ROTHAMSTED
RESEARCH

2020

YEARBOOK

RESILIENCE WINS OUT

2020 assured its place in the annals of human history in the most terrible and tragic of ways, and we cannot start this review of the year without acknowledging the loss and suffering endured by millions around the globe, nor the difficult transition we face as we head together into an uncertain future.

As the dark days of the pandemic recede, glimmers of hope are now appearing on the horizon. For those of us in the UK at least, a successful vaccine roll-out is, as I write, helping to ease restrictions and hopefully set us on a path back to 'normality'. Our wish for 2021 is that with sufficient global support, all countries will soon be able to say the same.

Two things have become very clear during this recent period: the incredible resilience and resourcefulness of human beings, and that science can achieve the truly remarkable when faced with the direst of challenges.

From heroic healthcare workers putting their own safety at risk to care for others, to the incredible efforts involved to develop and then deploy vaccines at speed, last year showed us the very best of what humans can achieve together when their backs are well and truly up against the wall.

As we cautiously start to emerge from the pandemic nightmare, we must front up again to the important challenges that still await us.

Climate change, hunger, malnutrition, and biodiversity loss have not gone away – but we can tackle them afresh in the knowledge that if we work together, anything is possible.

2020 will always be remembered for the bad, but with a concerted effort, perhaps 2021 will be remembered as the start of a golden age of human collaboration, innovation and achievement.

Professor Angela Karp
Director and CEO

It seems a lifetime ago now, but even as recently as last January COVID was for many of us – in Europe at least – a hemisphere away. Having seen the potential global threats of the previous SARS and MERS pandemics fail to materialise, life carried on with just the occasional nervous glance to the news coming out of China.

USING OUR LOAF

For Rothamsted, that included the announcement that we had developed a high fibre white loaf by doubling the fibre content of the white flour fraction of the wheat grain. Along with collaborators at the John Innes Centre and Bristol University, our scientists identified the section of the wheat genome responsible for fibre content.

This new white flour is otherwise identical and makes a good quality white loaf – but with all the added health benefits that come from eating wholemeal bread, including reduced cancer, diabetes and obesity risks.

The team has developed genetic markers that can easily be used by plant breeders to identify which individual wheat plants have the high fibre genes, allowing them to incorporate the high fibre into elite wheat lines – opening the possibility of significant increases in dietary fibre intake for everyone.

Conversely, the finding also allows the breeding of low fibre wheat lines, which whilst no good for bakers, is great news for distillers.


BBC NEWS

Menu

England | Local News | Regions | Bristol

Scientists find secret to healthier white bread

4 February 2020

Dr Alison Lovegrove said the high-fibre white loaf tastes the same as normal white bread

Healthier white bread could be available on supermarket shelves within five years after scientists discovered how to double its fibre content.

A group of scientists has pinpointed the genes responsible for the dietary content of flour.

At present using wheat grain is a problem for distilleries because it causes sticky residues that mean the whole distillery must be shut down for cleaning – so much so that whisky producers tend to import maize into the UK rather than use homegrown wheat.

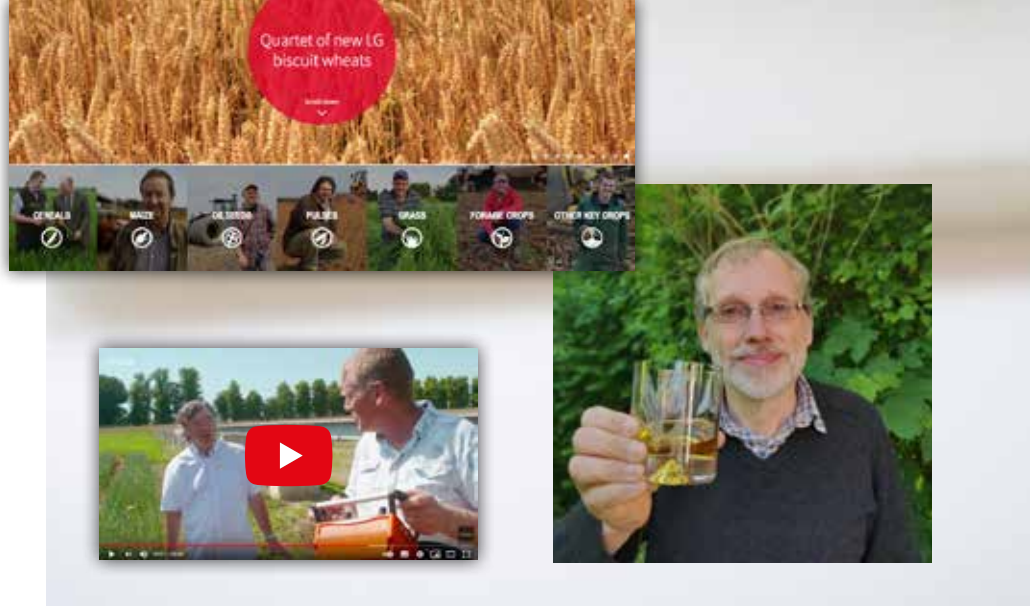
The Rothamsted group behind this finding have a patent on the use of the gene for this application and are now working with plant breeding company Limagrain to develop a new commercial variety.

