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Biological and Abiotic Environmental Stress on Photosynthesis

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Introduction

Photosynthesis is a remarkable cycle that has profoundly moulded life on our planet and made the circumstances for all realized living things. Plant species and photosynthetic forms have emerged during evolution and partial mechanisms have been optimized to function in a variety of environments. Climate change, environmental pollution and biotic factors, on the other hand, significantly restrict plant growth, biomass production and reproduction. Cyanobacteria are photosynthetic prokaryotic organisms with a lot of potential for agro biotechnology. They are utilized in the production of bio fertilizers and make a significant contribution to plant drought resistance and soil nitrogen enrichment. In rice fields, cyanobacterial strains that fix nitrogen were found, isolated and studied. We also looked at how Mo and Fe affected photosynthetic and nitrogenase activities when there was no nitrogen. Cyanobacterial separates detached from rice paddies in Kazakhstan were distinguished as *Trichormus variabilis* K-31 (MZ079356), *Cylindrospermum badium* J-8 (MZ079357), *Nostoc sp Tolypothrix tenuis* J-1 (MZ079361), *Oscillatoria brevis* SH-12 (MZ090011) and J-14 (MZ079360). The optimal concentrations of metals that stimulate the studied parameters were discovered through the investigation of the influence of various concentrations of Mo and Fe on photosynthetic and nitrogenase activities under nitrogen starvation conditions.

Description

During ontogenesis, the quality of the light plays a crucial role in regulating plant growth and development, such as germination, photo morphogenesis and induction of flowering, among other processes. In plants becoming under red light (RL), the biomass of needles and root foundations expanded by more than two and multiple times, separately, contrasted and those of the white glaring light (WFL) control. In the meantime, RL and blue light (BL) plants had lower rates of photosynthesis and respiration than blue–red-light (BRL) plants. The carbon balance, which is the difference between the rates of photosynthesis and respiration, was greatest under RL [1].

There hasn't been a lot of research done on how different nanoparticles affect terrestrial plants individually or together. Ecotoxicology today faces a challenge with this topic. Emerging pollutants include zinc oxide nanoparticles (ZnO NPs) and cerium oxide nanoparticles (CeO2 NPs). Plants of *Pisum sativum* were given either ZnO NPs or CeO2 NPs by themselves or a combination of these nano-oxides (at two concentrations: 100 and 200 mg/L) The researchers came to the conclusion that CeO2 NPs mitigate the toxicity of ZnO NPs by shielding the photosynthetic apparatus in *Pisum sativum* leaves from Zn's oxidative stress. They also noticed that both nano oxides had an effect on the transport and uptake of nutrients at all concentrations used. According to these findings, ZnO NPs toxicity is mitigated by CeO2 NPs free-radical scavenging properties. In the process of photosynthesis, light is very important; However, excessive amounts can harm cellular components [2].

As a result, photosynthetic organisms developed a collection of photo protective mechanisms, such as non-photochemical quenching and photo inhibition that can be studied in cell suspensions using conventional biochemical and biophysical techniques. Single-cell identification of micro domains in the thylakoid membrane during high light (HL) stress was combined with these bulk methods in this study the yellow fluorescent protein (YFP)-tagged photosystem I of PCC 6803 cells revealed a three-phase multiphase response of cyanobacteria to HL stress: intermediate, fast and slow Myxoxanthophyll accumulation and a more uniform spatial distribution of photosystems and phycobilisomes between micro domains were observed by the authors. They suggest that the overall increase in carotenoid levels during HL stress may be responsible for either direct photo protection (such as the scavenging of ROS) or for maintaining the ideal distribution of photosystems in the thylakoid membrane in order to achieve effective photo protection.

P700 oxidation typically prevents PSI photo inhibition. Plants are at risk from excessive light if there is no protective mechanism in place. PGR5 is necessary for P700 oxidation in angiosperms and may play a significant role in cyclic electron transport around PSI. Numerous studies on photosynthetic processes have utilized the Arabidopsis PGR5-deficient mutant pgr5-1, which lacks the ability to regulate P700 oxidation. In contrast, the double mutant pgr5-1 had an increased PSI photo inhibition. Compared to the newly isolated PGR5-deficient mutant pgr5hope1, growth was significantly reduced by pgr5-1. The presence of additional mutations in pgr5-1 can be seen from the fact that the pale-green phenotype was maintained despite the restoration of P700 oxidation regulation by the addition of PGR5. PSI photo inhibition by excessive light was seen in both pgr5-1 and pgr5hope1, with pgr5-1 showing a greater reduction in PSI activity [3].

