Water stress and wheat crop growth

Ir. Handoko, G.M. Rimmington and D.J. Connor

School of Agriculture and Forestry, The University of Melbourne, Parkville, Victoria 3052

In the Australian environment where rainfall is relatively low, water stress is a major problem affecting crop production. Attempts have been made to understand the effect of water on crop growth using the concept of water use efficiency (WUE). However, this approach has a number of difficulties which relate to the complex interactions of the underlying processes that determine water-use and growth. This paper presents an analysis of the interactions between soil hydrology and the wheat crop growth.

Methods

A wheat crop was sown on 6m x 3m x 1.2m deep drainage lysimeters on 27th May, 1988. A wide range of variation in soil moisture content between treatments was achieved by putting a rainout shelter on one plot (Treatment D) and by using irrigation (Treatment Il and 12). Measurements were also made on rainfed plots (Treatment RF, rainfall = 241mm). Soil moisture changes were measured by using a neutron-probe meter. The volume of percolated water was measured and above ground dry matter (AGD) was sampled and separated into leaves, stems, ears and dead material at nine times during the growing period. Yield components (ear number, spikelets/ ear, grain/ear and grain weight) were also measured. An automatic weather station was set up to monitor solar radiation, air temperature and humidity, windrun and rainfall.

Treatment	Sowing ↓	Anthesis ↓	Maturity ↓	Irrigation (mm)	AGDant (t/ha)	Grain Yield (t/ha)
RF:	----------	----------		0	5.4	0.8
D:	----------DDDD	III----------		275	3.2	0.5
I1:	---------- IIIIIIII	IIIIII----------		436	8.7	3.3
I2:	----------	IIIIII----------		362	5.1	1.6

D: Drought; I: Irrigation; AGDant: Live AGD at anthesis.

Results

Above ground dry matter (AGD) was significantly affected by both irrigation and imposition of drought treatments. Early irrigation (I1) enhanced vegetative growth giving rise to greater accumulated dry matter. Late irrigation around anthesis (I2) also increased dry matter production but the increase was much lower. The Treatment D decreased dry matter production through the effect of lowered soil water content. H^{o}wever, because the rainout shelter also reduced incident radiation by 25%, these two factors are confounded. Ear number correlated with water availability around anthesis, but the proportion of the productive ears was determined by the available water before anthesis. Grain weight was reduced when water was unavailable during grain filling stage.