





Plant Breeding Fit for the Future 12th October 2022

Introduction

The overall aim of the 'Plant Breeding Fit or the Future' conference was to bring together stakeholders across the plant breeding sector and discuss how to develop a sustainable future for agricultural systems. The conference included a series of plenary talks and panel discussions from key industry experts, followed by highly interactive breakout sessions where participants shared their views on the future of plant breeding.

Setting the scene

Tim Benton of Chatham House opened the plenary session with a presentation on the present and future challenges as well as drivers in agriculture. He highlighted how food supply chains are faced with significant challenges due to several factors such as geopolitical events and climate change disruptions. As a result, food systems are driven to become localised with more varied farming systems and diets, lower waste and shorter supply chains. In conclusion of his session, he pinpointed that plant breeding will need to adapt and facilitate such changes in farming systems.

The role and potential of plant breeding

Paul Gosling of AHDB described existing systems in plant breeding – the registration of new varieties, national listing and recommended lists. Strengths and weaknesses of the current system were discussed, as well as challenges and opportunities. The key opportunities identified by Paul, developing or adapting the recommended list, also aligned with Tim's vision with the addition of diversification of production systems, of crops/varieties, supplemented by use of data and technology

The first panel discussion included Bruce Pearce of Garden Organic, Joanna Matthews of Germinal, Jen Bromley of Vertical Future and Paul Gosling, and identified what changes are most urgent to meet the future needs of plant breeding. All panel members echoed the need to address the current lack of diversity and flexibility in variety trials, in particular the lack of on-farm trials and diversity of traits. To deliver this, the panel highlighted that high quality data collection will be a must.

Enabling plant breeding for the future

During the second plenary session, participants had the opportunity to explore potential strategies to future-proof the plant breeding sector. Tom MacMillan of RAU portrayed what the future of UK agriculture could be, hinting at its high potential to be diverse, decentralised and digitalised. He emphasised the present gap in research and development in the UK and the failure to implement innovation on-farm. This example is a clear illustration of a farmer's needs when performing research and development in this sector.

The final panel discussion included Charlotte Allender of UK Vegetable Genebank at the University of Warwick, Kate McEvoy of Real Seeds, Katherine Denby of University of York and Tom MacMillan. The panel members provided insights on the future of plant breeding. One crucial point was how do we identify the much-needed resources to better support plant breeding. This spanned across the entire value chain in plant breeding and includes increasing funding to allow longer term research and collecting data to support high quality research.

Breakout sessions

In the final session participants were divided into four breakout groups to discuss the various aspects of plant breeding. Key takeaways from these sessions are described below.

Mind the Gap

During the "Mind the gap" breakout group, participants agreed there are a number of ingredients required to fast-track plant breeding for a sustainable future.

It was recognised that having a strong and diverse community, from farmers, seed producers to researchers, SMEs, to bakers and chefs would be crucial going forward. Bringing all these actors together to focus on plant breeding could enable a mindset shift, moving away from linear value chains to improved collaborative ways of working together across the value chain. This could be achieved through the creation of a cross-sector network that links or reconfigures networks that already exist in institutions around the country. Examples from elsewhere in the world include the Culinary Breeding Network. A key area that is currently overlooked by plant breeding methodologies is the role of soil, particularly soil health, in plant breeding. A collaboration between stakeholders across the value chain would be important to better understand the relationship between soil and seed.

It was also felt that definition of needs and prioritisation are essential for the sector to move forward. This includes which plant traits to focus on in the future, how sustainability metrics could be used/integrated to improve resilience trade off and balances in policy frameworks and a better understanding of key market demands. A robust database of genetic markers could be developed as it would provide a much-needed resource, not only for plant breeders but across the value chain. Avoiding market failure entails a deep understanding of demand and the economic gains from developing a specific product. Data and big data were also noted as being crucial in the future development of the sector examples include the need to implement robust trialling systems where data can effectively be gathered and analysed.

The long-term availability and reliability of public sector funding dedicated for plant breeding was highlighted by delegates. This includes curation of genetic resources to provide varieties that can better respond to climate change and nature imperatives, as well as undertaking longer term field trials for new varietal development. To advance the UK's plant breeding sector, it was proposed that emulating strategies and methodologies from abroad could yield positive changes. These could include elements from the US system where research is closely interconnected with farmers, university agricultural systems and extension services. For example, the National Institute of Food and Agriculture (NIFA) in the USA operates a Cooperative Extension System (CES), which translates agricultural research into action at a local/regional level by working with end-users. Equally, the European Evaluation Networks (EVA) were also recognised to provide a suitable model for collaboration in the plant breeding sector. The EVA for Plant Genetic Resources and Agriculture (PGRFA) promotes public-private partnerships to utilise, improve and develop PGRFA in Europe.

