Outdoor cannabis operation in Ontario.

Cannabis Growing in Canada: An Expanding Market

By Joy Drohan

Many crop advisers in Canada have noticed the recent growth in the cannabis market and are wondering what the future may hold for the crop. What are the challenges to growing this crop efficiently? How is the industry evolving? Earn 1 CEU in Crop Management by reading the article and taking the quiz at https://bit.ly/3iUo5HO. View all CEUs online at https://web.sciencesocieties.org/Learning-Center/Courses.

Many crop advisers in Canada have noticed the recent growth in the cannabis market and are wondering what the future may hold for the crop. What are the challenges to growing this crop efficiently? How is the industry evolving?

We focus here on Canada because of the state-by-state regulations in the United States, but many of the same concerns would apply in some form in most U.S. states.

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A customer sniffs cannabis products at a retail shop, in Vancouver, BC. Photo by Elaine Thompson/AP/Shutterstock (10447707c).

"Cannabis is an emerging market, and it's going to be big, globally," says Sarah Campbell, director of the Craft Cannabis Association of British Columbia (CCABC), which represents micro-cultivators. These are growers with a maximum of 200 m^2 (2,153 ft^2) of grow space, indoors or out.

The legal recreational cannabis (*Cannabis sativa*) market in Canada, including smokable cannabis, extracts such as cannabidiol (CBD) oil, and edibles, recorded $2.6 billion Canadian ($2.1 billion U.S.) in sales in 2020. This does not include legal medical sales. Cannabis is regulated as a pharmaceutical under strict Health Canada regulations. Commercial cannabis growing became legal through Health Canada in 2018.

There are three scenarios for production:

- indoor—typically a warehouse, where all light, heat, carbon dioxide, and water are piped in
- traditional greenhouse
- outdoors

In December 2020, about 1,550 ac of licensed cannabis was grown outdoors in Canada and about 430 ac indoors. Field acreage grew by 148% from October 2019 to October 2020.

"Cannabis is still grown mostly indoors in the legal market," says Rajiv Dasanjh, emerging markets specialist and agrologist with the British Columbia Ministry of Agriculture. He notes that indoor facilities can typically harvest two or three times a year in a single grow-room. "But we do suspect outdoor production of cannabis will increase in the next two or three years," he says, because of lower costs. There's also a push toward greenhouses for economic efficiency.

"We have yet to see where cannabis will be concentrated in Canada," Campbell says. So far, the larger outdoor and greenhouse operations have clustered in the traditional agricultural areas, including in the Niagara region of southern Ontario, near Windsor, and in southern British Columbia. Traditionally, cannabis has been grown in rural areas across the country, both indoors and outdoors, where it supports the local economy. Groups such as CCABC are eager to protect that economic contribution.

Active Ingredients and Products

Cannabis produces more than 100 different cannabinoids, including tetrahydrocannabinol (THC), the main psychoactive agent. They're all produced within the trichomes—resin glands that grow all over the plant and are concentrated on the flower heads. Consumers are primarily concerned with high THC content when they shop for cannabis. The characteristic aroma of cannabis comes from terpenes, which are also produced in the trichomes.

Most indoor-grown cannabis is for the high-end flower market because this scenario allows multiple year-round harvests of consistent, high quality bud. The price per pound is much higher than cannabis grown for oil extraction. Much of the growth in cannabis acreage outdoors, with its much lower costs, is for oil extraction. Oil is processed into medicinal extracts, other smokable products, and edibles.

"I think there's a lot of attention on edibles and drinks," says Dasanjh, "just because that might cater to a more mainstream population. But the larger the organization, there's more of a push for diversification among products." Smaller producers

tend to grow more flower. There's also a strong emphasis among smaller growers on improving quality.

Moving young plants to be planted outside.

Propagation and Cultivation

"Cannabis is a unique crop, but there's been too much hype," says Bill MacDonald, professor and coordinator of the Commercial Cannabis Production Graduate Certificate Program at Niagara College in Ontario. "It's just a plant, whether you're picking cucumbers or flower buds with terpenes."

