HORTICULTURE

A serious effort

Cannabis growers are adopting the high standards of the consumer-product industry to meet regulatory requirements.

BY BRIAN OWENS

For years, the popular image of cannabis growers has been scruffy hippies getting high on their own supply in a disorganized underground economy, rather than shiny white industrial agriculture facilities. Even larger-scale operations involved minimal quality control or lacked formal record keeping.

But as legal medical — and increasingly, recreational — cannabis becomes more widespread, the cannabis industry is becoming more professional. By adopting the methods and rigour of plant science and analytical chemistry, it is ensuring that it can produce safe, consistent and high-quality products for a fast-growing and lucrative market.

"As the industry has gotten bigger, they realized they must transition to use modern horticultural science," says Youbin Zheng, a horticulture researcher at the University of Guelph, Canada, who works with cannabis companies.

Although small-scale growers of illicit cannabis can get away with vague descriptions of strains and considerable variation between batches, commercial producers have to meet the same standards as they would for other consumer products. They need to produce a reliable product and follow the stringent rules and regulations that apply to product labelling and safety in their country.

Many of the challenges of large-scale cannabis production can be solved by drawing on the experience of the commercial greenhouse industry, says Zheng. Growing crops commercially requires a homogenous soil and consistent irrigation. Small variations can mean that parts of the crop dry out at different rates, which leads to the spread of pathogenic agents and root rot, and to an inconsistent product. But the tomato industry, for example, has experience of growing tens to hundreds of hectares of produce at a time, and that expertise can be transferred easily to cannabis growers, says Zheng.

"Cannabis is just another crop," he says. "The commercial flower and vegetable industries have been working on the same problems for many years, and they have the technology already."

But other issues are unique to cannabis production. And achieving the most efficient production requires growers to do research under controlled conditions to understand how both plant genetics and growing conditions can affect the product.

Zheng's laboratory is one of many that are working with cannabis producers to support and guide this effort. He is studying how the amount and wavelength of light used in growing can affect the plant's cannabinoid composition. Increasing the amount of ultraviolet light, for example, can increase levels of tetrahydrocannabinol (THC), the main psychoactive component of cannabis. "We want to create a lighting recipe which will help producers get a consistent product," he says.

Cannabis companies are quickly adopting techniques and technologies that were pioneered by commercial agriculture and horticulturalists. Organigram, a cannabis producer in Moncton, Canada, stringently controls its growing operations, says Jeff Purcell, vice-president of operations. "The growing environment is standardized, and we have full control over the air, light, temperature and fertilizer," he says. "It's all highly automated and computer controlled."

Organigram's operation is in stark contrast to the image of an illicit farm hidden in the woods. It is entirely indoors, with 52 identical growing rooms on three floors. Plants are propagated by cloning, rather than grown from seed, so the crop's genetic identity remains the same from generation to generation. The growers track and log all growing parameters, and then tweak them as needed to maintain consistency. Purcell sees the company's operation as a 'manufacturing facility', rather than a garden or a greenhouse. "There are quality checks like you would see in any manufacturing facility, whether it was producing food or tyres," he says.

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The large-scale, controlled environment enables Organigram to conduct systematic, controlled trials and to produce huge amounts of data — with 5 cycles of growth per year in each of the growing rooms, it can generate more than 250 generations' worth of growing data each year, says Purcell. The company can use those data to determine what works best for the plants, and then replicate those conditions at scale. "That's the big difference with the black market," he says. "When you scale up, you have to take a data-driven approach."

To run these advanced facilities, cannabis companies need researchers who are experienced in plant science, microbiology, chemistry and other scientific disciplines — and they are turning to academia to find them. "Instead of underground growers, they are hiring lots of university-educated and trained people," says Zheng.

ORGANIGRAM INC.

Many of his postgraduate students, he says, receive job offers from cannabis companies before they have even completed their studies. Zheng will begin teaching a cannabis production class for undergraduates at the University of Guelph in January 2020, and several colleges in North America already offer courses designed to provide skilled workers to the industry. In April, the first 24 students graduated from an 8-month cannabis production course at Niagara College Canada in Niagara-on-the-Lake. That course, intended for students who already have a diploma or degree in plant science, focuses on how to grow cannabis and the surrounding regulations. Bill MacDonald, a plant scientist and the programme's coordinator, says that the graduates were snapped up by industry.

TESTING, TESTING

Besides the challenges of growing a sufficient amount of high-quality cannabis for a rapidly growing market, cannabis companies have to deal with something that illegal growers do not — government regulation.

