

Assessment and analysis of field trials at the Strategic Cereal Farm East

Overview of trials for harvest 2020

The table below outlines which assessments are required on each of the trials for harvest 2020. More detailed information on the assessments required within each work package and each of the trials are provided on the following pages.

Applicants should respond to each of the work packages detailed below. Your application should address each work package separately, and costs should be provided on a work package and trial basis. Proposals should include the table below, with each tick replaced with a cost.

		Trials							
		1. Managed Iower inputs	2. Early crop biomass	3. Cover crops	4. Flower strips	5. Very low inputs	6. Variable rate nitrogen	7. Repeat baselining	Deadline for assessments to be completed
Work package 1: Crops	1a: Biomass	\checkmark	\checkmark	\checkmark		\checkmark	\checkmark	\checkmark	Sep-20
	1b: Diseases	\checkmark				\checkmark			Sep-20
	1c: Rooting			\checkmark					Sep-20
Work package 2: Soils	2a: Earthworms	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	Apr-20
	2b: VESS	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	Apr-20
	2c: Nutrient and biological analyses	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	\checkmark	Apr-20
Work package 3: Pests and natural enemies		\checkmark		\checkmark	\checkmark	\checkmark		\checkmark	Sep-20



Site map

The site map showing the location of each of the trials is provided below. Electrical conductivity maps from October 2017 are also provided.

Trial locations





Deep electrical conductivity 0-120 cm





Shallow electrical conductivity 0-40 cm





Trials descriptions

The trial descriptions below are provided as a guide. Where appropriate, please include alternatives to the proposed trial design and assessments in your application based on your experience. Alternative trial designs and assessments should consider the intended aim of the Strategic Cereal Farm, budget and logistics of establishing and managing trials with farm scale machinery.

1. Managed lower inputs

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

The following work packages should be completed on this trial:

- Work package 1a: Biomass
- Work package 1b: Disease
- Work package 2a: Earthworms
- Work package 2b: VESS
- Work package 2c: Nutrient and biological analyses
- Work package 3: Pest and natural enemies

Trial background: In order to maintain activity of fungicides and disease control there needs to be a stepchange 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 – the project overview is available online. We would like to repeat this trial in five varieties for harvest 2020.

Trial design – replicated tramline trial:

- Field name: Kells
- Field size (hectares): 18.01
- Soil type: Sandy loam (67% sand, 15% silt, 18% clay)
- Harvest 2019 crop: winter wheat 5 varieties
- Harvest 2020 crop: winter wheat 5 varieties
- Number of treatments: 4 (high, medium, low, untreated)
- Number of replications: 2
- Total number of plots: 40



2. Early crop biomass

Trial aim: The aim of the trial is to explore ways in which canopy size in late-drilled crops of winter wheat can be enhanced to improve final yield.

The following work packages should be completed on this trial:

- Work package 1a: Biomass
- Work package 2a: Earthworms
- Work package 2b: VESS
- Work package 2c: Nutrient and biological analyses

Trial background: In 2018-2019 the Strategic Cereal Farm investigated whether biomass can be accelerated with starter fertilisers or biostimulants in an attempt to improve yields of later sown crops (mid-October onwards). Starter fertilisers are regularly used in oilseed rape to accelerate crop growth away from slugs or cabbage stem flea beetle. There has been some use of starter fertilisers in cereals for similar biotic factors and the project tested whether these work for promoting early crop biomass. The other stream of this trial looked into the use of biostimulants for reducing biomass loss from crop stress, increasing biomass or maintaining the biomass that has already formed.

We would like to develop this trial for harvest 2020, and include a comparison of placed and broadcast fertiliser as detailed below. The aim of the project is to create a better understanding of how the use of starter fertilisers, and the technique used to apply them, may contribute to increasing early season biomass in winter wheat. 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.

Field name:	Wyverstone Road	Crown	
Field size (hectares):	12.69	9.96	
Soil type:	Sandy loam (75% sand, 14% silt, 11%	Loamy sand (80% sand, 10% silt, 10%	
	clay)	clay)	
Harvest 2020 crop:	Winter wheat	Winter wheat	
Number of treatments:	Untreated, TSP, Kieserite, PolySulphate	Untreated, TSP, Kieserite, PolySulphate	
Application technique:	Placed with seed	Broadcast post-drilling	
Number of replications:	1	1	
Total number of plots:	4	4	



3. Cover crops

Trial aim: To determine the role of cover crops in reducing nutrient leaching.

