

Contents

1	Ecology and Epidemiology of Virus and Viroid Diseases of Tropical Crops	1
1.1	Introduction	1
1.2	Epidemiological Concepts	3
1.3	Conditions Favorable for Epiphytotics	5
1.3.1	Physical Factors	5
1.3.2	Biological Factors	11
1.4	Cropping Systems and Practices	17
1.4.1	Mono- and Mixed Cropping	17
1.4.2	Introduction of Crops into New Areas	18
1.5	Host Properties	19
1.6	Pathogen Properties	21
1.6.1	Virus Mutation and Evolution	27
1.6.2	Occurrence of New Virus Strains	28
1.6.3	Viruses in New Cultivars	30
1.6.4	Indigenous Viruses	30
1.6.5	Man-Made Introduced Plant Viruses	32
1.6.6	Synergism in Certain Plant Virus Interactions	33
1.7	Detection and Diagnosis of Plant Viruses and Viroids	35
1.7.1	Plant Virus Diagnosis	35
1.7.2	Selection of a Diagnosis Method	36
1.7.3	Routine Tests Used in the Early Stages of Plant Virus Research	37
1.7.4	Electron Microscopy	37
1.7.5	Protein-Based Diagnosis of Plant Viruses	38
1.7.6	Nucleic Acid Based Methods	44
1.7.7	Microarrays	51
1.7.8	Recombinant DNA Technology	53
1.7.9	DNA Barcodes Use as Genetic Markers	54
1.7.10	Conclusions	54
1.8	Pathways of Virus Spread	55
1.8.1	Contact Transmission	56
1.8.2	Long Distance Dispersal	57

1.8.3	Arthropod Vector Transmission	60
1.8.4	Non Arthropod Transmission.	74
1.9	Dispersal and Migration of Insect Vectors.	77
1.10	Factors of Vector Transmission	78
1.11	Virus Survival and Spread.	82
1.11.1	Strategies of Virus Spread.	82
1.12	Disease Forecasting	83
1.13	The Cyclical Nature of Plant Disease	85
1.14	Disease Progress Curves	88
1.14.1	Analyzing Disease Progress.	89
1.15	Growth Models for Disease Progress Studies.	90
1.16	Spatial Dynamics and Metapopulations.	92
1.17	Disease Gradients and Progress Curves.	96
1.18	Mathematical Modeling Techniques	101
1.19	Virus-Vector Population Model	105
1.20	Systems Analysis and Simulation Models	107
1.21	Conclusions.	110
	References	111
2	Management of Virus and Viroid Diseases	
	of Crops in the Tropics	149
2.1	Introduction.	149
2.2	Need for Diagnosis of Plant Virus and Viroid Diseases	149
2.3	Approaches for Virus and Viroid Diseases Management.	150
2.4	Use of Virus/Viroid-Free Vegetative Propagules and True Seed	151
2.4.1	Approved Seed Certification Standards.	153
2.4.2	Stages of Seed Multiplication	153
2.5	Certification Schemes of Crops Having Virus/Viroid Transmission Through True Seed.	154
2.6	Virus and Viroid Disease Transmission Through Vegetative Propagules	159
2.6.1	Production of Virus-Free Plant Material	160
2.6.2	Production of Virus-Free Stock Material.	164
2.6.3	National Certification System for Tissue Culture Plants NCS-TCP in India	165
2.7	Success Stories of Production of Virus-Free Plant Propagules	166
2.7.1	Certification Schemes.	167
2.7.2	Schemes for the Production of Certified Propagative Material	170
2.7.3	Certification Schemes of Economically Important Crops.	172
2.7.4	Virus Certification of Deciduous Fruit Trees.	172

