It seems common sense that practical projects led by farmers and growers are important for research to make a difference on the ground. Strange to think, then, how novel the first field labs seemed to researchers, policy makers and even farmers only six years ago.

Now there are almost 60 field labs on the go. Farmers and growers are involved all the way from Aberdeen to Ambridge, with Pip joining a group trialling diverse leys on The Archers. There have been stories about the groups’ research in the farming press every week of the year with recent features on Countryfile and Farming Today.

Thanks to hard work and leadership by the farmers and supporting scientists involved, this has caught the eye of the UK’s main agricultural research funders. The Agricultural and Horticultural Development Board (AHDB) and Biotechnology and Biological Sciences Research Council (BBSRC) back Innovative Farmers, and the Scottish Government has launched a Rural Innovation Support Service (RISS) that is bringing new groups into the network. Defra has trailed funding for farmer-led research in announcing the Agriculture Bill and there is also talk of support through the Industrial Strategy Challenge Fund.

It is exciting to see this interest. Any one of these big funders has the spending power to make farmer-led research normal and widely accessible, equipping the industry to make its own future through a time of unprecedented change.

Yet it also brings a risk. Farmers tell us they like field labs because the research is on their terms and aligned with their priorities. This means researchers and funders working differently. More investment will only have impact if it respects that call for real change.

This journal sums up the findings from a snapshot of the network’s latest field labs. There are many more. You can find out more and join the network for free at www.innovativefarmers.org.

Tom MacMillan
Innovation Director, Soil Association
How does intercropping affect arable yields and weeds?

**Why**

Are two crops better than one? By extracting different nutrients, accessing different parts of the soil profile and attracting different beneficial insects, intercropping — or growing two or more crops together — can produce significantly higher yields than growing the same crops separately. A second crop can offer weed suppression, help protect a vulnerable crop from lodging and provide insurance against pests or grain prices. Keen to reap these benefits, a group of growers with a broad mix of systems shared experiences and designed simple trials with combinations to suit their farms. Three of the farms have analysed their data from this year and share their results.

**Trial Design**

<table>
<thead>
<tr>
<th>Mark Lea Greenacre Farm</th>
<th>James Hares Roundhill Farm</th>
<th>Andrew Howard Bockhanger Farm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carlin peas at 250kg/ha</td>
<td>Wheat 175kg/ha Beans 125kg/ha</td>
<td>Beans 345kg/ha Mono</td>
</tr>
<tr>
<td>+ 5% Trit (12.5kg/ha)</td>
<td>Beans 125kg/ha</td>
<td>Beans 215kg/ha</td>
</tr>
<tr>
<td>+ 10% Trit (25kg/ha)</td>
<td></td>
<td>Oiled seed rape 3.4kg/ha</td>
</tr>
<tr>
<td>+ 20% Trit (50kg/ha)</td>
<td></td>
<td>Oiled seed rape 3.1kg/ha</td>
</tr>
<tr>
<td>+ 30% Trit (75kg/ha)</td>
<td></td>
<td>Beans 245kg/ha</td>
</tr>
</tbody>
</table>

1ha plot, 12m strips
- Mixed organic on sandy loam
- Motivation: support for peas
- Carlin peas on contract
- Triticale for animal feed

1 ha plots
- Mixed organic on heavy clay
- Motivation: weed suppression
- Wheat and beans for high protein animal feed

Replicated field plot x 2
- Conservation agriculture
- Motivation: increased yield and soil health
- Separated crops for two markets

**Measurements:** establishment plant counts, weed biomass quadrat cuts, tissue test analysis, combined yield

**The Results**

- **Greenacre:** next year, Mark will go for the 30% triticale mix. Even though this year it gave a slightly lower pea yield, the triticale offered visible difference in structural condition, protecting from lodging, making the peas easier to harvest.
- **Roundhill:** Even though the beans were the primary crop, James would rather have wheat than weeds so is planning the same plant pairing for next year. There was an average of 61.38% less weed biomass in the intercrop sample vs. the monoculture.
- **Bockhanger:** The wet spring meant that Andrew couldn’t plant his spring oilseed rape (OSR) until May. This combined with flea beetle attack meant a very poor harvest. Next year, he will try the same pairing but won’t spend any money on insecticides for the OSR. Andrew’s intercropped beans had approximately 50% more flowers than the monocrop, but extreme heat aborted the extra pods.