We also made a splash when we announced findings that despite many preconceptions, white flour is healthier now than it's been in at least 200 years. Not only did the Daily Telegraph run the story, it was also the subject of an editorial by the paper.

But that's not all. We also found that a small addition during bread making unlocks the potential of wholegrain bread, putting it on a par with other 'superfoods'. Working with the University of Reading, we added an enzyme commonly used by the drinks industry to bread, raising levels of micronutrient ferulic acid by more than five times.

Similar circulatory-improving compounds are found in foods such as cocoa, green tea, and red wine, but we hope by improving an everyday food such as bread, it will benefit health more widely. During a clinical trial, participants eating the improved bread saw the same short-term boost to their vascular function as gained from eating a punnet of blueberries.

Our expertise in wheat was also the subject when the BBC's Countryfile came to visit in the summer, when they featured our robot scanalyser. This clever machine spies on the growing crop 24/7 and is helping scientists understand how plants with different combinations of genes perform in the field.



What started as guidance not to travel to the city of Wuhan, had by the end of January, been revised to cover the whole of mainland China. The first two cases were confirmed in the UK at the end of January, rising to 23 by the end of February.

Looking back now, this Rothamsted paper from that month – that suggested most mathematical models of disease control have neglected the people aspect when it comes to disease control measures – seems almost prescient in the wake of several nationwide lockdowns.

THE BIRDS AND THE BEES

But for the time being, it was still business as usual at Rothamsted. As this tweet shows, our staff's thoughts were very firmly fixed on the challenges of making farming more sustainable as they came from across the Institute to participate in the UK's Big Farmland Bird Count.

Likewise, these animations demonstrated the great enthusiasm of our early career researchers that their work contributes to a healthy environment.

Whilst March also saw a study from the Rothamsted Insect Survey of more than 24 million individual insects caught over a period of almost half a century. Comparing 47 years' worth of data collected from 1969 onwards, it showed moth numbers have declined by 31% – however, this long-term downward trend was punctuated by several shorter periods of partial recovery, painting a complicated picture of moth population dynamics.

For aphids, the story is very different, and despite their totals fluctuating wildly from one year to the next, their overall number has remained pretty much constant across the decades.

As Survey Lead, Dr James Bell said, it's unlikely that climate alone is responsible, nor that land use change fully explains why moths are declining in seminatural environments – whereas other pressures, such as light pollution, urbanisation and disturbance, may also play a part.

"The problem of implicating these and other causes with any confidence is the absence of high-quality, long-term, land use and environmental data," he said.

In addition, 2020 saw different aspects of our bee research featuring on both the BBC's *One Show* and Channel Four's *Jimmy's Big Bee Rescue*, whilst Dr Jon Storkey braved torrential rain to introduce 'H is for Hawk' author Helen Macdonald to the wonders of the 164-year-old Park Grass experiment for her TV series *The Hidden Wilds of the Motorway*.

SOCIAL DISTANCING

Despite the difficulties of long-distance relationships, we didn't let Covid-19 stop our important international collaborations in 2020.

Below is a small selection of where we've (virtually) been.

Luxembourg
Along with the Luxembourg Institute of Technology, we've been working on the real time fingerprinting of river catchment sediment sources. Knowing exactly where agricultural run-off has come from is the first step in stopping it.

Finland
Hosted by the British Embassy, Helsinki and Natural Resources Institute Finland (Luke), we took part in a virtual gathering of sustainability experts from the UK and Finland to identify areas for joint future work including adaptation and resilience to Climate Change and developing nature based solutions.

India
The UK Government's Science and Innovation Network organised a virtual mission of Indian scientists to the UK in December 2020. Six leading Rothamsted Scientists took part presenting the latest findings from our research on climate resilient crops, bioengineering, soil health, remote sensing and integrated farming systems and exploring opportunities for future cooperation.

Zimbabwe
In partnership with the international maize and wheat research centre CIMMYT, we are working to reduce the double burden of malnutrition in Zimbabwe with a combination of biofortified maize varieties and adjusted crop management options. More nutritious crops and improved knowledge of crop management practices and soil will enable farmers, and especially women farmers, to make their own choices to improve their family health.

Malaysia
We signed a formal agreement in 2020 with the Malaysian Agricultural Research and Development Institute to develop collaborations in several common areas of research including Smart Crop Protection; Soil Microbiome; Data Science; and Rice and Ecological Engineering.

Australia
Strengthening our strategic partnership with CSIRO, our researchers came together with our Australian colleagues in Brisbane to share the latest research on tracking and forecasting of pests and pathogens. Workshops were also held on improving nutrient use efficiency in grazed systems, genetic improvement of canola vigour and designing the new generation of farming system experiments

Canada

In partnership with the University of Waterloo and Environment Canada, our soil to nutrition programme is looking at soil water-stable aggregate dynamics from field to landscape scale using the world's largest annular flume. These studies will inform land management strategies for sediment control in South West England.

Morocco

The first cohort of African PhD students have now been recruited as part of our partnership with the L'Université Mohammed VI Polytechnique (UM6P) and Cranfield University. Several were unable to return home during the pandemic but nevertheless managed to forge ahead with their projects including looking at soil structure in Moroccan cropping systems and investigating agricultural bioproducts from medicinal and aromatic plants in Uganda.

