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**MEDITERRANEAN AND TEMPERATE TALL FESCUES:
PHYSIOLOGICAL AND MORPHOLOGICAL RESPONSES
TO WATER DEFICIT, AND THE EFFECT OF NITROGEN
ON WINTER AND EARLY-SPRING FIELD
PERFORMANCE UNDER GRAZING**

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Silvia Graciela Assuero

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ABSTRACT

A major goal for grazing systems is to increase winter herbage growth. Tall fescue (*Festuca arundinacea* Schreb.) has been widely recognised as one of the most important cool season forage species. Among tall fescue populations, those of Mediterranean origin (e.g. *F. arundinacea* var. *letoumeuxiana* from North Africa) have shown higher growth rates in winter and early-spring than comparable germplasm from northern Europe. For this reason, the complementary use of Mediterranean and temperate tall fescue populations to improve continuity of seasonal forage supply has been suggested for the Pampa region, Argentina. It is known, however, that the low winter N availability of the region limits herbage growth and that water deficits are likely to occur. It has been found that endophyte-infected tall fescue plants tolerate drought better than endophyte-free ones and currently novel endophyte strains harmless to livestock are commercially available.

This study therefore sought to compare the responses of Mediterranean and temperate tall fescue cultivars to water deficit, to investigate the extent to which water deficit responses are modified by the presence or absence of endophyte, and to compare winter-early spring growth and animal production of two contrasting cultivars with and without N fertilisation in the Pampa region.

Three glasshouse experiments were carried out to evaluate the response of contrasting tall fescue cultivars to water deficit. In the first experiment two temperate cultivars, Grasslands Advance (GA) and El Palenque (EP), and a Mediterranean cultivar, Maris Kasba (MK), were studied. Water deficit was induced by complete cessation of watering and sequential harvests were made to follow the adjustment of the respective cultivars. Morphological measurements also included the distribution of mass and length of root with depth.

In the second experiment, only MK and EP were studied. Plants of both cultivars were grown in the same pots and received water daily with gradation in intensity of water deficit achieved by varying the daily water ration per pot. Reducing and fructosyl sugar concentrations were analysed to examine cultivar differences and to investigate whether these sugars were involved in osmotic adjustment.

The third experiment compared MK and EP cultivars under water deficit, but in addition the effects of two endophytes, Kentucky 31 wild type (KY31) and a commercial strain supplied by AgResearch (AR501), were studied.

Herbage growth and animal production in winter-early spring of MK and EP swards in response to N fertilisation were compared in a grazing experiment carried out in the SE of Buenos Aires Province, Argentina. The N treatments were zero and 100 kg N ha⁻¹ applied in equal split dressings in mid autumn and early winter. The paddocks were grazed by a variable number of growing steers in order to maintain a similar leaf area index (LAI) in all treatments.

The results of the water deficit experiments indicated that in comparison with the temperate cultivars EP and GA, the Mediterranean cultivar MK was characterised by a smaller plant size, higher tiller number, high root : shoot ratio, a lower stomatal resistance, lower content of reducing and fructosyl sugars and a lower growth rate under high temperatures. All tall fescue cultivars exhibited decreased growth rates, diminished evaporative surface area, and increased root : shoot ratio and osmotic adjustment in response to water deficit. A similar water status was observed for the different cultivars under comparable soil water availability. There was evidence that MK was able to delay onset of water deficit through its morphological characteristics. By contrast, stomatal resistance of temperate cultivars was more responsive to soil moisture changes and these cultivars had a greater tendency for osmotic adjustment than MK under the most stressful water deficit conditions studied. For the particular cultivars and endophytes strains studied here, the experimental evidence suggests that MK-KY31 and EP-AR501 combinations would be expected to perform better under water deficit than other combinations.

Maris Kasba swards had a higher stocking rate during mid winter-early spring, and consequently, the beef production was 26% higher than in EP swards. With N fertilisation the response was markedly increased and beef production was increased by 66% during the same period. However, by late August no differences in tissue turnover were found between cultivars, while in September EP showed a higher net growth rate (NGR) than MK. For both periods N application increased the NGR of the swards.

