MEDITERRANEAN AND TEMPERATE TALL FESCUES: PHYSIOLOGICAL AND MORPHOLOGICAL RESPONSES TO WATER DEFICIT, AND THE EFFECT OF NITROGEN ON WINTER AND EARLY-SPRING FIELD PERFORMANCE UNDER GRAZING

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ABSTRACT

A major goal for grazing systems is to increase winter herbage growth. Tall fescue (*Festuca arundinacea* Schreb.) has been widely recognised as one of the most important cool season forage species. Among tall fescue populations, those of Mediterranean origin (e.g. *F. arundinacea* var. *letourneuxiana* from North Africa) have shown higher growth rates in winter and early-spring than comparable germplasm from northen Europe. For this reason, the complementary use of Mediterranean and temperate tall fescue populations to improve continuity of seasonal forage supply has been suggested for the Pampa region, Argentina. It is known, however, that the low winter N availability of the region limits herbage growth and that water deficits are likely to occur. It has been found that endophyte-infected tall fescue plants tolerate drought better than endophyte-free ones and currently novel endophyte strains harmless to livestock are commercially available.

This study therefore sought to compare the responses of Mediterranean and temperate tall fescue cultivars to water deficit, to investigate the extent to which water deficit responses are modified by the presence or absence of endophyte, and to compare winter-early spring growth and animal production of two contrasting cultivars with and without N fertilisation in the Pampa region.

Three glasshouse experiments were carried out to evaluate the response of contrasting tall fescue cultivars to water deficit. In the first experiment two temperate cultivars, Grasslands Advance (GA) and El Palenque (EP), and a Mediterranean cultivar, Maris Kasba (MK), were studied. Water deficit was induced by complete cessation of watering and sequential harvests were made to follow the adjustment of the respective cultivars. Morphological measurements also included the distribution of mass and length of root with depth.

In the second experiment, only MK and EP were studied. Plants of both cultivars were grown in the same pots and received water daily with gradation in intensity of water deficit achieved by varying the daily water ration per pot. Reducing and fructosyl sugar concentrations were analysed to examine cultivar differences and to investigate whether these sugars were involved in osmotic adjustment.

The third experiment compared MK and EP cultivars under water deficit, but in addition the effects of two endophytes, Kentucky 31 wild type (KY31) and a commercial strain supplied by AgResearch (AR501), were studied.

Herbage growth and animal production in winter-early spring of MK and EP swards in response to N fertilisation were compared in a grazing experiment carried out in the SE of Buenos Aires Province, Argentina. The N treatments were zero and 100 kg N ha^{-1} applied in equal split dressings in mid autumn and early winter. The paddocks were grazed by a variable number of growing steers in order to maintain a similar leaf area index (LAI) in all treatments.

The results of the water deficit experiments indicated that in comparison with the temperate cultivars EP and GA, the Mediterranean cultivar MK was characterised by a smaller plant size, higher tiller number, high root : shoot ratio, a lower stomatal resistance, lower content of reducing and fructosyl sugars and a lower growth rate under high temperatures. All tall fescue cultivars exhibited decreased growth rates, diminished evaporative surface area, and increased root : shoot ratio and osmotic adjustment in response to water deficit. A similar water status was observed for the different cultivars under comparable soil water availability. There was evidence that MK was able to delay onset of water deficit through its morphological characteristics. By contrast, stomatal resistance of temperate cultivars was more responsive to soil moisture changes and these cultivars had a greater tendency for osmotic adjustment than MK under the most stressful water deficit conditions studied. For the particular cultivars and endophytes strains studied here, the experimental evidence suggests that MK-KY31 and EP-AR501 combinations would be expected to perform better under water deficit than other combinations.

Maris Kasba swards had a higher stocking rate during mid winter-early spring, and consequently, the beef production was 26% higher than in EP swards. With N fertilisation the response was markedly increased and beef production was increased by 66% during the same period. However, by late August no differences in tissue turnover were found between cultivars, while in September EP showed a higher net growth rate (NGR) than MK. For both periods N application increased the NGR of the swards.

Further studies would be necessary to evaluate the recovery capacity after drought of the cultivars evaluated and the ability for osmotic adjustment in the meristematic tissues as well as their behaviour under field conditions. Because the particular performance characteristics of each endophyte strain-grass genotype combination vary, it is recommended that any endophyte strain be evaluated in combination with the plant genotypes with which it is to be associated. The complementary use of temperate and Mediterranean cultivars in animal production systems of the SE of Buenos Aires Province improved feed supply during winter. In addition, winter herbage growth and animal production of both cultivar types can be considerably improved with N fertilisation.

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