



INCREASING FARM PRODUCTIVITY AND VIABILITY



GREEN HORIZONS





PART ONE

INTRODUCTION

A	GREEN HORIZONS: AN INTRODUCTION	4
B	INCREASING FARM PRODUCTIVITY AND VIABILITY: AN OVERVIEW	5

PART TWO

INCREASING FARM PRODUCTIVITY AND VIABILITY

1	SOILS AND NUTRITION	6-15
2	EXTENDING ROTATIONS	16-19
3	SEEKING INNOVATIVE SOLUTIONS	20-23
4	BENCHMARKING	24-30

PART THREE

BRINGING IT ALL TOGETHER

31-35

- + Case study: AA Clifton Ltd, Kent
- + Agrii's Action Plan for increasing farm productivity and viability
- + Where next for my farm?
- + Glossary of terms

CPD points are available for reading this publication. Please email info@agrii.co.uk with your name and BASIS/NRoSO number to claim your points.

A BACKGROUND AND INTRODUCTION

GREEN HORIZONS

Green Horizons is Agrii's commitment to sustainable food production, and to taking a lead on principles and practices that can help to create a robust future for UK agriculture.

At its centre is our Five Point Plan to help prepare for, and meet, the challenges of tomorrow, while ensuring that agriculture remains sustainable and profitable.

The **Five Point Plan** covers the action we are taking in each of the following areas:



Increasing farm productivity and viability



Providing integrated whole farm solutions



Improving soil resilience



Enhancing the environment



Extending stakeholder engagement

An Insight Report that pulls together all of the projects, research and ongoing work that Agrii is involved in, within each area, will be produced for each of the five points of the plan. This report focuses on **increasing farm productivity and viability**.

THE PRODUCTIVITY AND VIABILITY CHALLENGE:

- + Gradual reduction of basic payments up to 2027.
- + Uncertainty over future income streams and government incentives.
- + Increasing import competition.
- + Lack of access to new breeding developments.
- + Global technologies not yet available in the UK.

Our ambitions under this section of the Green Horizons Five Point Plan are covered in detail in this report. **In summary, they are to:**

Maximise productivity in food production in an environmentally sustainable way – maximising the resilience of farm businesses.

SECTIONS 1-4

Embrace high impact research and modelling technologies to facilitate sustainable research and development with a low environmental impact.

SECTION 3

Lead the way in creation and adoption of new technologies to fast-track climate and consumer benefits.

SECTIONS 2-3

Encourage creative thinking with an annual Agrii Innovation award.

SECTION 4

Develop new ways to reward excellence in integrated crop production.

SECTION 4

OUR OBJECTIVES ARE:

1. To help our growers build business resilience to adapt to climate change.
2. To sustainably increase agricultural production and incomes.
3. To help to reduce the carbon footprint of our industry and look after the natural environment.

IMPROVING FARM PRODUCTIVITY IN AN ENVIRONMENTALLY SUSTAINABLE WAY IS CORE TO BOTH BUSINESS VIABILITY AND REDUCING GREENHOUSE GAS EMISSIONS

Targeting areas of improvement through the adoption of new technologies will help to reduce the cost of production and minimise the risk of environmental harm.

Our R&D efforts, combined with our agronomists' capability to adapt scientific information to each farm's needs and circumstances, have produced substantial yield achievements, surpassing the DEFRA average from similar geographies over the years.

The effects of this integrated approach can be seen in the results from Agrii's MAP Benchmarking Group (more information in section 4).

CLOSING THE GAP BETWEEN GENETIC POTENTIAL AND YIELD

A holistic approach to crop planning and agronomy

Agrii agronomists take a holistic approach to agronomy, which starts well before the seed is in the ground.

Their in-depth knowledge is backed up by results from our vast range of national trials, and our internal specialists in soil biology, cultivations, seed, nutrition, crop protection and precision and digital farming solutions.

As part of this integrated approach, we identify T(-1) as the point of planting and recognise the importance of the planning and preparation required to maximise a crop's chances of reaching its genetic potential.

This can help to identify and target the level of inputs required, resulting in environmental benefits, reduced carbon footprint, greater crop resilience and a higher return on investment.

Please speak to your Agrii contact for more information about our integrated foundation to foliar approach to agronomy and business planning, and the opportunities that exist prior to planting to make the most from your fields.

In terms of ensuring that any seed you plant reaches its genetic potential, it's what you don't do that counts!



NITROUS OXIDE: THE LESSER KNOWN GREENHOUSE GAS

While it's carbon dioxide (CO₂) that gets all the press in terms of global warming; molecule for molecule, nitrous oxide (N₂O) is around 300 times more potent than carbon dioxide at heating the atmosphere.

Like CO₂, N₂O is also long-lived, persisting for around 114 years in the Earth's atmosphere before disintegrating. The Intergovernmental Panel on Climate Change (IPCC) has estimated that N₂O represents around 6% of global greenhouse gas emissions, with about three quarters of those N₂O emissions coming from agriculture.

Along with synthetic ammonia-containing fertilisers, anaerobic soil conditions are a major culprit when it comes to N₂O emissions from agriculture. These conditions prevent soil nitrogen mineralisation from occurring, and instead cause the process of denitrification which emits nitrous oxide. Ensuring soils are appropriately managed and aerated is an important part of minimising N₂O emissions on farm.

You can read more on how to manage your soils appropriately in Green Horizons Insight Report 1: Improving Soil Resilience.

A variety of measures to reduce N₂O emissions from agriculture have been identified by the UK Government's Committee on Climate Change (CCC).

These include:

- + **Precision techniques that target exactly where, when and how much** nitrogen is required to reduce wastage and release of N₂O to the atmosphere.
- + **Use of nitrification inhibitors** – chemicals that suppress the ability of microbes to turn ammonia into nitrate, keeping nitrogen in the soil for plants to use over a longer period of time.
- + **Preventing soil compaction in cropland and pasture** can reduce the need for cultivation and consequently minimise N₂O emissions from the soil.

1 SOILS AND NUTRITION

BUILDING SOIL RESILIENCE FOR INCREASED PRODUCTIVITY

Soil resilience and function is the core to a productive and viable farming system.

A soil that is well structured, biologically active and has a high organic matter content will be more resilient to withstand extreme weather events. Higher water infiltration rates seen in healthier, well structured soils, can increase the travel window, allowing you more days in the year to get onto the field. Our continued research into methods of improving soil resilience has demonstrated the impact it can have on crop health and gross margin.

For more information on soil health in general, please see **Green Horizons Insight Report 1: Improving Soil Resilience.**



REDUCING COMPACTION AT MIDLOE GRANGE

As part of the Green Horizons 'Field of the Future' project at Midloe Grange, Farm Manager David Felce is investigating the impact of cultivation methods and tyre pressures on compaction, diesel use and crop performance.

"Working with Will Mumford of Vantage England & Wales and Tom Carnell of Tramline Tec, we have developed our own sub-surface cultivator based on the He-Va Evolution for low disturbance OSR and cover crop establishment. We see better-targeted tillage and the most appropriate use of roots as good

opportunities to improve soils that are far from ready for direct drilling," explains Mr Felce.

"They may have much less of an impact on carbon than increasing soil organic matter, but reducing our ammonium nitrate usage by 50kg/ha or around 10t/year would cut our annual emissions by more than 28t CO₂ equivalent. It will also help to reduce compaction, and with it the need for remedial metal at depth. Shallower top-down cultivations and lower tyre pressures help us environmentally as well as giving economically-useful savings in diesel."

AGRII SOIL RESILIENCE STRATEGY

The Agrii Soil Resilience Strategy (SRS) can help you to improve the overall resilience of your farm and enable preparation for the new arable and horticultural soil standards under the Sustainable Farming Incentive (SFI).

The Agrii SRS is in the process of being launched and is based on:

- + Utilising the carbon:clay ratio approach to identify current on-farm soil status across different fields, measure long-term improvements in soil health, associated improvements in water infiltration and storage, nutrient use efficiency and yield resilience.
- + Determining subsequent changes in total carbon and carbon sequestration.
- + Utilising the active carbon approach to determine incremental changes over the shorter term as good practice is implemented.
- + Developing an agreed route map for the farmer and agronomist to improve soil health and resilience, based on the farmer's objectives.
- + Helping to prepare farmers for future SFI soil standards.

10 KEY CHARACTERISTICS OF A HEALTHY SOIL:

1. Good tilth.
2. Sufficient depth.
3. Reasonable pH.
4. Balanced nutrient supply.
5. Small population of pathogens and pests.
6. Large population of beneficial organisms.
7. Good drainage and water holding capacity.
8. Low weed pressure.
9. Resistant to degradation.
10. Resilient to unfavourable conditions.

FOCUS ON FRUIT

The use of green compost mulches in young orchards, not only suppresses weed competition during early establishment but also increases soil organic matter (SOM) and carbon sequestration.

The additional benefit of increased water holding capacity helps with tree health and fruit quality by providing resilience to drought stress events.

The development of a carbon:clay index could be a useful tool upon which to base soil management decisions around carbon sequestration.



CASE STUDY SOUTH WALES iFARM

At our Net Zero iFarm in South Wales, Richard and Lyn Anthony have been working to improve their soil health, resilience and sustainability, utilising a holistic management approach.

As part of their strategy, focusing on crop establishment and cultivations, their policy has shifted from a conventional tillage approach for establishing a proportion of their combinable crops to a strip till system. Many fields on the farm have not been ploughed for 20 years plus and have since been cultivated utilising a Vaderstad Top Down, which was pulled by a Quadtrac. The combinable crops have been established with either a Horsch Sprinter or Vaderstad Rapide. This approach improved soil health, promoted soil biology and allowed crops to be established very consistently, in a timely manner compared to ploughing. During this time, with the utilisation of digested food waste from local councils as their main source of fertiliser, in combination with their cultivation strategy, their soil health and function have greatly improved and average organic matter levels are now between 6-7% and rising.

With the adoption of a strip till approach in the last few seasons, the farm has now taken another step on the path to direct drilling and has further improved productivity, timeliness of drilling, soil resilience and function. The fuel-hungry Quadtrac and Top Down combination and subsequent drilling operations



Trial plots at the South Wales iFarm

have now been consolidated into a one-pass approach, utilising a 4m Mzuri drill and 270hp New Holland tractor on crops including winter cereals and winter oilseed rape. Due to the high predominance of silt in the soils on the farm and the heavy rainfall events that can occur over a season, the soils often 'run together' and require remedial action to aid porosity and aeration in the soil again, which the Mzuri drill does very well.

On heavier fields, which have short term grass leys of 2-3 years in amongst the rotation, this one pass system, combined with the root systems of the preceding grass, have stabilised the soil really well, allowing operations to be carried out later into the autumn and permitting travelling earlier in the spring, compared to the traditional approach. This has increased productivity in terms of the operational window available for operations on these fields, whilst improving the structure and function of the soil.

On fields that allow a wider variety of crops to be grown, including maize, winter oilseed rape and cereals, the cultivation and establishment approach is still mixed, although the drill is now exclusively utilised for cereals after grass and establishment of oilseed rape (+ companion crops). There is ongoing experimentation with the drill following maize as fusarium concerns had been raised with crop residues left intact on the soil surface, but following a few trial fields in the autumn of 2020, confidence is growing and more fields will be established using this method in the autumn of 2021.

There are a number of fields on the farm that have been drilled 'back to back' with the Mzuri drill and it will be interesting to monitor and assess these through the 2021/22 season, compared to the traditional establishment method.

The combined approach of an adaptable crop establishment system and utilisation

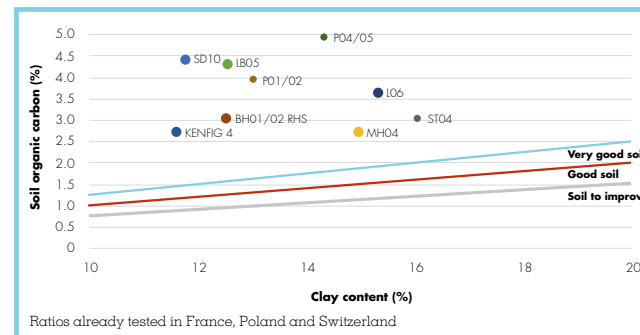


Figure 1: Clay:carbon ratios at the South Wales iFarm

of digestate as the main fertiliser source has demonstrated a more circular approach to food production and has had positive impacts on all aspects of sustainability and productivity.

Looking at the ratio of clay to carbon in the soil, we can see how increasing their organic matter levels over time has made the farm business and soils much more resilient to extreme weather events and improved water infiltration rates; sequestering more carbon in the process.

Machine	Work rate in ha/hour	This table shows the work rate of the various machines used in the South Wales iFarm team's journey towards direct drilling. While the work rate of the Mzuri is lower, its main benefit is that it requires one person and a tractor, compared with two drivers and machines with a more conventional approach. The fuel usage is significantly less and the South Wales team have seen great overall benefits to soil health.
Topdown	4.3	
Rapid	6.7	
Mzuri	2.5	
Cambridge roller	8.6	

1 SOILS AND NUTRITION



THE CLAY:CARBON RATIO: A MEASURE OF SOIL RESILIENCE

Part of our work on benchmarking has included identifying a metric that can provide a universal and simple measure of soil health.

