



*Heavy land  
rotational trials -  
in its sixth year*



**Spotlight on  
soil health**



*growing through **innovation***

# WELCOME

## to Project Lampport now in its sixth harvest.

The original concept was to develop a cultural approach to blackgrass control. The move to spring crops was always seen as a great opportunity to reduce the grassweed burden, but could they be consistently established on heavy land?

The project introduced the idea of growing specific autumn-sown cover crops, followed by direct drilling of spring cereals. During its development the work has established which species could be used, and importantly what seed rate to use.

In the early years the cover crops were established with methods that moved the topsoil fraction to stimulate grassweed germination. The next phase was to evaluate different methods like direct drilling and broadcasting into the standing crop. How do you deal with cover crop establishment if you have compaction issues? The programme then examined the timing of the cover crop destruction, which had an impact on yield.

**The research continues**

### How will this project evolve?

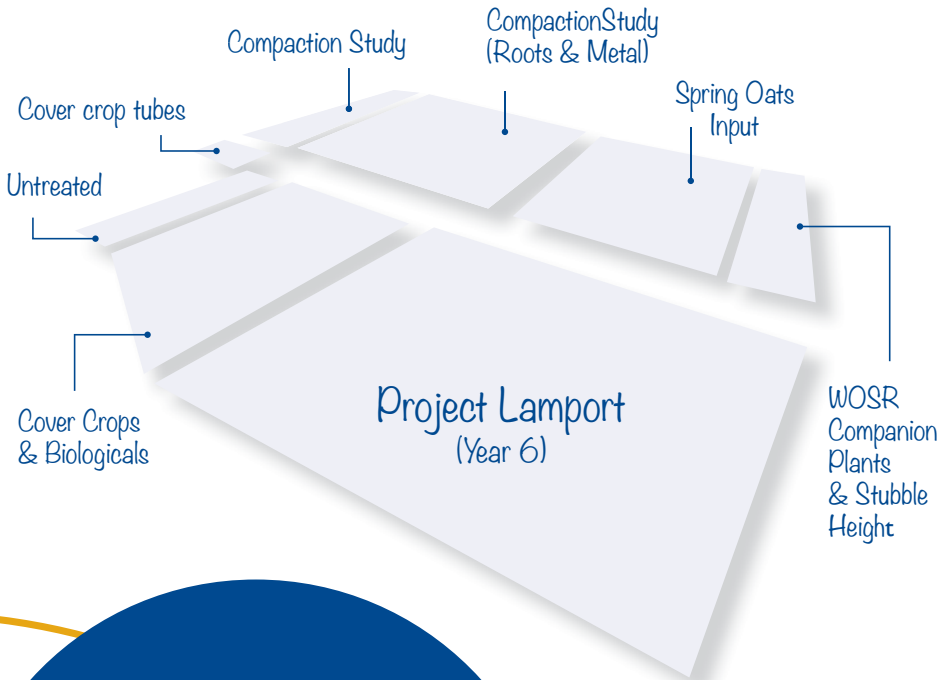
1. In the early years the main spring cereal was spring wheat but following grower requests we are now drilling spring barley and spring oats.
2. With the grass weeds under control, in some plots, the next phase will be evaluating and measuring any impact the system has on soil health.
3. Finally the ultimate aim is to bring back winter cropping, but incorporate cover cropping and spring cereals. We are looking for a sustainable and practical solution to this massive problem.





## Spotlight on soil health

- The benefits of roots and steel
- Soil research to benefit all growers
- Soil compaction trials
- Independent cultivation experts
- Long-term rotational systems



### Key topics

- Long-term rotational systems to control blackgrass and improve soil health
- The best combination of cover crops and cultivations, delivered in partnership with soil expert Philip Wright

### NEW FOR 2019

A comprehensive, replicated research project looking at the impact of cultivations, compaction and cover crops on soil structure, organic matter and microbiology.

In partnership with



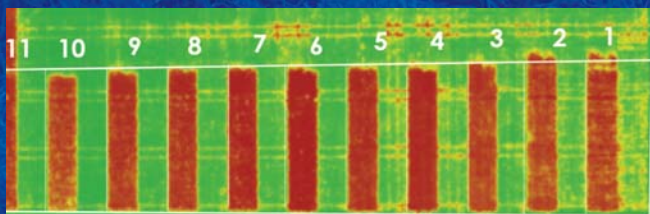
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## Compaction trials

Assisting natural soil-structuring actions.



