THE PULSE MAGAZINE

SUMMER 2023

PGRO

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THE PULSE MAGAZINE

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DATES FOR THE DIARY

13-14 June
Cereals Event in Perlethorpe, Notts
www.cerealsevent.co.uk

27 June
PGRO pea and bean open day in Stubton, Lincolnshire

EDITORIAL

Evolutionary change

Now I don't know much about dinosaurs but, listening to the radio back in 2022, I was captivated by an interview with an enthusiastic palaeontologist who was describing dinosaur evolution and their subsequent demise.

Apparently back in the Triassic period a multitude of crocodile-like creatures were the top predators. Some of these evolved into land dominating dinosaurs of the kind depicted in films such as *Jurassic Park*, and for aeons they were the "top dogs." Others are believed to have expanded veins and grown barbs for warmth and various other appendages for display, which gradually and accidentally evolved into feathered features that waggled and eventually created lift-off. Birds emerged.

When a giant six kilometre-wide meteor inconveniently hit the earth and wiped out most of the land-bound creatures, the only dinosaurs to survive were crocs and birds.

At that time, mammals had apparently already existed but there were none larger than a badger. Tiny in comparison, it is presumed that their small size helped them evade the giant dinosaur predators. Meteor impact wiped out 90% of the mammals too, but it was this catastrophic climate changing singularity that ultimately lead to mammals rising to top predator status and eventually to the dominance of humanity over the other creatures in the natural world. Fascinating acts of chance.

I was musing on this when considering what it might take for pulse crops to become mainstream, as critical and vital to our food system as the top predating dinosaurs once were to their own ecosystem.

Can pulses be analogously compared to the mammals of the Triassic? Underdeveloped, under resourced and hanging on under the repression of the dominant crops, their dinosaur oppressors. If so, what is the meteor that will upset the system and release pulses and vegetable legumes, enabling them to become the lynch pins of sustainability in the food production system?

Could it be our meteor has already landed in the form of deglaciation and climate change, world population increase, food security awareness in an unstable political world, the realisation that resources need protecting, or that soils are not inexhaustible, and the need to stop polluting and changing our atmosphere. Whatever it is, it is hard to deny that pulse cropping can positively contribute to their alleviation and mitigation.

Almost all this is under human control, so mammals win, as change can only be brought about by human intervention.

But, I wonder if ultimately mammals also lose, as without intervention, calamity awaits. Surely significant change is inevitable? It being sooner rather than later might influence how painful the experience of evolutionary change is!

> **CAN PULSES BE ANALOGOUSLY COMPARED TO THE MAMMALS OF THE TRIASSIC?**

In this issue of *The Pulse Magazine* we outline the launch of a number of research programmes under a single project. The NCS project is set to establish how much carbon footprints can be reduced by in UK farming with the greater use of pulse cropping. It will evaluate the benefits for climate change at farm level and national level and by enterprise type. There will be a lot to report on the NCS project over the next four years; it is a major new farmer-led research programme targeting more than half of the GHG emissions reduction target for UK Agriculture.

Roger Vickers, *PGRO Chief Executive*

MARKET PROSPECTS

Michael Shuldham
President of Pulses UK

Looking towards a positive future

Pulses sit on the precipice of the big time, with a lot of research and testing being undertaken to utilise their massive potential as a source of protein and fibre in diets. All of this work into the demand will undoubtedly create greater pull for the raw product from UK farms and that means a very positive future.

The picture painted by this season, however, has seen the overall pulse area slightly decline. The winter bean area in contrast is slightly up, although it has seen prime conditions for chocolate spot to set in. The spring crop generally looks good, the reduction in area coming from the large winter cereal area and following on from two tougher spring seasons thanks to the dry weather.

Meet Pulses UK's new president

Michael Shuldham has been named as the new president of Pulses UK, stepping up from vice president.

As the Pulse Product Manager for LS Plant Breeding, he has built a strong network of contacts from breeders and merchants to farmers and pulse traders. He is also heavily involved in pulse trials, where most of his role is focused around the growing, marketing and commercialisation of their varieties.

"Pulses UK has such a depth of knowledge and experience within its membership," Michael says. "I would like to ensure that we are using that knowledge to create the strongest future for the crop, through government and on farm, as well as utilising our unique position of having the whole supply chain to promote the use and grow demand for the end product."

Originally from South Yorkshire, Michael studied agribusiness at Harper Adams University, during which time he worked for a major UK merchant, gaining experience of seed and fertiliser markets, commodity trading, and logistics. After graduating he continued to work on an arable farm in both the UK and worked in the Swiss Alps before starting his current role.

William Ringrose, Head of Oilseeds and Human Consumption Pulses at ADM Agriculture, has been named vice president of Pulses UK.

Beans

Human consumption (HC) markets historically were North African whole bean consumption however this has waned somewhat thanks to the Bruchid pest, competition and unrest. Major retailers and agribusinesses are looking more toward bean flours and protein extraction for human foods as the likely major direction change for bean markets. Increasingly split beans are being seen in snack packets following several fairly widespread campaigns.

Feed will continue to be the outlet for beans not meeting HC spec and developments like Low Vicine Convicine beans mean there is a lot of scope for growth in this sector with large retailers and producers looking to replace soya in diets.

Peas

Human consumption marrowfat contracts remain popular with growers favouring them over greens. However, I believe next year we will see some revival in green price and area. There is certainly demand, and the UK remains the major supplier. Pea flours for snacks and pastas are increasingly common, and research is continuing into various other uses. Yellows and greens are viable for protein extraction and major global processors are looking closely at this option. I would anticipate large changes in this market over the next two years.

Feed – Highly digestible protein but in lower quantities than beans mean it will remain the back stop for the market.

Pulses are continuing to see research and funding in the face of net zero and food security concerns and a priority of Pulses UK is that the UK government understands the importance of pulses and prioritises them in decision making.

The need for chemistry for pulses remains, with limited options available for weed, pest and disease control. In addition to this, nutrition must be seen as a priority on farm to get the best from these crops; good nutrition creates resilient plants and consistent performance.

As a break crop with so many uses and potential markets, so many positive externalities and direct benefits to the grower, there is certainly a great need for farmers to keep planting them and working with industry and the PGRO to get the optimum out of their pulse crops.

PULSES UK

Pulses UK is the trade association which aims to promote the production and consumption of pulses within the UK.

Pulses UK continues to be active promoting pulses to the British public with a growing social media presence as well as attendance at trade shows and school days across the country.

The role of UK peas and beans as a sustainable raw material in the future of pig and poultry diets

SUPPLY CHAIN FOCUS

Brian Kenyon,
Senior Nutrition Manager

ABN is a British manufacturer of pig and poultry feed, with a simple mission to manufacture high quality, high performing and affordable feed solutions, safely and sustainably.