2.7.5	Strawberry Certification Programme.	177
2.7.6	Virus-Free Banana Production Certification.	179
2.7.7	Citrus Bud Wood Certification	185
2.7.8	Certification of Grapevine Planting Material	187
2.7.9	Cassava Seed Certification Scheme	188
2.7.10	Potato Seed Certification	192
2.7.11	Sweet Potato Production of Clean Plant Material.	199
2.7.12	Sugar Beet Certification Scheme	200
2.7.13	Virus-Free Yam Planting Material	201
2.7.14	Seed Programmes for Sugarcane	202
2.7.15	EPPO's Certification Schemes for Ornamental Plants.	203
2.7.16	Bulb Inspection Service Scheme	206
2.7.17	Performance of Virus-Free Plants.	206
2.8	Production and Use of Virus-Free Transplants.	208
2.9	Need for Managing the Virus Diseases.	208
2.9.1	Phytosanitation in Managing the Virus and Viroid Diseases	210
2.10	Avoidance of Sources of Infection/Inoculum.	224
2.11	Variation of the Crop Cultural Practices	228
2.12	Cross-Protection in Crop Plants	251
2.12.1	Theories to Explain Cross-Protection	251
2.12.2	Mechanisms of Cross Protection in Plants.	252
2.12.3	Practical Use of Cross-Protection.	252
2.13	Vector Control.	264
2.13.1	Insecticides	265
2.13.2	Chemical Control of Fungal Vectors	272
2.13.3	Soil Sterilants and Disinfectants for Reduction of Vector Populations.	275
2.14	Role of Botanicals in Plant Virus Management	277
2.15	Role of Oils in Arthropod Vector Control.	278
2.15.1	Oil, Virus-Vector Relationship and Virus Particle Morphology.	279
2.15.2	Types of Oils	279
2.15.3	Characteristics of Mineral Oils	281
2.15.4	Mechanism of Virus Inhibition by Oil Sprays	286
2.15.5	Application of Oil Under Field Conditions	290
2.15.6	Efficacy of Oils in Combination with Insecticides and Cultural Practices.	295
2.16	Biological Control of Plant Virus Vectors.	295
2.17	Avoidance of Vectors.	298
2.17.1	Bait Crops in Plant Virus Management.	298
2.17.2	Role of Plant Volatile Organic Compounds in Vector Management	299

2.18	Role of Repelling and Attracting Surfaces in Vector Control.	300
2.18.1	Aluminum Mulches	301
2.18.2	Plastic Mulches	305
2.18.3	Sticky Yellow Polyethylene Sheets	307
2.18.4	Saw Dust/Straw/Rice Husk Mulches.	307
2.18.5	Effect of Whitewash on Virus Incidence.	308
2.18.6	Effect of Silver Spray Paint on Planting Beds on Virus Incidence.	308
2.18.7	Protection of Greenhouse Crops by UV-Blocking Cladding Materials.	309
2.18.8	Use of Row Covers in Vegetable Production.	311
2.19	Resistance	314
2.19.1	Introduction.	314
2.19.2	Types of Resistance	315
2.19.3	Sources of Resistance.	317
2.20	Transgenic Approach	329
2.20.1	Protein Mediated Resistance	330
2.20.2	Movement-Protein-Mediated Resistance	331
2.20.3	Nucleic Acid-Based Protection	336
2.20.4	RNA- and Protein-Mediated Resistance	337
2.20.5	Replicase-Mediated Resistance (Rep-MR).	338
2.20.6	Transgenic Approaches Against Viroid Diseases	339
2.20.7	Performance of Transgenic Plants	339
2.20.8	Benefits Derived from Transgenic Crops	342
2.20.9	Risks Associated with Transgenic Crops.	342
2.21	Bio-Safety Regulations Against GM Crops	343
2.22	Induction of Systemic Resistance.	344
2.23	Quarantines	348
2.23.1	Introduction.	348
2.23.2	Exclusion	354
2.23.3	Plant Quarantine Legislation	354
2.23.4	Plant Quarantine Measures	355
2.23.5	Functions of Plant Quarantine	356
2.23.6	Quarantine Status of Plant Importations	362
2.23.7	Open Quarantine	363
2.24	Pest Risk Analysis (PRA)	364
2.25	World Trade Organization Regime and its Implications	367
2.26	Plant Biosecurity	367
2.27	Role of Bioversity International and NBPGR in Germplasm Maintenance and Exchange.	368
2.27.1	Types of Materials Received.	371

2.28	Role of FAO/Bioversity International in Germplasm Exchange	372
2.28.1	Conceptual Guidelines for Exchange of Legume Germplasm	373
2.28.2	The Technical Guidelines for Exchange of Germplasm and Breeding Lines	374
2.28.3	Movement of Germplasm	374
2.28.4	The Steps in Technical Recommendations for “Seed Germplasm”	376
2.29	Methods of Testing at Quarantine Stations	377
2.30	Important Cases of Introduction	378
2.31	Important Diseases Restricted to Some Countries	380
2.32	Effective Methods of Plant Importations	381
2.33	General Principles for the Overall Effectiveness of Quarantines	387
2.33.1	Quarantine Facilities	388
2.34	Need for Networking for the Developing Countries	388
2.35	Integrated Approach	390
2.35.1	The Tropical Whitefly IPM Project (TWFP)	392
2.35.2	Integrated Management of Insect-Transmitted Plant Virus and Viroid Diseases	397
2.35.3	Learning IDM	401
2.36	Challenges for the Future	402
	References	405
	Index	481

Plant Virus and Viroid Diseases in the Tropics

Volume 2: Epidemiology and Management

Sastry, K.S.; A. Zitter, Th.

2014, XXV, 489 p. 39 illus., 24 illus. in color., Hardcover

ISBN: 978-94-007-7819-1