In silico farming drives next wave in agriculture

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Using plants as sensors for the environment is helping farmers and even countries adapt to climate change

Precision agriculture came sharply into focus in July with the US House of Representatives passing a bill designed to boost farmers' adoption of digital technologies.

To ensure farms can operate the Internet of Things—self driving machinery, drones, and sensors—the Precision Agriculture Connectivity Act recommends setting up a task force to promote broadband internet service across 95% of agricultural land. Also in July, Canadian fertilizer giant Nutrien, of Saskatoon, paid $63 million to acquire Agrible, a company with a weather and agronomy prediction platform to help farmers plan using real-time information. But despite the potential to boost yields, reduce environmental impacts and adjust to climate change, agriculture has so far lagged behind other sectors in adopting machine learning and other advanced digital technologies.

Farmers are starting to embrace satellite and aerial imaging and soil and pest biosensors, however, to manage their farms. On a bigger scale, computer simulations of entire agricultural ecosystems are transforming how nations and large corporations make decisions that will ultimately affect food security. At the Sensors in Food and Agriculture conference held in Norwich, UK, the convergence of new technologies and data gathering systems was on display.

Crop imaging by drones is by far the most active area in precision agriculture, says conference organizer Michael Brand, a director of Captum Capital. "That technology is developing a life of its own," he says, Although drones carrying optical sensors drones have yet to prove cost-effective, many companies are aiming to change that. One of them, Hummingbird Technologies of London, combines drone-based image capture with multiple data sources, including satellite imagery. The data are analyzed by machine learning algorithms to provide crop monitoring and management services. The company received $4.1 million in March from the European Space Agency, Sir James Dyson, and Velcourt, a Ledbury, UK-based farm management corporation.

The Swiss company Gamaya, a spinoff from the École polytechnique fédérale de Lausanne, takes a similar approach but uses hyperspectral imaging to capture many bands of electromagnetic radiation in the visible and infrared portions of the spectrum. This allows it to collect data about diseases and water and nutrient levels that ordinary cameras can't detect.

Acoustic emissions can provide different types of information, including about what's going on below the surface. A team of researchers from the French National Institute for Agricultural Research and ETH Zurich developed a sound sensor to track root growth and earthworm burrowing in maize fields and how those biomechanical processes

Sangamo poised for CAR-T_{reg} race

Sangamo Therapeutics is set to expand its cell and gene therapy pipeline through the acquisition of Valbonne, France-based TxCell for €72 million ($84.5 million). If Sangamo's plans to initiate clinical trials in 2019 of TxCell's immunotherapy product TX200—which uses engineered regulatory T (T_{reg}) cells—are successful, then this will be the first therapy of this kind to enter the clinic. TX200 is based on the same chimeric antigen receptor (CAR) technology used to produce antigen-specific T cells for the spectacularly successful CAR-T therapies for treating B-cell malignancies. Whereas CAR-T engineers cytotoxic T cells to destroy target cells, CAR-T_{reg} cells protect the target from immune attack and so could be useful in treating autoimmune disease and transplant rejection. TX200 targets HLA-A2, an antigen that is commonly mismatched in transplantation procedures. The anticipated clinical trial will investigate the potential of TX200 to prevent graft rejection in kidney transplants. Results from preclinical studies suggest that human HLA-A2 CAR-T_{reg} cells inhibit graft rejection in a mouse model without disrupting the normal suppressive actions of endogenous T_{reg} cells (*J. Clinical Invest.* **126,** 1413–1424, 2016). Sangamo intends to use its expertise in zinc finger nuclease gene-editing technology to develop next-generation CAR-T_{reg} therapies to improve persistence and safety, and to use different target antigens to investigate CAR-T_{reg} cells in multiple sclerosis and Crohn's disease. But given the side effects and huge costs developers have incurred to bring anticancer CAR-T therapies to market (*Nat. Biotechnol.* **36,** 291–292, 2018) the company will likely have to overcome even greater hurdles to move CAR-T_{reg} cells into patients with non-life-threatening disorders, which will also require larger clinical trials.

"If we're not careful, that kid might grow up to be a … hedge fund manager. Do we really want that?" George D. Yancopoulos and Leonard S. Schleifer, principals at Regeneron, argue that the real healthcare crisis is not drug prices, but the lack of support for innovative science and lack of incentives to bring young talent into the field. (*Forbes,* 31 July 2018)

"There's a tendency for committees, including ours, to go for the surer bet, the thing we know will add to the knowledge base or make improvements. We're trying to do something different," says Jeremy Farrar, Director at Wellcome, the UK charitable foundation, which recently announced a £250 million ($333.5 million) "Blue Sky" fund for ideas too risky to attract funding. (*BioCentury,* 9 July 2018)