
FUTURE FARMING PROGRAMME



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The Allerton Project



Agenda

11.30: Katie Bliss - Intro and welcome

11.35: David Casebow - Farm tour:

Including: Wheat legacy / Winter intercrop / Spring intercrop / Diverse forages / Diverse rotations

Clarifying questions and comments

12.10: Insights from on farm trials in IF Field Lab

Andy Howard, Bockhanger Farms

Adrian Hares, Roundhill Farm

12.35: Others to give brief update on intercropping trials

12.45: Comments, questions and discussions



Intercropping in Arable Systems Field Lab

- Share experiences
- Collaborative research
- On farm trials



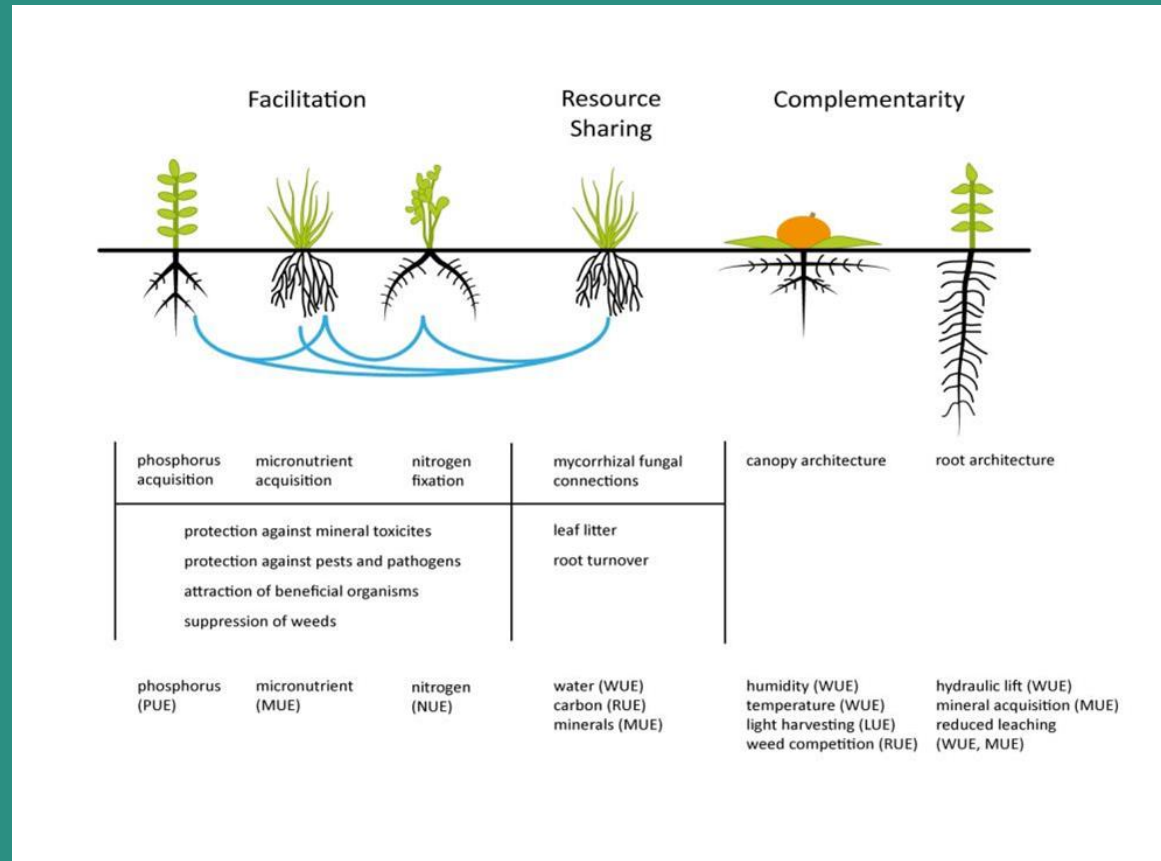
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What is intercropping?

