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COMPARATIVE STUDIES ON THE IMPLICATIONS OF CONDENSED TANNINS IN THE EVALUATION OF HOLCUS LANATUS AND LOLIUM SPP. SWARDS FOR SHEEP PERFORMANCE

A thesis presented in partial fulfilment of the requirements for the degree of Doctor of Philosophy at Massey University, Palmerston North, New Zealand.

FABIO MONTOSSI

AUGUST, 1995

This thesis is dedicated to my darling wife Adriana who helped with it more than she will ever know.

It is great beauty of our science that advancement in it, whether in a degree great or small, instead of exhausting the subject of research, opens the doors of further and more abundant knowledge, overflowing with beauty and utility, Michael Faraday 1791 - 1867.



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ABSTRACT

Montossi, F.M. 1995. Comparative studies on the implications of Condensed Tannins in the evaluation of *Holcus lanatus* and *Lolium* spp. swards for sheep performance. PhD Thesis, Massey University, Palmerston North, New Zealand.

The series of experiments which form the basis of the present study concentrated on evaluations of: (i) diet selection, grazing behaviour, herbage intake, and sheep performance between *Holcus lanatus* (Yorkshire fog) and *Lolium* spp. (perennial or annual ryegrass) swards both associated with *Trifolium repens* (White clover), and in one study with the presence or absence of *Lotus comiculatus* (Birdsfoot trefoil), and (ii) the effects of condensed tannins (CT) on the behaviour and performance of sheep grazing those swards. The effects of CT on sheep production were assessed by twice daily oral administration of polyethylene glycol (PEG; Molecular weight 4,000) to half of the lambs on each sward combination.

Three grazing experiments are reported; the first two (Experiments 1 and 2) were carried out at Massey University (New Zealand) from 1992 to 1993, while the final trial was undertaken at INIA Tacuarembó Research Station (Uruguay) during 1994. In the first experiment (Chapter 3), relationships amongst sward, grazing behaviour, and animal performance variables were studied on perennial ryegrass/white clover and Yorkshire fog/white clover swards rotationally grazed by ewes at medium and high daily allowances (6% and 12% of liveweight as herbage dry matter respectively) during late autumn in 1992. The next experiment (Chapter 4) was designed to investigate the effects of low concentrations of condensed tannins (CT) on lambs grazing perennial ryegrass/white clover or Yorkshire fog/white clover swards at a constant height of approximately 6 cm from December 1992 to March 1993. The final experiment (Chapter 5) was carried out from August to early November 1994 to examine differences in behaviour and performance between annual ryegrass/white clover and Yorkshire fog/white clover swards, both with presence or absence of birdsfoot trefoil, rotationally grazed by lambs

Abstract

Results from Experiments 1 and 2 showed that herbage intake achieved by sheep grazing perennial ryegrass swards was 15 - 27% higher than that achieved on *Holcus lanatus* swards. Bite weight was 13 - 38% greater for *Holcus lanatus* than for ryegrass, associated with the 15 - 25% greater sward bulk density. There was a consistent advantage (1 - 5%) in the organic matter digestibility of the herbage selected in favour of ryegrass swards. Sheep on both pasture types concentrated grass rather than clover in the diet. Sheep grazing on ryegrass swards had higher liveweight gains (8 - 51%), clean wool growth (6%), carcass weight (7%), GR values (22%), and carcass dressing out percentage (2%) than sheep grazing on Yorkshire fog swards. The stocking rate maintained on ryegrass plots was 25% greater than that on Yorkshire fog plots.

Similar low concentrations of CT were recorded in the diets of ryegrass and Yorkshire fog swards ($\leq 0.2\%$ on a DM basis). These results were confirmed by measurements of NH₃ concentration in the rumen fluid. The low levels of CT had no significant effects on diet selection, herbage intake, grazing behaviour patterns or lamb performance. However, the lambs grazing on Yorkshire fog swards showed small and non-persistent responses to CT in terms of faecal egg counts, wool growth and liveweight gain.

