

Martian Botany: A look at today's technology vs. the technology of *The Martian* by Andrew Weir

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With the discovery of seven new Earth-like planets, a question arises. Why are we still attempting to live and find life on Mars? Mars is a desolate planet that is 249 million miles away from Earth. Often called the 'Red Planet,' Mars is the fourth planet from the sun and the last planet before the asteroid belt. Mars also happens to be the second smallest planet in our solar system. With so much information coming through NASA about Mars and other planets, Hollywood has been given a lot of creative material. In 2011, Andy Weir wrote a science fiction novel entitled *The Martian* that later turned into an award-winning motion picture bearing the same title that starred Matt Damon. By analyzing Weir's novel and the motion picture along with scientific evidence, we will attempt to discover whether or not living like the Martian is a possibility in the near future.

To give a brief summary, protagonist Mark Watney is a botanist and mechanical engineer who has taken a trip to Mars to do research in the year 2035. A dangerous storm causes the crew to leave but Watney is left on the planet after he is hit by debris and flung out of sight. The crew fears that he is dead but Watney managed to survive and begins running experiments to ensure his survival. NASA discovers that Watney is still alive via satellite images that show his movements. Eventually, Watney is able to communicate with people on Earth and grow vegetables on Mars. While Watney gathers the materials needed to plan his escape, he grows plants that help ensure his survival. To do this, Watney used his educational background as a botanist and engineer to create an environment suitable for plant life to prosper. After his unplanned extended stay, Watney is rescued by his crew and he returns home to Earth safe and sound. Now, while the novel is science fiction and based in the year 2035, it is worth knowing if we, as a species, would be able to achieve the goal of sustaining ourselves via the environment, atmosphere, and resources available as Mark Watney did in the novel. Fortunately, we started considering this possibility in the latter half of the twentieth century.

Mars exploration started in the 1970's and continues to this day. Samples that our technology collects is continuing to evolve and give us better data and information about Mars. The most famous of the recent missions is the Curiosity rover that has been on Mars since August of 2012. The rover was designed to only last two years but has continued to send data to NASA for four plus years and will

continue to send data as long as the rover continues to regenerate its own power. Missions like the Curiosity rover have told NASA boundless amounts of information about Mars and its history. NASA has discovered that Mars, at one point in its history, potentially contained life and water on its surface. A necessary attribute for a world to support life is the presence of water. Mars has no water. Without water, plants cannot undergo photosynthesis. Without photosynthesis, plants cannot create their own food/energy and are unable to survive and sustain themselves. The atmosphere of Mars is 1/100th of that of Earth according to Fred Davies Jr., a professor of Biology and Agriculture at Texas A&M University. Dr. Davies also discusses other inhibitors that increase the challenge of growing plants on the surface of Mars. Mars has 2/5th the gravitational force that the Earth, making plant growth difficult. The weaker gravitational pull causes plants more stress and gives less energy to stay grounded. Without the proper atmosphere and gravitational force, Mars presents challenges for plant growing that Earth do not have.

Even Martian soil creates an issue. The soil of Mars has ions missing from its soil that would have to be added in promote plant growth. According to Dr. Schuerger, soil samples from the Viking and Pathfinder landing sites on Mars presented no traces of Copper, Zinc, Nitrogen, or Molybdenum, essential elements to plant growth. These elements would need to be added to the soil for plant life to grow and prosper on Mars. According to Dr. Schuerger and company, Advanced Life Support (ALS) systems will need to be in place. ALS systems help to regulate oxygen, water, and food from waste. Watney had these on his base in the novel. Watney accredits these systems and his degrees in mechanical engineering and botany. These ALS systems would regulate temperature, soil moisture, pH, and ambient humidity to a plants specific needs. Watney uses the ALS systems to grow his batch of potatoes that he hopes will sustain him until he can be rescued. Another major problem facing the challenge of growing plants on Mars is the travel availability. Dr. Davies stats that "The trip to Mars and back is a three-year process." With our current limitations in space travel technology, we are unable to give astronauts the supplies they would need to make the long trek to Mars and back. At this very moment, getting an astronaut to Mars and growing plants on its surface is not feasible.

So, how did Dr. Mark Watney achieve his goal of growing plants on Mars and sustaining life on a desolate planet? First, Watney had help. NASA had set up multiple stations on Mars that had equipment and rations to help future explorers. These stations provided tools that range from solar panels to shovels. The array of tools he gathered would allow him to eventually build an escape pod so he could make the journey home. The station that Watney lived in while on Mars was an ALS for human life. This particular ALS regulated temperature, chemical levels, and oxygen levels. The ALS was essentially a temporary house on Mars. For his trip to Mars, Watney also brought seeds of his own that he planned to plant on Mars. The seeds that Watney brought on the trip were genetically engineered specifically for the environment, atmosphere, and harsh conditions that Mars possessed. Second is the novel's setting, the year 2035. Technology is far more advanced in 2035 than what we have in 2017. The camp that Watney has set up allows for him to move freely because the camp has a built in gravity machine that sets the gravity to that of Earth's. Also, Watney has the technology to "create" his own water that he can drink and sprinkle on the plants. NASA presented Watney with all the tools to grow plants on Mars. His sole mission was to test soil samples and plant seeds during his stay and record his results. Watney never imagined that he would have to use his genetically engineered seeds for his survival. A key attribute about Watney's success is that he had to grow plants without water and without fertilizer. To solve these issues, Watney used a chemical reaction to break down Hydrazine to its base form of H_2 and he combined it with Oxygen to form water. If he performed the reaction improperly he could have caused a minor explosion that could have potentially damaged his camp. For fertilizer, Watney used his and his crew's fecal matter. The human waste gave nutrients to the soil that were not there naturally such as nitrogen, ammonia, and zinc. Watney would not have been able to accomplish this feat of surviving on Mars for over a year with no food without his educational background and the technology of his time.

If NASA were to plan out a trip for the distant future with the intent to grow plants and keep a human on Mars, I believe we can do it. The technology of today is always advancing and ever-changing. NASA plans to send a human to the Red Planet by the 2030s. By then, hopefully, the technology, the understanding of how the Mars environment works, and genetically engineered plants specific to Mars will be ready for the endeavor. Growing plants on Mars by humans is not only possible in the future but a certainty. Mars has

untapped potential and *The Martian*, while science fiction, is an indicator of what is to come. The Dr. Mark Watney that is needed to grow plants on Mars will be ready when NASA, or some other space program, has the means to do so.

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