Photosynthesis of pastures ponded with irrigation water

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There are 225,000 ha of perennial pastures in the Goulburn Valley and these grazed pastures are flood irrigated every seven to ten days during summer. However, their productivity is low, averaging 12 to 15 t DM/ha/yr. Experiments in the Goulburn Valley have shown that a major loss of yield occurs with only six hours of flooding at each irrigation during the season. This loss of yield may be caused directly by a rapid loss of oxygen or indirectly by enhanced denitrification or a build up of toxins in the soil. This experiment was designed to investigate the loss of yield caused by the immediate effects of flooding.

Methods

Pure swards of white clover and paspalum were created from existing pasture using selective herbicides and hand-weeding. Treatments were continuous flooding (free water depth 18 mm) and a well-watered control (watered daily by hand to replace Class A pan evaporation). They were imposed for 12 days on paspalum and 8 days on white clover. All swards were intercepting at least 80% of global irradiance. Photosynthesis was measured using open-system gas-exchange chambers. They were positioned on plots the day before treatments were imposed and remained in place until the end of the experiment. Measurements of net photosynthetic rate and irradiance were made to determine the daily photosynthetic efficiency of the pastures.

Results and discussion

The daily photosynthetic efficiency (gCO2/MJ) is plotted against time in Figure 1. This shows that for either species there was no large immediate effect of flooding on photosynthetic efficiency. Both species produced large, new roots that floated near the water surface. Presumably these roots were able to meet the plants requirements for oxygen and other nutrients. The loss of yield reported in studies of flooding at each irrigation during the season must be due to indirect effects. It is hypothesised that flooding of irrigation water may encourage a shallow root system, predisposing plants to increased soil water deficit stress at the end of an irrigation cycle.

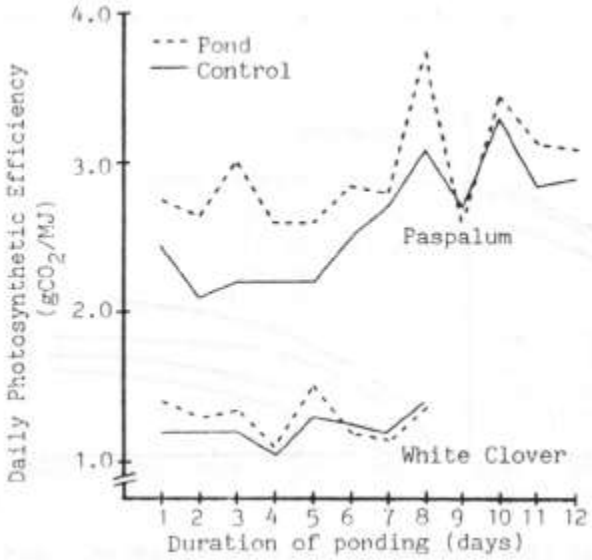

Figure 1. Photosynthetic efficiency of paspalum and white clover during a period of ponding.