**Andrew’s Analysis**

“We all joined the field lab with our own individual motivations, but you learn so much when working with other farmers on a project like this — it’s like speeding up time. You only get 50 harvests each but working in a group of 10, you can learn in one year what might otherwise take a decade. We’re definitely going to continue the trials next year; I’m interested to see whether my intercropped beans have more flowers again and whether this translates to the final yield this time.

If you’re thinking of trying intercropping, I would say trial a small area first. It depends on what you are trying to achieve to what you attempt to trial, there are so many options. The most common intercrops include a cereal/legume mix such as beans and oats or peas/barley. An easy entry would be growing companion species with winter oilseed rape.”
Can a drone predict the right time to harvest potatoes?

Why

Dry matter content influences the yield, texture and oil absorption of potatoes, so often buyers have strict dry matter content stipulations for ware processing potatoes. Currently, deciding when to harvest potatoes with the right dry matter content relies on taking samples over a 6-week period and judging whether they’re representative of the whole field. But nutrients, moisture levels and soil type vary across a field and the crop may not be uniform. If part of a crop doesn’t meet buyers stipulations it may go to waste. If it needs to be redirected to lower value markets, this can mean losses of up to £2,000 per load in devaluation, haulage and administration.

Now, a group of large-scale growers in Lincolnshire and Staffordshire are trialling the use of drone technology to map potato maturation. They hope this will help them harvest potatoes at the right time, with the right dry matter content, and inform a more targeted approach to fertiliser use – reducing inputs, saving on cost and protecting the environment.

Trial Design

<table>
<thead>
<tr>
<th>Farm A</th>
<th>Farm B</th>
</tr>
</thead>
<tbody>
<tr>
<td>7 x fields of 2 varieties</td>
<td>5 x fields of single variety</td>
</tr>
</tbody>
</table>

- drone flight path, mapping vegetation indices using infrared and RedEdge technologies

Measurements:

- By drone: dry matter content, emergence, canopy development, canopy senescence, chlorophyll content – which indicates plant stress, and cost.
- By spade: dry matter content for comparison

Sample Results

Although still in development the technology used in this project showed clear benefits as a decision support tool with potential to improve harvest management and efficiency. We look forward to further development and linking to other applications such as variable desiccation within the field.

Peter and John’s Analysis

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Peter Cook, field lab participant and partner, Cook and Watson

What we’ve seen this year has given us lots of encouragement that the technique is worth the investment. As well as identifying dry matter, the project identified future opportunities where the drone images can identify areas of variation, leading to better management decisions for crop nutrition and protection. Advanced warning of issues will improve timing and rather than spraying the whole field, we could use patch spraying with high precision; reducing our costs and environmental impact. This, along with a more consistent crop, could strengthen buyer relationships and boost our bottom line. This technology could also be used for other crops. It’s estimated that up to 70% of some herbicides go to waste. Using the drone to identify areas of grass weeds in a cereal crop, then precision spraying could mean significant reductions in inputs.”

John Cook, field lab coordinator
Is iron deficiency holding back calves fed on whole milk?

Why
Iron is essential for the production of haemoglobin which carries oxygen around the body. After noticing livers from his cull dairy cows showed low levels of iron, a Wiltshire farmer and his vet focused their attention on the group of calves fed whole milk, as studies have shown that whole milk may not meet their iron requirements. Their testing identified that anaemia caused by iron deficiency could be an issue.

It is well documented that anaemia in piglets reduces their growth rates, and some research has shown that the same is true for calves. Additionally, anaemia can lead to immunosuppression and potentially increase pre-weaning disease incidence. In light of this, they wanted to look into how widespread the issue of iron deficiency anaemia is across dairy farms.

In a field lab bringing together organic and non-organic dairy farmers, they trialled supplementing whole milk-fed calves with iron to find out how it affected their health and growth.

