Strategic Cereal Farm East

Harvest 2020

Strategic Farm Week, Summer 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 and Johnnie Balfour, Strategic Cereal Farm Scotland

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

Contents

Strategic Cereal Farm East

Host Farmer: Brian Barker

Location: E. J. Barker & Sons, Lodge Farm, Westhorpe, Stowmarket, Suffolk IP14 4SZ

Duration: November 2017 – September 2023

Introduction

E. J. Barker & Sons is, a family farm partnership and contracting business in Suffolk which dates back to 1957. The 513 ha arable farm business uses a traditional 12-year rotation, incorporating winter wheat for feed, herbage grass seed and break crops of spring barley, beans, oilseed rape and linseed. The farm is on a medium to heavy soil type and uses a cultivation strategy appropriate to that field and year, from ploughing to direct drilling.

Mission statement

An independent, open and honest platform for UK farmers to see and learn from the integration of research in a practical way within a commercial farming system.

Vision

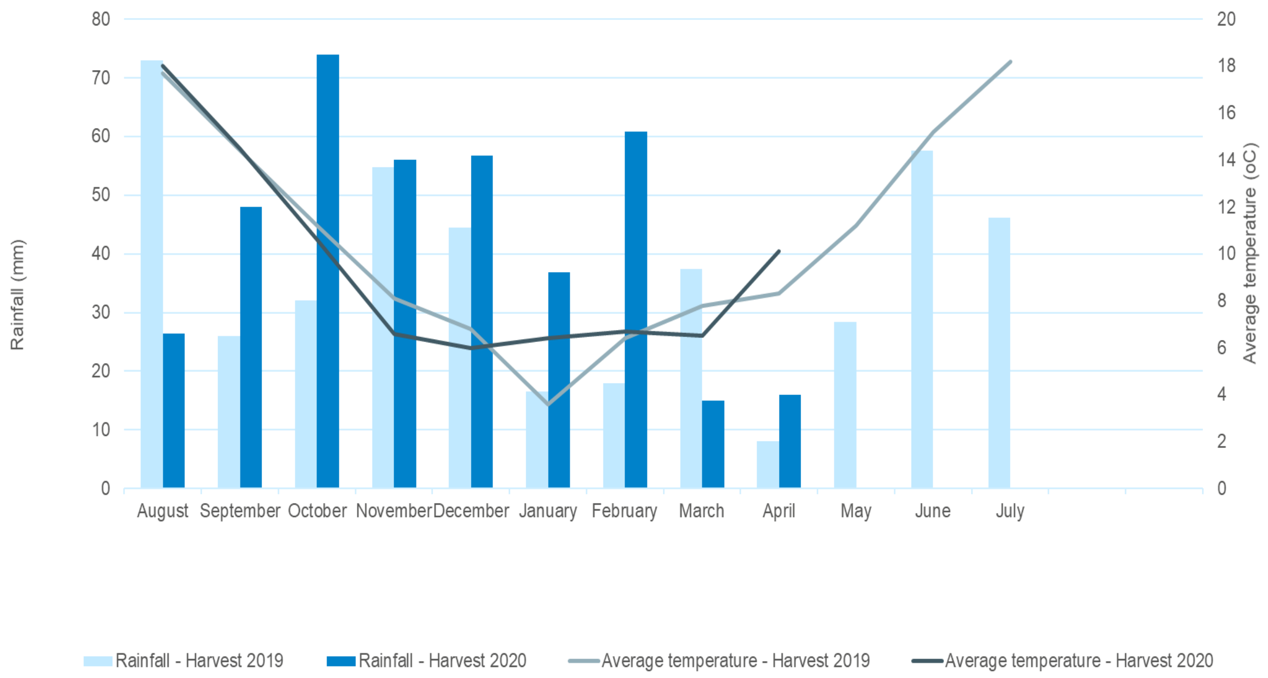
The vision of the Strategic Cereal Farm East is to understand the farmed environment and develop a long-term strategy to increase productivity and produce a high quality product without having a negative effect on the farmed environment. The project will bridge the gap between research and practical farming and provide a programme of demonstrations, subject to full net-margin cost benefit analysis, which are relevant to the current situation facing UK farming. The project will allow farmers to make informed decisions and increase farmer-to-farmer engagement.

The core values of the Strategic Cereal Farm East are independent, honest, practical, productive, cost effective and relevant.

Weather summary

The chart below shows the rainfall and temperature recorded at the Strategic Cereal Farm East weather station for the Harvest 2019 and Harvest 2020 years.

Between 1 August 2019 and 30 April 2020, the Strategic Cereal Farm East weather station recorded a total of 390mm mm of rainfall. The maximum temperature recorded was 31.4°C on 27 August 2019. The minimum temperature recorded was -1.9°C on 30 November 2019.



Video update

To watch a reflection on this season to-date from host, Brian Barker, please [click here].

Timeline

2017-2018

Baselining year

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 baselining activities completed at the Strategic Cereal Farm East September 2017 – September 2018 are listed below:

- Weather station
- Soil nutrient analysis
- Soil biology
- Earthworms
- Electrical conductivity scanning
- Water sampling
- Physical soil structure
- Crop biomass monitoring
- Black-grass mapping
- LEAF Sustainability Review

2018-2019

- **Managed lower inputs**: To determine the effect of high, medium, low and untreated fungicide strategies on disease control in varieties with different disease ratings
- **Cover crops**: To determine the role of cover crops in reducing nitrate leaching
- **Early crop biomass**: To explore ways in which canopy size in late-drilled crops of winter wheat can be enhanced to improve final yield

2019-2020

- See below for all trial details

2020-2021

- **Managed lower inputs:** To determine the effect of varieties with different disease ratings for disease control under high, medium, low and untreated fungicide strategies
- **Pests and natural enemies:** To monitor the pest and beneficial insect populations and monitoring across the Strategic Cereal Farm, including on perennial flower strips
- **Cover crops:** To determine the impact of cover crops in the following crop, including soil physics, chemistry and biology, crop establishment, yield and nitrogen uptake
- **Moisture management:** To determine the impact of soil management and crop nutrition on soil moisture management and nutrient accessibility in a spring cereal
- **Carbon:** Quantifying the Strategic Cereal Farm carbon to define areas of improvement to trial
- **Optimising land use:** Quantifying the profitability and productivity of Strategic Cereal Farm land for commercial arable production and the environment

Full details about all of the baselining and demonstrations at the Strategic Cereal Farm East are available online: ahdb.org.uk/farm-excellence/strategic_cereal_farm_east

Partners

We are very grateful to Brian Barker and all the team at EJ Barker and Sons for carrying out the operations, assessments and analysis as part of the Strategic Cereal Farm East.