USA

Supported by Royal Society Grant, a new partnership between Rothamsted and the University of Nebraska, Lincoln has been initiated for coordination of wheat phenotyping technology.

Uruguay

Rothamsted's experience of long-term experiments (LTEs) has been vital to the success of a study examining the sustainability of complex agroecosystems. Palo a Pique LTE has been running for 25 years in Uruguay, and a review published in 2020 evaluated its four pasture–crop rotations under livestock grazing. The results demonstrate that cropping systems reduced soil organic carbon compared with permanent pastures, and that perennial pastures rotating with crops were critical to mitigate these losses. Data from the Palo a Pique LTE has contributed to the establishment of new national policies to secure the sustainability of agricultural-based systems.

Mexico

With our local partners from CIAD Mexico, and seeds supplied by CIMMYT, early or late plantings have been continuing in Sonora to screen for heat tolerant strains of wheat. These will be vital to farmers as our planet warms and potentially tolerant strains have already been identified based on yield.

Ghana

Funded by the GCRF Agritech catalyst seeding award, our scientists worked with UK Companies and the University of Cape Coast and Crops research institute in Ghana to demonstrate and develop innovative products to tackle known agricultural challenges within Africa including a phosphorus field testing kit.

UNLOCKING NEW TRAITS

Designing Future Wheat is a UK cross-institute coordinated programme aimed at the genetic improvement of wheat both in the UK and globally.

- Rothamsted continues to have the central role in field-trial evaluation of pre-breeding wheat germplasm developed by the whole DFW consortium for the 'toolkit' prior to delivery to the breeding community.
- Development of automated phenotyping technology, using both ground-based and drones to identify and quantify multiple traits in wheat.
- Using X-ray CT scanning of field soil cores has shown that soil structure accounts for about 60% of the variation in root number density at depth in soil across a range of varieties, greater than any differences between genotypes suggesting the importance of the soil environment on root behaviour.
- A cross of susceptible wild-rye and a resistant wild-rye is being used to develop a mapping population to identify the genetic basis of rye resistance to take-all which involves re-rooting. This re-rooting trait is not present in wheat.
- Following publication of an article reporting on a molecular toolkit for genome editing applications in plants, more than 30 project leaders from different countries have requested the toolkit components.

By mid-March, COVID had gone from being the subject of international news bulletins to become very real – and very terrifying – for all of us. Rothamsted, like workplaces up and down the country, closed to all but the most essential staff as lab and field work reduced to a minimum.

KEEPING CALM AND CARRYING ON

Once the scale of the pandemic was known, we'd quickly sprung into action to make sure we could maintain business continuity without compromising the safety of our staff. A new cross-Institute task force was formed, and the 'Work Smart, Stay Apart' information campaign was launched to give up-to-the-minute guidance and reassurance to staff on how they could work safely, whether at home, or if necessary, onsite.

Bringing together our health and safety, facilities, administrative and science management staff, it did a sterling effort of ensuring life carried on at (and away from) Rothamsted as best it could.

In addition to issuing very clear, regularly updated guidelines on what staff should and shouldn't do, it also ruled on all and any requests to be present on one of our sites. Looking across all our activities, it ensured critical work that could only be done on site, such as tending to plants or livestock, could continue in the safest ways possible.

We even produced our very own Rothamsted face masks, to ensure staff on site always had access to good quality PPE.

Meanwhile, our staff forced to work from home adapted brilliantly, which involved everything from identifying insects at their kitchen table to appealing to the farming community for help with research that was no longer possible.

Virtual mingles and group quizzes became the order of the day as the Rothamsted community rallied round to keep our collective spirits up.

We also did what we could to assist the combined efforts to fight the disease. With the help of the Royal Navy, we lent out lab equipment to aid in the UK's Covid testing effort, whilst the team behind our Knetminer app turned it into a powerful tool to help researchers find and track rapidly burgeoning scientific knowledge of the disease.

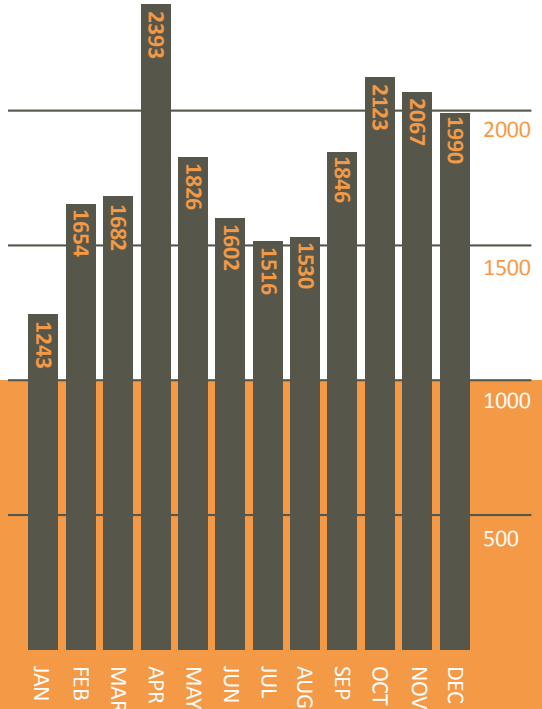
AT THE DOUBLE

Launched in January 2019, the Rothamsted Repository is a digital treasure trove of pretty much everything we've ever published since 1843.