Trial Design
8 farms took part, with a total of 272 whole milk-fed calves. 1 farm was not included in the results due to having a small sample size. Groups of calves were split at random, ½ into treatment and ½ in a control group. They were kept in mixed pens with all other factors kept the same.

Measurements: growth rates, haemoglobin levels (pre-treatment and at 6 weeks)

Treatment: 139 calves received an iron injection in their first week of life

Control: 133 calves - no injection

The Results

These early results certainly indicate that low iron levels may be affecting the growth of whole milk-fed calves. But the variation from farm to farm shows that management and total ration levels may have much more effect. There are also many additional variables to consider regarding the dam, effect of breed and feeding, for example mineral content of forage.

The calves will be monitored until they come into calf and weighed again at 6 and 12 months to see how iron levels affect their long-term development. Although growth rate is of interest, the potential effect of low iron levels on disease resistance and positive health are of most value to the group. That’s why we want to continue to record health data and try and obtain a greater sample of this data to see how iron levels effect an animal’s resilience.

Kate’s Analysis
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Why

A growing body of evidence is showing the benefits of cover crops for both soil health and productivity. But currently there are limited tools for destroying them prior to establishing a cash crop. The options are generally ploughing if farming organically, or glyphosate for non-organic and no-till farmers. Now, a group of organic and non-organic arable farmers are looking to add to the toolbox by assessing a range of alternative methods, including flailing, roller crimping, grazing and rolling, and comparing how effective they are against their normal practices.

Trial Design

7 farms took part in the trial. Each using a range of cover crop mixes and destruction techniques. At Hawk Mill Farm:
- Cover crops drilled early and destroyed on 25 November to take advantage of frost.
- A second field of beans and phacelia was rolled and flailed.
- After destruction a crop of spring barley was sown.

Mix A - Buckwheat, Phacelia, Mustard, Berseem Clover
Mix B - Spring Oat, Oil Radish Mix
Barracuda Radish Plot
Rolled Failed Crimper rolled

The Results

Variation in yield by destruction method

- The yield data are indicative of the potential for other destruction methods. However, they also reflect in-field variation as well as the success of the different techniques. Yield assessments could have been affected by some areas of the field that were waterlogged at establishment due to the wet spring of 2018.
- The group reported that they learned significantly more about cover crop selection, establishment and destruction methods from doing the trial – both in relation to their own farms, and from each other.
- "The main conclusion from this trial for this season is that there is scope to destroy cover crops in a variety of ways and not impact on yields of the following spring crop." – Helen Holmes

David’s Analysis

As a group, we’ve learned a lot this year about cover crops. There are so many variables, and good destruction is all about getting the species and the timing right. Destroying on 25 November felt a little early, but we wanted to take advantage of the effects of the frost plus the mustard was starting to set seed.

When it comes to the different destruction methods, it was a case of the right tool for the right crop. The Cambridge roller was pretty consistent though, and as we’ve already got one on the farm, that’s what I’d be most likely to use in the future. At a field scale I’d give it two passes, the first along the tramlines and the second at a 30 degree angle.

If I had the right cover crops in, this would mean I could halve my glyphosate use – just using it as a pre-emergence weedkiller, with the roller killing the cover crops.

In conservation agriculture it often feels like we’re forging our own path – trying things that are new and innovative. That’s why I got involved in this field lab, to see different farms, rotations and scenarios and to learn from what others are doing. That would be my recommendation for anyone thinking of doing their own trials – just give it a go, take a risk. Sometimes it works, sometimes it doesn’t but you always learn something you can apply the following year.”
How does hot water seed treatment affect yield and disease levels in chard?

Why

Leaf spot is a common fungal disease that impacts the yield and marketability of leafy greens. The disease can be caused by several pathogens; often these are air or soil borne but they can also be present in seed. Some seed companies are now beginning to offer Hot Water Seed Treatment (HWST) as an organic alternative to fungicides. The process involves heating the seed to a precise temperature for a set time to kill the pathogens. HWST has proved effective in the lab, but the team at Riverford Organic Growers wanted to explore the in-field benefits. They designed a trial to test how treated seed performed in crop production, while also finding out more about the environmental factors that affect the severity of the disease.

