



PLANT
SYNBIO
AUSTRALIA

TRANSFORMING
AGRICULTURE AND
BIOMANUFACTURING
THROUGH PLANT
SYNTHETIC BIOLOGY

Synthetic Gene Circuits for plant innovation



plantsynbio.au

Inspired by the design principles of electronic circuits, synthetic gene circuits integrate modular genetic components into functional networks, letting us engineer precise, programmable responses in plants.

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Programmable biology for next-generation agriculture

Synthetic gene circuits represent a transformative approach in modern biotechnology, enabling precise control over biological systems within living cells.

By engineering modular genetic networks that sense inputs and produce defined outputs, this technology allows researchers and innovators to program biological behaviour with unprecedented accuracy.

The benefits of synthetic gene circuits include:

- **Modular genetic design**
 - Assembly of standardised, interchangeable genetic components
 - Flexible circuit design adaptable across organisms and applications
 - Rapid prototyping and optimisation of biological functions
- **Programmable biological functions**
 - Input-responsive systems that detect and process biological signals
 - Controlled output generation for precise cellular responses
 - Tunable system behaviour for customised performance
- **Advanced circuit architectures**
 - Multi-layered and hierarchical circuit integration
 - Multi-input decision-making for complex environmental sensing
 - Dynamic feedback control and regulatory loops
 - Signal amplification for enhanced sensitivity and precision

Applications in plant systems

The implementation of synthetic gene circuits in plants unlocks new possibilities for understanding and engineering plant. By embedding programmable control systems into

plant genomes, the Plant SynBio Australia - Australian National University team can precisely manipulate how plants perceive and respond to their environment.

This capability enables:

- Fine-tuned regulation of stress sensing and response pathways
- Development of crops with improved resilience to environmental challenges
- Customisation of plant traits for enhanced performance and productivity

Research and translation opportunities

Synthetic gene circuits provide a versatile platform bridging fundamental research and applied innovation:

- Investigate complex signalling pathways in plant systems
- Develop tailored biological responses to environmental stimuli
- Enable translational outcomes in agriculture and biotechnology
- Support industry partnerships in crop improvement and sustainability

By combining modularity, scalability and programmable control, these systems empower both academic and commercial users to accelerate discovery and deployment.

Why it matters

As global agriculture faces increasing pressure from climate change and resource constraints, innovative solutions are essential. Synthetic gene circuits offer a next-generation toolkit to engineer crops that are not only more resilient, but also more adaptable and efficient.

This technology represents a shift from passive observation of biological systems to active design and control, enabling a future where plant performance can be precisely tailored to meet real-world challenges.

Capabilities:

- High-throughput single-cell screening powered by FACS.
- Circuit design, engineering and customisation expertise.
- Client-centric method development workflows customised for specific applications.

Find out more or partner with us

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