Further studies would be necessary to evaluate the recovery capacity after drought of the cultivars evaluated and the ability for osmotic adjustment in the meristematic tissues as well as their behaviour under field conditions. Because the particular performance characteristics of each endophyte strain-grass genotype combination vary, it is recommended that any endophyte strain be evaluated in combination with the plant genotypes with which it is to be associated. The complementary use of temperate and Mediterranean cultivars in animal production systems of the SE of Buenos Aires Province improved feed supply during winter. In addition, winter herbage growth and animal production of both cultivar types can be considerably improved with N fertilisation.

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TABLE OF CONTENTS

ABSTRACT	ii
ACKNOWLEDGEMENTS	iv
TABLE OF CONTENTS	vi
LIST OF TABLES	xi
LIST OF FIGURES	xvi
LIST OF PLATES	xix
CHAPTER 1. INTRODUCTION	1
1.1. Introduction	1
2.2. Objectives	2
1.3. Thesis structure	2
CHAPTER 2. LITERATURE REVIEW	4
2.1. Introduction	4
2.2. Tall fescue	4
2.2.1. Mediterranean and temperate populations	5
2.2.1.1. Studies comparing Mediterranean and temperate populations	5
2.2.1.1.1. Morphological and physiological responses to environmental factors	5
2.2.1.1.2. Origin	8
2.2.1.1.3. Feeding value	9
2.3. Nitrogen effect on the swards	9
2.4. Sward tissue turnover	11
2.4.1. Morphological basis and components of tissue growth and loss	12
2.4.1.1. Leaf growth	13
2.4.1.1.1. Leaf appearance rate	13
2.4.1.1.2. Leaf extension rate	13
2.4.1.2. Leaf senescence	14
2.4.1.3. Tiller number	15
2.5. Root systems	16
2.5.1. Function and characteristics of root systems	16
2.5.2. Root growth	17
2.5.3. Methods of studying root systems	18
2.6. Water stress	19
2.6.1. Water stress adaptation	21
2.6.2. Osmotic adjustment	22
2.6.2.1. Fructans	23

2.6.3. Morphological changes under water stress	25
2.7. Tall Fescue and endophyte	26
2.7.1. Morphological and physiological responses of tall fescue to <i>Neotyphodium coenophialum</i>	27
2.7.2. Endophyte and water stress	30
2.7.2.1. Morphological and growth effects	30
2.7.2.2. Physiological effects	32
2.8. Summary and conclusions	34
CHAPTER 3. MORPHOLOGICAL AND PHYSIOLOGICAL RESPONSES TO WATER DEFICIT OF ENDOPHYTE-FREE MEDITERRANEAN AND TEMPERATE TALL FESCUES	36
3.1. Introduction	36
3.2. Objective	37
3.3. Materials and Methods	37
3.3.1. Experimental design and statistical analysis	37
3.3.2. Plant culture	40
3.3.3. Measurements	42
3.4. Results and discussion	43
3.4.1. Plant structure	43
3.4.1.1. Shoot characteristics	44
3.4.1.2. Root system characteristics	47
3.4.1.3. Root : shoot ratio	57
3.4.2. Plant water relations	58
3.4.3. Stomatal resistance and transpiration	64
3.4.4. Carbon isotope discrimination	68
3.5. Summary	70
3.5.1. Water deficit effects	70
3.5.2. Cultivar effects	70
CHAPTER 4. PLANT GROWTH AND RESPONSES TO WATER DEFICIT OF ENDOPHYTE-FREE MEDITERRANEAN AND TEMPERATE TALL FESCUES	71
4.1. Introduction	71
4.2. Objective	71
4.3. Materials and Methods	72
4.3.1. Experimental design and statistical analysis	72
4.3.2. Plant culture	72
4.3.3. Measurements	76