As it strives to reduce the carbon footprint of its supply chain and support the future of the British pig and poultry livestock industries, it is placing greater emphasis on research into the increased use of UK-grown pulses as an alternative protein source in its feed.

As soya is one of the biggest contributors to overall emissions in pig and poultry diets, reducing reliance on the imported protein in feeds is currently a key priority area for ABN, with significant research being undertaken into potential alternative proteins.

When it comes to increasing pulses in monogastric diets, there is a need to introduce a primary processing step to help reduce some of the natural anti-nutritional factors present within pulses, and much of ABN's research is focused around developing and enhancing potential processes.

ABN currently use a processed product in poultry diets made up of 50% rape and 50% pulses, predominantly field beans and peas, which makes up in total around 5% of the total diet.

"The reason we use a processed product is quite simple – plants don't want animals to digest their seeds, but to spread them. They use factors, be that a fibrous shell or chemicals within the seed, to try and disrupt the digestive tract and prevent damage to the seed," says Brian Kenyon, Senior Nutrition Manager at ABN.

By introducing an initial processing step, some of those anti-nutritional factors can be broken down. By denaturing the chemical, removing some of the fibrous material or applying addition feed enzymes, this can make the nutrients of that raw material much more readily available.

"Taking field beans in poultry diets as an example, we can put the raw beans into the mill, grind them up, mix them in and put them through the standard heat treatment and pelleting processes, which will involve a degree of processing of the bean component parts," says Mr Kenyon.

"But is that enough to get the full value, or do we need to introduce primary processing steps, whether that is pre-heat treatment or something that helps release more of the nutrients to the chicken or pig?"

According to Mr Kenyon, ABN's research is taking a two-step approach, not only identifying what can be achieved by processing and feeding peas and beans, but also by identifying what else can be done to enhance this. This is the second stage of ABN's research.

From ABN's perspective, its immediate aims are to increase use of UK produced pulses, based on its ongoing research and including the current Innovate UK funded PGRO project.

"Looking at our current standard poultry diets, pulses currently only make up 2.5% of the diet based on the processed product. The aim is to increase this to 10%, which will have the dual benefit of not only increasing the home-grown content, but also contributing to reducing the soya reliance by half," says Mr Kenyon.

Pulses also bring value to other crops grown in the UK, particularly in East Anglia, a key region for pig and poultry production. It is important to quantify the full value in the subsequent cereal crops that follow.

> "ITS IMMEDIATE AIMS ARE TO INCREASE USE OF UK PRODUCED PULSES

RESEARCH

NCS
NITROGEN CLIMATE SMART

Launch of the 'defining farming project of our time'

A major new farmer-led research programme is set to deliver more than half of the GHG emissions reduction target for UK agriculture

One of the biggest and most comprehensive projects ever undertaken by UK agriculture to credibly achieve Net Zero is set to launch.

Nitrogen Efficient Plants for Climate Smart Arable Cropping Systems (NCS) is a four-year £5.9M ambitious research programme involving 200 UK farms and 18 partners.

"Everyone knows that pulses and legumes have considerable benefits for UK farming systems," says PGRO Chief Executive, Roger Vickers, who leads the NCS consortium.

"But these have never been truly and accurately measured. So their value has been sorely underplayed and their potential to address the climate crisis has gone unrecognised.

"Together we can change that. We now have the science, the tools and the know-how among UK farmers, not only to tap into that potential, but to develop it further.

"Bringing that talent together is what lies at the heart of NCS – it's never been done before, and there's never been a project on this scale with this much ambition."

What will the project deliver and how?

The consortium of UK companies, research institutes and farmer networks, led by PGRO, aims to bring about a reduction of 1.5Mt CO_2e per annum or 54% of the maximum potential for UK agriculture.

This will be achieved by increasing pulse and legume cropping in arable rotations to 20% across the UK (currently 5%). In addition, 50% of imported soya meal used in livestock feed rations will be replaced with home-grown legumes.

Both of these ambitious aims will be steered by science and proven by real farm enterprises, with significant benefits for both crop and livestock productivity, including cost savings of over £1bn/yr.

They will deliver to UK farms a reset in economic sustainability, transformative gains for the farmed environment and a massive move away from the UK's current dependence on imported, climate-wrecking protein sources.

NCS will give 200 UK farmers direct support to establish their business' carbon baseline.

The leading innovators among them will then be paid to co-design with scientists crop and feeding trials they'll carry out on their farms.

These Pulse Pioneers will explore ways and means for soils to thrive, crop yields to build and livestock productivity to flourish through better use and marketing of home-grown pulses and legumes.

The on-farm progress will be based on cutting-edge technologies and farming systems, incorporating some of the latest research and innovations from leading UK institutes and tech companies.

These will be underpinned by a rigorous use of data, including the UK's first ever full lifecycle analysis of cropping rotations and livestock systems.

How can the CO_2 reduction be achieved?

The reduction in annual CO_2 equivalent emissions can be achieved through:

- Increasing pulse and legume cropping areas to the rotational optimum of 20% (1M ha) across UK farms. This would reduce nitrogen fertiliser use by 233,000t, resulting in 0.55M tonnes CO_2e reduction.
- Using the subsequent produce in animal feed, replacing 50% of imported soya meal and delivering a further 0.7M tonnes CO_2e reduction.
- The residual nitrogen benefit to following crops through soil enrichment, leading to an additional 0.25M tonnes CO_2e reduction.

These changes can deliver a national cost saving to UK farming of £1032m per annum, by removing 20% of nitrogen fertiliser across UK growers and 1.8m tonnes of soya imports from the UK farming supply chain.

"This will be the defining project of our time," predicts Mr Vickers.

"It's not just the chance for UK Agriculture to make a seismic shift towards Net Zero, but it'll also deliver a prosperous and resilient way of farming for communities worldwide.

"We want farmers to join us and be part of this exciting journey of discovery. You will shape it. Your knowledge and experience will enrich the science we're bringing together.

"You will inspire others and accelerate the pace of change. And together we'll achieve a farming future that is richly rewarding and immensely gratifying."

How will the project work?

Part of the project will be to develop a policy tool for government that helps the adoption by UK farm businesses of measures and cost-effective solutions for transitioning agriculture to a greener, more resilient future and accelerating the path to Net Zero.

The farmer-led trials, carried out by the Pulse Pioneers, will play an essential role throughout the four years of the project in informing the practices that will achieve this.

And it will be the farmers in the PulsePEP (Performance Enhancing Platform) who will benefit first from the environmental and financial gains of the research solutions developed.