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

Many thanks go to Essex & Suffolk Water for the analysis of the drainage water samples from the cover crop demonstration and wider baselining work at the Strategic Cereal Farm East.

Demonstrations

1. Managed lower inputs

Start date: October 2019

Objective: To determine the effect of reduced fungicide applications and other inputs on varieties with different disease ratings, for disease control under high, medium, low and untreated fungicide strategies.

What was the challenge/demand for the work?

In order to maintain activity of fungicides and disease control there needs to be a step-change in the way cereal fungicides are used. AHDB already plays a key role in fungicide anti-resistance through monitoring and research of key diseases to develop the most effective anti-resistance strategies, including more resistant varieties. The AHDB Recommended Lists have raised minimum standards for variety disease resistance which potentially enables the reduced use of, and thus reduces pressure on, fungicides.

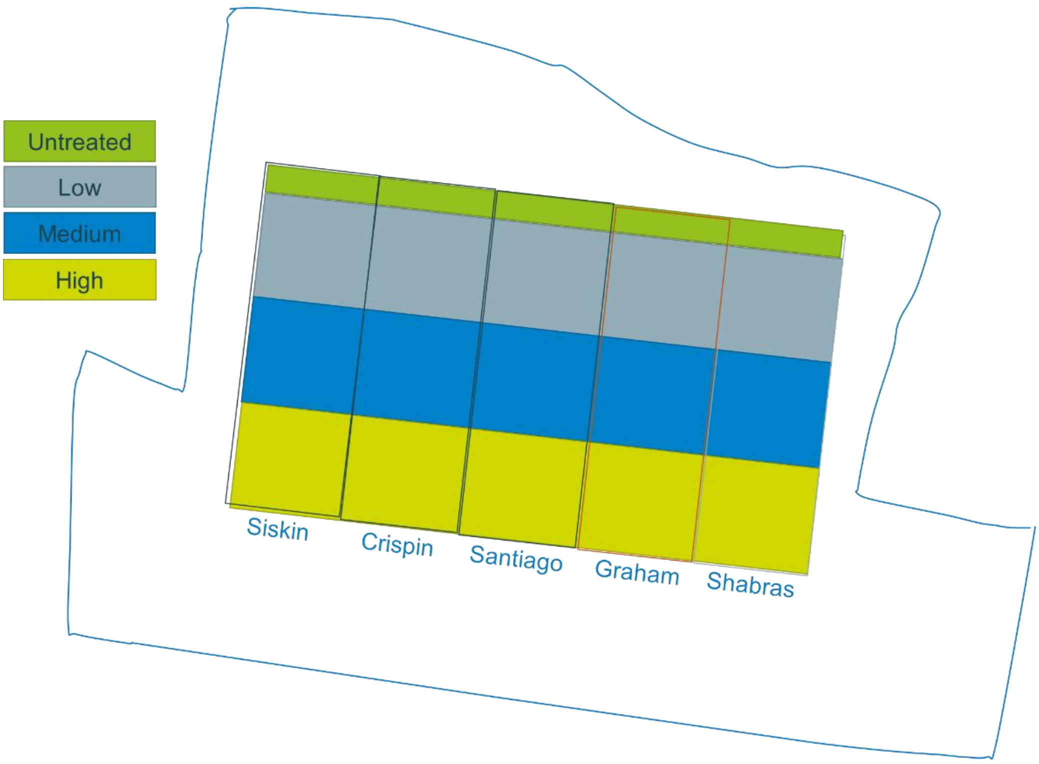
In 2018-2019 the Strategic Cereal Farm East investigated the impact of fungicide inputs on five winter wheat varieties: Siskin, Shabras, Graham, Santiago and Silverstone. Based on the results from harvest 2019, growing more resistant varieties with low fungicide inputs gave the best net margin. However, this was a single year with moderate disease pressure. Varieties that are more resistant do nevertheless reduce risk to the business, as even in a high disease pressure year they will suffer less of a yield loss.

In harvest year 2020, the demonstration is being repeated in the same field, which has gone into second wheat with the varieties Siskin, Shabras, Graham, Santiago, Crispin. Farmers are under increasing pressure to produce the best gross margins by managing all input other than fungicides, therefore each fungicide programme will also vary in inputs for plant growth regulators and bio-stimulants. This is to stimulate the decisions that farmers have to make into managing the crop over the whole season to produce the best net margin for disease control, crop growth and resulting yield.

Methodology

Site details

Field name	**Kells**
Size	18ha
Soil type	Sandy loam
Crop	Winter wheat
Drill date	31 October 2019



Treatments are a second wheat and have been positioned in the same location as the 2019 trial to help assess the cumulative effect of lower inputs.

There are 5 winter wheat varieties (Siskin, Shabras, Graham, Santiago, Crispin) differing in disease susceptibility:

Siskin - Septoria RL 6.7, Yellow Rust RL 9, Brown Rust RL 5
Graham - Septoria RL 6.9, Yellow Rust RL 8, Brown Rust RL 6
Shabras - Septoria RL 6.2, Yellow Rust RL 7, Brown Rust RL 5
Crispin - Septoria RL 5.8, Yellow Rust RL 9, Brown Rust RL 5
Santiago - Septoria RL 4.3, Yellow Rust RL 7, Brown Rust RL 5

Each of the varieties will receive four fungicide and other inputs programmes of varying intensity (high, medium, low and control). Treatments will be repeated twice and will be set up to fit in with the tramlines (i.e. not randomised). The fungicide programme will be decided upon as the season progresses, reflecting current weather and disease assessments, the treatments applied to date are listed in Table 1.

