UNIVERSITY of GUELPH

RESEARCH

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Precision agriculture

Dairy cows at the Livestock Research and Innovation Centre at Elora are outfitted with wireless collars that precisely monitor their activities.

Precision agriculture is based on pinpoint accuracy in crop and livestock production. It's key to feeding our growing population, helping farmers be as productive and environmentally and economically sustainable as possible while ensuring the food supply remains safe and wholesome.

In fact, precision agriculture is shaping the future of Canadian agriculture. And researchers at the University of Guelph — Canada's food university — are at the forefront of the field.

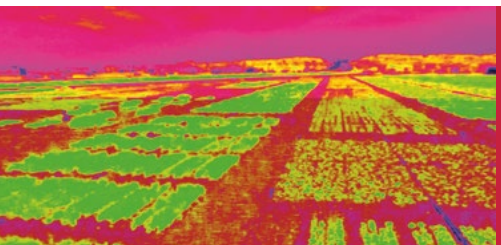
In crops, precision agriculture is seen in the closely managed use of inputs such as fertilizer and pesticides. It's guided by site-specific data gathered through advanced technology such as aerial drones and satellite mapping. Such data help farmers determine the exact placement and amount of inputs required, reducing waste and exposure and lessening their environmental impact.

On the livestock side, an example of precision agriculture is the identification and development of lines of livestock with naturally high immune response to disease — animals that are healthier and more productive and that require less veterinary attention.

Precision agriculture also includes DNA barcoding. Among its many attributes, DNA barcoding offers a way to rapidly identify invasive species that could devastate the agricultural sector.

A central feature of precision agriculture research at Guelph is the unique and unparalleled integration of a wide range of disciplines and skills, combined with huge advances in generating and gathering data.

The following pages illustrate ways in which Guelph is embracing precision agriculture.



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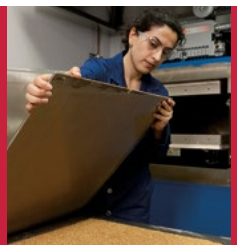

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PHOTO: SPARK

DNA barcoding casts new light on pest management

Invasive pests such as the brown marmorated stinkbug can damage a variety of agricultural crops. DNA barcoding, an identification technology based on genetic information, allows Guelph researchers to identify and catalogue pest species. DNA barcoding could lead to the development of rapid on-farm identification tools such as a smart phone app to help producers determine best management strategies.

A high-tech dairy barn for a high-tech industry

A $25-million investment in the Livestock Research Innovation Centre — Dairy Facility is giving researchers unprecedented opportunities to study animal welfare, productivity and renewable energy using innovative technology. The centre, which houses 300 dairy cows, provides a multitude of resources, including a computerized feeding system that uses Bluetooth technology to track production throughout the cow's lifecycle.

How genes influence methane emission

Methane is the second most prevalent greenhouse gas contributing to global climate change. Cows are blamed for part of the world's methane emissions. Guelph researchers are studying the genetics of low methane-producing cows in order to select for environment-friendly livestock.

Poultry virus defence only a spray away

Improving poultry's resistance to airborne, fecal and oral viruses can help limit the spread of disease. Using pathogen-associated molecular patterns (PAMPs) in a targeted spray that quickly triggers immune responses, researchers can help protect animals from an outbreak. Researchers are also looking to expand the use of PAMPs to other animal species.

Breaking down milk to prevent diabetes

One-quarter of Canadians are either diabetic or at risk of becoming diabetic. Those who consume more dairy are less likely to develop insulin resistance, which can lead to Type 2 diabetes (T2D). That's why Guelph researchers are identifying precise milk components such as galactose (a simple sugar) that may lead to the development of milk products used to help prevent T2D.

Handheld device spots disease

A handheld device called GryphSens, developed by a Guelph engineer, allows producers to evaluate cow health faster and easier than before. The device detects low but significant levels of metabolic disease indicators in the blood. Acting on these indicators quickly could help reduce complications and speed up recovery from disease.

Toward a booming biomaterials sector

The global biomaterials sector is on the upswing, and Guelph researchers are developing innovative biomaterial products and ideas. They already have a superb track record, having developed coffee pods from biodegradable materials and storage bins from natural plant fibres. They're identifying and testing agricultural biomaterials that hold commercialization promise such as switch grass, wheat straw and oat hulls.

