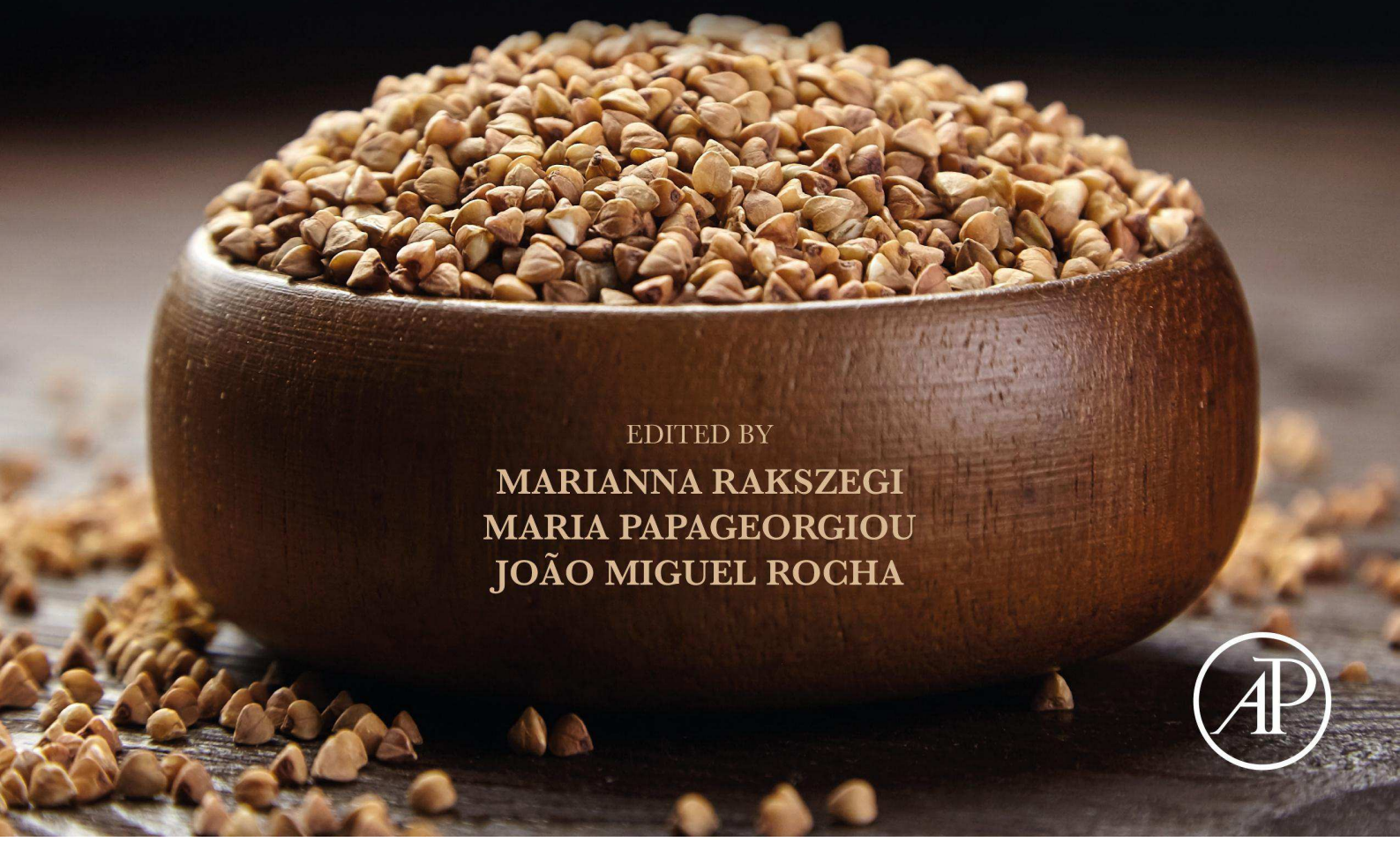


DEVELOPING SUSTAINABLE AND HEALTH-PROMOTING CEREALS AND PSEUDOCEREALS

CONVENTIONAL AND MOLECULAR BREEDING



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Conventional and Molecular Breeding

