



## OPEN ACCESS

EDITED AND REVIEWED BY  
Francesca De Luca,  
National Research Council (CNR), Italy

## \*CORRESPONDENCE

Brigitte Mauch-Mani  
✉ brigitte.mauch@protonmail.com  
Essaid Ait-Barka  
✉ ea.barka@univ-reims.fr

RECEIVED 04 June 2023

ACCEPTED 30 June 2023

PUBLISHED 14 July 2023

## CITATION

Ait-Barka E and Mauch-Mani B (2023)  
Editorial: Unraveling plant-microbe  
interactions: from ecology to  
mechanisms, volume II.  
*Front. Plant Sci.* 14:1234372.  
doi: 10.3389/fpls.2023.1234372

## COPYRIGHT

© 2023 Ait-Barka and Mauch-Mani. This is an open-access article distributed under the terms of the [Creative Commons Attribution License \(CC BY\)](https://creativecommons.org/licenses/by/4.0/). The use, distribution or reproduction in other forums is permitted, provided the original author(s) and the copyright owner(s) are credited and that the original publication in this journal is cited, in accordance with accepted academic practice. No use, distribution or reproduction is permitted which does not comply with these terms.

# Editorial: Unraveling plant-microbe interactions: from ecology to mechanisms, volume II

Essaid Ait-Barka<sup>1\*</sup> and Brigitte Mauch-Mani<sup>2\*</sup>

<sup>1</sup>Unité de Recherche Résistance Induite et BioProtection des Plantes- EA4707 - USC INRAe1488 UFR Sciences Exactes et Naturelles, Université de Reims Champagne-Ardenne, Reims, France,

<sup>2</sup>Département de Biologie, Laboratoire de Biologie Moléculaire et Cellulaire, Université de Neuchâtel, Neuchâtel, Switzerland

## KEYWORDS

oomycete, nitric oxide, resistance genes, endophytes, *Verticillium wilt*

## Editorial on the Research Topic

### Unraveling plant-microbe interactions: from ecology to mechanisms, volume II

The co-evolutionary relationship between plants and microbes has led to complex mechanisms of offense and defense, primarily centering on the innate immune system of host plants countering the virulence determinants employed by pathogens (Webster, 2014). Both above ground and underground plant organs are frequently exposed to intimate contact with a wide range of microorganisms, including members of phyla as diverse as viruses, bacteria, oomycetes, fungi, and eukaryotic protozoans. The outcome of interactions between the plants and these microbial communities can be neutral, detrimental, or even beneficial for the plants.

The molecular events occurring between plants and both 'friendly' and 'hostile' microbes trigger a range of highly dynamic plant cellular responses within the plant. These responses play a crucial role in pathogen recognition and the induction of appropriate signaling pathways for effective defense (Peyraud et al., 2017).

The Research Topic "Unraveling Plant-Microbe Interactions: From Ecology to Mechanisms, Volume II" encompasses various aspects of plant-microbe interactions and explores several intriguing questions. These include: why do certain microbes target specific plants while ignoring others? Is it due to the lack of necessary tools for infecting certain plants, or do some plants possess superior defense mechanisms to counteract such attacks? Is there a lack of attraction between the microbe and the plant? How do plants defend themselves in response to pathogen attacks? What mechanisms do they employ to recognize and counteract pathogens? How do plants interact with beneficial microorganisms? What are the molecular events and signaling pathways involved in establishing symbiotic relationships between plants and helpful microbes? Finally, how do plant pathogens respond to antagonistic microorganisms, and how does this response impact the effectiveness of biocontrol strategies?

Oomycetes, including *Phytophthora* (Erwin and Ribeiro, 1996) and *Plasmopara* (Koledenkova et al., 2022), pose significant and grave risks to plants, as emphasized in the study by Derevnina et al. (2016). These pathogens have the potential to inflict substantial losses on various plant species. This context sets the stage for the following three articles, which delve into novel perspectives and provide valuable insights into the intricate ways plants respond to oomycete attacks.

To better understand the events taking place during the infection of potato plants with the late blight pathogen *Phytophthora infestans*, Li et al. took advantage of the dual RNA-seq technique to study the genome-wide expression profiles in a late blight-resistant and susceptible cultivar. The study identified distinct infection profiles for effector, NBS-LRR, and kinase-encoding genes in the compatible and the incompatible interaction.

Drozda et al. investigated the influence of nitric oxide (NO) on the expression of resistance (R) genes regulated by the RNA-directed DNA methylation pathway (RdDM). Specifically, the authors studied the role of NO-dependent redox targets involved in the tuning of the *R gene* expression by complementary miRNA during the potato-avr *P. infestans* interaction. The researchers proposed that biphasic waves of NO released in response to *P. infestans* play a crucial role in the successful establishment of resistance to late blight in potato through the RdDM pathway controlling *R gene* expression.

