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THE IMPACT OF CLIMATE CHANGE ON PLANT PHYSIOLOGY

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ABSTRACT

This article analyzes the major effects of global climate change on plant physiology. In particular, it examines how factors such as rising temperatures, increased atmospheric carbon dioxide (CO_2) concentrations, altered precipitation patterns, and extreme weather events impact key physiological processes in plants, including photosynthesis, respiration, water exchange, and growth. The study also explores plant responses to stress conditions and their adaptation mechanisms. The findings of this article can serve as a valuable basis for assessing the impact of climate change on agricultural productivity and for developing sustainable agricultural systems.

Introduction

In recent decades, global climate change has become one of the most urgent environmental issues facing humanity. The increase in greenhouse gases in the atmosphere, especially carbon dioxide (CO_2), the rise in global temperatures, changes in precipitation patterns, and extreme weather events are all having serious impacts on biological systems across the planet, particularly on plant life. As living organisms, plants are highly sensitive to environmental conditions. Their physiological processes—such as photosynthesis, respiration, water exchange, and growth—are directly influenced by climate variables. This article examines the main effects of climate change on plant physiology, plant responses to stress conditions, and their adaptation mechanisms based on scientific literature. Additionally, it considers the potential consequences of these changes for agricultural productivity and food security.

Main Body

The increase in atmospheric carbon dioxide concentration can enhance the photosynthesis process, particularly in C3 plant species. However, when elevated CO_2 levels occur in conjunction with other environmental stresses—such as high temperatures, water shortages, or nutrient deficiencies—they may have harmful effects on plants. Even though photosynthetic efficiency may improve, overall crop productivity might decline under such combined stresses.

Climate change is also altering the amount and distribution of precipitation, leading to more frequent droughts in many regions. Drought disrupts plant processes such as transpiration, water uptake, and retention. Under drought conditions, stomata close to conserve water, which reduces CO_2 absorption and slows photosynthesis. Water deficiency also limits plant growth rates and restricts root system development. Extreme weather events like storms, hail, strong winds, sudden frosts, or heatwaves can cause direct mechanical and physiological damage to plants. These events may destroy plant tissues, damage leaves, and leave plants vulnerable to infections. To cope with climate-induced stress, plants employ various physiological and molecular mechanisms. These include the synthesis of osmoprotectants (e.g., proline), activation of antioxidant enzymes, deepening of root systems, and the expression of stress-resistant genes. In addition, research is underway to develop climate-resilient plant varieties through selection and genetic engineering.

Conclusion

In conclusion, global climate change significantly impacts the main physiological processes of plants—photosynthesis, respiration, water exchange, and growth. Factors such as rising temperatures, increased CO_2 concentrations, altered precipitation patterns, and drought are changing plant habitats and testing their resilience to stress. Understanding plant adaptation mechanisms under such conditions, developing new climate-resilient crop varieties, and improving agricultural technologies have become vital. To mitigate the negative effects of climate change, it is necessary to enhance scientific research, promote ecologically sustainable agriculture, and develop effective adaptation strategies. Only by doing so can we ensure food security and preserve ecosystem stability in the future.

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