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CHAPTER

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Rheology as a tool to predict the effect of different biotic and abiotic factors on the quality of cereals and pseudocereals

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1 Introduction

Cereals represent a staple food for a majority of the world's population and play an important role in food security and nutrition. They are the most produced crops in the world (2777 million tons in 2020), with maize, wheat, and rice comprising more than 80% of total cereal production (FAOSTAT, 2021). The distribution of cereal production around the world depends on various factors (environmental, cultural, political, and economic), among which temperature and water availability have a major impact on crop growth in a given region (Awika, 2011). Maize is the mostly produced cereal crop in the world with over 1162 million tons produced in 2020. The United States of America is the largest producer of maize, accounting for 30% of world production in 2020, followed by China at 22.7% and Brazil at 8.8%. World wheat production in 2020 reached 761 million tons. China and India are the world's largest producers of wheat, producing approximately 31% of world wheat in 2020, followed by the Russian Federation (9.7%) and the United States (6.8%). World rice production stood at 757 million tons in 2020. Asia is the world's largest producer of rice, producing about 90% of world rice, with China and India accounting for 57% of world rice production in 2020 (FAOSTAT, 2021). In regions where the main problem is frequent droughts, like in some parts of Africa and India, drought-tolerant crops, such as sorghum and millet, are commonly grown. On the contrary, barley is mostly produced in Northern Europe, northern parts of the United States of America and Canada being more tolerant to cold climates (FAOSTAT, 2021).

While having a large impact on the world's food supply, cereals' resilience to various biotic and abiotic stress factors is of the utmost importance. However, every year, biotic factors such as diseases, insect pests, and weeds lead to significant yield losses during both preharvest and postharvest period (Singh et al., 2020). According to Oerke (2006), weeds cause high yield losses (up to 34%) in spring wheat, rice, maize, while insect pests and plant diseases cause somewhat lower yield losses (18% for insects and 16% for plant diseases). Apart from lowering the yield, biotic stressors largely influence crop quality (Singh et al., 2020).

Unlike the biotic stresses, caused by living organisms, which directly affect the host's growth and development by depriving it of nutrients (Bakala et al., 2021), abiotic stresses, i.e., environmental factors (predominantly drought, cold, salinity, and heat), impede plant growth and development processes, which cause both reduction in seed yield and alteration in grain composition and quality (Ashraf, 2014).

Since rheological measurements are highly sensitive to changes in cereals' molecular structure and composition (Amjid et al., 2013), rheology is a widely used tool to measure the impact of different biotic and abiotic stressors on cereals' performance during processing, as well as to quantify the extent of changes in grain composition.

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DEVELOPING SUSTAINABLE AND HEALTH-PROMOTING CEREALS AND PSEUDOCEREALS

CONVENTIONAL AND MOLECULAR BREEDING

Provides comprehensive information on the use of genetic resources and pre-breeding activities to improve health-related properties of cereals and pseudocereals

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Developing Sustainable and Health-Promoting Cereals and Pseudocereals: Conventional and Molecular Breeding reviews the most recent knowledge in the field of cereal and pseudocereal breeding, with particular emphasis on the latest biotechnological techniques that are very likely to lead to breakthroughs in plant breeding.

Cereals and pseudocereals are of increasing interest as the world's population further supports plant-based diets and its consequent demand for raw- and versatile ingredients that can be processed into nutritious and yet affordable foods. The pseudocereals particularly allow the widening of the choice of gluten-free products. Simultaneously, the focus on plant breeding for grain crops is undergoing a clear shift from the focus on yield and disease resistance of a decade ago to now address concerns about sustainability, resilience to climate change, and health- and nutrition-associated benefits.

This book provides the overview necessary for understanding the potential impact and benefit of improved production of cereals and pseudocereals with high nutritional value by breeding and targeted field management (such as nutritional inputs, organic, low-input cultivation, etc.).

Key Features:

- Includes coverage of cereals and pseudocereals in a single comprehensive volume
- Focuses on sustainable circular economy, including assurance of food safety, quality, and health benefits
- Approaches breeding to attain robust cereal and pseudocereals with higher nutritional value and adapted to specific regions, climate change, and global warming

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