Table 1: Details of treatment inputs (up to T1) for Low, Medium and High inputs (note: the untreated area has not received any inputs of fungicide, plant growth regulator and trace elements)

Product	Type	Application Rate (l/ha)	Cost
Low inputs			
T0 - 11/04/20			

Tempo	PGR	0.05	£5.70
Gramitrel (Yara)	Trace Element	1	
T1 - 02/05/20			
Toledo (tebuconazole)	Fungicide	0.5	£14.18
3C Chlormequat 750	PGR	1	
Tempo	PGR	0.05	
Headland Magnesium Super 80	Trace Element	2	
		Total spend up to T1	**£19.88**
Mid Inputs			
19/03/20			
Headland Multiple Pro	Trace Element	1	£11.32
Maxi Phi Fast Root (Agrimax)	Trace Element	0.80	
T0 - 08/04/20			
Toledo (tebuconazole)	Fungicide	0.30	£11.58
3C Chlormequat 750	PGR	1	
Tempo	PGR	0.05	
Gramitrel (Yara)	Trace Element	1 (11/04/2020)	
T1 - 02/05/20			
Toledo (tebuconazole)	Fungicide	0.5	£25.08
Amistar Opti (azoxystrobin + chlorothalonil)	Fungicide	1	
3C Chlormequat 750	PGR	1	
Headland Magnesium Super 80	Trace Element	2	
		Total spend up to T1	**£47.98**
High Inputs			
19/03/20			
Headland Multiple Pro	Trace Element	1.6	£33

Maxi Phi Fast Root (Agrimax)	Trace Element	2	
T0 - 08/04/20			
Bravo 500 (chlorothalonil)	Fungicide	1	£17.58
Toledo (tebuconazole)	Fungicide	0.3	
3C Chlormequat 750	PGR	1	
Tempo	PGR	0.05	
Gramitrel (Yara)	Trace Element	1	
T1 - 02/05/20			
Wolverine (fluxapyroxad + metconazole)	Fungicide	1	£43.48
Bravo 500 (chlorothalonil)	Fungicide	1	
3C Chlormequat 750	PGR	1	
Tempo	PGR	0.1	
Headland Magnesium Super 80	Trace Element	2	
		Total spend up to T1	**£94.06**

N.B. Prices drawn from industry averages for the season.

Assessments

- Disease assessments at key growth stages
- Routine topsoil analysis
- Crop yield
- Pests and natural enemies monitoring

Links to further information/ references

Strategic Cereal Farm East Results from harvest 2019 for this managed lower inputs trial

AHDB Recommended List

AHDB Fungicide performance in cereals and oilseed rape

AHDB Biostimulant Product Review - Final Report

Combining agronomy, variety and chemistry to maintain control of septoria tritici in wheat (Project number: 2140003105)

2. Early crop biomass

Start date: October 2019

Objective: To demonstrate how the use of starter fertilisers, and the technique used to apply them, may contribute to increasing early season biomass in winter wheat.

What was the challenge/demand for the work?

In 2018-2019 Strategic Cereal Farm East investigated whether biomass can be accelerated with starter fertilisers or biostimulants. This is in response to the agronomic challenge of achieving high yielding fields whilst utilising integrated management techniques such as delayed drilling to reduce black-grass and barley yellow dwarf virus (BYDV) pressure.

The results from harvest year 2019 showed that using a starter fertiliser may improve initial crop establishment in late-sown crops, with placement alongside the seed tending to give the best results. There was no significant difference in crop yields between broadcast and placed fertiliser, however, there was an indication that placed Kieserite yielded slighted more compared to broadcast.

In harvest year 2020, the demonstration is being repeated to assess how the use of starter fertilisers, and the technique used to apply them, may contribute to increasing early season biomass in late-drilled winter wheat.

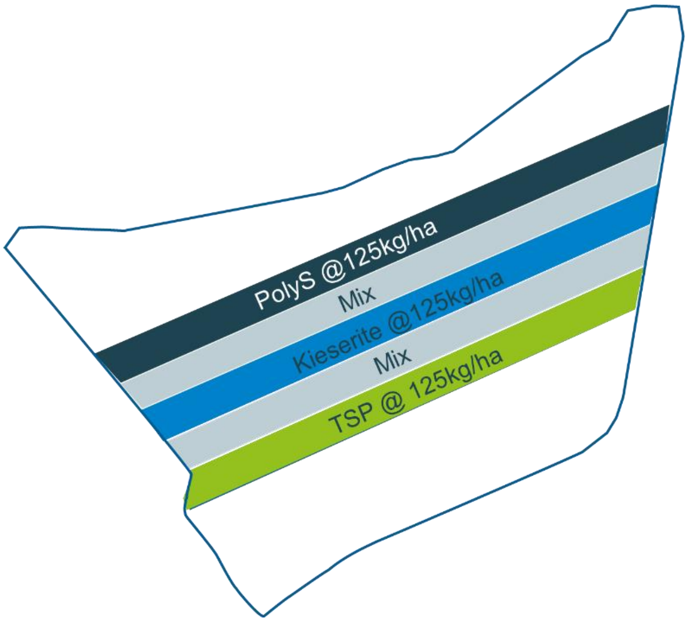
Methodology

Site details

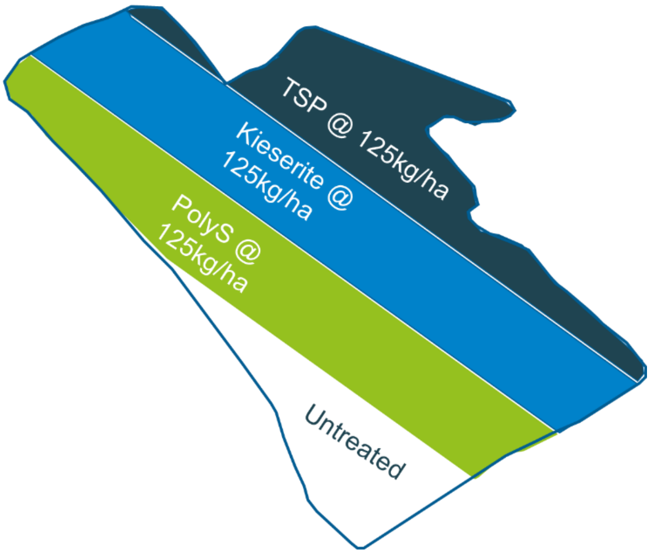
Field name	**Wyverstone Road**	**Crown**
Size	12.7ha	10ha
Soil type	Sandy loam	Loamy sand
Method	Plough and broadcast fertiliser	Strip-till with placed fertiliser
Drilling / starter Fertiliser date	19 October (fertiliser applied on 30 October)	30 October