“The growing of two or more crop species where part or all of their crop cycle overlaps temporally and/or spatially, where one or more of the component species is taken to harvest”

Andy Howard – Nuffield Report 2016



Facilitation, resource sharing and complementarity (Brooker et al, 2015)



- Virtual Farm tour

<https://www.uorcropsresearchunit.com/>

uorcropsresearchunit.com



Linseed and oats, Bockhanger Farm, Kent 18/19

Motivations: Oats to aid linseed establishment via reduction of pest pressure.

Establishment: Linseed and oats drilled with cross slot in one pass on 27/03/19;

- Linseed at 700 seeds/m² / Oats at 0, 70 and 140 seeds/m²



Flax Flea Beetle Trial

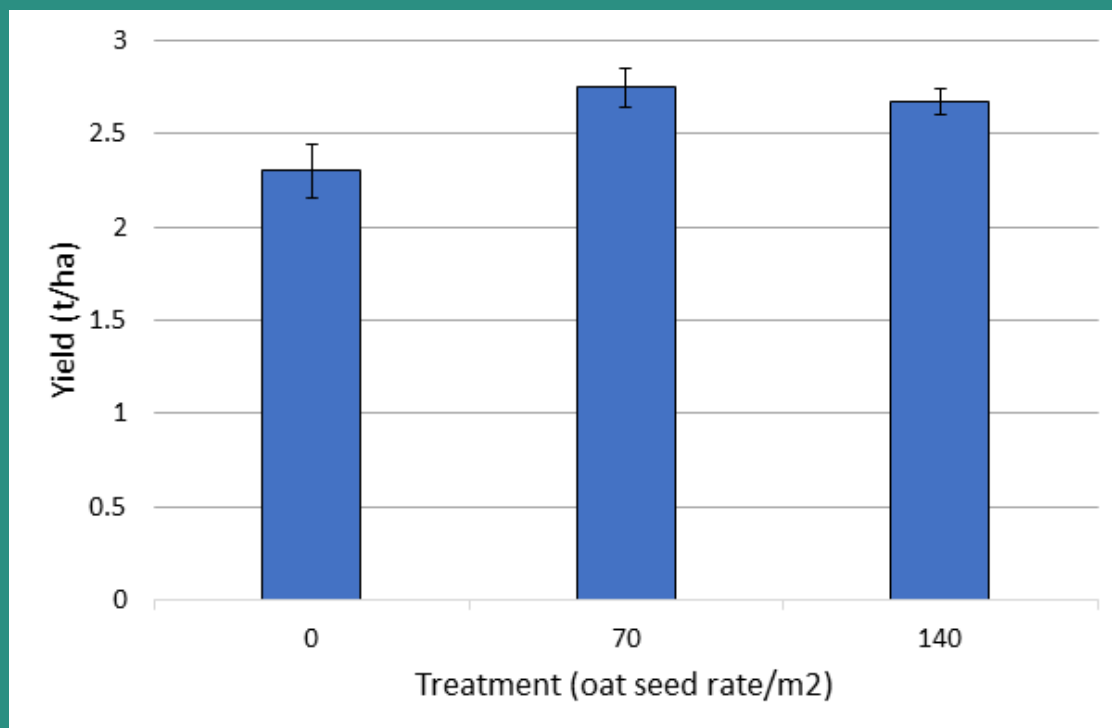
| Plot No. (Ha) | Linseed Seeds M ² | Oats Seeds M ² |
|---------------|------------------------------|---------------------------|
| 1 (0.72) | 700 | 0 |
| 2 (0.66) | 700 | 70 |
| 3 (0.61) | 700 | 140 |
| 4 (0.59) | 700 | 0 |
| 5 (0.54) | 700 | 70 |
| 6 (0.51) | 700 | 140 |
| 7 (0.50) | 700 | 0 |
| 8 (0.51) | 700 | 70 |
| 9 (0.54) | 700 | 140 |

1 2 3 4 5 6 7 8 9

Linseed and oats, Bockhanger Farm, Kent, 18/19

Results

- **Higher average linseed yield in treatments with oats**
- **Pest traps confirmed presence of flax flea beetle although in low abundance**
- **70 seeds/m² seed rate had a slightly lower pest damage score (NS)**





Linseed and oats 2019/20

OSR, Peas and oats, Bockhanger Farm, Kent 18/19

Motivations:

- a) Aid **OSR establishment** via reduction in pest pressure;
- b) OSR in supporting the pea crop and **reducing lodging**.

