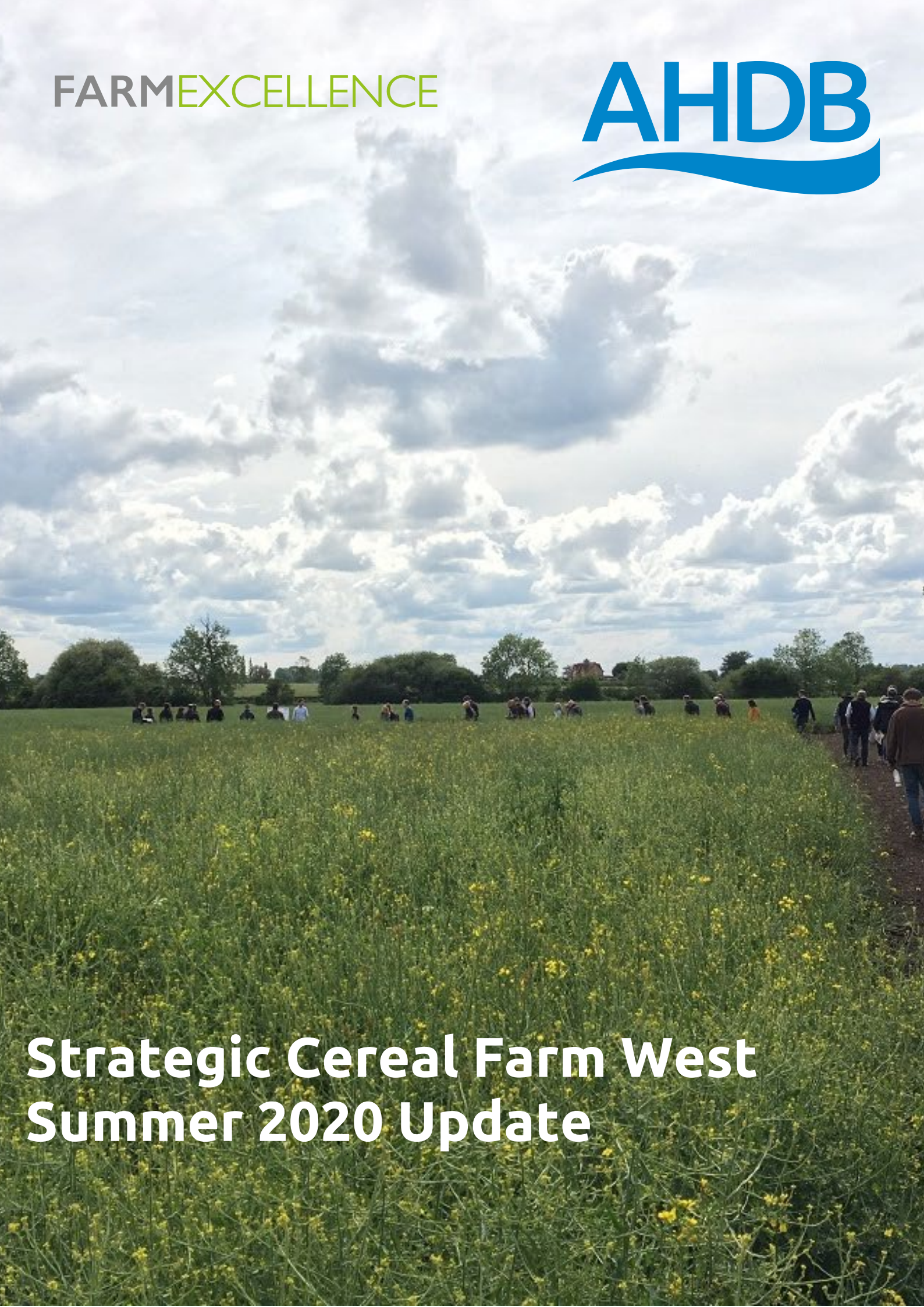
FARMEXCELLENCE

AHDB



Strategic Cereal Farm West Summer 2020 Update

Strategic Cereal Farms are a key part of AHDB's Farm Excellence network. They provide a platform to showcase research in practice via a structured combination of short and long term field and farm scale trials.

Each Strategic Cereal Farm runs for six years to allow independent demonstration of research to be conducted across a full rotation.

The farms test and demonstrate new ways of working in a commercial setting. Approaches are subject to full cost-benefit analyses using Farmbench which helps other farmers to assess the possibility of changing approaches on their own farms.

There are three Strategic Cereal Farms as part of the AHDB network:

- Brian Barker, Strategic Cereal Farm East
- Rob Fox, Strategic Cereal Farm West
- David Aglen, Strategic Cereal Farm Scotland

Visit our website for more information on AHDB Farm Excellence network: ahdb.org.uk/farm-excellence

Contents

Strategic Cereal Farm West

Host farmer:	Rob Fox
	@SquabRob
Location:	Squab Hall Farm, Harbury Lane, Leamington Spa, Warwickshire CV33 9QB
Duration:	November 2018 – September 2024

1. Introduction

Rob Fox manages Squab Hall farm, based just outside Leamington Spa. The business is highly diversified, with a large enterprise around general storage and document storage, as well as machinery and labour sharing with three arable farms. Robert farms 400 ha of owned and rented land, with a rotation of winter wheat, winter barley, winter oilseed rape, spring beans and spring barley.

