THE EFFECTS OF DEFOLIATION ON TISSUE TURNOVER AND PASTURE PRODUCTION IN PERENNIAL RYEGRASS, PRAIRIE GRASS AND SMOOTH BROMEGRASS PASTURE.

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

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This thesis reports the results of three experiments, one with perennial ryegrass (Lolium perenne L.) cv. Ellett under rotational sheep grazing, one with prairie grass (Bromus willdenowii Kunth.) cv. Grasslands Matua under rotational dairy cow grazing, and one with smooth bromegrass (Bromus inermis Leyss) under cutting management. The first two experiments were carried out at Massey University, New Zealand, the third at Beijing Agricultural University, China. Each experiment involved management variations set within a range considered to be appropriate to the species under examination, and was complete in itself. The objective of the study reported here was to examine the sensitivity to defoliation of the three grass species, sensitivity being defined principally in terms of adjustment in tiller population density and tissue turnover to variations in defoliation treatment. The results are reported separately, but are drawn together for comparative purposes in an integrating discussion.

Flexibility in response to defoliation, measured in terms of the number of live leaves per tiller, the rate of leaf appearance, dry weight per tiller, and tiller population density, differed substantially in perennial ryegrass, prairie grass, and smooth bromegrass, and had a major influence on the sensitivity of the species to contrasting managements.

Net herbage production was relatively insensitive to hard (2.5cm, post grazing 1000kgDM/ha) and lax grazing (15cm, post grazing 2000kgDM/ha) in perennial ryegrass pasture because of rapid adaptive change in tiller population density, which was usually greater under hard grazing than under lax grazing, and compensating changes in rates of herbage growth and senescence.

Net herbage production of prairie grass was greater under lax (12cm, post grazing
2500-3500kgDM/ha) than under hard (6cm, post grazing 1500-2000kgDM/ha) grazing, associated with reduction in tiller population density under the latter treatment, and a greater reduction in herbage growth than in senescence per tiller.

In smooth bromegrass, tiller populations were greater under lax (30 cm) than under hard (10 cm) cutting, though the closer cutting treatment resulted in greater green herbage accumulation, because of a greater reduction in the rate of herbage senescence than in the rate of herbage production.

In general terms, perennial ryegrass demonstrated substantial genotypic plasticity in the adaptive changes in the balance between tiller population density and tiller size, reflecting the high tillering potential in this species. Rates of leaf production on main and daughter tillers consistently made the major contribution to tissue turnover in this. In contrast, prairie grass showed little adaptive response in tiller population density when tiller size was reduced, and the main component of tissue turnover was generally stem material. Though tiller size was similar in smooth brome and prairie grass, adaptive changes in the balance between tiller size and population were more complete in the former species and leaf tissue made a greater contribution than stem to tissue turnover.

The effect of seasonal change in the environment on the growth of grass swards is complicated by progression from vegetative to reproductive development. In ryegrass pasture, there were advantages to spring and summer pasture production from a management which allowed seed head development to anthesis in spring, followed by hard grazing to enhance the subsequent development of new vegetative tillers. For smooth brome grass initial cutting at anthesis resulted in a greater rate of green herbage accumulation subsequently than did cutting one month later. In prairie grass the limited development of replacement daughter tillers contributed to the relatively
poor performance of this species under hard grazing. The relationship between the
timing and severity of defoliation and the physiological status of the plant was
therefore critical in determining subsequent herbage growth in all three species, though
there were clearly specific differences in effects on the balance between stem and new
tiller production and the expansion of daughter tillers.

This study suggested that a better understanding of the limits of adaptitive response in
the different species, particularly in tiller population structure and tissue turnover, will
provide an objective basis for planning pasture management. Studies of this kind,
preferably made under strictly controlled comparative conditions, would be a
particularly important component of evaluation programs for new plant genotypes.
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### LIST OF CONTENTS

**ABSTRACT**

**ACKNOWLEDGEMENT**

**LIST OF CONTENTES**

**LIST OF FIGURES**

**LIST OF TABLES**

**LIST OF APPENDICS**

**CHAPTER 1. INTRODUCTION**

1. Introduction

**CHAPTER 2. LITERATURE REVIEW.**

1. Introduction

2. The effects of defoliation on herbage production
   1. Effects of defoliation on plant regrowth
      1. The effect of removal of leaf
      2. The effect of removing the stem apex
      3. Carbon reserves
      4. Roots
   2. Effect of defoliation on sward characteristics
      1. Plant size
      2. Seed head production
      3. Tiller population density
   3. The effects of defoliation on pasture production
      1. The principal effects of management on tissue turnover in the grass crop
      2. Continuously stocked swards
      3. The effect of changing sward conditions
      4. Intermittent defoliation
      5. The duration of regrowth in an intermittently grazed sward
2.2.3.6. Regrowth in relation to time of defoliation 17
2.2.4. Summary 18