The soils at Project Lampport have been subjected to many extremes of weather over the past seasons. Much continues to be learnt about the ways that these soils naturally structure, and how to accelerate this process most efficiently. Well-structured soil is the basis for efficient farming, and also plays a key role in the control of grass weeds by supporting efficiently established, competitive crops.

This season's trials programme further extends our knowledge and understanding of the combination of roots and metal. We compare how these factors interact across a range of autumn-sown covers ahead of established spring crops.

### Observations will include:

- The effectiveness of metal in last season's dry conditions – was it needed, how did it perform, and what are the effects on the spring crop?
- The effect of soil disturbance on grass weed management alongside the soil restructuring action
- Methods of integrating the cover crop growth and any restructuring actions
- Future considerations – how can we make further improvements to techniques whilst continuing to respect the needs of the crop, the soil and the need to manage grass weeds effectively?

# Solutions to unlock your soil's full potential to benefit long-term farm profitability

Soils are facing unprecedented pressures as a result of climate change, population growth, pesticide resistance, competitive commodity markets and the need to balance production whilst being sympathetic to the environment.

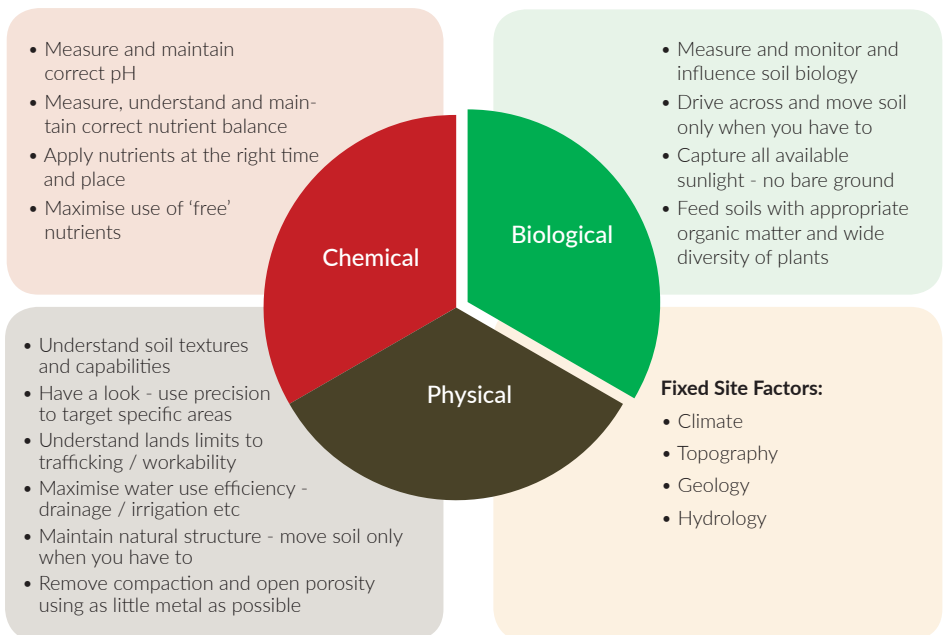
Driven by agricultural policy, the characteristics of many farmed soils have altered because of changing farming systems.

Modern agriculture is now characterised by larger more intensive farms using increasingly powerful, heavier and more sophisticated machinery. This has often translated into greater pressures being applied to the soil, reducing soil porosity and water absorption. This intensity has also led to a decline in organic matter levels, further reducing the productivity and resilience of soils.

Fortunately, nature is resilient, and we can with care and skill regenerate and restore our soils back to health.

A good quality soil with appropriate structure, chemistry and biology is essential for future crop and livestock production, farm profitability and the long-term sustainability of both farming and our environment. Understanding the relationship between the physical structure, biology and chemical processes within the soil, and the farming practices that affect them, is key to creating and maintaining a healthy soil.

Agrovista's new comprehensive soil health offer which will be on display across the Regional Demonstration Sites is designed to help growers focus on all aspects of soil health and provide the chemical, physical and biological solutions necessary to manage soils for the benefit of long-term farm profitability and soil stability.