By the end of its first year, it had reached 1000 downloads a month – and as you'll see on the right, downloads were double that throughout much of 2020.

The most downloaded?
They ranged from Fisher's seminal 1926 paper 'The arrangement of field experiments' through to more recent work on GM crops, soil microbes, climate change and phosphorus fertilisers.

In 2020, our staff produced a total of 372 publications – of which 344 were journal articles and 13 were book chapters – and you can see them all here in the Repository.



GREEN MACHINES

The Tailoring Plant Metabolism programme is delivering novel and improved traits in two bespoke crops, camelina and willow, through predictive re-programming of their metabolism. Our goal is to exploit fundamental understanding of plant metabolism to expand the value chains of crops.

- GM and GE field trials were run on two sites, including growing over one million GM camelina plants at Broom's Barn in Suffolk. Also tested, for the first time, was a triple stack of omega-3 fish oils, astaxanthin and herbicide tolerance, the latter demonstrating strong effectiveness for weed control in the field.
- Collaboration and options agreements have been signed between Rothamsted and **Yield10 Biosciences** to work together to develop useful camelina germplasm including the omega-3 trait.
- The research teams can now produce a range of styrene derivatives in seeds, which are useful starting materials to make industrial polymers.
- An efficient pipeline for the production of gene-edited poplar has been established that can be used to study many of the fundamentals of tree biology, as well as for specific research in carbon capture, energy biomass and chemical products.
- The programme identified a novel compound in willow, miyabeacin, as a **potential anti-cancer molecule** and is now seeking further clinical partners to develop this compound as a therapeutic.

'EXCITING'
ANTI-CANCER COMPOUND

Rothamsted scientists, working with cancer biologists at the University of Kent announced in April they had discovered a chemical in willow which kills various cancer cells, including those resistant to other drugs. Of particular excitement is its activity against neuroblastoma, a hard to treat and common childhood cancer where the overall survival rate is below 50%. The newly discovered chemical, miyabeacin, was also effective against several breast, throat and ovarian cancer cell lines.

Rothamsted's Professor Mike Beale, a co-leader of the study said whilst the pharmaceutical activity of salicin, the active ingredient in aspirin, is well known, the pharmacological properties of miyabeacin are potentially even greater.

"Structurally, it contains two salicin groups that give it a potential 'double dose' of anti-inflammatory and anti-blood clotting ability that we associate with aspirin.

"However, our results reporting the activity of miyabeacin against a number of cancer cell lines, including cell lines with acquired drug resistance, adds further evidence for the multi-faceted pharmacology of willow."

Rothamsted Research is home to the UK's National Willow Collection, and in conjunction with the Institute's established expertise in analytical chemistry, Dr Jane Ward, a co-leader of the study, puts the cancer breakthrough down to having 1500 willow species and hybrids available to screen with state of the art techniques.

"Possibly because of the success of aspirin, medicinal assessment of other salicinoids in willow has been mostly neglected by modern science, and the National Willow Collection has proven to be a goldmine of exciting new chemistry, that perhaps underlies its position in ancient therapies." she said.

By spring we'd started to adjust to this strange, new normal – face masks, hand gel, queueing to get into supermarkets, and long periods stuck indoors with only our home baking and Netflix for company. Not to mention the amateur hairdressing and the seemingly endless rounds of video calls. But early summer saw an easing of many lockdown restrictions, leaving many hoping that it would all be over by Christmas...

FOUR SEASONS IN ONE MONTH

If the pandemic wasn't enough, the UK weather certainly had an end of days feel about it.

June started with heavy rain – one of the wettest on record in the West Country, home to our 'farm lab' at North Wyke, whilst the latter part of June brought dramatic thunderstorms, lightning shows, large hail and even funnel clouds across the UK. Throw in a heatwave and a night-time temperature above 20°C in the South, and the month certainly felt like it had it all.

It was certainly a dramatic reminder that the long term warming of the planet and the associated extreme weather events had not gone away just because most of us were stuck indoors.

We've been collecting weather data at our HQ for more than 160 years, and in recognition of our global importance to climate change monitoring, the World Meteorological Organisation has bestowed Centennial Recording Station status upon us.

Rainfall

- 2020 was the second wettest year since records began in 1853.
- August was the wettest August ever recorded with 172.0 mm rainfall.
- Conversely, of the twelve months, five had below average rainfall.

Sunshine

- 2020 was the 9th 'sunniest' year since records began.
- May was the 'sunniest' it's been since sunshine hours records began in September 1890.

Temperature

- The overall mean temperature for the year was above average at 11.1°C (average is 9.80°C).
- The mean maximum temperature of 15.1°C was the highest since records began in 1878.
- The hottest day was the 31st July reaching 34.6°C.

* Average refers to the 30 year mean 1981–2010

THE FOOD WEB

It is no secret farming cannot carry on as it has, but our ASSIST research programme – in partnership with the UK Centre for Ecology and Hydrology – is measuring the contribution of biodiversity and a healthy farm environment to sustainable farming so we can change for the better.