The following work packages should be completed on this trial:

- Work package 1a: Biomass
- Work package 1c: Rooting
- Work package 2a: Earthworms
- Work package 2b: VESS
- Work package 2c: Nutrient and biological analysis
- Work package 3: Pests and natural enemies

Trial background: During the first year of the Strategic Cereal Farm East project, a comprehensive baselining assessment was completed. Included in this, was the sampling and analysis of water removed by the field drains under different crops, establishment systems and soil types. Two techniques of leaving land through the winter for spring crop establishment, namely over winter cover crop and over winter plough, were compared. The water analysis indicated that the use of cover crops could mitigate nitrate losses from soil. Overall, the loss of nutrients under the cover crop was reduced compared to the bare soil of the plough. It remains unclear, however, whether the nutrients taken up by the cover crop will be used by the subsequent cash crop or released and leached later on.

In 2018-2019, the Strategic Cereal Farm East investigated the role of cover crops in reducing nutrient leaching – the project overview is available online.

We would like to develop this trial for harvest 2020 and harvest 2021, as detailed below.

Field name:	Apple Tree	Church Field	Blacksmith	
Field size (hectares):	10.06	7.44	7.32	
Soil type:	Sandy loam (78% sand, 12% silt, 10% clay)	Sandy loam (75% sand, 11% silt, 14% clay)	Sandy loam (70% sand, 13% silt, 17% clay)	
Number of treatments:	2 (plough + cover crop; plough)	1 (stubble)	1 (stubble + cover crop)	
Autumn 2020 harvest crop:	Spring barley	Spring barley	Spring barley	
Autumn 2021 harvest crop:	Herbage grass	Herbage grass	Herbage grass	
Number of replications:	1	1	1	
Total number of plots:	2	1	1	



4. Flower strips

Trial aim: To determine the impact of perennial flower strips on beneficial insect and pest populations.

The following work packages should be completed on this trial:

- Work package 1a: Biomass
- Work package 2a: Earthworms
- Work package 2b: VESS
- Work package 2c: Nutrient and biological analyses
- Work package 3: Pests and natural enemies

Trial background: An AHDB sponsored PhD student investigated the impact of flower strips on wild pollinator populations in apple production. It was <u>reported</u> that the flower strips attracted a range of insects and there was a benefit of pollination on fruit yield.

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 <u>Managing biodiversity in field margins to</u> <u>enhance integrated pest control in arable crops</u>. 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.

We would like to determine the impact of perennial flower strips on beneficial insect and pest populations.

Assessments should be completed using a methodology appropriate to generate robust data to complement an on-farm demonstration. Proposals should consider the aim of the Strategic Farms which is to test research in a commercial situation and provide farmers with practical ways of conducting their own on-farm testing and assessments.

Site location and layouts of each of the trials are provided below.

Treatment name:	Within field and field edge flower strips	Field edge flower strips	Farm standard	
Field name:	Bottom 59	Top 59	Big Guinea Row	
Field size (hectares):	10.61	10.39	6.78	
Soil type:	Sandy clay loam (57% sand,	Sandy loam (70% sand,	Sandy clay loam (66%	
	20% silt, 12% clay)	16% silt, 14% clay)	sand, 15% silt, 19% clay)	
Harvest 2020 crop: Grass		Grass	Grass	



5. Very low inputs

Trial aim: To determine the effect of reduced pesticide input applications on pest, weed and disease.

The following work packages should be completed on this trial:

- Work package 1a: Biomass
- Work package 1b: Diseases
- Work package 2a: Earthworms
- Work package 2b: VESS
- Work package 2c: Nutrient and biological analyses
- Work package 3: Pests and natural enemies

Trial background: In order to maintain activity of pesticides there needs to be a step-change in the way cereal inputs are used. 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 – the <u>project overview is</u> <u>available online</u>. We would like to repeat this trial in five varieties for harvest 2020 as detailed in Trial 1.

In trial 5, we would like to incorporate the use of managed lower inputs of all pesticides (insecticides, herbicides and fungicides).

Trial design – field scale:

- Field name: Tom Dixon
- Field size (hectares): 3.08
- Soil type: Sandy loam (71% sand, 13% silt, 16% clay)
- Harvest 2020 crop: winter wheat
- Number of treatments: 1
- Number of replications: 1
- Total number of plots: 1



6. Variable rate nitrogen

Trial aim: To determine the cost-effectiveness of variable rate nitrogen

The following work packages should be completed on this trial:

- Work package 1a: Biomass
- Work package 2a: Earthworms
- Work package 2b: VESS
- Work package 2c: Nutrient and biological analyses

Trial background: AHDB have previously funded research projects on the use of variable rate nitrogen fertiliser to target applications, manage crop canopies and improve yields.