The Strategic Cereal Farm West, hosted by Rob Fox at Squab Hall Farm, is a platform for the integration of research and practical farming that has the potential to change the way we farm for the better. The Strategic Cereal Farm West demonstrates research outputs and communicates the full net-margin cost benefit analysis of demonstrations to help farmers make real differences to their businesses and continue to be proud of our industry and the jobs we do.

The vision of the Strategic Cereal Farm West is to test research outputs in an independent, open, honest and transparent way. The project will help the UK agricultural industry, primarily farmers, to try out new strategies and develop practical solutions to address regional priorities and challenges.

Rob Fox joins a growing network of Strategic Cereal Farms, including Brian Barker who hosts the Strategic Cereal Farm East near Stowmarket, Suffolk and David Aglen and Johnnie Balfour who host the Strategic Cereal Farm Scotland in Fife.

A steering group of local farmers and advisers help to guide the programme and support Rob over the six years. If you have any questions or suggestions, please feel free to get in touch with the steering group members – Jock Willmott, Colin Woodward, Ian Matts, Mark Wood, Richard Meredith and Emily Pope.

2. Weather summary

The monthly average temperature (°C) and total rainfall (mm) between 1 August 2019 and 30 April 2020 is shown in Figure 1.

Between 1 August 2019 and 30 April 2020, the Strategic Cereal Farm weather station recorded a total of 545 mm of rainfall, exceeding the total measured during the August 2018 to August 2019 growing season (533 mm). The maximum temperature recorded was 32.2°C in August 2019. The minimum temperature recorded was -2.9°C in March 2020.

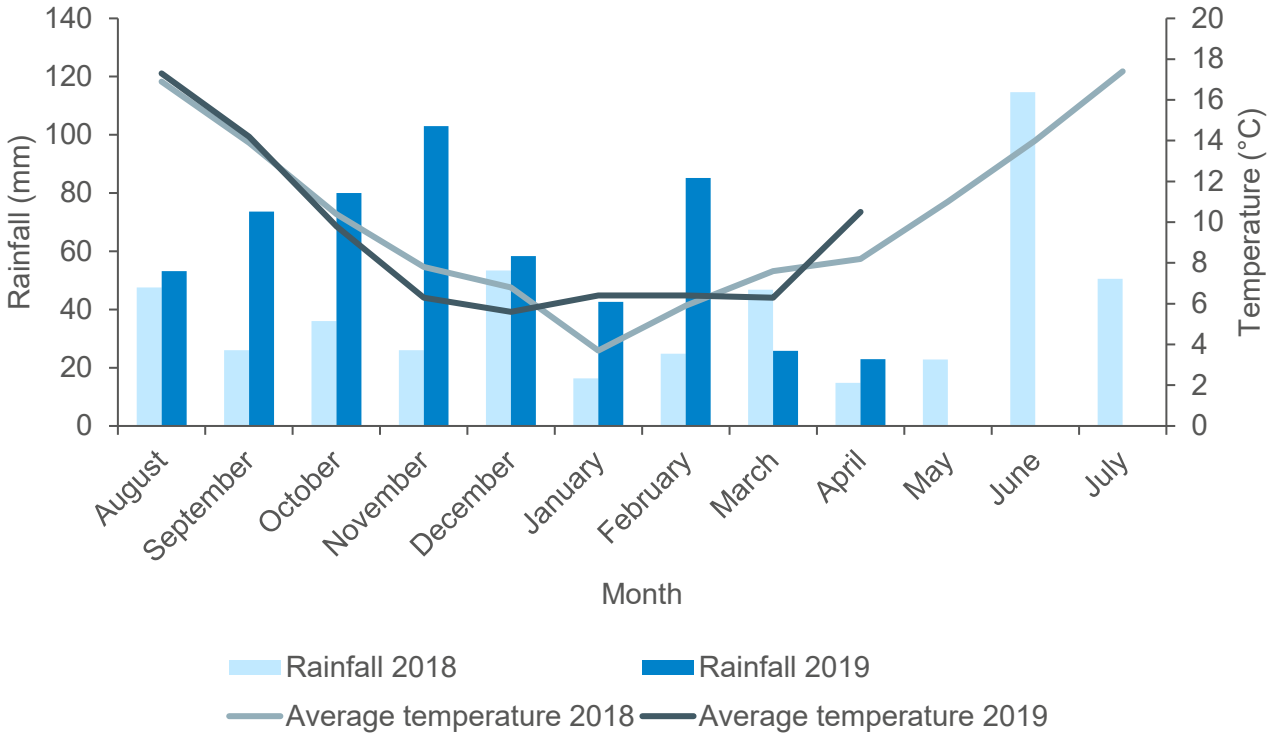


Figure 1. Weather data from weather station at Strategic Cereal Farm West (1 August 18 – 30 April 2020)