Treatment	Nutrient content	Product application rate (kg/ha)	Cost (Product + Operation Cost)
Untreated	n/a	n/a	n/a
Kieserite Broadcast	0N:0P:0K:25Mg:50S	125	£40.25/ha
Kieserite Placed	0N:0P:0K:25Mg:50S	125	£37.25/ha
Triple superphosphate Broadcast	0N:46P:0K:0S	125	£46/ha
Triple superphoshate Placed	0N:46P:0K:0S	125	£37/ha
Polysulphate Broadcast	0N:0P:14K:6Mg:48S:17Ca	125	£28/ha
Polysulphate Placed	0N:0P:14K:6Mg:48S:17Ca	125	£19/ha

N.B. Prices drawn from industry averages – purchased September 2019.



Wyverstone Road -Broadcast



Crown Field - Placed

Assessments

- Biomass - plant counts, NDVI, tissue analysis and crop yield
- Soil - routine topsoil analysis

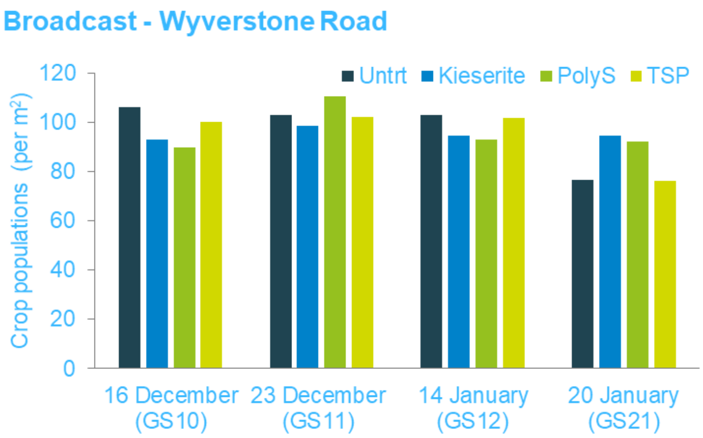
Preliminary results

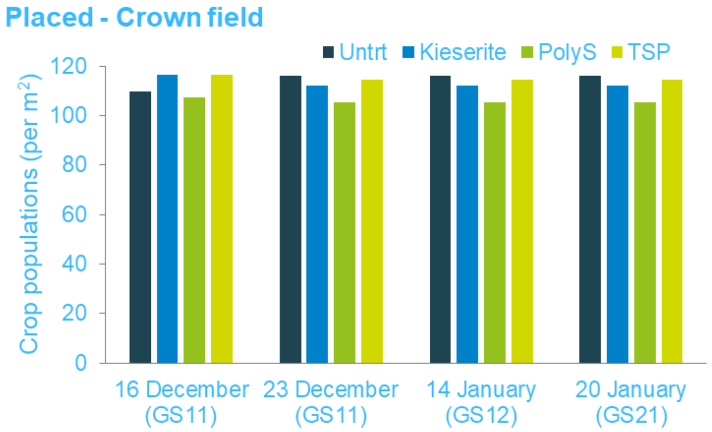
Table 2: Topsoil (0-15 cm) analysis

		Wyverstone Road	Crown Field
pH water		8.1	8.2
Available Phosphorus (Index)	mg/l	13.2 (1)	28.0 (3)
Available Potassium (Index)	mg/l	106 (1)	235 (2+)
Available Magnesium (Index)	mg/l	39.2 (1)	43.6 (1)
Organic matter	%	3.5	4.0

Established plant populations in both fields was fairly low and crop development slow over winter.

Within each field there was no effect of starter fertiliser on plant counts and no differences between fertiliser types. Wyverstone Road had slightly lower plant populations compared to Crown Field, however differences in establishment practices (i.e. plough or strip till, respectively) and soil nutrient availability (see Table 2) are likely to be a factor.





Crop populations (per m^2) measured on plots within
Wyverstone Road (broadcast fertiliser) and Crown Field (placed fertiliser)

Video update

To watch a video update on this demonstration from Brian Barker, host farmer, and the early research results from Damian Hatley, ADAS lead researcher, please click here.

Links to further information/ references

Strategic Cereal Farm East Results from harvest 2019 for this early crop biomass demonstration

Nkebiwe, P. M., et al. (2016). "Fertilizer placement to improve crop nutrient acquisition and yield: A review and meta-analysis." Field Crops Research 196: 389-401.

3. Cover crops

Start date: August 2019

Objective: To determine the role of cover crops in reducing nitrate leaching losses

What was the challenge/demand for the work?

During the first year of the Strategic Cereal Farm East project, a comprehensive baselining assessment was completed, including the analysis of water removed by the field drains under different crops, establishment systems and soil types. Overall, the loss of nutrients from fields with cover crops was lower compared to those which had been left bare (ploughed) over winter.

As part of the second year at SFE (2018-2019) a cover crop trial was established to assess if nitrogen (N) taken up by cover crops will be used by the subsequent cash crops or released and leached later on. The results demonstrated that a well-established cover crop is effective at taking up nitrogen and improving water quality by reducing nitrate concentrations in drainage water, however the impacts on the following spring crop (linseed) yields were variable. This demonstration is being continued into a second year in order to assess the impact of cover cropping on this years' winter wheat crop.

As part of Strategic Cereal Farm East 2020, a new cover crop demonstration has been set up, to help assess the effects of cover cropping in a different season.

