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ENGINEERED NANOMATERIAL EXPOSURE EFFECT ON ORGANELLE GENETIC MATERIAL IN ARABIDOPSIS THALIANA

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Mitochondria and chloroplasts not only are cellular energy sources but also have important regulatory and developmental roles in cell function. CeO2, FeOx ENMs, ZnS, CdS QDs, and relative metal salts were utilized in Murashige–Skoog (MS) synthetic growth medium at different concentrations (80–500 mg L–1) and times of exposures (0–20 days). Analysis of physiological and molecular response of A. thaliana chloroplasts and mitochondrion demonstrates that ENMs increase or decrease functionality and organelle genome replication. Exposure to nanoscale CeO2 and FeOx causes an 81–105% increase in biomass, whereas ZnS and CdS QDs yielded neutral or a 59% decrease in growth, respectively. Differential effects between ENMs and their corresponding metal salts highlight nanoscale-specific response pathways, which include energy production and oxidative stress response. Differences may be ascribed to ENM and the metal salt dissolution rate and the toxicity of the metal ion, which suggests eventual biotransformation processes occurring within the plant. With regard to specific effects on plastid (pt) and mitochondrial (mt) DNA, CdS QD exposure triggered potential variations at the sub-stoichiometric level in the two organellar genomes, while nanoscale FeOx and ZnS QDs caused a 1- to 3-fold increase in ptDNA and mtDNA copy numbers. Nanoparticle CeO2 exposure did not affect

ptDNA and mtDNA stoichiometry. These findings suggest that modification in stoichiometry is a potential morpho-functional adaptive response to ENM exposure, triggered by modifications of bioenergetic redox balance, which leads to reducing the photosynthesis or cellular respiration rate.