Establishment:

Marrowfat peas drilled at 70 seeds/m² with and without OSR and an oat companion on 30/03/19.

The treatments were:

- Monoculture peas;
- Peas + OSR at 35 seeds/m²;
- peas + OSR at 50 seeds/m²;
- peas + OSR at 50 seeds/m² plus oats at 70 seeds/m².

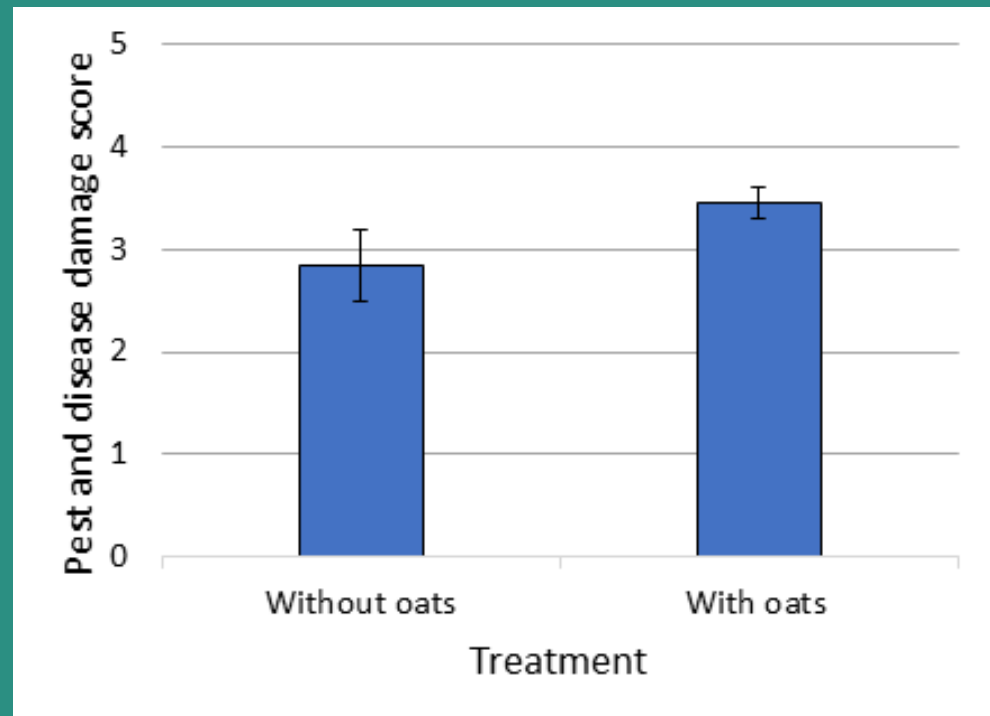
These were replicated twice in strips across the field with monocrop replicated three times to assay in-field heterogeneity.



