Scientists unveil bold vision for UK farming

Technical
Science news

Progressive farmers are set to play a key role in introducing innovations with the goal being to eliminate world hunger. *CPM* reports from the launch of Rothamsted Research’s five-year vision.

Tom Allen-Stevens

Just under one hundred new wheat pre-breeding lines, some containing novel traits never seen before on UK farms, will be delivered by scientists to commercial breeders every year for the next five years.

They’ll be fully genotyped, come with comprehensive performance data and will be completely free of intellectual property (IP) restrictions. Back-crossed into commercial breeding lines, the aims are to open up unprecedented genetic diversity in the UK wheat gene pool, introduce a new generation of varieties, and unlock a sizeable step-up in yield, resilience and quality characteristics.

This is just one of a string of pledges made earlier this month by Rothamsted Research as it launched its new five-year vision. These are underpinned by a new investment from BBSRC of £50.9M and will see Rothamsted working with other research institutes to deliver five strategic research programmes for the benefit of farmers.

“Our purpose is to bring together global science and innovation to benefit farmers and communities worldwide, to secure food production and to protect the environment,” says Prof Achim Dobermann, Rothamsted director and chief executive.

He introduced the institute’s three big science portfolios: Superior Crops, Securing Productivity and Future Agri-Food Systems.

Under Superior Crops, research programmes aim to develop seeds with key genetic traits tailored to their cultivation, environment and potential nutritional and industrial value as products.

Great opportunity

One example is the science that has already successfully crafted camelina plants to mimic the nutrient-producing potential of algae, creating the opportunity for crops rich in long chain omega-3 fatty acids, or fish oils. “One tonne of fish oil costs $2000 but a tonne of vegetable oil costs just $800 — that’s a great opportunity,” notes plant biochemist Dr Frederica Theodoulou.

Securing Productivity is about finding smarter ways to control pests, pathogens and weeds more efficiently and sustainably. Rothamsted scientists are hunting for genetic fixes to enable crops to look after themselves better and also for natural microbes to act as allies.

In another branch of the portfolio, agronomists and ecologists are working together to exploit ecosystem services. They’re investigating to what level pest control offered by ladybirds and pollination services provided by bees, for example,

Achim Dobermann’s far-reaching vision aims to benefit farmers and communities worldwide.

can replace agriculture’s technological innovations, such as chemical sprays.

“We don’t want to rely on a single intervention — the so-called silver bullet,” says weed biologist Dr Paul Neve. “We’re using genomic, chemical and environmental elements to influence plant and pest interaction.”

The third portfolio, Future Agri-Food Systems, is about making both arable and livestock farming more efficient and productive. The associated research programmes are also exploring ways of improving soil health and structure, of enhancing biodiversity, of reducing carbon footprints, and of raising the nutritional quality of produce.

The three science portfolios address six bigger challenges (see chart on p49l), explains Achim Dobermann. “In the UK, crop productivity is challenged by increasing biotic threats to plant and animal health, by ▸

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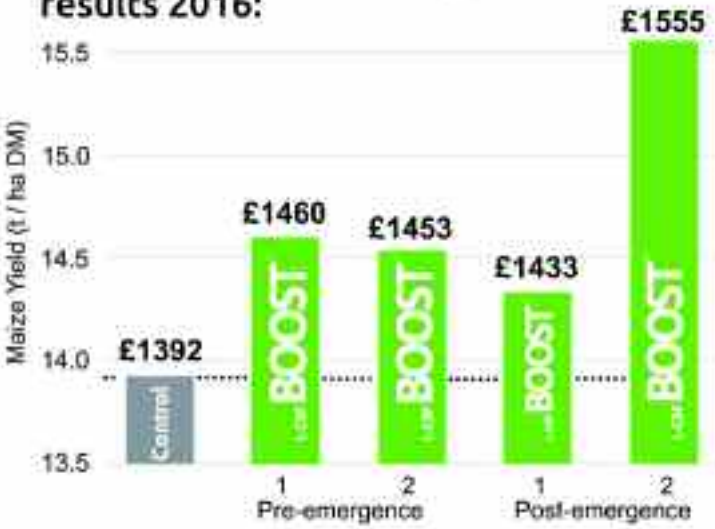

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The yield plateau (Challenge 1) is addressed through Designing Future Wheat — a national collaborative wheat research programme, explains research lead Dr Malcolm Hawkesford. "It involves Rothamsted working with John Innes Centre, Earlham Institute, Institute of Food Research, University of Bristol, EBI, NIAB and University of Nottingham. We're developing and screening novel wheat germplasm for the next generation of key traits which will underpin sustainable and productive agriculture."

With £24M of BBSRC funding, topped up from other sources, the pre-breeding programme brings into the wheat gene pool traits and novel qualities from wheat relatives such as wild goat grass, and germplasm a commercial breeder simply wouldn't have the resources to screen, he says.

It's a step on from Rothamsted's 20:20 programme that incorporated projects such as WISP, Wheat Improvement Strategic Programme. The aim of 20:20 was to deliver wheat with a yield potential of 20t/ha within 20 years. "The difference now is that we're looking at quality aspects and efficiency too. It's a programme strongly focused on germplasm diversity," explains Malcolm Hawkesford.

Wild material

"But one of the problems of doing this is that you're dealing with wild races and landraces that are very difficult to work with. We've looked at the wild material and done the analysis. The lines we pass to commercial breeders are all fully genotyped so they know the genetic markers — it's a toolkit, rather than just a bag of seeds we're handing over." The first 96 pre-breeding lines were supplied last year with the

The germplasm diversity Malcolm Hawkesford is delivering into the UK wheat gene pool should help lift yields of their current plateau.