The initial step will be to recruit farmers, scientists and tech innovators as active members of the PulsePEP community – a platform and knowledge exchange hub that will be developed by the consortium, led by ADAS.

Getting farmers involved and engaged will be led by BOFIN, with the help of LEAF, Agrii, PGRO, ADAS YEN and other consortium partners.

The aim is to establish a core group of 200 farmers, who will all receive tailored assistance from the Farm Carbon Toolkit (FCT) to establish their true carbon baseline and whose GHG emissions will be tracked throughout the project.

This will provide the most comprehensive dataset of farm carbon emissions ever gathered which will drive the ground-breaking life cycle assessment of crop rotations – work led by the James Hutton Institute.

Crop GOBLIN is the powerhouse this vast array of data will feed, which will become the model for integrated cropping systems, underpinned by the latest research findings from JHI's long-term project the Centre for Sustainable Cropping.

Bringing together pioneering work from Cranfield University, GWCT and others, experimental platforms will be set up to identify the mechanisms and resilience of soils for GHG-emission reduction.

This includes work at CHAP's Plant Phenotyping and Soil Health Facility at Cranfield University, a huge glasshouse allowing precise and accurate measurements of the whole crop production cycle in large, custom-built soil containers.

Farmer-led trials will put the cutting-edge research into the field with the Pulse Pioneers, working closely with the scientists. Some will use new in-soil nutrient sensors, developed by PBL Technology. Wessex Water will be tracking nitrate leaching on a selection of farms.

Agrii will be closely monitoring the effect of legume crops across the rotation, with further monitoring conducted through satellite imagery via Rhiza's digital agronomy platform Contour.

On the livestock side, end use of pulses and legumes in animal feeds will be developed in work led by McArthur Agriculture, with SRUC, Kelvin Cave, First Milk, LC Beef Nutrition, AB Agri and FCT.

Farm-based heat treatment and de-hulling of beans, whole crop forage optimisation and a score of other innovative techniques will be deployed in both scientific and commercial trials. These will be applied across a range of livestock sectors to assess how diets can be reformulated based around homegrown proteins.

Bringing all the data and outcomes together will result in the assessment of the carbon cost-benefits of this groundswell change in how the UK farms.

From collating the initial project data to understanding the feasibility of methods under test to reporting these to government, this element will ensure the project has impact, delivers resilience to the whole of UK farming and that it stays on track for its ambitious Net Zero goals.

For more information about the project visit: ncsproject.co.uk

AGRONOMY

Dr Becky Howard
PGRO R&D Manager

Pea growers urged to remain vigilant to threat of pea bruchid

Pea bruchid (*Bruchus pisorum*) is not currently troubling UK growers, but vigilance is encouraged in order to prevent this insect affecting domestic pea production.

It is important that growers remain vigilant as part of continued efforts to reduce the risk of this pest entering the UK in seed, and to ensure the supply of high-quality peas for the fresh, frozen and dry markets.

The greatest risk of establishment of pea bruchid populations in the UK is likely to come from imported seed containing live beetles. Although the incidence of live insects in imported pea seed has been low up to now, there were several reports of live beetles in seed lots for planting in the UK earlier this year.

Pea bruchid: a profile

Pea bruchid is widespread in Europe, North Africa, Asia, North America, Central and South America and South-western Australia. It is a pest that only affects peas and belongs to the family Chrysomelidae, order Coleoptera. Although the insect has been recorded in the UK, it has a limited distribution and does not occur outdoors. Records refer to established, or regular introductions in a limited number of stored dried peas, or flour mills. There have, to date, been no reports of crop damage caused by the pea bruchid in the UK.

Pea bruchid is classed as a regulated non-quarantine pest in peas in the UK. This means that if *B. pisorum* is found in pea seed, or in a crop for seed production, then APHA should be informed. To ensure seed complies with this requirement, PHSI monitor imported pea seed, and pea seed under the UK plant passporting scheme requires the professional operator who is linked to the seed under the scheme to look for, and if found or suspected, report *B. pisorum*.

Adults appear similar to bean bruchids and are 4 to 5mm long, grey or brownish black, covered with reddish-grey hairs on the upper surfaces of the body. The wing cases are short and do not completely cover the abdomen, the exposed part of which is white. The larvae are cream coloured with a brown head and 4 to 5mm long at final instar.

In the countries where the pest is present, the adults over-winter in pea seed during storage and also in the surrounding environment, under tree bark, leaf litter, mosses and lichens. US and Australian sources indicate that the adults over-winter in alfalfa, peas or other perennial legumes, in peas in storage or in the field, or in protected areas in trash along field margins and wooded areas.

Adults migrate from over-wintering sites in spring when temperatures reach 18°C. They may fly up to five kilometres in search of pea flowers as female reproductive development is dependent on the beetles feeding on pea flower pollen. Colonisation of crops can take place before flowering, but the maximum invasion usually occurs once flowering has begun.

In most countries, the time taken between invasion of the pea crop and eggs being laid is about two weeks. Eggs are cigar shaped, yellow to orange and 1.5 mm long by 0.6 mm wide. They are laid on the surface of developing pods and hatch between seven and 28 days later depending on the region. The larvae bore directly from the egg through the pod wall and into the seed without exposure, therefore control of pea bruchid adults must be carried out prior to egg-laying.

Larval development takes between four and six weeks. When nearly fully grown the larvae chew circular holes, about 3mm in diameter, partly through the seed coat, leaving a translucent skin over the hole before pupation.

Depending on the temperature, emergence of adults can take up to three weeks. Adults may leave the pea immediately or stay inside the pea during the winter and emerge the following spring. There is one life cycle per year and insects require peas to be harvested dry to reach adult maturity.

The adults survive well during cold conditions, with insects inside seeds surviving at temperatures as low as -20°C, and those in the natural environment surviving at -18°C where snow is abundant. Where there is no snow, insects die at temperatures below -9°C.

In peas harvested fresh for the freezing and fresh-picked markets, larvae are present in the seed and there is a degree of seedcoat blemishing as the larvae penetrate the seedcoat on entry. The main damage in combinable crops is a circular hole in the seed leading to rejection of produce for premium human consumption and seed markets.

Heavily infested combinable crops may suffer up to 10% yield loss as up to 25% seed weight can be lost through larval feeding. Seeds may also be more fragile at harvest causing further yield loss as they shatter. Germination capacity of pea seed is likely to be affected as the seed is small and the radicle and plumule likely to be damaged.

There may also be increased susceptibility to fungal pathogens caused by the hole in the seed.

What is the risk?