4.4. Results and discussion	78
4.4.1. Shoot characteristics	78
4.4.2. Tiller appearance rate	79
4.4.3. Tissue turnover	80
4.4.4. Plant water relations	83
4.4.5. Carbon isotope discrimination	85
4.4.6. Reducing sugar and fructosyl sugar concentrations	86
4.5. Summary	89
4.5.1. Water deficit effects	89
4.5.2. Cultivar effects	89
CHAPTER 5. PLANT GROWTH AND RESPONSES TO WATER DEFICIT OF EUROPEAN AND MEDITERRANEAN TALL FESCUES WITH AND WITHOUT ENDOPHYTE	90
5.1. Introduction	90
5.2. Objectives	91
5.3. Materials and methods	91
5.3.1. Experimental design and statistical analysis	91
5.3.2. Plant culture	92
5.3.3. Measurements	95
5.4. Results and discussion	97
5.4.1. Water content	97
5.4.2. Shoot characteristics	99
5.4.3. Tissue turnover	105
5.4.4. Plant water relations	113
5.4.5. Photosynthesis and stomatal resistance	122
5.4.6. Carbon isotope discrimination	124
5.4.7. Multivariate analyses	125
5.5. Summary	131
5.5.1. Water deficit effects	131
5.5.2. Cultivar effects	131
5.5.3. Endophyte effects	131
CHAPTER 6. GENERAL DISCUSSION OF WATER DEFICIT EXPERIMENTS	132
6.1. Water deficit effects	133
6.2. Mediterranean and temperate cultivars	135
6.3. Endophyte effects	138

CHAPTER 7. WINTER PASTURE GROWTH AND ANIMAL PRODUCTION FROM MARIS KASBA AND EL PALENQUE TALL FESCUES IN RESPONSE TO NITROGEN FERTILISATION UNDER GRAZING	141
7.1. Introduction	141
7.2. Objective	141
7.3. Materials and Methods	142
7.3.1. Experimental site	142
7.3.2. Experimental design	142
7.3.3. Experimental procedure	142
7.4. Results and discussion	149
7.4.1. Sward characteristics	149
7.4.2. Root mass	156
7.4.3. Tissue turnover	157
7.4.3.1. Plant characteristics	157
7.4.3.2. GGR, SR and NGR	161
7.4.3.3. Consumption	163
7.4.3.4. Actual efficiency of herbage use and balance between herbage net growth and consumption	168
7.4.4. Sward digestibility and N content	169
7.4.5. Stocking rate, daily live weight gain and beef production	171
7.5. Summary	173
7.5.1. Nitrogen effect	173
7.5.2. Cultivar effects	173
CHAPTER 8. CONCLUSIONS	174
Appendix 2.1. Plant water relations	176
Appendix 2.1.1. Cell structure	176
Appendix 2.1.2. Water potential	177
Appendix 2.1.2.1. Plant water potential	178
Appendix 2.2. Water movement in the soil-plant-air system	179
Appendix 2.3. Measuring the water content, water potential components and carbon isotope discrimination	180
Appendix 3.1. Derivation of mean root diameter formula	185
Appendix 3.2. Percentage of total root mass, total root length and coarse root length in each of the four soil strata before the application of water treatments (Harvest 1).	186
Appendix 3.3. Percentages of total root mass recovered from each of the four soil strata after the application of water treatments.	187