OSR, Peas and oats, Bockhanger Farm, Kent 18/19

Results

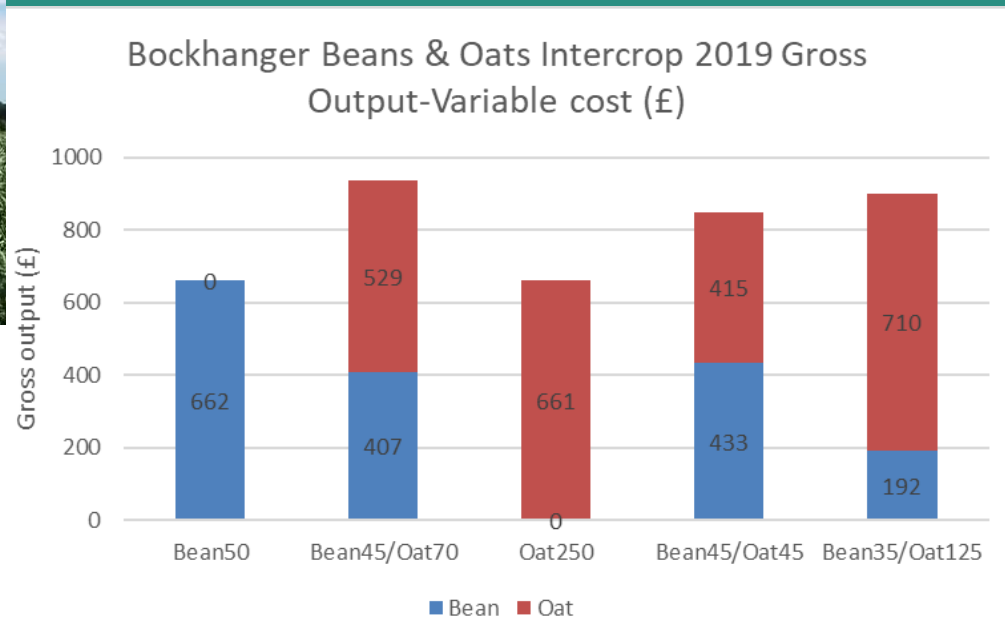
- Average pest and disease damage T2 'Peola' was higher in strips without oats (NS)
- Two cabbage stem flea beetle pests were trapped across the entire trial
- Poor establishment of the OSR
- No detrimental effect on the pea in terms of nutrition or yields across treatments