2.3. Characteristics of selected species and comparison between them.
2.3.1. Perennial ryegrass (*Lolium perenne*, L) 19
2.3.2. Matua prairie grass (*Bromus willdenowii* Kunth.) 20
2.3.3. Smooth bromegrass (*Bromus inermis* Leyss.) 21

CHAPTER 3 GRAZING MANAGEMENT, TILLER POPULATION AND TISSUE TURNOVER IN PERENNIAL RYEGRASS (*Lolium perenne*, L) PASTURE. 24

3.1. Introduction 24
3.2. Materials and methods 24
3.2.1. Site 24
3.2.2. Design 25
3.2.3. Pasture measurements 27
3.2.3.1. Sward measurements 27
3.2.3.2. Individual plant unit measurements 27
3.2.4. Tissue turnover 27
3.2.4.1. Linear change per tiller 28
3.2.4.2. The dry weight per individual tiller and the rate of change 28
3.2.4.3. Weight change per unit area 29
3.2.5. Tiller appearance rate 29
3.2.6. Leaf Growth Efficiency Index 30
3.2.7. Statistical analysis 30

3.3. Results 30
3.3.1. Tiller population density 30
3.3.2. Tiller size 33
3.3.2.1. Leaf number 33
3.3.2.2. Individual tiller dry weight
3.3.3. The standing herbage mass and the rate of herbage accumulation
3.3.4. Tissue turnover
  3.3.4.1. Individual tiller
  3.3.4.2. Herbage production per unit area
  3.3.4.3. Components and seasonal pasture production
  3.3.4.4. Leaf Growth Efficiency Index (LGEI)
3.3.5. Tiller Appearance Rate (TAR)
3.4. Discussion
  3.4.1. Techniques
  3.4.2. Pasture management
    3.4.2.1. Effects of sustained hard and lax grazings
    3.4.2.2. The effects of switch grazing in late spring
    3.4.2.3. Management implications
3.5. Conclusions

CHAPTER 4. THE EFFECTS OF SEVERITY OF GRAZING ON TISSUE TURNOVER IN MATUA PRAIRIE GRASS DAIRY PASTURE

4.1. Introduction
4.2. Materials and methods
  4.2.1. Experimental design and field management
  4.2.2. Measurements
    4.2.2.1. Sward
    4.2.2.2. Individual tillers
    4.2.2.3. Tissue turnover
  4.2.3. Statistical analysis
4.3. Results
  4.3.1. Herbage mass and morphological composition
4.3.2. Tiller size
   4.3.2.1. Number of live leaves
   4.3.2.2. The individual tiller dry weight
4.3.3. Population density
   4.3.3.1. Tiller population density
   4.3.3.2. The distribution of plant size
4.3.4. The herbage accumulation
4.3.5. The tissue turnover
   4.3.5.1. Turnover of tissue on individual tillers
     A. The effect of tiller position
     B. Growth
     C. Senescence
     D. Net herbage production
   4.3.5.2 Herbage production per unit area
     A. Growth
     B. Senescence
     C. Net herbage production
4.4. Discussion
   4.4.1. Sward measurement technique
   4.4.2. The distribution of plant size
   4.4.3. Seasonal effects
   4.4.4. The effect of treatment
4.5. Conclusion

CHAPTER 5 THE INFLUENCE OF CUTTING MANAGEMENT ON HERBAGE PRODUCTION IN SMOOTH BRMEGRASS (*Bromus inermis* Leyss).
5.2.2. Experimental design 95
5.2.3. Measurements 97
  5.2.3.1. Herbage harvested 97
  5.2.3.2. Standing mass and herbage accumulation 97
  5.2.3.3. Tiller population density and tiller weight 97
  5.2.3.4. Leaves per tiller 98
  5.2.3.5. Underground biomass 98
  5.2.3.6. Subsequent spring regrowth 98
  5.2.3.7. Statistical analysis 98

5.3. Results 98
  5.3.1. Tiller size 98
    5.3.1.1. Leaf number 98
    5.3.1.2. The dry weight of individual tillers 101
  5.3.2. Tiller population density 103
  5.3.3. Herbage mass and herbage accumulation 108
    5.3.3.1. Effect of timing of first cut 108
    5.3.3.2. Effect of cutting height and frequency 110
    5.3.3.3. Effect of number of cuts 114
  5.3.4. Underground biomass 115
  5.3.5. New season regrowth 117