3. Timeline of trials

Harvest 2019

Baselining

The aim of the first year of the Strategic Cereal Farm project, known as the baselining year, was to determine the starting point of a number of indicators within the farmed environment before any changes are investigated and evaluated. The following indicators have been assessed during the first year of the programme, 2018-2019, and will be monitored over the next six years:

- Weather station
- Soil nutrient analysis
- Earthworms
- Electrical conductivity scanning
- Soil physical structure
- Crop biomass
- Weeds
- LEAF Sustainability Review

Trials

- The impact of cultivation depth on soil properties and rooting on winter wheat yields
- The impact of reduced fungicide applications on yield of varieties with different disease resistance ratings
- The impact of cultivation depth on headland areas on soil health and crop productivity
- The impact of nutrient inputs on crop productivity

Harvest 2020

- The impact of cultivation depth on soil properties, rooting and yield of oilseed rape
- The impact of perennial flower strips on beneficial insect populations, pests and weeds
- The impact of summer catch crops on soil physical properties and performance of the following crop

Welcome to the Strategic Farm West. Meet the team by watching a video welcoming us to Strategic Farm Week 2020 here.

Learn more about the Strategic Farm programme and trials for harvest 2020 at the Strategic Cereal Farm West, here.

Full details about the baselining and trials at the Strategic Cereal Farm West are available online: ahdb.org.uk/farm-excellence/strategic_cereal_farm_west

4. Harvest 2020 partners

We are very grateful to Rob Fox and all the team at Squab Hall for their hard work and dedication in carrying out the operations, assessments and analysis at the Strategic Cereal Farm West.

We are pleased to be working with ADAS to carry out the assessments and analysis on the trials at the Strategic Cereal Farm West for harvest 2020.

Many thanks go to RAGT seeds for the provision of the phacelia and oil radish catch crop mix and sourcing of barley seed at the Strategic Cereal Farm West.

5. The impact of cultivation depth on soil properties, rooting and yield

Trial leader: Anne Bhogal, ADAS

Anne.Bhogal@adas.co.uk

@anne_bhogal

Start date: 19 October 2018

End date: Ongoing

Watch a video update on this trial from Anne Bhogal and Frances Pickering, ADAS, and Rob Fox, host farmer, here

This 6 year trial is investigating the impact of cultivation depth on soil properties, rooting and crop yield over the rotation. For harvest 2019, the trial was in winter wheat. Soil structure and earthworm numbers were identified as key soil constraints across the farm, including in this trial. Shallow cultivation, to a depth of 5 cm, increased topsoil strength and resulted in a steeper root angle that led to greater rooting in the subsoil. However, subsoil properties had a greater impact on measured crop traits than cultivation depth. At harvest there were no significant yield differences.

For harvest 2020, the trial was drilled in oilseed rape. Due to challenging field conditions at establishment, and pressures of cabbage stem flea beetle (CSFB), the trial was redrilled in spring beans.

What was the challenge/demand for the work?

There is an increasing need to manage soils sustainably, with the recognition of the importance of soil for providing food and delivering ecosystem services. Soil erosion, loss of organic matter and compaction are some of the main issues affecting arable soils. Additionally, it has been calculated that high yielding crops need to capture all the water in soil down to 1.5 m. Rooting measurements in recent years have shown that many crops have insufficient roots (less than 1 cm^{-3}) to fully access water below 40 cm deep. Limited rooting of crops could be a major limitation to crop yields (White et al. 2015). This is an important issue due to the predicted decreases in summer rainfall in the UK and the sensitivity of anthesis and grain fill growth stages in cereal crops to water limited conditions.

Cereal and oilseed roots cannot penetrate through strong soils. To reach deeper soil depths roots are dependent on exploiting pre-existing cracks, fissures and channels. Furthermore, soil conditions have an impact on pest pressure risk factors. Risk factors associated with cabbage stem flea beetle pressure in oilseed rape crops include drilling into dry and cloddy seedbeds resulting in crops that are slower to emerge, with reduced vigour.

There is a need for UK, farm-based replicated trials to test the impacts of different cultivation practices on soil quality and health, crop rooting and yield, and pest pressure in both the long and short term.

How did the project address this?

A replicated (2) tramline trial with three cultivation depths (5, 15 and 30 cm) was established in winter wheat var. Graham on 19 October 2018. Oilseed rape was drilled on 24 August 2019 and an additional direct drill treatment was added as shown in Figure 2. The field was divided into sampling zones to correspond with each treatment area. Within each sampling zone, three sampling points were identified corresponding to the maximum, median and minimum penetrometer resistance measurements to a depth of 30 cm. Each sampling point was marked and all assessments taken from within a 10 m radius.