The clay:carbon index is used in combination with other parameters as part of Agrii's Soil Resilience Strategy to examine how resilient a soil is. This can provide supporting evidence on:

- + Carbon sequestration
- + Improved nutrient use efficiency
- + Resilience to compaction
- + Improved water infiltration
- + Improved water holding capacity
- + Resilience to extreme weather events

You can read more about the research behind the clay:carbon ratio and Agrii's Soil Resilience Strategy in Green Horizons Insight Report 1: <https://www.agrii.co.uk/greenhorizons/soil-resilience/>



CASE STUDY A&R FRASER, BRAESIDE FARM, SHAFTESBURY, DORSET – A REGENERATIVE AGRICULTURE JOURNEY

A&R Fraser's family contracting business was started in the 1980s by Andy and Ros Fraser, with their sons George and Jonny returning to help run the growing business over the past ten years. Despite the scale and speed at which it has developed, A&R Fraser continues to be run as a determinedly family business with an impressive fleet of machinery, eight full time members of staff, and the support of the local Agrii team.

The A&R Fraser team made the decision to move to a no till approach in 2016 with the purchase of a Weaving GD drill and stubble rake, followed by an Amazone Cayena in 2019, and then a Weaving LD sub soiler. Their overall regenerative farming vision is to farm sustainably and sympathetically with nature, while still generating a profit. Their experiences so far have largely been positive, particularly with OSR, where they've not experienced much yield drop off at all, especially on



Agrii Agronomist Todd Jex and George Fraser (2021)

Transforming their whole farming service to specialise in direct-drilling, cover-cropping and reducing inputs over the past five years with the focus firmly on soil improvement, earned the Fraser family a place in the final of the 2021 Farmers Weekly Awards, Farm Contractor of the Year.

the chalk ground. Oilseed rape isn't grown nearly as widely or intensively at A&R Fraser as it is on many local units, with beans forming the main cereal break for their soil health, structure-building and all-round rotational advantages. Overall, the farm's highest yielding fields from harvest 2021 have been those that have been under a no till regime for the longest (c. 5 years).

The team's ethos overall is one of attention to detail – looking at the whole farm system, including traffic management and full plant nutrition. Soil health is central to their approach, and they see the measurement of soil health as an essential management tool. Their focus is on integration of organic manures to try and reduce the amount of synthetic fertiliser chemistry being used. They only use insecticides in late autumn against aphids in early drilled cereals, and see healthy plants as being core to reducing their reliance on fungicides. They're also keen to continually investigate their options for the integration of new technology and ideas, for example variable rate application of fertiliser, seed and lime.

A&R Fraser's vision for the future includes completely ceasing the use of insecticides. They believe that a focus on plant and soil health will help them to further reduce their artificial inputs and increase gross margins. They plan to continue to monitor and improve all aspects of soil health, making greater use of cover and catch



Agrii's Dorian Jones and Todd Jex with George and Andrew Fraser (taken in 2015)

crops, integrating companion crops and considering more diverse rotations. They are continuing to investigate and integrate new technologies into their farming enterprise, and are looking at opportunities for future payments linked to carbon and ecosystem services.

"We work closely with our farming contracts to achieve the very most from their land while building firmly for the future in just the same way we farm our own ground. For example we make the best possible use of organic matter from the slurry disposal contracts we have with dairy clients in particular to build soil structure and resilience."

Andy Fraser

"Our overall regenerative farming vision is to farm sustainably and sympathetically with nature, while still generating a profit."

George Fraser

NEW FERTILISER TECHNOLOGIES AND NUTRIENT USE EFFICIENCY

Agrii is at the forefront of new technologies in fertiliser development and we continue to research and develop products that target our key objectives:

- + Improve Nutrient Use Efficiency (NUE).
- + Increase yield.
- + Provide a cost saving to market alternatives.
- + Have a lower environmental footprint (e.g. by reducing greenhouse gas or ammonia emissions).

We are also researching which products have a positive effect on the soil environment and as part of product development, products that maintain or enhance soil biodiversity are of key importance. We are also looking into products that work to enhance cycling of nutrients, soil structure and aggregation and can reduce nutrient leaching.

As an example, for the horticulture (viticulture) market we have recently introduced a product that is 100% organic, contains 85% humus and works to improve soils in challenging situations (see focus box).

P-Reserve, a key active ingredient in our range of phosphate fertilisers, first went through our R&D process in 2009. **P-Reserve was our first Enhanced Efficiency Fertiliser (EEF)**, which has led to improved nutrient usage by allowing better utilisation of phosphate, and resulting in increased yields and uptake of other nutrients (including nitrogen),

whilst reducing phosphate fertiliser use. The next development phase was to provide a soil applied alternative that worked on phosphate in soils rather than on fertilisers.

Trials using the resulting product, named **Release**, have shown that it can be used to improve phosphorus use efficiency in situations where P cannot be justified due to high soil levels. Last season Release increased P offtake by 15% in what was deemed a high P soil, and the product also increased yields by 0.45t/ha (please see page 10 for more information on Release).

We have also been working for many years on **NUE technologies** and the management of nitrogen. Our current agronomy package looks at NUE and measures to improve NUE.

We have been researching urea inhibitors since 2006 and have a strong understanding of the effectiveness of the products in the market and their roles in reducing N use and their environmental footprint in terms of soil, water and air.

We also have ongoing projects looking at soil biology enhancements from a wide range of organic manures and their key properties in improving soils and nutrient cycling.

Please see Green Horizons Insight Report 1 for more information on this topic.



FOCUS ON FRUIT

One of the areas of ongoing research for Agrii's Fruit and Technical teams has been the role of biorational products in the agronomist's toolkit, and how and where products like Frutogard, Amylo-X and other new biorational products can be used to maximum effect. These biological or defence inducing products need a targeted approach. For example, Frutogard allows growers to use a smaller quantity of phosphonates to equal effect, whilst reducing overall residues on the crop and improving both crop protection and crop quality. Products based on living organisms often have more stringent pH requirements to maintain their efficacy in the spray tank and can

benefit from being applied under certain environmental conditions, for example, more humid conditions. Trichoderma products like Vintec now bring a sustainable option for growers to use against grapevine trunk diseases, which are difficult to control.

As we progress towards the National Farmers Union (NFU) goal of Net Zero by 2040, the role of viticulture and other perennial crops will become imperative, acting as sink for carbon without the requirement for intensive annual cultivation.



GETTING MORE FROM LESS: THE AGRII-START RANGE

Fertiliser technologies play an important part in an integrated approach to improving productivity. New technologies that help to improve nutrient use efficiency and increase yield are at the forefront of our research at Agrii, developing products that help to sustainably maximise crop potential.

Our Agrii-Start range encompasses fertiliser products that offer a more environmentally friendly approach whilst reducing costs and ensuring positive crop performance. For example, Agrii-Start Enhance is a granular urea fertiliser, powered by Nutrisphere-N, which stabilises nitrogen within the fertiliser, reducing the risk of volatilisation, leaching and nitrogen loss. Results from global academics have proven that Enhance Urea has had positive effect on soil mycorrhizae.



It works by shielding the nitrogen from the soil enzymes and bacteria involved in nitrogen losses. More of the nitrogen is held in the ammonium form for longer, allowing plants greater opportunity to access nutrition within the soil and reducing nitrous oxide losses to the atmosphere.

The Agrii-Start range includes products for cereal crops, pulses and OSR from winter through to spring. This unique range of fertilisers ensures that nutrition is available when the crops need it, tailored to the crop's specific demands, whilst offering the farm business the opportunity to reduce passes and engage with new technologies.

The overall aim is to make sure that the use of synthetic crop nutrition isn't detrimental to the soil or the environment.

NEW FERTILISER TECHNOLOGIES AND NUTRIENT USE EFFICIENCY

FOCUS ON REPLENISH

Agrii-Start Replenish is an Enhanced N P K SO₃ Plus P-Reserve^{Zn} enhanced efficiency fertiliser.

- Developed specifically for use across all cereals to fulfil nitrogen, phosphorus, potassium and sulphur requirements in one pass.
- Agrii-Start NPKS+ Replenish is a size-matched formulation designed for broadcast systems up to 36m.
- The Agrii-Start Enhance-treated nitrogen reduces nitrogen losses. The product also reduces nitrous oxide losses and has a lower carbon footprint compared to other fertiliser combinations.
- Agrii-Start NPKS+ Replenish is a cost-effective alternative to traditional seedbed fertilisers.
- The product contains P-Reserve^{Zn} – proven to increase phosphate availability and maximise root growth.



WATCH:
Tom Perrott discussing trials work using Agrii-Start Replenish.
<https://vimeo.com/578534825/e312667a45>



IMPROVING THE AVAILABILITY OF PHOSPHORUS

Agrii-Start Release is a new product that has been in development for ten years, but for the first time is now commercially available to arable farmers and vegetable growers.

It works to release phosphorus tied up in soil pools, making P more available to plants. Built on P-Reserve technology, Agrii-Start Release is particularly effective on high P soils where there is no justification for P fertilisers but where P may be a limiting factor because it is locked up or not readily available to establishing crops. One of the benefits of improved P availability is improved root growth and higher root mass, meaning the plant is able to maximise the uptake of other macro and micro-nutrients.

Spring barley trials at the Agrii Carnoustie iFarm site, recorded a yield response of + 0.45t/ha (Harvest 2020) with the inclusion of Release, and grain phosphate levels were elevated by 7.5% P – a notable increase in what was a really challenging year. Agrii-Start Release can be used on a broad range of crops including cereal crops, beets, forage crops, vegetables and potatoes.

Chris Wallwork, Agrii Technical Manager for Horticulture, says: "Agrii-Start Release is particularly relevant to vegetable crops, not only because many of them are very responsive to phosphorus but also because many vegetables are grown on soils with a fairly high P index."

"It is a catch-22 situation," adds Chris. "You need phosphorus to get good early

root growth, but you need the roots to grow early in order for the plant to obtain the phosphorus. Therefore, anything that makes P more available to the plant from the beginning is of benefit to overall crop yield and quality."

Where vegetable crops are grown on soils with high P indices due to historic fertiliser use, Agrii-Start Release can make the existing phosphorus in the soil more available, reducing the need for additional P fertiliser and making it extremely good value for high value crops such as field vegetables. "We are recommending that Agrii-Start Release is used pre-sowing or pre-planting on veg crops to maximise efficacy" explains Chris. "In dry soils the use of a silicone wetter (such as SP058) is recommended to improve the movement of Agrii-Start Release in the root zone, but care must be taken when using residual herbicides, so you should always consult with your Agrii agronomist."

"Where Agrii-Start Release is applied pre-planting in situations with fairly shallow power cultivations there may be a benefit to applying it ahead of the cultivator so that it is incorporated into the root zone, while deep cultivations, such as those using bed formers may dilute the product too much."

We continue to carry out trials on vegetable crops using Agrii-Start Release and other enhanced efficiency fertilisers. Our trials this spring on eight different vegetable crops gave yield increases of between 15 and 42% when using Agrii-Start Release.

LOWER YOUR CARBON FOOTPRINT WITH AGRII-START

Agrii-Start N+ Enhance@
217 kgs/ha
= 392 kgs/CO₂
equivalents/product
(based on 100 kgs/ha N)

62% reduction on CO₂ equivalents/ha.
when compared to alternative products



LOWER YOUR CARBON FOOTPRINT WITH AGRII-START

Agrii-Start NPKS+ Replenish@
350 kgs/ha
= 206 kgs/CO₂
equivalents/product

20% reduction on CO₂ equivalents/ha.
when compared to alternative products



TRIALS USING ENHANCED EFFICIENCY FERTILISERS AT THE DORSET iFARM

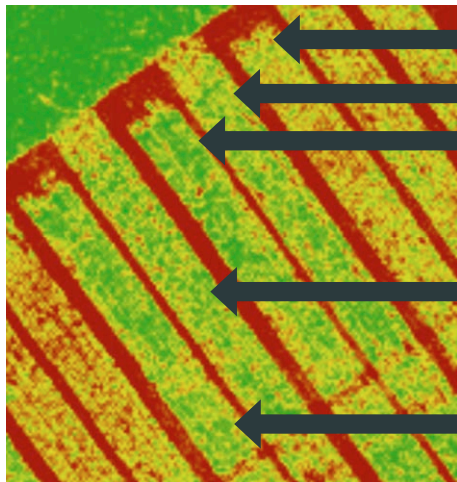
With the gradual reduction in basic payments between now and 2027, the question of how to further enhance a crop's response to the products we are applying is becoming increasingly important.

At our Dorset iFarm, we have been looking at how to get more from less with crop nutrition, by using products from the Agrii-Start range that reduce the number of passes and lower the farm's carbon footprint. We are currently running a five year product trial, which is looking at the relationship between soil health and nitrogen use efficiency (NUE) through the use of various products.

At the iFarm, Agrii-Start Replenish has demonstrated considerable benefits to the crop density compared to the untreated plots.

Used in combination with other products such as WOLFTRAX Mn and Efficie-N-t 28, this NPKS product applied at pre-emergence stage, has provided the crop with its nutritional requirements to increase ground cover during early establishment in just one pass.

NDVI IMAGERY SHOWING RESULTS IN THE AGRII-START REPLENISH TRIALS AT THE DORSET iFARM



UNTREATED

AGRII-START REPLENISH (350kg/ha)

REPLENISH + WOLFTRAX MN

Showing an increase in ground cover over other treatments during early establishment

REPLENISH

followed by Agrii-Start Release pre-emergence @ 2litres, similar establishment to standard but has finished off looking to have a denser canopy

REPLENISH

followed by 40kgs less granular N and Efficie-N-t 28 use instead

CF FERTILISERS NfUE TRIALS



CF Fertilisers have initiated a large scale programme to set up Nitrogen fertiliser Use Efficiency (NfUE) trials. Agrii is one of the trials partners, and we are running half of the trials on our growers' farms in order to help improve N fertiliser use efficiency as well as aiming to achieve the project aims of high yields, product quality and profit margins without compromising the environment.

