Silver nanoclusters with Ag2+/3+ oxidative states are a new highly effective tool against phytopathogenic bacteria

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The main measure worldwide adopted to manage plant bacterial diseases is based on the application of copper compounds, which are often partially efficacious for the frequently appearance of copper-resistant bacterial strains and have raised concerns for their toxicity to the environment and humans. Therefore, there is an increasing need to develop new environmentally friendly, efficient and reliable strategies for controlling plant bacterial diseases and among them the use of nanoparticles seems to be promising. The present study aimed to evaluate the feasibility to protect plants against attacks of Gram-negative and Gram-positive phytopathogenic bacteria by using electrochemically synthesized silver ultra-nanoclusters (ARGIRIUM-SUNCs®) with an average size of 1.79 nm and characterized by rare oxidative states (Ag2+/3+). ARGIRIUM-SUNCs strongly inhibited the in vitro growth (effective concentration, EC50, less than 1 ppm) and biofilm formation of Pseudomonas syringae pv. tomato, and of quarantine bacteria Xanthomonas vesicatoria, Xylella fastidiosa subsp. pauca and Clavibacter michiganensis subsp. michiganensis.

In addition, treatments with ARGIRIUM-SUNCs also provoked the eradication of biofilm for P. syringae pv. tomato, X. vesicatoria and C. michiganensis subsp. michiganensis. Treatment of tomato plants via root absorption with ARGIRIUM-SUNCs (10 ppm) is not phytotoxic and protected (80%) the plants against P. syringae pv. tomato attacks. ARGIRIUM-SUNCs at low doses induced hormetic effects on P. syringae pv. tomato, X. vesicatoria and C. michiganensis subsp. michiganensis as well as on tomato root growth. The use of ARGIRIUM-SUNCs in protecting plants against phytopathogenic bacteria is a possible alternative control measure.