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SULLA (*Hedysarum coronarium* L.); AN AGRONOMIC EVALUATION

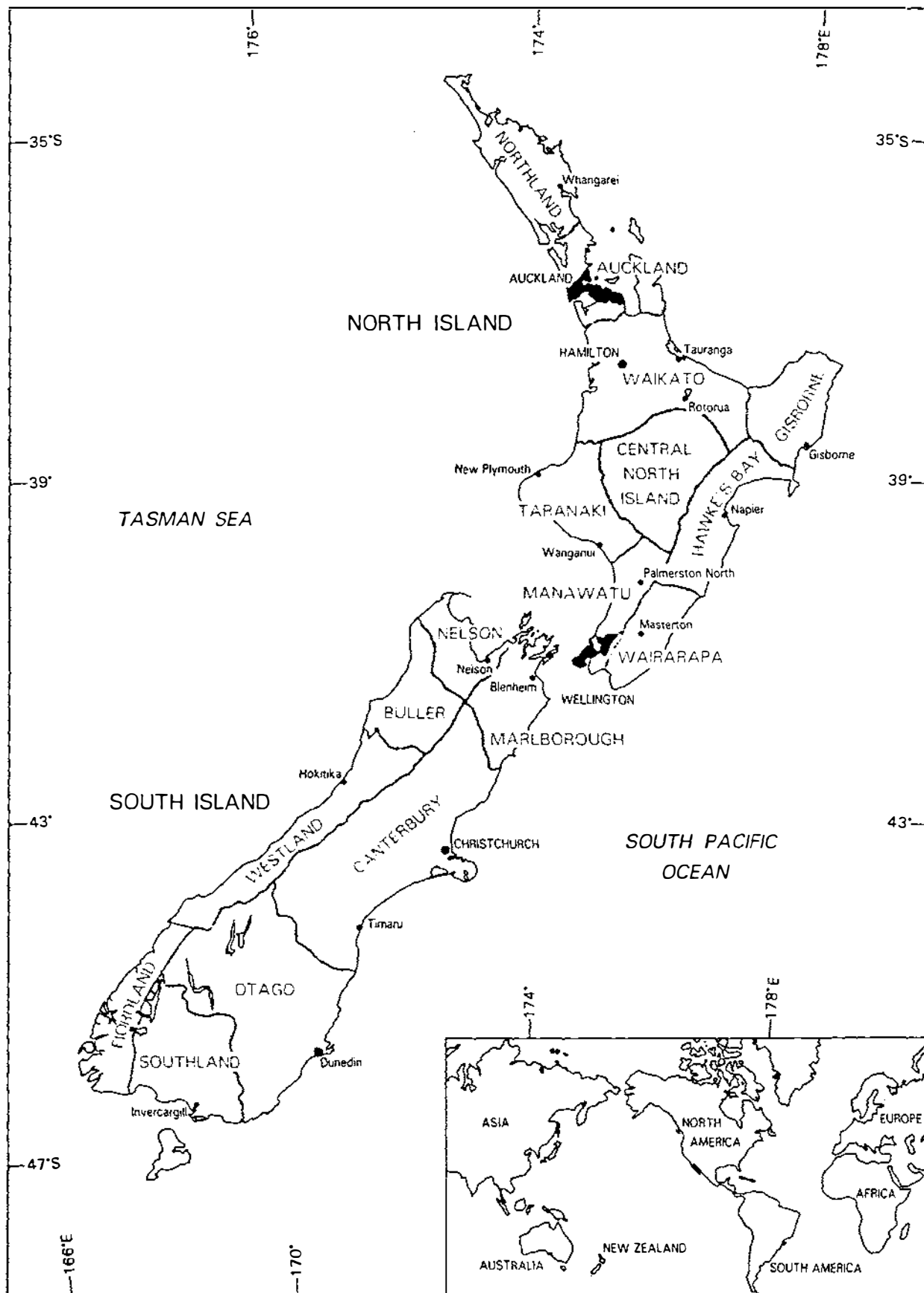
**A THESIS PRESENTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY
AT MASSEY UNIVERSITY**