Several factors are considered when assessing the risk of pea bruchid becoming a pest in the UK. The pest can be identified precisely to species and the area under consideration can be defined as any area within the UK that has suitable conditions for the survival of the adult. This should include any area with temperatures of, or exceeding, 18°C during the period of egg laying (May to June). Experience in the UK with the related species, bean bruchid (*Bruchus rufimanus*), shows that the spread of the insect, which requires the same conditions as pea bruchid, has extended as far north as the Scottish borders. The geographical extent of pea crops in the UK is similar to that of field beans, although the area is smaller at about 35,000ha of vining and fresh market peas and 40,000ha of combining peas. It could be assumed that, where suitable conditions exist for the survival of bean bruchid, it would be possible for pea bruchid to survive. Where infested seed is sown, there is evidence to suggest that live insects may colonise crops from the seed source, and populations would build from this point.

Climatic conditions in parts of the UK are comparable to other areas of the world where the pest is known to be a serious problem. It is also significant that vining peas are grown in the same areas as combining peas. In order to complete the life cycle, the insect requires that the crop reaches full maturity. They will reach only the larval stage in vining peas or fresh market peas, therefore only dry harvested peas will allow insect maturity and survival into the following year.

Pea bruchid can be considered to present a risk to the UK in terms of its requirements for survival. If it were to become established in the UK, it is likely that economic impact would be serious, although it is difficult to estimate the length of time needed for populations of the pest to build sufficiently to create a significant problem. Legislation in the UK states that certified seed of peas shall not be contaminated with pea bruchid. However, vining pea seed is covered by the Vegetable Seed Regulations which does not have these restrictions. This may help to constrain the build-up of populations from combining pea seed sources, but not from vining pea seed imports.

All seed that is imported into the UK should be free of pea bruchid. Where live insects are present the seed lot should be treated with a fumigant or be rejected or destroyed. The use of bruchid-free or fumigated seed is critical in controlling the spread of the pest in the UK. Any incidence of live bruchids in seed lots should be reported.

“ LARVAL DEVELOPMENT TAKES BETWEEN FOUR AND SIX WEEKS

Pea bruchid eggs on pods and damage to pea seeds

INNOVATION

The "PeaProtein" Project (Number: 10046667) is funded in collaboration between The Department for Environment, Food and Rural Affairs (Defra) and UKRI Transforming Food Production Challenge

Competition: Farming Futures R&D Fund: Sustainable farm-based protein, industrial research

PeaProtein project to drive new twin-goal breeding programme

Innovative new initiative which could see combining peas for human consumption displace soya imports

The rise in popularity of plant-based diets among consumers is viewed as a significant challenge by some UK farming business – not least the dairy and livestock sectors.

For those who have interests in pulses, however, shoppers seeking out alternative sources of protein should be seen as a huge opportunity.

A shift to plant-based food is the biggest trend in the UK food sector. Sales of meat alternatives could hit £1.1b by next year, growing 30% a year, while dairy alternatives should exceed £550m.

At the same time, farmers need to find ways to grow crops with fewer inputs in order to drive better profitability and reduce the carbon footprint of the food they produce.

This growing dynamic has created a perfect storm for combining peas, and sparked an initiative led by seed breeder Germinal to hit the twin goals of displacing South American soya with domestic protein, and reducing the amount of artificial fertiliser used on UK arable farms.

In collaboration with PGRO, John Innes Centre and Aberystwyth University, Germinal will take the PeaProtein project forward to develop a new approach for economically and environmentally sustainable farm-based protein production in the UK.

Aims and aspirations

On paper, the case for growing more peas domestically for human consumption makes a huge amount of sense; displacing imports, fewer crop inputs, and growing the market for UK farmers to sell into.

But it is not that simple.

David Lloyd, Head of Plant Breeding at Germinal, says the flavour profile of combining peas can force food companies to look elsewhere for ingredients when developing products with alternative protein sources.

"It's a question of inclusion rates," he said. "If you're using peas rather than soya as your plant-based protein you can currently only include them at a very low rate before you start getting 'off flavours' – typically somewhere between 10% and 20%.

"At higher rates you start getting earthy flavours coming in which can detract from the palatability of the food."

With the PeaProtein project, David and his team are embarking on a completely new breeding programme.

"We're breeding in a natural mutation that was found in a wild pea some years back to get that mutation into commercial peas so they can be used for pea flour or extracted protein without giving the off flavours to the food," he says.

"It's difficult to do. It's a lot easier to breed just for yield or disease resistance. This is a more genetic-based system. We're using marker-assisted selection to back cross this mutation into commercial varieties.

"We've got a number of different traits that we are back-crossing into commercial types and then hybridising once we've got them fixed within in the peas. We're using a system called single seed descent to get to a variety that is both yielding well and has the traits that we want. It's a very long-winded process and takes a lot of selection measurements in the field.

"Twenty years ago it would have been possible but very expensive – technology has now caught up though."

Even with the latest advances in plant breeding, David estimates that 10 years is a realistic timeframe for the project to deliver varieties for farmers.

Germinal has the support of the John Innes Centre to assist with molecular genetics, and Aberystwyth University for biochemistry – looking at the effects that breeding the different qualities within the into the peas will have on their nutritional makeup.

PGRO's role will be to conduct field trials and be involved in farmer engagement and knowledge transfer.

The need for change

There are about 2,300 pea growers in the UK who plant a total of around 72,000ha of the crop a year – a relatively small area when compared to other popular break crops such as oilseed rape which stood at well over 300,000ha in 2022.

But unlike oilseed rape, peas have agronomic values which fit hand-in-glove with sustainable and regenerative farming objectives.

Peas don't require nitrogen and also fix it in the soil for the following crop. A crop can supply in excess of 50kg N/ha to a following cereal crop which, at current nitrogen fertiliser prices of £800/t, represents a saving of £120/ha.

David says: "The ideal thing that we'll be getting from is more legumes into rotations.

"It's much harder to grow a break crop such as oilseed rape now than it used to be, and the price of nitrogen has gone through the roof. Synthetic fertilisers also have a very poor environmental profile so the more we can do to reduce our reliance on nitrogen fertiliser the better."

But he is also confident that this project can also displace a "significant" amount of imported soya. Currently the largest source of plant-based protein is soya-derived, with around 70% of UK imports – equating to 2.7m tonnes – coming from South America with associated problems of environmental sustainability. Approximately 0.7m tonnes of this is for direct human consumption.

"It's a long way off bringing this to farmers but we need to be looking at ways to reduce the reliance we've got on South American soya, which has issues with deforestation," David says. "There's a lot of rainforest that are being deforested at an alarming rate in Brazil and Argentina that we really could do with saving."

Once the breeding programme has been developed, dissemination and knowledge exchange activities on the potential of these new varieties to farmers and industry end users will be used to demonstrate the opportunities and how this novel approach matches industry priorities.