UK farmers could lead the world in innovation

UK farms could become the test bed for agricultural innovations that will lead the world into a new Green Revolution and potentially eliminate the growing global problems of malnutrition, extreme hunger and extreme poverty. Following Brexit, a policy approach to farming and science that's properly regulated, closely aligned with the EU, but free to choose its own path, "could be of huge interest" to global commercial and public institutes in the quest for innovation.

At the launch of Rothamsted's five-year vision, former Government chief scientist Prof Sir John Beddington, spelled out the "inexorable changes that will happen" and present society with "a moral imperative and a self-interest imperative" to work towards solutions.

"The population of Africa alone will soar over ten years from 1bn to 1.5bn. A greater proportion of this population will move to an urban environment, with 1000 cities the size of Edinburgh created. And climate change will continue — there's a 20-year time delay, so the shifts we're seeing currently result from greenhouse gas levels from the 1990s."

Among society's "enormous challenges" are extreme hunger and malnutrition, he said, with 11.3% of the world's population going undernourished on a daily basis. According to the Worldwatch Institute, more than 3bn people, or 40% of the world's population, are malnourished while the quantity of food produced per capita has been declining since 1984.

"So how do we address this?" asked John Beddington. "Through science and technology, through engaging with politicians and through engaging with industry."

It's now transpiring that UK farms and particularly progressive growers could have a key role to play. Prof Angela Karp, Rothamsted's director for science innovation, engagement and partnerships, says the institute is expanding and extending its approaches to partnerships, innovation and sharing of knowledge "Such engagement is being woven into our science."

She's leading Rothamsted's moves towards "lean science" in which laboratory ideas and anticipated outputs are shared with stakeholders, such as farmers, early in a programme of research. "This new thinking will encourage a more dynamic and responsive approach that is aligned with the needs of users, even pivoting to other ideas when changes of direction are called for," she says.

Following Brexit, there's concern that the UK would be too small an individual market for global chemical companies, for example, to go to the expense of launching new products, starving growers of the tools needed to meet these challenges and opportunities. But a major agchem manufacturer has told *CPM* that, given thecorrect political environment, and with its world-class regulatory system, the UK would be the ideal launch pad for innovations into Europe, and then throughout the world, with UK farms being the test bed for new technology.

The climate of encouraging innovation is currently lacking in Europe, however, Prof Achim Dobermann told *CPM*. "The European Commission doesn't favour innovation as it's very difficult to get a consensus of opinion, so the window of opportunity is often lost. Here in the UK, we are at the forefront of innovation.

Society has a moral and self-interest imperative to find solutions to the enormous challenges it faces from inexorable changes, said John Beddington.

Following Brexit, if we get our policy and legislation right, we will have the perfect environment for a test bed of innovation."

But central to delivering this would be for the UK to retain the current Precautionary Principle that guides how new technologies are introduced and regulated within the EU — an Innovation Principle would sit alongside side it to ensure progress isn't needlessly held back. "We cannot compromise environmental protection, and we need farmers prepared to share the knowledge they glean," notes Achim Dobermann.

"But why should we not be the first country in Europe to implement innovations and support farmers who have a more progressive approach to test how these will work in practice? We already have farmers who do these things but are not rewarded. They will be crucial in delivering what the public wants in terms of delivering natural capital. Can we come up with a policy framework that protects the environment but allows the integration of new technologies onto farms? I'm sure we can."

programme on track to deliver a similar number each year to breeders.

Achieving Agricultural Sustainable Systems (ASSIST), a collaborative programme of research led by Rothamsted Research and the Centre for Ecology and Hydrology (CEH), addresses Challenge 4. ASSIST essentially seeks to take integrated crop management one step further, explains Dr Jonathan Storkey.

Natural capital

"We're looking to weave the environment into increased production — the aim is to integrate natural capital and biodiversity into cropping systems."

Researchers have developed an app that will be launched later this year and allow farmers to enter yields for individual fields direct onto a centrally stored map. "It'll build into a large database so farmers will be able to benchmark performance and we can use the aggregated data to understand the variation in yields."

A network of 25 farms will be set up to explore this variation in more detail. Different levels of in-field biodiversity will be analysed on these farms. "We want to investigate how we can get increased crop benefits from field margins, for example. What's new is that we're quantifying the benefits."

Senior researchers involved in the Rothamsted projects will be available at Cereals on stand 921 where there'll be more information about research projects currently underway. ■

Breeding potential discussed at Cereals

Innovations in plant breeding hold the key for feeding the world is the title of a panel discussion at the Arable Conference at Cereals on Thursday 15 June. Sponsored and chaired by the Oxford Farming Conference, it brings together an expert panel, including Bill Clark (NIAB), Dr Charlie Baxter (Syngenta) and Prof Mike Bevan (John Innes Centre).

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Rothamsted's science portfolios and research challenge

Superior Crops	Securing Productivity	Future Agri-Food Systems
Challenge 1 Accelerate improvements in yield, quality and resource efficiency of wheat and other crops.	**Challenge 3** Monitor and forecast the spread of pests, weeds and diseases in real time.	**Challenge 5** Enable the majority of farmers to achieve at least 80% of the attainable potential.
Challenge 2 Discover or design novel traits that improve the nutritional or industrial value of plants.	**Challenge 4** Combine genetic, chemical, ecological and agronomic strategies for smart crop protection.	**Challenge 6** Create agri-food systems with better performance and nutrient value but lower environmental impact.