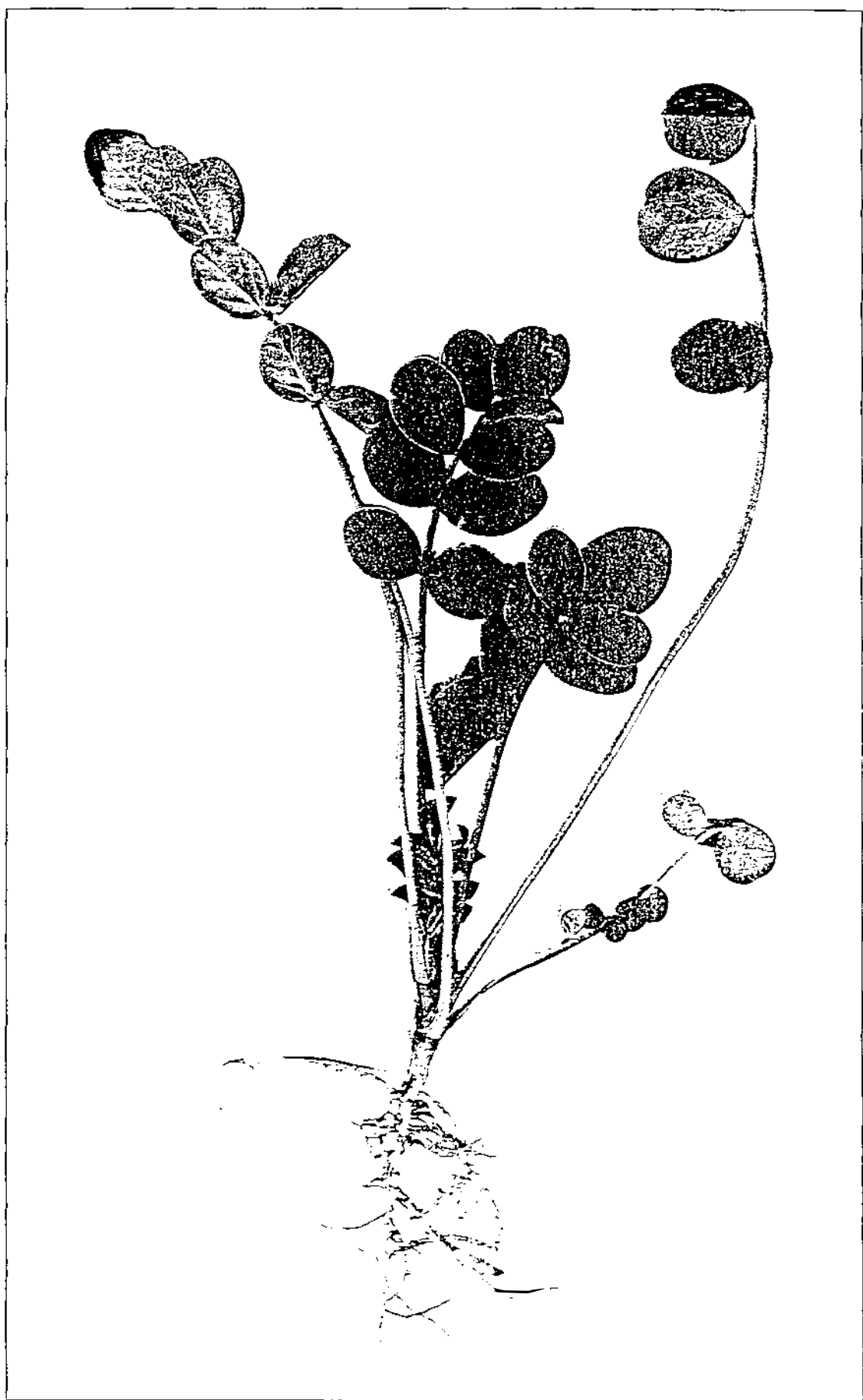
HARI KRISHNA

1993

***'THERE IS NOTHING GRATEFUL BUT THE EARTH; YOU CANNOT DO TOO
MUCH FOR IT: IT WILL CONTINUE TO REPAY TENFOLD THE PAINS AND
LABOUR BESTOWED UPON IT'***

LORD RAVENSWORTH





ABSTRACT

This thesis reports three studies conducted on the agronomic evaluation of the recently introduced forage legume species sulla (*Hedysarum coronarium* L.) cv. Necton, for its potential use in animal production systems in New Zealand. The utilisation of forages, grasses and legumes, in New Zealand is predominantly by grazing *in situ*. Sulla was introduced to New Zealand for soil conservation, but its use as a forage under a cutting regime is well known in the Mediterranean countries. Information was inadequate for its use under a grazing regime.

