

## **Nanotechnology meets sustainable agriculture: Nanohybrids from biowaste**

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Agriculture system is facing two contradictory challenges. On one hand, it is supposed to increase production of 70% by 2050, in order to feed near 10 billion people. On the other hand, it must fight against biotic and abiotic stress and soil degradation, due to climate changes, which are causing a significant decline in crop productivity. The use of nano-biostimulants can heavily support transition towards a more sustainable farming system, by exploring eco compatible substances able to enhance nutritional efficiency, biotic and abiotic stress tolerance, and/or crop quality.

At the same time, the huge amount of waste generated, 338 million tonnes per year worldwide, with biowaste (BW) being the widest component, has caused economic and technological challenges to reduce and mitigate its environmental impacts due to improper management. Indeed, BWs are emerging as a cheap and abundant source of chemical and biological richness, in view of their multiple properties including metal ion chelating, as well as intrinsic red-ox behaviour involving antioxidant and antimicrobial activity. Among BWs, lignin and humic acids exhibit great efficacy in improving plant growth and nutrition. Herein, the bio-stimulant potential of nanomaterials derived from BW valorisation is highlighted. Furthermore, it is evidenced that the molecular combination with an inorganic nanostructured and biocompatible phase is highly promising in improving the intrinsic features of organic and components, providing with organomineral nanostructures with boosted amendment features.