NUTRIENT EFFICIENCY OF SOME GRASSES AND LEGUMES IN RELATION TO ENVIRONMENTAL STRESS

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ABSTRACT

This thesis provides a definition of relative nutrient efficiency (RNE) by which species and strains of pasture plants can be differentiated in a quantifiable manner according to the shape of their response surface to applied nutrients. Attention is drawn to the fact that RNE is under genetic control and to the probability that no single casual mechanism controls RNE because of the interdependence of plant physiological processes.

Experiments are reported investigating the RNE of strains of Yorkshire fog (Holcus lanatus L.), perennial ryegrass (Lolium perenne L.), Lotus penduculatus Cav. (Syn L. uliginosis Schkuhr., L. major Sm.) and white clover (Trifolium repens L.). Initial experiments examined a number of strains of each species for their RNE in response to N for the grasses and P for the legumes. Subsequent experiments compared strains of both grass species in response to N and legume species in response to P together with the effects of climate. Measurements were made of dry matter yields, shoot:root ratios, N absorption and utilization, and in addition for legumes their N fixing activity and P absorption and utilization.

A final experiment examined climatic paramaters affecting RNE of two strains of white clover in response to P and their relative abilities to remobolize and re-utilize N and P in younger compared to older tissue.

Results of all experiments showed differences in RNE among strains of each species. They also showed that RNE is dependent upon climate, with high RNE generally being expressed under conditions most favourable for maximum growth.

A bred strain of Yorkshire fog - Massey Basyn, was found to provide high yields relative to others at low levels of N. This was attributed to its greater ability to absorb and utilize N. Among perennial ryegrasses Mangere strain possessed low RNE under a 15/10^{o}C day/night temperature and 200 Wm^{2} light intensity due to its inability to absorb N through restricted root development. Comparison of the most efficient strains of Yorkshire fog and perennial ryegrass showed that they did not differ in RNE and it is concluded that the 'low fertility' classification of Yorkshire fog is unwarranted.

The initial experiment with Lotus identified strains differing in RNE but this finding was not confirmed in the subsequent experiment. A strain of white clover from the Netherlands (Tamar) was found in two experiments to have high RNE through providing high yields at medium to high levels of P. In the final experiment where Tamar was compared with Huia white clover, its greater RNE

was due to a greater ability to absorb and utilize N and P, to remobolize N and P from older to younger tissue and to mobolize soluble sugars from shoots to roots.

Comparison of the most efficient strains of white clover and Lotus showed that the former responded better to high levels of P.

It is concluded from this series of experiments that genetic variability exists among the species studied and that their differing RNE could be exploited to bring about economies in the use of fertilizers.

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