5.4. Discussion 118
  5.4.1. The technique 118
  5.4.2. Tiller characteristics 118
  5.4.3. The effects of cutting treatment on pasture production 119
    5.4.3.1. Timing of first cut 119
    5.4.3.2. The cutting height and cutting intervals 120
    5.4.3.3. The number of cuts 121
  5.4.4. The effect of treatment on regrowth in following spring 122
5.5. Conclusion

CHAPTER 6 GENERAL DISCUSSION

6.1. Introduction

6.2. Sward structure changes in response to defoliation in ryegrass, prairie grass, and smooth bromegrass pasture

6.2.1. Leaves per tiller

6.2.2. The rate of leaf appearance

6.2.3. Dry weight per tiller

6.2.4. Tiller population density

6.3. The relationship between individual tiller weight and tiller population density

6.4. The effects of defoliation treatment on pasture production in swards of different species

6.5 The relationship between season and pasture management

6.6. Conclusions

6.6.1

6.6.2

6.6.3

6.6.4

6.6.5

REFERENCES

APPENDICES
LIST OF FIGURES

Fig 2.1 Relationship between ln(tiller weight) and ln(tiller density) in perennial ryegrass dominant swards. 9

Fig 2.2 Relationship between biomass sward height and LAI and rates of growth, senescence and net herbage accumulation in swards continuously stocked by sheep. 9

Fig 2.3a The effects of three severities of intermittent defoliation on the rate of gross tissue production. 16

Fig 2.3b The effects of three severities of intermittent defoliation on the rate of loss of tissue to death, as illustrated using a mechanistic model of grass production and senescence. 16

Fig 3.1 The grazing management schedule for ryegrass experiment (1987-1988) 26

Fig 3.2 Tiller population density (Tillers/m²) (Ryegrass) 32

Fig 3.3 Individual tiller dry weight (mgDM/Tiller) (Ryegrass) 37

Fig 3.4 The rates of herbage growth senescence and net production per individual ryegrass tiller (mgDM/Tiller/Day) 42

Fig 3.5 The rates of herbage growth senescence and net production per unit area ryegrass pasture (gDM/m²/Day) 45

Fig 3.6 The rates of herbage net production by components in ryegrass pasture (gDM/m²/Day) 48

Fig 4.1 The individual tiller dry weight of prairie grass (mgDM/Tiller). 66

Fig 4.2a The distribution of plant size under hard(H) and lax(L) grazing treatments on prairie grass pasture. 71

Fig 4.2b The distribution of plant size in different periods on prairie grass pasture. 72
Fig 4.2c The distribution of plant size before and after grazing on prairie grass pasture. 73

Fig 4.3 The rate of net herbage production and senescence per tiller by components on prairie grass (mgDM/Tiller/day). 82

Fig 4.4 The rate of net herbage production and senescence components on prairie grass pasture (gDM/m²/day). 86

Fig 4.5 The regression between estimates of herbage accumulation from cut quadrats and tissue turnover procedures on prairie grass pasture. 88

Fig 5.1 The tiller population density on uncut smooth bromegrass swards (Tillers/m²). 105

Fig 5.2 The harvested herbage mass and herbage accumulation in smooth bromegrass swards (gDM/m²). 113

Fig 6.1a The relationship between tiller density and weight in ryegrass swards in different growth seasons. 132

Fig 6.1b The relationship between tiller density and weight in ryegrass swards under different treatments. 133

Fig 6.2a The relationship between tiller density and weight in prairie grass swards in different growth seasons. 135

Fig 6.2b The relationship between tiller density and weight in prairie grass swards in different growth seasons (Corrected data). 136

Fig 6.3a The relationship between tiller density and weight in smooth bromegrass swards under different treatments. 137

Fig 6.3b The relationship between tiller density and weight in smooth bromegrass swards in different growth seasons. 138

Fig 6.4 The relationship between tiller density and weight in ryegrass, prairie grass and smooth bromegrass swards. 139
LIST OF TABLES

