

The concept on crispr system

[Science](#), [Biology](#)



If you are unfamiliar with the ' CRISPR-Cas9' system, it is the revolutionary technique discovered in bacteria (E. Coli) which they use to defend themselves against invading viruses. It works by the specific targeting of viral DNA and cleaves at determined locations, previously invading viral pathogens can be recognised, analogous to human immune system.

Scientists isolated the process and are now able to use it to cause specific changes in target organism genomes, including plants. These changes can be destructive or creative. This means genes, which control organisms' traits, can be silenced, turned up/down or even create new functions.

Many previously unknown gene functions have been elucidated, and even new genes have been discovered with CRISPR. The diverse functionality of CRISPR, in theory and proven in practice, allows scientists to remove negative traits in plants such as susceptibility to disease (often due to current breeding techniques which reduces genetic variation). Creation of beneficial genes or increasing effect of target genes can improve yield, nutrition and resistance of plants. Products of CRISPR edited plants include; disease and drought-resistant corn, canola oil with increased nutritional value, herbicide-resistant soybeans, and gluten-free wheat.

Genetic changes via CRISPR can take 7-8 years to be achieved by normal breeding techniques used in agriculture. Given adequate time and funding, the possibilities of improvements in modern plant cultivations are immense. However, due to the nature of these technologies there are many risks. The CRISPR system is far from perfect, but remarkable improvements in fidelity and accuracy of the system has occurred over the last few years with research focused on its development. An example of beneficial use of CRISPR

system in plants is genetically manipulating rice grains to alleviate vitamin A deficiencies of children, which causes blindness in an estimated 250, 000-500, 000 children, and is responsible for 1-2 million deaths each year. The 'golden rice' is enriched in beta-carotene, a vitamin A precursor, which provides over half of the recommended daily vitamin A intake and has been determined safe to eat by the FDA. With the looming threat of climate change, 'climate-smart' crops are considered essential by many to maintain food security and potentially reduce emissions. The thale cress (*Arabidopsis*) for example was genetically modified to improve water retention in its leaves. Experimentally, 54-57% of the modified plants survived 12 days of simulated drought conditions, and all normal, non-edited plants died.

CRISPR plants show great potential but are still highly debated. The introduction of foreign DNA elements into plants, especially from viruses and bacteria, is highly controversial and is illegal to do so in America. The real risk of the CRISPR editing technique is the potential for undetected off-target effects resulting in possibly weakened plant strains. It is important to note that breeders often treat their crops with mutagens to produce random mutations in the genome to attempt to create, by chance, a more resilient, improved strain. Comparatively, the CRISPR system is more specific than traditional plant breeding techniques.

Genetic alterations of any nature, in any organism often raise the question, should we do it just because we can do it? This is a huge matter of discussion in worldwide governmental bodies, including Ireland. Currently, there are discrepancies as to what the USDA and the EU consider a genetically

modified organism (GMO). In America, CRISPR modified plants are not considered GMOs, whereas in Europe they are, and they also legally must be labelled as such. Governmental rulings constrain the potential research that can be carried out with stringent regulations, but this may be necessary as the CRIPSR system, and gene editing as a whole is a relatively new process, yet to be perfected. The future of this technology remains unclear, but what is clear is that much more research and discussion is needed.