Appendix 3.4.	Percentage of total root mass recovered below 300 mm after the application of water treatments.	188
Appendix 3.5.	Percentage of total root length recovered from each of the four soil strata after the application of water treatments.	189
Appendix 3.6.	Percentage of total root length recovered from the 75-150 mm and below 300 mm strata after the application of water treatments averaged for cultivars and harvests.	190
Appendix 3.7.	Percentage of total root length recovered from the 0-75 mm and below 300 mm strata averaged for cultivars and water treatments.	191
Appendix 3.8.	Coarse root length as percentage of total root length recovered from each of the four soil strata after the application of water treatments.	192
Appendix 3.9.	Coarse root length as percentage of the total root length recovered from the 150-300 mm stratum averaged for cultivars and water treatments.	193
Appendix 3.10.	Carbon isotope discrimination averaged for harvests, cultivars and water treatments.	194
Appendix 4.1.	Methods used to measure reducing and fructosyl sugars	195
Appendix 5.1.	Surface sterilization of seeds	197
Appendix 5.2.	Osmotic potential (Ψ_o) adjusted by RWC for both periods (1 and 2) and water treatments.	198
Appendix 5.3.	Photosynthesis ($\mu\text{m ol CO}_2 \text{ m}^{-2}\text{s}^{-1}$) averaged for cultivars and endophytes	198
Appendix 5.4.	Stomatal resistance averaged for cultivars, water treatments and endophytes.	199
Appendix 5.5.	Average relative water content (%) between measurement periods and green tissue percentage averaged for cultivars and endophytes.	199
Appendix 7.1.	Calculation of LAI	200
Appendix 7.2.	Other grasses, <i>Lotus</i> spp. and weeds dry matter accumulation in MK and EP paddocks and the two nitrogen treatments ($\text{N0} = 0 \text{ kg N.ha}^{-1}$ and $\text{N1} = 100 \text{ kg N.ha}^{-1}$) from June to October.	202
BIBLIOGRAPHY.		203

LIST OF TABLES

CHAPTER 3

Table 3.1.	Plant dry weight (DW), percentages of shoot DW as leaf blade, sheath and dead tissue, and mean tiller number per plant for the cultivars MK, GA and EP before the water treatments were imposed (Harvest 1).	44
Table 3.2.	Main effect means for ⁱ plant dry weight (DW) and percentages of shoot DW as leaf blade, sheath and dead tissue, and mean tiller number per plant after imposition of water treatments.	46
Table 3.3.	Plant dry weight (DW) and percentage of plant DW as dead tissue for harvests and water treatments.	47
Table 3.4.	Root mass, root length, coarse root length, mean root diameter and root surface area for the cultivars MK, GA and EP before water treatments were imposed (Harvest 1).	48
Table 3.5.	Total root mass and root mass recovered from the four soil strata after water treatments were imposed	51
Table 3.6.	Total root length and root length recovered from the four soil strata after water treatments were imposed.	52
Table 3.7.	Total coarse root length and coarse root length recovered from the four soil strata after water treatments were imposed.	53
Table 3.8.	Mean diameter of roots recovered from the four soil strata and for the entire profile after water treatments were imposed	54
Table 3.9.	Mean diameter of roots recovered below 300 mm stratum, averaged for cultivars and harvests, after the application of water treatments.	55
Table 3.10.	Mean diameter of roots recovered from the entire profile, averaged for cultivars and water treatments.	55
Table 3.11.	Total root surface area and root surface area for the four soil strata after the imposition of water treatments.	56
Table 3.12.	Root : shoot ratio (g OM/g DM) for the cultivars MK, GA and EP before water treatments were imposed (Harvest 1)	57
Table 3.13.	Mean root : shoot ratio (g OM/g DM) after water treatments were imposed	58

Table 3.14.	Relative water content (RWC), water potential (Ψ_w), osmotic potential (Ψ_o), osmotic potential at full turgor ($\Psi_{o(f)}$) and pressure potential (Ψ_p) for the cultivars MK, GA and EP before water treatments were imposed (Harvest 1).	59
Table 3.15.	Relative water content (RWC), water potential (Ψ_w), osmotic potential (Ψ_o), osmotic potential at full turgor ($\Psi_{o(f)}$) and pressure potential (Ψ_p) after water treatments were imposed.	61
Table 3.16.	Osmotic potential (Ψ_o) averaged for cultivars and harvests after water treatments were imposed.	62
Table 3.17.	Relative water content (RWC), water potential (Ψ_w), osmotic potential (Ψ_o) and pressure potential (Ψ_p) averaged for harvests and water treatments.	62
Table 3.18.	Relative water content (RWC), water potential (Ψ_w), osmotic potential (Ψ_o) and pressure potential (Ψ_p) averaged for cultivars and water treatments.	63
Table 3.19.	Stomatal resistance and transpiration for the cultivars MK, GA and EP before water treatments were imposed (Harvest 1).	64
Table 3.20.	Abaxial leaf surface, adaxial leaf surface and total stomatal resistance, and abaxial and adaxial leaf surfaces transpiration rate after water treatments were imposed.	66
Table 3.21.	Abaxial leaf surface, adaxial leaf surface and total stomatal resistance averaged for cultivars and water treatments.	67
Table 3.22.	Transpiration rate of both leaf surfaces averaged for harvests and water treatments.	67
Table 3.23.	Carbon isotope discrimination (Δ) for the cultivars MK, GA and EP before water treatments were imposed (Harvest 1).	68
Table 3.24.	Carbon isotope discrimination (Δ) after water treatments were imposed.	69
Table 3.25.	Carbon isotope discrimination (Δ) averaged for harvest and water treatments.	70