Experiment 3 indicated that the organic matter digestibility of the diet selected and the herbage intake of lambs grazing on Yorkshire fog swards were higher than those on annual ryegrass (5% and 24% respectively), reflecting the higher contents in the diet of grass green leaf and of legume and the lower content of dead material in favour of Yorkshire fog swards. Lambs grazing on both swards showed similar behaviour patterns. Those on Yorkshire fog swards had higher clean wool growth (15%), greater fibre diameter (48%), and longer fibre length (5%), greater liveweight gains (41%), final weight (11%), carcass weight (29%), carcass weight gains (29%), GR value (38%), and lower faecal egg count (FEC) values (20%).

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Slightly higher CT dietary concentrations were recorded in Yorkshire fog swards than in annual ryegrass (0.420 vs $0.365 \pm 0.02\%$ on a DM basis). These low CT levels increased clean wool growth (11%), fibre diameter (4%), although differences in carcass measurements were relatively small, and tended to reduce FEC values (15%). The effects of CT on animal performance were greater in Yorkshire fog swards than in perennial ryegrass swards. CT had no significant effects on diet selection, herbage intake, or grazing behaviour patterns. The very small effects of lotus on sward composition, sward structure and on lamb performance were explained by its very low contribution to both swards.

The major conclusions of the first two experiments are as follows: (i) under high fertility conditions and intensive grazing management, perennial ryegrass/white clover swards appeared to have higher feeding value than Yorkshire fog/white clover swards for sheep production; (ii) the results of these experiments confirmed the presence of limited CT concentrations in *Holcus lanatus*, and provided further evidence that low CT concentrations also exist in perennial ryegrass; (iii) these low CT concentrations ($\leq 0.2\%$ on a DM basis) present in both swards did not influence sheep performance significantly. Finally, the conclusions of the last experiment were: (i) under low to moderate soil fertility conditions and lax rotational grazing management, Yorkshire fog swards had better composition and structure for lamb production than annual ryegrass; (ii) low CT concentrations (range 0.36 to 0.42% on a DM basis) consistently increased wool production and liveweight gains, particularly in Yorkshire fog swards.

The findings of these studies are discussed (Chapter 6) in the context of the role of *Holcus lanatus* for grazing systems and of the potential benefits of low dietary CT concentrations in *Holcus lanatus* and *Lolium* spp. for animal production.

Keywords: Lolium perenne (perennial ryegrass); Lolium multiflorum (annual ryegrass); Holcus lanatus (Yorkshire fog); Trifolium repens (White clover); Lotus corniculatus (Birdsfoot trefoil); Polyethylene glycol (PEG); Condensed tannins (CT); herbage intake; diet selection; grazing behaviour and lamb production.

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TABLE OF CONTENTS

ABSTRACT	. 1
ACKNOWLEDGEMENTS	IV
TABLE OF CONTENTS	VIII
LIST OF TABLES	(VII
LIST OF FIGURES	XIV
LIST OF PLATES XX	(VII
CHAPTER 1: INTRODUCTION AND OBJECTIVES	1
CHAPTER 2: LITERATURE REVIEW	4
2.1 GENERAL INTRODUCTION	4
2.2 HERBAGE INTAKE BY GRAZING ANIMALS	5
2.2.1 Introduction and overview	5
2.2.2 Regulation of herbage intake under grazing	
conditions	7
2.2.2.1 Behavioural constraints to herbage intake	
and ingestive behaviour	9
2.2.2.1.1 Intake per bite	10
2.2.2.1.1.1 Sward attributes affecting bite	
components	13
2.2.2.1.2 Rate of biting	14
2.2.2.1.3 Grazing time	14
2.2.2.1.4 Compensatory relationships	
amongst ingestive behaviour	
components	16
2.2.2.2 The influence of sward characteristics on	
ingestive behaviour and herbage intake	17
2.2.3 Conclusions	21
2.3 DIET SELECTION	22
2.3.1 Introduction and overview	22

1

.