Campbell says cannabis is pretty easy to grow.

Indoors, hydroponic growth is increasingly common in larger operations. Other indoor growing media include peat perlite, rockwool, or coconut husk.

Campbell says that some cultivators are planting seed directly in the ground. Seeds tend to make stronger, more adaptable plants, but there will be some genetic variability as opposed to planting with clones, which are essentially identical copies that produce a more consistent product.

"There's a huge race right now throughout Canada to do true-to-type genetics testing," says Dasanjh, "to ensure that the variety that you're growing is actually the variety that you think it is. I think companies that can diversify the genetic portfolio of the cannabis they grow, and ensure they are true-to-type, will have the most success in the long term."

Most propagation is done via cuttings from a mother plant to produce clones. Larger operations may start clones in specialized greenhouses, move plants to standard greenhouses after repotting, and then move plants outside for flowering.

Outdoors, cannabis is typically grown on plastic mulch for weed control with fertigation that closely mimics what is used for indoor production.

Young plant ready to be planted in the ground.

Fertilization and Supplementation

Cannabis requires high nitrogen. MacDonald says that nutrient balancing hasn't been too much of a problem, especially if salt-based fertilizer is used. Using organic fertilizer can be more

Growing cannabis indoors. Photo courtesy of OrganiCraft, a micro-cultivator in British Columbia.

challenging. Growing hydroponically makes nutrient application easier and more precise.

Jim Todd, industrial crops specialist for the Ontario Ministry of Agriculture, Food, and Rural Affairs, says there's ongoing research on recommendations for major nutrients for cannabis. He also warns that "there is a lot of misinformation about what the client actually needs coming from the internet."

Todd recommends a standard initial soil test and tissue analysis to see if plants are lacking nutrients. On sandy soils, it can be a challenge for outdoor growers to make sure the nutrients are available to plants throughout the growing season.

MacDonald notes that cannabis grown indoors requires carbon dioxide (CO_2) supplementation. The ambient atmosphere is about 400 ppm, and cannabis is supplemented to 800–1,200 ppm. Because light and humidity are added, photosynthesis occurs very rapidly. Without supplementation, there would be a deficiency of CO_2, resulting in growth restriction.

Cannabis needs long days to produce vegetative growth. When the plants have short days—12 hours or less—they flower.

Harvest and Drying

Cannabis is typically hand-harvested and processed. It's a challenge to harvest the flowers gently without losing oil if the trichomes break.

Experts agree that it's difficult to generalize about yield. It depends on the variety, quality, and end product.

The harvest must be dried and stored in a Health Canada–approved facility. Production is high, but processing capacity is currently a limiting factor. A separate license is needed for processing.

Cannabis grown for Health Canada sales is tested rigorously for contaminants such as the bacteria *Escherichia coli,* mold, heavy metals, and 96 kinds of pesticide. Therefore, MacDonald advises people looking to start operations to test the soil and/or the greenhouse or facility before purchase for potentially problematic contaminants because cannabis bioaccumulates these chemicals. He also cautions that cannabis grown outdoors near conventional crops could be rendered unsaleable by pesticide drift from a neighboring field.

Challenges

Pests

Todd notes that so far, pests on outdoor-grown cannabis are not much of a problem. This is probably because large acreages of the crop are a new development.

Cannabis aphid (*Phorodon cannabis*) and root aphid (*Rhopalosiphum rufiabdominalis*) are problematic indoors. "Cannabis aphid has really exploded in the past few years," MacDonald says.

Because Health Canada regulates cannabis as a pharmaceutical, treatment options are few. Only 42 registered pesticides, such as insecticidal soap and biopesticides, are approved for use.

Pests are more of a problem indoors because pest populations can build up in the continuous warmth and be difficult to eradicate with the limited storehouse of chemicals. To control pests in cannabis grown for Health Canada, the best option currently available is regular scouting. Health Canada's

regulations are the same for all cannabis, no matter the end use or production scenario.