Uptake of these new varieties will give farmers in England and across the UK the potential to increase the production of peas which are better suited to the protein market and end-user requirements.

It will allow farmers to benefit from the nitrogen fixation of peas, reducing their reliance on mineral nitrogen to following cereal crops, and improve the overall sustainability and environmental impact of farming.

The agronomic and environmental case for peas

Pulse crops, including peas, have a positive effect on the whole farm rotation, providing substantial benefits to subsequent crops, particularly cereals or oilseed crops.

Pulses are one of the most environmentally-friendly sources of protein that a farmer can grow. They require less energy and water than many other crops and result in the production of fewer greenhouse gases.

Peas provide a disease break for cereals and oilseed rape, and require no nitrogen fertiliser as sufficient nitrogen is fixed from the atmosphere by naturally occurring Rhizobium bacteria in root nodules.

European research shows that winter wheat yields increase by 0.84 t/ha after peas compared to wheat, and up to 1t/ha is regularly reported.

PHD SUMMARY

Tamy Jithesh
PhD Student, Harper Adams University

Optimising fertiliser recommendations for field beans in the UK

The cultivation of field beans *(Vicia faba L.)* offers numerous benefits.

Through specialised organs in their roots called nodules that house rhizobia bacteria, field beans can access nitrogen from the atmosphere through the process of biological nitrogen fixation (BNF). As well as meaning that field beans have no nitrogen requirement, they also reduce the nitrogen requirements of subsequent crops grown on the same field by contributing positively to the soil N balance.

With the price of nitrogen fertilisers highly volatile, and their worrying contribution to the emission of greenhouse gases, there is a renewed interest in growing legumes such as field beans.

Of course, it must not be forgotten that field beans themselves are an excellent source of protein, which is increasingly important in a more sustainable diet that is less reliant on animal-derived protein.

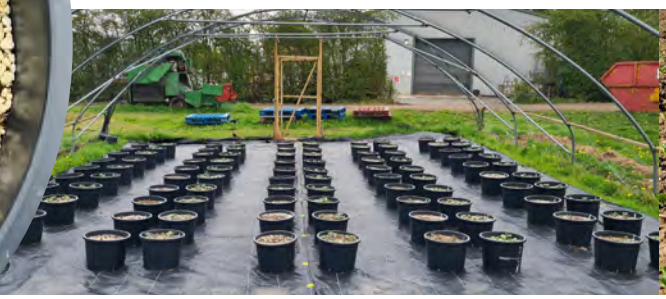
Establishing the optimum rate of mineral fertilisers

In 2021, 700,000 tonnes of field beans were harvested in the UK, making it the third largest producer of the crop globally behind China and Ethiopia. However, the average yields of field beans in the UK over the past two decades have ranged from 2.6 t/ha to 4.9 t/ha; a fluctuation that is greater than that found in any other arable crop. This year-to-year variability in yield is considered a major deterrent to farmers to include field beans more widely in their rotations.

Numerous biotic and abiotic factors are known to contribute to yield variability, including sowing dates, spring droughts and diseases. One important factor is the application of mineral nutrient fertilisers. Nutrient deficiency in agricultural soils is a major cause of yield losses worldwide. The UK fertiliser recommendations for peas and beans have not been updated for at least 30 years. The hypothesis underpinning this PhD is that there is an optimum rate of mineral fertilisers to maximise BNF and yields in field beans.

To explore this hypothesis, field trials at the PGRO trial site in Stubton will assess the effect of phosphorus (P), potassium (K) and sulphur (S), applied at 0%, 50%, 100% and 150% of the current RB209 recommendations, on yield and yield components. In addition, pot trials under a netted polytunnel at Harper Adams University looking at the same nutrients and same rates will aim to quantify BNF and nodulation. Spring bean trials at both locations have recently been established for Year One of this study, and it is planned that the field trials in Years Two and Three will involve both spring and winter beans. Additional studies in collaboration with the James Hutton Institute, Dundee, in Years Two and Three will also look at micronutrients such as Mo and Zn, as well as elite rhizobial strains, for optimising BNF and yields in field beans.

By optimising fertiliser recommendations for field beans, it is hoped that yield variability will be reduced and its cultivation can be encouraged, so that the true potential of the crop within sustainable UK agriculture can be harnessed.



EVENTS

PGRO announces June open day for pea and bean growers

The Processors and Growers Research Organisation (PGRO) will welcome farmers, agronomists and other industry stakeholders to its open day in Stubton on 27 June.

"The open day is a chance to explore the trials work carried out by PGRO with the goal of providing growers with more information about producing better pulse crops," says Chief Executive Roger Vickers.

"We carry out a huge number of trials every year to gain a better understanding of pests and diseases, evaluate varieties, and explore new production techniques, and these open days are an excellent opportunity to spend time with our technical team in the field, looking at their work in crops."

> **IT'S AN EXCITING TIME FOR PULSE GROWERS ACROSS THE UK**

As well as the Descriptive List and National List trials, PGRO will be showcasing its work which looks at the challenges around growing, protecting and harvesting intercrops of winter beans and winter wheat, beans and oats, and vining peas and oats.

There will also be the opportunity to see trials involving lentils. Since 2020, PGRO has been growing lentils to establish the viability of production in the UK and identify varieties of interest.

Other trials of interest include mechanical harrowing in combining peas as a tool to reduce herbicide use, and the use of biostimulants when establishing the crop. Work also continues on intercropping.

Experts in pulse diseases and crop pests will also be showcasing their work. We will also demonstrate the use of other crop species as trap crops for beetle management.

"It's an exciting time for pulse growers across the UK," Roger says. "There is a greater recognition of the benefits pulses bring to the soil, environment and rotation, but that opportunity should be maximised with applied research helping growers grow better beans and peas."

Attendance is free and no pre-booking is required.

Stubton site is ///gear.reddish.rejoined

Visitors are welcome to arrive from 10am.

NEWS

Meet the newest member of the PGRO team

Alek Ligeza has joined the PGRO team as a Trial Programme Manager.

Originally from Poland, Alek has an extensive background in molecular biology and plant genetics and has worked all over Europe in various plant researching roles, including three years at the University of Silesia in Poland and five years in Belgium researching plant phenotyping.

Alek moved to the UK in 2016 and worked in various research roles across the country before joining the PGRO team two months ago. As Trial Programme Manager, Alek manages a team of five, and organises all practical and theoretical aspects of PGRO's trials. He is primarily involved in trials handling herbicides, fungicides, nutrition, biostimulants and insecticides.

"It's not typical commercial work that we do here at PGRO," says Alek. "The research that we're conducting will really help pulse growers to improve their crops and their livelihoods."

