

Integrated
Pest
Management
CASE STUDY

Pragmatic change
with a constant focus
on the bottom line.



Project jointly produced with:



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The Hendred Estate

“I just keep seeing how much I can decelerate my industrial ag without it being detrimental”.

Julian Gold, The Hendred Estate, Wantage, Oxfordshire

Farm size and soil type: 750 ha large scale predominantly arable unit with a small scale sheep flock and shoot. Soils are highly alkaline (pH 8.2) silty clay loams over chalk.

Location: The Estate is located in the North Wessex Downs AONB between Oxford and Newbury.

History: The Estate has a long and well documented history with over 600 years of ownership in a single family.

Crops Grown: The Estate has a six-year rotation of oil seed rape (OSR), winter wheat, spring barley, spring or winter beans, winter

wheat, winter barley or second wheat, then back to OSR. There is a small area of permanent pasture and a sheep flock graze the cover crops.

Regenerative Agriculture and Integrated Pest Management: Julian has always farmed in a way that prioritises soil health and in recent years has widened this out to try to operate a farming system that is sympathetic with and minimises negative effects on all aspects of the natural ecosystems on the farm.



Fenland nightmare soil (Julian Gold)

Setting the context and stating the issues.

Julian Gold has managed the 750 ha Hendred Estate near Wantage on the edge of the Berkshire Downs since 1992. The soils on the estate are typically high pH. (8.2) silty clay loams over chalk. The arable system developed over the years by Julian reflects a steady focus on regenerative IPM principles to deliver profit, substantial investment each year in estate infrastructure and a steady increase in the natural capital from which the business will benefit in the future.

“An analogy I like to use is that of an industrial manufacturer operating a profitable production line process. Some of the profit generated from the production line is used to maintain the factory premises for obvious reasons. If we imagine the ecosystems we are working in are our ‘Factory Premises’ we should be spending money maintaining these in good condition.”

Top of the ‘To do’ list for Julian, who is BASIS and FACTs trained and manages all the agronomy for the estate, is to create a more robust farming system by progressively lowering artificial nitrogen, prompting slower crop growth and less reliance on growth regulators, fungicides and insecticides. The aim is to



Mid-flowering margin with deer (Julian Gold)

develop an effective middle way between industrial agriculture (a system that is ‘broken’ in Julian’s experience) and organic production, creating a business that thrives as the Basic Payment Scheme declines.

Over the years opportunities to build soil organic matter in this largely stockless arable system have been developed. Soil structure has been improved through a controlled traffic system that has reduced machinery trafficking from 80% to 20% of the land area. A six year rotation, including spring breaks, helps to reduce blackgrass and disease pressure.

The estate is also involved in trialling innovative in-field wildflower strips that maximise the impact of beneficial predators on insect pests. The Centre for Hydrology and Ecology are monitoring the impact of these in-field strips through the ASSIST project.

Q: How did you get started on this journey to IPM?

Julian grew up on a farm in Warwickshire which had Grade One soils.

“So literally, we were sitting on the most epic soil you can imagine. Even as a kid I used to be looking after the soils – and paranoid about compaction.”

Work experience on farms in Australia strengthened this focus by showing soils destroyed by unsustainable cropping systems.

“8,000 acres of basically beach sand moonscapes – not worth combining.”

Even in the UK in an easier climate, intensive cultivation for root cropping in the Fens had destroyed soil structure. Ploughing these Fen soils resulted in clay boulders that had to be irrigated before they could be cultivated to create a seedbed.

“So basically, all these farms and all these soils were just compromised, and I suppose that just reinforced my wanting to look after the soil.”



Moonscapes of soils (Julian Gold)



Handling bees (Julian Gold)

Getting a beehive, watching bees work in the fields and realising that spraying midday would kill them widened the focus of Julian's management from soil to the whole farming system at Hendred.

