PHYSIOLOGICAL RESPONSES OF THE SEMI-ARID GRASSES *THYRIDOLEPSIS* AND *ASTREBLA* COMPARED WITH *CENCHRUS.*

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Experiments were carried out under controlled conditions to investigate the physiological bases for the lower production of native plants of semi-arid Queensland compared with the introduced species buffel grass (*Cenchrus ciliaris* L.). Because of their influence on plant establishment and growth, the physiological responses to temperature, light and soil phosphorus and water supply of two valuable native perennial grasses, mulga (*Thyridolepis mitchelliana* (Nees) S.T. Blake and mitchell (*Astrebla elymoides* F. Muell. ex F.M. Baill.) grasses were compared with buffel grass. The development of the root system was also explored because of its influence on the uptake of nutrients and water.

The optimum temperature for vegetative growth of mulga grass was about 25°C, and for mitchell and buffel grasses, 30°C. The higher yield of buffel grass than both native grasses at all temperatures arose partly from its high growth rate during emergence. However, as this high growth rate was maintained during vegetative growth it can be ascribed to both its higher net assimilation rate and the diversion of a greater proportion of its dry weight into leaf area. A reduction in illuminance caused smaller changes in the relative growth rate of mulga grass than mitchell and buffel grasses.

Buffel grass, and to a less extent mitchell grass, had a much larger yield response with increasing phosphorus supply than mulga grass. Mulga grass required a lower external concentration for optimal growth than mitchell and buffel grasses and this was related to its superior system for absorbing and transporting phosphate from low concentrations. However, this was not related to any yield advantage, yield being related more to the photosynthetic rather than the nutritional characteristics of the plants.

The differences in yield between mulga and buffel grasses were traced to differences in rates of net photosynthesis. The lower rates for the C_3-species mulga grass than the C_4 buffel grass were associated with greater values of the residual resistance. Evidence presented suggests that mitchell grass may also be a C_4 species.

The vegetative growth of both species continued at soil water potentials below −15 bars, but only small increases in yield occurred below −30 bars. The decline in relative growth rate as soil water deficit increased was associated with a reduction in the rate of phosphate absorption as well as a decrease in tissue phosphorus concentration. As soil water deficit increased the relative water content of the measured leaf of buffel grass decreased at a greater rate than the measured leaf of mulga grass.

The pattern of root growth during seedling and early vegetative growth suggests that the emergence of axes, their extension and branching are co-ordinated in such a way that the mean rate of extension and distance between branches, for each component of the root system, remains fairly constant. Phosphorus deficiency did not greatly affect the length of the seminal axis, or the number of its primary laterals, but resulted in a significant reduction in the length of these laterals; the length and number of nodal roots were also greatly reduced.

Finally the integrated effects of the external factors are discussed in relation to growth, plant establishment and competitive ability. The ecological implications of selecting for increased yield for semi-arid environments are also discussed.