# Root versus iron research project

## Project title and objectives

Investigating the root versus iron philosophy with the application of cover and companion plants for building soil health, crop yield and managing blackgrass control in a spring wheat production system

Field trial	Physical treatments X		Biological treatments	
	No tillage Subsoiler@8"		No cover crop phacelia black oats	Phacelia + black oats companion plants berseem clover (part trial 8 plots)

7 BOPh	3 BO	4 Ph	6 SSPh	1 Control	22 SS	10 SS BOPh + CC	8 SSBOPh	5 SSBO	9 BOPh + CC
5 SSBO	9 PhCC + CC	10 SSBOPh + CC	6 SSPh	2 SS	3 BO	7 BOPh	1 Control	4 Ph	8 SSBOPh
9 BOPh +CC	4 Ph	3 BO	2 SS	8 SSBOPh	1 Control	2 SSBO	6 SSPh	10 SS BOPh +CC	7 BOPh
5 SSBO	8 SSBOPh	9 BOPh + CC	4 Ph	10 SSBOPh + CC	7 BOPh	6 SSPh	3 BO	1 Control	2 SS

Cylinder/pot trial	Cover crop treatments X		In crop treatment	
	No cover crops phacelia black oats phacelia + black oats		Companion plants berseem clover No companion plants	



Response variables	Methods	Units
Worms	Worms counts, functional groups, species, biomass weight, middens/casts	20cm <sup>3</sup> “biscuit tin”
Infiltration rate	Tension disc infiltrometer	mm/hr
Soil bulk density (soil porosity can be calculated from bulk density)	Core, oven baking, weighed	g/cm <sup>3</sup>
Soil structure	VESS test to 20cm	Score
Soil resistance	DataField digital Penetrometer test	KPa at every 2.5cm intervals
Soil moisture	Theta probe	%
Soil temperature	Temperature probe	°C
Decomposition rates	Small nylon bags (tea bags) with organic matter with C:N ratios of 10:1 40:1 80:1	dry weight before and after grams (g)
Plant root Mycorrhizal colonisation	Modified intersection method	% colonisation
Root biomass/weight	Spring wheat roots	Grams (g)
Root morphology	Root flatbed scanner	Digital image
Blackgrass heads	Manual counting	Heads/m <sup>2</sup>
Components of yield	Plant, ear, tiller counts	Counts/m <sup>2</sup>
Yield	Plot combine	kg/ha
Biomass growth & development	Drone image (NDVI)	Canopy cover & colour

## Early “significant” findings

- Fewer worms in disturbed soil
- Cover crops improve aggregation
- Resistance and bulk density effected by tillage
- Soil moisture reduced in disturbed soil
- Infiltration rates improved with tillage and cover crops

## Future thoughts and plans

- Add a pre-compaction treatment into field trial as another physical treatment
- Expand the companion plants trial, fully factorial & different plant species
- CT scan (soil structure) – funding dependant



# Soil health under the spotlight

There was a time when growers challenged with a potentially overwhelming blackgrass burden felt they couldn't reliably drill spring wheat on heavy land following a black oat-based cover crop. Project Lamport has clearly illustrated over recent seasons how this can be achieved, while maintaining profitable cereal production, according to Agrovista trials coordinator Niall Atkinson.

The project was originally designed to run for five years, but the decision was taken last year to extend it, despite the work clearly having met its initial objective to investigate the effectiveness of a range of cultural controls combined with agrochemical standards to tackle blackgrass.

"We believe we've nailed blackgrass control in physical terms," says Niall. "Over five very different seasons the cover crop/spring wheat system (see table on page 14) has beaten all expectations, keeping a huge infestation of blackgrass at bay and dramatically reducing weed seed return to the soil.

"It's been a fantastic success, offering a lifeline to many growers who otherwise would have to have given up winter cereal production. However, we believe there's much more to learn, and that by extending the work we'll find ways of doing the job even better."

While Lamport's main objective remains, soil health now lies at the heart of the project.

## Vigorous roots

"Well-structured soils that drain freely and enable vigorous root growth are at the heart of every successful blackgrass control programme," says Niall. "And, of course, they also underpin successful crop production.

"We believe this soil research will be extremely valuable to all growers, whether or not they

have blackgrass problems, to help develop sustainable farming systems.

"In addition, the political agenda is changing. Subsidy payments may be based around environmental protection, with a particular focus on soil. It's important to stay ahead and consider all options available for protecting and improving our soils."

Soil compaction trials are one of the most important introductions at Lamport and are being carried out in conjunction with independent cultivations expert, Philip Wright.

These trials are examining the benefits of various combinations of roots and steel to improve soils whilst reducing the need for heavy, expensive and potentially damaging cultivations.

"After many years of doing it myself I really wonder why we've been doing so much cultivation," says Niall.

"If you think logically, if you've just harvested a 10-11t/ha wheat crop there can't be much wrong with the soil. Yet, once the combine has left the field, it seems we can't wait to go in and rip everything up.

"The initial study at Lamport in 2017/18 captured visitors' imagination, so it will be really interesting to see the reaction from this year's work."

