Mitigation of Ti02 Stress and Characterization of a Brassinosteroid Insensitive-1 Gene in Aquatic Bioindicator Species Lemna minor

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Titanium dioxide nanoparticles (TiO2 NPs) are an abundant heavy metal stressor frequently discharged as industrial effluent. There has been little research on the effect of TiO2 NPs on aquatic organisms and their respective ecosystems. The brassinosteroid, 24-Epibrassinolide (24-EBL), regulates plant growth and stress through a Brassinosteroid Insensitive-1(BRI1) pathway as shown in past literature. This study investigated the effects of TiO2 NPs on Lemna minor, an understudied, aquatic bioindicator that is an important component of biofuel. Through physiological, molecular, and in silico analysis of L. minor, a previously undiscovered Brassinosteroid Insensitive-1(BRI1) pathway was identified and found to effectively mitigate stress from TiO2 NPs. Exposure to TiO2 NPs decreased growth and concentrations of photosynthetic pigments in L. minor. However, after a pretreatment of 24-EBL, plants displayed frond area, number, and root lengths similar to control, indicating that 24-EBL attenuates the harmful effects of TiO2 NPs in L. minor. Our discovery could lead to a better understanding of how effective L. minor is as a bioindicator, since it seems to possess a stress alleviating pathway that other organisms may not have. Additionally, a putative BRI1 sequence was successfully extracted from L. minor and it was concluded that pretreating L. minor with 24-EBL solution prior to TiO2 NP exposure resulted in stress reduction. Upon investigation using RT-PCR, the extracted fragment appeared to be upregulated when exposed to TiO2 NP. Future studies can examine how L.minor and other aquatic organisms expressing the BRI1 genetic pathway can contribute to the protection of global water systems and the sustainability of aquatic communities.