Spring beans and oats, Bockhanger Farm, Kent (PGRO) 18/19

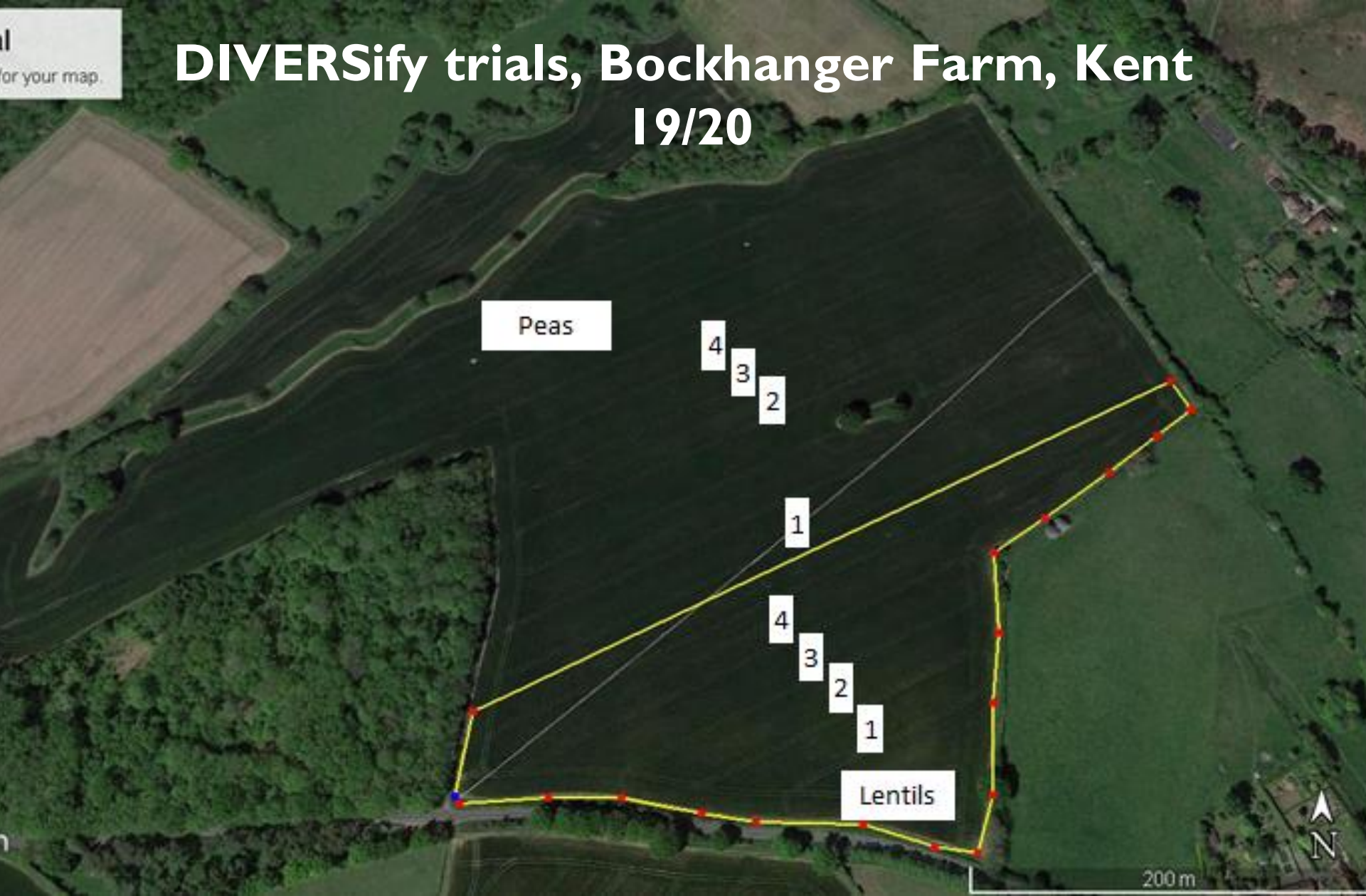
Results

- **Bruchid infestation:** Highest in low bean seed rates. Lowest in 45/45 plants/m²
- **LER:** All intercrop mixtures gave a LER > 1.0. Highest LER was from the mixture of Bean45/Oat70 (LER 1.30)
- **Gross Output-variable cost:** Highest in Bean45/Oat70 mixture



il
for your map.

DIVERSify trials, Bockhanger Farm, Kent 19/20



Peas and oats, Bockhanger Farm, Kent 19/20

Motivations: Trellis and weed suppression effects of oats

Establishment:

| Plot 1 | Pea plants/m2 | Oat plants/m2 (Total kg) |
|---------------|---------------|---------------------------|
| 1 (0.4ha) | 70 | 0 |
| 1a (0.4ha) | 70 | 18 6.3kg/ha (2.52kg) |
| 2 (0.4ha) | 70 | 75 26.25kg/ha (10.5kg) |
| 2b (0.4ha) | 70 | 0 |
| 3 (0.4ha) | 70 | 35 12.25kg/ha (4.9kg) |
| 3b (0.4ha) | 70 | 75 26.25kg/ha (10.5Kg) |
| 4 (0.4ha) | 70 | 18 6.3kg/ha (2.52kg) |
| 4b (0.4ha) | 70 | 35 12.25kg/ha (4.9kg) |



Conyer Peas and Oats Plot 3: 70 plants/m² Pea and 35 plants/m² Oats

Lentils and oats, Bockhanger Farm, Kent 19/20

Motivations: Trellis and weed suppression effects of oats

Establishment:

| Plot 1 | Lentil plants/m ² | Oat plants/m ² |
|-------------|------------------------------|---------------------------|
| 1 (0.14ha) | 90 | 70 |
| 1b (0.14ha) | 90 | 30 |
| 2 (0.2ha) | 90 | 50 |
| 2b (0.2ha) | 90 | 0 |
| 3 (0.25ha) | 90 | 30 |
| 3b (0.25) | 90 | 70 |
| 4 (0.34ha) | 90 | 0 |
| 4b (0.34ha) | 90 | 50 |



Conyer Lentils and Oats Plot 3: 90 plants/m² Lentils and 30 plants/m² O

Godinton Trial

Legend

| Plot | Oats | Bean |
|-------------|------|------|
| 1 (0.87ha) | 250 | 0 |
| 2 (0.88ha) | 0 | 50 |
| 3 (0.88ha) | 250 | 25 |
| 4 (0.87ha) | 125 | 25 |
| 5 (0.87 ha) | 80 | 15 |

5 4 3 2 1

Google Earth

100 m





Conyer Bean and Oats Plot 3 (RIGHT): 25 plants/m² Beans and 250 plants/m² Oats
Plot 4 (LEFT) 25 plants/m² Beans and 125 plants/m² Oats

