Phytochemical delivery in olive plants: microscopic and proteomic evaluation

S. Tacconi[1], M. Fidaleo[2,5], F. Mura[3,5], F. Cognigni[3,5], S. Ciarroni[7], V. Tagliavento[7], F. Baldassarre[1], M. Rossi[3,5], G. Ciccarella[1,4], G.M. Balestra[6], L. Dini[2,4,5]

1. Department of Biological and Environmental Sciences and Technologies (Di.S.Te.B.A.), University of Salento, 73100 Lecce, Italy;
2. Department of Biology and Biotechnology "C. Darwin", University of Rome Sapienza, 00185 Rome, Italy;
3. Department of Basic and Applied Sciences for Engineering, University of Rome Sapienza, 00185 Rome, Italy;
4. CNR Nanotec, 73100 Lecce, Italy;
5. CNIS - Interdepartmental research center on nanotechnologies applied to engineering of Sapienza, University of Rome Sapienza, 00185 Rome, Italy;
6. Department of Agricultural and Forestry Sciences (DAFNE), University of Tuscia, 01100 Viterbo, Italy;
7. Phytoparasites Diagnostics srl (PhyDia srl), 01100 Viterbo, Italy.

To date, the application of nanotechnologies in agriculture is increasing. Novel nano-formulated systems, such as nanopesticides or nanofertilizers, could provide targeted/controlled release of agrochemicals and enable more complete biological efficacy without overdosing. The combination of novel antibacterial nanomaterials and the early identification of infectious microorganisms appear to be a promising strategy for the treatment of bacterial infections in plants. One major emerging concern is Xylella fastidiosa (Xfp), Gram-negative bacterium belonging to the Xanthomonadaceae family, a plant pathogen mainly transmitted by vector insects and associated with serious diseases affecting a wide variety of plants. In 2013, a strain of the bacterium was, for the first time, detected in the European territory (southern Italy), causing the Olive Quick Decline Syndrome (OQDS). The rapid spread of the epidemic has caused serious damage to the oil industry in the Mediterranean area, in terms of production and economy. Currently, management of infected areas aims to control the spread of Xfp through the multiplication of bacterial vectors, but there is no cure for the infection. Conventional pesticide formulations have major drawbacks in relation to efficacy, toxic effects and environmental impact. Fosetyl-Aluminum (Fos-Al), a systemic fungicide that has been also applied against bacterial diseases, were recently investigated against Xfp. In this preliminary work, new Fos-Al nanoformulations were tested against Xfp infection. Specifically, chitosan-coated Fos-Al nanocrystals were tested on olive trees after 7 days of treatment. Through a detailed analysis of transmission electron microscopy (TEM) and X-ray nano-tomography of leaves, stems and roots, we identified both the presence and the bioaccumulation sites of CH-Fos-Al. Furthermore, proteomic analysis of Xfp-derived growth medium allowed us to identify new possible molecular targets for the treatment of infection with CH-Fos-Al.