Optimising Performance

The "Optimising performance" session assessed what can be done to support resilience in plant breeding and how a pipeline can be characterised to support such a system.

Within the resilience topic, stakeholders unanimously agreed that diverse plant varieties are needed now more than ever. Such varieties will not only have to tolerate but thrive in an ever-changing climate, be resistant to new pests and diseases, recover fast and be socially and financially sustainable. However, to develop new plant varieties, dependable data tools, empirical testing and a better understanding of plant resilience are needed. Alongside a risk management strategy that will encourage and support the implementation of new plant varieties.

It was also recognised that having access to key data such as gene bank collections or sequencing data is of high importance. With unrestricted access, the plant breeding community will develop a deeper understanding of traits regarding genetic components, heritability and ultimately futureproof plant varieties.

In conclusion of the session, stakeholders focused on the next steps and what should be implemented. An approach to funding streams that accommodates long-term research is needed but requires more refining to support a system that creates value. In order to enable greater plant diversity for the future, a novel way of tailoring good breeding to smaller, more niche applications is needed and it would entail a greater farmer and grower involvement.

Quick wins and long shots

The "Quick wins and long shots" group discussed how we can support and incentivise plant breeding, both today and for the future.

The effective use of data was a key focus of the discussion and one of the main ways that the plant breeding sector could be supported in the future. It was felt that existing data needs to be collated and served up to a range of users in an easy to access manner, whilst new data needs to be gathered in a coordinated way. For example, more data could be gathered from recommended list trials using a standardized system which would better allow modelling and prediction of phenotypes/traits.

This group also identified traits that would be important to increase resilience to climate change and adapt to new farming systems. These include resilience to drought and flooding in addition to adaptation to low till, no till and low input systems. The importance of involving farmers and agronomists in the early stages of trait selection and breeding was highlighted, alongside making available the range of data currently collected as part of the recommend list trials. Breeding for new traits could be achieved by testing existing varieties, particularly for CEA traits, and the process may be accelerated through speed breeding.

The final observation was that there needs to be greater connectivity between existing networks and stakeholders in the plant breeding community. This includes fostering a relationship between plant breeders and end-users such as farmers and supermarkets.

Future Landscapes

The aim of the "Future landscapes" breakout group was to compare a population-based approach to plant breeding with the current varieties system. Initial conversations focused on the definition of populations and varieties, including where seed mixtures would be classified and how genetically different individuals need to be from one another to form different populations.

The benefit of using populations was considered to be that they provide an adaptive system that is more resilient to stress with a stable yield. However, large manufacturers or processors require a product with low variation, which is a barrier to the wider use of populations. Additionally, the yield of populations is often lower than for varieties and current regulations prevent the commercial use of populations in plant breeding.

There was disagreement within the breakout group as to what role populations could play in the future of plant breeding. Some felt that populations would not be commercially viable due to their lack of uniformity, while others thought they could be used in high-value markets and to diversify growing systems. It was concluded that an evidence base needs to be built to understand how populations can be used more widely. More generally, it was felt there is a need to grow more diverse crops with more diverse systems and using populations for plant breeding could support this.

Conclusions and next steps

To develop a more diverse and resilient plant breeding system, stakeholders identified essential key areas in need of consideration to drive forward the sector:

- Greater collaboration across the whole plant breeding value chain. This includes increasing understanding of farmers' needs and dissemination/sharing academic resources.
- There needs to be better use, collection and collation of high-quality data to support the development of resilient plant varieties suitable for more diverse systems.
- More public and private funding is needed to support pre-competitive research in this sector, particularly allowing the characterization of genetic resources and long-term trials.
- Greater understanding of market needs and market pulls across the supply chain are required to target future R&D efforts.
- A greater diversity of crops, varieties and traits is needed to drive sustainable agriculture.

In order to achieve this progression in plant breeding, we have identified some key actions for CHAP, the Soil Association and the wider plant breeding sector:

- Develop organisational responses to the Plant Varieties and Seed Strategy call from Defra based on conference outcomes.
- Publish outcomes to increase reach and build a larger network of interested parties.
- Develop ideas for potential pilot projects across the sector for example:
 - Investigating how more data can be gathered from recommended list trials using a standardised system, which would allow better modelling and prediction of phenotypes/traits.
 - Assessing how current technology can assist farmer led field trial evaluation.
 - Prioritization of new traits to evaluate in existing varieties across a range of sectors (incl. arable, field veg, CEA).
 - Field research to better understand the value of populations in plant breeding.
 - Enhancing the use and maintenance of genetic resource collections.