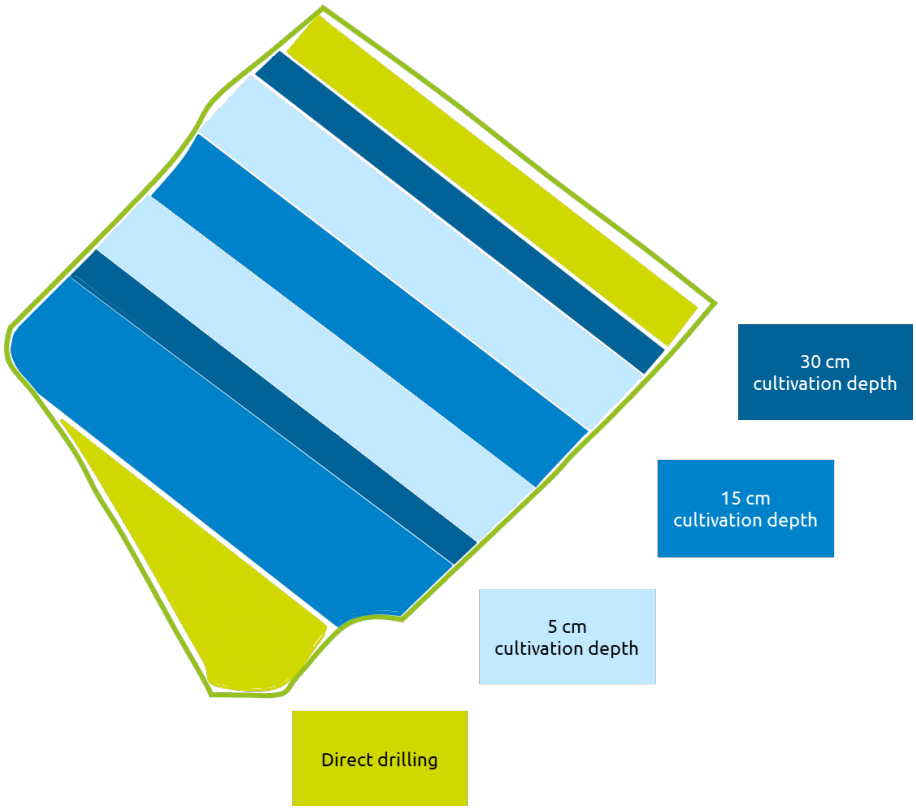


Figure 2. Cultivation trial layout harvest 2020

The majority of the trial had soil health scorecard assessments in spring 2019 so there is little to gain by re-sampling in the coming season as spatial and temporal variation is likely to be larger than any management effect. For harvest 2020, the following assessments will be completed:

- Topsoil VESS
- Earthworms
- Penetration resistance to 50 cm
- Soil moisture 0-15, 15-30, 30-50 cm
- Bulk density at 0-5, 5-10, 15-20 cm

This will allow identification of potential differences in soil properties caused by cultivation but also by combining this with crop rooting data it can be better understood how soil properties are improving or restricting crop rooting.

Soil health scorecards will be completed on the new direct drill treatment tramlines, excluding the microbial biomass C and nematodes as this will vary temporally and cannot be compared to the other tramlines in the field.

Rooting assessments will be undertaken on all treatments at full establishment. Three sample points will be assessed per treatment based on the maximum, median and minimum penetration resistance defined in the previous year.

Whilst the trial was in oilseed rape, cabbage stem flea beetle (CSFB) larvae counts were sampled in November/ December. Ten plants in five locations in each of the treatment tramlines were destructively sampled and dissected for CSFB larvae.

What results has the project delivered?

A summary of the harvest 2019 results is provided below. For more information, click here.

Soil health scorecard

The draft Soil biology and Soil Health Partnership scorecard evaluated soil properties and identified key issues including below average soil organic matter levels, some evidence of soil compaction, indicated by VESS and bulk density, and a depleted earthworm population.

Penetrometer resistance and crop rooting

The shallow cultivation depth (5 cm) had significantly (P<0.05) greater penetration resistance in the top 10cm of soil, compared to 15 and 30 cm cultivation depths. This increased topsoil resistance had no significant impact on aboveground biomass assessed at GS31, 39 and 61. Underlying subsoil compaction was present within the 30 cm cultivation depth tramlines.

Average root angle for each cultivation treatment was assessed at GS30. There was a significant (P<0.05) positive association between penetration resistance at 15 cm depth and root angle (r=0.49). Crop root angle was greater (steeper), in the shallow cultivation depth, indicating that increased consolidation in the topsoil promoted downward growth of roots. Root growth becomes restricted at >1.5 MPa (Whalley et al. 2008).

RLD and root dry weight in the subsoil (80cm) post anthesis were positively associated (P<0.05) with a steeper root angle (r=0.55).

Rooting and subsoil compaction

The association between RLD at 60 cm depth, measured post-anthesis, and penetrometer resistance at 25, 30, 35 and 40 cm depths, assessed at GS30 is shown in the graph below. Increased soil strength between 25 to 40 cm soil depth was associated with less rooting (RLD cm/cm^3) in the subsoil (60 cm soil depth). This negative association was statistically significant (P<0.05) (r =-0.67 to -0.75).

