

## Breakthroughs in the biocontrol of plant diseases in the past 50 years

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### Keywords

Biological control, *Trichoderma*, *Cryphonectria parasitica*, Suppressive soil, SynCom

Biological control of plant disease by beneficial (micro)organisms is one of the main tools presently available to preserve plant health within the wider context of One Health and in line with the goals of the 2030 Agenda for Sustainable Development. The authorship of the term “biological control” should be attributed to Carl Freiherr von Tubeuf who pioneered biological control of plant diseases and introduced this term to plant pathology over a century ago in 1914. However, historically, the foundation for modern biocontrol research was laid during the 1970s, with 1974 as a milestone, when Baker and Cook published the first book wholly devoted to the subject of biological control of plant pathogens.

The development of biocontrol agents (BCAs) continues to gain in prominence in plant pathology, addressing the need to feed the increasing world population and to insure safe and secure access to foodstuffs. In the past 50 years several investigations have focused on the selection, evaluation, and use of beneficial (micro)organisms to be developed as BCAs for the management of plant diseases affecting cultivated plants for feed, food, and nonfood purposes. During the same decades the definition of “biological control” has experienced many changes over time. According to Cook and Baker (1983), biological control should be defined as the “*direct or indirect inhibition of a disease, or the pathogen causing the disease, by another organism (antagonist) or group of organisms*”. However, a modern broader definition now also includes specialized metabolites often termed biopesticides.

The present invited review considers selected advances within the last 50 years, highlighting those that can be considered as breakthroughs for the biocontrol research field. Selected examples of successful BCAs and strategies are reported. The first example relates to the history of the progress in researching *Trichoderma* isolates as commercial BCAs, from the first report of an isolate of *Trichoderma lignorum* (*T. viride*) capable of reducing the symptoms caused by *Rhizoctonia solani* on citrus to the present; the exploitation of mycoviruses to confer hypovirulence to plant pathogenic fungi (the case of *Chryphonectria parasitica*, causal agent of chestnut canker); The second one concerns the role of microbial communities in the suppressiveness of soils, and evolving approaches including the establishment of synthetic microbial communities (SynCom), this last supported by new “omics” technologies to confer more efficient plant protection than individual strains.

In view of the need for sustainable development and considering the efforts made to improve the knowledge on biocontrol and render it a reality for the management of plant diseases, the use of beneficial (micro)organisms must now more than ever be a driver of agricultural research to improve the social situation where access to food is limiting.

Further research will hopefully permit to manage the resident natural (micro)organisms, thus representing a change in the perspective: less dependence on polluting treatments but greater reliance on resident (micro)biota to increase resilience of crops, a key to sustainable food and agricultural systems.

### Source:

Sarrocco S. (2023) Biological Disease Control by Beneficial (Micro)Organisms: Selected Breakthroughs in the Past 50 Years. *Phytopathology* <https://doi.org/10.1094/PHYTO-11-22-0405-KD>