"For a product to be sold in most US states, it has to be tested externally," says Jahan Marcu, director of experimental pharmacology and behavioral research at the International

A commercial medical-cannabis cultivation facility in Moncton, Canada.

Research Center on Cannabis and Mental Health in New York City.

In Canada, government regulations require producers to use an independent lab to measure the level of cannabinoid in dried cannabis flowers and oils so that the resulting products can be labelled appropriately. Producers must also test for contaminants such as the bacterium *Escherichia coli*, mould, heavy metals and 96 types of pesticide. When edible cannabis products become legal in Canada later this year, they will face similarly stringent rules, says Purcell; labels on such products will have to convey the same nutritional information as do those on any other food product. In the United States, the regulations are broadly similar to those in Canada. But each US state where medical or recreational cannabis is legal sets its own testing regime — and those requirements can vary widely and change quickly. "In Delaware, the regulations are now totally different than two years ago," says Marcu.

Independent testing labs have sprung up to help growers to meet the requirements, but like the wider cannabis industry, they face growing pains. "At the moment it's a bit like the Wild West, with different rules in different places," says Andrew James, marketing director of Ellutia in Ely, UK, which makes chemical analysis equipment for the cannabis industry, among other markets. "It can be hard to know what to test for, how to test and where to do it."

In the United Kingdom, for example, strict rules concerning THC levels in medical cannabis mean that labs can find it difficult to get the sample analytical standards that they need for comparing products. The licences required to handle the standards are the same as those needed by a lab doing research on the drug itself. "It's ludicrous that analytical standards are so tightly controlled," says James. "The cannabis products are treated the same as a kilo of cocaine."

And not all analytical labs are up to the job. Roger Brauninger, biosafety programme manager at the American Association for Laboratory Accreditation (A2LA), a non-profit organization in Frederick, Maryland, says that although US states introduced requirements for external testing as medical or recreational cannabis became legalized, there was rarely any infrastructure or expertise in place to facilitate a professional testing regime. Even the most established labs, located in California, have only been around since the mid-2000s — despite the state legalizing the medical use of cannabis in 1996.

"Because of the federal strictures, there weren't any standardized methods. Labs had to validate everything themselves," Brauninger says. "It's difficult to bring in expertise when there isn't a wealth of information available, and no trade association to help share techniques."

That led to labs being set up quickly with old equipment in unsuitable spaces, and with minimal quality control. James says that, in the past, it was not uncommon to meet people at trade shows who had bought analytical kits on the online auction site eBay and were running testing labs from their bedrooms.

Cannabis analytical labs are becoming more professional. "I've seen an evolution in the sophistication of the industry," Brauninger says. "Most of the people running labs now have PhDs and experience in the pharmaceutical industry. It's light years more sophisticated than five or six years ago."

Such labs are beginning to adopt standardized tests for potency and purity using gas chromatography and high-performance liquid chromatography. They are also developing methods to identify and measure levels of THC and other cannabinoids, as well as contaminants such as heavy metals and pesticide residues. "These aren't necessarily new tests that have been created for this industry, but the type that had to be applied for this product," says Brauninger.

A2LA is also helping labs to attain ISO/IEC 17025 accreditation, the main international standard for testing and calibration labs. It covers all phases of lab operation, including staff training, data protection and dealing with conflicts of interest.

Although many small-scale cannabis growers at first questioned the need for intensive product testing, most can now appreciate the benefits that the rules bring to the market. "People see the need for quality control and testing," says James. "It brings a legitimacy to the industry that hasn't always been there."

And as testing becomes more widespread, its importance is also reaching users, says Marcu. "Consumers are starting to realize that there is a big difference between illicit or grey-market products and those from a licensed operator," he says. "They can have more confidence in the products than before."

One sign of progress is that cannabis products can be recalled when they fail testing, just like other medical or consumer items. In December 2016 and January 2017, Organigram had to recall some of its products when residues from pesticides not approved for use in cannabis were detected. Although the company's reputation took a short-term hit, Purcell says that recalls are a sign of the industry's growing professionalism. Consumers can be confident that cannabis goods have been made "under a controlled, regulated environment and tested in a certified lab that guarantees safety and quality".

As the cannabis industry expands, the role of good science within it will also expand, and there will be further opportunities for collaboration. "More and more," says Zheng, "the scientific community and industry are directly communicating and sharing information." ■

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