Nanotechnology for wastes valorization in Mediterranean tree and industrial crops sustainable protection strategies

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Control strategies against crops pests, such as bacteria and fungi, nowadays still rely on the use of cupric salts and synthetic fungicides, whose overuse could lead to environmental pollution and dangers to human health. Considering recent bans and limitations about the possibility of applying traditional agrochemicals (copper, thiram, mancozeb), finding new sustainable compounds is mandatory, especially for those strategic economic sectors in Italy and in whole Mediterranean area, as well as tree crops, like hazelnut and olive, but also for herbaceous ones, like tomato and wheat. Moreover, the alternative enhancements of agroindustrial wastes needed to be rethought in a circular economy perspective as suggested by the European Green Deal. In this sense several ongoing studies are showing a huge potential applying nanotechnologies to sustainable pest management. Results so far highlighted the possibility of using cropping wastes (pruning residues, stalks, shells, stems and bran) to synthetize novel lignocellulosic nanocarriers, such as cellulose nanocrystals and lignin nanoparticles, through both chemical and enzymatic processes. Obtained nanomaterials displayed interesting biochemical properties (high crystallinity, antioxidant activity) but most important, a full compatibility respect to plant development, suggesting their potential use as carriers for active molecules. Among them, chitosan and gallic acid have being studied together with starch in order to formulate innovative organic nano and microsized pesticides. These compounds showed direct and indirect antimicrobial effects against several plant pathogens, such as the causal agents of olive knot (*Pseudomonas savastanoi pv. savastanoi*), of tomato bacterial speck disease (*Pseudomonas syringae pv. tomato*), of fusarium head blight (*Fusarium graminearum*), of hazelnut bacterial blight (*Xanthomonas arboricola pv. corylina*), also displaying the capability of releasing during time the active ingredients. Controlled release together with the capability of being moved inside plant tissues and in some cases boosting plant elicitation mechanisms, make bio-based nanopesticides a really promising tool for a sustainable agriculture.