Root and shoot associations

The association between RLD at 80 cm depth, measured post-anthesis, and crop tissue nitrogen (N) concentration at GS31 is shown in the graph below. Improved rooting in the subsoil was positively associated (P<0.05) with aboveground crop biomass at anthesis and increased tissue N concentration at GS31 (Fig. 5, r=0.64).

Crop yield

The average measured yield for the 15 cm treatment was 11.57 t/ha. We estimated apparent treatment differences from this yield, after correcting for spatial variation within the field. For the 5 cm cultivation treatment a yield decrease of 0.44 ± 0.71 t/ha was estimated compared to the farm standard cultivation (15 cm), and for the 30 cm cultivation treatment a decrease of 0.77±0.84 t/ha was estimated. The statistical model indicated that the size of these yield differences could have been due to chance or other sources of variation, such as soil differences.

Action points for farmers and agronomists

Regular monitoring of soil structural condition is vital at the field level to inform soil management decisions. The most effective and practical method for determining soil structure is the direct visual and physical examination of the soil profile (e.g. VESS). Earthworm counts are also a useful indicator of overall soil health, important in the development of good soil structure.

The impact of cultivation treatments on soil quality and crop performance are best assessed over the long term and this trial, which is currently in its second harvest year will continue for the duration of the Strategic Cereal Farm programme.

Links to further information and references

- **Research Review No. 43:** Management of cereal root systems (online)
- **Student Report No. SR41:** Quantifying rooting at depth in a wheat doubled haploid population with introgression from wild emmer (online)
- **Practical information** on soil management and soil assessment methodologies can be found online: ahdb.org.uk/greatsoils
- **Soil Biology and Health Partnership project:** ahdb.org.uk/greatsoils
- **AHDB Factsheet :** How to count earthworms (online)

6. Pests and natural enemies

Trial leader: Mark Ramsden, ADAS

Mark.Ramsden@adas.co.uk

@mwramsden

Start date: May 2019

End date: Ongoing

Watch a video update on this trial from Emily Pope, AHDB and Rob Fox, host farmer, here

What was the challenge/demand for the work?

The abundance and impact of invertebrate pests and their natural enemies is dependent on a number of different factors, including (but not limited to); soil type, crop variety and physiology, agronomy, local weather conditions, and the availability of non-crop resources in the surrounding landscape. These factors and their interactions lead to a high degree of variation in invertebrate abundance both within and between fields. This work will create a robust dataset to demonstrate the inherent variability in invertebrate abundance, and investigate locations with relatively high/low levels of abundance. It will describe the drivers of variation, and how observation data needs to be interpreted relative to that variation in order to be useful.

Within arable crop production, margins of pollen and nectar flower can be used to increase numbers of pollen and nectar feeding insects. In 2004, AHDB published research on Managing biodiversity in field margins to enhance integrated pest control in arable crops. The researchers reported that non-crop habitats constitute one of the most important sources of biodiversity within farmland. In many arable areas, field margins are the only major non-crop habitat, acting as the main source of beneficial species, and it has been recognised for some time that field margins can play an important role in the development of novel manipulation techniques to enhance insect predators and parasitoids.

How did the project address this?

Three AHDB Farm Excellence sites are hosting a trial that is investigating the impact of perennial flower strips on beneficial insect and pest populations within the field margins and within the arable crop. These sites are located at the Strategic Cereal Farm East and Petworth Monitor Farm.

In addition to the perennial flower strip field trials, the field team are monitoring slugs and summer aphids, and their natural enemies at a sub-field scale. Fields were selected for monitoring based on the trials undertaken within them (i.e. perennial flower strips), and to capture a range of likely drivers of variation across the farms. All monitoring is carried on 100m transects, with sampling points at 25m intervals. In most fields these are laid out in pairs; one close to the field margin, and one approximately 100m into the crop. This enables the team to look at the effect of distance into the crop on pest and natural enemy.

At the Strategic Cereal Farm West, a total of five fields were monitored. In three of those fields, a field scale trial was established as shown in Figure 3. The treatments are:

- Farm standard

- Within field and field edge strips
- Field edge flower strips

Field, cropping and soil type are provided in Table 1. Beneficial insects and pest populations will be monitored within the flowering strips and within the arable crop.

Table 1. Perennial flower strips trial site field details

Treatment name:	Farm standard	Field edge flower strips	Within field and field edge flower strips
Field name:	42	40	43
Field size (hectares):	32	9	7.5
Soil type:	medium, heavy, very heavy	Medium, very heavy	Medium
Harvest 2019 crop:	spring barley/ oilseed rape	Oilseed rape	Oilseed rape
Harvest 2020 crop:	Wheat	Wheat	Wheat

