

## **Antimicrobial action mechanisms of nanomaterials**

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Nanomaterials exhibit a wide range of antimicrobial properties that can be exploited to counteract plant pathogens. Nanomaterials can be used alone to inhibit fungal and bacterial growth, suppress their adhesion to surfaces or inhibit the biofilm production, or can be used as nanocarriers with other active molecules in order to smart-deliver them, granting a controlled release, or prevent them from being degraded in the environment. Nanomaterials can induce oxidative stresses in pathogens' cells, penetrate their membranes causing ATP depletion, cytoplasm leakage and vacuolization. Nanomaterials can even inhibit the motility of bacterial cells, while they can be exploited as resistance inducers in plants. Studying and understanding these mechanisms and the chemical factors on which they rely, is important to optimize the antimicrobial activity of nanopesticides.