A preliminary study was conducted under sheep grazing to assess annual herbage production, seasonal patterns of DM production and persistence. Nodulation failure resulted in the application of 100 kg N ha⁻¹ after each grazing. Severe grazing (H=70-75% herbage consumed) and less severe (L=60-65% herbage consumed) grazing intensities were imposed at the early reproductive (ER) and late reproductive (LR) growth stages. The resultant management treatments over one year were ERHHHH, ERHLLL, ERLHHH, ERLLLL, LRHHH and LRLLL. Grazing intensities did not affect herbage production as residual herbage senesced after grazing. The annual herbage production ranged from 12000-20000 kg DM ha⁻¹ in the ERGS and LRGS treatments. Plant density declined 83 and 46% in the ERGS and LRGS respectively. Regrowth originated from the crown region in both growth stages. Autumn grazing management, ineffectively nodulated plants, inadequate weed control and poor stand persistence were identified as constraints to herbage production and needed further research. An effective *Rhizobium* strain ICMP 10149 was reisolated, and a concurrent trial elsewhere, not by the author of the thesis, identified Stomp 330 E a preemergent herbicide as suitable for sulla.

A greenhouse defoliation trial was conducted to elucidate the influence of plant growth stage at defoliation and grazing intensity on herbage accumulation in the absence of compounding factors such as selective grazing and trampling. Plants were defoliated to 1, 7, 15 and 30 cm at the late vegetative (LV), midstem elongation (MSE) and early flowering (EF) growth stages. Across growth stages, the residual leaf area was 0, 84, 180 and 415 cm² respectively. Destructive harvests were carried out on days 0, 14, 25, 40 and 60 after defoliation. Plant maturity at defoliation and defoliation intensity were determinants of herbage increase in 60 days of regrowth. Complete (1 cm) defoliation at the LV growth stage resulted in

a smaller root system, decreased starch accumulation and reduced plant size. Defoliating to 15 cm at the EF growth stage produced the maximum regrowth of herbage, maintained high taproot starch and root mass.

A grazing trial was designed to evaluate annual herbage production, seasonal patterns of DM production and plant persistence in an effectively nodulated stand with minimum weed competition. Severe (H=70-80% herbage consumed) and less severe (L=60-70% herbage consumed) grazing intensities were applied at the late vegetative (LV), midstem elongation (MSE) and early flowering (EF) growth stages. LVHHHH, LVLLLL, MSEHHHH, MSELLLL, EFHHH and EFLLL were the resultant management treatments over one year. Grazing intensity did not influence herbage produced as the postgrazing herbage senesced. Across intensities, the annual herbage produced ranged from 22000-25000 kg DM ha⁻¹ for the various growth stages. Herbage accumulation rates were 55 kg DM ha⁻¹ d⁻¹ in early summer and peaked at 78 kg DM ha⁻¹ d⁻¹ in late summer and early autumn. Plant density declined 79, 74 and 29% over a year in the LV, MSE and EF treatments respectively and remaining plants subsequently disappeared. Late autumn grazing in wet soil conditions resulted in significant plant losses which affected spring herbage production.

Sulla was best grazed or cut at the EF growth stage for maximum herbage production and persistence. Complete removal of herbage maximised utilisation as remaining stubble senesced and did not contribute to herbage accumulation. Under grazing sulla was short-lived and thus should be managed as an annual forage species. Allowing seed to shatter may be a potential management tool for the maintenance of stands. An autumn sowing for spring utilisation to exploit winter growth activity may be advantageous. However, late autumn grazing especially with high stocking densities under wet soil conditions should be avoided, and, in general, damage to the crown should be minimised. Although a residual leaf area (200 cm²) on the stubble would improve the rate of regrowth this would appear difficult to attain under grazing. It may be best to cut sulla to exploit its winter growth activity. Sulla has potential as a special purpose forage when summer and autumn/winter pasture deficits restrict animal production.

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TABLE OF CONTENTS

Abstract	v
Acknowledgments	vii
Table of Contents	viii
List of Tables	xv
List of Figures	xx
List of Plates	xxv
List of Appendices	xxviii
 Chapter 1. General Introduction and Objectives	 1
 Chapter 2. Literature Review	 3
2.1 Introduction	3
2.2 Botanical classification, origin and distribution	3
2.3 Importance and brief history of the introduction of sulla in New Zealand	5
2.4 Breeding history in New Zealand	6
2.5 Ecology - Edaphic and environmental requirements	7
2.6 Cultural requirements	8
2.6.1 Soil fertility	8
2.6.2 Inoculation	8
2.6.3 Establishment	9
2.6.4 Weed control	10
2.6.5 Diseases and pests	10
2.6.6 Mixtures	11
2.6.7 Forage production	11
2.6.8 Hay and silage	13
2.6.9 Seed production	13
2.6.10 Nutritive value	14

