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Delivery of developmental regulators to whole plants for the induction of genetically altered meristematic tissue (Dr. Voytas)

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Category
Agriculture & Veterinary/Ag Biotechnology

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Research out of the Voytas Lab provides a method for the creation of genetically-altered seeds within one generation via the induction of new plant meristems.

The bottle-neck of gene editing in plants: a slow process in a fast changing industry

The ability to genetically alter plants to add desirable traits or relevant resistances is an incredibly powerful tool in commercial agriculture and basic research. However, the process for doing so is both lengthy and technically challenging. Current protocols use sterile tissue culture of plant cells, which is not possible in many plant species and calls for technical expertise and instrumentation. Plant cells that are successfully altered must be grown for months to form a new, mature plant and obtain seed for subsequent planting. New work coming out of the Voytas lab at the University of Minnesota has created a method to bypass these limitations. The lab induced novel meristems (plant stem cells) on existing plants in the presence of gene editing reagents, resulting in the formation of genetically altered shoots. By allowing these shoots to mature to seed, it's possible to harvest seed months faster than current methods without needing tissue culture.

Getting genetic technology in agriculture "up to speed"

This technology is the combination of three innovations: (1) the identification of developmental regulator combinations that induce shoot meristem formation, (2) a method for delivery of regulators to whole plants and (3) a strategy for co-delivery of regulators and gene editing reagents in a transient expression system. Different combinations of developmental regulators (i.e. WUS, STM, MPΔ), produced growths/plantlets in species where it has been challenging, including agriculturally relevant crops. Two unique methods for the delivery of regulators to plants were developed, AgroBest treatment of seedlings and direct injection into trimmed plants, the latter of which does not require sterile tissue culture. The availability of these two methods provides flexibility and optimization for varying situations. Bringing this technology one step further, the researchers devised a transient expression system to simultaneously introduce the genome editing tools and the developmental regulators. Using a non-integrating vector makes it possible to create plants that are gene-edited but not transgenic, relieving regulatory burdens for commercial crops and increasing customer adoption. Compared to the current methods of genetically engineering plants and harvesting seed, this approach is faster, simpler, and increases the number of species it's possible to modify.

Phase of Development

- Proof of concept. Experiments have shown the ability to use this method to genetically alter multiple plants (including agriculturally relevant crop species).

Benefits

- **Saves time:** Removes multiple steps in the process, providing the ability to acquire genetically engineered seed months faster.
- **Requires fewer technical resources:** Does away with the need for sterile tissue culture, removing the requirement for sterile facilities, technical expertise, and lengthy periods of time.
- **Relieves regulatory burdens and increases potential customer base:** Use of non-integrating vector makes it possible to create genetically edited plants and seeds that are non-transgenic.
- **Increases the variety of plants that can be genetically altered:** Flexibility in the process facilitates editing of both monocot and dicot plants, including those that have been refractory to previous editing technologies.

Features

- Developmental gene combinations for the induction of new meristems on a variety of plants
- Agrobest and direct injection delivery protocols for introduction of genetic engineering tools to plants
- Transient expression system that contains both developmental regulators and gene editing reagents
- No requirement for sterile tissue culture techniques

Applications

- Commercial genetic engineering of a wide variety of plants
- Basic plant research
- High throughput production of edited plants

Researchers

Daniel Voytas, PhD

Professor, Department of Genetics, Cell Biology and Development

External Link (cbs.umn.edu)

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