As he settles into his role, Alek hopes to be given further responsibility within PGRO and expand his knowledge further.

"Working at PGRO is very interesting, and I learn something new daily," says Alek. "I'm a practical person, and combining the everyday practice of field trials with the scientific approach is something that excites me in applied research.

Alek Ligeza

If you don't know, why would you sow?

Test your farm-saved seed before drilling to increase your chances of a higher yield.

PGRO's seed testing laboratory is able to test for:

- Seed quality
- Germination and vigour
- Disease presence
- Pea disorders
- Pea foot rot
- Bacterial diseases: including bacterial blight and halo blight
- Pea seed-borne mosaic virus
- Stem and bulb nematode
- Beans thousand seed weight evaluation

Testing your seed is the first step in growing a healthy bean crop and increased productivity.

Scan the QR code for a list of prices, or visit the seed testing pages of www.pgro.org

PHD SUMMARY

Lisa King
PhD Student, University of Warwick

Tackling pea foot rot pathogens in a bid to stop decline in vining pea yield

The UK has seen a sharp decline in vining pea yield in recent years.

On average, annual production between 1961 and 2011 was 10.60 tonnes ha-1. This declined to an average of 4.11 tonnes ha-1 between 2012 and 2019, a reduction of 61.2%.

In the UK, the major pathogens of the pea foot rot complex (PFRC) include *Fusarium solani forma speciales* (f. sp.) pisi, *F. oxysporum, Didymella pinodella* and *Aphanomyces euteiches*. Knowledge regarding the genetics, dynamic and control of these pathogens, in particular for *D. pinodella,* is limited. Therefore, the main aims of my PhD project were to characterise selected PFRC pathogen isolates through multilocus DNA sequencing, better understand PFRC pathogen virulence and interactions and identify biofumigant crops that can suppress individual PFRC pathogens.

PhD findings

Multilocus DNA sequencing analysis of both *D. pinodella and F. solani* isolates revealed the lack of genetic diversity within *D. pinodella* isolates from the UK and other countries, while DNA sequencing analysis of UK *F. solani* isolates challenged an idea that *F. solani* formae speciales are specific to single plant species.

Both lab-based experiments (For *F. oxysporum, F. solani f. sp. pisi* and *D. pinodella*) and pot-based experiments using *D. pinodella* in the glasshouse established positive relationships between the concentration of fungal spores, pea foot rot disease development and plant mortality.

A further test tube assay revealed the additive nature of interactions between *F. oxysporum, F. solani f. sp. pisi* and *D. pinodella* when co-inoculated in terms of disease development in pea. Preliminary quantitive polymerase chain reaction analysis of root colonisation in this experiment successfully quantified DNA for each of the three pathogens.

Commercial biofumigant varieties of *Brassica juncea* (brown mustard) and *Eruca sativa* (rocket), bred for high glucosinolate concentrations significantly reduced mycelial growth of *F. solani f. sp. pisi, F. oxysporum, D. pinodella* and *A. euteiches* in plate-based lab experiments. These species were also successful at supressing *D. pinodella* foot rot disease development in a pot-based glasshouse experiment.

Overall, this research has contributed substantial knowledge regarding the genetic variation, disease development and interactions of PFRC pathogens, and the potential of biofumigation as a management strategy.

Becca McGowan
PhD Student, University of Warwick

Managing bean seed fly sustainably

There are currently no approved insecticides to manage bean seed fly in the UK, therefore a sustainable strategy is essential.

A generalist dipteran pest, bean seed fly causes crop damage when larvae (maggots) feed on germinating and emerging seeds and plants. The worse affected crops in the UK are legumes (such as vining peas) and alliums (salad onions).

The aim of the PhD project is to contribute towards an Integrated Pest Management (IPM) strategy for the fly.

Flies are attracted to lay their eggs in areas of high organic matter. It is thought that the fly is less attracted to lay their eggs near newly sown seeds when cultivation occurs in advance of sowing the crop. We found that damage is reduced on French beans when cultivation occurs at least seven days before sowing. We also found that covering the crop with a fine mesh (0.6mm gaps) on the day of sowing reduces damage, should the grower not be able to delay cultivation.

We tested multiple trapping methodologies. We found that blue sticky traps set up horizontally are selective for the fly. Alternatively, blue sticky traps curled around a lure (sold by Andermatt) were effective at trapping the fly. We also discovered that traps mimicking an increased level of insect cover on the sticky cards were less attractive to the fly. Traps should be left outside for one to two days.

We have realised that bean seed fly has a different overwintering strategy to similar species such as cabbage root fly and onion fly. They seem to have a shorter diapause (similar to hibernation). This means that the methods used to forecast the fly may have to differ from those used to forecast similar species. The forecast is currently in development and will be finished by September 2023.

A bean and wheat intercrop at the Eastleach Downs trial site

RESEARCH

Trials hope to boost organic bean production

Trials to determine the best bean varieties purely for organic production have begun, in a bid to support farmers looking to add the crop to their rotation.

The farmer-focused trials, which are facilitated by Organic Arable, will monitor varieties in real-life conditions as part of an EU-wide project.

"Live Seeding aims to promote the use of organic seed across Europe, as the EU is pushing for 25% of agricultural land to be under organic farming by 2030," says Dominic Amos, Grain Representative at Organic Arable.

"Within that project, there's a tranche of work looking at on-farm cultivar evaluation. Modern breeding is great but it's not looking to address organic farming.

"I understand why because the organic seed sector is so small, and the economics don't stack up. But, at the very least, we felt the need to evaluate crops under organic conditions so that we can guide farmers to help them make decisions about the best varieties for them to grow."

Helping boost bean production

Dominic believes demand for organic beans will increase moving forwards but admits they're not the easiest crop to grow.

"We can see that the market is going to grow but they are a difficult crop to grow organically," he says.

"We've spoken to farmers who currently grow beans and the main issue they're up against is that the crop is not very competitive against weeds.

"There are also several diseases that can affect them quite badly and growing them without herbicides or fungicides can be a bit of a challenge."

Trials of both spring and winter beans will take place over a period of four years.

"As the emphasis is on the trial's real-world context, we're working with everybody – we've pulled together two breeders, LSPB and Aberystwyth, Mole Valley is involved as a buyer, PGRO are supporting the project, Organic Research Centre (ORC) are on board as a researcher, Organic Arable is representing grain merchants and then we have our farmers," says Dominic.

"The whole supply chain is represented."

Variety selection

So far, the first spring beans trial has been planted, looking at the LSPB varieties Victus, Futura and Lynx, and Viper from LG Unity.