2.7 Defoliation management and herbage production	20
2.7.1 Fundamental concepts	20
2.7.2 Defoliation management of <i>Medicago sativa</i> L.	21
2.7.2.1 Defoliation based on fixed interval	21
2.7.2.2 Defoliation by growth stage	22
2.7.2.3 Defoliation by crown shoot development	23
2.7.2.4 Defoliation height	24
2.7.2.5 Autumn defoliation management	26
2.8 The importance of organic reserves in forage management	27
2.8.1 Introduction	27
2.8.2 Definition of organic reserves	28
2.8.3 Starch and fructosan accumulators	28
2.8.4 Seasonal and environmental variation	29
2.8.5 Defoliation variation	30
2.8.6 Organic reserves and regrowth	31
2.9 Shoot as a component of herbage production	33
2.10 Defoliation effects on the root system	35
2.11 Summary	36

Chapter 3. A preliminary agronomic evaluation; The response of sulla

(*Hedysarum coronarium* L.) cv. Necton to different grazing

management systems over one year 38

3.1 Introduction	38
3.2 Material and methods	39
3.2.1 Site information	39
3.2.2 Design and treatments	41
3.2.3 Measurements	45
3.2.4 Statistical analysis	47

3.3 Results	47
3.3.1 Climate	47
3.3.2 Herbage and components of herbage accumulation	48
3.3.3 Herbage mass at each grazing	50
3.3.4 Leaf mass at each grazing	52
3.3.5 Stem mass at each grazing	54
3.3.6 Plant density	56
3.3.7 Individual plant dry weight	58
3.3.8 Relationship between plant dry weight and plant density	60
3.3.9 Leaf-to-stem mass ratio	62
3.3.10 Weed accumulation	65
3.3.11 Herbage consumption	67
3.3.12 Regrowth sites and regrowth site characteristics in sulla	69
3.3.12.1 Shoot number	69
3.3.12.2 Shoot length	72
3.3.12.3 Leaf number	72
3.3.12.4 Petiole length	72
3.3.12.5 Leaf area	73
3.4 Discussion	73
3.4.1 Herbage production	73
3.4.2 Plant density, plant size and their relationship	74
3.4.3 Changes in leaf-to-stem mass ratio	75
3.4.4 Weed infestation	76
3.4.5 Efficiency of grazing	76
3.4.6 Origins of regrowth in sulla	77
3.4.7 Persistence problems	77
3.4.8 Conclusions and further research	78

Chapter 4. The regrowth of defoliated sulla (<i>Hedysarum coronarium</i> L.) cv.Necton; A greenhouse physiological evaluation	79
4.1 Introduction	79
4.2 Material and methods	81
4.2.1 Site information	81
4.2.2 Design and treatments	86
4.2.3 Measurements	91
4.2.4 Statistical analysis	94
4.3 Results	94
4.3.1 Greenhouse climate	94
4.3.2 Leaf number	94
4.3.3 Leaf area	98
4.3.4 Shoot dry weight	100
4.3.5 Relationship between shoot dry weight and leaf area	103
4.3.6 Root dry weight	104
4.3.7 Root starch concentration	106
4.3.8 Root starch content	110
4.3.9 Shoot/root ratio	113
4.3.10 Whole-plant dry weight	113
4.3.11 Relative growth rate	117
4.3.12 Unit leaf rate	120
4.3.13 Leaf area ratio	120
4.4 Discussion	123
4.4.1 Effect of growth stage at defoliation and stubble leaf on net herbage production	123
4.4.2 The effect of stubble leaf area and starch status at defoliation on the regrowth pattern in sulla	124

4.4.3 Effect of growth stage and intensity of defoliation on the root system	128
4.4.4 Severity of defoliation and dry matter partitioning	130
4.4.5 Severity of defoliation and its effects on plant size	131
4.4.6 Conclusions	131
Chapter 5. The effect of various grazing management systems on the production and persistence of sulla (<i>Hedysarum coronarium</i> L.) cv. Necton	133
5.1 Introduction	133
5.2 Material and methods	134
5.2.1 Site information	134
5.2.2 Design and treatments	136
5.2.3 Measurements	142
5.2.4 Statistical analysis	143
5.3 Results	143
5.3.1 Climate	143
5.3.2 Herbage and components of herbage accumulation	144
5.3.3 Herbage mass at each grazing	146
5.3.4 Leaf mass at each grazing	148
5.3.5 Stem mass at each grazing	150
5.3.6 Plant density	151
5.3.7 Individual plant dry weight	154
5.3.8 Individual plant dry weight versus plant density	157
5.3.9 Leaf-to-stem mass ratio	159
5.3.10 Weed accumulation	161
5.3.11 Herbage consumption	163
5.3.12 Regrowth site characteristics	166