	2.3.2	Theorie	s of diet	selection	23
	2.3.3	Factors	affecting	selection between alternative	
		forage	sources		26
		2.3.3.1	The link	ed role of animal senses	26
		2.3.3.2	The effe	ct of previous experience of animals	
			on diet s	selection	28
		2.3.3.3	Animal	factors influencing diet selection	30
		2.3.3.4	Sward o	characteristics affecting diet	
			selection	٦	32
		2	2.3.3.4.1	Selection of plant parts in a	
				pasture	33
		2	2.3.3.4.2	Selection of plant species in a	
				pasture: with special reference to	
				selection of white clover from	
				perennial temperate swards	34
		2.3.3.5	Hunger	and diet selection	37
	2.3.4	Conclus	sions		38
2.4	CONDE	NSED T	ANNINS	AND ANIMAL PRODUCTION	40
	2.4.1	Conden	sed tann	ins: definition, classification and	
		ecologia	cal role .		40
	2.4.2	Factors	affecting	the concentration of condensed	
		tannins	in forage	es	41
	2.4.3	The effe	ects of co	ondensed tannins on diet selection	
		and her	bage inta	ake	43
	2.4.4	The pa	rticular e	ffect of condensed tannins on wool	
		growth,	liveweigh	nt gain, carcass composition, parasite	
		infestati	ion and b	loating under temperate conditions .	48
	2.4.5	Analytic	al metho	ds available for the measurement of	
		tannins	in plants		55
	2.4.6	Conclus	sions		56

IX

2.5 THE POTENTIAL OF <i>HOLCUS LANATUS</i> (YORKSHIRE FOG) ANIMAL PRODUCTION	FOR 59
CHAPTER 3: EXPERIMENT 1	
A COMPARATIVE STUDY OF HERBAGE INTAKE, INGESTIVE BEHAV	IOUR
AND DIET SELECTION IN SHEEP GRAZING HOLCUS LANATUS	AND
LOLIUM PERENNE SWARDS IN LATE AUTUMN	61
3.1 ABSTRACT	61
3.2 INTRODUCTION	62
3.3 MATERIALS AND METHODS	63

Table of Contents

Х

3.3	MATER	IALS AN	ID METHODS	63
	3.3.1	Site pre	paration and management	63
	3.3.2	Experim	nental design	64
	3.3.3	Sward r	measurements	64
	3.3.4	Animal	measurements	65
	3.3.5	Statistic	al analysis	67
3.4.	RESUL	TS		67
	3.4.1	Sward r	neasurements	68
		3.4.1.1	Herbage mass, surface sward height and	
			sward bulk density	68
		3.4.1.2	Sward composition	68
		3.4.1.3	Tiller and node populations	71
		3.4.1.4	Tiller and node dissection	71
		3.4.1.5	Canopy structure	74
		3.4.1.6	Defoliation height	77
	3.4.2	Animal	measurements	80
		3.4.2.1	Chemical composition of the diet selected	80
		3.4.2.2	Diet selection, diet digestibility, herbage	
			intake and animal performance	80
		3.4.2.3	Ingestive behaviour	83

3.5 DISCUSSION	85
3.5.1 Herbage mass, sward height and sward	
	86
3.5.2 Sward bulk density, tiller-node dissection and tiller	
density	87
3.5.3 Diet selection and sward structure	88
3.5.4 Chemical composition of the diet selected	89
3.5.5 Herbage intake, liveweight gain and grazing	
behaviour	91
3.6 CONCLUSIONS	92

