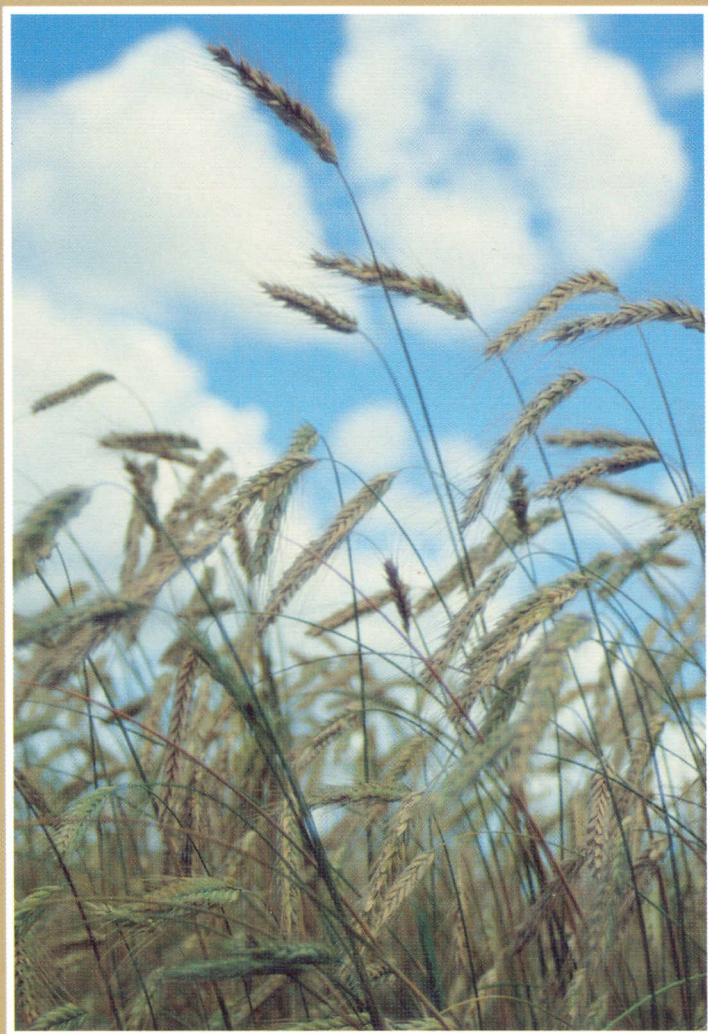


Second Edition

RYE

Production, Chemistry,
and Technology



Walter Bushuk, editor

CONTENTS

1. History, World Distribution, Production, and Marketing.

W. BUSHUK, 1

Origin and History, 1

Classification, 2

Area, Yield, and Quantity of World Production, 2

Uses, Merits, and Deficiencies, 3

International Trade, 4

2. Genetics and Breeding. G. J. SCOLES, J. P. GUSTAFSON, and J. G. McLEOD, 9

Genetics, 9

Disease Resistance • Pest Resistance • Cold Hardiness • Self Incompatibility •
Cytoplasmic Male Sterility • Plant Height • Other Plant Characteristics • Seed
Enzymes • Isozyme Studies • Meiosis • Seed Storage Proteins • Genetic and Physical
Maps

Cytogenetics, 18

In Situ Hybridization • Synteny with the Triticeae • B Chromosomes

Molecular Genetics, 20

Tandemly Repeated Sequences • Dispersed Repetitive Sequences • Ribosomal RNA
Genes

Plant Breeding, 22

Breeding Methodology • Biotechnology

3. Diseases and Pests of Rye. H. J. CZEMBOR and W. SOWA, 37

Fungal Diseases, 37

Diseases Caused by Seed-Transmitted and Soilborne Pathogens • Diseases Caused by
Windborne Pathogens

Bacterial Diseases, 47

Viral Diseases, 47

Nematodes, 48

Insects and Mites, 48

Aphids • Cereal Leaf Beetle • Frit Fly • Hessian Fly • Stem Maggots • Thrips • Mites

4. Physiology of Rye. E. NALBORCZYK and A. SOWA, 53

Growth and Development, 53

Phenological Phases • Morphogenesis of Rye

Environmental Factors Affecting the Growth and Development of Rye, **59**
Water • Temperature • Light • Mineral Nutrition
Production of Biomass and Grain Yield, **65**

5. Morphology and Chemistry of the Rye Grain. P. R. SHEWRY
and D. B. BECHTEL, **69**

Morphology of the Rye Grain, **69**

The Rye Inflorescence • Flowering • Microstructure of the Mature and Developing Rye Caryopsis

Composition of the Mature Rye Kernel, **82**

Proximate Composition • Minerals • Vitamins • Alkylresorcinols • Phytic Acid • Amino Acids • Glycerolipids and Fatty Acids • Other Components • Comparison of the Compositions of Whole Rye Grain and Grain Fractions

Rye Proteins, **90**

Extraction and Characterization of Rye Proteins • Rye Prolamins (Secalins) • Hydrolytic Enzymes and Their Inhibitors • “Resistance-Related” Proteins

Carbohydrates in the Mature Grain, **110**

Starch • Nonstarch Carbohydrates

6. Milling of Rye. H. ZWINGELBERG and A. SARKAR, **129**

Properties of Rye Grain, **129**

Rye Milling, **130**

Rye Milling in Europe • Rye Milling in North America

7. Bread Baking and Other Food Uses Around the World. W. SEIBEL
and D. WEIPERT, **147**

Grading of Rye and Baking Strength, **148**

Canada • United States • Former Soviet Union • European Union • Other Countries • Perspective

Tests for Milling and Baking Quality of Rye, **156**

Assessment of External Quality Factors of the Grain • Assessment of Internal Quality Factors of the Grain • Estimation of Enzyme Activities • Implications of Enzyme Activities on Baking Quality • Quality Assessment of Flours and Meals • Quality Tests on Dough • Standard Baking Tests and Assessment of Bread Quality

Rye and Mixed Rye-Wheat Bread, **195**

Commercial Production • Shelf Life and Mold Prevention • Packaging and Storage • Nutritional Value

Rye Bread and Baked Products Around the World, **203**

North America • Europe

Other Food Uses Around the World, **205**

8. Animal Feed and Industrial Uses. W. SEIBEL and D. WEIPERT, **213**

Animal Feed, **214**

Feeding Value of Rye • Other Active Substances • Antinutritive Substances • Toxic Substances • Experience in Feeding of Rye

Industrial Uses, **226**

Utilization