Prospects and Applications for Plant-Associated Microbes

A laboratory manual

Part B: Fungi

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Main cover photo, taken by Anna Maria Pirttilä, presents bog bilberry (*Vaccinium uliginosum* L.). The picture was taken on a midsummer day in Lapland, Enontekiö, Finland, in June 2006. The sand dunes of Kalmakaltio in the subarctic Enontekiö are famous for their beauty, having patches of bog bilberry, lingonberry, crowberry, juniper, lichen and grasses dispersed between the dunes.

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PREFACE

Plants possess a generally sessile life style and therefore they have to receive nutrition, to suffer the seasonal effects, and to survive pathogenic attacks continually at the same stand. This stationary whereabouts of plants has caused pressure to create different strategies to survive. One such way is through collaboration at various levels with other mobile organisms.

In plants, the first reports of microbial symbiosis were made at the end of the 19th century when mycorrhizae and rhizobia were found in association with plant roots. Mycorrhizae are today the best studied plant-associated fungi, but not the only ones. Plants have numerous endophytic infections in every tissue, some being more systemic in nature, and others very localized. Endophytic fungi can be transferred to the next generation in the seeds, which is referred to as vertical transmission, whereas transmission by wind or water is called horizontal. “Endophytic continuum” describes the range of the interactions being from that of latent pathogens to mutualistic symbionts. Plant-associated fungi increase plant growth and resistance towards abiotic and biotic stresses. They can affect plant disease resistance directly by acting as nematophagous fungi or mycoparasites, or by producing antagonistic compounds towards pathogens, and indirectly by inducing plant defense. The richness of secondary metabolites produced by endophytic fungi is overwhelming, and they are considered one of the most promising sources of new drug compounds.

Studying plant-microbe interactions can be challenging as two organisms are involved. Localizing the fungi in plant tissue, analyzing the community structure of unculturable strains, studying the gene expression during host infection, or cues leading to activation of secondary metabolism require specific knowledge and skills. Isolation, culturing, and screening of endophytic fungi for bioactive compounds can be fruitful, if experience-driven information on the growth conditions and secondary metabolite production, as well as tests for bioactivity are provided. This book guides the reader in the word of plant-associated fungi, giving both theoretical and practical insight on the potential of this interaction in biotechnology. Detailed instructions and step-by-step protocols are described for isolation, identification, localization and community analysis of fungi, studies on their bioactivity, molecular plant-fungal interactions, and development of fungi as tools for biotechnology.

We thank all colleagues and friends who selflessly expended their valuable time to contribute to this volume.

Anna Maria Pirttilä
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