THE RESPONSE AND RECOVERY OF TEN HILL COUNTRY PASTURE SPECIES SUBJECTED TO WATER DEFICIT STRESS

A thesis presented in fulfilment of the requirements for the degree of Masters in Agricultural Science

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January 1995

ABSTRACT

The objectives of this study were to: screen the response of several pasture species when subjected to water deficit stress, use these responses to test some predictions of plant strategy theory (Grime *et al.* 1988) in relation to stress, and examine some plant functional characteristics related to stress and interpret the responses in relation to plant community structure in hill country pastures. The rationale here is that by testing a range of species responses to controlled stress in artificial conditions significant patterns of ecological specialisation in plant traits may be detected.

Ten hill country pasture species were exposed to a controlled water deficit stress in a glasshouse experiment. The response of the plants to a progressively severe water stress followed by the resumption of water and nutrient supply for a three-week recovery period was assessed, using measurements of leaf extension, dry mass, senescence and tissue nutrient contents.

The ranking of species for resistance to water stress (defined as the ability of the plant to continue functioning during the stress) based on the measurements of leaf/petiole extension rate, was (lowest to highest): *Lolium perenne* < *Dactylis glomerata* < *Holcus lanatus* < *Agrostis capillaris* < *Plantago lanceolata* < *Agrostis castellana* < *Trifolium repens* < *Rytidosperma clavatum* < *Lotus corniculatus* < *Hieracium pilosella*. *Lolium perenne*, *Dactylis glomerata* and *Rytidosperma clavatum*, followed by *Trifolium repens* showed the highest resilience (defined as the rate of recovery after the stress is removed) again measured by leaf/petiole extension rate.

The difference in total dry mass between control and stress treatments was used to assess the effect of the stress on biomass accumulation. Those species classified with C attributes according to plant strategy theory survived the water stress through rapid plastic adjustments in leaf extension and senescence and developed a large difference in dry mass between the stress and control treatments. The stress tolerant type species had the least response in terms of difference in biomass accumulation and senescence.

The broad differences between plants with S-type and C-type attributes are consistent with plant strategy theory. However within the CR-CSR classification several different types of response to water deficit stress were evident. In particular, the CR-CSR strategists *Lolium perenne* and *Dactylis glomerata* showed a well developed capacity to cease leaf elongation early and senescence leaf material so as to preserve meristems in a viable state to allow recovery when water supply resumed. Other CR-CSR strategists did not have this capacity and several species died as a result of water stress.

This suggests that secondary functional types may be recognised within the primary types of CSR theory.

The results are discussed in relation to the coexistence of hill country pasture species. It is suggested that the persistence of *Lolium perenne* and *Dactylis glomerata* in hill country pastures may be partly related to a capacity for rapid plastic adjustments in leaf extension and leaf area so preserving dormant vegetative meristems during water stress, allowing rapid recovery in the cooler period of the year with adequate water.

ACKNOWLEDGMENTS

I would like to acknowledge and thank the following people for their assistance in various stages of this work. Their help is deeply appreciated

Peter Kemp

Bruce Campbell

Ian Valentine

Technicians at the Plant Growth Unit. Massey University.

Plant Science Department. Massey University.

Massey University Agricultural Research Foundation

Hugh and Angela Davis

Jill Lawler

Glen Houghton

Ian (Piggy) Millward

Shelly Wrigly

Anne-Marie O'Neill

John Lockhart

Ashby Howitt

Jeannie Rossiter

Janet McAllister

'. . . omnes observationes nostrae propter instrumentorum sensuumque imperfectionem non sint nisi approximationes ad veritatem . . .'

Gauss 1890

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES