UK Government must deliver on commitments to support plant breeding post-Brexit

BSPB Chairman Dr Richard Summers welcomes the UK Government’s support for continued innovation in plant breeding, including the potential opportunities of new breeding methods developed from genomics research and the selection of varieties adapted to advances in agronomy. However, given the current high level of pan-European trade and research activity in the plant breeding and seeds sector, he warns that failure to secure a seamless regulatory transition on issues such as plant variety rights, variety registration, seed certification and plant health as a result of the Brexit negotiations may jeopardise prospects for investment as well as British growers’ continued access to such advances.

I agree that we must continue to encourage innovation in plant breeding and high quality seed production as a means of ensuring that the UK remains attractive for inward investment. The breeding of innovative varieties is essential to improve a wide range of attributes benefiting farmers, food manufacturers and processors, and more widely to increase the competitiveness of UK agriculture. I appreciate the potential for new varieties to deliver environmental benefits.

The Rt Hon Michael Gove MP
Secretary of State for Environment, Food and Rural Affairs
February 2018

With growth in UK agricultural productivity lagging behind other countries, and Britain’s farmers facing not only a reduction in direct support payments but also the prospect of competing on increasingly open global markets post-Brexit, the need for access to on-farm innovation has never been greater.

In its command paper Health and Harmony: the future for food, farming and the environment in a Green Brexit, DEFRA underlined the importance of agricultural innovation and research in supporting future productivity gains on UK farms, alongside a renewed emphasis on rewarding farmers for public goods such as protecting and enhancing the natural environment.

The consultation singled out the need for Government to encourage more commercial research to drive advances in plant breeding, the latest in a series of positive statements from Environment Secretary Michael Gove and his department about the role of crop genetic innovation in supporting a competitive and sustainable future for UK agriculture.

In a recent letter to BSPB regarding plant breeding and the Brexit negotiations, the Environment Secretary stressed that continued innovation in plant breeding would be essential to attract inward investment, to meet the demands of the UK’s £110 billion food chain, and to increase the competitiveness of British agriculture. He also explicitly recognised the potential for new crop varieties to support his vision of a ‘Green Brexit’ by delivering environmental benefits.
However, future access to advances in crop varieties will depend crucially on maintaining the conditions to support a vibrant, UK-based plant breeding sector. Commercial plant breeding companies provide the only route to market for crop genetic innovation, including the research currently underway in our institutes and universities.

At the same time, many of the plant breeders developing varieties for the British market are not owned or headquartered in the UK. In fact, a very high level of pan-European trade and research activity in plant breeding and seeds supports UK growers’ access to innovation.

Failure to secure regulatory alignment and/or mutual recognition on issues such as plant variety rights, variety registration, seed certification, trade and phytosanitary arrangements, all of which are currently regulated on an EU-wide basis, will inevitably drive up the costs of investing for the UK market alone, potentially impacting the competitiveness of UK crop production.

For BSPB members (as well as our EU counterparts), the requirement is for as frictionless a transition as possible from current to post-Brexit regulatory arrangements, with a focus on the following outcomes:

**Plant Variety Rights (PVR)**
Complete and continued collaboration with the EU PVR system through UK associate membership of CPVO (Community Plant Variety Office).

**Variety registration**
Reciprocal recognition of varieties registered on the UK National List and EU Common Catalogue, allowing EU-registered varieties to be marketed in the UK and vice versa.

**Seed certification**
Mutual recognition of seed produced in the EU and seed produced in the UK and a continuing free market in seed with no tariffs.

**Phytosanitary arrangements**
Agreement on continued free movement of seed between the UK and EU without increased import checks and without a requirement for phytosanitary certificates for moving seed between the UK and EU.

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**Have your say on the RL**

The industry-funded AHDB Recommended List for Cereals and Oilseeds is widely regarded as one of the best systems of independent variety evaluation and recommendation in Europe, if not the world.

BSPB members are major contributors to the AHDB Recommended List (RL). Indeed the scale, quality and technical value of the RL system would not be possible without plant breeders’ input.

BSPB’s total contribution to the RL – including trials and their associated activity together with the statutory fees paid by breeders and in-kind support from BSPB staff and members – amounts to over £2 million per annum, more than matching AHDB’s annual RL expenditure.