Chilstons Trial

Legend

| Plot | Beans | Oats |
|------------|--|---|
| 1 (0.50ha) | Alternating 3m strips: 50 plants m ² | Alternating 3m Strips: 250 plants m ² |
| 2 (0.52ha) | Alternating 6m strips: 50 plants m ² | Alternating 6m strips: 50 plants m ² |
| 3 (0.54ha) | Alternating Rows: 50 plants m ² | Alternating Rows: 70 plants m ² |
| 4 (0.54ha) | Alternating Rows: 50 plants m ² | Alternating Rows: 125 plants m ² |
| 5 (0.54ha) | Mixed Rows 50 plants m ² | Mixed Rows 50 plants m ² |

1 2 3 4 5

Google Earth

200 m





Chilston Plot 2 Beans and Oats: Alternating 6m strips: 50 plants m²



Chilston Plot 4 Beans and Oats: Alternating rows: 50 plants m²

Cowhouse Undersowing Trial

Legend

| Plot | Herbicide | Undersown |
|-------------|-----------|--------------------|
| 1 (0.35 ha) | No | No |
| 2 (0.35 ha) | Yes | No |
| 3 (0.35 ha) | Yes | 2kg/ha Microclover |
| 4 (0.35 ha) | No | 2kg/ha Microclover |
| 5 (0.35 ha) | No | 4kg/ha Microclover |

5 4 3 2 1





Cowhouse Plot 5: No herbicide and 4kg/ha microclover

Wheat and beans, Roundhill Farm, Wiltshire

Motivations: Weed suppression (especially wild oat), increase wheat protein?

Establishment: 1 ha strips, wheat and beans in two passes

2018

Tundra

Mulika

| | |
|--|-------------------|
| Wheat 174kg/ha Beans 125kg/ha | Beans 125kg/ha |
|--|-------------------|

2019

Tundra

Mulika

| | |
|--|-------------------|
| Wheat 100kg/ha Beans 200kg/ha | Beans 200kg/ha |
|--|-------------------|

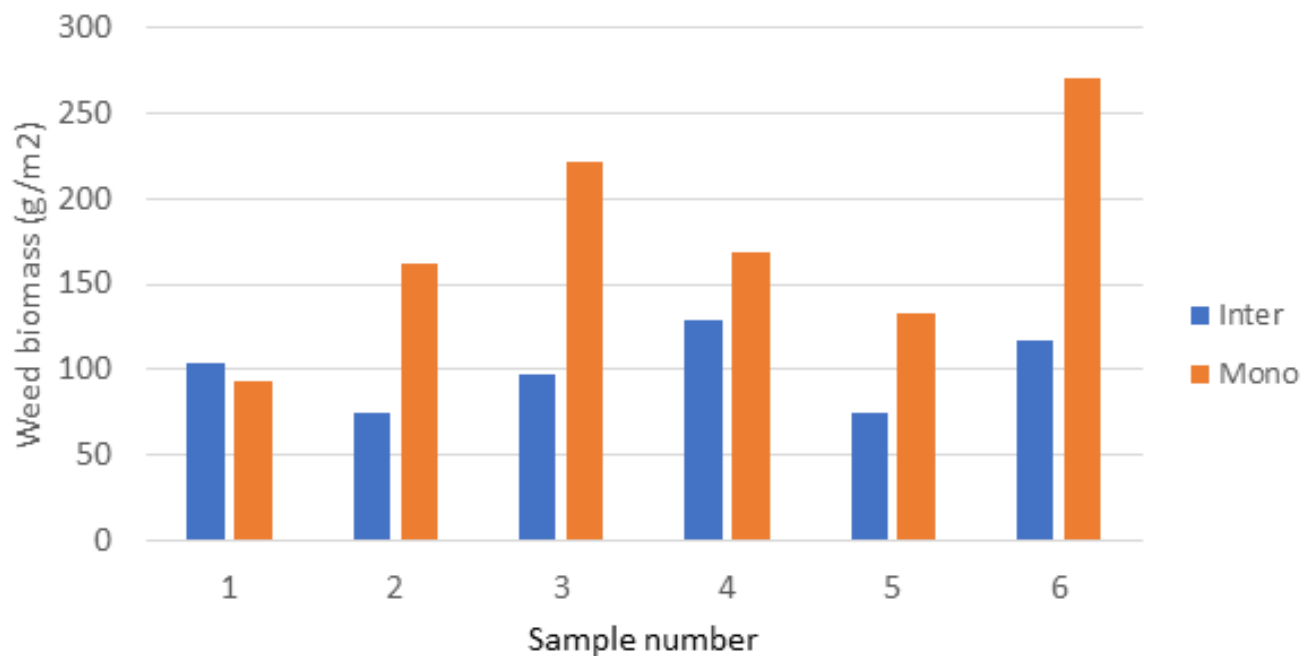
Processing and use: Harvested together and used on farm as a mixed feed for livestock.



