



DEVELOPING SUSTAINABLE AND HEALTH-PROMOTING CEREALS AND PSEUDOCEREALS

CONVENTIONAL AND MOLECULAR BREEDING



EDITED BY

MARIANNA RAKSZEGI
MARIA PAPAGEORGIU
JOÃO MIGUEL ROCHA



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Edited by

MARIANNA RAKSZEGI

Agricultural Institute, Centre for Agricultural Research, Martonvásár, Hungary

MARIA PAPAGEORGIU

Department of Food Science and Technology, International Hellenic University, Thessaloniki, Greece

JOÃO MIGUEL ROCHA

*Universidade Católica Portuguesa, CBQF—Centro de Biotecnologia e Química Fina—Laboratório Associado,
Escola Superior de Biotecnologia, Porto, Portugal*



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Contributors

- Vladimir Aćin** Institute of Field and Vegetable Crops, Novi Sad, Serbia
- Melekşen Akın** Department of Horticulture, Iğdır University, Iğdır, Turkey
- Admas Alemu** Department of Plant Breeding, The Swedish University of Agricultural Sciences, Lomma, Sweden
- Osvin Arriagada** Department of Plant Sciences, Faculty of Agronomy and Forest Engineering, Pontifical Catholic University of Chile, Santiago, Chile
- Suman Bakshi** Nuclear Agriculture & Biotechnology Division, Bhabha Atomic Research Centre, Mumbai, Maharashtra, India
- Pradeep Bhati** Borlaug Institute for South Asia Ludhiana, Ludhiana, Punjab, India
- Ljiljana Brbaklić** Institute of Field and Vegetable Crops, Novi Sad, Serbia
- Zsuzsanna Bugyi** Research Group of Cereal Science and Food Quality, Department of Applied Biotechnology and Food Science, Faculty of Chemical Technology and Biotechnology, Budapest University of Technology and Economics, Budapest, Hungary
- Elaine Ceresino** Department of Plant Breeding, The Swedish University of Agricultural Sciences, Lomma, Sweden
- Aakash Chawade** Department of Plant Breeding, The Swedish University of Agricultural Sciences, Lomma, Sweden
- Tamara Dapčević Hadnađev** University of Novi Sad, Institute of Food Technology, Novi Sad, Serbia
- Sadiye Peral Eyduran** Department of Horticulture, Muğla Sıtkı Koçman University, Fethiye, Turkey
- Arnout R.H. Fischer** Marketing and Consumer Behaviour Group, Wageningen University, Wageningen, Netherlands
- Agata Gadaleta** Department of Soil, Plant and Food, University of Bari, Bari, Italy
- Tamer H. Gamel** Guelph Research & Development Centre, Agriculture & Agri-Food Canada, Guelph, ON, Canada
- Grzegorz Ganczewski** Management in Networked and Digital Societies (MINDS) Department, Kozminski University, Warsaw, Poland
- Svetlana Glogovac** Institute of Field and Vegetable Crops, Novi Sad, Serbia
- Hanna Górska-Warsewicz** Department of Food Market and Consumption Research, Institute of Human Nutrition Sciences, Warsaw University of Life Sciences, Warsaw, Poland
- Mustafa Guzel** Department of Biotechnology, Middle East Technical University, Ankara; Department of Food Engineering, Hitit University, Corum, Turkey
- Nihal Guzel** Department of Food Engineering, Hitit University, Corum, Turkey
- Miroslav Hadnađev** University of Novi Sad, Institute of Food Technology, Novi Sad, Serbia
- Cynthia Helou** Saint Joseph University of Beirut, Faculty of Pharmacy, Department of Nutrition, Beirut, Lebanon
- Maria Itria Ibba** Global Wheat Program, International Maize and Wheat Improvement Centre (CIMMYT), Texcoco, Mexico DF, Mexico
- Goran Jaćimović** Faculty of Agriculture, University of Novi Sad, Novi Sad, Serbia
- Edina Jaksics** Research Group of Cereal Science and Food Quality, Department of Applied Biotechnology and Food Science, Faculty of Chemical Technology and Biotechnology, Budapest University of Technology and Economics, Budapest, Hungary
- Sanjay J. Jambhulkar** Nuclear Agriculture & Biotechnology Division, Bhabha Atomic Research Centre, Mumbai, Maharashtra, India
- Radivoje Jevtić** Small Grains Department, Institute of Field and Vegetable Crops, Novi Sad, Serbia
- Bojan Jocković** Institute of Field and Vegetable Crops, Novi Sad, Serbia
- Eva Johansson** Department of Plant Breeding, The Swedish University of Agricultural Sciences, Lomma, Sweden
- Suchita Kamble** Nuclear Agriculture & Biotechnology Division, Bhabha Atomic Research Centre, Mumbai, Maharashtra, India
- Marietta Kiss** Department of Marketing, Institute of Marketing and Commerce, Faculty of Economics and Business, University of Debrecen, Debrecen, Hungary
- Ankica Kondić-Špika** Institute of Field and Vegetable Crops, Novi Sad, Serbia