CHAPTER 4

Table 4.1.	Soil characteristics	75
Table 4.2.	Shoot dry weight (DW) and percentages of shoot DW as leaf blade, sheath and dead tissue, and mean tiller number per plant.	78
Table 4.3.	Relative water content (RWC) and water potential (Ψ_w), osmotic potential (Ψ_o) and pressure potential (Ψ_p) at dawn, at midday and the difference.	84

Table 4.4.	Osmotic potential (Ψ_o) difference between dawn and midday for MK and EP and the four water treatments.	85
Table 4.5.	Main effects means for carbon isotope discrimination (Δ).	86
Table 4.6.	Reducing sugar and fructosyl sugar concentrations.	88
Table 4.7.	Fructosyl sugar contribution to the osmotic potential at midday.	88

CHAPTER 5

Table 5.1.	Gravimetric water content on 24 June and at harvest, and water content difference.	98
Table 5.2.	Plant dry weight (DW) and percentages of shoot DW as leaf blade, sheath and dead tissue for the cultivars MK, GA and EP, the four water treatments and three endophytes.	102
Table 5.3.	Percentage of shoot DW as dead tissue (%) for cultivars and water treatments.	102
Table 5.4.	Percentage of shoot DW as sheath (%) for cultivars and water treatments.	103
Table 5.5.	Initial tiller number, final tiller number, tiller number difference and tiller size for the cultivars MK, GA and EP, the four water treatments and three endophytes.	103
Table 5.6.	Leaf appearance rate (LAR).	112
Table 5.7.	Relative water content (RWC) of the two periods (1 and 2), and the adjusted difference between them.	113
Table 5.8.	Water potential (Ψ_w) of the two periods (1 and 2), and the adjusted difference between them.	114
Table 5.9.	Osmotic potential (Ψ_o) of the two periods (1 and 2), and the adjusted difference between them.	116
Table 5.10.	Pressure potential (Ψ_p) of the two periods (1 and 2), and the adjusted difference between them.	119
Table 5.11.	Photosynthesis on leaf area basis (Pa) and on leaf weight basis (Pb) and stomatal resistance.	123
Table 5.12.	Main effects means for carbon isotope discrimination (Δ).	125
Table 5.13.	Principal component (PC) coefficients, variance (eigenvalues) and percentage of total variance explained.	126
Table 5.14.	Standardised mean scores for cultivar, endophyte, water and cultivar x endophyte interaction.	129
Table 5.15.	Total canonical structure and standardised canonical coefficients of the first canonical variate (CV) for cultivar and cultivar x endophyte interaction, and of the first and second canonical variate for endophyte.	130

CHAPTER 6

Table 6.1. Summary of details of the three water deficit experiments carried out.	132
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CHAPTER 7