Methodology

Site details

	Field 1 – Appletree	Field 2 – Blacksmiths
Area:	10.1 ha	7.3 ha
2018 harvest crop:	Winter wheat	
Treatments: Drilled: 28/08/2019 (Apple tree) and 24/08/2019 (Blacksmith) Destroyed: 13/3/20 (using Glyphosate)	Treatment 1:	Treatment 3:
	Plough – soil left bare over-winter	Over-winter Stubble
	Treatment 2:	Treatment 4:
	Rye (32%), Buckwheat (40%), Phacelia (8%), Oil Radish (8%,) Sunflowers (12%), drilled at 20kg/ha Established into ploughed soil	Rye (32%), Buckwheat (40%), Phacelia (8%), Oil Radish (8%), Sunflowers (12%), drilled at 20kg/ha Established in one pass system into stubble
2019 harvest crop:	Spring barley (drilled 28 March 2020), undersown with herbage grass	

Costings

Treatment	Operation Costs (£/ha)						Cover crop cost	Total cost
Treatment 1: Plough	Plough £57	Press £20	DD £40	Roll £10				**£127**
Treatment 2: Plough and cover crop	Plough £57	Press £20	DD £40	Roll £10	DD £40	Roll £10	£42/ha	**£219**
Treatment 3: Over-winter stubble	SL £60	DD £40	Roll £10					**£110**
Treatment 4: Over-winter stubble and cover crop	SL £60	Press £20	DD £40	Roll £10	DD £40	Roll £10	£42/ha	**£222**

*DD – Direct Drill; SL = Simba SL

Assessments

- Biomass - cover crop establishment, dry matter yield and N uptake, spring crop establishment, yield and N uptake
- Soil assessments - standard topsoil analysis, soil nitrogen supply, penetrometer resistance, gravimetric soil moisture, soil bulk density, Visual Evaluation of Soil Structure (VESS) and earthworms
- Nutrient content of drainage water
- Pests and natural enemies monitoring

Preliminary results

- Following drilling, cover crop establishment was better (i.e. greater biomass and more even cover) on the one-pass system compared to ploughing (photos taken 2nd December 2019).


Blacksmith – One-pass system


Appletree – Ploughed

- By February 2020, cover crops had produced similar amounts of biomass at 1.4 t/ha (ploughed) and 1.6 t/ha (one-pass system) taking up around 45 kg N/ha (Figure 1).

- The spring soil nitrogen supply (SMN and above ground biomass nitrogen content) indicates that mineralisation had occurred over-winter, with an additional 25–30 kg N/ha recovered in the crop and soil in spring 2020 compared to that present in the autumn; in the absence of a cover crop, this N would have been lost as nitrate leaching.

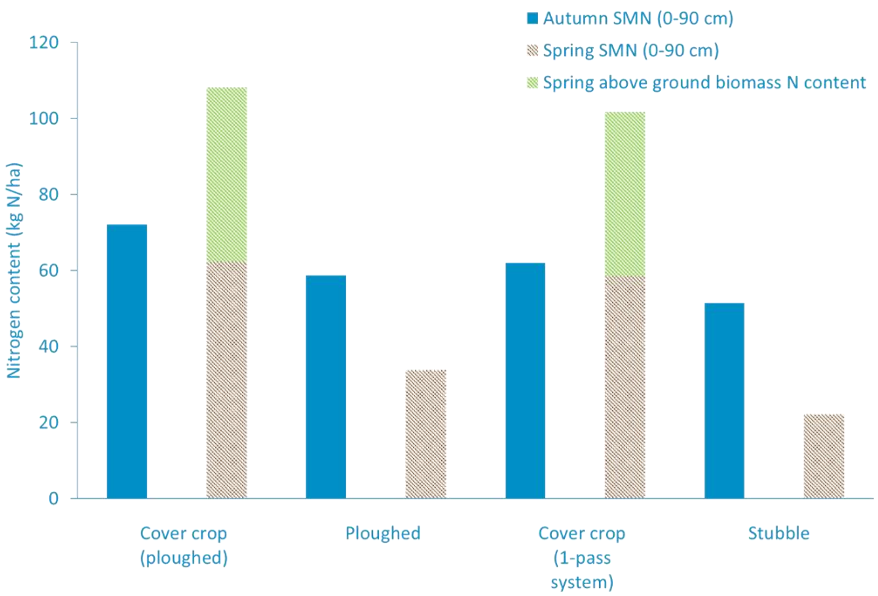


Figure 1: Soil mineral nitrogen (0-90 cm) measured in autumn 2019 and spring 2020 and above ground biomass nitrogen uptake

- The higher nitrate (NO_3) concentrations in drainage water (Figure 2) from the ploughed and over-winter stubble treatment compared to the cover crop treatments indicate that more NO_3 was leached over-winter from these treatments.

- This is supported by, the lower soil mineral nitrogen contents measured in February 2020 (Figure 1) on the ploughed and stubble compared to the cover cropped treatments.

- On the cover crop 1-pass system, NO_3 concentration in drainage water was consistently below the EC drinking water nitrate limit of 50 mg/l.

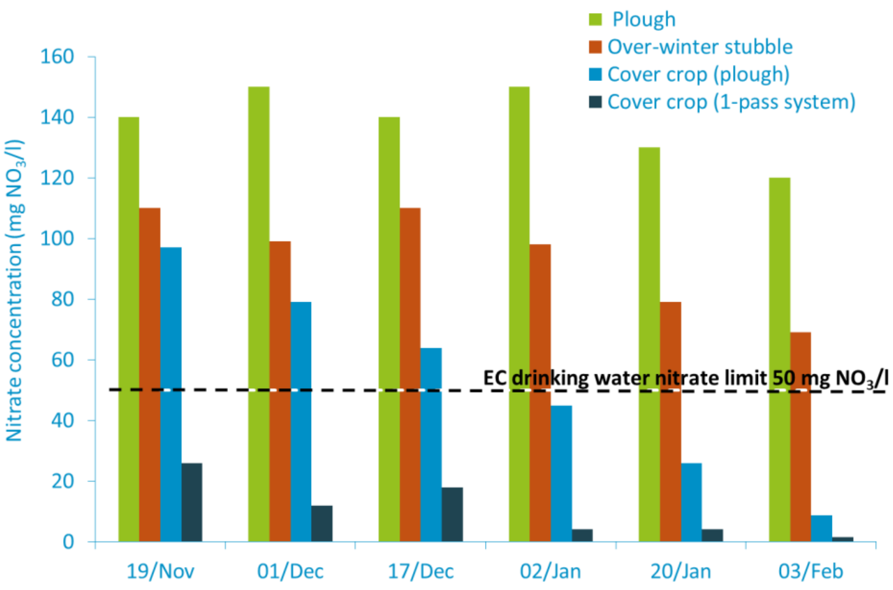


Figure 2: Drainage water nitrate concentrations from November to February

Video update

To watch a video update on this demonstration from Brian Barker, host farmer, and the early research results from Kate Smith, ADAS lead researcher, please click here.