One of the strengths of the RL system is that it is subject to regular review to ensure that it continues to be technically relevant and meets the needs of farmers and their customers.

In March, BSPB participated in a ‘look ahead’ workshop hosted by AHDB as part of this review process, alongside other industry partners. The consensus among participants was that the RL continues to provide a valuable and cost-effective service, and enjoys strong support across the industry.

Discussion about possible improvements to the RL system focused on issues such as digital dissemination of data, recognition of new traits and assessing yield stability over time.

In addition, AHDB has launched an on-line survey to collect feedback from across the industry on how the Recommended List is used in variety decisions, which aspects are most valued by users, and how the system could be improved or developed further. Responses to the survey are invited until August 2018. To have your say visit the RL section of the AHDB Cereals and Oilseeds website at www.ahdb.org.uk.
F1 hybrid varieties, which can offer significant advantages in crop performance and quality, have long dominated the commercial production of UK crops such as sugar beet, forage maize and many vegetable crops. Recent breeding advances have now extended the availability of hybrid varieties to include combinable crops such as oilseed rape, barley, wheat and rye.

The benefits of F1 hybrid seed in terms of yield improvement, agronomic performance and consistency of end-use quality are due to the heterosis, or ‘hybrid vigour’, derived in a single season by combining the best characters from two carefully selected parent lines. But if a hybrid crop is grown on again as farm-saved seed it will lose this boost in performance, producing a segregating population with variable offspring, reduced yields and loss of agronomic characters. This is why the law excludes hybrid varieties from the list of crops allowed to be farm-saved.

Plant Breeding Matters asked three leading experts to explain the practical and agronomic risks of using farm-saved seed from hybrid varieties in oilseed rape, barley and rye.

### Oilseed rape

**Dr Rachel Wells, Senior Scientist – Crop Genetics, John Innes Centre**

Conventional oilseed rape varieties are pure inbred lines, selected and self-crossed over at least eight generations to ensure that all resulting plants and their offspring are genetically identical.

While the quality of seed saved from a conventional variety may not be as good as certified seed (because seed germination quality and vigour can be influenced by the seed production environment), the offspring of seed saved from a conventional variety will be genetically identical and show the same quality traits as the parent.

To produce hybrid varieties, two genetically distinct inbred parent lines are crossed to create a heterozygous F1 population containing 50% genetic information from either parent. Because oilseed rape is self-fertile, one parent (the female) is male sterile to prevent pollen production and self-fertilisation. The other parent is male fertile. A number of different male sterility systems exist.

F1 oilseed rape seed is produced by sowing male and female plants in adjacent blocks. Only the female lines are harvested as any seed produced in these blocks will be the result of cross-pollination from the male parent. This system makes the production of hybrid seed more costly compared to conventional seed.

If the correct combination of parents is selected then the resulting F1 hybrid line will display ‘hybrid vigour’, outperforming each of its parent lines with greater uniformity, more predictable and robust performance, and may also have valuable selected traits such as pod shatter resistance.

Unlike conventional inbred varieties, self-pollination of an F1 hybrid variety and subsequent use of the seed will result in an F2 population that segregates for the characters of the parents, with genes controlling key traits mixed in a random assortment within the offspring, very much like we see in humans, with no two, independent offspring being the same.

If farm-saved seed of an F1 hybrid oilseed rape variety is sown as a crop it will produce a non-uniform mix of vigorous plants, weak plants, tall plants, short plants, lodging plants, standing plants, disease susceptible plants and resistant plants all with potentially variable flowering and harvest date requirements. Very different from the uniform F1 variety with all the good quality traits originally selected by the grower!
Barley
Dr Bill Thomas, International Barley Hub and The James Hutton Institute

Like wheat and oats, barley is a self-pollinating cereal with male and female organs in the same flower. In conventional barley varieties the male anthers ripen and shed pollen on the female stigma within each barley flower resulting in an inbred seed.

Hybrid barley seed is produced when this self-pollination process is disrupted allowing the stigma to be fertilised by pollen from a different variety. A natural genetic disruption technique known as cytoplasmic male sterility (CMS) is used to produce a female line which can only be pollinated by non-CMS barley plants.