That initial work on conventionally managed, winter-cropped heavy clay at Lamport clearly showed that using some metal in conjunction with soil-improving cover crops produced better soil structure than roots alone, he points out. This could accelerate the switch to efficient root-only systems based on direct drilling.

In the damp autumn and wet winter of 2017/18, shallow, low-disturbance operations combined with a black oat/berseem clover cover crop resulted in greatly improved wheat establishment and the crop produced an effective canopy much sooner than deep, high-disturbance cultivations.

This season's trials were established in much drier conditions last autumn. Some plots were again shallow cultivated to a few cm, while others were loosened to either 15cm or 25cm, both with low disturbance legs and with/without discs. A further plot was left undisturbed and fallow.

Two different cover crop techniques are being tested on the cultivated plots; a combi-drilled black oats/phacelia mix and a combination of black oats sown behind the loosening legs followed by broadcasted phacelia.

"We want to see if the latter approach helps black oat roots blast down the cracks and fissures, to hold them open for longer," says Niall. "The phacelia provides a shallow, fibrous root system to condition the soil nearer the surface."

All three areas have since been planted with spring wheat, where establishment, growth and yield will be judged and blackgrass levels assessed.

"Roots are the ultimate soil-conditioning solution, so we shouldn't pass up the opportunity to use them. Through this work we'll be able to show the best ways to move

towards a low-or no-till operation on these unforgiving soils, where roots are doing most of the work for us."

Further work by David Purdy, PhD student and John Deere's East Anglia territory manager, is aiming to collate and measure the benefits of good soil management.

"Over the course of Project Lamport, we've observed substantial physical improvements in the soil," says Niall.

"Now we're starting to measure them so we can provide objective advice in the future, giving growers even more confidence to implement the findings on their own farms."

Using fully replicated trials, David will examine the impact of roots among a range of cover crop species with and without metal, in mixtures and on their own.

Compaction, soil density, visual assessment of soil structure, worm counts and organic matter levels are just a few of the numerous measurements that will be taken.

Further work on cover crops establishment is being carried out at Project Lamport.

Residue management is a critical area.

"We've tried direct drilling cover crops but without much success compared with the tried and tested method of power harrow/drill combination," says Niall.

"However, the latter method undoes a lot of the good we are doing, so we're looking at alternatives, including shallow discing to 2-3cm to mix in residues before using a direct drill. This has been a big improvement.

"We're also looking at blowing cover crops into the previous standing cereal crop just before harvest. Where it established well there was no sign of any blackgrass, whereas even the shallow discing produced a carpet that emerged with the cover crop."

“ We believe we’ve **nailed blackgrass control** in physical terms ”



**2018 SYSTEM C**  
**Autumn Legume Pro / S.Ba**

*Legume Pro 10kg combi-drilled on 20th August  
cover crop destroyed on 8th January  
AWCS plus 450 seeds/m<sup>2</sup> direct drilled on 10th April*

DATE	CROPPING	SEEDS	PLANTING
20/08/18	Autumn Legume Pro 10kg combi-drilled on 20th August	450 seeds/m <sup>2</sup>	10/04/19
10/04/19	Autumn Cereals 10kg combi-drilled on 10th April	450 seeds/m <sup>2</sup>	10/04/19
10/04/19	Autumn Cereals 10kg combi-drilled on 10th April	450 seeds/m <sup>2</sup>	10/04/19
10/04/19	Autumn Cereals 10kg combi-drilled on 10th April	450 seeds/m <sup>2</sup>	10/04/19

This could also be a very useful tool to replace stale seedbeds, says Niall, and might also replace ploughing on some soils when setting out on the low- or no-till route.

“Ploughing is the generally accepted reset tool. But the standard of ploughing is not always sufficient to effectively bury all blackgrass seeds, and can turn up huge numbers of dormant seed. It might be better to leave the seed on the surface and let the cover crop start doing its work straight away.”

### Blackgrass control at Lamport

Now entering its sixth year, trials at Project Lamport will continue to fine-tune cultural solutions to help growers tackle severe blackgrass infestations to best effect.

All the techniques will be on show this summer, with Agrovista staff on hand to talk through the findings in detail.

“Our main aim when we started out was to ensure customers with blackgrass problems could continue to grow profitable crops,” says Mark Hemmant, technical manager at Agrovista.

The site at Lamport was pretty typical of the East Midlands in terms of blackgrass issues, with extremely high infestation levels coupled with high resistance.

Research shows that the two most successful options for controlling blackgrass are rotational ploughing and using spring cropping in the rotation.