"Supporting the CF NfUE project fits very well with our Green Horizons initiative as it will help farmers make the best use of applied fertiliser. Not only that, but it will ensure maximum crop usage while minimising losses, and therefore emissions."

Tom Land,
Fertiliser Product Manager

MAP SHOWS LOCATION OF CF NfUE TRIALS



1 SOILS AND NUTRITION

TAILORING NUTRITION FOR GREATER CROP RESILIENCE

ATTENTION TO DETAIL IS KEY FOR CROP RESILIENCE

Agrii's North Region R&D Manager, Jim Carswell sees a tailored approach to crop nutrition as one of today's biggest opportunities for improving arable performance and sustainability.

"Better nutrition can't replace crop protection in dealing with weed, pest and disease problems," stresses Jim. "Nor can it make-up for serious inadequacies in soil structure or health. All the trial work I've been involved with for more than 30 years now, however, convinces me that better-managed nutrition is crucial to securing the greater resilience – both economic and environmental – that we need in our future crop production.

"Nitrogen is our biggest input and there are lots of things we can do to improve the efficiency with which we use it – including urease and nitrification inhibitors and variable application. But I believe NUE should really stand for Nutrient Utilisation Efficiency, because we have at least as much – if not more – to gain from using the whole range of other plant nutrients better. Which will, in turn of course, improve the way our nitrogen is used.

"By protecting the autumn TSP we apply, so it's available for longer, for example, we know we can increase winter wheat

yields by half a tonne a hectare; and not just on low P index soils either. What's more, adding a manganese coating can increase this advantage to over three quarters of a tonne for a return on investment of more than £120/ha.

"Over the past four seasons, we've also seen highly economic responses to specialist zinc, copper and manganese seed dressings as well as physiology-enhancing treatments that give better rooting for greater early nutrient uptake.

"Add in the substantial yield and margin benefits our trials show from fresh available P & K in the spring as well as the autumn plus the best targeted foliar nutrition, and the case for greater attention to nutrient management is compelling," he insists.

YOU CAN'T MANAGE WHAT YOU CAN'T MEASURE

Although Jim Carswell has no doubt that feeding the plant rather than the soil is the primary key to such performance improvements, a decent soil analysis remains his vital starting point, with N-Min testing another important aid that we ignore at our peril. He sees tissue testing to modern growth stage and performance level benchmarks as equally essential. Several years of trial work have shown him the value of grain analysis in planning for the future on the basis of actual crop experience.

"We must get away from the basic P, K and pH approach to soil analysis, though," he says. "Instead, a broad-spectrum analysis of all 12 macro and micro-nutrients is essential to identify the basic resource we're working with and any interactions likely to limit crop uptake. Laser soil texturing can also tell us a lot about how best to manage our nutrition, and the latest biological assessments can be very valuable tools too – providing they are done in the spring when there's sufficient moisture, that is."

The graphical benchmarking tissue test reporting system Agrii has developed with Lancrop to replace the historic and very limited single guideline traffic light approach is transforming its value for agronomists and growers. At the same time, analysing the grain of particularly encouraging or disappointing crops is something we've been finding more and more useful in fine-tuning our nutrition.

JIM CARSWELL'S THREE KEY FACTORS FOR TAILORING NUTRITION:

1. Feed the plant not the soil
2. Be as precise as you can
3. Make sure you get things right early on

Agrii research at Bishop Burton Technology Centre and iFarms across northern England and Scotland, identifies four particularly fruitful areas for improving crop nutrition:

1. Seedbed fertilisation
2. Seed treatment
3. Spring top dressing
4. Foliar feeding

Although each of these offers considerable extra crop performance value, Jim Carswell sees the big prize coming from a tailored approach throughout the season involving all four elements informed by the most effective soil, tissue and grain analyses (Figure 1).

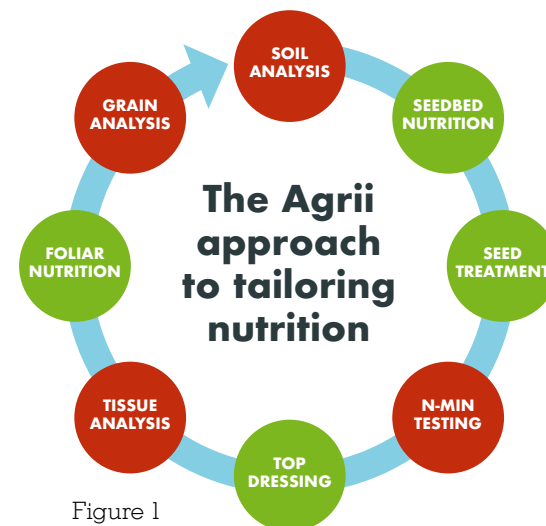


Figure 1

“Because most soils lock-up the nutrient in one way or another regardless of their pH, it makes sense to apply P-Reserve protected phosphate in the spring as well as the autumn” explains Jim. “In exactly the same way, it is only sensible to protect urea nitrogen top dressings by using OEN or Liqui-Safe to very substantially reduce both ammonia and nitrous oxide emissions and leaching. As is balancing key micro-nutrients with well-formulated foliar feeds wherever and whenever they are needed.

“Our research shows better top dressing and foliar feeding are likely to give you by far the greatest benefit if you get your nutrition right from the start. I’ve always seen sowing day as the most important day in a crop’s life. And it certainly is nutritionally. Feeding to address any nutritional gaps and nutrient interactions at this stage is crucial in maximising early crop growth and development to set up the crop’s yield potential and enable it to cope with challenging conditions.”

“If you don’t have a combi-drill, then your best approach would probably be to incorporate protected phosphate ahead of drilling then use specialist high load seed dressings like i-Man (Mn), Zax (Zn) or AgNition (Cu) that make their nutrients available through the seed coat as well as to the young roots. It’s probably one approach or the other in most cases, but there’s a strong argument for using both with the later-drilled wheats that invariably profit from greater early nutritional support.”

Jim Carswell,
Agrii North Region R&D Manager

KEY EARLY NUTRITION CONSIDERATIONS:

- + Drill or place fertiliser with the seed to optimise early root uptake
- + Make available phosphate the priority (along with nitrogen for OSR)
- + Manganese and zinc are also important considerations here with most soils and crops
- + Copper is vital where soils are deficient
- + Boron is invariably worth thinking about with OSR
- + The chelating ability of P-Reserve seems to free-up these micro-nutrients as well as protecting phosphate in both high and low pH soils, so combining it with a Wolfrax trace element coating can be doubly valuable

Jim Carswell and his team find combining a nutritional seed treatment with the early root and stem development boost of a physiological seed dressing gives greater value than either alone.

That this isn’t necessarily apparent without well-balanced subsequent nutrition is underlined in recent iFarm work. In this case, wheat showed little, if any, response to combining Vibrance Duo with i-Man and AgNition under the basic farm nutrition programme. In marked contrast, tailored foliar feeding added 0.23t/ha to the Vibrance Duo treatment but 0.84t/ha where the three seed treatments were employed together (Figure 2).

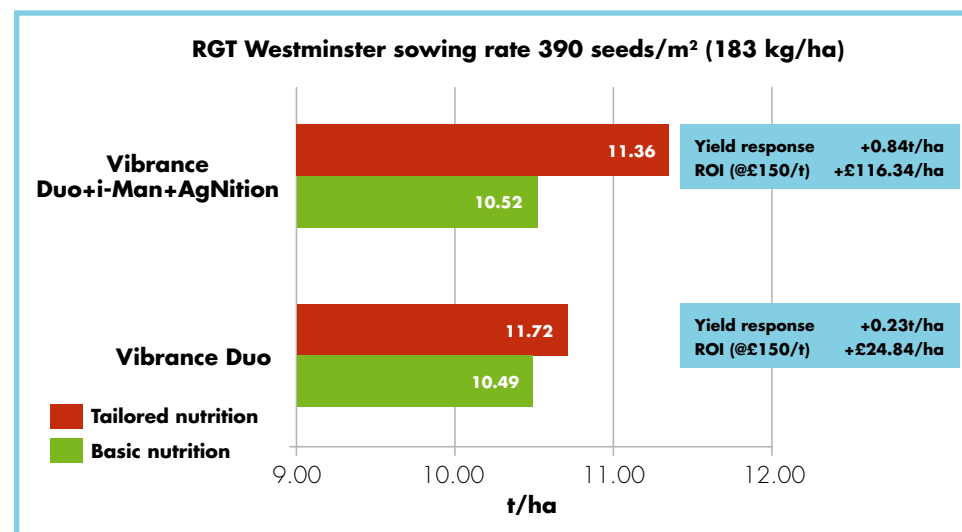


Figure 2: Culbokie iFarm Response to Seed Dressing & Tailored Foliar Nutrition (2019)

YIELD RESPONSES FROM AGRII NUTRITION RESEARCH

(Recent examples)

NUTRITIONAL APPROACH	CROP	RESPONSE
Protecting autumn phosphate (TSP) with P-Reserve	Winter wheat	+ 0.50 t/ha
Adding Wolfrax Manganese to protected TSP	Winter wheat	+ 0.31 t/ha
Employing specialist AgriiStart seedbed fertiliser	Winter OSR	+ 0.43 t/ha
Adding Vibrance Duo to standard seed treatment	Winter wheat	+ 0.43 t/ha
Adding Take-off to standard seed treatment	Winter wheat	+ 0.34 t/ha
Splitting P & K treatment between autumn & spring	Winter wheat	+ 0.16 t/ha
Tailoring foliar nutrition against standard farm regime	Winter wheat	+ 0.47 t/ha
Tailoring foliar nutrition against standard farm regime	Winter barley	+ 0.93 t/ha
Tailoring foliar nutrition against standard farm regime	Spring barley	+ 0.17 t/ha
Tailoring foliar nutrition and seed treatment	Winter wheat	+ 0.84 t/ha

1 SOILS AND NUTRITION

TAILORING NUTRITION FOR GREATER CROP RESILIENCE

CASE STUDY TAILORED NUTRITION: PULSES

A field-scale Yorkshire trial run by Agrii's northern R&D team across 18ha of commercial vining pea and bean crops around Beverley, Market Weighton and Driffield, has shown that spring crop performance can be substantially improved with tailored seedbed nutrition.

Last season, the team set out to build a clearer picture of early spring pulse nutrition and the potential for improving it, to support growers' increased rotational interest in peas and beans. They used vining crops as their most convenient local testbed, but the fundamental growth and development responses they recorded, left them in no doubt that their findings are more widely applicable. The trial sites had very different pH levels and P and K indices, making the results equally relevant across a wide range of soils.

The extent and consistency of improvements over the standard farm programmes really surprised the team.

In all three trial crops, visually obvious improvements in plant rooting and shoot growth were evident within three weeks of sowing. These carried through to noticeably faster leaf production, higher plant chlorophyll levels (recorded with an N tester and NDVI satellite imagery) and both taller and stiffer pea canopies. Markedly better podding and pod fill were obvious in the run up to harvesting too, confirmed by the recorded yield increases (Figure 1). Alongside these improvements, tissue analyses through the growing season showed higher levels of up to seven of the eleven key nutrients measured. What's more, despite the dilution effect of higher yields, analysis of the harvested produce also showed increased nutrient levels in many cases.

The protection P-Reserve treatment gave the phosphate clearly worked well in boosting both root and shoot growth. This was to such an extent that both the pea crops that received it were almost a full leaf pair ahead of the farm programme from a month after sowing.

The differences in plant health and stiffness were also very obvious in these crops. Once the beans began growing, those that received the starter fertiliser romped away so that they were almost 10cm taller and had an NDVI advantage of over 30% by harvest. This was associated with far better root proliferation and nodulation. With the starter fertiliser, the team also recorded higher levels of

important key trace elements like manganese, zinc, molybdenum and boron, in both tissue and final produce testing, even though the starter fertiliser provided no extra micronutrients. This suggests that the chelating action of the P-Reserve was valuable in maintaining their bioavailability too – a useful extra bonus.

Key Improvements from Tailored Pulse Seedbed Nutrition in 2020 Agrii Trials

	Beverley Peas	Market Weighton Peas	Driffield Beans
	Normal pH Low P & K status	High pH High P & K status	High pH Normal P & K status
Early root length	+6.6%	+14.3%	+11.4%
Early shoot length	+7.9%	+8.0%	+12.2%
Mid-season NDVI	+11.7%	+16.6%	+17.6%
Plant height at pod set	+18.0%	+12.9%	+11.2%
Pods per plant	+5.5%	+32.5%	+29.4%
Peas/beans per pod	Not measured	+33.6%	+12.6%
Harvested yield	+52.8%	+20.7%	+14.4%

Figure 1

TAILORING NUTRITION FOR GREATER CROP RESILIENCE IMPROVING PERFORMANCE OF FARM SAVED SEED WITH NUTRIENT ANALYSIS

Farm saved seed nutrient analyses offer great potential for growers to improve crop health and performance from the outset by tailoring early crop nutrition to specific farm needs.

Extensive trials work on Agrii iFarms, together with Lancrop Laboratories, has shown nutrient analysis of harvested grain to be valuable in fine-tuning future crop nutrition by identifying and correcting important gaps in local supply.

At the same time, the team have recorded valuable improvements in crop performance from the use of the specialist nutritional seed treatments i-Man (manganese), AgNition (copper) or Zax (zinc).

This work shows that grain analysis can be a good way of predicting a farm's likely nutritional imbalances so they can be corrected at an early stage in the life of future crops. It also highlights the precise nutrient levels of any grain intended for seed.