“That triggered the mindset to change. It made me realise how much we're destroying the natural capital around us. Industrial agriculture has been destroying the factory premises, and you know that's MY factory premises.”

Understanding the basic principles that underpinned pesticide resistance was another key trigger.

“I was starting to realise that industrial agriculture was this little 50-year experiment - a blink of an eye. It worked for a few years, but then the standard biological principles destroyed it. You know, we can see insects declining by 75% in the last 20 years, the inexorable rise and difficulty of controlling black grass, cereal varieties breaking down to Septoria. So I started thinking – so how can I change this system? Be part of the solution rather than part of the problem?”

Q: So, do you have examples of where IPM has worked well on your farm?

Two case studies show how the Hendred Estate has changed the farming system to become more sustainable.

Building a new system of Nitrogen Management using Integrated Pest and Soil Management Principles.

Manufacturing nitrogen fertilisers uses large amounts of fossil fuels, emits greenhouse gases and is highly vulnerable to shocks in the global energy price. Uptake of artificial nitrogen by the crop is never 100% efficient and leaching results in surface and ground

water pollution. Wheat plants in higher nitrogen systems tend to be more susceptible to foliar diseases such as Septoria - and the yield penalty from new resistant strains of Septoria are severe. Fungicide applications to control foliar diseases like Septoria can kill soil fungi which reduces plant food from the soil - driving the ongoing requirement for fertilisers. In fact, it's a vicious circle.

Julian explains how in his experience high levels of nitrogen fuel is an unsustainable system. In the short term this is cost effective BUT by driving the system at a speed that exceeds biological processes, nitrogen creates many of the problems faced by intensive systems.

“Nitrogen, that's the fuel that's oiling the industrial agriculture bandwagon because it's driving all the other inputs like big fungicide spend, growth regulators, pest attack etcetera.”

The alternative approach at Hendred is based on the use of resistance varieties, investment in soil organic matter whilst cutting nitrogen and fungicides with no sacrifice of yield or profitability.

“The journey I'm just starting down now is reducing nitrogen use and reducing fungicides. To be able to reduce inputs, you have to start reducing nitrogen first because that's a driver for everything else. We're working on nitrogen use efficiency. Bringing nitrogen down slows the whole hamster wheel of industrial agriculture. Lower N means you can use less growth regulators, less fungicides, less everything really because your growing system is more robust and more akin to a natural growing system. When crops are growing more slowly they're more insect and disease resistant. We're doing a six-year trial growing a block of wheat with nutrition rather than fungicides. I'm just seeing how much I can decelerate my industrial ag without it being detrimental to the business.”

Even in year one, soils in the low nitrogen trial have improved their fungal-bacterial ratio. *“We're cutting nitrogen rates and cutting pesticides - particularly fungicides - down, and putting micronutrients on instead. So we're trying to manage the disease by making the plants super healthy. It's only the first year but anecdotally there seems to be better fungal bacterial ratios than my commercial area.”*

Considerable effort has been made to maximise the benefits of photosynthesis and root exudates in the soil by growing high yielding cereal and rape crops and avoiding cultivation. The five-year rolling average for yields¹ confirms this to be a productive and profitable approach with winter wheat consistently yielding over 10.3 t/ha, winter barley fractionally below 8 t/ha and OSR over 3.5 t/ha.

“Once you start realising soil is a natural ecosystem – you realise that nature doesn’t cultivate soil. We haven’t got a lot of grass leys rotating around – and we’ve not got farm yard manure - so I have to build my soil carbon with photosynthesis. So I’m relying on big high yields of crops and root exudates, and then not re-oxidizing soil carbon by cultivating.”

Glomalin, the sticky ‘root glue’ created from root exudates that secures soil structure is preserved through minimal cultivation. Julian avoids the traditional approach where soil structure is created and then smashed to pieces by cultivation each year.

“It’s like there’s somebody flattening your house every summer, and you’re thinking, ‘flipping heck’ that was a nice house I was just living in, and then you spend 12 months rebuilding the top bit, and then the following year, somebody flattens it again.”