- Carabid beetles are major predators in agro-ecosystems and have been proven to be important for bio-control of pests. An experiment, utilising Rothamsted's new large scale crop rotation experiments, showed responses to crop type varied by species, but **novel subterranean trapping** revealed that both above- and below-ground community appraisal can inform more effectively on appropriate management.
- A paper assessing the effects of sub-lethal insecticide exposure on the predation rates of 12 generalist predators feeding on the aphid *Sitobion avenae* showed the importance of **community diversity** in the resilience of natural pest control following insecticide use.
- Evidence of negative environmental impacts from herbicides and tilling is growing, and herbicide resistance is increasingly prevalent. A review of the current state of **weed ecology** identified how this can be translated into practical weed management, including encouraging the diversity and type of crops and using ecological approaches to weed management.

THEORY OF SOIL

June saw the publication of important new work showing how microbial action influences the structure of soil, with the team behind it developing a hypothesis showing how carbon underpins soil's functions.

In healthy soils, relatively low nitrogen levels limit microbes' ability to utilise carbon compounds, so they excrete them as polymers which act as a kind of 'glue' – creating a porous, interconnected structure **in the soil** which allows water, air, and nutrients to circulate.

Writing in the journal *Scientific Reports*, the researchers revealed that the Victorian-era switch from manure to ammonia and phosphorous based fertilizers has caused microbes to metabolise more carbon, excrete less polymers and fundamentally alter the properties of farmland soils when compared to their original grassland state.

At the aforementioned North Wyke, research published in June showed that emissions of the greenhouse gas nitrous oxide from pasture containing white clover are lower than previously thought – meaning the climate impact of grass-fed cattle herds may be overestimated.

In perhaps the most realistic re-creation of real farming practices to date, the researchers measured emissions from just one herd on the experimental beef and sheep farm – whereas most studies looking at the emissions from livestock arrive at their conclusions by combining data from a variety of experimental systems in addition to some estimated values.

June also saw the SHAKE Climate Change programme announce its **first three investments** – marking the start of an exciting journey for everyone involved. SHAKE is unique in blending an agri-tech incubator programme with unrivalled access to world-class mentoring from both leading academics and experienced entrepreneurs.

SHAKE CLIMATE CHANGE

Glaia

Economad Solutions

Pherosyn

TRACED NUTRIENTS

Our Soil to Nutrition programme is disentangling the complex interactions between the physical, biological and chemical processes that underpin how nutrients get from the soil, via our food, and therefore to us – and asking how we can make this journey more efficient.

- We published a new analysis of what constitutes a good level of soil organic matter based on an organic carbon to clay ratio index. It showed **nearly 40% of arable land in England and Wales is degraded**, which impacts nutrient supplies.
- The microbiome of the soil is vital to its health. A new BBSRC funded consortium project will create a **cryopreserved microbiome** bank from the root zone of important UK crops. The aim is to test the microbiomes from these crops for their ability to contribute to more sustainable agriculture, and as potential sources of useful natural products.
- Our work on the interaction between soil, pasture and animals showed how **nitrous oxide emissions from temperate grazing systems** are regulated as well as assessing the contributions of methane and nitrous oxide from pasture-based beef production systems to global warming.
- Using computer modelled data from the North Wyke Farm Platform, current government advice on how to minimise sediment loss in ruminant farming was assessed, revealing that conventional on-farm measures **do not fully mitigate** the sediment loss to target rates.

Late summer saw repeated – but ultimately futile – attempts to avoid a further national lockdown in England after schools returned and shops, pubs, and restaurants resumed operations. But any prolonged easing of restrictions was rendered impossible when in September, the highly transmissible Alpha variant of the disease arose in Kent.

