Safeguarding the environment

The urgency of innovation in the fight against plant diseases

There is no doubt that, in addition to first place in Europe in the number of organic farmers, among the successes that the Italian agriculture and food sector can boast stand food safety and environmental sustainability of agricultural production. The valorisation and promotion of the quality and excellence of Italian foodstuffs made possible to mark progress in 2014 for "made in Italy" food exports, which rose about 0.6% more than exports overall. Furthermore, the guidelines of the ten-year European development plan "Europe 2020" and the paper "The Cap towards 2020" on the Common Agricultural Policy both recognise agriculture as a strategic sector for Europe, essential for generating economic growth in a context of food safety through high and uniform quality and safety standards for products, standards capable of meeting the expectations of trading partners in Europe and beyond. In line as well with such European planning, sustainable food farming development cannot stand apart from environmental protection, in view of, among other things, on-going climate change. All of these matters are in close relation with the management and control of plant diseases, for which development and introduction of innovative tools involving reduction of the use of synthetic pesticides are urgently needed, and called for by the most recent European legislation on the question; however, the sector's income and production must be maintained. The defence of crops against fungal and bacterial phytopathogens is still mainly based on the use of copper-based compounds, even in organic farming, where the few synthetic fungicides and the only effective product usable against downy mildew for grapevine exploit the antimicrobial properties of that metal. In the past 100 years