Future work

On-going work will follow the potential impact of the cover crop on spring yields and soil properties.

Links to further information/ references

Strategic Cereal Farm East Results from harvest 2019 for cover crops and water quality demonstration

AHDB Maxi cover crop project: Final Report

AHDB (2015). Opportunities for cover crops in conventional arable rotations. Information Sheet 41

Crop Production Magazine (2019). A clearer course for cover crops

4. Flowering strips

Start date: May 2020

Objective: To determine the effect of perennial flower strips on beneficial insect and pest populations

What was the challenge/demand for the work?

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.

The trial will determine the impact of perennial flower strips on beneficial insect and pest populations.

Site details

Field name	Bottom 59	Top 59	Big Guinea Row
Size	10.6ha	10.4ha	6.8ha
Soil type	Sandy clay loam	Sandy loam	Sandy clay loam
Treatments	Within field and field edge flower strips	Field edge flower strips	Farm standard

On 4 May 2020, the flowering strips were drilled, with a grass and flower mix (see Table 3). Once established the botanical composition will be assessed and impacts on beneficial insects and pest populations will be monitored.

Table 3: List of sown grass and flower species

Grass mix – sown at 20 kg/ha		Flower mix – sown at 6 kg/ha	
Percentage	Species	Percentage	Species
5	Comment Bent	12.5	Common knapweed
10	Crested Dogstail	15	Wild carrot
20	Sheep's fescue	15	Lady's Bedstraw
20	Slender Creeping Fescue	10	Oxeye Daisy
20	Chewing's Fescue	12.5	Ribwort Plantain
5	Small Timothy	5	Salad Burnet
20	Smooth-stalked Meadow-Grass	1.5	Selfheal
		6	Common Sorrel
		10	Red Campion

Costings

Item	Cost
Preparation of strips operation (4m discs/tines + power harrow + roll)	£100/ha
Seed	£589.91/ha
Broadcast operation	£15/ha
Rolling operation	£10/ha
Total cost of establishment	£714.91

Video update

To watch a video update on this demonstration from Brian Barker, host farmer, please click here.

Links to further information/ references

[ASSIST Research]

[GWCT Wildflower mixes and pollen and nectar strips]

5. Very low inputs

Start date: October 19

Objective: To determine the effect of reduced input applications on pests and diseases, crop yields and gross margins

What was the challenge/demand for the work?

In order to maintain activity of pesticides there needs to be a step-change in the way cereal inputs are used.

This demonstration will incorporate the use of managed lower inputs of all pesticides (insecticides, herbicides, fungicides) and fertilisers to investigate the impact on pest and disease pressure, crop yield and gross margins. Lower inputs will be applied to the whole field and the results will be compared to conventionally managed winter wheat elsewhere on the farm.

Methodology

Site details

Field name	**Tom Dixon**
Size	3.1 ha
Soil type	Sandy loam
Application type	Broadcast

Assessments

- Crop yield
- Disease assessments at key growth stages
- Routine topsoil analysis
- Pests and natural enemies monitoring

Applications to date

T0 - 11/04/20			
Product	Type	Application Rate	
Tempo	PGR	0.05 l/ha	
T1 - 02/05/20			
Product	Type	Application Rate	
Toledo (tebuconazole)	Fungicide	0.5 l/ha	

3C Chlormequat 750	PGR	1 l/ha	
Tempo	PGR	0.05 l/ha	
Other Inputs			
Product	**Type**	**Application Rate**	**Date**
KayNitro Sulphur	Fertiliser	200 kg/ha	20/03/2020
SingleTop	Fertiliser	296 kg/ha	14/04/2020
SingleTop	Fertiliser	125 l/ha	05/05/2020
Azural	Herbicidie	3 l/ha	28/10/2019
Liberator	Herbicidie	0.60 l/ha	31/10/2019
Gramitrel (Yara)	Trace Element	1 l/ha	11/04/2020

Video update

To watch a video update on this demonstration from Brian Barker, host farmer, please click here.

6. Repeat baselining

Start date: October 2020

Objective: To monitor soil and crop characteristics through the rotation

What was the challenge/demand for the work?

The first year of the Strategic Cereal Farm project, known as the baselining year, aimed to determine the starting point of a number of indicators within the farmed environment before any changes were investigated and evaluated. Details of the baselining activities completed at the Strategic Cereal Farm East September 2017 – September 2018 are available online.

The autumn 2017 soils baseline assessments found that, there was clear inter field and intra field variability linked to soil texture and management. Based on the Visual Soil Assessment (VSA) method, 14% of the field areas were in 'good' condition; 86% of the field areas were in 'moderate' condition. Based on Visual Evaluation of Soil Structure (VESS) assessments, 81% of the field areas had a 'firm' or 'compact' layer.

In harvest year 2018, a wide range of crop measurements relating to aspects of crop performance were taken that can be useful in predicting and explaining yield, defining both 'source' (photosynthetic area) and 'sink' (tillers, stems, ears, grains) as well as development phases. These assessments found that consistent differences in crops were detectable with simple measures (particularly shoot numbers) which could be associated with differences in soil structure and nutrient status, both between and within fields.

In harvest year 2020 the soils and crop 'baselining' assessments will be repeated in the fields detailed below and results compared to the assessments carried out in 2017, the results have the potential to explain differences between seasons and inform better management practices.

