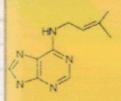
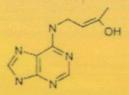
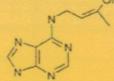
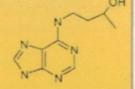
Handbook

Seed Science and Technology















Amarjit S. Basra, PhD · Editor

CONTENTS

About the Editor	xii
Contributors	XV
SECTION I: SEED DEVELOPMENTAL BIOLOGY AND BIOTECHNOLOGY	
Chapter 1. Molecular Control of Ovule Development Sureshkumar Balasubramanian Kay Schneitz	3
Introduction What Are Ovules? Emergence of the Ovule As a Model to Study Organogenesis Ovule Specification Initiation/Outgrowth of the Ovule Primordia Pattern Formation Cell-Cell Communications During Ovule Development Morphogenesis Perspectives	3 4 4 7 8 9 17 18 20
Chapter 2. Female Gametophyte Development Wei-Cai Yang	27
Introduction Organization of the Female Gametophyte Archesporial Cell Formation Megasporogenesis Formation of the Functional Megaspore Megagametogenesis The Female Germ Unit Genetic Control of Megagametophyte Development Conclusions and Perspectives	27 28 32 33 38 41 51 52 54
Chapter 3. Cytokinins and Seed Development Neil Emery Craig Atkins	63
Introduction	63

Cytokinin Biosynthesis in Plants	•	64
Discovery and Characterization of CKs in Developing Seeds Sources of Cytokinin in Seeds Developing Seeds: A Rich Mine of Cytokinin Enzymes		68
		69
		71
Biological Activity of Cytokinin		75
Can CK Content Be Manipulated	d to Alter Grain	
Development?		82
Molecular Basis of a Signaling F	Role for Cytokinins	85
Future Prospects		86
Chapter 4. Grain Number Deteri	nination in Maior	
Grain Crops		95
Gustavo A. Slafer	L. Gabriela Abeledo	
Fernanda G. González	Daniel J. Miralles	
Adriana G. Kantolic	Roxana Savin	
Elena M. Whitechurch		
Introduction		95
Grain Number Determination		96
Extrapolations to Other Major C	rons	105
Concluding Remarks	ТОРЗ	114
Chapter 5. Carbon Partitioning i	n Developing Seed	125
Yong-Ling Ruan		
Prem S. Chourey		
Introduction		125
Seed Anatomy and Cellular Path		126
Temporal and Spatial Patterns of		131
Key Genes Controlling Carbon I		135
Conclusions and Future Perspect	tives	146
Chapter 6. Metabolic Engineerin	g of Carbohydrate	
Supply in Plant Reproductive	· ·	153
Marc Goetz		
Thomas Roitsch		
The Impact of Plant Reproduction	on Events on Agriculture	153
The Role of the Tapetum in Male	e Gametophyte	
Development	¥ ¥	154
Strategies to Generate Male Ster	ility in Plants	155
-	-	

Importance of Carbohydrates in Plant Growth	
and Development	155
Carbohydrate Supply and Male Sterility	157
Future Perspectives	164
Chapter 7. Enhancing the Nutritive Value of Seeds	
by Genetic Engineering	171
N. D. Hagan	
T. J. V. Higgins	
Enhancing the Nutritive Value of Seed Protein	171
Enhancing the Fatty Acid Content of Seeds	177
Enhancing the Vitamin and Mineral Content of Seeds	181
Current Limitations	186
Conclusions	187
Chapter 8. The Process of Accumulation of Seed Proteins	
and the Prospects for Using Biotechnology to Improve	
Crops	195
Eliot M. Herman	
Introduction	195
Synthesis and Accumulation of Seed Proteins	195
The Protein Storage Vacuole	196
Protein Bodies	203
Biotechnology to Study and Change Seed Proteins	206
Identifying and Altering Molecular-Based Traits in Seeds	208
Chapter 9. Synthetic Seed Technology	227
P. Suprasanna	
T. R. Ganapathi	
V. A. Bapat	
Introduction	227
Encapsulation Methods	229
Different Propagules Used for Synthetic Seeds	236
Applications	241
Case Studies	245
Critical Considerations	253
Limitations and Prospects	257

SECTION II: SEED DORMANCY AND GERMINATION

Chapter 10. Dormancy and Germination Henk W. M. Hilhorst Leonie Bentsink Maarten Koornneef	271
Introduction The Regulation of Dormancy and Germination:	271
A Mutant Approach	273
Dormancy and Germination: Mechanisms	283
Prospects and Challenges	290
Chapter 11. Hormonal Interactions During Seed	
Dormancy Release and Germination Gerhard Leubner-Metzger	303
Introduction Abscisic Acid (ABA): A Positive Regulator of Dormancy Induction and Maintenance, a Negative Regulator	303
of Germination Gibberellins Release Dormancy, Promote Germination,	305
and Counteract ABA Effects Ethylene Promotes Seed Germination and Counteracts	312
ABA Effects on Seeds	319
Brassinosteroids Promote Seed Germination	324
Cytokinins and Auxins	327
Conclusions and Perspectives	328
Chapter 12. Photoregulation of Seed Germination Chizuko Shichijo	343
Osamu Tanaka Tohru Hashimoto	
Introduction	343
Phytochromes	347
Action Modes (LFR, VLFR, and HIR) of Phytochromes	
in Seed Germination	353
Multiple Modes of Seed Germination and Explanation	
by Action Modes of Phytochromes	358

