

High-Tech Horticulture: How Automation is Changing the Greenhouse



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Abstract

It is well known that growing plants in the greenhouse provides an optimal environment for crop production. In modern conditions, when new techniques have become widely used in agriculture, the process of growing plants has been significantly improved through the use of technology and automation. Modern horticulture is associated with sensor technology, climate management, robotics, and artificial intelligence. The aim of this article is to discuss how automation can change the practice of growing plants in greenhouses, highlighting its key elements, advantages, disadvantages, and further perspectives.

Keywords: High-tech horticulture, greenhouse automation, smart farming, climate control, sensors, sustainable horticulture

Introduction

Indeed, greenhouses had been used for many years to enable growers to cultivate plants regardless of seasonal constraints by offering protection against harsh climatic conditions. Traditionally, growing activities in greenhouses had depended mostly on manual practices as well as grower expertise since decisions concerning watering, air exchange, and other factors were made based on observations.

Things, however, are moving fast nowadays as technology has enabled the implementation of automation processes that make the greenhouse operation and monitoring process more efficient than ever before. It is now possible to automate temperature control, irrigation, fertigation, and other essential processes to enhance production outcomes.

Automation is, thus, becoming central to horticulture and farming in general as more people require more produce.

What is High-Tech Greenhouse Automation?

High-tech greenhouse automation is the application of technological means in order to control operations in a greenhouse without much need for human interaction. Such systems are able to monitor and control the environment in which the crops are grown.

In contrast to manual processes, where someone has to open up vents and control the irrigation process, high-tech systems do such things automatically, according to available data. This means that in case of exceeding the set temperature, the high-tech system will trigger a response to lower the temperature. The same way, it is possible to provide crops with water.

The purpose is clear: create an environment that will favor plant growth.

Key Components of Automated Greenhouses

1. Sensors and Monitoring Devices

Sensors provide the eyes and ears of automation in greenhouses. They constantly monitor different variables, including:

- Temperature and humidity
- Soil moisture content
- Light intensity
- Carbon dioxide concentration

2. Climate Control Systems

Another critical component in greenhouse agriculture is climate management. Automated climate control systems manage various factors such as temperature, humidity, light, and carbon dioxide.

Heating systems maintain appropriate temperatures for the plants when weather conditions are cold, while cooling systems, including fans and foggers, help regulate temperature. Ventilation systems promote adequate airflow, preventing disease transmission.

3. Automated Lighting Systems

In many greenhouses, lightening systems are used to make up for a lack of natural light. Automated lighting systems adjust according to the needs of the plants, providing consistency in their growth despite weather conditions.

4. Automated Irrigation and Fertigation Systems

Water and nutrition play an important role in horticulture. Automated irrigation systems provide water whenever and wherever it is required.

Fertigation systems help add fertilizers to the water used in irrigation, allowing for better nutrition for the plants. Not only does it benefit their growth, but it also minimizes wastage.

5. Robots and Automation Tools

Robots are now being used for planting and transplanting, harvesting, sorting, and packing of crops. These systems also reduce labor requirements and improve efficiency.

6. Software for Data Management and Control

Everything that the sensors collect is processed by software applications. Farmers are able to control and monitor greenhouse conditions via their smartphones or computers from afar.

Such high connectivity enables rapid action to be taken.

Benefits of Automation in Greenhouses

1. Year-Round Production
2. Improved Crop Yield and Quality.
3. Efficient Use of Resources
4. Consistency in Production
5. Better Disease and Pest Management
6. Reduced Labor Dependency

➤ Challenges in Adopting Greenhouse Automation

Despite its advantages, high-tech horticulture is not without challenges.

1. Technical Complexity
2. High Initial Investment
3. Maintenance Requirements
4. Energy Dependence
5. Limited Awareness

Role in Sustainable Agriculture

The process of automation is instrumental in ensuring that horticulture is made sustainable.

- Decreases chemical usage through accurate monitoring
- Decreases impact on the environment
- Decreases water usage through accurate irrigation
- Ensures efficient usage of natural resources

Future of High-Tech Greenhouses

Future trends in greenhouse cultivation will be characterized by advancements that involve:

- Development of affordable automation technologies for small-scale farmers
- Incorporation of artificial intelligence to enhance decision-making capabilities
- Renewable sources of energy, including solar energy
- Vertical farming techniques and hydroponic farming

The adoption of automation technologies in greenhouse cultivation is likely to grow with technological advancements.

Conclusion

Advanced horticulture through technological innovations in greenhouse farming is changing the way agriculture operates. Every single process in greenhouse farming can now be automated from the regulation of environmental conditions to the watering, harvesting, and planting of crops. Although there are certain challenges to consider, like the relatively high costs involved, the advantages that come with this development are many. The future of agriculture looks promising because automation in greenhouse farming will revolutionize horticulture.

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