Methodology

Site details

Field name	**Barn Field**	**Retters**	**West Farm**	**Wally's**	**Big Lawn**	**Rushbottom**	**Shrubbery**	**Kells**
Size	34.2ha	13.2ha	31.1ha	8.3ha	14.9ha	5.9ha	12.6ha	18ha
Soil type	Sandy loam	Loamy sand	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam	Sandy loam
Harvest 2018 crop	1st winter wheat	1st winter wheat	2nd winter wheat	2nd winter wheat	2nd winter wheat	Cover crop/spring linseed	Grass	Spring linseed
Harvest 2020 crop	Spring beans	Spring beans	Spring Linseed	1st winter wheat	1st winter wheat	2nd winter wheat	2nd winter wheat	2nd winter wheat

In 2017, electrical conductivity (EC) scanning was used to map soil variability as part of the initial baseline measurements at the farm. The EC maps were used to identify intra field variation, so that areas of contrasting soil texture could be established for separate soil structure assessments (Figure 3); as would be carried out to establish soil management zones by soil type. In 2020, soil assessments have been carried out in these same zones.

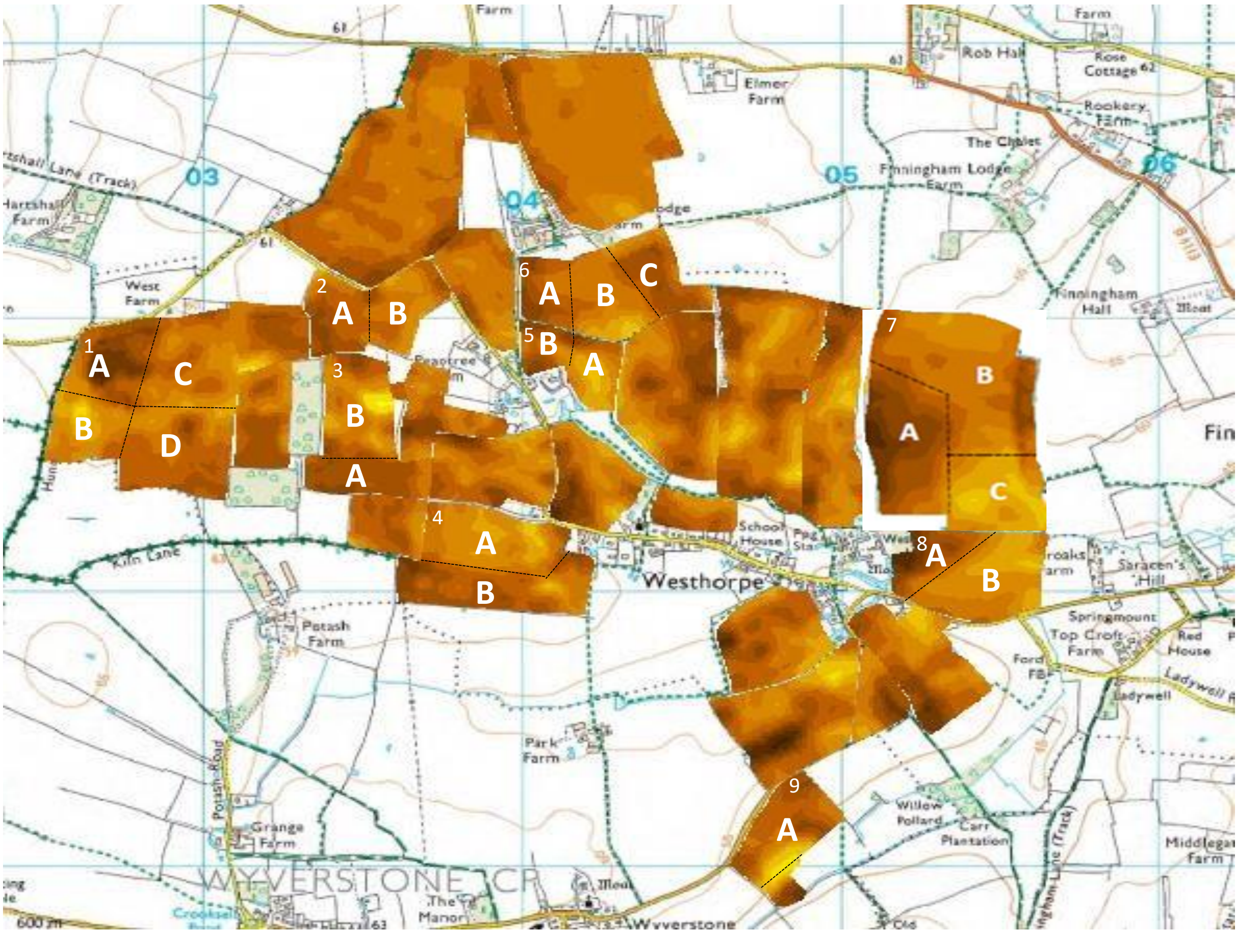


Figure 3: Shallow EC map Westhorpe Lodge Farm. Fields are numbered: West Farm (1); Apple Tree (2) *not included in baseline study*; Shrubbery (3); Kells (4); Rushbottom (5); Big Lawn (6); Barn Field (7); Retters (8); Wally's (9)

Assessments

- Biomass – *taken from one representative area in each field* plant counts: NDVI, green area index, tissue analysis and crop yields
- Soil analysis – *taken from each zone within each field*: routine topsoil analysis, structural assessments and earthworms

Preliminary results

The summary of VESS scores from Big Lawn, West Farm and Rushbottom recorded in November 2017 and April 2020 are shown in Table 4, the scores have been colour coded according to the Soil Health

Scorecard that is being developed as part of the AHDB/BBRO Soil Biology and Health Partnership (ahdb.org.uk/greatsoils). Here 'traffic light' coding is used to identify properties where further follow-up investigation is required to help guide management decisions. Differences in soil structural condition can be related to soil management, cropping history and soil texture:

- **Big Lawn** - In 2017, compact layers were observed (sq 4) as a result of drilling in wet soil conditions. In 2020, scores remain high with firm / compact soil structure (sq 3-4) containing some angular aggregates (Plate 1) this was recorded following winter wheat drilled in wet conditions (described by Brian as 'borderline to drill').

- **West Farm –** Winter wheat (harvest year 2017) was direct drilled in wet conditions resulting in moderate soil structure in autumn 2017 (sq 3 – measured in the wheat stubble). In 2020, zones of lighter texture were seen to have good soil structure (sq 2) containing a mixture of porous and rounded aggregates; whilst heavier textured zones still indicated a degree of compaction (sq 3).

