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BBSRC contributes to



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Crop Science Initiative Projects

A genetic system to study resistance to the soil-borne pathogen *Verticillium dahliae* in strawberry
Simpson, D; East Malling Research

A trait-led approach which exploits natural variation in seed vigour to enhance crop establishment
Finch-Savage, W; University of Warwick

Accelerating breeding for biomass yield in short rotation coppice willow by exploiting knowledge of shoot development in *Arabidopsis*
Karp, A; Rothamsted Research: Leyser, O; University of York

Adding Value to the UK *Brassica* Crop Science Community (AdvAB)
King, G; Rothamsted Research: Ostergaard, L; John Innes Centre: Pink, D; University of Warwick

Development of multi-parent advanced intercross populations for fine mapping QTL in wheat
Mackay, I; NIAB: Snape, J; John Innes Centre

Enhancing resistance to existing and emerging insect pests of UK cereals
Gatehouse, A; Newcastle University: Gatehouse, J; Durham University: Weaver, R; FERA

Enhancing wheat field performance and response to abiotic stress with novel growth-regulatory alleles.
Boulton M; John Innes Centre: Phillips, A; Rothamsted Research

Exploitation of genomic knowledge for sustainable resistance to the crop pest, *Globodera pallida*
Urwin, P; University of Leeds

Exploiting eIF4E-based and associated broad-spectrum recessive resistance to potyviruses in dicots and monocots
Kanyuka, K; Rothamsted Research: Walsh, J; University of Warwick

Exploiting the *Phytophthora infestans* genome to identify gene targets for sustainable potato protection
Birch, P; SCRI: van West, P; University of Aberdeen

Mapping and analysis of genetic loci controlling quality traits in broccoli
Buchanan-Wollaston, V; University of Warwick

Optimising wheat grain shape and size for improved processing quality
Campbell, G; University of Manchester: Dickinson, H; University of Oxford: Waugh, R; SCRI: Scott, R; University of Bath: Shewry, P; Rothamsted Research: Snape, J; John Innes Centre

Pre-Breeding at NIAB - *Ppd* alleles and markers, QTL for earliness per se and novel variation from synthetic wheat useful to UK/EU wheat improvement
Greenland, A; NIAB: Laurie, D; John Innes Centre

SIROtyping : siRNA and miRNA profiles of tomato and barley
Baulcombe, D; University of Cambridge: Manning, K; University of Warwick

The establishment and application of a forward genetic resource for the development of efficient breeding strategies in grass and cereals
King, I; IBERS: Ramsay, L; SCRI: Snape, J; John Innes Centre

The potential to control insects and other organisms antagonistic to wheat by the up regulation of hydroxamic acids.
Pickett, J; Rothamsted Research

The Smart Carbohydrate Centre
Powell, W; NIAB: Smith, A; John Innes Centre

Tools for modifying chromosome pairing and recombination during breeding
Moore, G; John Innes Centre

Crop Science Initiative

In 2007 BBSRC committed over £13M to support excellent plant science research that is aimed at solving the practical problems faced by plant breeding and agriculture.



The Crop Science Initiative funded 18 projects across the UK, with the aim of applying the principles of sustainable development to future crop production. The projects have harnessed the potential of genetics to sustain crop yields, combat pests and diseases and improve the range of products – all the while reducing negative environmental impacts. The projects have focused on a range of crops from strawberry and broccoli to wheat and barley.

Economic growth

It is vital that we harness our excellent science base to ensure that UK research can drive economic growth and social development. The Crop Science Initiative had the aim of facilitating the collaboration and transfer of knowledge and expertise between the academic research base and end-users such as plant breeders. The short examples in this pamphlet highlight just some of the successes arising from the initiative.

Insect pests

Insect pests cause serious losses to crop yields, both through eating the plant and by spreading virus diseases. Pesticides can control insect pests but are expensive and can have negative environmental impacts.



While commercial wheat is able to defend against some insects, there are others to which it is very susceptible. The cereal aphid, *Stibio avenae*, and the wheat bulb fly are particularly damaging. Researchers have found genes buried in the complex wheat genome that could make wheat plants resistant to these pests. This knowledge can now be used in conventional breeding to create pest-resistant wheat that will require less pesticide during cultivation.

Wild relatives of commercial wheat varieties use a very effective chemical defence against aphid attacks – they produce compounds called benzoxazinones that repel the insects. Researchers have found that modern wheat varieties have lost most of this ancestral defence ability. These findings can be used to help breeders to enhance aphid resistance.

Resistance

Late blight is a devastating disease of potatoes and tomatoes costing industry £5-6Bn a year worldwide. Researchers have developed a new approach to breeding resistance to the mould-like organism, *Phytophthora infestans*, which causes this disease. Other research will look for naturally occurring blight resistance in potatoes and further explore the genetics of *Phytophthora infestans* infection.



Research has uncovered the genetic basis of remarkable broad-spectrum resistance to a viral disease of leafy and arable *Brassica* crops, including broccoli, cauliflower, cabbage, kale, swede and oilseed rape.

A patent is pending for the novel basis of the resistance and molecular markers are being used to speed up breeding resistant plant lines in collaboration with Syngenta Seeds. The resistance will increase the yields, quality and reliability of crops. Syngenta is now using this information to

breed durable resistance to turnip mosaic virus (a very important pathogen of *Brassica* crops) into Chinese Cabbage and hopes to introduce this trait into other *Brassica* crops in the future.

Better seeds

About 5 million tonnes of wheat grain are milled every year in the UK to produce flour. The success of the milling depends on many factors such as grain size, shape and topology – in particular the size and shape of the crease that runs down the length of each grain. Researchers have now identified some of the genes responsible for grain size and shape and plan to use this information to develop wheat varieties that have better milling yield and quality.



Cereal grains are a source of starch that is used for a huge variety of purposes – directly as food, in processed food and drinks, and in the manufacture of glue, paper, cosmetics and biodegradable packaging. Each use requires a different sort of starch but the UK varieties of wheat and barley currently have very little diversity for starch properties. By working with end-users, researchers have identified and characterised new genetic variation for starch properties in barley and wheat. They have produced 'pre-breeding' barley plants with new sorts of starches, from which commercial varieties can be bred.

Resources

The time of flowering of wheat can have a big effect on the eventual yield. Working with the British Wheat Breeders' Group, researchers have created lines of wheat that are nearly identical apart from their flowering time – this will allow them to create 'pre-breeding' varieties that can be used by breeders to create high-yielding wheat.

Modern crop breeding regularly uses genetic fingerprinting to identify traits such as drought tolerance in breeding populations. The bottleneck of this process is matching a fingerprint to a trait. Researchers are developing a new method – called MAGIC – that will increase the precision of this matching in winter wheat.

Making experimental resources and information accessible to other researchers and end-users is vital to ensuring research can have maximum impact. The AdVAB project has been involved in efforts to ensure that information underpinning *Brassica* breeding is available and useful. Deliverables include: establishment of *Brassica* data curation pipelines; setting nomenclature standards and development and distribution of experimental materials. This has helped the UK to remain a major international leader in *Brassica* research.



Researchers have analysed the grass genome and have used comparisons with rice to allow the transfer of information from grass to other monocots such as wheat and barley. The work will allow breeders to use knowledge gained in one species to develop effective breeding programmes in others.