Table 3.1 Effect of grazing management on perennial ryegrass tiller population density (Tillers/m²). 31
Table 3.2a The number of green leaves per perennial ryegrass tiller (Pre-grazing, Leaves/Tiller). 34
Table 3.2b The dry weight of leaf per perennial ryegrass tiller (Pre-grazing, mgDM/Tiller). 34
Table 3.2c The dry weight of stem per perennial ryegrass tiller (pre-grazing, mgDM/Tiller). 35
Table 3.2d The dry weight of daughter tillers per perennial ryegrass tiller (pre-grazing, mgDM/Tiller). 35
Table 3.2e The total dry weight per perennial ryegrass tiller (pre-grazing, mgDM/Tiller). 36
Table 3.3 The rate of herbage accumulation estimated by cut quadrats in perennial ryegrass pasture (gDM/m²/day). 39
Table 3.4 Rates of herbage growth (RG), senescence (RS), and net production (RNP), and of net leaf production (RNPL) in perennial ryegrass pasture (mgDM/Tiller/day). 41
Table 3.5 Rates of herbage growth (RG), senescence (RS), and of net leaf production (RNPL) in perennial ryegrass pasture (gDM/m²/day). 44
Table 3.6 The rate of net production per unit area by components in perennial ryegrass pasture (gDM/m²/Day). 47
Table 3.7 The Leaf crop growth efficiency index (LCGEI) in perennial ryegrass pasture. 49
Table 3.8 The absolute rate of tiller appearance (TAR) in perennial
ryegrass pasture (Daughter tillers/100tiller/Day).

Table 3.9 The parent tiller activity rate (PTAR) in perennial ryegrass pasture (Tillering tillers/100tiller/day).

Table 3.10 The coefficient of variation for the rate of herbage production per tiller in perennial ryegrass pasture.

Table 4.1 Periods of pasture regrowth and measurement.

Table 4.2a The number of live leaves per tiller before grazing in hard(H) and lax(L) grazed prairie grass pasture.

Table 4.2b The total number of leaves and the rate of leaf appearance in hard(H) and lax(L) grazed pasture (Sep to Nov 1988, prairie grass).

Table 4.3a The individual tiller dry weight in hard(H) and lax(L) grazed prairie pasture (pre-grazing, mgDM/Tiller).

Table 4.3b The ratio of stem to total tiller dry weight in hard(H) and lax(L) grazed prairie grass pasture.

Table 4.4 The tiller population density on permanently marked plants in hard(H) and lax(L) grazed prairie grass pasture.

Table 4.5a The effects of treatment and period on distribution of plant size and plant population density in hard(H) and lax(L) grazed prairie grass pasture.

Table 4.5b The distribution of size and plant population density during regrowth under hard(H) and lax(L) grazed prairie grass pasture.

Table 4.6 The pre and post-grazing standing herbage mass (gDM/m²) and the rate of green(G) and total(T) herbage accumulation (gDM/m²/day) estimated by cut quadrats.

Table 4.7 The coefficient of variation of estimates of herbage growth on sample tillers in period 2.
Table 4.8a The effect of tiller position in the plant on rate of herbage growth per tiller (mgDM/Tiller/day).

Table 4.8b The effect of tiller position in the plant on rate of herbage senescence per tiller (mgDM/Tiller/day).

Table 4.8c The effect of tiller position in the plant on rate of herbage net production per tiller (mgDM/Tiller/day).

Table 4.9a The rate of herbage growth per tiller over different treatment periods as estimated by individual tiller tissue turnover (mgDM/Tiller/Day)

Table 4.9b The rate of herbage senescence per tiller over different treatment periods as estimated by individual tiller tissue turnover (mgDM/Tiller/Day)

Table 4.9c The rate of herbage net production per tiller over different treatment periods as estimated by individual tiller tissue turnover (mgDM/Tiller/Day)

Table 4.10a The rate of herbage growth per unit area as estimated from individual tiller tissue turnover and tiller population density (gDM/m²/Day)

Table 4.10b The rate of herbage senescence per unit area as estimated from individual tiller tissue turnover and tiller population density (gDM/m²/Day)

Table 4.10c The rate of herbage net production per unit area as estimated from individual tiller tissue turnover and tiller population density (gDM/m²/Day)

Table 4.11 The Plant size distribution on prairie grass pasture (Current study and Dodd)

Table 5.1 The experimental design in smooth bromegrass pasture.

Table 5.2a Number of green(G), senescent(S), and total(T) leaves
per vegetative tiller (Leaves/tiller) in smooth bromegrass (Measured at 5 July).

Table 5.2b Number of green(G), senescent(S), and total(T) leaves per vegetative tiller (Leaves/tiller) in smooth bromegrass (Measured at 22 September).

Table 5.3a Influence of treatment on the dry weight of individual smooth bromegrass tillers (mg/Tiller).

Table 5.3b Influence of season on the dry weight of individual smooth bromegrass tillers (mg/Tiller).