In their study, Philisoph et al. explored the response of cucumber plants to co-infection with two distinct pathogens: *Pythium spinosum*, a necrotrophic pathogen, and *Cucumber green mottle mosaic virus* (CGMMV), which belongs to a different kingdom and has a different lifestyle. An intriguing finding from their research is the rapid downregulation of host defense gene activity associated with defense against necrotrophic pathogens following the establishment of the virus in plants previously infected with *Pythium*. The study by Philisoph and colleagues provides valuable insights into the complex interactions and regulatory processes involved when plants face the challenge of co-infection by pathogens from different kingdoms and with distinct lifestyles.

In addition to their role in defense against pathogens, plant defense mechanisms also play a role in the case of endophytes. *Epichloë*, a fungal endophyte, is known to colonize cool-season grasses (*Poaceae*) (Selosse and Schardl, 2007). Zhang et al. studied seed transmission of *Epichloë* in perennial ryegrass, focusing on the transcriptomes of reproductive tissues from host genotype with high-transmission and low-transmission rates. Their research revealed that the efficiency of seed-transmission of the endophyte is mainly influenced by plant defense responses lowering the colonization of host tissues by *Epichloë*. The findings highlight the significance of plant defense mechanisms in modulating the establishment and transmission of endophytes such as *Epichloë* in cool-season grasses.

The incidence of *Verticillium* wilt, a devastating disease affecting olive trees, poses significant challenges in olive-growing regions worldwide, and its control is notoriously difficult (Tsror, 2011). In an effort to better understand the mechanisms underlying olive tree tolerance to this pathogen, Cardoni et al. employed a comprehensive approach. Using different olive varieties with varying degrees of susceptibility/tolerance to *Verticillium* wilt, the authors investigated multiple aspects, including root functional traits, expression of defense-related genes, root lignin content, and membrane permeability. Through their research, the authors successfully identified specific factors that influence the performance of olive trees when confronted with *Verticillium* invasion.

Finally, in their review article on the potential role of the microbiome in managing Hualongbin disease in citrus caused by *Candidatus Liberibacter asiaticus* (Das et al., 2021), Srivastava et al. present the knowledge, prospective methodology, and open questions remaining in this area of research.

Overall, the articles included in this Research Topic further validate the extensive range of defense mechanisms that plants possess to safeguard themselves against various threats.

## Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

## Acknowledgments

We thank all the authors who contributed to this Research Topic.

## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

## Publisher's note

All claims expressed in this article are solely those of the authors and do not necessarily represent those of their affiliated organizations, or those of the publisher, the editors and the reviewers. Any product that may be evaluated in this article, or claim that may be made by its manufacturer, is not guaranteed or endorsed by the publisher.

## References

- Das, A. K., Chichghare, S., Sharma, S. K., Singh, S., Kumar, A., Nerkar, S., et al. (2021). Genetic diversity and population structure of 'Candidatus liberibacter asiaticus' associated with citrus HLB in India based on the prophage types. *World J. Microbiol. Biotechnol.* 37, 95. doi: 10.1007/s11274-021-03057-8
- Derevnina, L., Petre, B., Kellner, R., Dagdas, Y. F., Sarowar, M. N., Giannakopoulou, A., et al. (2016). Emerging oomycete threats to plants and animals. *Philos. Trans. R. Soc. B: Biol. Sci.* 371 (1709), 20150459. doi: 10.1098/rstb.2015.0459
- Erwin, D. C., and Ribeiro, O. K. (1996). *Phytophthora diseases worldwide* (American Phytopathological Society (APS Press)).
- Koledenkova, K., Esmael, Q., Jacquard, C., Nowak, J., Clément, C., and Ait Barka, E. (2022). *Plasmopara viticola* the causal agent of downy mildew of grapevine: from its taxonomy to disease management. *Front. Microbiol.* 13. doi: 10.3389/fmicb.2022.889472
- Peyraud, R., Dubiella, U., Barbacci, A., Genin, S., Raffaele, S., and Roby, D. (2017). Advances on plant-pathogen interactions from molecular toward systems biology perspectives. *Plant J.* 90 (4), 720–737. doi: 10.1111/tpj.13429
- Selosse, M., and Scharidl, C. L. (2007). Fungal endophytes of grasses: hybrids rescued by vertical transmission? an evolutionary perspective. *New Phytol.* 173, 452–458. doi: 10.1111/j.1469-8137.2007.01978.x
- Tsrur, L. (2011). Review: epidemiology and control of verticillium wilt on olive. *Isr. J. Plant Sci.* 59, 59–69. doi: 10.1560/IJPS.59.1.59
- Webster, N. S. (2014). Cooperation, communication, and co-evolution: grand challenges in microbial symbiosis research. *Front. Microbiol.* 5. doi: 10.3389/fmicb.2014.00164