SECTION III: SEED ECOLOGY

Chapter 13. Competition for Pollination and Seed Set Beverly J. Brown	369
Introduction	369
Pollen Quantity	374
Pollen Quality	380
Chapter 14. Seed Size	397
Jorge Castro	
José A. Hódar	
José M. Gómez	
Introduction	397
Setting Terminology	398
Seed Mass Variability	399
Seed-Size Determination	399
Dispersal	405
Depredation	406
Germination	407
Seedling Performance	408
Habitat Type and Plant Traits	411
Seed-Size Evolution	412
Seed Size and Global Change	414
Humans and Seed Size	415
Chapter 15. Seed Predation	429
Jose M. Serrano	
Juan A. Delgado	
Introduction	429
Defending Seeds	431
A Hierarchical Perspective	435
The Case of Cistus ladanifer L.	440
Chapter 16. Natural Defense Mechanisms in Seeds	451
Gregory E. Welbaum	
Introduction	451
Seed Defense Mechanisms	452
Summary	464

Chapter 17. Seed Protease Inhibitors		475
A. M. Harsulkar	V. S. Gupta	
A. P. Giri	M. N. Sainani	
V. V. Deshpande	P. K. Ranjekar	
Introduction		475
Protease Inhibitors		477
Expression of Protease Inhibito	ors in Seeds	480
Biological Role of Protease Inf	nibitors	485
Protease Inhibitor Transgenic F	Plants for Pest Control	489
Conclusions		490
Chapter 18, Soil Seed Banks		501
A. J. Murdoch		
What Is the Soil Seed Bank?		501
Functions of Soil Seed Banks		502
Prerequisites for a Seed Bank		503
How Many Seeds Are in the So		506
What Types of Seeds Are in the		510
Where Does the Seed Bank Co		510
What Happens to the Soil Seed		511
Impacts on Weed Management		516
Chapter 19. The Ecophysiologic	cal Basis of Weed Seed	
Longevity in the Soil		521
R. S. Gallagher		
E. P. Fuerst		
Introduction		521
Conceptual Model for Seed Lo	ngevity	522
Resource Allocation to Seed		524
Seed Dormancy		527
Role of Seed Vigor		536
Microbial Seed Decay		542
Implications for Seed Bank Ma	ınagement	547
Implications for Future Research	ch	548

SECTION IV: SEED TECHNOLOGY

Chapter 20. Seed Quality Testing Sabry Elias	561
v	
Introduction	561
What Is Seed Quality?	561
Is Testing the Quality of Seed Really Important?	564
Seed Purity Testing	566
Seed Viability Testing	576
Testing for Special Seed Attributes	586
Seed Vigor Testing	590
Pathological Testing of Seed	590
Testing Genetically Modified Seeds	594
Quality Assurance in Seed Testing	595
Seed Quality Testing and Seed Certification	597
Seed Testing Organizations	598
Chapter 21. Seed Vigor and Its Assessment Alison A. Powell	603
Concept of Seed Vigor	603
Causes of Differences in Seed Vigor	606
Assessment of Seed Vigor	618
Standardization of Vigor Test Procedures	631
Current Status of Vigor Testing	632
Presentation and Interpretation of Vigor Tests	633
Application of Vigor Tests	635
Conclusions	636
Chapter 22. Diagnosis of Seedborne Pathogens	649
Emily Taylor	
Jayne Bates	
David Jaccoud	
Introduction	649
Conventional Seed Health Diagnostic Methods	651
Molecular Methods for Seed Health Testing	659
Conclusions	670

Chapter 23. Seed Quality in Vegetable Crops S. D. Doijode	677
Introduction	677
Factors Affecting Seed Quality	679
Improvement of Seed Quality	686
Maintenance of Seed Quality	690
Revival of Seed Quality	694
Conclusion	696
Chapter 24. Vegetable Hybrid Seed Production	
in the World	703
David Tay	
Introduction	703
The Gene-Control Pollination F1 Vegetable Seed	705
Production System	705
The Hand-Pollinated F1 Vegetable Seed Production System	705
Distribution of F1 Vegetable Seed Production in the World	706
Development of Hand-Pollinated Hybrid Vegetable Seed	, 00
Production in the World	708
F1 Hybrid Vegetable Seed Production: A Case Study	
on Tomato in Taiwan	713
Future of Hand-Pollinated F1 Vegetable Hybrid Seed	,
Production	718
Chapter 25. Practical Hydration of Seeds of Tropical	
Crops: "On-Farm" Seed Priming	719
D. Harris	11)
A. Mottram	
A. Mourani	
Chapter 26. Seed Technology in Plant Germplasm	
Conservation	731
David Tay	
Introduction	731
Seed Science and Technology in Gene Banks	733
Gene-Bank Management System	737
Basic Gene-Bank Design	744
Gene-Bank Research Program	745
Index	749