PHOTO: BIOPRODUCTS DISCOVERY & DEVELOPMENT CENTRE

Automated system helps crop production

Automatic wireless sensor networks technology is helping producers improve soil irrigation and fertilization. The sensors measure changing levels of water, fertilizer and other components in soil. The information is sent through a wireless network to an automated system that triggers irrigation or fertilizing equipment appropriately. The sensors will be field tested across Canada this fall.

PHOTO: HIGHEYE AERIAL IMAGING INC.

Canada's first national dairy database

Guelph researchers are at the forefront of Canada's first national dairy study, involving more than 1,300 farmers from across the country. Data provided by those farmers will be presented as an online, publicly accessible, interactive database on topics such as farm management practices and demographics, farm animal care and biosecurity practices. The database will allow producers to compare their farms with Canadian benchmarks.

Automatic system for counting pests

Management systems that identify and count insects with images taken from inside field traps could help producers remotely monitor for pests. Researchers are exploring a potential automatic detection system based on "deep learning," a computer framework for extracting specific information from complex data. The system will classify the pests by analyzing the images from the trap and learning selective insect features such as wing structure, colour and shape measurements, without requiring previously entered information.

Math models predict swine disease

Porcine Reproductive and Respiratory Syndrome (PRRS) is a highly contagious pig disease that threatens swine herd populations. Infectious disease modelling uses mathematical models to estimate the effect of control and prevention strategies in PRRS outbreaks. Using these types of models, researchers aim to investigate risk-based surveillance methods to help the swine industry detect new cases of PRRS earlier, preventing large outbreaks.

Improving dairy cow feed

Dietary manipulation could help reduce cattle methane emissions that have been shown to affect the environment. Using mathematical models of dairy cow digestive and metabolic systems, a team of Guelph researchers is studying the effect of grass diets on methane emissions and nitrogen excretion in cattle. This research could yield a feed that meets the nutritional needs of animals during milk production without compromising environmental health standards.

Computer program simulates disease outbreak

Guelph researchers have helped design the North American Animal Disease Spread Model. By entering various scenarios into a computer, researchers model the effects of moving animals on and off the farm and the changing characteristics of a disease to simulate patterns of an outbreak. With this technology, they can act to prevent an outbreak, or react quickly and accurately if an outbreak happens.

Monitoring mastitis with robotics

Mastitis causes inflammation in the udder tissue of cows. It's painful for livestock and expensive for producers, who must take infected animals out of production and treat them with antibiotics until their udders recover. Researchers are using robotic sensors to gather and analyze large sets of data that show infection patterns within a dairy herd. This data will help detect mastitis, prevent transmission and reduce the use of antibiotics.