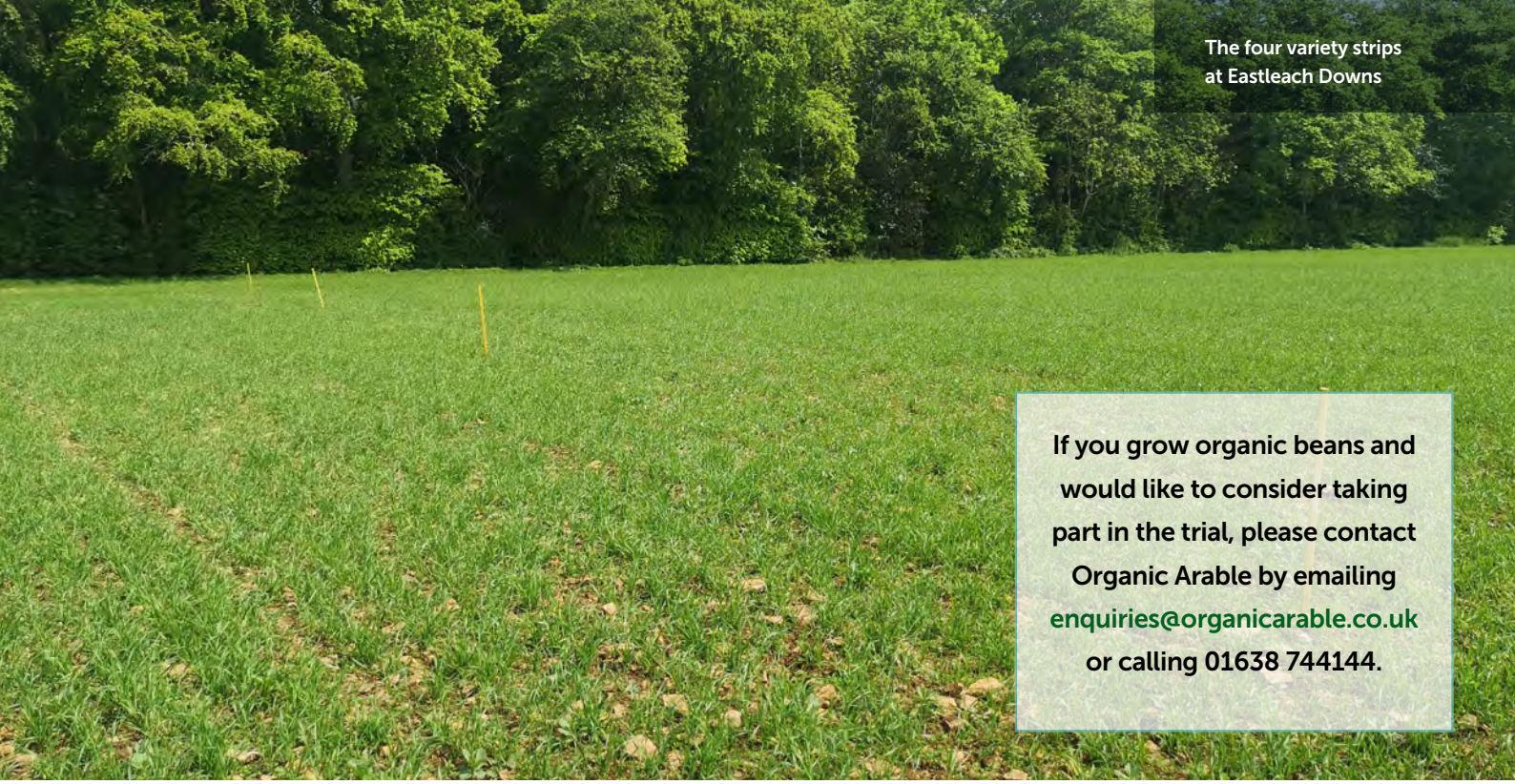
Dominic believes the trials will be invaluable as there isn't currently much evidence of how the varieties recommended for organic production actually perform under organic methods.

"Seed merchants are using data relating to the varietal performance from standards achieved in a higher-input environment," Dominic says. "The differential for beans between conventional and organic is less than cereals because they are generally a lower input crop. You don't need to fertilise them as much because they're producing their own nitrogen.

"We're conscious that we need to do the variety trials on organic farms under organic conditions, as real world as possible, so that a farmer's management can be taken into account.

"When you're doing plot trials, conventionally you can modify the environment more because you can take out the weeds and fertilise if you need to. But when trials are done under organic conditions you can't modify the environment. Therefore, it's key we test in that environment and allow farmers to do whatever their usual weed management approach is, on whatever their soil type is."

Dominic is looking forward to seeing how the four varieties fare in the trials. "We need to learn a bit more about their performance under organic farming conditions and understand more about the traits in order to work out how much of a varietal difference there really is.



The four variety strips at Eastleach Downs

If you grow organic beans and would like to consider taking part in the trial, please contact Organic Arable by emailing enquiries@organicarable.co.uk or calling 01638 744144.

"There is a sense they're quite similar – there aren't particularly unique traits amongst the different varieties, but no one's actually researched it in organic situations, so let's have a look because things really change."

Seeing how varieties perform from purely an organic perspective will be hugely valuable to growers moving forwards.

"Organic is still another world even to those using low-impact methods such as regen or no till – they're all still using herbicides," Dominic explains. "There is a massive difference, so you can't just take low input regen results and transfer them to organic.

"We want to expand that work, understand more about their performance on organic farms, particularly in real-world conditions, and figure out what the most important traits are."

Desired outcomes

Five farmers are currently taking part in the trial from different locations up and down the country; Devon, Hampshire, the Cotswolds and two in Northumberland.

One farmer is intercropping his beans with a cereal crop. "PGRO have presented work to us that shows how intercropping can work really well, so maybe once we've started to realise which varieties work best, we can start to look at management and the difference that can make," says Dominic.

The geographical spread of test sites will show what difference varying weather conditions can make, plus other factors such as latitude and day length.

"Bruchid beetle is another big issue for beans that are destined for human consumption, which is why cultivation of beans has been moving further and further north – to avoid it."

> **"WE'RE CONSCIOUS THAT WE NEED TO DO THE VARIETY TRIALS ON ORGANIC FARMS**

Dominic hopes the results of the trials may encourage more farmers to consider growing beans as part of their rotation.

"We had a limited number of farmers we could call upon as the organic bean crop area is small. But we hope that encouraging more growers to produce organic beans and expand the crop area will be tangible outcomes of these trials. The varieties are one aspect but we also hope to learn more about organic management approaches and the environments and the effects these have on crop performance".

"We're also hoping to feed the data back to seed merchants because making sure the right varieties are available organically is key."

The Organic Research Centre, with the support of Organic Arable, has had success with similar trials of wheat and oats in the past.