Wheat and beans, Roundhill Farm, Wiltshire

Results:

- 2018
 - **Weeds:** 74% less dry weed biomass in intercrop than monocrop
 - **Yield:** Small bean yield penalty in intercrop (wheat rate too high?)
- 2019
 - **Weeds:** 73% less dry weed biomass in intercrop than monocrop
 - **Yield:** Monoculture crop destroyed due to high weed burden



Some indication of improved wheat quality in intercrop in 2019 with protein content of 10.94 v 10.67 in monocrop.



DIVERSify @ James Hutton Institute



DIVERSify @ James Hutton Institute





REMIX @ Scotland's Rural College





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In summary....



- No silver bullet – find what works on your farm
- Set key objectives for mixture
- Priority crop? Focus on yield of this crop
- Try different seed rates / varieties on small area
- Be clear about the end use and how to separate if needed
- Speak to others who are doing it – join the Intercropping Field Lab!



Find out more...www.agricology.co.uk @agricology and YouTube channel! 😊

Agricology @agricology · 20 Sep 2017
 Beans and wheat #intercropping: a new look at an overlooked benefit
bit.ly/2xdSuu4 @OrgResCen #organic #sustainablefarming #Farming



1 13 18

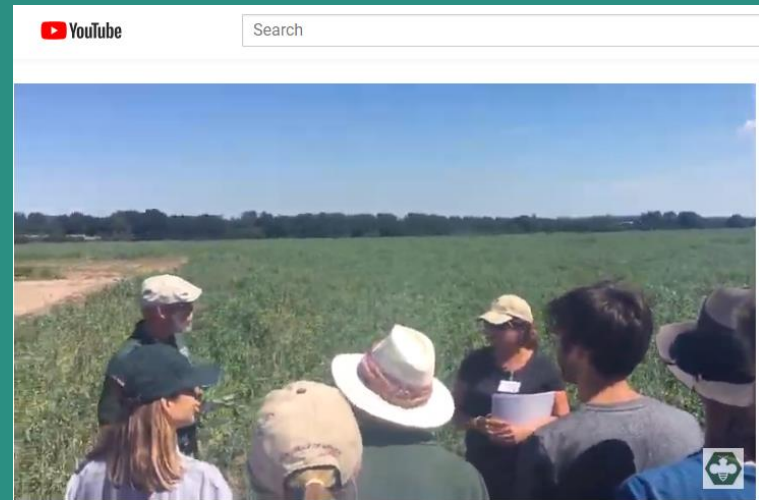
Combinable protein crop production

Institute of Organic Training & Advice Research Review

Download the PDF

AUTHOR(S): Wright, I
 FUNDERS: Defra
 ORGANISATION: Institute of Organic Training & Advice (IOTA)
 COPYRIGHT: © IOTA
 EVIDENCE: Academic research
 RELATED THEME:
 - Weeds
 - Pests & diseases
 - Poultry
 - Cereals, oil seeds & pulses

RESOURCE EXPLAINED:
 - This paper provides valuable information taken from research and observational experience of combinable protein crop production in UK organic farming systems. It also refers to European research on peas, faba beans and lupins, their role in rotations, nitrogen fixation, varieties, establishment, weed control, pests, machinery, processing and preservation with animal products.



Intercropping carlin peas and triticale @ Green Acres Farm

INNOVATIVE FARMERS

Home Field Labs Inter cropping in arable systems

MEET THE TEAM

ORGANIC RESEARCH CENTRE
 ELM FARM
 01483 653248

Researcher Institution
 Organic Research Centre
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UK's leading independent research centre for the development of organic/agricultural food production and land management solutions.