Some biocontrols—beneficial insects that chase off or kill pests—are being explored, MacDonald says. Before legalization, biocontrol companies couldn't do research on cannabis, so "the biocontrol industry is having to play catch up," he says.

When growing indoors, the cannabis aphid (*Phorodon cannabis*) can be a problem. Photo courtesy of Whitney Cranshaw, Colorado State University, Bugwood.org.

Diseases

The main disease seen so far in cannabis is powdery mildew. MilStop, a potassium bicarbonate-based foliar fungicide, is typically the best allowable treatment for powdery mildew.

Because of Health Canada's chemical restrictions, MacDonald notes that there's a push to breed for resistance to powdery mildew. Before legalization, clandestine breeding was focused only on increasing THC content. This focus increased THC in cannabis from 3–4% in the 1970s to 20, 25, or even 30% now, MacDonald says. If clandestine growers had a disease or pest problem, they sprayed it with whatever they wanted with no regard for the effects of ingesting that chemical during smoking.

Until resistant cultivars are available, environmental controls of humidity fluctuations for indoor and greenhouse operations are the most effective defense. Humidity should not be allowed to get close to the dew point to prevent powdery mildew. Growers install dehumidification systems to work when the sun goes down. Powdery mildew is not currently much of a problem outdoors.

Dasanjh, in British Columbia, is consistently hearing about cannabis infected with hop latent viroid. This can reduce the quality and quantity of flowers and cannabinoids the plants produce but may also be asymptomatic. "Prevention from the onset through good sanitation practices and strong adherence to biosecurity measures is how growers seem to be approaching production, both indoors and outdoors," he says.

Scaling Up

Many growers are struggling to scale up production and transfer the knowledge gained from decades of clandestine production to this new market economy. Scaling up to 2,000 ft^2 or 10 ac or more of a single variety requires a quantum leap in management. And doing it efficiently is even more challenging.

MacDonald urges indoor producers to look to the vegetable greenhouse industry for lessons. Cannabis is "similar to a greenhouse-grown chrysanthemum or poinsettia," he says. People with greenhouse experience "know the logistics, they know labor management, they know environmental controls."

Whether you're growing indoors or out, "it's quality," he says, "and controlling your price. You have to get a system in place—a written production plan—and you have to follow it to the letter."

Regulatory Compliance

Campbell finds the most challenging thing about growing cannabis for Health Canada is the regulations, compliance, and paperwork. Licensed growers have monthly reporting requirements to thwart the illegal market.

The licensing process also creates a high barrier to entry into the industry, Campbell says. Applicants for the micro-cultivator license must first secure land and have a building suitable for drying before even applying for a license. This strict requirement

Cannabis plants hang in a curing shed at a craft grow operation in British Columbia, Canada. Photo by Ben Nelms/Bloomberg and courtesy of Getty Images.

was implemented because Health Canada was swamped with applications, and they wanted to weed out people who weren't really committed.

Campbell says the minimum up-front investment for the outdoor micro-cultivator license is about $15,000 for someone who already owns land where they could have up to 200 m^2 of grow space and a building they can use for drying. The cost would cover, for example, installation of the required fencing and security system, application fees, and security clearance.

Secrecy

Todd notes that the industry to this point has been secretive and dispersed. "The entire industry doesn't really have a single lobby voice. So it's difficult for us to get information on the industry, because each operation is very secretive. They don't want to let their competitors know that they're having a problem. It's not like other crops where you can go to the Grain Farmers of Ontario and discuss the issues that they have. It's a growing industry, and it's had growing pains."

What to Expect for the Future

The young industry has been in a constant state of flux since it began. It started mainly indoors, then transitioned mainly to greenhouses, and now outdoor growth is increasing.

But experts agree that the industry is now stabilizing. "We're certainly seeing the boom-and-bust cycle of the industry settle," Dasanjh says. "We're starting to see more small-scale to medium-scale producers enter the sector versus the large-scale corporate production of cannabis that was propped up by investors unfamiliar with the agricultural sector."