CHAPTER 4: EXPERIMENT 2

4.1 ABSTRACT		93
4.2 INTRODUCTION		95
4.3 MATERIALS AND METHODS		96
4.3.1 Site preparation and management		96
4.3.2 Experimental design	•••	97
4.3.3 Sward measurements		98
4.3.4 Animal measurements		98
4.3.4.1 Liveweight gain, carcass weight, dressing	out	
percentage and GR measurements		98
4.3.4.2 Midside wool growth		99
4.3.4.3 Diet selection and extrusa analyses		99
4.3.4.4 Dry matter intake and grazing behaviour		100
4.3.4.5 Faecal egg counts	•••	100
4.3.4.6 Rumen metabolism evaluation	• •	101

4.3.5 Statistical analysis	101
4.4 RESULTS	102
4.4.1 Sward measurements	102
4.4.1.1 Herbage mass, sward surface height and	
sward bulk density	102
4.4.1.2 Sward composition	105
4.4.1.3 Canopy structure	105
4.4.2 Animal measurements	109
4.4.2.1 Botanical and chemical composition of the	
diet selected	109
4.4.2.2 Rumen metabolism	111
4.4.2.3 Herbage intake and ingestive behaviour	113
4.4.2.4 FEC measurements	116
4.4.2.5 Wool growth and wool yield	119
4.4.2.6 Liveweight gain, carcass weight and yield,	
and carcass GR measurements	119
4.5 DISCUSSION	123
4.5.1 Evaluation of sward results	123
4.5.1.1 Herbage mass, surface sward height, sward	
bulk density, and sward composition	123
4.5.2 Evaluation of animal results	126
4.5.2.1 Botanical and chemical composition of the	
diet selected and canopy	
structure	126
4.5.2.2 Rumen metabolism	131
4.5.2.3 Grazing behaviour and herbage intake	132
4.5.2.4 Internal parasites	135
4.5.2.5 Lamb performance	135
4.5.2.5.1 Effects of sward species and sex .	135
4.5.2.5.2 Condensed tannins and PEG	
effects	137

4.6 CONCLUSIONS 1	39
-------------------	----

CHAPTER 5: EXPERIMENT 3

5.1	ABSTR	ACT	141
5.2	INTRO		143
5.3	MATER	NALS AND METHODS	144
	5.3.1	Site preparation and management	144
	5.3.2	Experimental design	146
	5.3.3	Sward measurements	149
		5.3.3.1 Herbage mass, sward height, and herbage	
		bulk density	149
		5.3.3.2 Sward structure	149
		5.3.3.3 Tiller population and tiller dissection	150
	5.3.4	Animal measurements	150
		5.3.4.1 Liveweight gain, carcass weight, dressing out	•
		percentage and GR measurements	150
		5.3.4.2 Midside wool growth and yield, fibre diameter	
		and length	151
		5.3.4.3 Diet selection and extrusa analyses	152
		5.3.4.4 Organic matter intake and grazing	
		behaviour	153
		5.3.4.5 Faecal egg counts (FEC) and abomasal and	
		intestinal worm burden measurements	154
	5.3.5	Statistical analysis	154

5.4	RESUL	TS		155
	5.4.1	Soil fer	ility	155
	5.4.2	Sward r	neasurements	155
		5.4.2.1	Herbage mass, sward surface height, and	
			herbage bulk density	155
		5.4.2.2	Sward components	160
		5.4.2.3	Tiller dissection and tiller population	162
		5.4.2.4	Sward structure	163
	5.4.3	Animal		169
		5.4.3.1	Botanical and chemical composition of the	
			diet selected	169
		5.4.3.2	Herbage intake and ingestive behaviour	172
		5.4.3.3	FEC measurements, and abomasal and	
			intestinal worm burdens	174
		5.4.3.4	Greasy and clean wool growth, wool yield,	
			fibre diameter, and fibre length	176
		5.4.3.5	Liveweight gain and carcass measurements	178
5.5	DISCUS	SION .		182
	5.5.1	Evaluat	ion of sward results	182
		5.5.1.1	Herbage mass, surface sward height, sward	
			bulk density, and sward composition	182
	5.5.2	Evaluati	on of animal results	185
		5.5.2.1	Botanical and chemical composition of the	
			diet selected and canopy structure	185
		5.5.2.2	Grazing behaviour and herbage intake	191
		5.5.2.3	Internal parasites	193
		5.5.2.4	Wool production	194
		5	5.5.2.4.1 Effects of grass species and lotus	194
		5	5.5.2.4.2 PEG supplementation and the	
			effects of CT	195
		5.5.2.5	Liveweight gain and carcass measurements	196

.