Table 5.4a Smooth bromegrass (Bromus inermis Leyss) vegetative (V), reproductative (R) and total (T) tiller population density (Tillers/m²).

Table 5.4b Density of various size class smooth bromegrass tillers (C1, >9 leaves/Tiller; C2, 4-9 leaves/Tiller; C3, <3 leaves/Tiller), and the numbers of tillers and buds per plant in October (Tillers/m²).

Table 5.5a The effect of initial cutting time on green(G), dead(D) and total(T) herbage harvested in summer, autumn and overall in smooth bromegrass pasture (gDM/m²).

Table 5.5b The effect of initial cutting time on green(G), dead(D) and total(T) herbage accumulation in summer, autumn and overall in smooth bromegrass pasture (gDM/m²).

Table 5.6a The effect of cutting height (Treatments 3&4 vs 5&6), cutting frequency (Treatments 3&5 vs 4&6), and cutting height*frequency interaction (Treatments 3&6 vs 4&5) on green(G), dead(D) and total (T) herbage harvested in summer, autumn and overall in smooth bromegrass pasture (gDM/m²).
Table 5.6b The effect of cutting height (Treatments 3&4 vs 5&6), cutting frequency (Treatments 3&5 vs 4&6), and cutting height*frequency interaction (Treatments 3&6 vs 4&5) on green(G), dead(D) and total(T) herbage accumulation in summer, autumn and overall in smooth bromegrass pasture (gDM/m²).

Table 5.7 The effect of number of harvests on yield and accumulation of green(G), dead(D), and total(T) herbage over the full growth period in smooth bromegrass pasture (gDM/m²)

Table 5.8 The effect of cutting treatment on underground biomass in smooth bromegrass pasture (Sampling on 22 October) (gDM/m², to 40cm depth).

Table 5.9 The effect of previous cutting treatment on smooth bromegrass tiller population density, standing herbage mass per unit area and weight per tiller.

Table 6.1a The responses of tiller characteristics to defoliation in ryegrass, prairie grass and smooth bromegrass pasture (at reproductive phase).

Table 6.1b The rate of leaf appearance and the number of leaves at the beginning (post grazing) and the end (pre-grazing) of regrowth in perennial ryegrass, prairie grass and smooth bromegrass.

Table 6.1c The proportion of reproductive tillers in ryegrass, prairie grass and smooth bromegrass swards

Table 6.2 The rates of herbage growth, senescence, and net production per tiller (mgDM/Tiller/day) and per unit area (gDM/m²/day) in ryegrass, prairie grass, and smooth bromegrass swards.
LIST OF APPENDICES

Appendix 3.1a (Fig) 161
The rainfall per month from August 1987 to March 1989 (Palmerston North).

Appendix 3.1b (Fig) 162
The average air temperature from August 1987 to March 1989 (Palmerston North).

Appendix 3.2 163

Appendix 3.3 166
The ANOVA analysis of net leaf production (g/sq-m/day) in December 1987.

Appendix 3.4 167
Tissue dry weight per unit length (mg/mm).

Appendix 3.5a (Table) 167
The standing herbage mass estimated by cut quadrats in spring (gDM/m²).

Appendix 3.5b (Table) 168
The standing herbage mass estimated by cut quadrats in summer (gDM/m²).

Appendix 3.5c (Table) 168
The standing herbage mass estimated by cut quadrats in winter (gDM/m²).

Appendix 4.1 169
The ANOVA analysis of leaf growth rate per unit area.
Appendix 4.2a (Table) 170
Mean values of post and pre-grazing herbage mass (kgDM/ha) (From Rugambwa, et al 1990)

Appendix 4.2b (Table) 170
Mean values for morphological composition (% dry weight) and leaf:stem ratio in the post-grazing herbage from lax grazed (L) and hard grazed (H) prairie grass swards, average across all season (From Rugambwa, et al 1990).

Appendix 4.3 (Table) 171
Mean chemical composition of herbage on offer and animal production in hard grazed (H) and lax grazed (L) prairie grass pasture (Rugambwa, et al 1990)

Appendix 4.4 (Table) 171
Mean botanical composition and morphological components of pasture on offer (% of DM) in hard grazed (H) and lax grazed (L) prairie grass pasture (Rugambwa, et al 1990).

Appendix 4.5 (Table) 172
Plant population of Matua prairie grass under lax and hard grazed (Plants/m²) (Chu, Unpul. data).

Appendix 5.1. 173
The green herbage accumulation in summer (June-August) --- an example of ANOVA and contrast statistical analysis.