As well as showing their value in overcoming initial shortfalls in soil supply, the team's work further suggests that a more robust supply of key nutrients like manganese, copper and zinc at drilling can produce plants better able to take advantage of subsequent, more tailored foliar nutrition.

Putting these findings together makes a strong case for routine analysis of farm saved seed for the 12 key nutrients we routinely measure in our broad-spectrum soil and tissue analyses.

Costing relatively little, this allows the right balance of early nutrition to be provided by our mobile seed dressing teams, or as one of the growing number of nutritional coatings that can be specified with Agrii-Start seedbed fertilisers.



“This will help overcome the ‘hungry gap’ we so often find before seedlings are able to acquire sufficient nutrients from the soil – especially where soils are cold and wet or where both high or low pH leads to nutrient lock-up. It’s all part of the better tailored approach to nutrition we are convinced offers such opportunities for crop improvement.”

Jim Carswell, Agrii North Region R&D Manager

Our trials have shown the frequent additional seed treatment of i-Man (manganese) on spring barley increases yield and provides a healthier crop.

Example of the cost benefit of nutritional seed treatments:

Seed Treatment	Cost at 6 ha per tonne (£/ha)	Value of yield response (£/ha)	ROI
iMan	9.3	£21.70	2:1
iMan+Zax	18.3	£34.40	2:1

Based on >20 trials over 5 years

ALTERNATIVE CROPS

Extending rotations has become part of the farming story. As growers look to the various options available to them for widening the rotation, alternative and innovation crops can bring an increased overall rotation value and gross margin opportunity. Agrii has worked hard to source and investigate different crop options to find those profitable opportunities. These have included both cereals and legumes.

CEREALS

The mainstays here are in Explorer spring barley, available on buyback through Agrii with Viterra Agriculture UK Limited, and naked oats and food barley, on buyback through GB Seeds.

Explorer (see box on right) offers growers, in particular those on heavy ground, an option to grow spring barley without exceeding nitrogen specification for brewing. The variety also provides good grassweed competitiveness and is early to mature.

Naked oats are a white straw break crop and growers have the option of winter and spring types to suit their rotation. They are naturally lower yielding due to the loss of husk, however, with good premiums over feed wheat available, high gross margins are attainable.

Food barley is a new and evolving story for the business. This is solely targeted at the human chain where the product offers a very high nutritional profile to the consumer. Currently a naked type this is also naturally lower yielding, but grain buybacks have been created to provide growers with at least as much gross margin opportunity as that of malting barley.

We are investigating other cereal opportunities including **purple wheat** and **durum wheat**. However, these are still very much in the early phase of examination.

LEGUMES

Legumes provide a great opportunity to improve soil vitality and eventually resilience. With the rise of the plant-based sector, home grown proteins are becoming more sought after as well.

We have continued our work on **chickpeas** and are looking to grow some more pilot crops, should we see promising results from this harvest. Maturity, and how to deal with maturity, remains a key focus in getting this crop over the line. The market currently exists and so it really does come down to how can we grow this crop effectively. The variety that we have chosen to expand on currently was selected out of a large variety screen and gives us the best chance of getting on top of this maturity question. Moving forwards we are hopeful to expand this option to a larger acreage.

Haricot beans also continue to be investigated. This high value option provides many benefits to the grower, including nitrogen fixation and short cycling from planting to harvest. A key factor is around harvesting the crop as it is close to the ground. We are investigating various agronomic manipulations to see if we can get the pod height higher, as well as looking to machinery to see if that could provide an answer. At the moment we are watching and learning.

FOCUS ON:

explorer
SPRING BARLEY

100% of barley for British-brewed Budweiser beer is now sourced from British farms.

Growing British grain for the British supply chain helps reduce the carbon footprint of production and improves food security by reducing reliance on imports.

It also provides growers with some protection from the challenges and uncertainties of current times, helping to increase business resilience.

Explorer's speed of growth is extremely competitive against grassweeds, which can help to reduce crop protection inputs and increase farm productivity.

Purple wheat

Durum wheat

Haricot beans

Explorer barley



Naked oats



Naked barley



Chickpea crop

HEALTHY CROPS: CONSUMER TRENDS

AN IMPORTANT DRIVER FOR UK AGRICULTURE IN THE SEARCH FOR ALTERNATIVE CROPS IMPORTANTLY INVOLVES THE HEALTH BENEFITS THAT THOSE CROPS MAY OFFER THE FOOD SYSTEM

In recent years dietary fibre, sometimes referred to as resistant starch or resistant fibre, has been identified as a key contributor to human health due to the pre-biotic effect in the bowel.

The short chain fatty acids associated with this, encourage the good bacteria, which improves intestinal health and can reduce colon cancer. A combination of a slower digestive system, aided by good levels of beta glucan and improved gut fermentation, increase health whilst also encouraging insulin sensitivity – improving glucose control, thus helping to control incidence of type 2 diabetes.

Agrii is invested in alternative cropping choices that can contribute societally in this way to improve our food choices in an informed healthy manner.

For example, some naked barleys contain up to four times the amount of resistant fibre compared to the mainstream cereal crops. Some lines have this combined with high levels of beta glucan which results in a barley grain with 'superfood' properties.

The opportunity for growth in this market is with us currently as food processors continue to drive research into how they can add these lines to their ingredient range. These naked types also benefit from being used as 'wholegrains' as they are milled, or used, whole, due to the husk naturally separating at harvest.

Resistant fibre is also present in combining peas and other legumes such as haricot beans and chickpeas.

These are increasingly being used in the plant protein sector of the food market as consumers look to move part of their

diet to plant-based food. The increased satiety associated with these types of food could be a major contributor to future food systems directed at weight loss and health generally. It could be in the form of a meat substitute or a plant-based protein extracted product in a new area of the market that we haven't yet envisaged.

Reports by the Smart Protein Project state that European consumption of plant-based foods increased by

49%

over the two year period 2018 to 2020. This resulted in a market size of 3.6 billion Euros from 2.4 billion Euros.

Only the most cost effective crops will suit this market. However, Agrii is well placed through an evolving testing system on these crops for robustness to UK conditions, overall return to growers and suitability to a fast moving and exciting food market.

2 EXTENDING ROTATIONS

ROTATIONS WORK AND IMPACT ON MARGINS

RESULTS FROM AGRII TRIALS

More than six years of independent multi-factor trials at Stow Longa and our other iFarm sites across the country, have demonstrated what impact can be made on blackgrass and gross margins through a diversified rotational strategy.

The blocks at Stow Longa are combinations of cropping options and within each block there is a plough-based system, deep one pass cultivating to 12-15 cms and a catch / cover crop area.

Gross margins summarised to harvest 2021 are now extensive, but here we can see the best versus the worst in gross margin terms from Stow Longa.

Everything is costed from the cultivations, drilling, seed, fertiliser and agchem – plus of course the levels of blackgrass within the various rotations and cultivation strategies.

Although there is a common theme here where both the previous crops were winter wheat, it is worth noting that the early drill (beginning of October) timings combined with the previous crops in the rotation performed badly.

On the other hand, where the previous two crops had been winter wheat, now drilled late (third week October), we have a completely different gross margin.

The work also shows that spring cereals can make a real change to blackgrass numbers and deliver a decent gross margin. Results indicate that you can drill spring cereals very successfully on heavier land IF the ground is set up well.

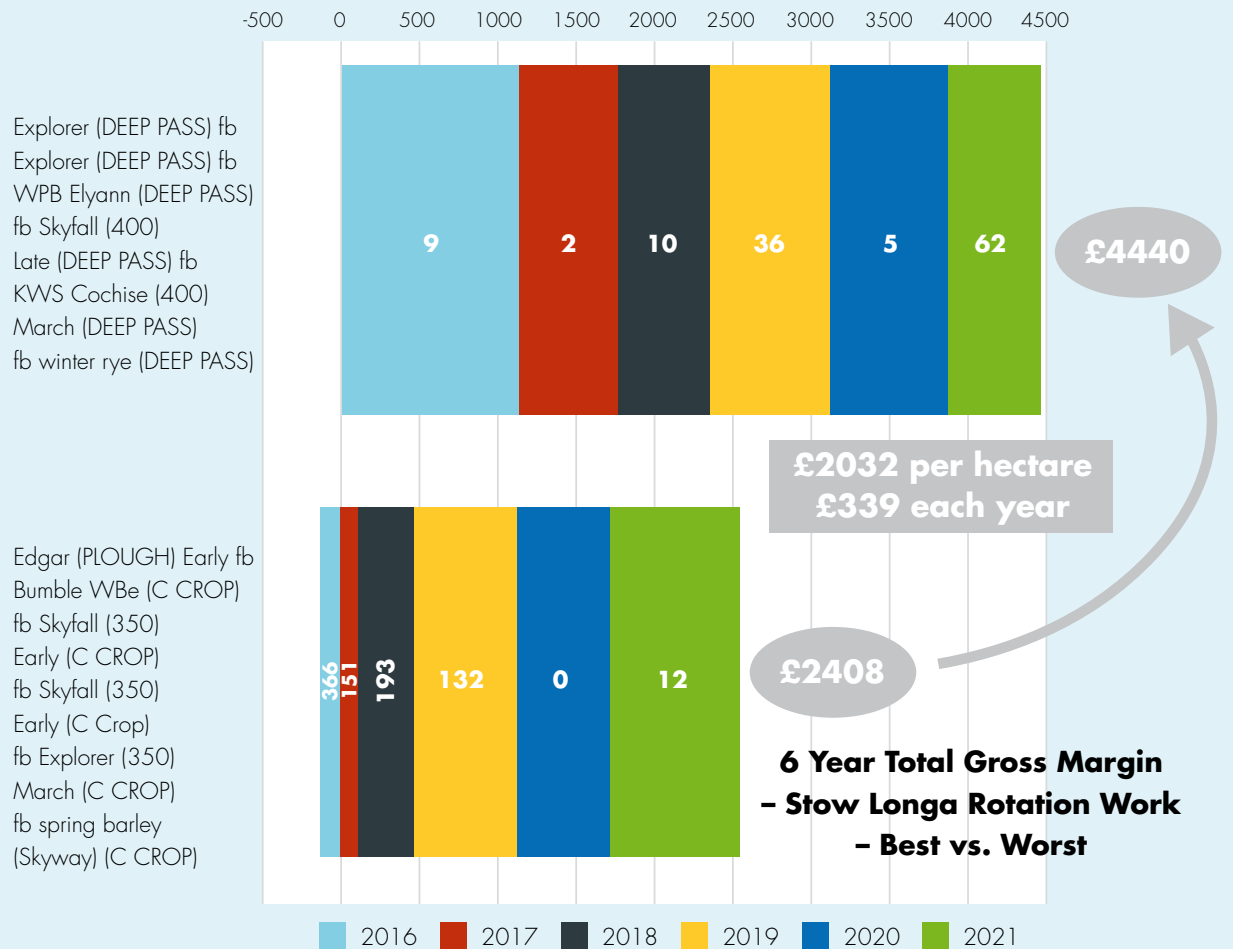
The gross margin swing over six years = £2032 per hectare, equivalent to £339 per year. In 2020 the equivalent figures were £2552 per hectare, or £510 per year over five years.

This shows that the gap narrows when the worst block has been proactively managed by adding spring barley into the rotation!

So the attention to detail around previous grassweed history, cultivation strategy, the soil structure and drilling dates all contribute towards successful and sustainable crop production.

Gross margin (£) per hectare over six years

Numbers in white indicate blackgrass ears/m²



INTEGRATING LIVESTOCK INTO THE ROTATION

Integrating livestock into the rotation is a key part of a regenerative agriculture approach. Livestock grazing of cover or cash crops on arable land not only provides a natural source of organic matter, but also encourages new plant growth, which increases the amount of carbon returned to the soil, driving nutrient cycling and recycling.

Herbal leys are also becoming increasingly popular as they have been shown to provide benefits for livestock, biodiversity and soil health. This means that for livestock farmers, there may be opportunities for animals to benefit from the same strategies that improve soil fertility and productivity.

Permanent pasture builds and maintains soil organic carbon faster than rotational arable cropping. The absence of cultivations and use of continued cover prevents carbon losses from occurring. With almost 60% of UK agricultural arable land used for livestock, grazing management is an important part of achieving net zero within agriculture. A well-managed grazing system can lead to greater accumulation of soil carbon compared to a non-grazed system.

CASE STUDY MIXED FARMING IN THE COTSWOLDS

More than ten different combinable crops are routinely grown across 1400 ha between Winchcombe and Wotton-under-Edge, farmed as part of a joint venture farming business built by Toby Baxter for a growing number of landowners on the western edge of the Cotswolds over the past decades.

These are complemented by a wide range of forage and cover crops, all supporting extensive beef and sheep grazing. This diversity gives both the land and business the greatest ability to cope with changing environmental and economic conditions.

Undoubtedly, the single most crucial ingredient for success in this case has been getting livestock back into the arable rotation in a sustainable way. As the business has grown, greater reliance has been placed on forage breaks as well as cover crops, both for an expanding sheep flock and a New Zealand-style, year-round grazed beef enterprise, which has been recently developed.

“Grazing cover crops adds to their value considerably” says Toby Baxter. “It provides a timely injection of extra fertiliser-saving and soil-improving fertility, while decimating any

slugs. It also allows us to turn arable challenges into livestock opportunities. For example, around 1.5t/ha was knocked out of 55ha of a conventional oat crop we were growing for seed last August. But the thick sward this produced gave us excellent autumn finishing for 500 lambs ahead of our next crop.”