“Before the project started the field was ploughed,” says Mark. “The objective thereafter has been to leave nature to control the high population of buried very resistant blackgrass, whilst we minimise soil disturbance with the aim of depleting the weed seed-bank and minimising seed return.

“Under the farm’s winter wheat/oilseed rape rotation, blackgrass numbers were building up. So we decided to look at developing a system that would enable spring cropping.”

Over the past five years, Agrovista has been comparing 14 different rotational systems on farm-scale plots.

These have included:

- Winter and spring cropping
- Autumn cover crops and spring wheat rotations
- Traditional fallows
- Hybrid rye for AD plants
- Winter wheat and OSR rotations
- Late-drilled winter wheat.

The most successful trial across the programme has used spring wheat following an autumn-sown cover or trap crop.

The cover crop needs to have sufficient enough biomass to condition heavy soil and pump out enough moisture over the winter to enable timely and reliable drilling. It also needs to be open enough early on to allow as much blackgrass as possible to come through, before being sprayed off ahead of spring drilling.

“We’ve found that a black oat-dominated mix has helped control blackgrass the best,” says Mark. “This species allows a low seed rate to be used to trap the grassweed; retaining an open growth habit early on, before putting on rapid growth both above and most importantly below ground later in the autumn.”

The cover crop, along with the ‘trapped’ blackgrass, is then sprayed off. The exact timing of this can make a real difference to the performance of the following crop, explains Mark.

## Other key work at Lamport on show this summer

- **Depleting the blackgrass seed-bank** – ongoing work at Project Lamport shows that spring cropping may have to be adopted for several consecutive years to control high populations of blackgrass on heavy-land farms.
- **Environmental work** – studies on wild flower margin management have been ramped up to help farmers optimise their response to future support payment requirements.
- **Biologicals** – examining the benefits of mycorrhiza inoculants (beneficial fungi that grow in association with plant roots) on plant nutrition and soil biology.
- **Nutrition** – is it necessary to make up for the lack of soil N mineralisation under no-till systems?
- **Flea beetle** – to investigate indications that OSR establishment improves when companion crops are grown, which may help reduce the impact of flea beetle damage.



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"It's crucial that the cover crop is desiccated in good time. In the first two years of the trial we carried this out six weeks before drilling and again a couple of weeks before. We've since found that applying the first spray around Christmas gives the best results in terms of spring cereal establishment and yield, while still delivering the benefits we want from the cover crop."

Spring wheat is sown using a direct drill to minimise soil disturbance and therefore blackgrass chitting. "The more the soil is moved, the more the blackgrass grows."

While the past few growing seasons have been very variable in terms of temperature and rainfall, the direct-drilled plots have consistently performed, delivering 8.3-10.6t/ha of spring wheat, similar to yields achieved in a winter wheat crop with a moderate blackgrass population.

"The blackgrass control has been so impressive that last season we only counted two heads/m<sup>2</sup> pre-harvest under this system," says Mark.

Although there are often concerns over reduced yields by opting for a spring crop over a winter option, if blackgrass isn't successfully controlled then this will put pressure on even the highest yielding winter crop, he adds. "A winter wheat crop with a moderate blackgrass infestation won't perform any better, costs more to grow and is exacerbating the blackgrass problem – each year it gets worse.

"Our rule of thumb is once head counts reach 40-50/m<sup>2</sup> you're looking at serious yield loss in the following crop, if you don't make significant changes."

## Spring cropping on top for control

The effectiveness of spring cropping following autumn cover cropping compared with the conventional rotation and reset (ploughed) plots at the Lampport site shows that over the past four years this approach has consistently suppressed the blackgrass population.

### Conventional rotation

Harvest Year	Cropping	Yield (t/ha)	Blackgrass Heads (m <sup>2</sup> )
2017	First wheat	8.88	500
2016	OSR	4.24	-
2015	Second wheat	7.83	274
2014	First wheat	12.18	55

### Spring cropping (after autumn cover)

Harvest Year	Cropping	Yield (t/ha)	Blackgrass Heads (m <sup>2</sup> )
2017	Autumn cover crop / spring wheat	8.6	<2
2016	Autumn cover crop / spring wheat	8.65	<2
2015	Autumn cover crop / spring wheat	10.3	<3
2014	Late-sown autumn cover crop	-	-

### Reset

Harvest Year	Cropping	Yield (t/ha)	Blackgrass Heads (m <sup>2</sup> )
2017	Autumn cover crop / spring wheat (destroyed)	-	-
2016	First wheat	5.69	129
2015	Autumn cover crop / spring wheat	9.5	<13
2014	Autumn cover crop / spring wheat	8.7	<3



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