



Time for bold Government action on crop genetic research

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Faced with an urgent need to drive improvements in the productivity, resilience and climate impact of British agriculture, leading plant scientist Professor Jane Langdale CBE FRS, University of Oxford, asks why, in its plans for R&D funding, the UK Government seems to be ignoring the most significant factor – crop genetic innovation.

In its recently published [Food Strategy](#), the Government made a number of commitments which, if implemented according to the science, offer renewed hope that Ministers recognise the importance of maintaining a productive and resilient domestic farming sector in the context of major challenges to the global food system.

So, for example, Defra's food plan committed to 'broadly maintain' current levels of domestic food production, and to create a separate Horticulture Strategy for England.

It also pledged to develop a land use strategy by 2023 which, if it follows the three-compartment approach advocated in Henry Dimbleby's original National Food Strategy document '[The Plan](#)', shows a welcome shift in policy emphasis towards the scientific evidence which supports a land-sparing rather than a land-sharing approach as the most efficient way to reconcile competing demands for food production, nature conservation and climate change mitigation.

The Food Strategy also confirmed that the Government will support a Farming Innovation Programme to the tune of £270 million between now and 2029, focused on improving farm-level productivity, sustainability and resilience.

Disappointingly, however, there is still no mention of any long-term vision for targeted R&D investment, and no commitment to a strategic Crop Genetic Innovation Research Fund, as many in the plant breeding and plant science community have advocated. In fact, the longest research grant available under the Farming Innovation Programme appears to be just four years.

In view of the evidence identifying crop genetic innovation as the single biggest driver of productivity gains and emissions reduction in agriculture, and my own review of the UK plant science sector which concluded that major opportunities for crop improvement are being lost due to fragmented and short-term funding tranches, this could turn out to be a catastrophic policy omission on the Government's part.

Access to genetic innovation is more critical than ever. In May 2021, for example, a [study](#) by HFFA Research GmbH concluded that, since 2000, progress in plant breeding has accounted for two-thirds of the productivity gains in UK arable crops. An earlier peer-reviewed [study](#), led by NIAB scientists in 2011, found that for the UK's main cereal crops (wheat and barley), the contribution of genetic improvement to yield gain was closer to 90%.

Indeed, without the contribution of improved varieties over the past 20 years, the HFFA study found that UK crop yields would be 19% lower, and 1.8 million hectares of additional land would be needed in other parts of the world to meet our food needs, placing additional pressure on scarce global resources and causing more than 300 million tonnes of additional GHG emissions.

The HFFA study also highlighted the challenges of maintaining current rates of yield improvement. It underlined the critical importance of access to novel sources of germplasm, and new breeding techniques, with the potential to accelerate the rate of progress in crop innovation.

Alongside the HFFA research, a major review of UK plant science - which I led and authored - reached a very similar set of conclusions.

Published in March 2021, the review - entitled '[UK Plant Science Research Strategy: A Green Roadmap for the next ten years](#)' - included recommendations across a range of areas, from priorities for fundamental research and our national infrastructure through to the training and recruitment needs of tomorrow's plant scientists.

The review also found that the lack of long-term strategic funding, from either public or private sector, to transfer early-stage genetic discoveries from lab to field to farm remains the one of the most significant barriers to future productivity gains.

It is a simple case of market failure. The modest and relatively inelastic income from seed royalties limits commercial plant breeders' ability to invest in more speculative or long-term targets. Because of this, and the lengthy timescales involved, the current system for financing near-market and translational R&D is not working, and opportunities to exploit major advances in our understanding of plant science are being lost.

This gap in the research funding landscape, often termed the 'Valley of Death', was identified in a similar review of UK plant science led by Professor Chris Gilligan for BBSRC more than 17 years ago.

His 2004 review advised that: "BBSRC should take the lead to establish a national plant breeding initiative ... that would promote public good breeding by establishing

crop genetic improvement programmes with the aim of providing improved germplasm and technology for the development of new varieties”.

There is little evidence that the Government really grasps the significance or urgency of this issue. For example, Defra have suggested that the UK’s primary vehicle for bridging the long-recognised gap between early-stage discovery research and its translation into relevant crop backgrounds for use in commercial breeding programmes are the four Genetic Improvement Networks (GINs) covering wheat, oilseed rape, pulses and vegetables.

While valuable as a mechanism for networking between key players along the crop improvement pipeline, the GINs are woefully under-resourced. Defra currently funds the four GINs to the tune of £5.5 million over five years from 2018 to 2023. In other words, £275,000 per GIN per year.

To set that in context, the Government’s flagship Transforming Food Production R&D programme is investing £90 million over four years in digital and precision farming projects such as robotic harvesters, vertical farms, AI and sensor technology.

These agri-tech innovations are incredibly important in driving efficiency improvements, but they will prove to be relatively worthless in the context of a failure to support and enable corresponding gains in genetic potential.

My report on the UK plant science landscape also called for a critical review of the Government’s Agri-Tech Strategy, to investigate whether the multi-million pound investments in the four Innovation Centres have provided value for money, or delivered the kind of step-change gains in agricultural productivity, efficiency and sustainability originally envisaged.

I strongly endorse calls for a more coherent R&D strategy for crop genetic improvement which ensures promising new scientific discoveries have a clear translational pathway into crops and products of value to UK farmers and consumers.

As described earlier, independent studies have shown that crop genetic improvement is the primary driver of productivity gains in agriculture. Future allocation of research funding must reflect that, and a new, long-term Crop Genetic Innovation Research Fund (CGIRF) is urgently needed to bridge this long-recognised gap in R&D investment.

There can be no justification for taxpayer investment in translational and near-market research on digital and precision farming applications to exceed the equivalent spend on crop genetic innovation more than 20-fold.

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