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 REQURIEMENTS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY AT MASSEY UNIVERSITY.

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ABSTRACT

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 rotional 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 Agicultural 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 generaley 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 enviroment 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.

ACKNOWLEDGEMENT

I would like to express my deep gratitude to my chief supervisor, Prof.J.Hodgson for his patient guidance, and close supervision through the course of this study.

I also feel deeply grateful to Dr.A.C.P.Chu my co-supervisor for his patient supervision; and to Prof.P.Wang, Beijing Agricultural University, for arranging and guiding my experiment in China. I would like to express my sadness at the death of prof. S.S. Chia, and my gratitude for his patient guidance during my tenure of a teaching position at Beijing Agricultural Universityand and in the early phases of this study.

I am personally indebted to Mr.C.Matthew for his advice during this study and his cooperation in the ryegrass experiment. Special thanks are due to Dr.I.Gordon for his tuition on computer statistics programs, Dr. A. Younger for his advice on thesis writing; Mr.F.Y.Liu for his help in the experiment in China, and V.K.Rugambwa, for his frindly cooperation in the prairie grass experiment.

My study at Massey University was made all the more pleasant by staff of the Agronomy Department.

I would like to express my sincere thanks to Massey University for financial support during the course of this project, and Beijing Agricultural University for granting me study leave.

Finally, I thank my wife Mrs.C.L.Zhao, for her tolerance of long absence from our home in Beijing and her gentle support and encouragement.

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