MOOVING ON UP

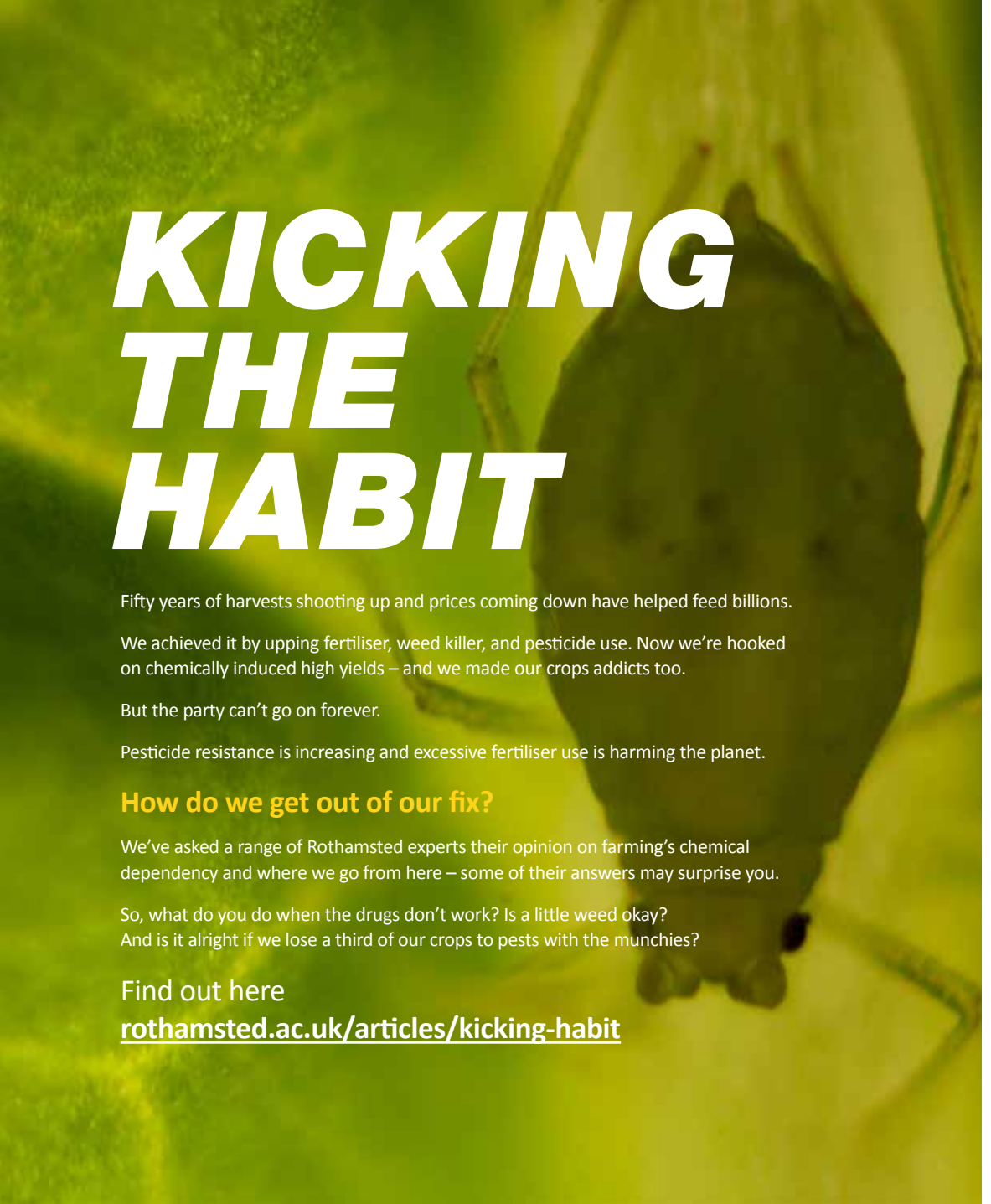
Some good news here at least was when our interim CEO and Director, Professor Angela Karp was given the chance to lead the Institute on a permanent basis. A long time Rothamsted stalwart, her official appointment was greeted with congratulations from the around the world.

We sadly said goodbye to Professor Michael Lee, livestock farming champion and head of our North Wyke site, but our loss was Harper Adams' gain. The 'farm lab' is still in very good hands though as Michael was very ably replaced by Professor Adie Collins, whose research interests span the impact of farming on water quality and pollution, a research area that North Wyke is ideally set up for.

September also saw the release of a sobering report into the carbon-zero readiness of the UK livestock sector. Commissioned by CIEL (Centre for Innovation Excellence in Livestock), and written by environmental, climate and livestock scientists from eight renowned UK research institutions, including Rothamsted Research, the *Net Zero Carbon & UK Livestock Report* identified that the currently available technologies cannot deliver the industry's 2050 carbon emissions reduction goal.

As one report author said:

"Even if all known methods for mitigation of carbon emissions were taken up rapidly, the industry could only deliver 19% of the aspirational carbon reduction target by 2035."



KICKING THE HABIT

Fifty years of harvests shooting up and prices coming down have helped feed billions.

We achieved it by upping fertiliser, weed killer, and pesticide use. Now we're hooked on chemically induced high yields – and we made our crops addicts too.

But the party can't go on forever.

Pesticide resistance is increasing and excessive fertiliser use is harming the planet.

How do we get out of our fix?

We've asked a range of Rothamsted experts their opinion on farming's chemical dependency and where we go from here – some of their answers may surprise you.

So, what do you do when the drugs don't work? Is a little weed okay?
And is it alright if we lose a third of our crops to pests with the munchies?

Find out here
rothamsted.ac.uk/articles/kicking-habit

Whether it's the safety or necessity of pesticides, or the sustainability of inorganic fertilisers, farming's reliance on chemicals has been the subject of heated debate for more than six decades.

