



# Table of Contents

Introduction	xvii
<b>1 Introduction to Organic Crop Production</b>	<b>1</b>
1.1 History of Organic Farming	1
1.2 The Organic Foods Production Act	3
1.3 Definition of Organic Farming	4
1.4 Organic Farming Management Practices	6
1.4.1 Plant Nutrition	6
1.4.2 Weed Management	6
1.4.3 Pest Management	7
1.4.4 Disease Management	7
1.4.5 Worldwide rules on Organic Agriculture	7
1.5 Sustainable Agriculture	8
1.6 References	8

<b>2</b>	<b>Organic Crop Certification</b>	<b>10</b>
2.1	Introduction	11
2.2	National Organic Program (NOP)	11
2.3	Transitioning to Organic Production	15
2.4	Genetically Engineered Crops	18
2.5	Organic Certification Agencies	20
2.6	Organic Certification Process	21
2.7	Organic System Plan	22
2.8	Requirements for Organic Labelling	24
2.9	References	24
<b>3</b>	<b>Approved Materials for Organic Farming</b>	<b>27</b>
3.1	Introduction	27
3.2	The National List	28
3.2.1	Allowed and Prohibited Substances	28
3.2.2	Allowed Synthetic Materials	29
3.2.3	Inert Ingredients	29
3.2.4	Restrictions in Using Approved Substances	29
3.2.5	Organic System Plan	30
3.2.6	Removing or Amending Ingredients on the National List	30
3.3	Accredited Certifying Agents	30
3.3.1	Organic Materials Review Institute (OMRI)	30
3.3.2	OMRI List	31
3.3.3	Washington State Department of Agriculture (WSDA)	31
3.3.4	Review Process for Determining Compliance of Materials	31
3.3.5	Products with Multiple Reviews	31
3.3.6	Federal Product Labeling	31
3.4	List of Approved Inputs for Organic Production	32
3.5	References	35
<b>4</b>	<b>Soil Management on Organic Farms</b>	<b>37</b>
4.1	Introduction	37
4.2	Soil Management on Organic Farms	38
4.3	National Organic Program Practices	39
4.4	Regulation of the program	40

4.5	Soil Properties	40
4.5.1	Physical Properties	41
4.5.2	Chemical Properties	42
4.5.3	Biological Properties	43
4.6	Soil Organic Matter	44
4.6.1	What is the Organic Matter?	44
4.6.2	Ways in which Organic Matter Benefits the Soil	45
4.6.3	Sources of Organic Matter	45
4.6.4	Classification of Organic Matter	46
4.6.5	Quantity of Soil Organic Matter	46
4.7	Management Practices to Improve Soil Health	47
4.7.1	Reducing Tillage	47
4.7.2	Growing Covering Crops	48
4.7.3	Better Crop Rotations	49
4.7.4	Organic Amendments	50
4.8	Managing Soil Fertility in Organic Systems	50
4.8.1	Nitrogen Management	51
4.8.2	Phosphorus Management	52
4.8.3	Potassium Management	53
4.9	Micronutrients	53
4.10	References	53
<b>5</b>	<b>Soil Tillage in Organic Farming Systems</b>	<b>55</b>
5.1	Soil Tillage Systems	56
5.1.1	Conventional Tillage Systems	57
5.1.2	Conservation Tillage Systems	60
5.1.3	Pros of Tillage System	61
5.1.4	Cons of Tillage System	61
5.1.5	Conventional vs. Conservation Tillage	61
5.2	Conservation Soil Tillage Systems	62
5.2.1	No-Till	64
5.2.2	Strip-Till	65
5.2.3	Ridge Till	66
5.3	Soil Tillage Implements	67
5.3.1	Mould Board Plow	67
5.3.2	Disc Plow	68
5.3.3	Chisel Plough	69
5.3.4	Cultivators	70

5.3.5	Spike, Spring, and Tine-toothed Harrows	71
5.3.6	Disc Harrow	71
5.3.7	Blade Harrow	72
5.3.8	Plank and Roller	73
5.3.9	Seed Drill	74
5.3.10	Residue Management Implements	74
5.4	References	75

## **6 Cover Crops for Organic Farms 76**

6.1	Introduction	76
6.2	Benefits and Limitations of Cover Crops	78
6.3	The Process Behind The Practice	80
6.4	The estimated range and mid-range values	81
6.5	Predicted timing or delay and Seasonality of Reductions	82
6.6	How do Site Conditions Like Soils, Topography, Hydrology, Climate Affect Effectiveness in Reducing Nutrient Losses	83
6.7	Types of Cover Crops	90
6.7.1	Legumes	90
6.7.2	Crimson Clover	91
6.7.3	Field Peas	92
6.7.4	Hairy Vetch	93
6.8	Nitrogen Fixation by Legumes	94
6.9	Green Manures	95
6.10	Catch Crops	97
6.11	Managing Pests with Cover Crops	99
6.12	Cover Crop Strategies with Crop Rotations	99
6.13	Selecting Cover Crop Species	100
6.14	Establishment of Cover Crops	102
6.15	References	107

