Productivity of perennial pasture species through an irrigation cycle

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The dairy industry in northern Victoria is based on the production of irrigated perennial pasture. However, pasture yields in this area are below potential levels, particularly during the irrigation season. This loss of potential yield has been associated with soil-mediated problems in plant and soil water relations. One of the most common soil types in the Goulburn Valley is Lemnos loam (L1). This soil comprises a shallow (10cm) loam topsoil overlying a very dense (1.6g/cm^3), clay B horizon which is highly dispersive and of low porosity. These soil characteristics cause problems with compaction and the infiltration and drainage of water. It has been shown (1) that if the root environment is modified to overcome these problems, it is possible to increase pasture yields up to three times. The degree to which improved plant and soil water relations account for these yield increases is the subject of the current investigations.

Methods

Pure swards of white clover, perennial ryegrass and paspalum were established on normal and modified LI profiles. Modification (in 1979) involved shattering the profile to 1.Om, adding calcium (10t/ha) to the B horizon and draining with PVC pipes. On each soil and for each species, one sward was allowed to dry after an initial irrigation while the other was maintained in a well watered state. Photosynthesis and evapotranspiration of the pastures were assessed by the use of field gas-exchange chambers. Also, measurements were regularly taken of leaf extension, leaf water potential and volumetric soil water content.

Results and Discussion

On LI white clover was the most sensitive to water stress and leaf elongation rates began to decline after 40mm cumulative Class A pan evaporation (E-R). After 65mm photosynthesis began to be affected and was reduced to 53% of the well-watered sward after 80mm E-R. Ryegrass was less sensitive and after 90mm E-R was producing at 83% of the well-watered sward. Paspalum showed no decline in photosynthesis until at least 80mm E-R and was 65% of the well-watered sward after 135mm E-R.

Soil modification delayed the onset of water stress by improving the availability of soil water for white clover and paspalum at all stages through the irrigation cycles. As a result, leaf water potentials and transpiration rates were higher than on normal Ll. Consequently, photosynthesis was maintained at a higher level as the drying cycle progressed. After 80mm E-R the photosynthesis of white clover on modified was reduced to 80% of the well-watered while that of paspalum was reduced to 95% after 135mm E-R.

The commonly used irrigation interval of 10 days or more causes a substantial loss of pasture production as a result of adverse soil and plant water relations on Ll. When L1 is modified, the soil has the potential to support much higher levels of pasture production. In this experiment the loss of DM yield in the most sensitive species, white clover, was almost twice as large on normal L1 compared with modified L1.

1. Martin, F.M.(1982). Proc. 2nd. Aust. Agron. Conf., Wagga Wagga, p304.