

GRASS

ITS PRODUCTION & UTILIZATION

THIRD EDITION

EDITED BY Alan Hopkins

Published for the British Grassland Society

by Blackwell Science

Suranaree University of Technology



31051000595054

b

Blackwell
Science

Contents

<i>List of contributors</i>	x
<i>Foreword by C.K. Mackie</i>	xii
<i>Preface to the third edition</i>	xiii
1 Introduction	1
<i>A. Hopkins</i>	
1.1 Objectives	1
1.2 The development and distribution of grasslands	1
1.3 Classification of grasslands – ecological	4
1.4 Classification of grasslands – agricultural	6
1.5 Leys and permanent pastures	7
1.6 Grassland production	8
1.7 Grass as a source of feed for livestock	8
1.8 Grass utilization	10
1.9 Grassland production and environmental objectives	10
1.10 References	11
2 Sward Establishment and Renovation	13
<i>R.D. Sheldrick</i>	
2.1 Introduction	13
2.2 Options for sward improvement and reseeding	14
2.3 Species for sowing	15
2.4 Sward establishment	20
2.5 Post-sowing management	24
2.6 Sward renovation	25
2.7 Sward establishment in special situations	27
2.8 References	28
3 The Principles of Pasture Growth and Utilization	31
<i>A.J. Parsons and D.F. Chapman</i>	
3.1 The grass plant	32
3.2 The white clover plant	41
3.3 Factors affecting leaf growth	45
3.4 Some background on photosynthesis	50

3.5	The overall trade-off between growth and utilization	52
3.6	Different managements – or a question of scale?	54
3.7	Regrowth – and the ceiling to yield	55
3.8	The optional timing of harvest – marginal value theorem	57
3.9	Effects of 'residual sward state' on regrowth	59
3.10	Optional solutions for residual sward state and the duration of regrowth	62
3.11	Operational constraints to utilization under grazing	63
3.12	The functioning of clover, relative to grass, in mixed swards	64
3.13	Grass-legume balance – a problem and a theory	66
3.14	Modifying factors – adaptation to defoliation	69
3.15	Modifying factors – seasonal changes in physiology	71
3.16	Seasonal pattern(s) of grass production and utilization	73
3.17	Theory into practice – a basis for management	75
3.18	Heterogeneity and its impact on utilization	77
3.19	References	79
4	Herbage Production	90
	<i>A. Hopkins</i>	
4.1	Introduction	90
4.2	Measurement of herbage production	90
4.3	Climatic factors	92
4.4	Irrigation	93
4.5	Soil drainage	94
4.6	Soil pH and liming	96
4.7	Soil nutrient status and the role of fertilizers	96
4.8	Herbage production and botanical composition	101
4.9	References	106
5	Herbage Seed Production	111
	<i>A.H. Marshall and D.H. Hides</i>	
5.1	Introduction	111
5.2	Use and production of herbage seed	112
5.3	Herbage seed production in the UK	114
5.4	Seed crop management	114
5.5	Seed certification	116
5.6	References	117
6	Weeds, Pests and Diseases of Grassland	119
	<i>G.C. Lewis and A. Hopkins</i>	
6.1	Introduction	119
6.2	Weeds of grassland	120
6.3	Pests of grassland	124
6.4	Diseases of grassland	128

