Preface

Nutrient Use Efficiency in Plants: Concepts and Approaches is the ninth volume in the *Plant Ecophysiology* series. It presents a broad overview of topics related to improvement of nutrient use efficiency of crops.

Nutrient use efficiency (NUE) is a measure of how well plants use the available mineral nutrients. It can be defined as yield (biomass) per unit input (fertiliser, nutrient content). NUE is a complex trait: it depends on the ability to take up the nutrients from the soil, but also on transport, storage, mobilization, usage within the plant, and even on the environment. NUE is an important contributor to growth control and yield; the same levels of nutrients may cause growth and yield penalty in one species or variety but not in another one. NUE is of particular interest as a major target for crop improvement. Improvement of NUE is an essential pre-requisite for expansion of crop production into marginal lands with low nutrient availability but also a way to reduce use of inorganic fertiliser. Aspects of NUE have been covered in detail within the *Plant Ecophysiology* series, in the volumes on nitrogen, phosphorus, sulfur, or root physiology. In this volume, the expanding field of nutrient use efficiency is comprehensively discussed, with the aim to present the current approaches, concepts, and ideas on how to better understand the genetic control of NUE and how to use this knowledge for its improvement.

This volume, however, is special not only because of the new topic. It is also a presentation of a Marie Curie Initial Training Network BIONUT-ITN (BIOchemical and genetic dissection of control of plant NUTrition). BIONUT-ITN is a network of eight research institutions and one company who came together to provide state-of-the-art research training in different aspects of plant nutrient use efficiency. The individual student's projects have been linked to ensure that a fully integrated approach is taken to get the whole picture of plant nutrition. This integration is a key feature of the network, as it advances the science beyond focusing on one mineral nutrient, such as nitrogen or sulfur, to look at the combined nutritional needs of the plant using models and crops, in the laboratory as well as in the field. BIONUT is also a hub for activities in plant nutrition field, organizing conferences and fostering new collaborations. This volume is evidence of such integration. The contributions of the eight students span a broad range of themes

within NUE. There are detailed reviews focused on single nutrients – sulfur, phosphorus, iron, and boron. Thus, macronutrients are discussed alongside micronutrients needed in small quantities, but still essential. But these reviews stress also the importance of interaction between different nutrients and the need for integrative view on plant nutrition. Other chapters bring overviews of large and complex topics or approaches – natural variation, autophagy, or effects of elevated CO_2. Included are contributions targeting nutrient deficiency on a molecular level as well as its monitoring in the field. Together with a thorough introduction into the NUE topic, the book presents ten chapters that wrap up the theme of NUE and the potential for crop improvement.

We hope that this book will find broad audience. It is not only an overview of an interesting and important research area; it is also a snapshot of current activities in the field and introduction of new generation of scientists from the BIONUT-ITN. We believe that it will be of interest to graduate students and researchers in a wide range of disciplines including plant nutrition, plant physiology, plant biochemistry, and agriculture.

Harpenden, UK — Malcolm J. Hawkesford
Cologne, Germany — Stanislav Kopriva
Groningen, The Netherlands — Luit J. De Kok

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