5.5.2.5.1 Effects of grass species and lotus	196
5.5.2.5.2 PEG supplementation and the	
effects of CT	197
5.5.3 Practical implications of the grazing management	
imposed in the present study	198
5.6 CONCLUSIONS	199
CHAPTER 6: GENERAL DISCUSSION AND CONCLUSIONS	200
6.1 INTRODUCTION	200
6.2 EVALUATION OF THE EXPERIMENTAL PROCEDURES	
USED IN THE CURRENT RESEARCH PROGRAMME	200
6.2.1 Sward procedures	200
6.2.2 Animal procedures	202
6.3 INTERRELATIONSHIPS BETWEEN ANIMAL BEHAVIOUR,	
ANIMAL PERFORMANCE, AND SWARD VARIABLES	206
6.3.1 Preparation and statistical analysis of the data	206
6.3.2 Results and Discussion	208
6.4 OVERALL EVALUATION OF THE EFFECTS OF THE	
LOW DIETARY CT CONCENTRATION ON SHEEP	
PERFORMANCE, HERBAGE INTAKE, DIET SELECTION,	
AND INTERNAL PARASITES	212
6.4.1 Effects on wool production, liveweight gain, and	
carcass weight	212
6.4.2 Effects on diet selection, herbage intake, and	
ingestive behaviour parameters	218
6.4.3 Effects on internal parasites	219
6.5 THE PLACE OF HOLCUS LANATUS IN GRAZING SYSTEMS	220
6.6 CONCLUSIONS	223
BIBLIOGRAPHY	. 226

XV

Table of Contents	XVI
APPENDICES	269
Appendix 3.1 (Chapter 3). Preliminary report of Experiment 1	
published in the Proceedings of the New Zealand Society of	
Animal Production	269
Appendix 4.1 (Chapter 4)	272
Appendix 5.1 (Chapter 5)	279

.

LIST OF TABLES

CHAPTER 3:

Table 3.1.	The effect of species and allowance on herbage mass	
	(kg DM ha ⁻¹), sward height (cm), and sward bulk density	
	(kg DM ha ⁻¹ cm ⁻¹) before and after grazing	69
Table 3.2.	The proportions of components of ryegrass and Yorkshire	
	fog swards estimated from hand separation (DM basis)	70
Table 3.3.	Tiller and node population density in ryegrass and	
	Yorkshire fog swards (Tillers or nodes/m ² , data based on	
	tiller and node separation)	72
Table 3.4.	Tiller dissection results of ryegrass and Yorkshire fog	
	tillers in the corresponding swards	73
Table 3.5.	Node dissection results of white clover in ryegrass and	
	Yorkshire fog swards	75
Table 3.6.	Botanical composition of ryegrass and Yorkshire fog	
	swards determined from inclined point quadrat contacts	
	(proportion of total hits)	76
Table 3.7.	Comparison of maximum values of sward heights (cm) for	
	grass and clover components above grazing height before	
	and after grazing (measured by point quadrat)	78
Table 3.8.	Comparison of proportions (%) of botanical components	
	above grazing height before and after grazing (measured	
	by point quadrat)	79