Trial design – multiple split fields:

Within this trial, we would like to investigate whether variable rate nitrogen should be used to apply more nitrogen to high or low biomass areas. Each field will be scanned by Brian Barker to measure crop biomass, and variable rate will be used to apply more N on higher biomass areas in one field, and lower biomass areas in the second field. Proposals for this trial should therefore provide an indication of the cost of completing the work packages list below. Sampling strategies will be finalised at the inception meeting and will need to be able to respond to the results of the crop scanning.

Field name:	Shrubbery	Paddy	
Field size (hectares):	12.63	8.95	
Soil type:	Sandy loam (73% sand, 14% silt, 13% clay)	Sandy loam (67% sand, 15% silt, 18% clay)	
Harvest 2020 crop:	Winter wheat	Winter wheat	



7. Repeat baselining

Trial aim: To monitor soil and crop characteristics through the rotation.

The following work packages should be completed on this trial:

- Work package 1a: Biomass
- Work package 2a: Earthworms
- Work package 2b: VESS
- Work package 2c: Nutrient and biological analyses
- Work package 3: Pests & natural enemies

Trial background: The first year of the Strategic 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 are investigated and evaluated. Details of the <u>baselining activities completed at the Strategic Farm East September</u> <u>2017 – September 2018</u> are available online.

We would like to continue this monitoring for the harvest 2020 season in the fields detailed below:

Field name:	Barn Field	Retters	West Farm	Wally's	Big Lawn	Rushbottom
Field size (hectares):	34.23	13.16	31.11	8.27	14.89	5.91
Soil type:	Sandy loam	Loamy sand	Sandy loam	Sandy loam	Sandy loam	Sandy loam
	(71% sand,	(81% sand,	(69% sand,	(70% sand,	(65% sand,	(72% sand,
	16% silt,	10% silt, 9%	15% silt,	16% silt,	18% silt,	14% silt,
	13% clay)	clay)	16% clay)	14% clay)	17% clay)	14% clay)
Harvest 2020 crop:	Spring	Spring beans	Spring	1 st winter	1 st winter	2 nd winter
	beans		wheat	wheat	wheat	wheat



Work package assessment descriptions

The work packages descriptions are provided below. Where appropriate, please include alternatives to the proposed assessments in your application based on your experience. Alternative assessments should consider the aim of the Strategic Cereal Farm which is to test research in a commercial situation and provide farmers with practical ways of conducting their own on-farm testing and assessments. Proposals should also take into consideration the budget and logistics of establishing and managing trials on a commercial farm.

Work package 1: Crops

Work package 1 has been divided into three sub-packages, specifically: 1a) Biomass, 1b) Diseases, and 1c) Rooting.

Applicants should propose appropriate sampling strategies which take account of the trial design and field characteristics, for example, variation in soil type and treatments.

1a) Biomass

Work package 1a Biomass should be completed on the following trials:

- Trial 1: Managed lower inputs
- Trial 2: Early crop biomass*
- Trial 3: Cover crops*
- Trial 5: Very low inputs
- Trial 6: Variable rate nitrogen
- Trial 7: Repeat baselining

Assessments should be completed in winter wheat at the following timings:

- Crop emergence (GS10) plant counts
- Start of stem extension (GS30, T0) plant and tiller counts
- Stem extension (GS31-33, T1) tiller counts
- Flag leaf emerged (GS39, T2) tiller counts
- Flowering (GS61-65, T3) tiller and ear counts
- Milk development (GS71) ear counts
- Harvest yield and grains per ear

At each timing the following assessments should be completed:

- Growth stage
- NDVI
- Above ground fresh and dry biomass
- Tissue sampled for full nutrient analysis including
 - o Nitrogen
 - o Sulphur
 - Phosphorous
 - o Potassium
 - Magnesium
 - Calcium
 - Copper
 - o Manganese
 - o Zinc
 - o Iron
 - o Boron



*Additional assessments are required on Trial 2: Early crop biomass for work package 1a, as detailed below:

- Emergence and NDVI: 1, 2, 3, 4 weeks after drilling
- Analysis of plant tissue: 2 and 4 week after emergence
- Tiller number, destructive biomass and LAI: GS21-25
- Analysis of yield: harvest

Additional assessments are required for Trial 3: Cover crops for work package 1a, as detailed below:

- Percentage bare ground: winter 2019
- Cover crop establishment NDVI: post drilling autumn 2019 (3-4 weeks, 5-6 weeks and 7-8 weeks)
- Cover crop N uptake: spring 2020
- Spring crop establishment NDVI: post drilling spring 2020 (3-4 weeks, 5-6 weeks and 7-8 weeks)
- Nitrogen uptake of spring crop: harvest 2020
- Winter crop establishment NDVI: post drilling autumn 2020 (3-4 weeks, 5-6 weeks and 7-8 weeks)
- Nitrogen uptake of winter cereal crop: harvest 2021

