

Contents

Preface	v
Contributors.....	xiii

PART I INTRODUCTION

1 Plant Cytogenetics: From Chromosomes to Cytogenomics	3
<i>Trude Schwarzacher, Qing Liu, and J. S. (Pat) Heslop-Harrison</i>	

PART II SIZING THE NUCLEUS: METHODS FOR GENOME SIZE AND PLOIDY LEVEL ESTIMATION

2 The Use of Flow Cytometry for Estimating Genome Sizes and DNA Ploidy Levels in Plants	25
<i>João Loureiro, Martin Čertner, Magdalena Lučanová, Elwira Sliwińska, Filip Kolář, Jaroslav Doležel, Sónia Garcia, Silvia Castro, and David W. Galbraith</i>	
3 Nuclear DNA Content Estimation of Seaweed by Fluorimetry Analysis	65
<i>Rafael P. Martín-Martín, Noemí Salvador-Soler, Jordi Rull Lluch, and Amelia Gómez Garreta</i>	
4 K-Mer-Based Genome Size Estimation in Theory and Practice	79
<i>Uljana Hesse</i>	
5 A Bioinformatic Pipeline to Estimate Ploidy Level from Target Capture Sequence Data Obtained from Herbarium Specimens	115
<i>Juan Viruel, Oriane Hidalgo, Lisa Pokorný, Félix Forest, Barbara Gravendeel, Paul Wilkin, and Ilia J. Leitch</i>	

PART III GETTING TO THE CHROMOSOMES: METHODS FOR CHROMOSOME FIXATION, PREPARATION, AND MANIPULATION

6 Nitrous Oxide-Induced Metaphase Arrest: A Technique for Somatic Chromosome Analysis	129
<i>Patrice S. Albert and James A. Birchler</i>	
7 Preparation of Mitotic Chromosomes with the Squash Technique	141
<i>Alexis J. Maravilla, Marcela Rosato, and Josep A. Rosselló</i>	
8 Preparation of Mitotic Chromosomes with the Dropping Technique	151
<i>Nicola Schmidt, Beatrice Weber, Jessica Klekar, Susan Liedtke, Sarah Breitenbach, and Tony Heitkam</i>	
9 Laser Capture Microdissection: From Genomes to Chromosomes, from Complex Tissue to Single-Cell Analysis	163
<i>Tomáš Janiček, Roman Hobza, and Vojtěch Hudzieczek</i>	
10 Flow Cytometric Analysis and Sorting of Plant Chromosomes.....	177
<i>Petr Cápal, Mahmoud Said, István Molnár, and Jaroslav Doležel</i>	

PART IV PUTTING ON COLOR: BANDING AND STAINING TECHNIQUES

- 11 C-Banding of Plant Chromosomes 203
Adam J. Lukaszewski
- 12 CMA/DAPI Banding of Plant Chromosomes 215
Ana Emilia Barros e Silva and Marcelo Guerra
- 13 Silver Nitrate Staining of Nucleolar Organizer Regions (Ag-NORs) in Plant Chromosomes 225
Claudio Palma-Rojas, Pedro Jara-Seguel, and Cristian Araya-Jaime
- 14 Chromatin Immunostaining of Plant Nuclei 233
Nobuko Ohmido and Aqwin Polosoro

PART V LABELING DNA: IN SITU HYBRIDIZATION AND OTHER METHODS USING FLUORESCENT LABELS

- 15 Critical Steps in DAPI and FISH Imaging of Chromosome Spread Preparations 247
Hans de Jong, José van de Belt, and Paul Fransz
- 16 Formamide-Free Genomic In Situ Hybridization (ff-GISH) 257
Hanna Weiss-Schneeweiss and Tae-Soo Jang
- 17 The Use of Ribosomal DNA for Comparative Cytogenetics 265
Gülru Yücel, Magdalena Senderowicz, and Bożena Kolano
- 18 Identification of the Sequence and the Length of Telomere DNA 285
Martin Lyčka, Petr Fajkus, Leon P. Jenner, Eva Sýkorová, Miloslava Fojtová, and Vratislav Peska
- 19 Chromosome Painting Using Chromosome-Specific BAC Clones 303
Terezie M. Mandáková and Martin A. Lysák
- 20 CRISPR-FISH: A CRISPR/Cas9-Based In Situ Labeling Method 315
Bhanu Prakash Potlapalli, Takayoshi Ishii, Kiyotaka Nagaki, Saravanakumar Somasundaram, and Andreas Houben
- 21 Preparation of Male Meiotic Chromosomes for Fluorescence In Situ Hybridization and Immunodetection with Major Focus on Dogroses 337
Jana Lunerová and Radka Vozárová
- 22 Extended DNA Fibers for High-Resolution Mapping 351
Paul Fransz, José van de Belt, and Hans de Jong
- 23 Visualizing Chromosome Territories and Nuclear Architecture of Large Plant Genomes Using Alien Introgressions 365
Katerina Perníková and David Kopecký
- 24 Visualization of the Nucleolus Using 5' Ethynyl Uridine 377
Martina Dvořáčková and Jiří Fajkus

PART VI LEVERAGING DATA ONTO NUCLEI: GENOMICS-INFORMED METHODS

25	Bioinformatic Prediction of Bulked Oligonucleotide Probes for FISH Using Chorus2	389
	<i>Guanqing Liu and Tao Zhang</i>	
26	Visualization of Oligonucleotide-Based Probes Along Pseudochromosomes Using RIdogram, KaryoploteR, and Circlize (Circos)	409
	<i>Ludwig Mann and Sophie Maiwald</i>	
27	Bulked Oligo-FISH for Chromosome Painting and Chromosome Barcoding.....	445
	<i>Denisa Beránková and Eva Hřibová</i>	
28	Flow Sorting-Assisted Optical Mapping	465
	<i>Hana Šimková, Zuzana Tulpová, and Petr Cápal</i>	
29	Chromosome Conformation Capture of Mitotic Chromosomes	485
	<i>Petr Cápal</i>	
30	Analysis of 5S rDNA Genomic Organization Through the RepeatExplorer2 Pipeline: A Simplified Protocol.....	501
	<i>Sònia Garcia, Joan Pere Pascual-Díaz, Alice Krumpolcová, and Ales Kovarik</i>	

PART VII SOFTWARE AND ONLINE PLANT CYTOGENETICS & GENOMICS RESOURCES

31	Tools for Drawing Informative Idiograms.....	515
	<i>Shoaeib Mahmoudi and Ghader Mirzaghaberi</i>	
32	Using ChromEvol to Determine the Mode of Chromosomal Evolution	529
	<i>Marcial Escudero, Enrique Maguilla, José Ignacio Márquez-Corro, Santiago Martín-Bravo, Itay Mayrose, Anat Shafir, Lu Tan, Carrie Tribble, and Rosana Zenil-Ferguson</i>	
33	Online Resources Useful for Plant Cytogenetics and Cytogenomics Research	549
	<i>Maria Luisa Gutiérrez, Roi Rodríguez-González, Joan Pere Pascual-Díaz, Inés Fuentes, and Sònia Garcia</i>	
	<i>Name Index</i>	561
	<i>Subject Index</i>	563