
CONTENTS

PREFACE	ix
1	
THE CLASSIFICATION, ORIGINS, DISTRIBUTION AND ECONOMIC IMPORTANCE OF THE MAJOR VEGETABLE CROPS	1
<i>Classification of Alliums</i>	1
<i>Distribution and Ecology</i>	4
<i>The Types, History and Evolution of the Edible Crops</i>	5
<i>Economic Importance</i>	22
2	
THE STRUCTURE OF EDIBLE ALLIUMS	27
Visible Growth Stages	27
Outline of the Overall Plant Structure	27
The Structure of the Vegetative Shoot Apex	32
Stem Structure	33
Bulb Structure	36
Foliage Leaf Structure	39
The Root System	40
Inflorescence and Flower Structure and Development	45
Seeds	47
3	
THE GENETICS AND PLANT BREEDING OF ALLIUM CROPS	51
Introduction	51
The Chromosomes	52
Breeding Systems	54
Genetics	56

Genetic Linkage Maps	59
Genomics	64
Hybrid Vigour	65
Genetic Male Sterility and Hybrid Breeding	65
Techniques of Breeding and Cultivar Improvement	67
Pollination Control in Breeding	73
Breeding Objectives in Edible Alliums	73
Selection Methods and Environmental Influences	75
Genetic Transformation of Alliums	77
Breeding for Disease and Pest Resistance	79
Conclusions	83
4	
PHYSIOLOGY OF CROP GROWTH, DEVELOPMENT AND YIELD	85
Fundamental Determinants of Yield	85
Agronomic Factors Influencing Bulb Onion Yields	90
Seed Viability, Germination and Emergence	93
Vegetative Growth	116
Onion Bulbing	123
Models for Onion Growth and Bulbing	135
Physiology and Environmental Control of Flowering	138
Interrelations of Growth, Flowering and Bulbing in Onion	149
Shallots	151
Wakegi Onion	152
Garlic	156
Leek	160
Japanese Bunching Onion	166
Rakkyo	168
Chives	168
Chinese Chives	169
Concluding Remarks	169
5	
INTERACTIONS WITH OTHER ORGANISMS: WEEDS, PESTS, DISEASES AND SYMBIONTS	171
Introduction	171
Weeds and Weed Control	173
Arthropod Pests	186
Nematode Pests	198
Viral Diseases	201
Bacterial Diseases	209

Fungal Leaf Diseases	216
Fungal Diseases Infecting from the Soil	231
Fungal Diseases of Stored Bulbs	240
Mycorrhizal Fungi	246
6	
AGRONOMY AND CROP PRODUCTION	251
Onion Production	251
Seed Production	293
Garlic Production	299
Leek Production	300
Japanese Bunching Onion Production	306
Chive Production	307
Chinese Chives Production	307
7	
CROP STORAGE AND DORMANCY	309
Bulb Crop Storage and Dormancy	309
Garlic Dormancy and Storage	341
Leek Storage	342
Green Onion Storage	344
8	
BIOCHEMISTRY, HEALTH BENEFITS AND FOOD SCIENCE	
OF ALLIUMS	347
The Biochemistry of Flavour	347
Carbohydrate Biochemistry	356
Flavonoids	361
Medicinal Effects of Alliums	364
Processed Products from Alliums	370
REFERENCES	373
INDEX	413

The colour plate section can be found following p. 212