Mr Baxter also sees the forage breaks that the team have introduced as one of their most valuable assets. “Herbal leys are like walk-in concentrates for lambs – allowing us to finish more than 700 from a single 23ha field this autumn. What’s more we’ve seen our following crops outyielding the same varieties after the normal arable breaks. They also allow us to safely sow wheat into previously problematic blackgrass ground, as well as providing useful Stewardship payments for their biodiversity and landscape contribution.”

“Four year herbal leys are proving especially useful in supporting first class beef and sheep performance.” Toby Baxter

Read the full case study at: www.agrii.co.uk/blog/no-till-proves-its-worth/



DOING THINGS DIFFERENTLY – CHANGES MADE BY TOBY BAXTER AND HIS AGRII AGRONOMIST, JOHN VICKERY:

- + Half of the team’s first cereals are no longer wheat
- + They routinely employ double cereal breaks and four year herbal leys
- + Year round soil cover is standard practice
- + All cropping is closely integrated with beef and sheep enterprises



3 SEEKING INNOVATIVE SOLUTIONS

NEW TECHNOLOGIES

The potential for new technologies to help growers and their agronomists sustainably increase the productivity of their arable, vegetable and fruit enterprises is immense. Agrii is committed to the development of new technologies to help develop a more sustainable future for UK agriculture.

New technologies come in many guises, whether it be new crop protection products, alternative biosolutions, genetic advancements, use of big data to refine decision-making, or alternative methods of establishing crops – all have the potential to help with the twin goals of sustainable and profitable food production. Through our comprehensive research programme these new developments are put through their paces and if shown to deliver benefits, Agrii will promote their use to our customers based on the facts and evidence from our own and other independent trials organisations.

Genetic advancements have recently provided the UK with improved **variety characteristics**, such as reduced pod shatter in oilseed rape, tolerance to BYDV in barley and improving *Septoria* resistance in wheat, to name but three.

Agrii has worked to summarise these characteristics into an easily understandable Variety Sustainability Rating (VSR) system as part of our Advisory List for wheat, barley and oilseed rape, to encourage sensible variety choices to be made.

You can read more about these genetic advancements and VSRs in Green Horizons Insight Report 3.

Biosolutions are also becoming better understood. Agrii has now trialled more than 130 biostimulants, elicitors, endophytes and biopesticides, and we are working hard to separate fact from fantasy as these begin to flood onto the UK market.

All sorts of claims for these products have been made, and we have learned, as with other emerging technologies, that it is as important to identify where they don't work, as well as where they might have a place. We have defined some very clear positions where benefits have accrued; but we have to recognise these technologies are less reliable than conventional products.

Out of the 130 tested, around 25% are showing promise; and some of these have actually been part of our portfolio for 20 years or more and are well tried and tested. Laboratory and glasshouse tests are allowing us to prioritise those that go into field trials.

There's more information about our work with biosolutions in Green Horizons Insight Reports 2 and 3. You can also read the Agrii document, **Biosolutions Explained** here: <https://www.agrii.co.uk/wp-content/uploads/2021/03/BioSolutions-Explained-March-2021.pdf>



Adjuvant technology has advanced considerably in the last decade and offered reliable improvements in product targeting, retention and performance, as well as associated benefits to the environment including drift reduction. We are currently working with manufacturers of these technologies to explore the potential of "bio-adjuvants", products with cleaner labels that still deliver the benefits.

"**Tailored rate**" **water conditioners** too, are a focus for our research team to help get the most from products we prescribe – hard water is affecting the performance of some active ingredients.

New **Crop Protection Products** are still coming to the market but are few and far between, with ever more stringent environmental and operator safety requirements before they gain approval. As Agrii has always done, we have been putting these into trials three years before they come onto the UK market in order to identify what benefits they bring over older chemistry.

We will seek to adopt new chemistry where possible due to improved safety, but only where the return on investment makes sense for our customers. Working to economic thresholds is a critical driver, and fundamental to Agrii's Integrated Pest Management (IPM) ethos.



Soil health enhancers such as mycorrhizal fungi are interesting new arenas for broad acre crops, although they have been used widely in ornamental and fruit production. Recent research work suggests benefits but currently cost in use is quite high.

These fungi, present in all soils to a greater or lesser extent, aid the use and uptake of nutrients, but can be disrupted by certain cultivation systems / crop rotations. The natural population is likely still to be there and, given the right habitat and food supply, may well re-establish themselves.

You can read more about soil health enhancers in Green Horizons Insight Report 3.

Agrii's focus more recently has been around **targeted nutrient applications**, using RHIZA variable nutrition systems, and also new technology **Enhanced Efficiency Fertilisers** such as the Agrii-Start range, which have a lower carbon footprint than conventional products.

There's more information about EEFs in section 2 of this document and in Insight Report 2. Variable rate nutrient applications are covered in more detail on page 21 of this document and in Insight Report 3.

PRECISION: VARIABLE RATE NITROGEN TRIALS WITH LIQUI-SAFE

There has been great interest over the past couple of years in the use of nitrogen inhibitors to reduce losses of nitrogen to the environment through volatilisation, denitrification and leaching.

There is now more than ever, a renewed focus on encouraging and rewarding farmers for safeguarding the environment by minimising losses as well as aiding us to reach crucial goals on climate change. This has therefore focused us to develop our trials to maximise nitrogen use efficiency. A large proportion of Agrii's Digital Technology Farms operate using liquid nitrogen products, therefore we saw an opportunity to combine Agrii-Start Liqui-Safe into our nitrogen programmes and feature RHIZA variable rate applications.

Liqui-Safe is designed to improve nitrogen use efficiency whilst minimising environmental losses. It improves Nutrient Use Efficiency (NUE) of nitrogen, when applied with UAN based fertilisers by 15% and through 42 trials in winter wheat has produced an average yield increase of 4%. We have five Liqui-Safe trials running this year as part of the Digital Technology Farm trials, all applying 60% of their total nitrogen to the crop at the first application typically in February/March with the inclusion of Liqui-Safe. This was then followed up 3-4 weeks later with the remaining nitrogen applied as split tramlines with half variable rate and half flat rate.

The trial is designed to understand how we can further maximise NUE through using Liqui-Safe, but coupled with variable rate applications, which is not only beneficial to yield as we have seen from previous trials but is also focused on financial advantage. The two-split programme also means there is a financial saving from a reduced pass in the crop too but without compromising the total nitrogen required by the crop.

WHAT ARE THE BENEFITS OF LIQUI-SAFE?

Liqui-Safe is a highly water-soluble organic compound, primarily created from fermentation of maize.



It provides the opportunity to increase yield while benefitting soil biology and reducing nitrous oxide losses to the atmosphere.

Liqui-Safe slows down the loss of nitrogen to the air and water by maintaining higher levels of nitrogen in the ammonium form in the soil for the growing crop to use more efficiently.

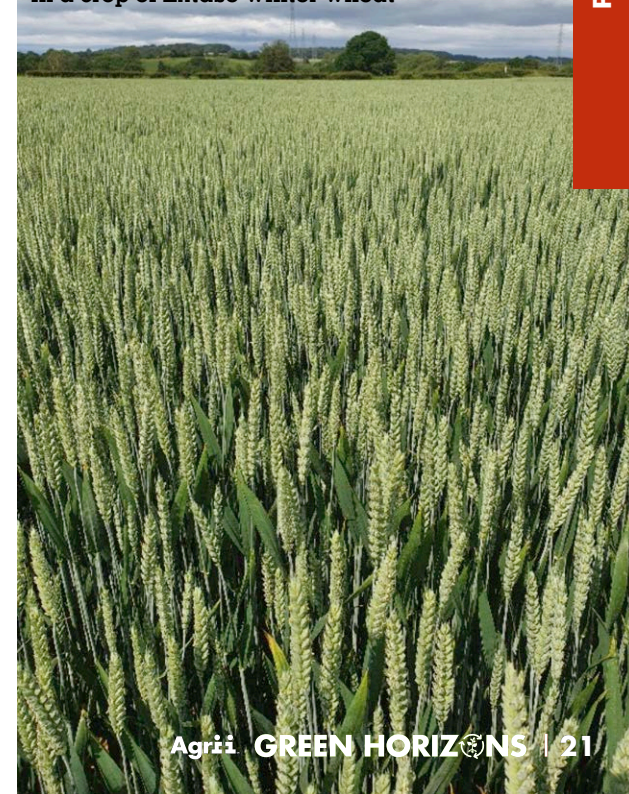
As an organic compound Liqui-Safe degrades in the soil to leave only carbon, hydrogen and oxygen.

- + **Reduced passes required, frees up the sprayer during busy periods.**
- + **Keeps the fertiliser where it is needed for longer, increasing nitrogen efficiency, yield and crop quality.**
- + **Studies have demonstrated a beneficial effect on the soil biome and significant reductions in nitrous oxide and ammonia losses from field applications of Liqui-Safe.**

READ: Find out more about how Liqui-Safe works here:
<https://www.agrii.co.uk/wp-content/uploads/2021/02/LiquiSafe-A4-Documents-TL-and-SM.pdf>



One of the DTF trials in South Staffordshire in a crop of Extase winter wheat



3 SEEKING INNOVATIVE SOLUTIONS

A PRECISION APPROACH TO NITROGEN USE EFFICIENCY

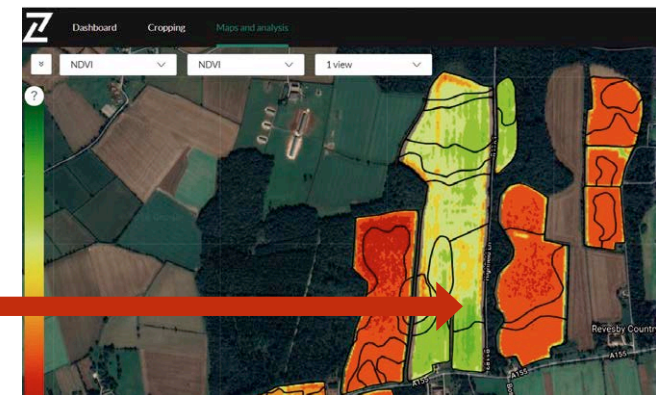
With changing weather patterns trending towards dry springs, a larger dose of nitrogen early, in a protective form, will allow growers to ensure enough nutrient is applied to sustain crop growth throughout the early stages of development.

Having studied RHIZA satellite imagery and yield maps over the past few seasons we have found that around the traditional N3 (nitrogen split) timing, crop variability is generally set. Areas of fields with higher biomass at this time will inevitably yield higher at harvest. With this in mind we can, with some level of confidence, apply the balance of nitrogen variably, targeting the higher biomass areas with higher applications of N, in effect feeding for yield. There may be some lower biomass areas of fields that we will have met the nitrogen requirement for with the 60% early dose, so in effect only applications to actual crop potential will be made.

Throughout the year we are able to monitor the crop using satellite imagery such as NDVI and GCVI, to determine any visual effects of applications.

We also take two leaf stage plant counts and follow this up with ear counts in the crop, which helps to give us an indication of how the crop has performed in different application areas. Ultimately the yield maps, once analysed, will give us a true understanding of how each of the plots have performed and we can compare these yield results to a neighbouring winter wheat field on the same soil type which received flat rate nitrogen applications without Liqui-Safe.

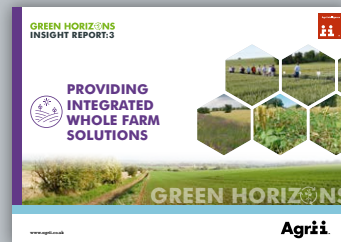
We are in our second year of conducting variable rate nitrogen trials. NUE calculations last year saw our variable rate applications average 75% NUE over flat rate applications which averaged at 69% NUE. These trials were just focused on variable rate nitrogen applications versus flat rate so with the Liqui-Safe we would expect these to be higher.



Revesby 2020 – Currently trialled in Chafer 35S

For more information on RHIZA and Agrii's Digital Technology Farms, please see Green Horizons Insight Report 3.

<https://www.agrii.co.uk/greenhorizons/integrated-whole-farm-solutions/>



PART TWO

INNOVATION AWARD

Agriculture is one of the most innovative sectors in the UK, exploring climate smart technologies that can be used to grow food for the increasing population.

When launching our Green Horizons initiative, we were aware that many farmers and Agrii employees were already practicing sustainable, innovative approaches. To capture these ideas, we launched our own Innovation Award, encouraging creative approaches that could ultimately help to shape the future of agriculture.



AGRII INNOVATION AWARD WINNER 2021

Luke Medd West Whorley Hill, County Durham, Durham

On his farm, Luke is aiming to improve soil health and reduce reliance on chemical controls, whilst enhancing biodiversity and increasing the future sustainability of the farm.



Luke Medd (right) and Alan Medd (left)

After graduating from Harper Adams in the summer of 2021, Luke, together with his father Alan, is looking to explore options for moving towards a more regenerative approach from their conventional tillage system. With an interest in exploring the benefits and barriers regenerative agriculture can bring to their own farm in County Durham, Luke is organising a long-term trial to compare a regenerative system to the traditional 'farm standard', with the hope that it will not only benefit them, but also communities of farmers in the area, encouraging open days and telling their story through social media.

With the phasing out of BPS and gradual introduction of ELMS, Luke sees it timely that farmers look to employ more sustainable approaches to food production, working to support

the environment. "I feel that our region tends to be distanced from major research areas. Areas such as Lincolnshire tend to be favoured where there is predominantly more cropped land" says Luke. "With many differing factors such as climate and soil types, what is seen to work for some, may not work on a farm like ours in the North East."

Luke is keen to explore how different equipment, cover crop species and establishment techniques impact soil health and crop quality. With the help of RHIZA field scanning and Agrii's input, through his studies, he hopes to provide scientific evidence for the benefits and potential caveats of employing a regenerative approach, and help others to make similar transitions.