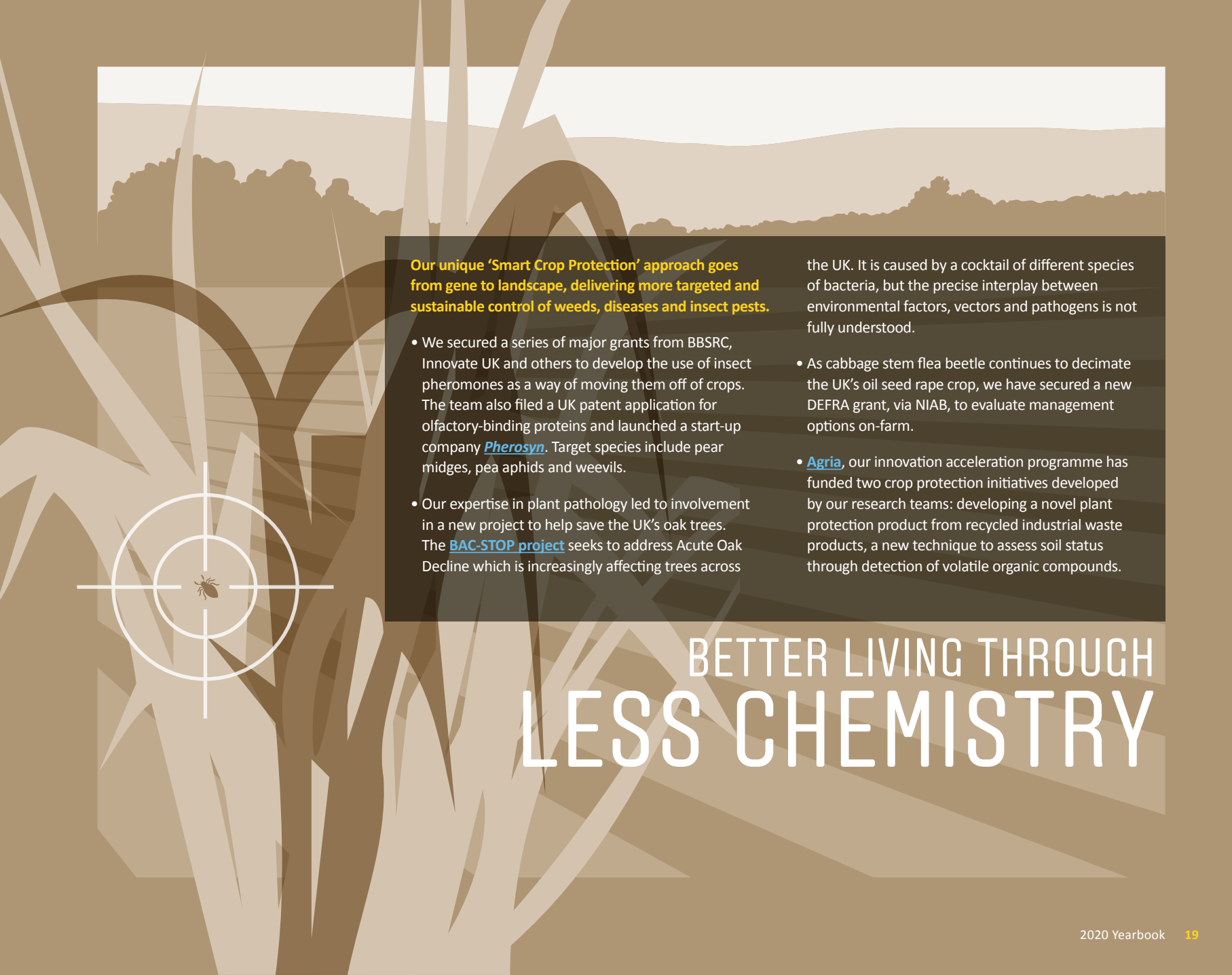
And the argument continues to rumble on, which is why Politico asked Rothamsted's Professor Lin Field to take part in an online debate on the use of pesticides in the EU.

You can watch and decide for yourself – or alternatively, see what our experts think the future of agrichemicals is (left).

We certainly couldn't grow the amount of food we do without them, but that said, decades of inappropriate use have also harmed the environment in myriad ways. This is well illustrated by this research that shows how almost 40% of arable farmland in England and Wales has become degraded through farming practices that revolve around the use of man-made chemicals.

And in many cases, regardless of alternatives or the will to move away from chemicals, we may not have an option. Using mixtures of multiple pesticides is widely employed by farmers to stop resistance arising in weeds, insect pests and diseases. However, a study, led by Rothamsted, showed that one such herbicide mixture strategy employed by farmers, can have the unintentional consequence of promoting more generalist defences.

As Professor Field says, what we need is a smarter approach to 'crop and environment' protection that looks to target the use of less chemicals rather than throw them out altogether.

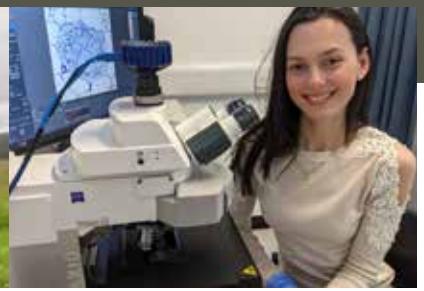


Our unique 'Smart Crop Protection' approach goes from gene to landscape, delivering more targeted and sustainable control of weeds, diseases and insect pests.

- We secured a series of major grants from BBSRC, Innovate UK and others to develop the use of insect pheromones as a way of moving them off of crops. The team also filed a UK patent application for olfactory-binding proteins and launched a start-up company ***Pherosyn***. Target species include pear midges, pea aphids and weevils.
- Our expertise in plant pathology led to involvement in a new project to help save the UK's oak trees. The **BAC-STOP project** seeks to address Acute Oak Decline which is increasingly affecting trees across the UK. It is caused by a cocktail of different species of bacteria, but the precise interplay between environmental factors, vectors and pathogens is not fully understood.
- As cabbage stem flea beetle continues to decimate the UK's oil seed rape crop, we have secured a new DEFRA grant, via NIAB, to evaluate management options on-farm.
- **Agria**, our innovation acceleration programme has funded two crop protection initiatives developed by our research teams: developing a novel plant protection product from recycled industrial waste products, a new technique to assess soil status through detection of volatile organic compounds.

BETTER LIVING THROUGH LESS CHEMISTRY

Threats of localised lockdowns persisted throughout the autumn, to eventually be replaced by a three-tier system of restrictions. When, in early November, it was clear that had failed to halt the rising number of new cases, the dreaded second national lockdown was announced. Any thoughts that it might be all over by Christmas had been replaced by doubts that Christmas would happen at all.



Pushing aside concerns over what the coming months might hold, here at Rothamsted our thoughts were very much on the future – specifically the training of the next generation of scientists.

October saw a further three postdoctoral posts announced as part of our ongoing collaboration with Cranfield University and Mohammed VI Polytechnic University (UM6P).

The capacity building partnership, which was launched in March, is focusing on the delivery of a programme of world-class research and the creation of a Centre for Doctoral Training, supporting the development of African scientists and engineers. The £12m programme currently funds seven collaborative projects being worked on by 10 PhD students and 14 early career researchers.

Similarly, we were one of nine UK universities and research institutes who joined together to create a joint PhD training centre focused on developing the next generation of interdisciplinary food systems experts.

Part of £47.5 million of UK Government funding earmarked to transform the UK's food chains, the £5 million Centre for Doctoral Training is being led from the Natural Resources Institute at the University of Greenwich.

Also, with an eye to the future, the £3.5m Shake Climate Change Programme announced a shortlist of five new companies for investment, including a novel way to convert farm bio-waste into protein using black soldier fly larvae, and a radical approach to growing cotton that reduces inputs of water and nutrients by 80%.

MAKING POLICY
A PRIORITY

Science and agriculture in the UK are undergoing a series of policy changes not seen for a generation. This throws up unique challenges for our scientists in making sure their research remains relevant, impactful and cost-effective.

In 2020 we responded to this rapidly advancing agenda by taking a long hard look at how we influence and respond to policy changes at all levels and across multiple jurisdictions. A new policy group has begun to monitor and share relevant policy developments with staff, working closely with the Director and the grants office to feed into research planning.

"One of the advantages of Rothamsted is that we are seen as an honest broker. We are not trying to push a particular viewpoint but are trying to collate objective evidence and provide neutral, agnostic opinion."

Dr Jon Storkey, Achieving Sustainable Agricultural Systems programme leader

Our policy priorities:

Gene technologies
Post Brexit, the UK government has initiated a public consultation process on the regulation of GM and GE crops. We are feeding directly into this process and working with DEFRA and the media to explore the issues in full.

Crop protection
Current chemical approaches to crop protection are in turmoil as legislators continue to restrict the use of control agents popular with farmers. This is leading to growing pest resistance and increasing consumer demand for more natural solutions. Our unique independent expertise in this field leaves us well placed to inform the debate and influence the development of evidence-based policy.

Sustainable farming futures
The UK is moving away from direct payments to a new farm support system rewarding agricultural practices that enhance the environment. New practical ways of measuring and monitoring environmental benefits will need to be rapidly established. Our long track record of field experiments should provide a valuable resource for developing these metrics.

Climate change
As the UK prepares to host the important UNFCCC COP 26 meeting in November 2021, increased attention is being paid to the greenhouse gas emissions created by farming. Livestock is under particular scrutiny and our expertise in grassland management will provide vital information to the sector as it aims for net zero by 2050.

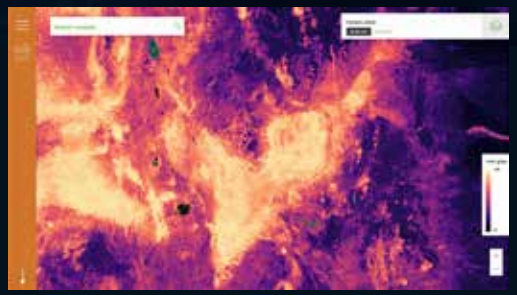
EARTH OBSERVATION

This landmark map charts soil fertility every 30 metres across the whole of Africa, the first time farm-level soil data has been available for an entire continent.

The map has been produced by iSDA, a social enterprise founded by three research institutes – Rothamsted Research, World Agroforestry and the International Institute of Tropical Agriculture.

Their hope is to tackle the major human health challenges caused by food grown in poor quality soil, including the estimated 1.1 million child deaths caused each year by malnutrition.

Armed with highly tailored soil information, they say, sets African farmers on the road to achieving higher yields, producing healthier crops, and earning higher incomes.



BY THE NUMBERS

Rothamsted PhD students

71 STUDENTS 18 COUNTRIES

Rothamsted funding

£10.2m STRATEGIC GRANT

Successful research grants totalling £9.2m started in 2020

BBSRC (strategic funding)	**£10.2m**
BBSRC (other)	**£12.1m**
Other UK Gov	**£2m**
EU	**£0.85m**
Industry	**£1m**
Grants, trusts and charities	**£1.9m**
SHAKE	**£1.1m**
Other	**£2.3m**

ROTHAMSTED RESEARCH

www.rothamsted.ac.uk

Email
comms@rothamsted.ac.uk

Post
Rothamsted Research
Harpenden
Hertfordshire AL5 2JQ
United Kingdom

Phone
+44 (0)1582 763 133

Rothamsted Research receives a total of £22.3m in strategic programme grants from the Biotechnology and Biological Sciences Research Council

UKRI Biotechnology and Biological Sciences Research Council

Yearbook design vincentdesign.co.uk