"Five years on, I'm certain our organic wheat trials expanded and improved yields," Dominic says.

Although organic farmers face several challenges when growing beans, Dominic hopes to replicate the success of these other trials and show farmers that there are myriad benefits to growing pulses.

"It's been quite an exceptional year; we were selling organic beans for more than £600 a tonne so there are definite financial advantages, although prices have fallen back now," he says.

"Getting more legumes into organic rotations is important, because they leave residual fertility for the next crop. So, as much as possible, we want to support farmers to grow more beans. Plus, we know the market is growing, especially as the feed mills are looking to reduce imported protein."

FARM STORY

Andrew & Joe Hodgson
Lincolnshire Farmers

Intercropping trial yields impressive results

A Lincolnshire farmer who has experimented with intercropping is excited to repeat the process after seeing some incredible results from a small trial area.

Andrew and Joe Hodgson, who farm near Sleaford, decided to grow oats and spring beans in the same field after research suggested his yields could benefit.

And benefit they did; when grown together, the beans produced 4.2t/ha, with the oats achieving 2.1t/ha. By comparison, spring beans grown on their own yielded 3.9t/ha.

"On the one hand, I can't believe the result, but on the other I can because it looked so much better in the field," Joe says.

"When working our gross margins, even after taking into account cleaning costs and having to drill twice, we were still more than £500/ha better off.

"The beans performed around the same in the intercrop as they did grown on their own, but we were also getting two tonnes of oats for nothing, which is obviously a lot more profitable than just growing spring beans on their own."

G J & A Hodgson's rotation includes winter oilseed rape, wheat, beans and spring barley across 600 acres, with 125 acres in a stewardship scheme. Options range from AB15 to low-input cereals, which is usually achieved by growing spring barley under sown with clover, which is then fallowed for a year.

"We opted to grow oats and beans because they seemed to go well together and it would be beneficial for the following crop," Joe explains.

"Wheat is the major cash crop in our rotation so I didn't really want to grow wheat and beans together because, if I'm going to grow a pulse, I probably want to follow it with a winter wheat.

"We discounted barley for similar reasons; wheat after barley isn't really a proper break."

As well as boosting yields, intercropping proved beneficial for tackling blackgrass on the clay loam soil, which has high organic matter of nine to 10%.

All pulses are quite open growing and we seem to be suffering more than we have in the past with spring-germinating blackgrass. Intercropping really closed up the gaps in the field, providing

much more blackgrass competition" Joe says.

Although some drills can plant up to three different types of seed at the same time, Joe has a Weaving GD drill which has just one metering unit and a single seed tank.

However, this didn't create any issues. "We direct drilled into a cover crop that had been sprayed off," he says. "We drilled both on 23 March last year; I finished drilling the beans and then put the oats in the drill and went back over the plot."

Although the intercropping of oats and beans exceeded expectations, Joe didn't see such strong results with another trial of peas with barley.

"The results were less exciting," he says. "The barley did 5.1t/ha with the peas yielding 0.82t/ha, and the straight barley produced 7t/ha. In gross margin terms, the intercrop returned £150/ha less.

"I suspect we had the barley too dense at seed rate of 100kg/ha – it was very cereal dominant. With no nitrogen fertiliser applied to the intercrop, the barley may have been nitrogen deficient.

"On reflection, we would keep the legume component at least 50% to avoid this. This trial was more like 90% barley, 10% peas. On seed rates, I would use no more than 50 kg/ha of cereal, with a full seed rate of pulse."

> **THERE IS NO ONE BLUEPRINT THAT WILL SUIT EVERYONE**

The only issue Joe encountered with the oats and beans was during cleaning after harvest.

"A gravity table didn't do a great job of cleaning it; people who have been doing it longer have told me we need to use a rotary cleaner instead," Joe says.

Last year's intercropping trial took place on half a hectare, but Joe is set to dedicate more land to it following his positive results.

"Last year we grew 120 acres of spring beans but this year we don't have any, we're doing larger scale beans and oats intercropping on a failed field of rape," he says.

"We will do around seven to eight acres this year and if that goes well, we will go full field scale next year."

Growing a successful oat/ bean intercrop

- **Oat variety:** Isabel, drilled at 50kg/ha
- **Bean variety:** Lynx, drilled at 330kg/ha
- **Herbicide pre-em:** pendimethalin + imazamox (Nirvana)
- **Fungicide:** None
- **Harvest date:** 3 September 2022

For more information or to ask Joe about his intercropping experience,

email gjahodgson@gmail.com

Start small and build it up

Comment from Steve Belcher, Principal Technical Officer

To quote farmer Andy Howard, who is a Nuffield Scholar on intercropping: "There is no one blueprint that will suit everyone and what works for one person may not work for someone else."

Andy also tells anyone thinking of intercropping to start small and increase the hectarage as you learn.

I would also encourage farmers to initially conduct strip or tramline trials, where intercrops are grown alongside the sole crops. This way you get a direct comparison as how well the intercrops are performing.

Consider why you want to intercrop. Is it to increase yield? Are you trying to reduce inputs? Is it more about a resilience mission? Are you targeting a disease or weed reduction? Or are you driven by land use efficiency?

There will be many other reasons, but these reasons will dictate the intercrop species and the ratios in which they are used.

The yields of the components of an intercrop are often lower than as a sole crop. They compete for resources such as light, water, and nutrients. But there is often some complementary sharing of resources, particularly where pulses are part of the intercrop.

Post-harvest crop separation, if needed, is a downside, but if in the future intercropping practices increase then manufacturers of cleaning equipment will find efficient solutions to separation.

So, it is about compromise and finding the species and ratios of a mix that will give the best outcome. No two years are the same however, and what works in one season may not be best for another.

PGRO Agronomy App tool

The PGRO Pea & Bean App, an agronomy assistant in your pocket. Providing up to date technical backup as well as the DL variety guides and an interactive pest and disease reporting tool via your smartphone or tablet.

Download the App from Apple and Google Stores - search for PGRO Pea and Bean Guide

PGRO the UK's centre of excellence for peas and beans

Growers of peas and beans qualify for membership of PGRO by virtue of the small voluntary levy on produce sold through the merchant trade. Grower membership of PGRO means that advice from the PGRO team is only a phone call away. There are also these other benefits:

- Full access to the PGRO website **(www.pgro.org)** and to all the updates, technical information and associated services provided there. Telephone and farm visit support is also available.
- PGRO is accessible for two-way communication via social media on Twitter @pgroresearch.
- PGRO Crop Updates are emailed throughout the growing season to highlight topical issues.
- Pulse Market Updates are published and circulated on a monthly basis to registered members along with the Pulse Magazine in spring, summer and winter.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