WHAT MAKES LUKE THIS YEAR'S WINNER?

We asked entrants to consider three questions as part of their application for this year's Award. Here are Luke's responses:

A Is it providing a solution to one of today's many agronomic challenges?

We have all recognised the increased focus on regenerative agriculture with the introduction of carbon markets and a rising awareness of the need to improve soil health. With scientific assessments, this long term trial will help us understand what the benefits and the challenges of regenerative agriculture are. From that, we can help other farmers who would like to set out on a regenerative agriculture journey, to a more sustainable and productive system.

B Will it increase productivity in a sustainable way?

The claimed benefits of regenerative agriculture will help us move towards a more productive system, saving both time and money. The approach is said to enhance both environmental and economic sustainability.

C Will it improve farmer profitability?

With the move towards direct drilling and improving soil health usually comes a reduction in costs and an increase in time and travel windows. The interest will be in looking at the impact during the transition phase as well as the long term impact.

Follow Luke's progress on Instagram @ReGenAgNorthEast

NETWORKS FOR SUSTAINABLE YIELD ENHANCEMENT

GREEN HORIZONS FARMER NETWORK

The Farmer Network is currently made up of 12 Agrii customers who are each at different stages on their journey towards a more sustainable production system.

Following the Farmer Network group's initial meeting in early 2021, the Green Horizons team set out on a 'grand tour' around the country, looking at the various systems and trials that people had on their own farms. Despite the different challenges and way of working, the same questions persisted throughout:

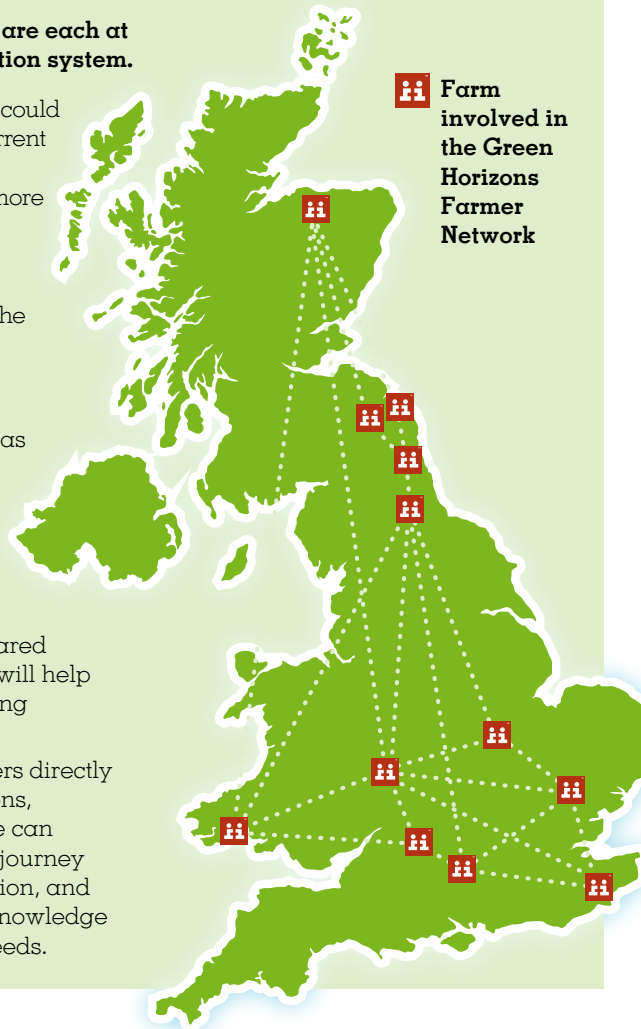
- + How can I reduce my reliance on inputs whilst still growing a good quality crop?
- + What can I do to become more resilient to the extreme weather events we are getting?
- + What will ELMS look like? How can I prepare for it?
- + How can we maintain or increase farm productivity whilst enhancing the environment?

These questions came as no surprise, and the Green Horizons team were conscious that the answer on one farm may not be the answer on another. In the hope that the project could at least start new ways of thinking, the team began looking at different areas

of the farm where efficiency could be improved, in line with current systems and objectives. With thoughts planted and more questions being pondered, a series of 'black and white' tramline trials will be established to help provide the Green Horizons team and the farmer network with some answers.

More importantly, these ideas will be tested under the network members' own farming systems and on a large scale, providing answers that will work for them. At the end, data and experiences will be shared amongst the group, which will help others accelerate faster along their journey.

By having a group of farmers directly inputting into Green Horizons, we hope to listen to how we can support people along their journey to sustainable food production, and deliver opportunities and knowledge based on our customers' needs.



Farm involved in the Green Horizons Farmer Network

THE YIELD ENHANCEMENT NETWORK – YEN

The Yield Enhancement Network – or YEN – is an ADAS initiative that connects agricultural organisations and farmers who are striving to improve crop performance.

Networks are open to any interested individual or organisation – commercial, academic or other.

YEN networks exist to help any member from the UK, Europe or beyond to close the gap between their current and potential performance.

YEN ZERO

The newest addition to the ADAS YEN Family is the YEN Zero network.



With the aim of creating a net-zero community, Agrii has joined the network to analyse and benchmark combinable crop carbon footprints.

Being a part of this will enable us to provide the most scientifically robust information for calculating on farm greenhouse gas emissions and employing mitigation strategies.

You can read more about YEN Zero here: <https://www.yen.adas.co.uk/projects/yen-zero>

AGRII MAXIMISING ARABLE PRODUCTIVITY (MAP) PROJECT

Agrii's Maximising Arable Performance (MAP) benchmarking project, is a consolidation of farm gross margin data based on measured yields and standardised output prices, applied according to crop quality. Understanding crop and rotational performance on your farm and how you compare to other farms on similar soil types will help your decision making process.



The long-established MAP project now extends to well over 30,000 ha of annual cropping with members across 15 central, southern, Midlands and south eastern counties. It provides them with the best available performance intelligence on all the main combinable crops from validated farm data.

This intelligence is proving invaluable in dealing with modern crop management challenges like blackgrass, cabbage stem flea beetle and BYDV, not to mention wider business sustainability in the face of an increasingly uncertain climate and the biggest changes to farming support in a generation.

Wiltshire-based agronomist and regional technical adviser, Tim Horton, who co-ordinates the scheme, insists that the secret of MAP's success is being built up from field data rather than down from enterprise or farm records. "Originally, we based our free customer service on the Crop Management Systems field recording package" he explains. "But now it can automatically be linked to Gatekeeper for seamless transfer of data. We are also developing it to work with Muddy Boots, although this is proving far from as straight-forward as we'd like it to be."

As it comes in, the Agrii team validates the line-by-line field record information so there's no 'missing' data. Any entries outside pre-set upper and lower limits are flagged-up and questioned. Input usage is also matched to farm purchasing and storage records. "In addition to ensuring the accuracy of the MAP database, our members find this cross-checking a real help in ensuring their record-keeping is as accurate as it can be for their 'duty of care', together with any external auditing" explains Tim.

As a rule, data entry is closed towards the end of each calendar year to allow enough time from harvest for the most accurate performance records. We then apply standardised output prices according to actual crop quality to ensure the results reflect production efficiency rather than being skewed by any market differences. Finally, each member's results are fed back to them in a confidential January report benchmarking their performance in a whole host of different ways.

"This gives each grower/agronomist team the best possible crop-by-crop basis for assessing how they've performed against their peers, measuring the progress they've made from previous years, and pinpointing particular challenges they need to address."

Tim Horton, Agrii Regional Technical Advisor and MAP Project Coordinator

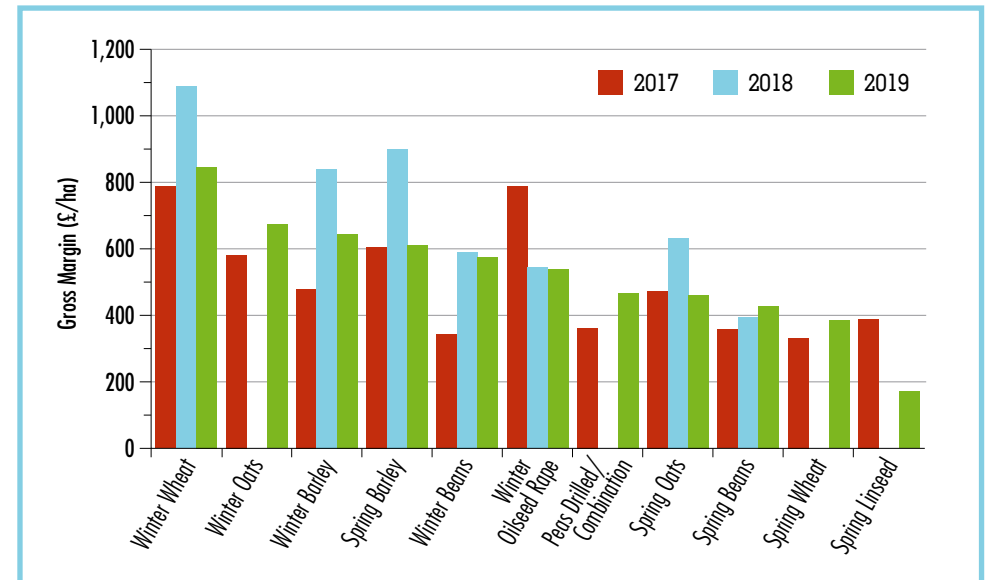


Figure 1: Comparison of MAP Project results from 2017-2019

Each farm that has contributed data is marked as a point on the graph showing the relative position of their gross margin performance in the group of farms; you can also see the farm yield, average variable costs and gross margin for all farms while the identity of businesses remains confidential.

WHAT EXACTLY DOES MAP BENCHMARKING SHOW ABOUT RECENT ARABLE PERFORMANCE, AND WHICH ELEMENTS DO THE FARM TEAMS FIND MOST VALUABLE?

- + Separate comparisons are made for five main types of ground – chalk, clay, medium, light and brash soils.
- + Wheat performance is benchmarked separately for milling and Group 3 and feed types.
- + Winter wheats, winter OSRs, and winter and spring barleys are further broken down by variety.
- + Winter wheats and OSRs are also assessed by drilling date and previous cropping.
- + Finally, all the field data is combined, allowing overall harvested farm performance to be compared between farms of similar sizes and types by yield, variable cost and gross margin.

“The intelligence our farm teams gain from being able to see how their crops are performing compared to previous years and against others in similar situations in an accurate and thoroughly objective way is really valuable, as is the discipline of doing it.

Beyond this, though, analysis of the data over a number of years provides everyone with wider insights into the economic reliability of different crops, gross margin and cost trends and the performance of different varieties or variety types – amongst other things – to help forward planning.”

Tim Horton, Agrii Regional Technical Advisor and MAP Project Coordinator



It’s not surprising to see MAP results that show milling wheat has been the best cereal margin earner over the past five years. More interestingly, though, it also reveals the crop to be less variable in its annual performance than Group 3 and feed wheats.

Furthermore, spring barley stands out (admittedly in a group of experienced spring barley growers) for being a much better and more reliable earner than winter barley. And while spring oats and spring wheat have delivered almost identical five-year average margins, it’s crystal clear which is the least risky (Figure 1).

MAP analyses of the economic performance of different crops over the past five years also tell an interesting story. Average and top 25% wheat gross margins show an encouragingly upward trend and a fairly consistent performance gap between them (Figure 2). It’s a very different picture with oilseed rape, though – the growing challenges the crop has faced have seen margins fall and the gap between the average and better-performing crops increasing (Figure 3).

“Looking into the data in more detail highlights the declining yields and increasing costs of OSR production in recent years,” Tim notes. “And, more interestingly for forward-planning, the fact that earlier drilled crops are now performing noticeably better than those in what always used to be the more profitable, later-drilling windows (Table 1). “While sufficient commercial crop data is only now coming through, it’s also interesting to see TuYV-resistant varieties taking the top three mainstream ‘double low’ OSR performance slots.

Drilling date	Before Aug 19	Aug 19 - 31	After Aug 31
2019/20			
Yield (t/ha)	2.96	2.59	2.40
Variable costs (£/ha)	497	516	517
Gross margin (£/ha)	510	368	305
2017/18			
Yield (t/ha)	3.09	3.33	3.42
Variable costs (£/ha)	511	522	553
Gross margin (£/ha)	431	488	510

Table 1: MAP winter OSR performance by sowing date (2017/18 vs 2019/20)

This is good confirmation of both our own variety trials and Recommended List results.”

More data over a longer timescale has also highlighted to the MAP team, the clear performance gap between hybrid six-row and conventional two-row winter barleys in margin as well as yield terms. Over the past three years, hybrids have delivered gross margins some 14% ahead of conventional two-row crops, together with less year-to-year variation (Figure 4).

Drilling down further into the MAP data gives a good idea of how individual varieties are performing in terms of sustainability too. The current advantage of KWS Extase is, for instance, clear in an average fungicide spend of just over £79/ha last season against an all-variety benchmark of over £92/ha, with previous stalwarts, Dunston and JB Diego at over £100/ha.

