

Soil water and thermal-infrared determination of water stress of wheat growing on a red-brown earth in Southern New South Wales

R.C.G. Smith, H.D. Barrs and R. Sides

CSIRO Centre for Irrigation and Freshwater Research, Griffith, NSW 2680

To establish irrigation scheduling criteria for wheat grown on an irrigated red-brown earth soil (Hanwood Loam) in south-eastern Australia, the crop water stress index (CWSI) approach (1) based on infrared measurements of foliage temperature was used to study the relationship between water deficit stress and soil water depleted (2). The soil used was a permeable loam used extensively for irrigated horticultural production in the Murrumbidgee Irrigation Area.

Methods

The experimental technique involved the comparison of the foliage temperature and soil water of a well watered and an unwatered plot over 60 days. Foliage temperature and associated meteorological data was monitored every 10 minutes during the day using a computer controlled system for scanning the crop and logging data.

Results and discussion

Multiple regression analysis indicated that eighty six percent of the variation in CWSI was related to the level of water in the soil profile and a further five percent was associated with the vapour pressure deficit (VPD) of the air. Comparison of the relationship between CWSI and plant available water (PAW) with comparable data from other soils throughout the world indicated the existence of significant root zone limitations to root water uptake in the red brown earth soil studied.

These root zone limitations were associated with two factors. The first was a low PAW of 145 mm in the soil profile. The second was the early onset of stress when only 50 mm or 34% of PAW had been extracted. The multiple regressions indicated that the critical soil water content at which the onset of stress occurs decreases by 10 mm for each 1 kPa increase in vapour pressure deficit.

The low PAW was associated with the limitation of root water extraction to the top 0.8 m of soil, while the increase in CWSI at a high level of soil water was postulated to be due to a non-random root distribution resulting from roots developing preferentially along zones of weakness in these structured fine-textured soils.

1. Idso, S.B., Jackson, R.D., Pinter, P.J., Reginato, R.J. and Hatfield, J.L. 1981. *Agric. Meteorol.* 24:45-55.

2. Jackson, R.D. 1982. *I.E.E.E. Trans. Geosci. Remote Sensing* GE-20:282-286.