Li	st	of	Tab	les

Table 3.9. Chemical composition of the diet selected (g/kg DM) 8
Table 3.10. Results from diet selection, diet digestibility, herbage intake and animal performance 82
Table 3.11. The effect of species and grazing behaviour on bite size, rate of biting, grazing time, ruminating time and resting time 84
CHAPTER 4:
Table 4.1. The effect of sward species on herbage mass (kg DM ha ⁻¹) and on sward bulk density (kg DM ha ⁻¹ cm ⁻¹) from December to February Table 4.2. The proportions of components of ryegrass and Yorkshire
fog swards estimated from hand separation (DM basis)
from December to February 106
Table 4.3. Botanical (a) and chemical (b) composition of the diet selected from ryegrass and Yorkshire fog swards in December and January 110
Table 4.4. Variation in pH values in two sampling periods (0500 and 1700 hours) in rumen fistulated wethers grazing on Yorkshire fog and perennial ryegrass swards treated with zero or 40 g sheep ⁻¹ day ⁻¹ of polyethylene glycol (PEG: MW 4.000)
S ,

XVIII

Table 4.5. Effects of sward species on intake per bite (mg OM bite ⁻¹),
rate of biting (bites minute ⁻¹), grazing, ruminating and
resting times (minutes)
Table 4.6. Effects of sward species, oral PEG supplementation and sex of
lamb on herbage intake (HI; g OM lamb ⁻¹ day ⁻¹ or g OM kg
LW ^{0.73} day ⁻¹) for December and January
Table 4.7. Effects of sward species and PEG supplementation on mean
faecal egg count (FEC; eggs g fresh faeces ⁻¹) 118
Table 4.8. Effects of sward species, oral PEG supplementation and sex of
lamb on greasy and clean wool growth from midside areas (μ g
$cm^{-2} day^{-1}$) and on wool yield (%)
Table 4.9. Effects of sward species, oral PEG supplementation and sex of
lamb on liveweight gain (g/day) from December to March
assessed in three different periods and overall
Table 4.10. Effects of sward species, oral PEG supplementation and sex
of lamb on carcass weight (kg), GR (mean value of left and
right sides, mm) and dressing out (%)
Table 4.11. Relationships between the proportions of sward components
in the upper layers (between 4 to 10 cm) of the ryegrass
and Yorkshire fog sward canopies and the composition of
the diet selected during December and January
CHAPTER 5:

Table 5.1.	Experimental	design of the trial	 48
		a congre contro tribu	

Table 5.2.	Wool scouring procedure (as described by SUL, personal communication)	151
Table 5.3.	The proportion of components for each sward combination estimated from hand separation before and after grazing during August, September, October and Overall	161
Table 5.4.	Botanical composition of the diet selected by oesophageal fistulated wethers for each sward combination in September, October, and Overall	170
Table 5.5.	Chemical composition (% DM) of the diet selected by oesophageal fistulated wethers for each sward combination in September, October, and Overall	171
Table 5.6.	The effects of grass, lotus and PEG administration on the mean release rate of Cr_2O_3 (mg day ⁻¹), herbage intake (g OM lamb ⁻¹ day ⁻¹ or g OM LW ^{0.73} lamb ⁻¹ day ⁻¹), bite weight (mg OM bite ⁻¹), rate of biting (bites min ⁻¹), grazing time (min), ruminating time (min), and resting time (min) for September, October, and Overall	173
Table 5.7.	The effects of grass, lotus and PEG administration on mean faecal egg count (FEC; eggs g fresh faeces ⁻¹) for August, September, October, and Overall	175
Table 5.8.	The effects of grass, lotus and PEG administration on greasy and clean wool growth from midside areas (μ g cm ⁻² day ⁻¹), and on wool yield (%), fibre diameter (μ) and fibre length	
	(mm)	177