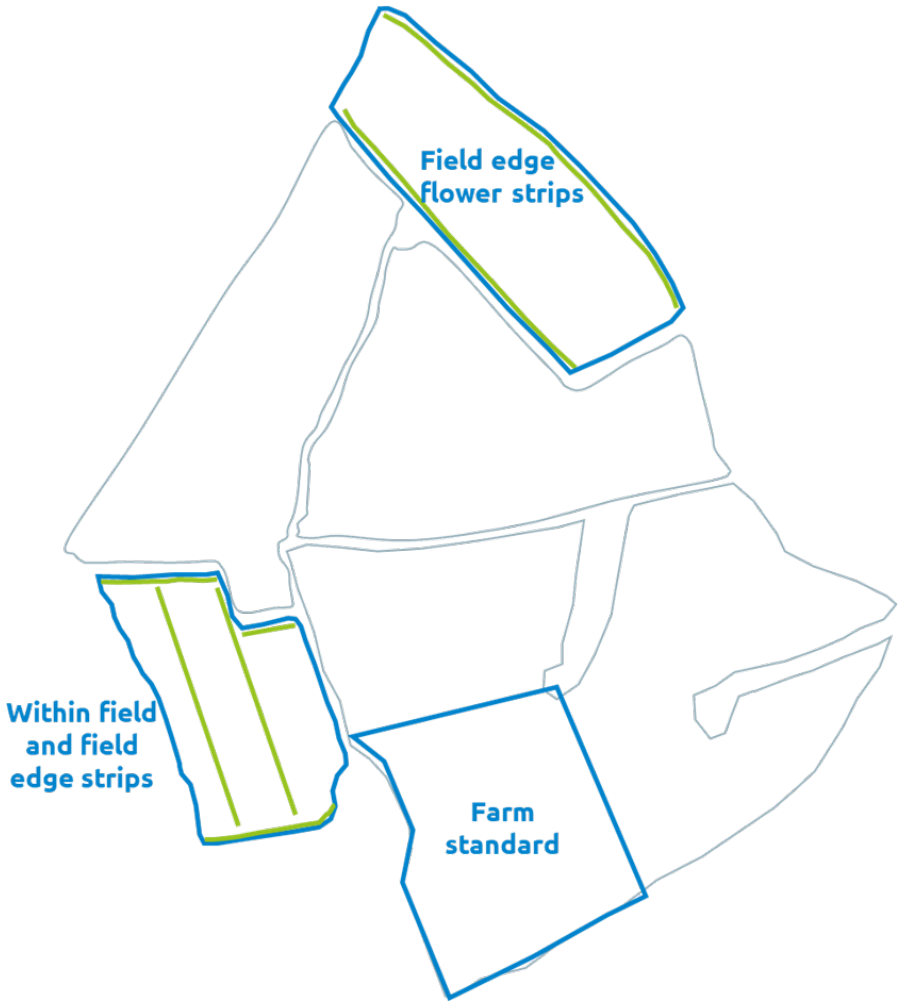


Figure 3. Perennial flower strips trial layout

The seed mix was shown in Figure 4 was sown in May 2019.