“From a carbon point of view traditional farming it’s a bit like the Hokey Cokey, you know. So we have all this carbon below ground in structural root carbon and also liquid carbon from root exudates. If you go and cultivate like normal farming systems- ploughing and tilling - you oxidise it all back out. Whereas what I want to do is sequester, sequester, sequester - just building the carbon in my soil.”

This approach to conserving soils has worked well. Analysis of soils on the Estate 20 years ago showed a range of organic matter from 2.6 to 3.2%. These soils are now 5.5-6% SOM² a steady increase of 0.13% p.a. Later drilling is easier now as soil structure and workability have both improved.

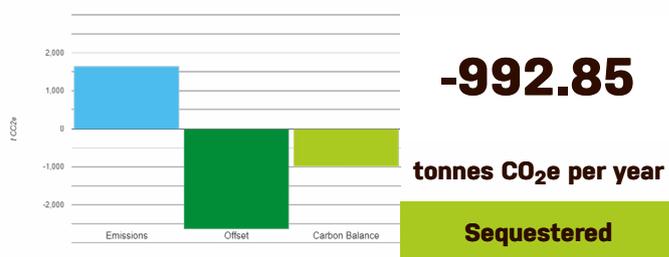
“Late drilling fits with reducing blackgrass pressure, reducing Barley Yellow Dwarf Virus (BYDV) pressure, reducing Septoria pressure. So it’s all later drilling varieties, reducing nitrogen and making sure that the crops are fed in the right way with a healthy structured soil.”

As a result of all this effort and investment, the farming system as a whole is now carbon positive. The 2020 annual audit of carbon using the Farm Carbon Calculator revealed over 990 tonnes of CO₂ equivalent has been sequestered on the estate. Depending on carbon prices in the future – the integrated pest and soil management system at Hendred seems a useful opportunity to ease the loss of the Basic Payment Scheme.



Hendred Farm Partnership 30 Sep 2020

Summary



¹Winter Wheat: 10.39 t/ha. Winter Barley : 7.97 t/ha. Spring Barley: 6.8 t/ha. Winter OSR: 3.55 t/ha. Winter beans: 3.09 t/ha. Spring Beans: 3.08 t/ha

²Loss on ignition at 430 degrees

Reducing insecticides through in-field wildflower strips and the work of beneficial insects.

An arable system using minimum tillage on heavy soils with chopped straw and cover crops to build organic matter inevitably builds pressure from slugs. Using an IPM approach which supports beneficial predators helps to ensure successful oilseed rape (OSR) establishment.

Carabid beetles are voracious predators eating their own bodyweight of eggs, larvae and adult slugs each day - as well as plant materials. Adult beetles require undisturbed habitat, such as hedges and field margins, for breeding and overwintering. Their ability to protect emerging OSR seedlings from slug damage, however, depends on their distribution through the crop. Many carabid species are reluctant fliers – some have no wings at all so must run or walk through the crop to get to their prey.



Carabid beetle (Stephanie Williamson)

By establishing in-field strips, Julian is proactively building and dispersing carabid beetles right through the middle of the crop – not just relying on the potential for long distance migration from field margins.

“Beneficials only move about 50 metres but if you’ve got a big prairie – the beneficials can’t get into the middle of the field. If you are relying on field margins they’re not really doing any good. But if you then start to put the strips down the middle of the fields, mine are 90 metres apart, so they only have to go 45 metres max, so everything is covered with beneficials.”

The in-field wildflower strips have been established as part of a trial run for ASSIST. This trial compares two treatments as Figure 1 describes.

“CEH are doing the technical monitoring. It’s all part of a five year experiment and the data will gradually come out. The obvious things that are coming out of those strips are ladybirds preying on aphids. You can see a lot of ladybirds living in them. And the other thing coming out of the strips are ground beetles, carabid beetles, preying on slugs. CEH are counting carabid beetles all the time. The scientists around here are constantly monitoring things. They’ve got, for example, plasticine slugs, and they come and count the bite marks on them – toothmarks from the carabid beetles.”