5.3.12.1 Shoot number	166
5.3.12.2 Shoot length	168
5.3.12.3 Leaf number	168
5.3.12.4 Petiole length	168
5.3.12.5 Leaf area	169
5.3.12.6 Shoot dry weight	169
5.3.13 Taproot diameter	170
5.3.14 Root dry matter	170
5.4 Discussion	171
5.4.1 Herbage production	171
5.4.2 Effect of growth stage at grazing on herbage production	171
5.4.3 Seasonal pattern of herbage accumulation	174
5.4.4 Effect of winter grazing and stocking density on plant density . .	174
5.4.5 Relationship between plant dry weight and plant density	177
5.4.6 Weed encroachment	177
5.4.7 Efficiency of grazing	178
5.4.8 Regrowth sites and their contribution to herbage accumulation .	178
5.4.9 Effect of grazing on the root system	182
5.4.10 Grazing management and persistence of sulla	182
5.4.11 Conclusions and management implications	183
Chapter 6. General Discussion	184
6.1 Introduction	184
6.2 Comparative annual production and seasonal distribution of herbage	184
6.3 Managing sulla for maximum productivity, utilisation and persistence	186
6.4 The potential role of sulla in animal production systems in New Zealand	191

6.5 Limitations	192
6.6 Conclusions	193
Bibliography	196
Appendices	219

LIST OF TABLES

Table 2.1 Chemical composition of stem, leaves and inflorescence of sulla. Data presented on a dry weight basis	15
Table 2.2 Mineral composition of sulla in 100 g of ash	16
Table 2.3 Vitamin content of sulla at pre-flowering stage	16
Table 2.4 Total digestible nutrients of sulla on a percentage moisture free basis	17
Table 2.5 Some nutritive aspects of sulla cut at the early flowering growth stage (% dry weight basis) at Courtenay, Christchurch	18
Table 2.6 Nutrient content of healthy sulla at Courtenay, Christchurch. Samples were taken in late spring	18
Table 2.7 Predicted <i>in vivo</i> digestibility of the feed on offer to grazing lambs (n=3)	19
Table 2.8 Predicted <i>in vivo</i> digestibility of the feed selected by the grazing animal (n=8)	19
Table 3.1 Flow chart showing the grazing intensity treatments imposed on sulla at the early reproductive (ER) and late reproductive (LR) growth stage at each grazing, over 365 DAS	45
Table 3.2 Grazing schedule as determined by plant growth stage at each grazing, over 365 DAS	46

Table 3.3 Summary of climate data at the trial site from September 1988 to September 1989, recorded at the DSIR climate station (40°23'S 175°37', 34 m asl)	48
Table 3.4 The effect of plant growth stage at grazing and grazing intensity on the total herbage and components of herbage accumulated (kg DM ha ⁻¹) in sulla, over 365 DAS	49
Table 3.5 The effect of plant growth stage (ERGS) at grazing and grazing intensity on the herbage accumulation rate (kg DM ha ⁻¹) at each grazing in sulla, over 365 DAS	50
Table 3.6 The effect of plant growth stage (LRGS) at grazing and grazing intensity on the herbage accumulation rate (kg DM ha ⁻¹ d ⁻¹) at each grazing in sulla, over 365 DAS	52
Table 3.7 The effect of plant growth stage at grazing and grazing intensity on the final plant density (plants m ⁻²) in sulla, at 365 DAS	56
Table 3.8 The effect of plant growth stage at grazing and grazing intensity on the final dry weight (g plant ⁻¹) in sulla, at 365 DAS	58
Table 3.9 The effect of plant growth stage at grazing and grazing intensity on the total accumulated leaf-to-stem mass ratio in sulla, over 365 DAS	62
Table 3.10 Chemical and estimated <i>in vivo</i> digestibilities of herbage components in sulla, sampled at the late reproductive growth stage	64
Table 3.11 The effect of plant growth stage at grazing and grazing intensity on the total weed accumulated (kg DM ha ⁻¹) in sulla, over 365 DAS	65

