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PHOTOSYNTHETIC PIGMENTS AND THEIR ROLE IN PLANT ADAPTATION TO ENVIRONMENTAL STRESS

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Abstract

Photosynthetic pigments are essential molecules that absorb light energy and protect plants from environmental stress. Chlorophylls and carotenoids participate in photosynthesis, photoprotection, and regulation of oxidative balance. This study analyzes the role of photosynthetic pigments in plant adaptation to stress conditions such as drought, salinity, high temperature, and light intensity changes. The findings show that pigment composition changes reflect stress intensity and adaptive capacity.

Keywords: photosynthetic pigments, chlorophyll, carotenoids, environmental stress, plant adaptation

Introduction

Photosynthesis is the primary process supporting plant growth and ecosystem productivity. Photosynthetic pigments determine light absorption efficiency and influence plant responses to environmental conditions. Stress factors may reduce chlorophyll content and damage photosynthetic apparatus. Carotenoids play a protective role by dissipating excess energy and neutralizing reactive oxygen species.

Materials and Methods

Literature on plant physiology and pigment biochemistry was reviewed. Studies measuring chlorophyll a, chlorophyll b, carotenoid content, photosynthetic efficiency, and stress tolerance were analyzed. Comparative evaluation was performed across different stress conditions.

Results

Environmental stress generally reduced total chlorophyll content and altered the chlorophyll a/b ratio. Carotenoid concentration often increased under high light and oxidative stress. Plants maintaining higher pigment stability demonstrated better photosynthetic activity and biomass accumulation. Pigment degradation was associated with leaf senescence and reduced productivity.

Discussion

Changes in pigment composition are important indicators of stress response. Chlorophyll reduction reflects damage to photosynthetic structures, while carotenoid accumulation supports photoprotection. Pigment stability may be used as a criterion for selecting stress-tolerant plant varieties. Integration of pigment analysis with physiological measurements improves understanding of plant adaptation.

Conclusion

Photosynthetic pigments are essential for plant productivity and stress resistance. Chlorophyll and carotenoid levels provide valuable information about plant physiological status. Pigment analysis can support ecological monitoring and crop improvement programs.

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