It’s the relative performance of individual crops on individual farms’ specific soil types that most MAP group members find most valuable. First and foremost, this shows them the extent to which what they’ve achieved

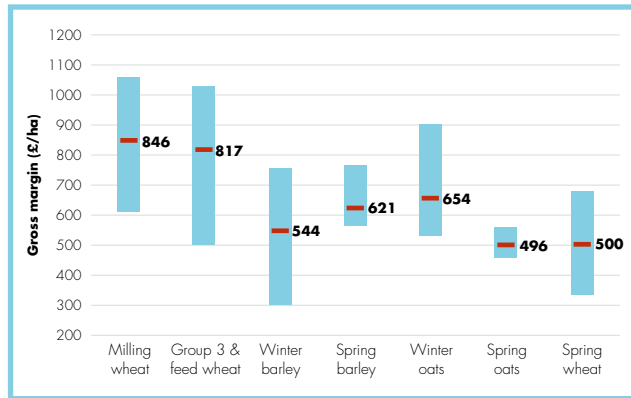


Figure 1: MAP five-year average cereal margins & range (2016-2020)

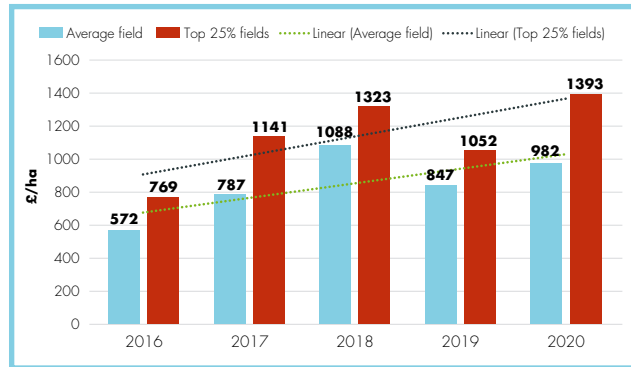


Figure 2: MAP five-year winter wheat gross margin/ha trends

is in line with the group, so more due to the season than anything else. Where it's out of line (one way or another) they can then delve further into the main margin components to find out why. Is it more to do with yields, for instance, or input differences?

Individual farm data over a number of years provides farm teams with the best basis for future crop planning and budget setting too, and it provides the financial accountability that Agrii has always seen as vital for agronomists.

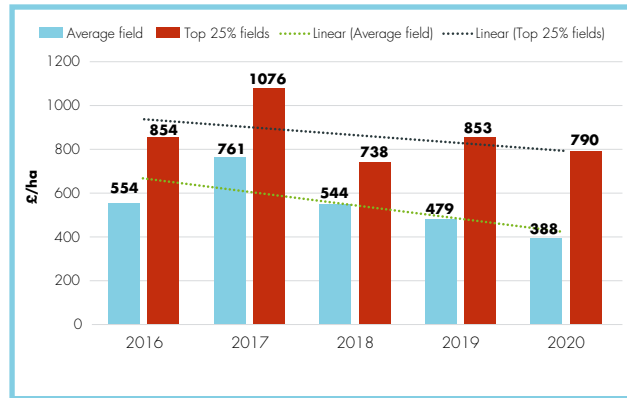


Figure 3: MAP five-year winter OSR gross margin/ha trends

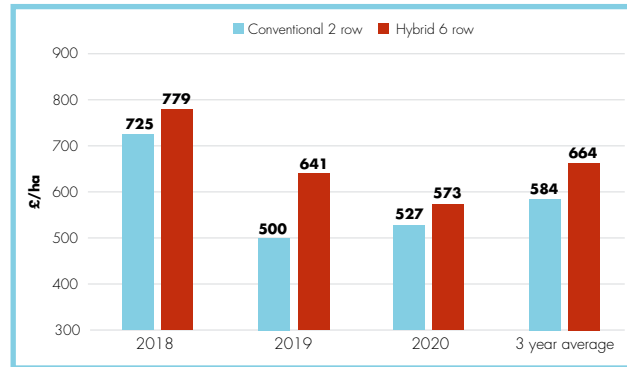


Figure 4: MAP gross margin performance by winter barley type 2018-2020

"The group experience with different crops, varieties, input levels or drilling dates is equally important," summarises Tim. "It helps those involved make better-informed decisions about what to grow, when to sow and how best to manage their crops. The great value here is knowing this intelligence is based on the most reliable field records."

If you would like to get involved with the MAP project and see how you compare, please enquire with your local Agrii agronomist.

MAP
BENCHMARKING GROUP

MAXIMISING
ARABLE
PERFORMANCE

"Our agronomist/grower teams find the 'bigger picture' they get from the data of great value in their improvement efforts.

The first thing they invariably look at when they get their report is where their farm actually sits against the rest of the group, and how their position in the 'league table' may have changed."

Tim Horton

4 BENCHMARKING

CASE STUDY

QUALITY MAP PROJECT INTELLIGENCE UNDERPINS ESTATE IMPROVEMENT

At Facombe Estates on the Hampshire-Wiltshire border near Newbury, director Al Brooks finds his annual MAP benchmarking report a mine of valuable information, giving him vital season-by-season intelligence on his 1250 ha of cropping, identifying areas for particular attention and ensuring his forward planning is based on solid facts.

He stresses, however, that any monitoring stands or falls on the quality of the data behind it, taking particular care to ensure his Gatekeeper records are as comprehensive and accurate as they can be.

"Benchmarking each season's performance against previous years and other businesses is hugely valuable," he says. "Especially when we can drill down into individual varieties, soil types and categories of inputs to really see what's going on. The value we get out of it is only as good as what we put in, though. The discipline of accurate record-keeping is something every member of our team appreciates, and having our field records validated by Agrii helps keep us all up to the mark. While the headline MAP benchmarking comparisons only go up to gross margin level, we always record to net margin, allowing us to assess our performance as fully as we can.

"The league tables are the first thing I look at when our annual report arrives and they are especially useful in providing context to my board reporting," observes Mr Brooks. "They give us a good snapshot of how our crop performance compares with the overall season. If we have disappointing results in some areas

but beat the season we know we've done as well as we could have. But, if the disappointments are out of line with others, we clearly have things to address.

"The most important thing about MAP is that we can examine our performance crop by crop and line by line to identify the most profitable priorities for our improvement efforts. The benchmarking, for instance, clearly highlighted the inconsistency of winter and spring barley performance across the estate over the years, leading us to drop them both."

Being able to interrogate the detail of the data to identify any inputs or costs out of line with past experience or local benchmarks is also particularly valued at Facombe. As is tracking the relative performance of individual varieties to inform future seed decisions; seeing how the changes being made in cultivation and soil management practice are affecting the bottom line; and enabling future budget-setting to be as accurate as it can be.

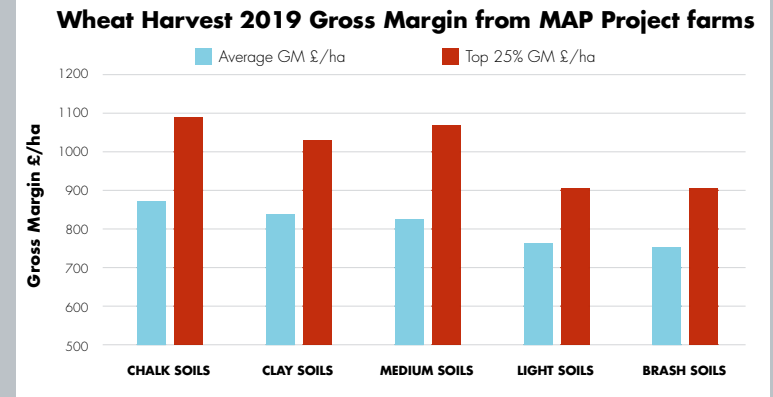
"There's no replacing good data," Mr Brooks insists. "It may tell you something you'd rather not hear, but you ignore it at your peril. With so much uncertainty in farming today, one thing we can be certain of, thanks to MAP, is that our decision making is based on solid facts from the best available internal, as well as external, intelligence."



HOW MAP BENCHMARKING DATA CAN HELP GROWERS TO UNDERSTAND CHANGING TRENDS AND THE IMPACT OF DIFFERENT SOIL TYPES

The use of soil type data provides a better comparison when comparing crop performance than looking at just the overall figures.

The graph below shows that on brash soils in the 2019 harvest, the best performing fields did not match those from the more robust soil types and therefore any comparison would need to consider soil type when looking at performance.



"With so much uncertainty in farming today, one thing we can be certain of, thanks to MAP, is that our decision making is based on solid facts from the best available internal, as well as external, intelligence."

Al Brooks, Facombe Estates

AGRII FARM BUSINESS CONSULTANCY

The Agrii Consultancy and Environmental Services team provides challenging advice, strategic solutions and technical innovation to agriculture and the rural community – enabling individual businesses to prosper.

Some of the areas that the team provides support on, include:

- + Stewardship and capital grant applications
- + Environmental Land Management
- + Whole farm budgeting and business planning
- + Nutrient planning, including organic manures and Nitrate Vulnerable Zones

MEET THE TEAM:

SIMON ROLLINSON
Agrii Farm Business Consultant



“Farm strategy, fixed cost management, utilisation of labour and machinery, environmental land management, diversification – all of these factors affect the overall success of a farm business.

It is for this reason that Agrii’s Consultancy and Environmental Services team was formed – to bring an environmentally friendly, professional and profitable farm business to work alongside our agronomists and provide customers with a more complete profitable farm solution.”

THE FUTURE OF ENVIRONMENTAL LAND MANAGEMENT SCHEMES (ELMS)

There are three new government schemes that will replace the Basic Payment Scheme and reward environmental land management. These schemes are intended to support the rural economy while achieving the goals of the Government’s 25 Year Environment Plan and its commitment to net zero emissions by 2050.

THE SUSTAINABLE FARMING INCENTIVE:

Pilots being carried out in 2021 before launch in 2022

LOCAL NATURE RECOVERY:

The scheme will begin piloting in 2022 and launch in 2024

LANDSCAPE RECOVERY:

The scheme will begin piloting in 2022 and launch in 2024

BRIDGING THE GAP

“Most farming businesses should actively look well beyond the new Environmental Land Management Scheme (ELMS) to replace lost Basic Payment Scheme (BPS) income. This means careful planning to capture the all-round value essential to make environmental improvements sustainable.”

Simon Rollinson, Agrii Environmental Advisor

With the loss of direct payments by 2027 and ELMS not making up the shortfall to the bottom line, thinking about a Countryside Stewardship application now can help to bridge the gap: providing both a financial boost and helping to develop experience of what works on your farm. Anything put in place under stewardship now will help you to prepare for future funding which will be based on delivery of public goods.



THE SUSTAINABLE FARMING INCENTIVE (SFI)

The SFI scheme will reward farmers for managing their land in an environmentally sustainable way. The full scheme will launch in 2022, initially for farmers in England who currently receive payments under the Basic Payment Scheme (BPS).

Here we provide information on the pilot SFI, currently underway in England, and at least some of these standards will become available to all farmers in England in 2022. At the time of writing, it's not certain which standards these will be, although those specific to soil are going to be introduced in 2022 to all farming businesses.

With more than 2,000 businesses having expressed an interest in being part of the pilot scheme, the overarching question is 'does the scheme represent a reasonable financial return for the time, effort and parcels of land involved?'. Clearly there can't be a single answer for all businesses, as much will depend on the resources available to each business and the productive capability of the land involved. However, it is possible to come up with some indications of financial returns (Figure 1).

There are eight standards available under the pilot scheme (with the possibility that further standards may be added) and for all but farm woodland there are three levels: introductory, intermediate and advanced.

The higher the level, the greater the commitment, and the higher the payment. For each standard the farmer can choose which level to enter, but that level must be consistent across all fields. On any single field it is also possible to 'stack' schemes, so several standards could be combined depending on the habitat present. Within the arable and horticultural land section, from doing some brief calculations, it appears that this part of the scheme will only be attractive where marginal land can be brought into it: those parts of the arable land that are unproductive and where yields are about 2t/ha less than average. It requires 5% of arable land to get into the scheme, which is a big ask for reasonably productive farms. The costs and returns from stacking soil standards and hedges or buffer zones within the same field will make a difference, but it remains to be seen if this is sufficient to compensate for taking good land out of production.

The full details for all standards are too extensive to list here, there is (a lot) more information at www.gov.uk/guidance/sustainable-farming-incentive-pilot or please ask your Agrii contact for more information.

Sustainable Farming Incentive	Introductory (£/ha)	Intermediate (£/ha)	Advanced (£/ha)
1 Arable & horticultural land	28	54	74
2 Arable & horticultural soil	26	41	60
Combined	54	95	134
Percentage of 2020 BPS	23%	41%	58%
3 Improved grassland	27	62	97
4 Improved grassland soil	26	44	70
Combined	53	106	167
Percentage of 2020 BPS	23%	45%	72%
5 Low/no input grassland	22	89	110
Percentage of 2020 BPS	9%	38%	47%
6 Farm woodland	-	49	-
7 Hedgerows	16/100m	21/100m	24/100m
8 Waterbody buffering	16/100m	29/100m	34/100m

Figure 1: Summary of standards, indicative payments and possible returns from 'stacking' of standards within the pilot SFI scheme*.

* These rates are for the SFI pilot only and subject to ongoing review.





CASE STUDY AA CLIFTON LTD, KENT

AA Clifton Ltd is a 1600ha family farm based on Romney Marsh in Kent, with high silt soils and a high-water table which can have its benefits, but can also bring with it challenges with soil structures and the ability to travel on the ground later in the season.

The business took a hard look at how it was farming 15 years ago when blackgrass, a tight rotation, and the loss of response from chemical active ingredients, were not helping to maximise their returns.

To start with, the farm had to combat the growing blackgrass pressure which had taken winter wheat yields from 10+ tonnes/ha to a struggling 5 tonnes/ha. At first the farm put large areas down to 2-3 year grass leys for silage to a local dairy farmer, which helped stabilise the soil and removed the worst of the blackgrass before it came to head.