- **Rushbottom –** In 2017, there was evidence of surface compaction following strip tillage of a cover crop into wheat stubble. However, repeat measurements in spring 2020 showed the soils to be in good structural condition, following ploughing and drilling winter wheat in August/September 2019 (sq 1 & 2 – 'friable/intact' (Plate 1).

Table 4: Visual Evaluation of Soil Structure mean scores and worst ('limiting') layer scores, for 2017 & 2020 (mean of 3 assessments per zone).

Field	Zone	November 2017		April 2020	
		Mean overall score	Limiting layer score	Mean overall score	Limiting layer score
Big Lawn	a	3	4	2	2
	b	2	3	3	3
	c	1	3	3	4
West Farm	a	3	3	2	3
	b	3	3	2	2
	c	3	3	2	2
	d	3	3	3	3
Rushbottom	a	3	3	2	2
	b	2	3	1	1

[a]VESS limiting layer score is the maximum score recorded to 25cm depth. VESS scores have been colour coded according to the Soil Health Scorecard. Scores of 1 or 2 indicate good soil structure (friable/intact) indicating no changes needed; a score of 3 indicates moderate structure (firm) with long term improvements required and scores of 4 or 5 poor soil structure (compact or very compact) with short term improvements required.

Big Lawn (Zone C): VESS score 3 with a 'compact' (score 4) limiting layer - Moderate/compact soil structure

Rushbottom (zone A): VESS score 2 - *Good soil structure*

Plate 1: VESS photos taken post break-up from field areas with examples of moderate and good soil structure VESS scores

The number of earthworms found during assessments carried out in November 2017 and April 2020 are summarised in the Table 5; again the results have been colour coded according to the prototype AHDB/BBRO Soil Health Scorecard.

Overall, with the exception of Wally's Field, the results show that from 2017 to 2020 there has been either no change or an improvement in the total number of earthworms (i.e. both juveniles and adults).

In 2020, most fields have an intermediate earthworm population, whilst in Wally's earthworm numbers are depleted. The largest increase in earthworm numbers was measured in Barn Field and in April 2020 earthworm populations are classed as being active.

Further analysis will be carried out to investigate how earthworm populations from 2017 to 2020 have varied within the different soil texture zones and how this relates to field management.

Table 5: Number of earthworms in a 20 x 20cm cube of soil; November 2017 and April 2020.

Field	2017		2020	
	Cropping at assessment	Earthworm numbers	Cropping at assessment	Earthworm numbers
Barn Field	Winter wheat	7	Spring beans	14
Big Lawn	Winter wheat	7	Winter wheat	4

Kells	Stubble OW	3	Winter wheat	7
Retters	Winter wheat	9	Spring beans	9
Rushbottom	Cover crop (not grazed)	8	Winter wheat	8
Shrubbery	Herbage Grass	9	Winter wheat	8
Wallys	Winter wheat	8	Winter wheat	3
West Farm	Winter wheat	4	Spring linseed	7

Earthworm numbers have been colour coded according to the Soil Health Scorecard. Red indicates earthworm numbers are depleted, orange that intermediate population size and green active population.

Future work

Will evaluate the crop performance over the growing season and link this to soil structure.

Links to further information/ reference

Visual Evaluation of Soil Structure

How to Count Earthworms

AHDB/BBRO Soil Biology and Health Partnership – a range of resources and case studies of the work currently being conducted as part of this research programme

AHDB Soils resources

7. Pests and natural enemies

Start date: September 2020

Objective: Monitor selected invertebrate pests and natural enemies to investigate natural variation in species and abundance.

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. Work carried out on AHDB Strategic Cereal Farms East and West in 2019/20 will create a robust dataset to demonstrate the inherent variability in invertebrate abundance, and investigate locations with relatively high/low levels of abundance. By carrying this work out at Strategic Cereal Farms East and West, with additional data from the Petworth Monitor Farm, we can describe the drivers of variation, and how observation data needs to be interpreted relative to that variation in order to be useful. This will help set the scene prior to the establishment of floral strips at Strategic Cereal Farms East and West.

Methodology

We are assessing two key pests, 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, 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 us to look at the effect of distance into the crop on pest and natural enemy abundance.

Figure 4. Slug trap using chicken layers' mash as bait, from the AHDB Integrated slug control factsheet.

Assessments

Throughout this work, we are aiming to use methods that farmers could feasibly carry out themselves with minimal support.

- 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 4).

- 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 5) 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 on each tiller selected

Figure 5. 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 6).

Table 6: 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	4	2
	Field 42	1	0
	Field 43	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 6). This generalist predator is often found in agricultural fields, and is an important natural enemy of a wide range of invertebrates.

Figure 6. 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.

If you are interested in monitoring pest and natural enemies on your farm, please get in touch with Mark.Ramsden@adas.co.uk

Video update

To watch a video update on this demonstration from Brian Barker, host farmer, and the early research results from Mark Ramsden, ADAS lead researcher, please click here.

Links to further information/reference

- AHDB Encyclopedia of pests and natural enemies
- AHDB Integrated slug control factsheet

Keep up to date

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

For further information on Strategic Cereal Farm East, please contact:

Emily Pope
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

Teresa Meadows
Knowledge Exchange Manager Arable
teresa.meadows@ahdb.org.uk
07387 015465
@CerealsEA

For more details about Farmbench and benchmarking, please contact:

Holly Shaw
Knowledge Exchange Manager – Benchmarking
holly.shaw@ahdb.org.uk
07767 001543

Strategic Cereal Farm East Host

Brian Barker
Strategic Cereal Farm East Host
@The_Barker_Boys

FARMBENCH

We are able to arrange bespoke visits/virtual sessions by interested groups (farmers, growers, stakeholders, supply chains, agronomists etc.) with all of our Strategic Cereal Farms. Please get in touch to arrange your own farm visit.

AHDB Cereals & Oilseeds
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

T 024 7 669 2051
E info@ahdb.org.uk
W cereals.ahdb.org.uk
@AHDB_Cereals

CEREALS & OILSEEDS