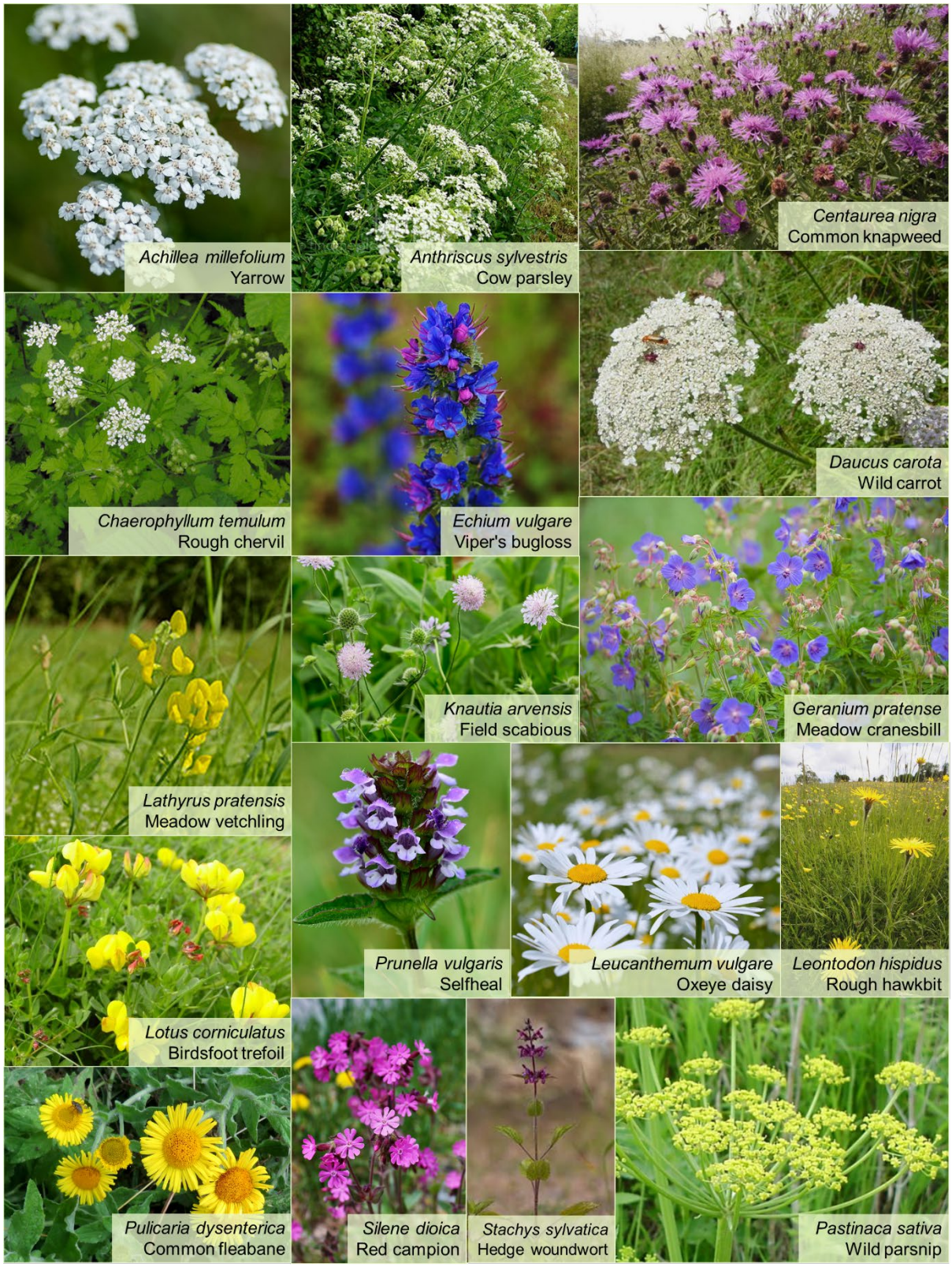


Figure 4. Seed mix sown in flower strips

An aerial photograph, taken in June 2019, of the field sown with flowering strips within the field and on the field edges is shown in Figure 5.

Figure 5. Within field and field edge strips

Figure 6 shows photographs of the flowering strips, taken in May 2020.

Figure 6. Photographs of the flowering strips, taken in June 2020

Assessments

Throughout this work, the methods that are being used are feasible for other farmers to try out themselves:

- Pests and natural enemies will be assessed in the autumn (late October/start of November), and in the summer (around wheat GS60). Slugs are monitored using simple bait traps; a teaspoon of bran covered with an inverted plant pot saucer, fixed to prevent it blowing away (Figure 7)

Figure 7. Slug trap using chicken layers' mash as bait, from the AHDB Integrated slug control factsheet

- To monitor natural enemies of slugs and other ground dwelling invertebrates, we are using pitfall traps. These consist of a plastic tub (e.g. yogurt pot or pint glass) submerged into the ground so that the open end is level with the soil surface. These are part filled with saline solution to kill and preserve any invertebrates that fall into the tap over a three day period
- Summer aphids (Figure 8) and their natural enemies will be monitored using plant counts. Each monitoring point will consist of twenty randomly selected tillers at transect monitoring points
- On each tiller the number of aphids, diseased aphids, mummified aphids, hoverfly larvae, ladybird larvae, adult ladybirds, or other invertebrates will be counted

Figure 8. Grain aphids *Sitobion avenae* on wheat ear

Preliminary results

Detailed analysis of slug abundance and distribution will be completed once all data has been collected, however early indications suggest that slugs were found in higher numbers further away from field margins across all fields and farms (Table 2).

Table 2. Initial results of slug trapping: average number of slugs per trap November 2019

Farm	Field	Close to field margin	100m into crop from margin
Strategic Cereal Farm East	Big Guinea Row	35	40
	Top 59	13	16
	Bottom 59	20	16
	Kells	0	0
	Tom Dixon	1	1
	Wally's	3	2
Strategic Cereal Farm West	Field 40 (field edge flower strips)	4	2
	Field 42 (farm standard)	1	0
	Field 43 (Within field and field edge flower strips)	7	7
	Field 6	4	7
	Field 7	2	8
Petworth Monitor Farm	14.A	40	84
	10.A	6	4
	06.A	33	73
	Overall Average	12	18

Invertebrates collected in the autumn pitfall traps are still being assessed, however initial results indicate that the ground beetle *Pterostichus niger* was the most prevalent insect collected (Figure 9). This generalist predator is often found in agricultural fields, and is an important natural enemy of a wide range of invertebrates.

Figure 9. A common ground beetle found in most fields, *Pterostichus niger*

Future work

A further round of slug trapping and pitfall trapping is scheduled for June 2020. The cereal aphid and natural enemy assessments will also take place in June.

Once all the data is collected, it will be analysed with respect to location, agronomy and surrounding habitat in each field, to identify any key drivers of variation within slug, aphid, and natural enemy distribution.

Links to further information and references

- **AHDB Encyclopaedia of pests and natural enemies** (online)
- **AHDB Integrated slug control factsheet** (online)
- **ASSIST Research** (online)
- **GWCT Wildflower mixes and pollen and nectar strips** (online)

7. The impact of summer catch crops on soil physical properties and performance of the following crop

Trial leader: Anne Bhogal, ADAS

Anne.Bhogal@adas.co.uk

@anne_bhogal

Start date: May 2020

End date: Ongoing

Watch a video update on this trial from Emily Pope, AHDB and Rob Fox, host farmer, here

What was the challenge/demand for the work?