1b) Diseases

From the plant assessments collected in work package 1a, work package 1b Disease should be completed on the following trials:

- Trial 1: Managed lower inputs
- Trial 5: Very low inputs

Growth stage	Foliar disease	Stem disease	Ear disease
GS30	40 tillers, 3 leaf layers		
GS31-33	40 tillers, 3 leaf layers	25 tillers	
GS39	40 tillers, 3 leaf layers		
GS61-65	40 tillers, 3 leaf layers		
GS71	40 tillers, 3 leaf layers	25 tillers	50 fertile tillers

1c) Rooting

From the plant assessments collected in work package 1a Biomass, work package 1c Rooting should be completed on the following trials:

• Trial 3: Cover crops

Within work package 1c we require assessment of crop rooting at establishment and post-flowering as follows:

- Root angle
- Number of seminal roots (cereals)
- Number of nodal roots (cereals)
- Branding density score
- Photograph of root crown
- Above ground fresh and dry biomass
- Below ground fresh and dry biomass
- Tiller number



• GPS locations being collected at each sample points

We also require assessments of root length density between flowering and grain fill in wheat, and between flowering and harvest in oilseed rape, as follows:

- Soil cores to 1 m depth
- Measuring root length density (RLD) and root biomass in 20 cm soil layers

Work package 2: Soils

Work package 2 has been divided into three sub-packages, specifically: 2a) Earthworms, 2b) VESS, and 2c) Nutrient and biological analysis.

Applicants should propose appropriate sampling strategies which take account of the trial design and field characteristics, for example, variation in soil type and treatments.

2a) Earthworms

Work package 2a should be completed on the following trials:

- Trial 1: Managed lower inputs
- Trial 2: Early crop biomass*
- Trial 3: Cover crops**
- Trial 5: Very low inputs
- Trial 6: Variable rate nitrogen
- Trial 7: Repeat baselining

Within work package 2a we require earthworm assessments using the AHDB How to count earthworms.

2b) VESS

Work package 2b should be completed on the following trials:

- Trial 1: Managed lower inputs
- Trial 2: Early crop biomass*
- Trial 3: Cover crops**
- Trial 5: Very low inputs
- Trial 6: Variable rate nitrogen
- Trial 7: Repeat baselining

Within work package 2b we require soil physical structure to be assessed using Visual Evaluation of Soil Structure method.

2c) Nutrient and biological analyses

Work package 2c should be completed on the following trials:

- Trial 1: Managed lower inputs
- Trial 2: Early crop biomass
- Trial 3: Cover crops**
- Trial 4: Flower strips
- Trial 5: Very low inputs
- Trials 6: Variable rate nitrogen
- Trial 7: Repeat baselining

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Within work package 2c we require soil assessments as listed below. Applicants should propose an appropriate sampling strategy which takes account of the trial design and field characteristics, for example, variation in soil type, trial focus.

- Standard Soil Analysis to include; P index, K index, Mg index, active pH
- Boron, Manganese, Iron, Copper, Zinc, Molybdenum, Cobalt, Chloride, Sulphur
- Bulk density
- Buffer pH
- Soil organic matter (LOI)
- Organic carbon
- Biological analysis to include measures of bacteria, fungi; protozoa

**Additional assessments are required on Trial 3: Cover crop for work package 2, as detailed below:

- Earthworms: spring 2020; spring 2021
- VESS: spring 2020; spring 2021
- Soil mineral nitrogen: post-harvest 2019; spring 2020, autumn 2020, spring 2021
- Penetrometer resistance: spring 2020; spring 2021
- Gravimetric soil moisture: spring 2020; spring 2021
- Soil bulk density: spring 2020; spring 2021

Work package 3: Pests and natural enemies

Work package 3 should be completed on the following trials:

- Trial 1: Managed lower inputs
- Trial 3: Cover crops
- Trial 4: Flower strips
- Trial 5: Very low inputs
- Trial 7: Repeat baselining

The following key pest species have been identified using the <u>AHDB Encyclopaedia of pests and natural</u> <u>enemies in field crops</u>. Applicants should propose appropriate assessments and sampling strategies which take account of the trial design and field characteristics, for example, variation in soil type, trial focus.

- Key pest species in cereals, including but not limited to: wireworms, leatherjackets, slugs, aphids, wheat bulb fly, orange wheat blossom midge, gout fly, frit fly
- Natural enemies of key pest species

Proposed sampling strategies and assessments should be completed using a methodology appropriate to generate robust data to complement an on-farm demonstration. Proposals should consider the aim of the Strategic Farms which is to test research in a commercial situation and provide farmers with practical ways of conducting their own on-farm testing and assessments.