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ASSESSMENT OF ENVIRONMENTAL FACTORS AFFECTING PLANT GROWTH AND PHYSIOLOGICAL DEVELOPMENT

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Abstract

Environmental factors play a fundamental role in regulating plant growth, metabolism, productivity, and physiological adaptation. Temperature, light, water availability, soil composition, humidity, and atmospheric conditions directly influence photosynthesis, respiration, nutrient absorption, and plant development. The aim of this study was to assess the influence of major environmental factors on plant growth and physiological processes. The analysis demonstrated that optimal environmental conditions significantly improve germination, biomass accumulation, chlorophyll synthesis, and reproductive activity, whereas unfavorable conditions lead to physiological stress, growth inhibition, and reduced productivity. Understanding plant responses to environmental changes is essential for agriculture, ecology, plant physiology, and sustainable crop management.

Keywords: plant growth, environmental factors, photosynthesis, plant physiology, temperature, soil, water stress, ecological adaptation.

Introduction

Plants are living organisms highly dependent on environmental conditions for survival, growth, reproduction, and physiological functioning. Unlike animals, plants are unable to relocate from unfavorable environments and therefore must continuously adapt to changing ecological factors [1].

Plant growth and development are regulated by both internal genetic mechanisms and external environmental influences. Among the most important environmental factors are light intensity, temperature, water availability, soil nutrients, humidity, and atmospheric gases [2]. These factors determine the rate of photosynthesis, respiration, transpiration, cell division, and metabolic activity [3].

Light is considered one of the primary environmental regulators of plant growth because it provides energy for photosynthesis [4]. The duration, intensity, and spectral composition of light influence chlorophyll formation, leaf expansion, flowering, and photoperiodic responses [5].

Temperature also has a major effect on plant physiology. Enzymatic activity, seed germination, root growth, and metabolic processes depend on optimal temperature conditions [6]. Excessively high or low temperatures may disrupt cellular metabolism and inhibit plant development.

Water availability is another essential factor influencing plant survival and productivity. Water participates in nutrient transport, photosynthesis, transpiration, and maintenance of cellular turgor [7]. Water deficiency causes stomatal closure, reduced photosynthetic activity, oxidative stress, and growth retardation [8].

Soil composition and mineral nutrition strongly affect root development and physiological activity. Nitrogen, phosphorus, potassium, calcium, magnesium, and trace elements are required for normal plant metabolism and structural development [9].

Climate change and environmental pollution increasingly influence plant ecosystems worldwide. Drought, salinity, temperature fluctuations, and atmospheric contamination may negatively affect agricultural productivity and biodiversity [10].

Understanding the physiological responses of plants to environmental factors is important for improving crop production, ecological sustainability, and adaptation to changing climate conditions.

The aim of this article was to evaluate the influence of environmental factors on plant growth and physiological development.

Materials and Methods

This study was conducted as an analytical review of scientific literature related to plant physiology and environmental biology. Scientific articles, experimental studies, and botanical investigations indexed in international databases were analyzed.

The study focused on major environmental factors affecting plant growth, including light, temperature, water supply, soil nutrients, humidity, and atmospheric conditions.

Comparative analysis methods were used to evaluate physiological responses of plants under optimal and stressful environmental conditions.

Results

The analysis demonstrated that environmental conditions significantly influence plant growth and physiological activity.

Light intensity was directly associated with photosynthetic efficiency and chlorophyll accumulation. Plants grown under adequate light conditions showed increased biomass production, stronger stems, and improved leaf development. Reduced light intensity caused slower growth and decreased photosynthetic activity.

Temperature strongly affected metabolic processes and germination rates. Moderate temperatures promoted enzymatic activity and optimal plant development, while extreme heat or cold conditions reduced physiological efficiency and caused cellular stress.

Water availability was identified as one of the most critical growth factors. Adequate irrigation improved nutrient transport and photosynthesis, whereas drought conditions caused reduced leaf expansion, stomatal closure, and decreased growth rates.

Soil nutrient availability influenced root system formation and reproductive development. Nitrogen deficiency resulted in chlorosis and reduced vegetative growth, while phosphorus deficiency negatively affected root development and flowering.

Environmental stress factors such as salinity, pollution, and climate instability disrupted physiological balance and increased oxidative damage within plant tissues.

Discussion

The findings confirm that plant growth and physiological development depend on complex interactions between environmental and biological factors.

Light regulates photosynthetic processes and energy metabolism. Plants exposed to optimal photoperiods demonstrate improved physiological activity and reproductive success. Light deficiency may reduce chlorophyll synthesis and impair carbohydrate production.

Temperature affects enzyme systems and cellular metabolism. Every plant species possesses specific thermal tolerance limits, and deviation from optimal conditions may lead to physiological disturbances and reduced productivity.

Water stress is considered one of the most serious environmental challenges affecting agriculture worldwide. Drought conditions impair photosynthesis, nutrient uptake, and cell expansion. Prolonged water deficiency may result in tissue dehydration and reduced crop yield.

Mineral nutrition is essential for structural and metabolic processes. Nutrient imbalance may alter physiological pathways and weaken plant resistance to environmental stress.

The study also emphasizes the growing impact of climate change on plant ecosystems. Increased temperature fluctuations, salinity, and environmental pollution create additional stress factors influencing plant physiology and agricultural sustainability.

Modern agricultural strategies should focus on improving stress resistance, optimizing irrigation systems, and developing environmentally adaptive crop varieties.

Further experimental studies are necessary to investigate molecular and biochemical mechanisms of plant adaptation to environmental stress.

Conclusion

Environmental factors play a crucial role in regulating plant growth, physiological activity, and ecological adaptation. Light, temperature, water availability, soil nutrients, and atmospheric conditions directly influence photosynthesis, metabolism, cellular development, and productivity.

Optimal environmental conditions support healthy plant growth and reproductive development, whereas environmental stress factors may impair physiological balance and reduce agricultural productivity.

Understanding plant responses to environmental changes is essential for sustainable agriculture, environmental protection, and food security. Improved knowledge of plant physiology may contribute to development of adaptive cultivation technologies and stress-resistant crop varieties.

Further scientific investigations are required to evaluate the long-term effects of climate change and environmental stress on plant biological systems.

References:

1. Taiz L, Zeiger E. *Plant Physiology.* 6th ed. Sinauer Associates; 2015.
2. Hopkins WG, Hüner NPA. *Introduction to Plant Physiology.* Wiley; 2009.
3. Salisbury FB, Ross CW. *Plant Physiology.* Wadsworth Publishing; 1992.
4. Raven PH, Evert RF, Eichhorn SE. *Biology of Plants.* 8th ed. Freeman; 2013.
5. Hall DO, Rao KK. *Photosynthesis.* Cambridge University Press; 1999.
6. Levitt J. *Responses of Plants to Environmental Stresses.* Academic Press; 1980.
7. Kramer PJ, Boyer JS. *Water Relations of Plants and Soils.* Academic Press; 1995.
8. Farooq M, et al. Plant drought stress: effects and management. *Agron Sustain Dev.* 2009;29:185–212.
9. Marschner P. *Marschner's Mineral Nutrition of Higher Plants.* Academic Press; 2012.
10. IPCC Climate Change Report. Climate impacts on plant ecosystems. Geneva; 2022.