



Chemistry, activity, and impact of plant biocontrol products

Cédric Bertrand^{1,2} · Claire Prigent-Combaret⁴ · Azucena Gonzales-Coloma³

Received: 3 September 2018 / Accepted: 11 September 2018 / Published online: 24 September 2018
© Springer-Verlag GmbH Germany, part of Springer Nature 2018

The success of modern-day intensive farming practices is often attributed to the use of agrochemicals. However, the development of these chemicals, and specifically those which are synthetic, has led to many negative environmental consequences including the direct contamination of soil and water. Moreover, with the emergence of an increasingly frequent phenomenon of resistance among conventional pesticides and in a regulatory context for a use of pesticides more in line with sustainable development (EU “pesticide package”), biocontrol products may represent ideal candidates in the search for new eco-friendly products.

This special issue on chemistry, activity, and impact of plant biocontrol products includes a selection of papers presented at the 3th International Congress Natural Products and Biocontrol, which was held in Perpignan on September, 2016. The biennial Natural Products and Biocontrol Congress represents the most advanced research on biocontrol products’ mechanism and activity, leading the development of innovative biocontrol products in Europe and the world. More than 300 experts, from academic and industrial sectors, and scholars from 17 countries and regions worldwide attended this conference. Thirty-five oral presentations and 41 poster presentations were given during the conference. The topics include, but are not limited to:

- Plant extract and essential oil, characterization and activity
- Microbial metabolite, chemical characterization, activity and field evaluation

- Microbial interaction
- Fate and impact of biocontrol products

This congress wants to promote multidisciplinary approaches and to create cross discussions between research and industrial stakeholders, to stimulate European and international collaborations between scientists and biocontrol manufacturers for the purpose of developing innovative biocontrol products and improving practices.

Plant extract and essential oil, characterization and activity

From a total of 20 articles in this issue, 11 deal with plant-derived compounds and 8 of these articles are on essential oils, demonstrating that these volatile extracts from plants are becoming important role players in the search for new biocontrol agents. The articles focused on the control of important pests and diseases with known essential oils (Yarou et al., Benomari et al., Nguemezi Tchameni et al., Muchembled et al., and Habbadi et al.), push-pull strategies (Lamy et al.), use of distillation residues (Andreu et al.), and synergism (Ouedrhiri et al.).

Microbial biocontrol mechanisms and metabolites, characterization and activity

Five research papers and two review papers deal with microbial mechanisms of biocontrol and their regulation through biotic interactions. An important focus in this special issue is made on cyclic lipopeptides (e.g., surfactin, fengycin, mycosubtilin) that are produced by several bacterial genera, but the most well-known genus remains the *Bacillus* genus. These compounds are produced via non-ribosomal peptides synthases (NRPS) or polyketide synthases (PKS) or hybrid NRPS/PKS pathways, and specific features of gene clusters involved in their biosynthesis are discussed in this special issue (Esmaeel et al. 2018). NRPS/PKS are modular enzymes and allow the biosynthesis of a very large diversity

Responsible editor: Philippe Garrigues

✉ Cédric Bertrand
cedric.bertrand@univ-perp.fr

¹ PSL Research University : EPHE-UPVD-CNRS, USR 3278 CRILOBE, Université de Perpignan, Perpignan Cedex, France

² Société Akinao, Perpignan Cedex, France

³ ICA-CSIC, Serrano115-dpdo, 28006 Madrid, Spain

⁴ Université Lyon, Université Claude Bernard Lyon 1, CNRS, INRA, VetAgro Sup, UMR5557 Ecologie Microbienne, F-69622 Villeurbanne, France

of molecules with potential biocontrol activities but also as pharmaceuticals (Esmaeel et al. 2018). Here, their ability to control fusariosis in ornamental bulb plants (Mihalache et al. 2018), septorisosis in wheat (Mejri et al. 2018), and fungal disease in maize in Central Africa (Kulimushi et al. 2018) are reported. These compounds like surfactin also have other important ecological roles as they contribute to the rhizosphere colonization with exopolysaccharides (Al-Ali et al. 2018). When combining different cyclopeptides, synergistic antifungal effects may exist (Mihalache et al. 2018). The biocontrol activities of secondary metabolites from other chemical families (e.g., viridin and gliovirin) produced by *Trichoderma* species on *Phytophthora* species are also described (Pakora et al. 2018). Finally, it is also debated how secondary metabolites and cooperation between bacteria in the root microbiota can affect the biocontrol efficiency of biocontrol agents and must be taken into account as much as possible (Besset-Manzoni et al. 2018).

Fate and impact of biocontrol products

Romdhane et al. and Salvia et al. develop research on environmental fate and biocontrol products' dissipation and impact. Romdhane et al. develop research to study abiotic (i.e., photolysis) and biotic (i.e., biodegradation) processes involved in the fate of leptospermone, a natural β -triketone herbicide, by combining chemical and microbiological approaches. Salvia et al. propose a new proxy based on a new approach (called Environmental Metabolic Footprint) for the discrimination between control and pesticide-exposed sediments in order to further characterize environmental impact of conventional pesticide and biocontrol products.



Pr. Cédric Bertrand Since 2008, Cedric Bertrand is the Chairman of the Groupe Francophone d'Etude des Pesticides Organiques d'Origine Naturelle and since 2018 of the "Académie du Biocontrôle et de la Protection Biologique Intégrée." He has a Ph.D. in Agroressources and Phytochemistry from the National Polytechnic Institute of Toulouse, France. He has worked in University of Lyon and he is currently Professor in Perpignan University and the Scientific

Director of Akinao, a society dedicated to biocontrol research and

development. He moved from applied research in ecological chemistry to develop new metabolomics tools for environmental fate characterization of phytopharmaceutical products.



Dr Claire Prigent-Combaret is a Scientific Research Director at the National Center for Scientific Research (CNRS). She received her doctorate in Microbiology from the University of Paris, and has worked as a postgraduate researcher at the University of Lyon 1 and Geneva. She is the head of the Rhizosphere group in the Lab of Microbial Ecology at University Lyon 1 since 2013. Her group is focusing on the microbiota associated to plant roots and involved in the alleviation of

plant biotic and abiotic stresses and promotion of plant growth. It is studying the ecological mechanisms of interaction between microorganisms within the microbiota and between the plant and the microorganisms and has discovered biocontrol secondary metabolites against fungal pathogens and parasitic plants.



Dr. Azucena Gonzales-Coloma is a scientific researcher at the Institute of Agricultural Sciences, CSIC. She received her doctorate from the Complutense University of Madrid, Spain, and worked as a postgraduate researcher at the University of California, in Los Angeles, and Hokkaido Agricultural Experiment Station, Japan. She is the head of the CSIC Research group: Biopesticides: Biotechnology and Natural Products Chemistry, focused on the discovery and pro-

duction of botanical and fungal biopesticides from plant and fungal species (endophytic fungi) and agricultural residues. She has published more than 140 scientific articles and has seven patents, three of them licensed.