6.5	Fungal endophytes	132
6.6	Nutritional disorders	133
6.7	References	133
7	The Feeding Value of Grass and Grass Products	140
	<i>D.E. Beever, N. Offer and E.M. Gill</i>	
7.1	Introduction	140
7.2	Chemical and physical characteristics of forage	140
7.3	Nutritive value of forage	143
7.4	Regulation of forage intake	153
7.5	Digestion in the ruminant	158
7.6	Tissue utilization of forage energy and protein	166
7.7	The use of supplements and nutritional manipulants	169
7.8	Prediction of animal performance	171
7.9	Nutritional disorders	178
7.10	Potential for forages	185
7.11	References	190
8	The Conservation of Grass	196
	<i>R.J. Merry, R. Jones and M.K. Theodorou</i>	
8.1	Introduction	196
8.2	Principles of conservation	196
8.3	Crop management	197
8.4	Haymaking	198
8.5	Silage making	200
8.6	The ensilage process	202
8.7	Evaluation of silage quality	208
8.8	Silage additives	208
8.9	Production response of animals offered additive-treated silages	216
8.10	Silage technology	218
8.11	Silage losses	220
8.12	Future trends in silage making	223
8.13	References	224
9	Principles of Foraging and Grazing Behaviour	229
	<i>A.J. Rook</i>	
9.1	Introduction	229
9.2	Measuring grazing behaviour	229
9.3	Factors affecting bite mass	230
9.4	Factors affecting biting rate	233
9.5	Factors affecting grazing time	235
9.6	Meal patterns	236
9.7	Foraging in heterogeneous environments	237

9.8	Conclusions	241
9.9	References	241
10	Grassland Management under Grazing and Animal Response	247
	<i>C.S. Mayne, I.A. Wright and G.E.J. Fisher</i>	
10.1	Introduction	247
10.2	Potential production from grazed pasture	248
10.3	Effects of stocking rate, herbage allowance and grazing severity on animal performance	250
10.4	Grazing systems and integration with forage conservation	253
10.5	Principles of supplementation at pasture	261
10.6	Practical grazing management – dairy cows	264
10.7	Practical grazing management – beef cattle	275
10.8	Practical grazing management – sheep	278
10.9	Mixed and sequential grazing	280
10.10	Hill and upland grazing systems	281
10.11	Animal health on grazed pasture	283
10.12	References	286
11	Grassland Management for Natural Landscapes and Wildlife	292
	<i>R.G. Jefferson and H.J. Robertson</i>	
11.1	Introduction	292
11.2	Value of grasslands for wildlife and landscape conservation	292
11.3	Grazing management	298
11.4	Mowing for hay	302
11.5	Use of artificial fertilizers, farmyard manure and lime	306
11.6	Use of herbicides, pesticides and veterinary products	307
11.7	Other management practices	308
11.8	Grassland management decision-making and management mechanisms	310
11.9	References	312
12	Amenity Grassland	317
	<i>D. Thorogood</i>	
12.1	Introduction	317
12.2	The importance of amenity turfgrass	317
12.3	The evolution of amenity grassland and the demands of modern turfgrass	320
12.4	Species of importance in amenity turfgrass	321
12.5	Establishment of turfgrass	323
12.6	Maintenance of turfgrass	328
12.7	Turfgrass stresses	335
12.8	References	339
12.9	Further information	342

13	Control and Utilization of Livestock Manures	343
	<i>B.F. Pain</i>	
13.1	Introduction	343
13.2	Plant nutrients in manures	344
13.3	Biochemical oxygen demand	352
13.4	Pathogens	352
13.5	Strategies for controlling losses and utilizing plant nutrients	354
13.6	Contamination of herbage	357
13.7	Farm nutrient budgets	358
13.8	Treatment of wastes	359
13.9	References	360
14	The Role and Management of Grassland in Organic Farming	365
	<i>D. Younie</i>	
14.1	Introduction	365
14.2	Principles of organic farming	366
14.3	Certification of organic farming	366
14.4	Contribution of grassland and forage legumes to organic farming systems	368
14.5	Organic grassland management in practice	378
14.6	References	387
15	Economic Aspects of Grassland Production and Utilization	394
	<i>J.P. McInerney</i>	
15.1	Introduction	394
15.2	The framework for economic analysis	395
15.3	Efficiency in grassland farming	397
15.4	Defining optimality	399
15.5	Measuring economic performance in production	402
15.6	Determinants of profitability in grassland farming	410
15.7	Responding to the market	415
15.8	A cautionary note	418
15.9	Grassland and the non-food system	419
15.10	Grassland production and the environment	422
15.11	References	427
	<i>Index</i>	429