- Ramune Kuktaite** Department of Plant Breeding, The Swedish University of Agricultural Sciences, Lomma, Sweden
- Uttam Kumar** Borlaug Institute for South Asia Ludhiana, Ludhiana, Punjab, India
- Bartosz Kwiatkowski** Department of Food Market and Consumption Research, Institute of Human Nutrition Sciences, Warsaw University of Life Sciences, Warsaw, Poland
- Maryke Labuschagne** Department of Plant Sciences, University of the Free State, Bloemfontein, South Africa
- Mirjana Lalošević** Small Grains Department, Institute of Field and Vegetable Crops, Novi Sad, Serbia
- Sbatie Lama** Department of Plant Breeding, The Swedish University of Agricultural Sciences, Lomma, Sweden
- Yuzhou Lan** Department of Plant Breeding, The Swedish University of Agricultural Sciences, Lomma, Sweden
- Bernadett Langó** Research and Development Department Cereal Research Non-Profit Ltd., Szeged, Hungary
- Amir Maqbool** Department of Agricultural Genetic Engineering, Faculty of Agricultural Sciences and Technologies, Niğde Ömer Halisdemir University, Niğde, Turkey
- Iaria Marcotuli** Department of Soil, Plant and Food, University of Bari, Bari, Italy
- Cristina Martínez-Villaluenga** Department of Technological Processes and Biotechnology, Institute of Food Science, Technology and Nutrition (ICTAN-CSIC), Madrid, Spain
- Sanja Mikić** Institute of Field and Vegetable Crops, Novi Sad, Serbia
- Milan Miroslavljević** Institute of Field and Vegetable Crops, Novi Sad, Serbia
- Dorothy Nakimbugwe** Department of Food Technology and Nutrition, School of Food Technology, Nutrition & Bioengineering, Makerere University, Kampala, Uganda
- Renáta Németh** Research Group of Cereal Science and Food Quality, Department of Applied Biotechnology and Food Science, Faculty of Chemical Technology and Biotechnology, Budapest University of Technology and Economics, Budapest, Hungary
- Nhamo Nhamo** International Centre for Biosaline Agriculture, Crop Diversification and Genetics, Dubai, United Arab Emirates
- Dubravka Novotni** Faculty of Food Technology and Biotechnology, University of Zagreb, Zagreb, Croatia
- Gül Ebru Orhun** Department of Energy Management, Faculty of Canakkale Applied Science, Çanakkale Onsekiz Mart University, Çanakkale, Turkey
- Natalia Palacios-Rojas** International Maize and Wheat Improvement Center, Global Maize Program, Texcoco, Mexico
- Elena Peñas** Department of Technological Processes and Biotechnology, Institute of Food Science, Technology and Nutrition (ICTAN-CSIC), Madrid, Spain
- Milica Pojić** University of Novi Sad, Institute of Food Technology, Novi Sad, Serbia
- Mahbubjon Rahmatov** Department of Plant Breeding, The Swedish University of Agricultural Sciences, Lomma, Sweden
- Marianna Rakszegi** Cereal Breeding Department, Agricultural Institute, Centre for Agricultural Research, Martonvásár, Hungary
- Krystyna Rejman** Department of Food Market and Consumption Research, Institute of Human Nutrition Sciences, Warsaw University of Life Sciences, Warsaw, Poland
- Ritva Repo-Carrasco-Valencia** Centro de Investigación e Innovación en Granos Andinos, CIINCA, Universidad Nacional Agraria la Molina, Lima, Peru
- João Miguel Rocha** Universidade Católica Portuguesa, CBQF—Centro de Biotecnologia e Química Fina—Laboratório Associado, Escola Superior de Biotecnologia, Porto, Portugal
- Aldo Rosales-Nolasco** International Maize and Wheat Improvement Center, Global Maize Program, Texcoco, Mexico
- Alexandru Vasile Rusu** Life Science Institute; Genetics and Genetic Engineering, Faculty of Animal Science and Biotechnology, University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca, Cluj-Napoca, Romania
- Eszter Schall** Research Group of Cereal Science and Food Quality, Department of Applied Biotechnology and Food Science, Faculty of Chemical Technology and Biotechnology, Budapest University of Technology and Economics, Budapest, Hungary
- Andrés R. Schwember** Department of Plant Sciences, Faculty of Agronomy and Forest Engineering, Pontifical Catholic University of Chile, Santiago, Chile
- Endang M. Septiningsih** Department of Soil and Crop Sciences, Texas A&M University, College Station, TX, United States
- Jose Miguel Soriano** Sustainable Field Crops Programme, IRTA (Institute for Food and Agricultural Research and Technology), Lleida, Spain
- Zoltán Szakály** Department of Marketing, Institute of Marketing and Commerce, Faculty of Economics and Business, University of Debrecen, Debrecen, Hungary
- Firew Tafesse** Centro de Investigación e Innovación en Granos Andinos, Ethiopian Biotechnology Institute, Addis Ababa, Ethiopia
- Abidemi Olutayo Talabi** International Centre for Biosaline Agriculture, Crop Diversification and Genetics, Dubai, United Arab Emirates