The land was then entered into a new longer rotation with spring cropping as an integrated part of this. Cover crops were placed in front of the spring crops to:

- a) protect the soil during the winter;
- b) try and increase the organic matter level of the soil; and
- c) create a false crop that the blackgrass could germinate in, to later be sprayed off.

Different species and mixes of cover crop were trialled, and continue to be trialled on farm in a joint project between AA Clifton Ltd and Agrii.

The philosophy has been to try an idea on a large enough area over multiple years, to help understand if it will work on different soil types, with different years of weather. What works in one year, on one site might not work the next and so the system needed to be resilient.

Over the same period AA Clifton Ltd have looked at their machinery, and with help and advice from Neil Harper, the farm's Agrii agronomist, they have invested in an Amazone tined Cayena seed drill in addition to the established Vaderstad rapid drill. This has allowed the farm to direct drill some of the cropping and given some additional flexibility in how to drill. A Grange Machinery low disturbance subsoiler toolbar has been brought in to help with compaction from the high silt levels, as well as reducing the number of passes that have to be made.

What has become clear is that the soil needs to be in tip top condition on this farm for direct drilling to work with the high potential yields that are achievable, and the increased pressure of a high-water table. If that is not achieved, then the financial penalty can be severe.

In conjunction with Neil and Agrii, the farm business is closely monitoring the

financial performance of each crop on a field-by-field basis, alongside looking at the whole farm. This is done on an open book basis through the Farmplan Gatekeeper software and using the Agrii MAP benchmarking and the Yagro benchmarking tools.

The farm has been part of the ADAS YEN yield competitions as they are keen to understand how to try and maximise yields in all crops. This resulted in achieving the 2018 Silver Award in Oilseed Rape with a yield of 6.2t/ha.

The farm business also works with Adama, which has given the team an insight into the pipeline of agchem coming in the future. Both initiatives and Agrii research and field trips have given the farm the ability to see what other farmers are trying and the results others are achieving.

For the future, like all farms, the business is always changing and adapting. The latest insights have been in understanding that spring barley hasn't

performed on this farm, but spring oats have, so the cropping has changed accordingly. Alternative crops are being grown with chickpeas being the latest crop that the farm are trialling, and which have shown promise after their second year on the farm. The reintroduction of livestock on to the farm is currently being actively looked at, which could give benefits within a wider arable rotation and lead to improved soil health, greater grassweed control and the potential for access into environmental payments.



Alan Clifton-Holt (left) and Agronomist Neil Harper (right)



BRINGING IT ALL TOGETHER

Agrii actions relevant across all five Insight Reports:

- + Green Horizons Challenge Field of the Future reduced input R&D project (more detail in Insight Reports 2 and 3).
- + Agrii annual Innovations Award Scheme (please see page 23 for more info).
- + Fast-track biosolutions screening programme (more detail in Insight Reports 2 and 3).
- + Accredited environmental training (please see Insight Report 2 for more information).
- + Extended enterprise benchmarking (please see section 4 of this document).
- + General company drive towards net zero (please see Insight Report 5 for more information).
- + Target of 100% of Agrii trials to include an IPM element by 2022 (please see Insight Report 3 for more information).

Agrii's Action Plan for Increasing Farm Productivity and Viability

Action	Details	Timescale	Where to go for more information?
Encouraging innovation from Agrii customers and employees	In Spring 2021, we launched our inaugural Agrii Innovation Award, to welcome creative ideas on what we could be looking into within our own R&D.	Starting in 2021, and recurring annually.	Please see page 23 for more information.
Healthy crop development	We have been looking into alternative crops that provide higher levels of resistant starch; a key contributor to human health. Going forward, we are examining smart proteins which have the potential to play a large role in the plant-based food market.	Ongoing investigation into new healthy crops that meet consumer trends	Please see pages 16-17 for more information.
Examining opportunities for extending rotations	Our R&D has involved looking into alternative crops that can help to extend the rotation for a more sustainable farming system. So far we have looked into cereals and legumes, and we are also in the initial stages of trialling other alternative crops.	Ongoing, with new developments in initial phases	Please see pages 16-17 for more information.
Horizon scanning for new technologies	Technologies that can help farmers improve productivity and efficiency, are at the heart of our horizon scanning work. We will support any new technologies that will improve farm resilience and continue to explore options in our own R&D.	Ongoing	
Explore regenerative agriculture as a way of improving productivity	As part of our evolving R&D, we will explore the opportunities that arise from moving to a more regenerative system. Our focus will be on increasing productivity whilst maximising environmental potential.	Ongoing	More information in Insight Report 1 .
Farm benchmarking	Our MAP project continues to provide farmers with intelligence benchmarking. We will work to expand this project and include new and other aspects of benchmarking, eg. soil resilience.	Ongoing. Benchmarking soil resilience will be developed as part of our Soil Resilience Strategy (SRS).	Please see section 4 for more information. More information on the SRS is available in Insight Report 1 .
Exploring opportunities to reduce costs of production in an environmentally sustainable way	Work under the Green Horizons Challenge will be looking into opportunities and associated challenges to reduce establishment and production costs.	Commenced in 2021 and ongoing as part of a long term project.	Please see Insight Report 3 for more information.
Expand range and use of fertilisers with a low carbon footprint	Aim for 20% of Agrii fertiliser sales to have low carbon footprint (currently at 11%). Product development and trials ongoing. Internal and external communication programme ongoing. Aim to provide more information on the carbon footprint of the products we sell.	By 2023	Please see sections 1 and 3 of this document for more information.

This Action Plan will be continually updated as our work progresses. You can view updates at www.agrii.co.uk/greenhorizons

WHERE NEXT?

For more information on anything that you've read in this brochure, or to discuss how to develop integrated whole farm solutions for your farm, please get in touch with your usual Agrii contact, call us on 0845 607 3322 or email info@agrii.co.uk

You can also keep up to date with the latest news from our environmental improvement projects as part of Green Horizons at www.agrii.co.uk/greenhorizons



INSIGHT REPORT:1 IMPROVING SOIL RESILIENCE



INSIGHT REPORT:2 ENHANCING THE ENVIRONMENT



INSIGHT REPORT:3 PROVIDING INTEGRATED WHOLE FARM SOLUTIONS



This is INSIGHT REPORT:4 INCREASING FARM PRODUCTIVITY AND VIABILITY



INSIGHT REPORT:5 EXTENDING STAKEHOLDER ENGAGEMENT

This Insight Report is one of five produced as part of Green Horizons: Agrii's Commitment to Sustainable Food Production.

Find out more at:

www.agrii.co.uk/greenhorizons

The next Insight Report in this series is

INSIGHT REPORT:5

EXTENDING STAKEHOLDER ENGAGEMENT



Adjuvants:

Substances used to enhance the effectiveness of pesticides, herbicides, insecticides, fungicides and other agents that control or eliminate unwanted pests.

Benchmarking:

In an agricultural context this means gathering data about best performing farms and comparing them with other farms to provide insights into how you compare and how higher levels of performance could be achieved.

Bioavailability:

This is the amount of an element or compound that is accessible to an organism such as a plant, for uptake or absorption across its cellular membranes.

Biopesticides:

A contraction of 'biological pesticides' which includes several types of pest management intervention, through predatory, parasitic or chemical relationships. In the EU, biopesticides have been defined as a 'form of pesticide based on micro-organisms or natural products.' They are obtained from organisms including plants, bacteria and other microbes, fungi, nematodes etc. They are often important components of IPM programmes, and have received much practical attention as substitutes to synthetic chemical PPPs.



Biosolutions:

A biological or naturally occurring solution to a problem. In this context – the possibility of utilising naturally occurring organisms for pest control.



Biostimulants:

A plant biostimulant is any substance or micro-organism applied to plants, seeds or the root environment with the intention of stimulating natural processes, to benefit nutrient use efficiency and/or tolerance to physical (abiotic) stress and/or crop quality traits. This effect is independent of the substance's nutrient content. This means that a biostimulant's main role should not be to provide fertilisation or pesticidal activity. This definition is currently under debate/review.

Carbon footprint:

The amount of greenhouse gas emissions released into the atmosphere as a result of the activities of a particular individual, organisation, or community.



CO₂e (carbon dioxide equivalent):

This is a metric measure used to compare the emissions from various greenhouse gases on the basis of their global warming potential. It is calculated by converting amounts of these gases to the equivalent amount of carbon dioxide with the same global warming potential.

Chelation/chelates:

Chelates prevent the loss of nutrients through leaching by increasing the mobility of nutrients in soil, which enhances the uptake of nutrients by plants.

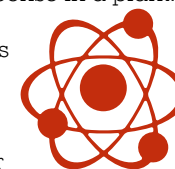
Digital Technology Farms (DTFs):

The DTF project is a farmer-led initiative involving Agrii growers, their agronomists and digital agronomy specialists, RHIZA. Digital technologies are put through their paces on 10 Digital Technology Farms throughout the country, the idea being that they will demonstrate their most profitable use and provide the broadest base for future improvements.



Elicitors:

An elicitor is a molecule that triggers the hypersensitivity response in a plant. Elicitors can attach to special receptor proteins located on plant cell membranes. These receptors are able to recognise the molecular pattern of elicitors and trigger intracellular defence signalling. This response results in increased synthesis of metabolites which reduce damage and increase resistance to pests, disease or environmental stress.



Enhanced efficiency fertilisers:

Forms of fertiliser, including nitrogen fertilisers, designed to reduce nutrient losses to the environment and increase nutrient availability to crops.

Endophytes:

Often a bacterium or fungus, which lives inside a plant for the entirety of its life cycle without causing apparent disease. Most endophyte/plant relationships are not well understood. Some endophytes may enhance host growth, nutrient acquisition and improve the plant's ability to tolerate stresses such as drought, and decrease biotic stresses by enhancing plant resistance to insects, pathogens and herbivores.

Food barley:

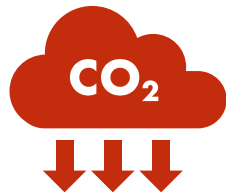
Currently only a small amount of barley is grown for human consumption, yet the health benefits of barley are widely known. It is rich in beneficial micronutrients and is among the best source of dietary fibre and beta-glucans in the human diet. It is thought to have antioxidant and anti-inflammatory properties and positive impacts on cardiovascular health and blood sugar.





Greenhouse gases (GHGs):

Gases that contribute to the greenhouse effect (or warming of the earth's atmosphere) by absorbing infrared radiation. Greenhouse gases trap heat – they let sunlight pass through the Earth's atmosphere, but prevent the heat that the sunlight brings from leaving the atmosphere. Many GHGs occur naturally in the atmosphere, while others are synthetic. Carbon dioxide, methane and nitrous oxide are all naturally occurring greenhouse gases, however human activity has led to their rapid release into the atmosphere – accelerating the greenhouse effect.



Naked oats:

As the name implies, naked oats naturally thresh free from the husk during harvest. This natural groat is nutrient dense and has a high digestible energy. Their versatility means they are used in a wide range of different sectors including wild bird food, dog food, poultry, horses and cosmetics.



Nitrogen inhibitors:

In the context of fertiliser, a nitrogen inhibitor is a compound added to a nitrogen-based fertiliser to slow the microbial conversion of ammonium-nitrogen to nitrate-nitrogen, reducing nitrogen losses to the surrounding environment when the fertiliser has been applied to the crop. This increases the fertiliser's nitrogen use efficiency.

Nitrous oxide:

A colourless gas emitted through agriculture, industrial activities, combustion of fossil fuels and solid waste and during the treatment of waste water. Globally about 40% of total N₂O emissions come from human activities, with agricultural soil management being one of the largest sources. Nitrous oxide is a greenhouse gas (a gas that traps heat in the atmosphere) and so is a major factor in climate change. N₂O emissions account for about 4% of the UK's greenhouse gas emissions, but its global warming potential is around 298 times that of carbon dioxide (IPCC, 2007).

Nutrient lock-up:

This occurs when a plant can no longer take up the nutrients it needs from its growing medium. It can also happen when pH levels, water or antagonistic nutrient levels are too extreme or not suitable for the crop in question.

Nutrient Use Efficiency (NUE):

A measure of how well plants use available mineral nutrients. NUE can be defined as yield (biomass) per unit of nutrition input.

Soil health enhancers
Products and approaches claimed to improve soil health and resilience.



Resistant fibre:

Also referred to as resistant starch, this is a form that can't be digested in the small intestine. This means that it is classified as a type of fibre. It passes through the small intestine intact and is then fermented in the large intestine, where it produces short chain fatty acids (SCFA) which act as an energy source for cells in the colon. Foods that lead to an increase in the number of SCFAs in the colon are thought to be beneficial to health through prevention of abnormal cells in the gut.



Variety Sustainability Ratings:

Variety Sustainability Ratings provide an unbiased way of comparing the overall robustness and resilience of varieties.

Through collating and analysing 'real-time' data, they help us to answer the following questions:

- + Are the varieties technically robust?
- + Which varieties offer consistent yields and quality and reduce agronomic risk?
- + Do they provide the flexibility to use crop protection products more efficiently?

Scores are also added for traits which reduce pesticide usage in the crop, e.g. wheat orange blossom midge, BYDV, TuYV and pod shatter resistance.



FIND OUT MORE ABOUT GREEN HORIZONS:

Visit www.agrii.co.uk/greenhorizons

or scan the QR code

Contact us at: info@agrii.co.uk

Go to www.agrii.co.uk/events to sign up for our latest Green Horizons webinars and view past events



THE GREEN HORIZONS FARMER NETWORK

This network of like-minded Agrii customers is working collaboratively, sharing knowledge and answering its own questions around how to produce sustainable and profitable food. Please get in touch for more information about how to get involved.

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