## **7 Crop Rotation on Organic Farms 110**

7.1	Introduction	110
7.1.1	Two-field System	112
7.1.2	Three-field System	112
7.1.3	Four-field System	112
7.2	National Organic Program	114
7.3	National Organic Standards Board (NOSB)	114

7.4	National Organic Program Standards	114
7.5	Benefits and Limitations of Crop Rotation	128
7.5.1	Benefits	128
7.5.2	Limitations	129
7.6	Management of Diseases with Crop Rotation	129
7.7	Management of Insect Pests, Weeds, and Nematodes with Crop Rotation	129
7.8	References	130
<b>8</b>	<b>Intercropping on Organic Farms</b>	<b>133</b>
8.1	Introduction	133
8.2	Benefits and Limitations of Intercropping	135
8.2.1	Advantages of Intercropping	135
8.2.2	Restrictions of Intercropping	136
8.3	Intercropping Technical Criteria	137
8.3.1	Yield Choice	137
8.3.2	Plant Densities	137
8.3.3	Plant Maturity Dates	138
8.3.4	Planting Architecture	138
8.4	Summary	139
8.5	References	139
<b>9</b>	<b>Manure Management on Organic Farms</b>	<b>141</b>
9.1	National Organic Program Standards	142
9.1.1	Composite Manure Rules	143
9.1.2	Processed Manure Regulations	143
9.1.3	Raw Manure NOP Standards	144
9.2	Benefits and Limitations of Manure	145
9.2.1	Benefits of Manure	145
9.2.2	Limitations of Manure	147
9.3	Managing Nutrients in Manure	149
9.3.1	Composition of Nutrients	151
9.3.2	Nutrient Content for Crops	152
9.3.3	Manure Sampling and Testing	152
9.4	Timing of Manure Application	154
9.4.1	Spring Manure Application	154
9.4.2	Summer Manure Application	155
9.4.3	Fall Manure Application	155

9.4.4	Winter Manure Application	155
9.5	Manure Application Rates	156
9.5.1	Nitrogen Based Manure Application rate Calculation	157
9.5.2	Phosphorus Based Manure Application Rate Calculation	158
9.6	Manure Application Methods	159
9.6.1	Broadcasting Application Method	159
9.6.2	Broadcasting with the Incorporation Application Method	159
9.6.3	Solid Manure Application Equipment	160
9.6.4	Liquid Manure Application Equipment	161
9.7	Manure Storage Systems	162
9.7.1	Storage of Manure for Solid Systems	162
9.7.2	Storage of Manure for Slurry or Liquid Systems	163
9.8	References	164

## 10 Compost Management on Organic Farms 165

10.1	Introduction	165
10.1.1	What can be Composted	168
10.1.2	What cannot be Composted	169
10.2	Types of Composting Practices	170
10.2.1	Vermicomposting	170
10.2.2	Windrow Composting	172
10.2.3	Aerated Static Pile Composting	172
10.2.4	In-vessel Composting	173
10.3	Advantages and Disadvantages of Composting	175
10.4	Composting Organic Materials with High Lignin Content and Lime Treatment	177
10.5	Compost Enrichment	178
10.5.1	Preparation of Phospho-Compost	179
10.5.2	Preparation of high-grade Compost	179
10.6	Compost Quality	179
10.7	Compost Pile Management	181
10.8	The Benefits of Using Composts to Agriculture	183
10.8.1	Improves the Physical Properties of Soils	183
10.8.2	Enhances the Chemical Properties of Soils	184
10.8.3	Economic and Social Benefits of Composting.	184

10.9	Crop Residue Composting	186
10.9.1	Waste Collection	186
10.9.2	Shredding of Waste Materials	186
10.9.3	Mixing of Green Waste and Brown Waste	186
10.9.4	Formation of Compost Heap	187
10.9.5	Aerating the Compost Material	187
10.9.6	Maintaining the Moisture	187
10.9.7	Compost Maturity	187
10.9.8	Enriching the Compost	188
10.9.9	Nutritive value of Bio-compost	188
10.10	References	189
<b>11</b>	<b>Integrated Pest Management in Organic Farms</b>	<b>191</b>
11.1	Introduction	191
11.2	Monitoring for Crop Pests	193
11.3	Identification of Pests	195
11.3.1	Examining the Plant	197
11.3.2	Identification of Pests	197
11.4	Importance of Economic Thresholds	198
11.4.1	Improved Productivity	200
11.4.2	Cost-saving	200
11.4.3	Useful Insects	200
11.4.4	Consideration of External Factors	200
11.5	Tactics for Integrated Pest Management Control	201
11.5.1	Cultural Methods	202
11.5.2	Physical Methods	202
11.5.3	Genetic Methods	202
11.5.4	Biological Methods	202
11.5.5	Chemical Methods	202
11.6	Record Keeping	203
11.6.1	Varieties of Pests	203
11.6.2	Economic Thresholds	203
11.6.3	Targeting the Productive Activities	204
11.6.4	Information Sharing	204
11.7	National Organic Program Standards for IPM	204
11.7.1	Pest Prevention	204
11.7.2	Use of Materials which are Approved	205
11.7.3	Application of Materials which are not Approved	205
11.8	References	205