The aim of this trial is to assess the impact of a summer catch crop on soil nitrogen supply, soil structure and the performance of the following crop in the rotation. The trial will:

- Compare the impact of contrasting summer catch crop mixes compared to leaving the land fallow on soil nitrogen supply and following crop yields
- Assess the impact of contrasting summer catch crops compared to leaving the land fallow on soil structural condition

How will the project address this?

Catch crops were drilled in May 2020 (Figure 10) and will be destroyed in July 2020 ahead of drilling winter wheat in September 2020. There are two replicates of three treatments, with plots covering a 300 m tramline width and up to 900 m in length. Penetrometer resistance will be measured across each tramline, the location of the median point of resistance will be GPS recorded and all assessments (Table 3) taken within a 10 m radius of this point.

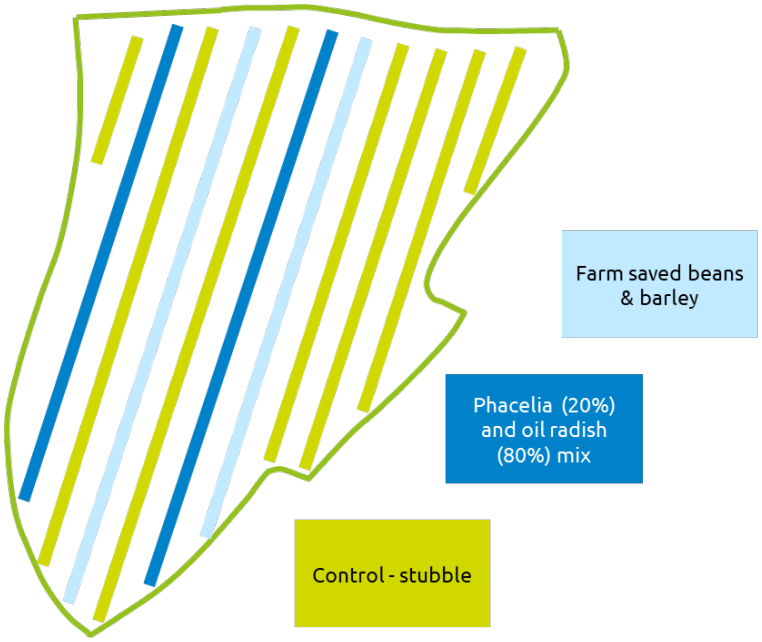


Figure 10. Catch crop trial layout

Table 3. Timeline of assessments on catch crop trial

May 2020	• Drill catch crop
	• Topsoil sample (0-15 cm)
	  • pH
	  • Available P, K, Mg
	  • Soil texture
	  • Total N
	  • Organic matter
	• Catch crop establishment NDVI

June 2020	• Catch crop establishment NDVI • % cover of each species in the mix (and other non-drilled species) • % dry matter and total N content • Destroy catch crop
July 2020 August 2020	
September 2020	• Drill winter wheat • Winter crop establishment NDVI
October 2020	• Winter crop establishment NDVI

November 2020	• Winter crop establishment NDVI
	• Soil nitrogen supply
	  • Soil mineral nitrogen 0-90 cm
	  • Above ground biomass N
	• Soil structure:
	  • Penetrometer
	  • VESS
	  • Bulk density
	• Earthworms
	• Weed assessments

December 2020 January 2021 February 2021	

March 2021	• Soil nitrogen supply
	  • Soil mineral nitrogen 0-90 cm
	  • Above ground biomass N
	• Soil structure:
	  • Penetrometer
	  • VESS
	  • Bulk density
	• Earthworms
	• Weed assessments

April 2021 May 2021 June 2021 July 2021	
August 2021	• Nitrogen uptake of winter wheat • Harvest winter wheat

Links to further information and references

- **Maximising the benefits from cover crops through species selection and crop management (Maxi-Cover crop)** (online)
- **AHDB Rotations Partnership** (online)

Keep up-to-date

- **Visit ahdb.org.uk/farm-excellence for the latest information**
- **Follow #strategicfarm on Twitter**

For further information on the Strategic Cereal Farm West, please contact:

Emily Pope
Senior Knowledge Transfer Manager
emily.pope@ahdb.org.uk
07790 948 248
@emilypope_KT

Fiona Geary
Knowledge Transfer Officer
fiona.geary@ahdb.org.uk
07891 656 784
@FionaGeary_KT

Richard Meredith
Senior Knowledge Exchange Manager
richard.meredith@ahdb.org.uk
07717 493 015
Cereals_West

For more details about Farmbench and benchmarking, please contact:

Meg Spendlove
Knowledge Exchange Manager – Benchmarking
meg.spendlove@ahdb.org.uk
07815 600 240

FARMBENCH

AHDB Cereals & Oilseeds
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

T 0247 669 2051
E info@ahdb.org.uk
W cereals.ahdb.org.uk
@AHDB_Cereals

CEREALS & OILSEEDS