Table 7.1. Tall fescue green dry mass (kg DM ha ⁻¹) for MK and EP cultivars and two N treatments (N0 = 0 kg N ha ⁻¹ and N100 = 100 kg N ha ⁻¹) from May to October.	153
Table 7.2. Dead herbage mass (kg DM ha ⁻¹) for MK and EP cultivars and two N treatments (N0 = 0 kg N ha ⁻¹ and N100 = 100 kg N ha ⁻¹) from May to October.	153
Table 7.3. Tiller density for MK and EP cultivars and two N treatments (N0 = 0 kg N ha ⁻¹ and N100 = 100 kg N ha ⁻¹) from May to October.	154
Table 7.4. Root mass (g OM m ⁻²) to 400 mm depth for MK and EP cultivars and two N treatments (N0 = 0 kg N ha ⁻¹ and N100 = 100 kg N ha ⁻¹) for 30 April and 8 October soil cores and for 8 October sand cores.	156
Table 7.5. Mean number of leaves per plant, length of individual leaves (1 = youngest, 6 = oldest) and leaf appearance interval (LA) for MK and EP cultivars and two N treatments (N0 = 0 kg N ha ⁻¹ and N100 = 100 kg N ha ⁻¹) in the two periods studied.	159
Table 7.6. Length of leaf 5 for MK and EP cultivars and two N treatments (N0 = 0 kg N ha ⁻¹ and N100 = 100 kg N ha ⁻¹) in the first period studied (16 August to 3 September).	159
Table 7.7. Percentage of individual leaf lamina removed for the different leaf categories (1 = youngest, 6 = oldest) and tiller defoliation interval (days) for MK and EP cultivars and two N treatments (N0 = 0 kg N ha ⁻¹ and N100 = 100 kg N ha ⁻¹) in the two periods studied.	165
Table 7.8. Percentage of lamina removed from leaf 2 for MK and EP cultivars with two N treatments (N0 = 0 kg N ha ⁻¹ and N100 = 100 kg N ha ⁻¹) in the second period studied (6-24 September).	166
Table 7.9. Interval between defoliation events on each tiller for MK and EP cultivars and two N treatments (N0 = 0 kg N ha ⁻¹ and N100 = 100 kg N ha ⁻¹) in the second period studied (6-24 September).	166
Table 7.10. Herbage consumption rate per ha (kg DM ha ⁻¹ d ⁻¹) and per	

	animal (kg DM an. ⁻¹ d ⁻¹) for MK and EP cultivars and two N treatments (N0 = 0 kg N ha ⁻¹ and N100 = 100 kg N ha ⁻¹) in the two periods studied.	167
Table 7.11.	Actual efficiency of herbage use (AEHU=herbage consumption/ herbage growth), balance between net herbage production (kg DM ha ⁻¹ d ⁻¹) and stocking rate (an. ha ⁻¹) for MK and EP cultivars and two N treatments (N0 = 0 kg N ha ⁻¹ and N100 = 100 kg N ha ⁻¹) in the two periods studied.	169
Table 7.12.	Mean stocking rate, beef production and daily live weight gain (DLWG) for MK and EP and two N treatments (N0 = 0 kg N ha ⁻¹ and N100 = 100 kg N ha ⁻¹).	172

LIST OF FIGURES

CHAPTER 2

- Figure 2.1. The interrelationships between various components of dry-matter flux. 12

CHAPTER 3

- Figure 3.1. Experimental management schedule, conditions of plant culture and harvest dates for the first water deficit experiment. Massey University, New Zealand 38
- Figure 3.2. Daily maximum and minimum glasshouse temperatures during the application of the water treatments 41

CHAPTER 4

- Figure 4.1. Experimental management schedule, conditions of plant culture and measurements for the second water deficit experiment. Unidad Integrada Balcarce INTA-FCA, Argentina. 73
- Figure 4.2. Daily maximum and minimum glasshouse temperature during the application of the water treatments. 75
- Figure 4.3. Gross growth rate (GGR), senescence rate (SR) and net growth rate (NGR) for MK and EP cultivars. 81
- Figure 4.4. Gross growth rate (GGR), senescence rate (SR) and net growth rate (NGR) for the four water treatments. 82