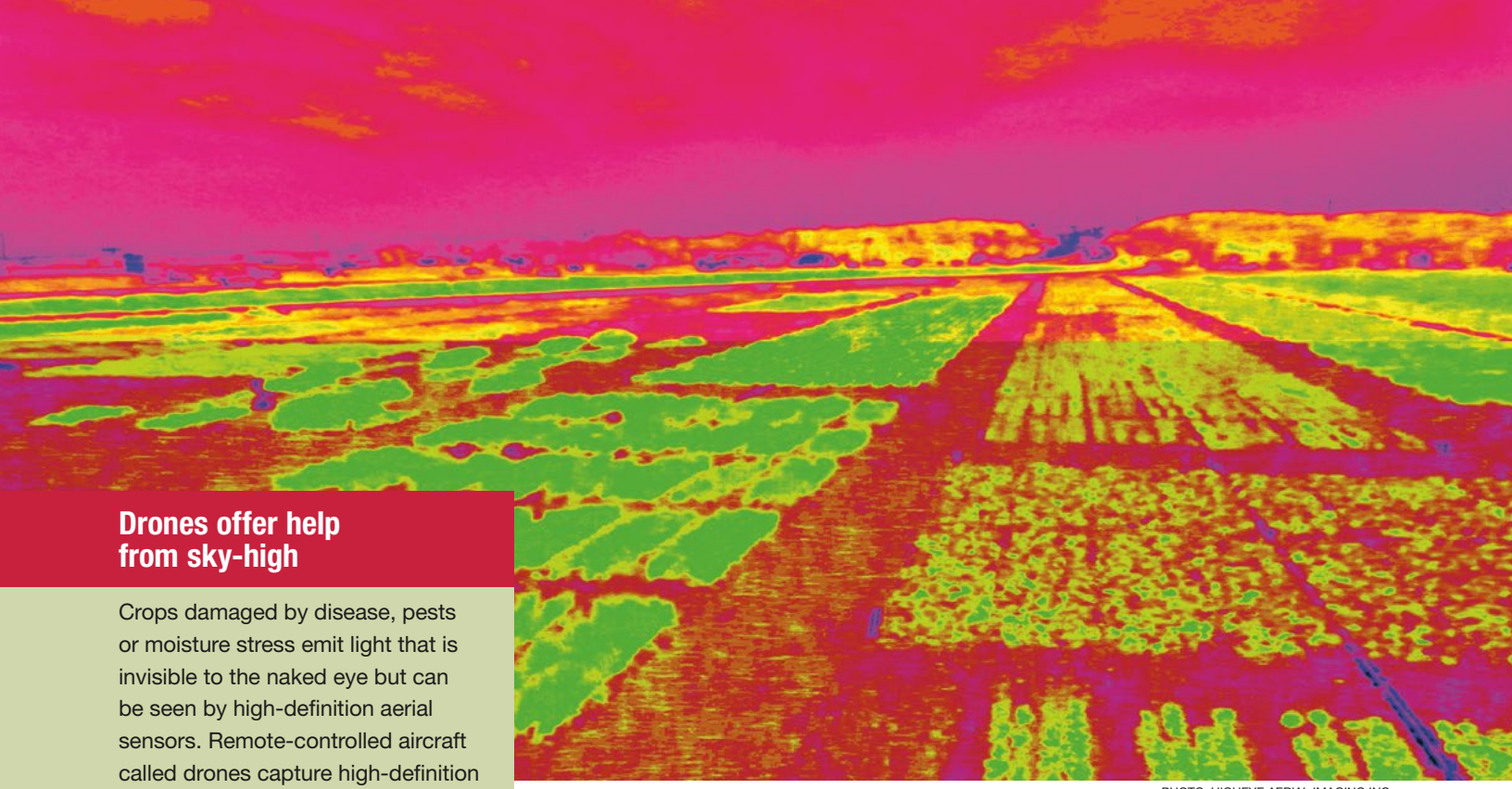

PHOTO: HIGHEYE AERIAL IMAGING INC.

Drones offer help from sky-high

Crops damaged by disease, pests or moisture stress emit light that is invisible to the naked eye but can be seen by high-definition aerial sensors. Remote-controlled aircraft called drones capture high-definition images of the infrared rays associated with damaged crops, allowing producers to act quickly to mitigate the damage. Research teams at Guelph are also using drones to gather data that will improve pesticide and fertilizer use by identifying areas in fields that are lacking in nutrients or threatened by pests.

Making crop selection easier with data management technology

Selecting the best crop variety is an essential decision for producers. But it can be difficult when crop performance data is scattered across different manufacturer websites. Guelph researchers are developing a user-friendly data management system (web-based and mobile applications) to collect and more easily compare performance data. Using these tools, producers will have easy access to important crop variety recommendations and information such as yield, disease resistance and growth rate—all in one place.

Soil sensors help researchers measure water quality

Almost half of Ontario's municipalities depend on groundwater for drinking—and groundwater can be influenced by agricultural practices far away. Researchers are using soil water sensors to determine water content and water flow in soil. Water volume and movement detected by the sensors are analyzed to precisely observe how certain environmental conditions (such as heavy precipitation) influence content and flow. Further, water content is sampled for contaminants such as pesticides, which may have travelled through the soil with the water.

Database connects aquaculture industry

A new online database called the Asian Aquaculture Feed Formulation Database is intended to improve the efficiency of small- and large-scale aquaculture feed manufacturers around the globe. It provides nutritional specifications for 20-plus aquatic species, as well as detailed information on the nutritive value of about 300 feed ingredients. Aquaculture is the world's fastest growing form of animal production, and Asia contributes the bulk of global production. Feed is the most important expense for aquaculture producers, and improving cost-effectiveness of aquaculture feeds is critical.

Better and more efficient beef starts with good genes

Beneficial cattle traits are being identified through genomic technologies that analyze features such as cattle DNA, proteins, phenotypes (physical traits) and specific mutations within genes. By understanding the processes genes undergo to create phenotypes, Guelph researchers are discovering which genes lead to economically important characteristics such as meat quality and feed efficiency. Understanding how genes are expressed and regulated in the body can allow producers to select the highest quality cattle.

COVER PHOTO: D3 IMPACT

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Compiled by Alaina Osborne and Joanne Pearce,
Students Promoting Awareness of Research Knowledge (SPARK)
Editorial Coordination: Owen Roberts and Liz Snyder
Design and Layout: Gareth Lind, LINDdesign.ca
For more information on any of these stories,
contact lsnyder@uoguelph.ca.