# ASPECTS OF WATER DEFICIT AND VEGETATIVE GROWTH IN SELECTED PASTURE AND FORAGE GRASSES

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TABLE OF CONTENTS

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## LIST OF FIGURES

Page

Page

## LIST OF TABLES

Page

Page

## LIST OF APPENDICES

Page

# ASPECTS OF WATER DEFICIT AND VEGETATIVE GROWTH IN SELECTED PASTURE AND FORAGE GRASSES

## ABSTRACT

In this study, the sensitivity of leaf extension to plant water status, the ability of the plant to recover after different periods of water deficit and the plant's reaction to atmospheric pre-conditioning were examined using different pasture and forage grasses.

The sensitivity of leaf extension to plant water status was studied in 3 separate experiments using sudax (SX-6, a forage sorghum hybrid, *Sorghum bicolor* (L) *Moench* x *S. sudanese* (piper) Staff), prairie grass (*Bromus catharticus* Vahl. cv. Grasslands Matua) and 2 cultivars of perennial ryegrass (*Lolium perenne* L. c.v. Grasslands Nui and Grasslands Ruanui). The sudax experiment was conducted in the field, whereas the prairie grass and ryegrass experiments were conducted in the Climate Laboratory, D.S.I.R. The day/night temperatures used in the prairie grass experiment was $22.5^{\circ}/12.5^{\circ}C$. For the ryegrass, 2 contrasting temperature regimes were used; these were high (H), $27.5^{\circ}/12.5^{\circ}C$, and low (L) $17.5^{\circ}/12.5^{\circ}C$ day/night temperatures.

It was found that leaf extension was very sensitive to small changes in leaf water potential during the initial stages of desiccation, but the response became less sensitive with increasing levels of desiccation. However, the relationship between leaf water potential and leaf extension rate was not unique. It varied according to the environmental conditions. The true relationship between leaf water potential and leaf extension rate can only be established when the leaf water potential at the site of measurement can be related unequivocally to the leaf water potential at the site of elongation.

The rates of recovery in leaf extension, leaf emergence, tiller

number, green leaf number, leaf area and dry weight per plant were followed after different water deficit treatments in one experiment with prairie grass and in another experiment with 2 cultivars of perennial ryegrass under 2 contrasting temperature regimes. The environmental conditions for these experiments were the same as those used in the leaf extension experiments.

In prairie grass, upon relief of water deficit, the previously desiccated plants showed an "accelerated" rate of leaf extension up to 20% higher than those of the well-watered control plants of the same physiological age. The "accelerated" rate lasted for over 28 days after rewatering during which time 4 to 5 new leaves emerged. However no such "accelerated" rates were observed in the ryegrasses.
The "accelerated" response following rewatering in prairie grass would be consistent with a differential sensitivity of cell division and cell elongation to water deficit. The desiccation treatment was more severe in the ryegrass experiment where both cell division and cell elongation could be suppressed, and this could account for the absence of a similar response in the ryegrasses.

Under well-watered conditions, the mean leaf emergence rate was 4.1 days per leaf for the prairie grass. The corresponding mean leaf emergence rates for Nui and Ruanui were 5.7 and 6.3 days/leaf under the H and 6.6 and 6.6 days/leaf under the L temperature regimes respectively. Within the grass species, post-desiccation leaf emergence rates between the previously desiccated and the well-watered plants were similar.

During desiccation, tiller number was the least sensitive parameter to water deficit, followed by dry weight and leaf number. Leaf area was the parameter most sensitive to desiccation. Amongst the dry weight components, lamina component was the most sensitive followed by the root component with the sheath component the least sensitive to desiccation.

The pattern of recovery from desiccation was examined to see if positive or negative carryover effects occurred. To enable valid comparison of desiccated and control plants, physiological age was adjusted by removing a number of "drought" days from the chronological age. It was found that when the desiccation was mild e.g., in the prairie grass experiment, reductions in plant dry weights were proportional to the number of "drought" days. On the other hand, under a more severe level of desiccation, e.g., as in the ryegrass experiments, using the same method of adjustment, it was found that the dry weights of the previously desiccated plants were substantially lower than those of the well-watered control plants of the same physiological age. The reduction in dry weight was more pronounced under the H than under the L temperature regime.

After rewatering, in both prairie grass and ryegrass, the relative rates of increase of leaf area were higher in the previously desiccated plants than the well-watered control plants. In contrast to this, the relative rates of increase in dry weight, tiller number and leaf number in the previously desiccated plants were either similar to, or slightly less than those of the well-watered control plants.

Although the pattern of recovery in the leaf extension rates was different between the two experiments, this had no apparent positive or negative carryover effects on the relative rates of recovery in the growth parameters measured (e.g., tiller number, green leaf number, leaf area and dry weight per plant).

The reaction of prairie grass to desiccation following either a "dry" or a "wet" atmospheric pre-conditioning was compared with those plants that were grown continuously under either the "dry" or the "wet" vapour pressure environments.

Plants with a previously "dry" history were able to grow longer into the desiccation period than those with the "wet" history as well as those under the continuous "wet" or "dry" conditions. This apparent "adaptation" was due to a more efficient rate of water use per unit leaf area by the "hardened" plants. But the mechanism that enabled these plants to use water more efficiently was not known.

Nui had been reported to outyield Ruanui under the summer and autumn conditions in New Zealand. Because of the importance of perennial ryegrass to New Zealand, a comparison of these 2 cultivars was also made in this study. Between the two cultivars of ryegrass, Nui had a higher leaf extension rate (+20%) under the H temperature regime, it also had a heavier mean tiller dry weight (+28%), a larger mean area per leaf (+24%), but a lower tiller number (-24%) and a lower green leaf number (-18%) per plant than Ruanui. All the other paramters measured, including total leaf area and total dry weight per plant, top to root ratio, specific leaf area, leaf area ratio, stomatal resistance and transpiration rates were similar between the two ryegrass cultivars. Some of the possible reasons for the lack of difference on a per plant basis are discussed.

The possibility of using leaf extension rate to predict plant dry weight changes in water deficit studies is also discussed.