

Effects of irrigation on CO₂ exchange of wheat

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Effects of irrigation regime on CO₂ exchange of wheat were measured during heading and grain filling to quantify effects of treatment and environment. Relationships between CO₂ exchange, green leaf area index (LAI) and yield were investigated.

Methods

Daily rates of CO₂ exchange (P_N) of a rainfed crop (treatment R_F) and of crops irrigated at fortnightly (treatment I_F) and weekly (treatment I_W) intervals were measured between heading and maturity using the field chambers described by Connor et al (1). Each treatment was sown to cultivar 'Condor' and received 150 kg N ha⁻¹, 30 kg P ha⁻¹ and 5 tonne gypsum ha⁻¹ prior to sowing on June 14, 1984. Irrigation treatments were imposed 120 days after sowing (DAS 120), 20 days before the crops reached anthesis. 22 mm of a total of 210 mm of rainfall fell between DAS 120 and 180.

Results and discussion

A maximum green leaf area index of approximately 7 was achieved by DAS 108. In treatment R_F , LAI decreased almost linearly after DAS 120 until none remained at DAS 160. In treatments I and I LAI was maintained at the maximum for approximately 140 days after which it also decreased to reach zero at approximately DAS 180 and 187, respectively. Grain filling, which commenced at DAS 1148, finished by DAS 167 in treatment R_F , and by DAS 180 in treatments I and I . In treatment I P increased from 140 g CO₂ m⁻² day⁻¹ at DAS 108 to a maximum of 70 g CO₂ m⁻² day at DAS 150 (see Fig. 1). It then decreased in W N parallel with LAI to zero at approximately DAS 180. At the other extreme, treatment R_F reached a maximum of 55g CO₂ m⁻² day⁻¹ before a rapid decrease to approximately 10 g CO₂ day⁻¹ at anthesis. This was again associated with changes in LAI. Rainfall and soil reserves maintained this rate until approximately DAS 160. Before anthesis, the response of treatment I_F was the same as that of treatment I . In subsequent drying cycles, rates equal to those of treatment I were maintained for only approximately one week after irrigation, but were generally restored at the next irrigation.

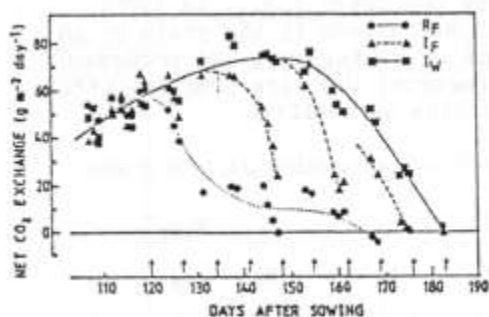


Fig. 1. Effects of irrigation treatment on net daily CO₂ exchange. Arrows indicate dates of irrigation of treatment I_W .

The data suggest that P_N is strongly related to LAI and hence leaf area duration and, further, that grain filling is maintained while P_N is positive. The association with LAI is circumstantial, as the contribution of the ears was not measured. The data also demonstrate the sensitivity of P_N to irrigation frequency. However, factors other than P_N were important in yield determination because yields of treatments I_F and I_W were not significantly different.

1. Connors, D.J., Palta, J.A., and Jones, T.R. 1985. Field Crops Res. 12:281.