CHAPTER 5

- Figure 5.1. Experimental management schedule, conditions of plant culture and periods of measurements for the third water deficit experiment, AgResearch, New Zealand. 93
- Figure 5.2. Daily maximum and minimum temperatures during the application of water treatments. 95
- Figure 5.3. Gravimetric water content of the pots of MK and EP for the four water treatments studied. 99
- Figure 5.4. Effect of the endophyte on MK and EP initial tiller number. 104
- Figure 5.5. Gross growth rate (GGR), senescence rate (SR) and net growth rate (NGR) for MK and EP cultivars. 107
- Figure 5.6. Gross growth rate (GGR), senescence rate (SR) and net growth rate (NGR) for the four water treatments. 108
- Figure 5.7. Gross growth rate (GGR) per tiller of MK and EP cultivars for the four water treatments. 109

Figure 5.8. Senescence rate (SR) per plant of MK and EP cultivars for the four water treatments.	109
Figure 5.9. Gross growth rate (GGR), senescence rate (SR) and net growth rate (NGR) for the endophyte treatments.	110
Figure 5.10. Gross growth rate (GGR) of MK and EP cultivars for the three endophyte treatments.	111
Figure 5.11. Osmotic potential for the second period (a) and osmotic potential difference between periods (b) for MK and EP cultivars under the four water treatments.	117
Figure 5.12. Osmotic potential of MK and EP cultivars for the three endophyte treatments. a: Period 1. b: Period 2.	118
Figure 5.13. Pressure potential for the second period (a) and pressure potential difference between periods (b) for MK and EP under the four water treatments.	120
Figure 5.14. Water potential (a), osmotic potential (b) and pressure potential (c) in relation to the relative water content (RWC) for MK and EP cultivars.	121
Figure 5.15. Tiller (a) and plant (b) net growth rate (NGR) in relation to the relative water content (RWC) for MK and EP cultivars.	122

CHAPTER 7

Figure 7.1. Experimental management schedule and measurements for the grazing experiment, Unidad Integrada Balcarce INTA-FCA, Argentina.	144
Figure 7.2. Radiation and mean soil and air temperatures recorded from 10 May to 14 October 1996 at INTA Balcarce.	145
Figure 7.3. Monthly rainfall (mm) recorded at INTA Balcarce during 1996 and average monthly rainfall for 1986-1995.	145
Figure 7.4. Leaf area index (LAI) for MK and EP (a) and N0 and N100 treatments (b).	150
Figure 7.5. Leaf are index (LAI) for MK and EP cultivars at N0 and N100 treatments on 4 and 16 July.	151
Figure 7.6. Tiller density from May to October for MK and EP at N0 and N100 treatments.	155
Figure 7.7. Site usage for MK and EP (a) and N0 and N100 treatments (b).	160
Figure 7.8. Gross growth rate (GGR), senescence rate (SR) and net growth rate (NGR) for MK and EP and N0 and N100 treatments.	162

Figure 7.9. Total herbage accumulation for MK and EP at N0 and N100 treatments.	163
Figure 7.10. Dry matter digestibility (%) for MK and EP (a) and N0 and N100 treatments (b).	170
Figure 7.11. Nitrogen content (DM%) for MK and EP (a) and N0 and N100 treatments (b).	171

LIST OF PLATES

CHAPTER 3

- Plate 3.1. Experimental conditions in the glasshouse (a,b) and water deficit effects on the three cultivars (c-h). 39

CHAPTER 4

- Plate 4.1. Experiment in progress. a: Blocks 1 and 2 after transplanting (8 July). b: Blocks 1 and 2 before the imposition of the water treatments (16 October). c: Block 1 after the imposition of the water treatments (11 November), from left to right Control, S2, S1, and S3 treatments 74

CHAPTER 5

- Plate 5.1. Plants after transplanting (a) and photographs showing the layout of part of the trial within the glasshouses (b and c). b: Block 2 at the imposition of the water treatments (1 June). c: Block 4 before Period 2 of measurements (13 July), from left to right S3, S2, S1, and Control treatments. 94

CHAPTER 7

- Plate 7.1. Views of the grazing experiment on 4 July (a) and 8 October (b), respectively. In (a) the greener stripe visible is a paddock that had received N on 6 May. Plate (c) shows technicians taking root samples with a corer of 5 cm internal diameter and (d) a close-up view of a sand-filled core marked with a red ring 146