Elucidating Crop Plant Response to Engineered Nanomaterials Using Metabolomics and Proteomics

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Engineered nanomaterials (ENMs) have the potential to improve crop yields, providing protection against pests, improving nutrient delivery and enhancing particular characteristics of food products. In order to gain a higher resolution view of the molecular mechanisms that are influenced by ENMs, we have employed metabolomics and proteomics on a number of crop plants exposed to various ENMs. Proteomic characterization of ENM-treated plants can identify the proteins and associated interactions that are differentially regulated in response to ENM exposure, providing a link between altered gene expression and metabolic processes4. In addition, analysis of plant metabolites provides snapshots of the biochemical processes modulated by ENMs exposure. An integrated approach efficiently provides a holistic overview of the signaling processes and biological pathways regulated by ENMs. There are a number of challenges in using these advanced omics approaches, but our studies serve to establish the major metabolic pathways that are perturbed by these interactions. These include glutathione metabolism, tricarboxylic acid cycle, glycolysis, fatty acid oxidation and biosynthesis of phenylpropanoid and amino acids. This information can then be used to select and design better ENMs to achieve the desired outcomes while minimizing toxicity.