How does hot water seed treatment affect yield and disease levels in chard?

• The HWST showed 100% control of Alternaria before sowing, and similar levels for other pathogens.
• The treated plants yielded an average of 25t/ha of crop, compared to 22t/ha if untreated. This could be due to a priming effect on the seed that may lead to better germination, faster emergence, and more vigorous growth.
• On average, 72% of the HWST crop was marketable, compared to 69% of the untreated crop.
• At a chard price of £2/kg, results from this year suggest that using treated seed could offer an additional £5,910/ha of crop over the course of a season. HWST could be cheaper than chemical treatments and with less potential for unforeseen consequences.
• On top of these savings, with less disease the crop is quicker to harvest, meaning a significant saving in labour costs.
• With a long, dry summer, this was a low risk year for fungal disease. The group plan to continue the trial to substantiate these results and test the technique under different weather conditions.

Zac Goodall and Joanna Bellamy from the Riverford Organic Farmers field lab team

Zac and Joanna’s Analysis

I’ve done other, more academic trials before and what struck me about the field lab was how practical it was. We paced out the sampling spots, and then used everyday equipment – a field crate and a knife – to collect the samples. This year’s results have been really promising, but it was a particularly dry year with low levels of disease in general. It will be interesting to see what happens next year – particularly if we have a warm wet summer.” - Zac Goodall, Riverford field lab team

My advice to anyone planning their own field trial is to be utterly realistic about what you can commit to – both with yourself and your partners. We started off with a far more complicated trial design, but soon realised following it would be a full-time job! Working with Dominic we scaled it back to what we could really commit and stick to. It’s really rewarding to see these results. A second year of trialling will provide further evidence. This will enable us to decide whether we are going to seek to use hot water treatment on a commercial basis.” - Joanna Bellamy, Riverford field lab team
Does co-composting increase phosphate availability?

**Why**

Soil phosphate availability can be a major limiting factor in low-input cropping systems. The addition of rock phosphate can help, but this requires chemical and biological processes to break it down and make it available to the crop. In their first year, the group carried out baseline soil testing that showed many of the farms had a lack of available phosphate in their soils. With a diverse mix of systems, soil types, and crops, the group wanted to design a trial to boost available soil phosphate that would work for everyone. They decided to co-compost rock phosphate with farmyard manure (FYM) to test whether it was more effective than applying separately.

**Trial Design**

<table>
<thead>
<tr>
<th>Farm A</th>
<th>Farm B</th>
<th>Farm C</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
<td><img src="image3.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

- **GAFSA (reactive rock phosphate) at 300kg/ha co-composted with 10-15 tonnes/ha of FYM**
- **Wheat**
- **Grass**
- **Same quantities of GAFSA and FYM applied separately**
- **1-2h trial plots**
- **Measurements: worm counts, plant tissue (P), yield, biomass**

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**Adrian’s Analysis**

These results certainly suggest **co-composting has an impact on phosphate availability** to the crop. Now we’ll be taking what we’ve learned and extending the field lab, maybe for the next three years. Long-term we want to know how co-composting is affecting soil health and that kind of trial takes time. But the good thing about working together in this way – when research is practical, in-field and replicated across several farms – is that we have the results both on our own land and on a wider scale, so it speeds up what we’re learning.

**Trialling co-composting on your farm is straightforward**, just split your FYM into two piles and mix the GAFSA into one of them. We kept ours side by side, turning them two or three times over winter ready for application in the spring. Like with any trial though, make sure you plan ahead and get any equipment or products well ahead of time.

**The Results**

- Phosphate concentration was up to 20% higher in the flag leaf on the co-composted plots.
- Effects were most evident where they were co-composted for at least 4 months before application.
- Differences in grain yields were not statistically significant, but biomass was higher on all co-composted plots.

