Kew's growth strategy: hybrid crops without the genetic modification

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- Sustainable Agriculture [1]

Plan to crossbreed crops with their wild cousins to help boost resistance to climate change

British researchers are leading an unprecedented global project to track down and store wild relatives of common crops – to help breed hybrids with higher yields that could be resistant to the effects of climate change.

Crossing staple crops such as wheat, potatoes and rice with their wild cousins offers a natural, safe alternative to the genetic modification of plants in the lab, according to experts at the Royal Botanic Gardens in Kew, which is behind the scheme.

A report by researchers at Kew found that so-called "crop wild relatives" offer a badly neglected "treasure trove" of genetic information that, if harnessed properly, could boost agricultural production and be worth up to £128bn to the global economy.

But global stocks of crop wild relatives are woefully low and many species are close to extinction, with aubergine, potato, apple, sunflower and carrot varieties most at risk, the report found.

More than half the 455 known crop wild relatives of the world's 29 most-consumed food plants have either not been collected at all, or are badly under-represented, making it essential to build stocks as soon as possible, warns Jonas Mueller, of the Kew Millennium Seed Bank.

"Now that we have identified the gaps the next step is to collect them and make them accessible for agricultural research. We know the climate will change but we don't know how. So we don't yet know how it will affect the crops that have been bred in the past specifically for the climate of today," said Dr Mueller.

"It can take 15 to 20 years to breed a new crop variety, so every year we delay has a knock-on effect. It is a matter of urgency," he added.

Locating and storing the crops will begin this summer in Italy, Cyprus and Portugal. It is a huge task that in many cases is easier said than done. Many crops lie in conflict-ridden regions such as Pakistan and Sudan, where wars can put both the species and the collectors at risk.

Some wild relatives of the faba bean – better known in this country as the broad bean – are found only in war-torn Syria and are a particular cause for concern. Bolivia, China, Ecuador, Ethiopia, India, Kenya, Mexico, Mozambique, Australia and the US also have large numbers of priority crop wild relatives that need to be collected and stored.

Britain could benefit tremendously from an injection of wild genes as its widely grown crops of conventional wheat, potatoes, barley, carrots, sugar cane and apples face an increasingly unpredictable climate.

A new generation of wild-domesticated crop hybrids could be more resistant to floods, droughts and extreme temperatures, using a technology which many scientists say is better understood and more effective than genetic modification. Ruth Eastwood, of Kew's Millennium Seed Bank, said the procedure could potentially be safer than GM because their similar genetic backgrounds meant there was a "lower likelihood of unexpected interactions between genes". "It certainly is another option that has proved to be effective already," she said.

Andy Jarvis, of the International Centre for Tropical Agriculture in Colombia, also involved in the project, said: "Crop wild relatives are a potential treasure trove of useful characteristics that scientists can put to good use for making agriculture more resilient and improving the livelihoods of millions of people."

Kew's global 10-year programme with Germany's Global Diversity Trust to identify and plug gaps in wild relative stocks is unprecedented.

Britain is also playing a leading role in the science. In May, the National Institute of Agricultural Botany in Cambridge claimed to have developed a new type of wheat that could increase its productivity by 30 per cent. It did this by recreating the original rare cross between an ancient wheat and wild grass species that happened in the Middle East 10,000 years ago, to form a "synthetic" wheat that can be crossed with modern UK varieties.

Advocates of plant breeding with crop wild relatives, which has been going on for decades, say it is a much safer and more effective way of improving plant yields than the fledgling process of genetic modification, which the Government is promoting in the face of an effective ban in Europe.

Success stories include a nutritionally enhanced variety of broccoli which contains higher levels of glucoraphanin, thought to slow down the progress of skin cancer.

An analysis of Kew's research by the financial consultants PricewaterhouseCoopers estimates that commercial crops that have already benefited from the input of crop wild relatives will generate a total of £44bn in their lifetimes. This would rise to £128bn if the technique boosted the yield, disease resistance, and tolerance to temperature, drought and flooding of the world's 32 most-consumed crops.

Ms Eastwood said: "Adapting agriculture to climate change is one of the most urgent challenges of our time. Crop wild relatives are already being used to improve our food crops right now and are extremely valuable economically as well. But they are underutilitised."

The project team first identified all known wild relatives of the world's most important crops. It then spent two years scouring gene banks, dried plant collections and museums to determine stock levels and gather data on sightings in the wild. From the data, the team identified species that are a high priority for collection.

Mr Mueller said: "Kew recognises that GM technologies have the potential to make a positive contribution to human wellbeing, through helping to increase the production of more nutritious food with fewer environmentally damaging inputs. Kew engages with partners around the world who are involved in the genetic modification of plants for the good of humanity and the environment. At the same time, Kew also recognises that genetic modification is not a "magic bullet"; it is just another tool that can be used in the effort to achieve sustainable food security."

The report comes a week after the UK Government announced plans to invest £160m setting up centres for innovation in sustainable farming and bringing new agricultural technologies to market.
The 29 crops: What's involved?

The 29 crops covered in the project are: African rice, alfalfa, apple, eggplant (aubergine), bambara groundnut, banana, barley, wheat, lima bean (butter bean), carrot, chickpea, common bean, cowpea, faba bean (broad bean), finger millet, grasspea, lentil, oat, pea, pearl millet, pigeon pea, plantain, potato, rice, rye, sorghum, sunflower, sweet potato and vetch.
Early winners: potatoes and wheat

The breeding of staples with their "crop wild relatives" (CWRs) has already proved beneficial.

Late blight is one of the most damaging diseases for potatoes: its negative economic impact is thought to be $3.5bn per year in developed countries alone. Resistance to the condition in current European potato varieties has been exclusively derived from CWRs. Varieties of potato with

CWR-derived late-blight resistance, such as the C88 potato, are also being introduced into China. In one study, it was estimated that CWR-derived resistance was responsible for preventing the loss of approximately 30 per cent of the annual yield, where conditions for blight were prevalent.

Wheat varieties such as Veery have benefited from the introduction of genes from rye, a relative of wheat. The beneficial traits inherited include tolerance to extremes of temperature and drought conditions, as well as resistance to a variety of diseases such as wheat rust. These wheat varieties have had a significant impact in the developing world, as well as in developed-world markets such as the US.

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