Introduction

Gene-editing techniques enable the production of plants with improved traits, such as resilience to environmental stress and pest pressure or greater yields and food products with extend shelf-life and enhanced nutritional properties. These and other applications also contribute to environmental management and industrial processing to offset pollution and create products such as biofuels.

Conventional plant breeding processes are extremely time and resource-intensive due to long breeding cycles and time taken to reproduce desired traits. This breeding takes many years and a lot of research funding to accomplish, and represents a significant issue given the ever present need to address issues associated with climate change and food security.

Gene-editing is a promising tool as it speeds up the breeding process by allowing plant breeders to target and adjust specific DNA sequences and achieve desired traits immediately. It is just one example of the kind of new breeding techniques (NBTs) that are needed to speed up the breeding process by improving precision and efficiency, and solve some of the world's most pressing health, environmental and food production issues.

Australia's current regulations are unclear and act as a deterrent to critical investment in research, development and the ability to commercialise products from techniques such as gene-editing. This has a global impact by limiting access to and the application of these agronomically, environmental, and socially valuable technologies.

Gene editing in global policy

Biotechnology continues to gain momentum as a major focus for the world's policy makers. Over the past four years, several countries including Argentina, Brazil, Chile, Colombia, Israel Paraguay and the US, have clarified the regulatory status of gene-edited crops and their products, with those that do not incorporate foreign DNA currently regulated as conventional plants with no additional restrictions.

More recently, some of Australia's major trading partners, such as China, and competitor nations, including Russia and Canada, have also indicated interest in considering policy changes related to gene editing and products derived from NBTs.

For plant breeders and technology developers, research and development (R&D) of NBTs with agricultural applications is possible but for the most part, economically unfeasible. The primary constraint for the R&D and commercialisation of products from these techniques is the regulatory and cost hurdles associated with assessment and registration processes.

Gene technology regulations should promote innovation and industry growth and ensure Australia's farmers have access to safe, innovative, modern agricultural tools to support the production of safe and nutritious food, feed and fibre, and environmental sustainability.

Case Study – Heart-healthy Tomatoes, Japan

In late 2020, Japanese start-up, Sanatech Seed, was granted approval by Japanese regulators for the commercial release of a new tomato variety with enhanced nutritional properties. The tomato was gene-edited to increase the accumulation of the naturally occurring amino acid, Hamma-AminoButryric Acid (GABA), which promotes health and has nutritional benefits for treating metabolic disorders and reducing blood pressure and stress. GABA is also involved in stress-tolerance and is reported to be highly involved in plant-pest interactions, meaning it also has production benefits for farmers and home-gardeners.

The improved variety, called 'Sicilian Rouge High GABA', was produced from the 'Sicilian Rouge', a conventionally bred variety already popular with Japanese consumers.

Set for release in May 2021, the Sicilian Rouge High GABA tomato will be the world's first direct consumption gene-edited tomato and is reported to be the first of several other new varieties under development with enhanced nutritional benefits. It will initially be available for free to 5,000 home-gardeners who subscribed to take part in the pilot program. A complimentary education program with consumers and the community will also be rolled out prior to the major commercial release which is expected in 2022.

Widespread government-led marketing campaigns in Japan to educate consumers about the difference between genetically modified organisms (GMOs) and gene-edited crops, means that there is a higher level of understanding and acceptance of these products than in other parts of the world. This means strong consumer acceptance is predicted however, the start-up will closely monitor consumer sentiment and satisfaction with the tomatoes prior to major commercial release.

The Sicilian Rouge High GABA tomato took over 15 years to produce, with more rapid advances only occurring following the development of CRISPR/Cas9 in 2012. Commercialisation was only viable because in 2019 Japanese regulators removed unnecessary regulations and provided clarity on gene-edited plants and their products where they are developed comparably to natural processes of genetic mutation.

Similar to the US, Japan has voluntary labelling requirements for gene-edited foods and the Sicilian Rouge High GABA tomato seedlings and fruit will reportedly be voluntarily labelled by Sanatech Seed and participating growers as being produced with gene editing technology to promote transparency and consumer choice.

The approval of this tomato is a huge step forward for plant science in Japan and promotes ongoing R&D and development of improved processes and products that not only add to the suite of tools available to growers for sustainable production but enhance consumer choice and access to nutritious produce.