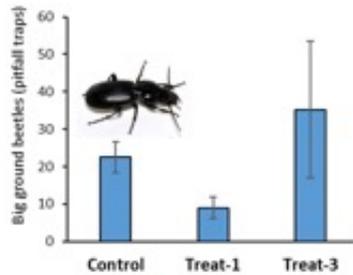
The impact on OSR establishment is still anecdotal but visually it appears that beneficial predators are helping crops to establish. Early results from ASSIST (see Figure 2) reveal that large predatory beetles are more abundant where in-field strips have been established. This benefit extends to the centre of the field. Indicators of soil health, such as Collembola, are more prevalent where cover crops and compost are combined with flower margins and in-field flower strips.

Figure 1: ASSIST nature based solutions in arable farming systems.

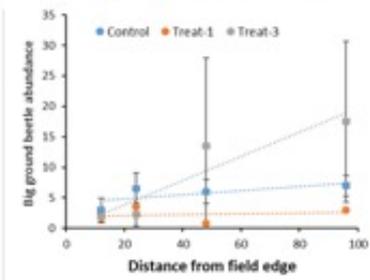


Figure 2: East Hendred 2020

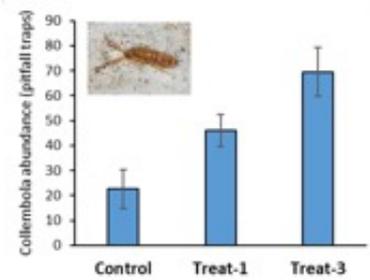
Large predatory ground beetles (slug eaters) are more abundant in treatment 3 with infield strips



Large predatory ground beetles increase in abundance going into field centres where there are infield strips (treatment 3)



Collembola abundance - an indicator of soil health in terms of organic matter and bioactivity are more prevalent in treatment 3



Control	Treatment 2	Treatment 3
CONTROL No treatment Business as usual	SUPPORTING soil health & beneficials + Cover crops + Flower margins	MAXIMIZING soil health & beneficials + Cover crops + Compost/FYM + Flower margins + In-field flower strips

Figure 3



"I am using less slug pellets over time. We're rolling more but hopefully, we're getting more predators as well on slugs. Hopefully by using no insecticides and using ferric phosphate slug pellets we're not harming beneficials, and, anecdotally, it's all helping."

Q: What have been the main benefits of using an IPM approach?

Economic Benefits.

- The critical infrastructure of the Estate has been boosted by investment in future productive capacity (i.e. ecosystems services).
- Yields are high: the system is profitable and well prepared for future shocks (e.g. the impact of climate change, nitrogen or pesticide taxes, higher fuel costs). The farming system has higher inherent resilience.
- As the soil becomes easier to work, lighter, lower horse power tractors (40hp lower) pulls wider kit with lower impact on soil and less labour required.

"I've also got anecdotal evidence that my oilseed rape establishment was much better in the field with the in-field strips. The oilseed rape field with two ASSIST strips in [marked in red on Figure 3] has no slug damage. It was drilled on the same day with the same variety after the same winter barley chopped straw and identical cultivations, and interestingly, it sticks out like a sore thumb on Google Earth from the other two treatments which have suffered from slug damage."

Other IPM approaches to controlling slugs include choosing slug pellets with less impact, rolling and using seed rates to boost plant populations.

- Diesel use has reduced bringing both variable costs and greenhouse gases down. In addition, wear and tear on machinery is lower. *“It is also the time - our big tractor used to spend something like 850 hours a year, but now it does about 375 hours a year.”*
- Lower pesticide costs balance the additional costs of foliar feeds. *“IPM allows you to minimise your use of pesticides rather than them being the first solution. So it’s just a way of thinking really – a way of changing your mindset to good farming.”*

Social benefits: “This approach? It’s way more interesting!”