<b>12 Insect Pest Management for Organic Crops</b>	<b>207</b>
12.1 Introduction	207
12.2 Biology of Insects	209
12.3 Entomology	211
12.3.1 Farmers	211
12.3.2 Environmentalists	212
12.3.3 Scientists	212
12.3.4 Industries	212
12.3.5 Teachers	212
12.3.6 Foresters	213
12.4 Insect Pests	213
12.4.1 Effect on Plants and Crops	214
12.4.2 Effect on Humans	215
12.4.3 Effect on Livestock	215
12.4.4 Effect by Transmitting and causing Diseases in Plants	215
12.4.5 Effect on the Environment	216
12.5 Insect Pest Management	216
12.5.1 Acceptable Pest Levels	217
12.5.2 Preventive Cultural Practices	218
12.5.3 Monitoring	219
12.5.4 Mechanical Controls	219
12.5.5 Biological Controls	219
12.5.6 Responsible use	219
12.6 Benefits of implementing Integrated Pest Management programs	220
12.7 Methods of Insect Pest Management	221
12.7.1 Cultural Control of Insect Pests	222
12.7.2 Biological Control of Insect Pests	226
12.7.3 Microbials for Controlling Insect Pests	229
12.7.4 Botanicals for Controlling Insect Pests	231
12.7.5 Spray Oils for Controlling Insect Pests	234
12.7.6 Insecticidal Soaps	236
12.7.7 Minerals for Controlling Insect Pests	238
12.7.8 Pheromones for Controlling Insect Pests	239
12.7.9 Insect Growth Regulators	240
12.8 References	241



<b>13 Plant Disease Management of Organic Crops</b>	<b>243</b>
13.1 Various sorts of Plant Disease Pathogens	244
13.1.1 Fungi	245
13.1.2 Bacteria	245
13.1.3 Viruses and Viroids	245
13.1.4 Phytoplasmas	246
13.1.5 Nematodes	246
13.2 Cultural Control of Crop Disease	246
13.2.1 Rotation with Unrelated Crops	247
13.2.2 Fertilizer usage	247
13.2.3 Deep burial of Crop Residue	247
13.2.4 Using Raised Bed for Plantation	247
13.2.5 Time of Seeding Cultural Practice	248
13.2.6 Removal of Undesirable Plant	248
13.2.7 Volunteer Plant Practice	248
13.2.8 Rouging (removal) of Diseased Plants	248
13.3 Soil Solarization for controlling Soil-borne Diseases	248
13.3.1 Soil-Borne Diseases	248
13.3.2 Soil Solarization	250
13.3.3 Principles of Solarization	252
13.3.4 Procedure of Solarization	252
13.3.5 Gross Procedure	252
13.4 Biorational Control of Crop Disease	254
13.4.1 Minerals	254
13.4.2 Oils	255
13.4.3 Microbial	255
13.5 References	256
<b>14 Weed Management for Organic Crops</b>	<b>258</b>
14.1 Introduction	258
14.2 Key Points	259
14.3 Prevention	259
14.4 Weed Biology	261
14.5 Controlling Weeds	263
14.6 Cultural Weed Control	264
14.6.1 Weed Control Systems	265
14.6.2 What is Cultural Weed Control?	267

14.6.3	Why Control Weeds?	267
14.6.4	Why Use Cultural Control for Weeds?	268
14.6.5	How to Use Cultural Studies to Control Weeds?	268
14.6.6	The Limitations	269
14.6.7	Controlling Weeds by Tillage and Cultivation	269
14.6.8	Controlling weeds by Mowing	271
14.6.9	Cutting and mowing are techniques that can decrease weed difficulties.	271
14.6.10	Techniques	272
14.6.11	Useful tips for a Healthy Lawn	274
14.7	Flame Weeding	274
14.7.1	What is Flame Weeding?	274
14.7.2	Flame Weeding Techniques	275
14.8	Soil Solarization for Weed Control	277
14.8.1	Solarization Works	278
14.8.2	What Is Solarization?	278
14.8.3	Preparing the Ground for Soil Solarization	279
14.8.4	How to Solarize Your Soil	280
14.9	Bio-rational control of weed	281
14.9.1	Viable Alternative	282
14.9.2	New Biorational Herbicide for Weed Control in Veg Crops	283
14.10	References	284
<b>Appendix A: Abbreviations</b>		<b>286</b>
<b>Index</b>		<b>289</b>