Kassahun Tesfaye Centro de Investigación e Innovación en Granos Andinos, Ethiopian Biotechnology Institute; Centro de Investigación e Innovación en Granos Andinos, Institute of Biotechnology, Addis Ababa University, Addis Ababa, Ethiopia

Michael J. Thomson Department of Soil and Crop Sciences, Texas A&M University, College Station, TX, United States

Irene Tomé-Sánchez Department of Technological Processes and Biotechnology, Institute of Food Science, Technology and Nutrition (ICTAN-CSIC), Madrid, Spain

Sándor Tömösközi Research Group of Cereal Science and Food Quality, Department of Applied Biotechnology and Food Science, Faculty of Chemical Technology and Biotechnology, Budapest University of Technology and Economics, Budapest, Hungary

Monica Trif Food Research Department, Centre for Innovative Process Engineering GmbH, Syke, Germany

Kurniawan Rudi Trijatmiko Plant Breeding Innovations Platform, International Rice Research Institute, Los Baños, Laguna, Philippines

Dragana Trkulja Institute of Field and Vegetable Crops, Novi Sad, Serbia

Nikolaos Tsakirpaloglou Department of Soil and Crop Sciences, Texas A&M University, College Station, TX, United States

Secil Turksoy Department of Food Engineering, Hitit University, Corum, Turkey

Daniel Vazquez Centro de Investigación e Innovación en Granos Andinos, Instituto Nacional de Investigación Agropecuaria (INIA), Programa de Cultivos de Secano, Estación Experimental INIA La Estanzuela, Colonia, Uruguay

Kubilay Yıldırım Department of Molecular Biology and Genetics, Faculty of Sciences, Ondokuzmayıs University, Samsun, Turkey

Dragan Živančev Institute of Field and Vegetable Crops, Novi Sad, Serbia

Vesna Župunski Small Grains Department, Institute of Field and Vegetable Crops, Novi Sad, Serbia

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

Miroslav Hadnađev^a, Sanja Mikić^b, Milica Pojić^a,
and Tamara Dapčević Hadnađev^a

^aUniversity of Novi Sad, Institute of Food Technology, Novi Sad, Serbia, ^bInstitute of Field and Vegetable Crops, Novi Sad, Serbia

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

Edited by

Marianna Rakszegi

Researcher of Cereal Chemistry, Cereal Breeding Department, Agricultural Institute, Centre for Agricultural Research, Martonvásár, Hungary

Maria Papageorgiou

Professor of Cereal Chemistry and Technology, Department of Food Science and Technology, International Hellenic University, Alexandrian Campus, Thessaloniki, Greece

João Miguel Rocha

Universidade Católica Portuguesa, CBQF - Centro de Biotecnologia e Química Fina – Laboratório Associado – Laboratório Associado Escola Superior de Biotecnologia, Porto, Portugal

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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