Table 3.12 The effect of plant growth stage at grazing and grazing intensity on the total herbage, herbage components and weeds consumed (kg DM ha ⁻¹) over 365 DAS	68
Table 3.13 The origin of leaf axil buds on regrowth sites and regrowth site characteristics in sulla, grazed at the early reproductive growth stage (85 DAS), 18 days after first grazing. Data meaned over all intensities . . .	71
Table 3.14 The origin of leaf axil buds on regrowth sites and regrowth site characteristics in sulla, grazed at the late reproductive growth stage (106 DAS), 48 days after first grazing. Data meaned over all intensities . .	71
Table 4.1 Summary of the treatments imposed on greenhouse grown sulla .	87
Table 4.2 Defoliation dates and destructive harvest schedule of greenhouse grown sulla	91
Table 4.3 The effect of plant growth stage at defoliation on the mean relative growth rate (g g ⁻¹ d ⁻¹) of sulla, in four intervals over the first regrowth cycle. Data meaned over defoliation intensities	118
Table 4.4 The effect of defoliation intensity on the mean relative growth rate (g g ⁻¹ d ⁻¹) of sulla, in four intervals over the first regrowth cycle. Data meaned over growth stages	119
Table 4.5 The effect of defoliation intensity on the mean unit leaf rate (g cm ⁻² d ⁻¹) of sulla, in four intervals over the first regrowth cycle. Data meaned over growth stages	121
Table 4.6 The effect of plant growth stage at defoliation on the mean leaf area ratio (cm ² g ⁻¹) of sulla, in four intervals in the first regrowth cycle. Data meaned over defoliation intensities	122

Table 4.7 The effect of defoliation intensity on the mean leaf area ratio ($\text{cm}^2 \text{g}^{-1}$) of sulla, in four intervals over the first regrowth cycle. Data meaned over growth stage	122
Table 5.1 A flow chart showing the grazing intensity management treatments imposed at the late vegetative (LV), midstem elongation (MSE) and early flowering (EF) growth stages, at each grazing, over 365 days	140
Table 5.2 Grazing schedule of sulla as determined by plant growth stage at grazing, at each grazing, over 365 DAS	141
Table 5.3 Summary of climate data at the trial site from October 1989 to October 1990, recorded at the DSIR climate station ($40^\circ 23'S$ $175^\circ 37'E$, 34 m asl)	144
Table 5.4 The effect of plant growth stage at grazing on the total herbage and components of herbage accumulated (kg DM ha^{-1}) in sulla, over 365 days. Data meaned over all grazing intensities	145
Table 5.5 The effect of plant growth stage at grazing and grazing intensity on the herbage accumulation rate ($\text{kg DM ha}^{-1} \text{d}^{-1}$) at each grazing in sulla, over 365 DAS	148
Table 5.6 The effect of plant growth stage at grazing and grazing intensity on the final plant density (plants m^{-2}) in sulla, at 365 DAS	152
Table 5.7 The effect of grazing sulla in winter at the late vegetative and midstem elongation growth stage on plant density (plant m^{-2}), in grazed and ungrazed subplots (means of treatments LV and MSE) on 20 September 1990	154

Table 5.8 The effect of plant growth stage at grazing on the final individual plant dry weight (g plant^{-1}) in sulla, at 365 DAS. Data meaned over all grazing intensities	156
Table 5.9 The effect of plant growth stage at grazing on the total accumulated leaf-to-stem mass ratio in sulla, over 365 DAS. Data meaned over all intensities	160
Table 5.10 The effect of plant growth stage at grazing and grazing intensity on the total weed accumulated (kg DM ha^{-1}) in sulla, over 365 DAS	162
Table 5.11 The effect of plant growth stage at grazing and grazing intensity on herbage, herbage components and weeds consumed (kg DM ha^{-1}) of sulla, over 365 days	164
Table 5.12 The effect of plant growth stage at grazing and grazing intensity on the regrowth site characteristics of sulla, at 15 days after the first grazing	167
Table 5.13 The effect of plant growth stage at grazing and grazing intensity on taproot diameter and root dry weight in sulla, at 15 days after first grazing	170
Table 6.1 Annual herbage production of some forage species used for complementing pasture in the Manawatu	185
Table 6.2 Seasonal herbage accumulation rates of different forage species for complementing pasture in the Manawatu	187

LIST OF FIGURES

Figures 3.1 a & 3.1b The effect of plant growth stage at grazing and grazing intensity on the pregrazing herbage mass in sulla, at each grazing over 365 DAS	51
Figures 3.2a & 3.2b The effect of plant growth stage at grazing and grazing intensity on the pregrazing leaf mass in sulla, at each grazing over 365 DAS	53
Figures 3.3a & 3.3b The effect of plant growth stage at grazing and grazing intensity on the pregrazing stem mass in sulla, at each grazing over 365 DAS	55
Figures 3.4a & 3.4b The effect of plant growth stage at grazing and grazing intensity on the pregrazing plant density in sulla, at each grazing over 365 DAS	57
Figures 3.5a & 3.5b The effect of plant growth stage at grazing and grazing intensity on the pregrazing individual plant dry weight in sulla, at each grazing over 365 DAS	59
Figure 3.6 Scatterplot showing the relationship between \log_{10} plant dry weight and \log_{10} plant density at the end of the experiment	61
Figures 3.7a & 3.7b The effect of plant growth stage at grazing and grazing intensity on the pregrazing leaf-to-stem mass ratio in sulla, at each grazing over 365 DAS	63
Figures 3.8a & 3.8b The effect of plant growth stage at grazing and grazing intensity on the pregrazing weed mass in sulla, at each grazing over 365 DAS	66