According to principal component analysis of the composition of the foliar pigments, Malva resembled fast-growing annuals, whereas Lemna resembled slow-growing evergreens. Overall, Lemna exhibited characteristics similar to those of its close relatives in the family *Araceae*, including a remarkable capacity to adapt to full sunlight and deep shade. Overall, duckweed has foliar pigment features that are an exaggerated version of those of terrestrial perennials combined with an unusually high growth rate, making it a hybrid of fast-growing annuals and slow-growing evergreens. Success in a dynamic light environment with periodic cycles of rapid expansion can be supported by duckweed's ability to thrive under a wide range of light intensities.

Until now, no research has examined the effectiveness of microbial endophytes in promoting plant growth or compared them to hormones applied exogenously. The purpose was the isolation, identification and characterization of bacterial and fungal endophytes taken from the roots of the *Phaseolus vulgaris* plant. Then, they were compared to two common hormones that are applied exogenously to plants to see how they affected the growth and biochemical properties of *P. vulgaris* plants. The goal was to see if these microbial isolates could be used as biofertilizers to boost crops growth and metabolites. Their findings suggested that the *Endophyte Brevibacillus agri* (PB5) has a lot of potential as a stimulator for common bean plant growth and productivity [4].

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One of the most devastating diseases in the world is black spot disease, which is caused by Alternaria brassicicola in Brassica species. This is especially true given that no known Brassica cultivar is fully resistant to the disease. In this context gives a report on the defenseless cooperation between *B. oleracea var* from the fungus and host plant perspectives, *capitata f. alba* (cultivar "Glory of Enkhuizen") and *A. brassicicola* At the light and transmission microscopy levels, the authors focused on the specifics of fungal development, colony formation and plant-cell interactions during infection. From the beginning of the infection, the most downregulated process in infected leaves was photosynthesis, according to ultrastructural, molecular, physiological and transcriptional analyses. When developing a plan to treat black spot disease, additional research should take this finding into account.

The striking disparity between the physiological responses of various *Synechococcus spp* is one of our most striking findings adapts phenotypes to changing conditions in the environment. The main goal of the paper by Liwiwska-Wilczewska was to find out the acclimatization capacity of three Baltic phenotypes of *Synechococcus sp*., which is a crucial link in predicting how these organisms will change in the future in the context of global warming. In addition, the focus of the research was on how irradiance, temperature and their interactions affected the proportions and content of cell-specific photosynthetic pigments in the cyanobacterial phenotypes under investigation. According to the authors, determining the degree of acclimatization of the examined cyanobacteria phenotypes to particular environmental conditions necessitates the thorough characterization of the quantitative and qualitative composition of pigments. Forecasting their potential expansion requires knowledge of these organisms biology and physiology, which can be obtained by recording their responses to various environmental factors [5].

Conclusion

Seeds from plants are a necessary component of agriculture; however, environmental stresses can have a negative impact on seeds vigour, establishment of seedlings and crop production during their developmental stages. Crop yields can be increased with seeds that are resistant to high salinity, drought and climate change. The main conclusions suggested review In light of the growing demand from the expanding global population, refer to nano-priming as an emerging seed technology for sustainable food production. This novel technology has the potential to have an impact on crop yield and sustainably guarantee the quality and safety of seeds. Due to their enhanced metabolism, nano-primed seeds go through a series of synergistic events when they germinate: improving disease resistance by influencing biochemical signaling pathways, triggering hormone secretion and reducing reactive oxygen species. As well as giving an outline of the difficulties and restrictions of seed nanopriming innovation, this audit additionally portrays a portion of the arising nanoseed preparing strategies for feasible horticulture and other mechanical improvements utilizing cold plasma innovation and AI.

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Conflict of interest

None.

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