However, while the seed produced from such a pollination will grow normally, the resulting plants will also be male-sterile because the male-sterile trait is transmitted down the maternal line. In hybrid barley production, dominant nuclear ‘restorer’ genes are therefore used in a male parent to ensure that pollen development proceeds normally in the F1 hybrid, producing a fully fertile plant.

Restorer genes do not exist in current commercial barley varieties and must be introgressed into a contemporary winter barley variety by careful breeding and selection to produce a restorer line. F1 hybrid seed is produced by pollinating a CMS female with the male restorer line so that all F1 plants will be fully fertile.

Importantly, however, the male restorer gene segregates in typical Mendelian fashion across the seeds produced on the F1 plants, and the harvested seed will therefore be a mixture of three fully fertile plants to one male-sterile plant. As a consequence, whilst all seed will germinate normally and produce plants, seed set on the male-sterile plants in a field of farm-saved hybrid barley seed will be far from complete, yield will be vastly reduced and inputs effectively wasted on 25% of the crop.

In addition to the loss of yield due to a halving of the hybrid advantage, a crop of farm-saved seed from an F1 barley hybrid will also segregate for all other characters that differentiate the male and female parent lines.

This means that the crop is likely to exhibit a mixture of agronomic characteristics such as height and disease resistance, and it will look non-uniform, possibly with developmental differences that may make timing of fertilisers and sprays difficult.

Rye
John Burgess, Maize & Hybrid Rye Product Manager, KWS UK Ltd

Traditionally grown as a grain crop and increasingly as a whole-crop substrate for use in biogas plants, rye is suited to a wide range of soil types across the UK and offers important agronomic benefits such as improved black-grass control, moderate input requirements and reduced soil erosion.

However, unlike wheat or barley, rye is a cross-pollinating species which means that it can be more susceptible to poor flowering and pollination leading to variable grain yields and in some cases high incidence of ergot.

Breeders have now overcome this problem by introducing a gene into hybrid rye varieties which significantly increases pollen formation, so ensuring good quality flowering and pollination, resulting in more consistent grain yields and quality.

However, if a hybrid rye crop is grown on again as farm-saved seed, it will lose this boost in performance, producing a segregating population with indeterminate pollination and grain set, as well as increased susceptibility to disease – particularly brown rust.

This can also affect the marketability of the crop. In terms of grain quality, farm-saved hybrid rye is likely to have lower hagbergs and protein content, and a far higher risk of ergot contamination.
**Farmer Focus:** Paul Temple

A former NFU vice-president and now chairman of both AHDB Cereals and Oilseeds and the Voluntary Initiative, Paul Temple is a well-known and influential figure in the farming industry.

A third generation partner in the family business at Wold Farm near Driffield in East Yorkshire, Paul manages 410 hectares in total – mostly tenanted with some farmed on contract.

It is a mixed farming operation on Grade 2, primarily chalky soils including a six-course arable rotation – wheat, oilseed rape, vining peas, grass, rye and cover crops – alongside a commercial beef unit comprising 220 head of Stabiliser suckler cows.

Paul emphasises the importance of genetics in driving the productivity and efficiency of both sides of his farming business.

“Innovation in livestock genetics is supporting productivity improvements in our beef operation, and it is a minor miracle that wheat yields on our thin Wolds soil have increased from 4 tonnes per hectare to more than 10 tonnes per hectare over the past 40 years,” he says.

“Genetic improvement delivered through new wheat varieties has been the single most important factor behind that achievement.”

And Paul believes that unprecedented advances in our scientific understanding of genetics, with the rapid emergence of new marker, sequencing and breeding technologies, make this one of the most exciting times for innovation in global crop and livestock production.

Supported by innovation in digital technology and precision farming, he can see the possibility that 15 tonnes/ha will be an achievable wheat yield on his farm in the not too distant future.

Paul is also passionate about improving soil health and fertility as the foundation for successful crop production, with soil quality at Wold Farm benefiting from livestock manures from the beef operation and neighbouring pig units.

And although he describes himself as a ploughman by nature, Paul is in the process of converting the entire farming operation to a no-till cropping system, persuaded of the long-term economic, environmental and agronomic benefits in terms of improved nutrition, moisture retention, soil structure and reduced input costs.