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**Researcher Coordinator**
- Adrian Hares, Roundhill Farm

**Number of triallists**: 3

**Amount invested**: £5,970

**Sponsor**
- University of Reading

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**Table**

<table>
<thead>
<tr>
<th>Researcher Coordinator</th>
<th>Number of triallists</th>
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<td>Adrian Hares, Roundhill Farm</td>
<td>3</td>
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</table>

**GAFSA (reactive rock phosphate) at 300kg/ha co-composted with 10-15 tonnes/ha of FYM**

**Wheat**

**Grass**

**Ryegrass**

**Winter wheat**

**Site A**

**Site B**

**Site C**

**Yield (t/ha)**

**Mean leaf phosphorus concentration (mg P g dry weight)**

**Phosphorus concentrations**

- **Applied separately**
- **Co-composted**
Which winter wheat varieties perform best in organic conditions?

It can be really challenging selecting the right wheat variety for an organic farm. Most current research is carried out in non-organic conditions with the untreated controls only missing out on the chemical fungicides and growth regulations, leaving fertiliser and weed control the same as any other conventional crop – so it is a completely unclear picture for an organic farmer.

Our field lab tested different winter wheats, including Maris Widgeon, European and new varieties, under organic conditions. Growing with the different soil biota, weed profiles and zero input management should give growers a more accurate picture of how a variety will perform on their farm.†

Charles Hunter-Smart, Bradwell Grove Farms

Why

Trial Design

10m x 4m plots. Each variety replicated at random x 4

Varieties

Anapolis
AWC13
Costello
Crispin
Dunstan
Gament
Gourmet
Graham
Maris Widgeon
Mortimer
Olympus
Revelation
Siskin
Skyfall
Sundance
Zyatt

Yield by variety

The Results

• Based on the trial plots, the best performing variety would be worth at least £175/ha more than the worst performing.
• The only heritage variety, Maris Widgeon, was one of three that outperformed the yield/protein trade-off.
• Only one variety (Skyfall) had signs of yellow rust, to a lesser extent brown rust affected the Crusoe variety.
• Trial yields were far lower than general yields at Bradwell Grove. Revelation trial plot: 2.39t/ha vs. Revelation in surrounding field: 3.8t/ha. Likely cause is later drilling and trial machinery.
• The varieties that did best tended to be those with good early ground cover.
• Mortimer is no longer available commercially despite its strong performance in this year’s trial. This is due to lack of interest from conventional growers and highlights that there is often an incongruence between varieties’ responses to high and low input systems.

Charles’ Analysis

This field lab has been really interesting as we have found significant differences in both yield and protein levels when these seeds are grown under organic conditions. Now we have the start of some scientific results that will hopefully help us to have confidence in the wheat varieties we are selecting. However, it’s important we have more trials on different soil types. That’s why I’m keen to have them growing in our own Cotswold brash soils; on another soil type you could get a different result.

Next year we are extending the field lab on three farms. Combining our results with other trials, we’ve chosen to concentrate on seven promising varieties that fit with current farm choices and trial them at field scale using our own equipment. This will be more cost-effective than hiring the plot drill and combine and will also give us a better idea of how the varieties perform in a real farm setting.†
Working with other farmers is like speeding up time. You only get 50 harvests each but working in a group of 10, you can learn in one year what might otherwise take a decade.

Andrew Howard, Bockhanger Farm

Who’s involved?

Innovative Farmers is a network, made up of a growing group of progressive farmers, growers, researchers and advisors; working together to tackle the stark challenges which farming faces. There are more than 1,700 farmer and grower members, with 300 currently involved in field labs and 20 research institutions supporting them.

The network is part of the Duchy Future Farming Programme, and is funded by the Prince of Wales’s Charitable Fund through the sales of Waitrose Duchy Organic products.

Increasingly, other companies and farming institutions are investing in the network, seeing the value in supporting farmer-led research.

Innovative Farmers is backed by a team from LEAF (Linking Environment and Farming), Innovation for Agriculture, the Organic Research Centre and the Soil Association.

And you?

1. Get involved, for free: the support of field lab sponsors mean that many field labs are free to join.

2. Got an idea that isn’t in this journal? You could get funding and support to test it out. Just get in touch with the team on 0117 987 4572.

3. Join: if you just want to stay up to date with the latest field lab findings, sign up at www.innovativefarmers.org/join