List of Tables

XX

Table 5.9.	The effects of grass, lotus and PEG administration on lamb	
	liveweight gain (g day ⁻¹) in August, September, October, and	
	Overall	. 179
Table 5.10	. The effects of grass, lotus and PEG administration	
	on final weight (kg), carcass weight (kg), carcass	
	gain (g lamb ⁻¹ day ⁻¹), GR (mean value of left and	
	right sides, mm), and dressing out (%)	181
Table 5.11	. Relationships (%) amongst sward components in the upper	
	layers (above 15 cm) of the ryegrass and Yorkshire fog	
	sward canopies and the composition of the diet selected	
	during September (a) and October (b)	187
CHAPTER	6:	
Table 6.1.	Overall partial correlation matrices for the relationships	
	between sward variables ($n = 7$), ingestive behaviour	
	variables ($n = 4$), and animal performance variables	
	(n = 4)	209
Table 6.2.	Canonical correlation coefficients between the sets of	
	swards variables, behaviour variables, and animal	
	performance variables, standardised coefficients,	
	structural coefficients and summary of important	
	statistics of the first canonical score	210
Table 6.3.	Review of the effect of a broad range of dietary condensed	
	tannin concentrations on wool growth and liveweight gain in	
	sheep receiving or not receiving PEG Supplementation	213

XXI

.

	-
Summary of comparative grazing studies carried out with	
Holcus lanatus and other species on aspects of sheep	
performance	221
ZES	
Variation in rumen ammonia concentration (mg NH3 ml-1 of	
rumen fluid) during 24 hours in rumen fistulated wethers	
grazing on Yorkshire fog and perennial ryegrass swards	
treated with zero or 40 g sheep ⁻¹ day ⁻¹ of polyethylene	
glycol (PEG; MW 4,000)	272
Effects of sward species and oral PEG supplementation	
on the mean release rate of chromium sesquioxide	
$(Cr_2O_3; mg day^{-1})$ measured in rumen-fistulated wethers	
and in intact experimental lambs	273
Effects of sward species, oral PEG supplementation and	
lamb sex and their interactions on herbage intake (HI; g OM	
lamb ⁻¹ day ⁻¹ or g OM kg LW ^{0.73} day ⁻¹) for December and	
January	274
Effects of sward species, oral PEG supplementation and	
lamb sex on greasy and clean wool growth from midside areas	
(μ g cm ⁻² day ⁻¹) and on wool yield (%)	275
Effects of sward species, oral PEG supplementation and	
lamb sex on lamb liveweight gain (g day ⁻¹) from December to	
	Summary of comparative grazing studies carried out with <i>Holcus lanatus</i> and other species on aspects of sheep performance

Table 4.6.	Effects of sward species, oral PEG supplementation and	
	lamb sex on carcass weight (kg), GR (mean value of left and	
	right sides, mm) and dressing out (%)	277
Chapter 5	5:	
Table 5.1.	Levels of pH, Resinas-Phosphorus, Exchangeable Potassium	
	and Carbon of experimental plots measured in April 1993	279
Table 5.2.	The effect of grass and lotus on herbage and dead herbage	
	masses (kg DM ha ⁻¹), sward height (cm), and sward and green	
	bulk densities (kg DM ha ⁻¹ cm ⁻¹) before and after grazing	
	during August, September, October and Overall	280
Table 5.3.	The effect of grass and lotus on sward height at plot level	
	estimated by ruler and rising plate meter (RPM) before and	
	after grazing during August, September, October and Overall	281
Table 5.4	Tiller and node nonvelation density in each award combination	
I able 5.4.	(tillers and node population density in each sward combination $(tillers and node m^2)$, data based on tiller and node hand	
	(inters and nodes in), data based on the and node hand	202
	separation procedure measured in September 1995	202
Table 5.5.	Tiller dissection results of rvegrass and Yorkshire fog	
	tillers in each sward combination measured in September	
	1993	282
	16	
Table 5.6.	Mean abomasal, intestinal, and total worm burdens in lambs	
	grazing on Yorkshire fog or on ryegrass swards, which were	
	slaughtered at the end of the trial	283

LIST OF FIGURES

CHAPTER 4:

