

Space farms will feed astronauts and earthlings

28 June 2017, by Michael Dixon



Matt Damon as astronaut and exobotanist Mark Watney in the film *The Martian* grows crops on Mars. Credit: 20th Century Fox/Handout

Canadian researchers are leading an effort to grow crops in space, paving the way for humanity to live on other worlds and push the frontiers on Earth.

Food is the main obstacle to long-term [space](#) exploration. It limits how far away from Earth we can travel and how long we can stay in space.

We can stock enough [food for inhabitants of the International Space Station](#) or even for [travel to the moon and back](#). But if we are to travel to Mars and support long-term exploration missions, we need bio-regenerative, self-sustaining [food](#) production systems. Or, in simpler terms, space farms.

Farming in space is probably one of the biggest challenges we will have to overcome if we are ever going to spend extended periods on the [red planet](#) within the next 150 years. But it's a challenge Canadians can definitely lead in tackling.

Although [people have signed up to be a part of the first human settlement on Mars](#), our [next home planet](#) is more likely to be one with fewer environmental challenges.

Severe Mars environment resembles Northern Canada

Mars has a miserable climate. Its average temperature is below -60°, its atmospheric pressure is less than one per cent of Earth's and made up largely of [carbon dioxide](#), and it can be rather windy and dusty for long periods. There are also the dangers of radiation exposure, and without a molten core like ours on Earth —meaning virtually no magnetic field —the planet's environment would have to be significantly altered if we were to ever live there.



In the film *The Martian*, Matt Damon portrays a stranded exobotanist who builds a controlled environment to successfully grow food on Mars. Credit: 20th Century Fox/Handout

However, that's not to say we won't be hanging out on the red planet. When Canada turns 300, we will have hundreds of space explorers spending decades searching for life on Mars. I say decades because a round trip takes two-and-a-half years, so when we do go, we will want to make it worth our while. This means setting up enclosed housing, research facilities and [space farms](#). This is where controlled environment systems will come in.

Canada is among the world's leaders in biological life support research and technology development. This is because when it comes to farming, the severe conditions of space are similar to those in the northern parts of our country. Trying to grow a tomato on Mars is much like trying to grow a tomato in a snowbank: You can't without creating a controlled environment.

Mars needs vegetarians

At the [University of Guelph, we are moving toward growing crops in space](#) with the research we are conducting on controlled environment systems. Our ongoing work in this area has revealed that plants can function under some strange environmental conditions such as very low atmospheric pressures and much less oxygen than on Earth. This means we don't need enclosed structures that precisely replicate Earth's atmosphere for plant-based life support systems on Mars.

In 150 years, we will grow food on Mars in inflatable structures. Inside, everything will be designed to ensure the highest crop yield. The intensity of light—and even its colour or spectrum—will be tailored for each individual crop. Air flow and pressure, temperature, nutrients, carbon dioxide levels and humidity will be strictly controlled to create the ideal atmosphere in which plants can thrive.

We will grow a conventional array of [crops](#) associated with a balanced and nourishing vegetarian diet. Most of the vitamins and minerals we need are available in plants and we will get our protein from soybeans and similar crops.

This huge variety of plants, or "candidate crops", will be neatly packed or layered into a small space—the opposite of the expansive Canadian prairies. These compact crops will be produced using limited amounts of water and zero waste, because away from Earth, you can't afford to throw anything away. We must learn to recycle everything, as it will be a matter of life and death—extreme agriculture at its most challenging.



Martian base would include inflatable structures to grow crops. Credit: Shutterstock

Benefits at home on Earth

The [work we are doing at Guelph](#) is designed not only for space, but for Canadians and others worldwide who may live in places where food security is a problem and extreme agriculture is the only way to address it.

Today, we spend millions of dollars flying perishable food to Northern Canada, such as buying strawberries from Mexico for sale in Yellowknife. This doesn't make sense.

Sustaining our presence in the North depends on food production in the same way that sustaining our presence on Mars will. By creating these systems, we will be able to inhabit challenging parts of Canada, such as the North, and other parts of the world, such as the deserts of the Middle East.

Space exploration generates invaluable technology on all fronts. For food production, [space exploration](#) will enable us to learn how to grow crops almost anywhere and with as little impact on the environment as possible.

By the time Canada's 300th birthday rolls around, we will have overcome the challenge of living on Mars and the huge advancements we will have made to get there will serve not only space exploration but our own survival here on Earth.

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