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**A STUDY OF SEASONAL ROOT  
AND TILLER DYNAMICS IN SWARDS OF  
PERENNIAL RYEGRASS (*Lolium perenne* L.).**

A thesis presented  
in partial fulfilment of the requirements  
for the degree of Ph D in Agronomy  
at Massey University.

**Cory Matthew, 1992.**

## ABSTRACT

Objectives of this study were (i) to provide data on seasonal variation in root mass and root replacement in perennial ryegrass dominant swards, (ii) to simultaneously collect parallel data for above-ground parameters tiller population density, tiller natality, tiller mortality, herbage mass and herbage production, and (iii) to determine if such information on the behaviour of root and shoot systems and the inter-relation between the two could identify ways in which grazing management manipulation favouring root system development might subsequently result in pasture production increases.

Perennial ryegrass was chosen for study because it is the species most commonly used in new pasture sowings in New Zealand. Four field experiments and two glasshouse experiments are reported.

In the first field experiment, techniques for making measurements of root mass and root production in field swards were evaluated. Over 80 days from November 1985 to February 1986, total root mass measured by washing roots from "intact" soil cores did not change, but root mass in core-holes bored out and "refilled" with sand was 53% of that in intact cores. The refilled core technique was therefore adopted as a measure of "apparent" root production, and a later calibration study showed that measurements using the refilled core technique underestimate actual root growth. Using the refilled core technique, differences in root production were detected between six mowing treatments designed to allow varying degrees of reproductive development. Root growth was greater where mowing of swards was delayed sufficiently to allow reproductive growth until head emergence or anthesis than where seedheads were either removed before head emergence or left un-mown until seed-set. There was also evidence of increased tillering on treatments with the highest root growth.

In the second experiment (December 1986 to May 1988) plots were subjected to lax (LL) or severe (HH) grazing management or to cross-over LH or HL grazing managements. The cross-over date, December 7 1987, was timed to coincide with peak reproductive development. Swards in this study had approximately  $100 \text{ m m}^{-2}$  underground stolon, with a seasonal increase in late winter and higher stolon formation on LL plots than on HH plots. Apparent root growth rates exhibited marked seasonal variation, and were typically about 15% of above-ground net production. For 12 months from January 1987 to January 1988 apparent root growth averaged 8.4 and

7.3 kg DM ha<sup>-1</sup> day<sup>-1</sup> for LL and HH plots, respectively for 0 - 600 mm soil depth. Because of these relatively small differences in root growth, it was concluded that manipulation of root growth would not enable herbage production advantages to be achieved. However, after introduction of cross-over grazing managements, high herbage production was observed on LH plots and tissue turnover and herbage dissection measurements showed that this high herbage production was associated with high daughter tiller formation, probably from stubs of decapitated flowering tillers.

Experiment 3 (November 1988 to January 1989) comprised 3 plots under common grazing management, and was designed to provide detailed information on the location on the tiller axis of actively elongating roots, and to confirm seasonal patterns of root and tiller growth observed in Experiment 2. Root initiation normally occurred at the same node as leaf senescence, normally two roots formed at each node, and few active roots were found more than 10 nodes below the last leaf. Seasonal timing of peak root growth and tiller appearance was different from that in Experiment 2, however. This is believed to reflect genetic differences between the cultivars 'Ellett' used in Experiment 2 and 'Grasslands Ruanui' used in Experiment 3, but specifically designed controlled comparisons would be needed to confirm this.

Experiments 4, 5, and 6 were designed to provide more information on the reasons for high tillering on LH plots in Experiment 2, and investigated the number of daughter tillers formed by flowering tillers subjected to differing cutting treatments. In all three experiments the number and weight of daughter tillers formed was greatest where a degree of reproductive growth occurred, and was reduced where seedheads were cut closer to the ground or earlier, and where seedheads remained uncut to act as a competing sink. These observations indicate that assimilate from parent flowering tillers is important for daughter tiller formation and, in Experiment 6, a cutting treatment which increased translocation of carbon-14 tracer from labelled flowering tillers to daughter tillers also increased the number and weight of daughter tillers formed.

It is concluded that grazing management which exploits the potential for high tillering rates from stubs of flowering tillers could increase herbage production on many New Zealand farms by more than 0.5 t DM ha<sup>-1</sup> over the summer/autumn period, and implications for farm practice are briefly discussed.

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