"Very large facilities typically aren't doing well," Campbell says. "Most of them are downsizing or supplementing with outdoor growing, which has greater margins."

Growers are adjusting their plantings in response to supply and demand. In October 2019, the price dropped to about one-fourth of the typical previous price because the outdoor harvest flooded the market and overwhelmed processing capacity.

Many growers in British Columbia look to California for trends because that state is a few years ahead in cannabis industrialization. "Outdoor production is huge there now, as is doing more with less," Campbell says.

Along with education of growers, policymakers, and others, CCABC is pushing Health Canada to incentivize outdoor "sun-grown" production because it is more sustainable.

"We're really trying to preserve our agricultural land here in British Columbia by emphasizing regenerative and sustainable farming practices and find the best way cannabis can fit into that," Dasanjh says. "It's a bit of a balancing act as cannabis should be treated the same as any other agricultural crop, but it's still very new in a legal sense. We're striving to meet the needs of both cannabis producers and local governments." In practice, this means that the licensed production of cannabis on British Columbia's Agricultural Land Reserve—a provincial zone where agriculture is the priority use—is permitted without question when it is strictly soil-based. But any concrete-based structure that was not built or under construction before Oct. 18, 2018, requires local government approval.

Sustainable certification for growers is something CCABC would like to see. Campbell thinks cannabis will follow the trend toward organic, small-scale production that we're seeing in foods. By helping micro-cultivators navigate regulatory requirements, her organization is hoping the legal market will grow. "We think we're on the right track," Campbell says, "by promoting small, independent producers who bring economic benefit and a sustainable approach to rural regions."

SELF-STUDY CEU QUIZ

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1. Micro-cultivators have a maximum of _____ ft^2 of growing space, inside or out.
   - **a.** 253.
   - **b.** 1,235.
   - **c.** 2,153.
   - **d.** 3,125.

2. In Canada, _____ acres of cannabis were grown outdoors and _____ acres were grown indoors in 2020.
   - **a.** 148, 1,325
   - **b.** 430, 1,550
   - **c.** 1,325, 1,550
   - **d.** 1,550, 430

3. The characteristic aroma of cannabis comes from the THC.
   - **a.** True.
   - **b.** False.

4. Seed-grown cannabis plants tend to _____ while clones tend to _____.
   - **a.** produce a more consistent product, be more potent.
   - **b.** be stronger and more adaptable, produce a more consistent product.
   - **c.** be more potent, be stronger and more adaptable.
   - **d.** require more nitrogen, produce a more consistent product.

5. Which growing method tends to allow for more precise, easier nutrient application?
   - **a.** Hydroponic.
   - **b.** Greenhouse.
   - **c.** Outdoor.
   - **d.** None of the above.

6. Cannabis plants produce _____ during long days while producing _____ during short days.
   - **a.** flowers, trichomes
   - **b.** trichomes, vegetative growth
   - **c.** flowers, buds
   - **d.** vegetative growth, flowers

7. There are very few registered pesticides for cannabis because it is regulated as a horticultural crop in Canada.
   - **a.** True.
   - **b.** False.

8. Which of the following is the most prevalent disease in cannabis?
   - **a.** Powdery mildew.
   - **b.** Fusarium wilt.
   - **c.** Yellow leaf spots.
   - **d.** Grey mold.

9. Greenhouse cannabis production is similar to which of the following greenhouse-grown plants?
   - **a.** Geraniums.
   - **b.** Poinsettia.
   - **c.** Salvia.
   - **d.** Caladiums.

10. Which of the following are the greatest challenges facing growers producing cannabis for Health Canada?
    - **a.** Regulations, pesticide costs, and paperwork.
    - **b.** Reporting requirements, nutrient requirements, and greenhouse size.
    - **c.** Regulations, compliance, and paperwork.
    - **d.** Pesticide costs, operation size, and compliance.