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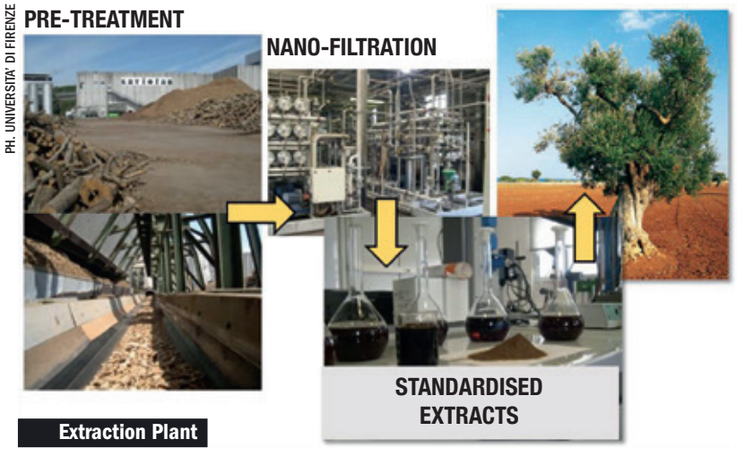
the repeated and continued use of copper-based compounds in plant protection has, however, resulted in the accumulation of this element in the soil of agro-ecosystems, from which it can reach and pollute surface and ground water, causing heavy environmental risks and episodes of acute and chronic toxicity on a wide spectrum of organisms and microorganisms. The obvious adverse effects on the environment and for human health arising from the use of copper-based substances in plant protection of plants have led to the introduction in Europe of a regulation limiting such use. At the same time research has been initiated to evaluate possible alternatives to the use of copper in phytoiatry, with success so far mainly against few pathogenic fungi. Conversely there are still no alternatives to copper that have been found effective against bacterial pathogens of plants, where this deficiency is even more dramatic considering that climate changes are expanding the area of diffusion of many quarantine phytopathogenic bacteria for Europe, while also exacerbating the incidence and severity of those that are endemic. Furthermore, in addition to its direct toxicity, the repeated use of copper salts in agriculture has a very important collateral effect, absolutely not to be underestimated, which consists in an alarming increase in the percentage of antibiotic-resistant bacteria in agro-systems' microflora. This entails the creation in the environment of a veritable reservoir of genes for antibiotic resistance, which can easily be transmitted to bacteria that are pathogenic to humans and animals, making them resistant to antibiotics and thus nullifying the antibiotics' prophylactic and therapeutic action in human and veterinary medicine. This phenomenon proceeds in parallel to the obvious selection and diffusion of copper-resistant bacteria, which have thus become insensitive to copper-based phytoiatric treatments; this comes of the fact that the genes for the resistance to antibiotics and copper are usually located on the same bacterial plasmids. It is in this general framework that the two-year LIFE European project "After Cu" ("Anti-infective environmental friendly molecules against plant pathogenic bacteria for reducing Cu", LIFE12 ENV/IT/000336) has emerged, coordinated by the Department of Agrofood productions and environment Sciences (Dispaa), and whose scientific head is Dr. Stefania Tegli, from the Molecular Plant Pathology Laboratory. The ultimate goal of the "After Cu" project is to demonstrate in vitro and in planta the anti-infective performances of several innovative peptides, designed and synthetised by the research group in Florence, against Gram-negative phytopathogenic bacteria, so as to reduce in the next future the use of copper as a bactericide in agriculture. Among the main innovations that deserve to be highlighted is the fact that the target of these small proteins is not essential for the bacterial viability, but only for their pathogenicity: this is why their action is defined as anti-infective and not as antibiotic, hence with a low risk of development of resistance as a result of repeated treatments, along with effectiveness also against copper-resistant bacteria already present in agro-ecosystems. Besides Dispaa, also part of the team of the University of Florence are the researchers of the BioElectroLab (Dept. of Chemistry), and of the Laboratory of Plant Genetics (Dept. of Biology). The success of "After Cu" is also guaranteed by the collaboration with other highly qualified partners, such as the Centro d'edafologia y biology aplicada del segura (Cebas) of the Consejo Superior de Investigaciones Científicas (Csic) (Spain), the Istituto di Chimica dei composti organo metallici (Iccom) of the CNR in Pisa and two Italian companies dealing with greenhouse and field trials, which are Astra Innovazione e sviluppo Srl and Fattoria Soldano. Polyphenol preparations extracted and purified from vegetal residues and wastes not intended for human or animal consumption will be demonstrated to be anti-infective molecules equally effective against Gram-negative phytopathogenic bacteria under another two-year LIFE European project, which is also coordinated by Dr. Tegli (Dispaa), known by the acronym "Evergreen" ("Environmental friendly biomolecules from agricultural wastes as substitutes of chemical pesticides for plant diseases control", LIFE13ENV/IT/000461). In brief, polyphenols are secondary metabolites present in all vegetable species, where they are distributed accordingly to their role in the different organs and tissues, depending from their chemical structure. In general, the fundamental role of polyphenols is to contribute to the plant defenses against attacks by pathogenic microorganisms, insects and other animals, as well as against several abiotic and environmental stresses. Precisely because of these properties, in "Evergreen" polyphenols of plant origin will also be used to address another important issue, linked to the eco-sustainable and low environmental impact control of plant diseases caused by nematodes, in view to replace highly toxic conventional nematicides. Preliminary results have already shown the nematicide/nematostatic effects of extracts from chestnut biomass, rich in specific polyphenols such as hydrolysable tannins, currently used almost exclusively in the tanning industry. Essential for the development of this project are the competencies on polyphenolic compounds of plant origin brought into play by the University of Florence in the person of Prof. Annalisa Romani, from PhytoLab, specifically involved in optimising the processes of purification, fractioning, concentration and prototyping of the polyphenolic extracts, in order improve their anti-infective and nematicide performances. Finally, it is important to recall that the eco-sustainability of such production processes is based not exclusively on the use of vegetal waste, but also on the possibility of exploiting the exhaust resulting from extraction in order to power co-generation installations. The close connection between "After Cu" and "Evergreen" is also demonstrated by the participation as partners in both projects of Dispaa, of BioElectroLab and of the Laboratory of Plant Genetics (for the University of Florence), such as well as that of researchers from the Cebas-CSIC and Astra Innovazione e sviluppo Srl. These are flanked in synergy by the Consorzio Interuniversitario Nazionale per la Scienza e Tecnologia dei Materiali (Instm) and the company Mondo Verde Casa e Giardino Srl, in charge, respectively, of the evaluation of phenolic extracts' nematicide/nematostatic action and of the development of their prototyped formulations.



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