Figure 4.1.	Weekly variation of average pasture heights for perennial	
	ryegrass and Yorkshire fog swards when continuously	
	grazed by lambs to a desired height of 6 cm during	
	December, January, February, and March	104
Figure 4.2.	Proportional distribution of plant species and morphology	
	for ryegrass and Yorkshire fog swards during December,	
	January, and February determined from inclined point	
	quadrat contacts	107
Figure 4.3.	Variation in the canopy structures of ryeorass and	
9	Yorkshire fog swards during December, January, and	
	February	108
		100
Figure 4.4.	Variation in rumen ammonia concentration (mg N/ml) during	
	24 hours in rumen fistulated wethers grazing on	
	perennial ryegrass and Yorkshire fog swards treated	
	with zero or 40g/wether/day of polyethylene glycol	
	(PEG; MW 4,000)	112
Figure 4 F	Liveweight agin of lembe grazing on Verkehire fog er	
Figure 4.5.		
	perennial ryegrass swards treated with zero or	
	40g/lamb/day of polyethylene glycol (PEG; MW 4,000)	
	from December to March. Vertical lines indicate the	
	standard error of the mean	122

+

CHAPTER 5:

Figure 5.1.	Partition of herbage mass into dead material, green leaf,	
	and green stem/petiole components for ryegrass and	
	Yorkshire fog swards during August, September, and	
	October before and after grazing	156
Figure 5.2a	a. Weekly variation of average sward surface heights (cm)	
	estimated by rising plate meter for Yorkshire fog or	
	ryegrass swards before (a.1) and after (a.2) grazing	
	from August to early November	158
Figure 5.2b	o. Weekly variation of average sward surface heights (cm)	
	estimated by ruler for Yorkshire fog or ryegrass	
	swards before (b.1) and after (b.2) grazing from	
	August to early November	159
Figure 5.3.	Proportional distribution of plant species and morphology	
	for ryegrass and Yorkshire fog swards during September	
	before and after grazing, determined from inclined point	
	quadrat contacts	165
Figure 5.4.	Proportional distribution of plant species and morphology	
	for ryegrass and Yorkshire fog swards during October	
	before and after grazing, determined from inclined point	
	quadrat contacts	166
Figure 5.5.	Variation in the canopy structure of ryegrass and Yorkshire	
	fog swards during September before and after grazing,	
	determined from inclined point quadrat contacts	167

Figure 5.7. The effects of grass species, lotus and PEG administration on lamb liveweight (kg) from August to November Vertical lines indicate the standard error of the mean 180

APPENDICES

Chapter 4:

Figure 4.1.	Botanical composition (%) of perennial ryegrass and	
	Yorkshire fog swards during December, January,	
	and February determined from inclined point	
	quadrat contacts	278
100 million 100 million 100 million		

Chapter 5:

Figure 5.1.	Botanical composition (%) of perennial ryegrass and	
	Yorkshire fog swards during September determined from	
	inclined point quadrat contacts 2	284
Figure 5.2.	Botanical composition (%) of perennial ryegrass and	
	Yorkshire fog swards during October determined from	
	inclined point quadrat contacts 2	285
Figure 5.3.	The effect of grass species on lamb liveweight gain (Kg)	
	from August to November. Vertical lines indicate the	
	standard error of the mean 2	286

XXVII

Figure 5.4. The effect of lotu	is treatments on lamb liveweight gain (Kg)	
from August to N	November. Vertical lines indicate the	
standard error o	f the mean	287
Figure 5.5. The effect of PE	G administration on lamb liveweight gain (Kg)	
from August to N	lovember. Vertical lines indicate the	
standard error of	the mean	288

LIST OF PLATES

Chapter 5:

Plate 5.1. General view of the experimental area (background) surrounded by the native vegetation of the Basaltic region of Uruguay . . 147

Plate 5.2. View of annual ryegrass plot (front) and Yorkshire fog plot	
(rear) before and after grazing, showing the advanced stage	
of maturity of ryegrass swards with accumulation of dead	
material	189