

# Chapter 1

## Introduction to Plant-Microbe Interactions

**Ben Lugtenberg**

**Abstract** Pathogenic microbes and pest organisms as well as unfavorable growth conditions can be a threat for plant growth. Other beneficial microbes and small organisms can be used to protect plants against these attackers or to assist the plant to overcome the unfavorable conditions. These plant-beneficial organisms can be divided into classes which (i) reduce plant diseases, (ii) which regulate plant growth, (iii) help plants to overcome stresses, and (iv) inactivate soil pollutants which inhibit plant growth or make (parts of) the plant unsuitable for consumption.

**Plant Pathogens and Pest Organisms are a Threat for Plant Growth** In this book we discuss pathogens and pest organisms which are a threat for plant growth. We highlight the roles which microbes can play in making agriculture and horticulture more sustainable. Selected microbes are able to (partly) replace most chemicals which are presently used in agriculture. In addition, microbes can often be used against diseases for which no chemicals are available. In this book, the following activities and applications of microbes will be discussed.

**Biological Control of Plant Diseases** Approximately 25 % of the world's crop yield is lost every year, mainly due to diseases caused by fungi, by other pathogens, and by pests. Plant protection products are on the market to fight these diseases. Presently these are mainly chemicals. Their use can be threatening the health of people and polluting the environment. Disease control with beneficial microbes is an alternative which allows sustainable crop production. The use of microbial plant protection products is growing and their importance will strongly increase because of political and public pressure.

**Regulation of Plant Growth** The world population is growing and the amount of food needed by 2050 will be the double of what is being produced now, whereas the area of agricultural land is decreasing. We have to increase crop yield in a sustainable way, i.e. chemical plant growth regulators have to be replaced by microbiological

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B. Lugtenberg (✉)  
Institute of Biology, Sylvius Laboratory, Leiden University,  
Sylviusweg 72, 2333 BE Leiden, The Netherlands  
Tel.: +31629021472  
e-mail: Ben.Lugtenberg@gmail.com

products. Also here, the use of microbial products is growing and their importance will strongly increase.

**Control of Plant Stress by Microbes** An increasing area of agricultural land is arid and/or salinated. Global warming will increase this area. Plant growth is inhibited, or even made impossible, by drought and salt. It has been proven already that microbes can be used successfully to alleviate such stresses.

**Microbial Cleaning of Polluted Land** Chemical pollution of land can make plant growth difficult or even impossible. But even when crop plants grow on such lands, their products are often polluted and not suitable for consumption. Selected microbes have been already been used successfully to detoxify chemical pollutants in soil and to remove heavy metals, thereby allowing the growth of healthy plants.

The field of Plant-Microbe Interactions has made important progress thanks to the development of new technologies. Attention to state-of-the-art DNA and visualization techniques is paid in two separate chapters. Moreover, successful examples of progress are presented under Paradigms of Plant-Microbe Interactions. The book ends with the presentation of a number of real innovative research projects of which the future will show whether these are dreams or big steps forwards.