Figure 3.9 Regrowth sites of a sulla plant	70
Figure 4.1 The effect of regrowth period on the leaf number in sulla	95
Figure 4.2 The effect of plant growth stage at defoliation on the number of leaves in sulla. Data meaned over defoliation intensities and sampling dates	96
Figure 4.3 The effect of defoliation intensity on the number in leaves of sulla. Data meaned over growth stages and sampling dates	97
Figure 4.4 The effect of defoliation intensity on the leaf area in sulla, over 60 days of regrowth. Data meaned over growth stages	98
Figure 4.5 Response surface diagram illustrating the effect of the interaction between plant growth stage at defoliation and defoliation intensity on leaf area. Data meaned over sampling dates	99
Figure 4.6 The effect of plant growth stage at defoliation on the shoot dry weight in sulla, over 60 days of regrowth. Data meaned over defoliation intensities	101
Figure 4.7 The effect of defoliation intensity on the shoot dry weight of sulla, over 60 days in regrowth. Data meaned over growth stages	102
Figure 4.8 The relationship between shoot dry weight and leaf area throughout the experiment	103
Figure 4.9 The effect of plant growth stage at defoliation on the root dry weight in sulla, over 60 days of regrowth. Data meaned over defoliation intensities	104

Figure 4.10 The effect of defoliation intensity on the root dry weight in sulla, over 60 days of regrowth. Data meaned over growth stages	105
Figure 4.11 The effect of plant growth stage at defoliation on the starch concentration in sulla, over 40 days of regrowth. Data meaned over defoliation intensities	107
Figure 4.12 The effect of defoliation intensity on the starch concentration in sulla, over 40 days of regrowth. Data meaned over sampling dates . .	108
Figure 4.13 Response surface illustrating the interaction between plant growth stage at defoliation and defoliation intensity in root starch concentration. Data meaned over sampling dates	109
Figure 4.14 The effect of plant growth stage at defoliation on the starch content in sulla, over 40 days of regrowth. Data meaned over defoliation intensities	110
Figure 4.15 The effect of defoliation intensity on the starch content in sulla, over 40 days of regrowth. Data meaned over growth stages	111
Figure 4.16 Response surface diagram illustrating the effect of the interaction between plant growth stage at defoliation and defoliation intensity on the starch content in sulla. Data meaned over sampling dates	112
Figure 4.17 The effect of defoliation intensity on the shoot/root dry weight ratio in sulla, over 60 days of regrowth. Data meaned over growth stages	114

Figure 4.18 The effect of plant growth stage at defoliation on the shoot/root dry weight ratio in sulla. Data meaned over defoliation intensities and sampling dates	115
Figure 4.19 The effect of plant growth stage at defoliation on the whole-plant dry weight in sulla, over 60 days of regrowth. Data meaned over defoliation intensities	116
Figure 4.20 The effect of defoliation intensity on the whole-plant dry weight in sulla, over 60 days of regrowth. Data meaned over growth stages	117
Figure 5.1 The effect of plant growth stage at grazing and grazing intensity on the pregrazing herbage mass in sulla, at each grazing over 365 DAS	147
Figure 5.2 The effect of plant growth stage at grazing and grazing intensity on the pregrazing leaf mass in sulla, at each grazing over 365 DAS . . .	149
Figure 5.3 The effect of plant growth stage at grazing and grazing intensity on the pregrazing stem mass in sulla, at each grazing over 365 DAS . .	151
Figure 5.4 The effect of plant growth stage at grazing and grazing intensity on the pregrazing plant density in sulla, at each grazing over 365 DAS	153
Figure 5.5 The effect of plant growth stage at grazing and grazing intensity on the pregrazing individual plant dry weight in sulla, at each grazing over 365 DAS	157

Figures 5.6a, b, c, d & e Scatterplots showing the relationship between
log₁₀ plant dry weight (w) and log₁₀ plant density (p), at each grazing
over 365 DAS 158

Figure 5.7 The effect of plant growth stage at grazing and grazing intensity
on the pregrazing leaf-to-stem mass ratio in sulla, at each grazing over
365 DAS 160

Figure 5.8 The effect of plant growth stage at grazing and grazing intensity
on the pregrazing weed mass in sulla, at each grazing over 365 DAS . . 163