“More farmers are now taking an active interest in managing their soils rather than just what is happening above the ground, although we still face a major challenge in the lack of soil scientists helping farmers to understand the importance of this vital medium,” he says.

A strong advocate for agricultural innovation, Paul regularly welcomes the public onto his farm to highlight the importance of science and technology in securing a safe, reliable and affordable supply of food. He was a trial grower in the Government’s GM crop Farm Scale Evaluations in the early 2000s, and has often raised concerns that Europe’s farmers are being left behind their counterparts in other parts of the world due to an anti-science culture among EU politicians.

Although he had hoped that Britain would choose to remain in the EU, he is now resigned to Brexit and recognises that crop science is one key area in which leaving the EU may open up more positive opportunities for science-based regulation and enable the UK to exploit its world-class agri-science capabilities and expertise more fully.

Above all, he emphasises the importance of speaking up for agricultural science and its vital role in producing not only the food but also countryside we value and enjoy.

“We need people to understand that the farmed landscape, beautiful as it is, is a man-made environment – every tree and hedge placed there strategically. At the same time, not a single crop grown in Britain is native to this country. All have been adapted to thrive under the UK’s unique growing conditions through the scientific ingenuity and skill of plant breeders.”

“Faced with the prospect of a reduction in production-based support after Brexit, UK farmers’ ability to compete on an increasingly global stage, to produce a secure and affordable food supply, and to care for the countryside for future generations, will depend critically on our ability to access the latest advances in agricultural science and technology.”

“Visiting the international maize and wheat improvement centre at CIMMYT in Mexico recently reinforced two key things: the importance of wheat in global nutrition and the importance of modern breeding techniques to ensure we meet the challenges of changing plant disease, climate and unlock the potential of the crop to feed a growing global population sustainably,” he concludes.
Meet the BSPB team
Olivia Herdman, Farm-Saved Seed Officer

Olivia Herdman joined BSPB as Farm-Saved Seed Officer in December 2017. With a strong focus on communication, her primary responsibility is to optimise the collection of FSS payments – ensuring individual farmers and growers understand their legal obligations on FSS use, highlighting the benefits of supporting investment in UK plant breeding, and seeking continued improvements in the FSS declaration and payment system.

Olivia joins BSPB after working in the travel industry, with a background in project planning and marketing.

A farmer’s daughter and YFC member, Olivia grew up on the family farm in Cambridgeshire, a mixed dairy and arable holding. With such a strong farming background, she is delighted to be back working in an industry she understands and takes an active interest in.

“The farming industry is facing a great deal of uncertainty, but one thing is clear – continued investment in the development of improved crop varieties, bred for our growing conditions and our markets, will be essential to stay competitive and to help the industry cope with new challenges,” says Olivia.

Maintaining and strengthening the FAIR PLAY campaign on farm-saved seed will be a key part of Olivia’s role as Farm-Saved Seed Officer. Through FAIR PLAY, BSPB and the farming unions have joined forces to support continued innovation in plant breeding by optimising the collection of FSS payments from individual farmers.

“Through improved communication, more targeted enforcement and simplified declaration and payment arrangements, the FAIR PLAY campaign has come a long way in ensuring all farmers using farm-saved seed contribute fairly for the benefits of breeding investment and innovation,” explains Olivia.

“FSS payments now account for a third of the total income available to support UK breeding but there is still work to do to deliver 100% compliance. That’s why FAIR PLAY will continue to reinforce the need for all farmers to pay their fair share for the benefits of using farm-saved seed,” she says.

Plant breeding exhibition heads to Parliament

BSPB will showcase plant breeding to MPs and Lords at Westminster this summer. Sponsored by Yorkshire farmer and Conservative MP Julian Sturdy and supported by Defra, the exhibition will run from 18-21 June in the Houses of Parliament.

“Our exhibit will show how plant breeding improves yield, end-use quality and in-field performance of home-grown agricultural and horticultural crops. “As decision-making powers over the future for British agriculture switch from Brussels to Westminster, BSPB is taking every opportunity to ensure UK politicians understand the importance of our plant breeding and seeds sector as the essential foundation for competitive, sustainable agriculture and the starting point in our £110 billion food chain,” explains BSPB chief executive Dr Penny Maplesone.