DIVERSify INTERCROPPING GROUP
 Founded 13 September 2017

Field Lab Timeline

ORC Bulletin No. 112, Spring/Summer 2015

Beans and wheat intercropping: a new look at an overlooked benefit


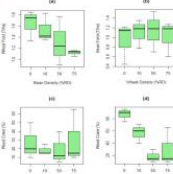
Nearly a decade ago and after several years of R&D, ORC researchers were convinced that intercropping of beans and wheat would be a valuable approach for organic farmers. Despite clear evidence of benefits few took it up. It is now being rediscovered by researchers in other countries. Martin Whibley, one of the earliest proponents of the approach, has never doubted its value. Here he, Nick Padgugley, Louise Whidder and Thomas Diving report on a trial last year, at Walsley's Agroforestry, intercropping spring wheat and beans.

each other, delaying the spread of pathogens. There are also several suggested mechanisms by which intercropping reduces pests for example, beans may provide habitat and food sources for beneficial insects, thus controlling pest populations.

Intercropping - weeds and yield

A trial was carried out at Walsley's Agroforestry in growing season 2012 to investigate the system's ability to reduce weeds in a spring wheat-bean crop of wheat and faba beans.

The wheat cultivar used was Pagan and the beans were Fuego. The experimental trial included plots of wheat or bean-only sole crops as well as various combinations of wheat and bean rows sown at 75, 50 and 10% of their Recommended Density (RD) for sole cropping.

Beans are an important crop, mainly used for high protein livestock feed and wheat is a valuable cash crop. However, beans are often unreliable under organic conditions as yields can be depressed by British beetle attack, Chocolate Spot disease and weed competition. Intercropping wheat with field beans can be a practical approach to reduce these risks while making use of additional benefits:

Provided that the rotation time of the two crops is similar, they can be harvested together and either separated using a weed harrow or used as a mixed livestock feed. Alternatively, the intercrop can be used for whole crop silage.^{1,2} Depending on variety choice, there is the further possibility of using both crop components directly for human consumption.

There are several ways in which wheat and beans are complementary:

- Beans, being legumes, are able to fix and use atmospheric nitrogen whilst wheat only uses nitrogen already in the soil.
- When plants sown at lower density relative to their density in a monoculture in a mixed crop may have access to more nutrients per plant than they would in a dense monoculture.
- Light competition in the intercrop is lower than in the sole crop as the two species make use of light resources in different parts of the canopy and at different times in the growing season.
- disease incidence is also generally lower in diverse cropping systems as host plants are further apart from

Figure 1: Yield in t/ha (panel a, b) and seed cover in % ground cover (panel c, d) depending on the density of the bean (L) or the wheat partner (H, O). In panel (d) wheat yield responds to the density of the accompanying bean, to keep results comparable those which are included in panel (c) where wheat is sown at 75% of the recommended density (RD). Generally panel (b) shows the response of the bean yield to the density of the wheat when the bean density is fixed at 75% RD. Similarly, panel (c) is shown for plots of wheat at 75% RD and varying bean density (L), and for plots of beans at 75% RD with the accompanying wheat at the variable 10 RD shown on the x-axis.

www.organicresearchcentre.com

Field Beans and Lupins

Field Beans

View the website

AUTHOR(S): Babbley, J & Walker, R
 FUNDERS: Scotland's Rural College (SRUC)
 ORGANISATION: Scotland's Rural College (SRUC)
 DATE: January 2014
 COPYRIGHT: © SRUC
 EVIDENCE: Applied research
 RELATED THEME:
 - Markets & food systems
 - Cereals, oil seeds & pulses
 - Grasslands & forage crops

RESOURCE EXPLAINED:
 With purchased protein being expensive, home-produced protein in the form of crops such as field beans and lupins can be an attractive alternative. This technical summary of Scotland's Rural College (SRUC) provides practical information on growing field beans and lupins. Whilst aimed at farmers and growers in Scotland, it has a broader relevance.