LIST OF PLATES

Plate 2.1	Sulla - <i>Hedysarum coronarium</i> L.	4
Plate 2.2	<i>Phalaris aquatica</i> found growing in association with <i>Hedysarum coronarium</i> L. in experimental plot	12
Plate 3.1	General view of trial site located at Frewens 7 Massey University	40
Plate 3.2	Sulla sward at the early reproductive growth stage	42
Plate 3.3	Sulla sward at the late reproductive growth stage	42
Plate 3.4	Severely grazed treatment	43
Plate 3.5	Less severely grazed treatment	43
Plate 3.6	Sheep grazing sulla	44
Plate 4.1	General view of greenhouse no.3 located at Massey University Plant Growth Unit	82
Plate 4.2	Hydrothermograph enclosed in an aspirated wooden box	83
Plates 4.3a & b	<i>Hedysarum coronarium</i> L. effectively nodulated by <i>Rhizobium</i> strain ICMP 10149	84
Plate 4.4	Simulated sulla sward actively growing in greenhouse	85
Plate 4.5	Sulla plants at the late vegetative growth stage	88

Plate 4.6	Sulla plants at the midstem elongation growth stage	89
Plate 4.7	Sulla plants at the early flowering growth stage	90
Plate 4.8	The effect of cutting sulla to 1, 7, 15 and 30 cm (from right to left) on the root system, 14 days after defoliation	129
Plate 5.1	General view of established sulla plots located at Frewens 3, Massey University	135
Plate 5.2	Sulla sward at the late vegetative growth stage	137
Plate 5.3	Sulla sward at the midstem elongation growth stage	137
Plate 5.4	Sulla sward at the early flowering growth stage	138
Plate 5.5	Severe grazing treatment	138
Plate 5.6	Less severe grazing treatment	139
Plate 5.7	Summer grazing in progress. Note green herbage on offer compared to surrounding pasture	139
Plate 5.8	Winter grazing in progress in the midstem elongation growth stage treatment	155
Plate 5.9	The consequence of winter grazing on plant productivity in spring. Plants in the background were ungrazed	155
Plate 5.10	Stubble decaying after grazing	172
Plate 5.11	Crown shoots emerging after first grazing	173

Plate 5.12	Early regrowth in the LV growth stage treatment, 10 days after first grazing	173
Plate 5.13	The effect of frost on sulla, in late winter	175
Plate 5.14	The same sward in spring, showing no signs of frost damage . .	175
Plate 5.15	The origin of shoots on the crown in defoliated sulla	180
Plate 5.16	Shoots dissected from a single crown	181
Plate 5.17	A typical sulla shoot	181

APPENDICES

Appendix 3.1 Site soil pedology - Marton silt loam	219
Appendix 3.2 Site soil pedology - Matapiro silt loam	220
Appendix 3.3 Presowing site soil analysis (Frewens 7)	221
Appendix 3.4 Postsowing site soil analysis (Frewens 7)	222
Appendix 3.5 Leaf nutrient analysis	223
Appendix 3.6 Layout of preliminary grazing trial	224
Appendix 3.7 50 years climate data for Palmerston North	225
Appendix 3.8 The effect of plant growth stage (ERGS) at grazing and grazing intensity on herbage, herbage components and weeds consumed (kg DM ha ⁻¹), and percent herbage consumed at each grazing, over 365 DAS	226
Appendix 3.9 The effect of plant growth stage (LRGS) at grazing and grazing intensity on herbage, herbage components and weeds consumed (kg DM ha ⁻¹), and percent herbage consumed at each grazing, over 365 DAS	227
Appendix 3.10 The effect of grazing sulla under different intensity management treatments at the early reproductive growth stage on pregrazing plant morphology - stem density (stems plant ⁻¹), stem node number (number stem ⁻¹) and stem height (mm) (n=15)	228

Appendix 3.11 Published paper on some aspects of the preliminary grazing trial	229
Appendix 4.1 Layout of greenhouse trial	232
Appendix 4.2 Procedure for carbohydrate analysis	233
Appendix 4.3 The relationship between whole-plant dry-weight and leaf area (A) throughout the experiment	244
Appendix 5.1 Presowing site soil analysis (Frewens 3)	245
Appendix 5.2 Postsowing soil and plant analysis	246
Appendix 5.3 Soil analysis at the conclusion of the trial (Frewens 3)	247
Appendix 5.4 Layout of large-scale grazing trial	248
Appendix 5.5 The effect of plant growth stage at grazing and grazing intensity on herbage, herbage components and weeds consumed (kg DM ha ⁻¹), and percent herbage consumed at each grazing, over 365 DAS . .	249