- Once you have started dealing with complexity – it is much more interesting.
- Knowing you are investing in the long term health of the farm feels positive.
- Being part of the solution not part of the problem is satisfying.

“So regenerative agriculture is more about much more complex management - lots of balls in the air at once and multiple enterprises, multiple income streams, multiple things going on. It’s way more interesting than the simplified system we’ve got used to. And there are emotional benefits too. Big time. All through June, every night we went on a dog walk, we basically used to go and stand in the herbal ley because it was so nice. It’s almost like woodland bathing as a way of getting mental wellness. It was almost like ‘herbal ley’ bathing. So - when you see a barn owl hunting around - that’s great. I think there’s massive social and psychological benefits to IPM and doing the right thing and maintaining the ‘factory premises’ if only people could latch on to it. It’s so interesting.”

Environmental benefits.

- The move to lighter machinery and less cultivation has improved soil structure and drainage.
- Building soil carbon and cutting diesel – the estate is now carbon positive.

- Wildflower strips through the crop itself helps beneficials to control aphids and provides habitat for other birds and mammals. Corn buntings and kite numbers have increased.

“This year we’ve seen lots of bumblebees around - absolutely shed loads compared to normal.”

Q: Do you have any Top Tips for other Farmers who want to start IPM?

Talk to other farmers.

- Go and see things on the ground – visit demo farms and engage with discussion groups. AHDB Monitor Farmers are great for being inspired and for sharing practical knowledge. They can act as a catalyst.

Read books.

- Gabe Brown’s ‘Dirt to Soil: one families journey into regenerative agriculture.’
- Not all books are great: read widely BUT think for yourself what you agree with from your farm.

Create trend data for your business.

- Plot graphs with rolling five year averages of costs and yields. The five year graphs take out anomalous years and give you the trends.

Get a FEEL for your soils.

- Rather than precise figures look for long term trends in your soils.
- Get a feel for your soils to be able to track improvements:

“When you’re looking for change with soil, often it’s better to use your hands, your nose, and your eyes. Seeing a mass of worm middens negates the need to do worm counts. The feel of the soil under your feet indicates whether the structure is good or not. A functioning soil has a different smell to an anaerobic, compacted, damaged soil. We don’t necessarily need to have a lot of expensive soils tests to tell us what is happening in our fields.”

Change your system slowly but aim to change the WHOLE system.

- Make incremental change in small steps to reduce risk, preserve profit and keep the landowners on board.
- Choose carefully what changes you want to push.
- IPM is all about the whole system. All aspects of farm management are integrated.

Enjoy the personal benefits of being close to biodiversity.

- Sit in a herbal ley that's flowering and is being worked on by many species of bees.
- Get yourself a beehive to get an interest in insects going.
- Be grateful you can see Nature coming back very quickly given the right conditions.

"Proper immersion really works. So, say you sit somebody in a seminar - they're not going to pay any attention to you whatsoever, but you walk them through a herbal ley that's being worked on by every species of bumblebee under the sun or a

flowering strip in the middle of your fields and seeing all the ladybirds in it and showing them less crop damage in a field that's got flowering strips. That's the way to show people the change - it's full immersion. It has to be three-dimensional. It all comes back to the same old thing - farmers in boots on demonstration farms. Farmer to farmer knowledge transfer and seeing it on farm."

Finally, engage with training and knowledge exchange if you can.

- Engage wherever you can with training, maybe with your friends and neighbours. Good training can encourage longer term thinking, especially where it triggers your own on-farm trials and innovation.
- Get involved with farmer to farmer knowledge exchange.

"Farmers that come to our open days or farm walks, they'll actually see the strips in the fields. Nobody ever says oh, this is rubbish. I wouldn't want this. They say these are amazing!"



Mid-flowering margin (Julian Gold)