Soil water storage and extraction for irrigated maize on a red-brown earth

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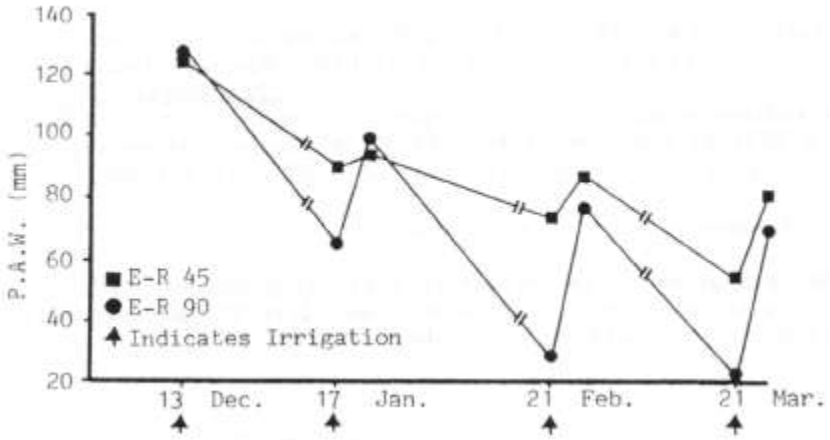
Root zone problems associated with crop production on red brown earths are widely recognised (1). The shallow surface soils have a high silt content (>30%) and are low in OM (<2%) which makes cultivated aggregates highly susceptible to slaking. The B horizons are dense clays with low hydraulic conductivity (2-3 mm/day). These characteristics make it difficult to sustain an adequate soil water supply to an irrigated summer crop.

Maize was irrigated at three frequencies with evaporation deficits (E-R) of 45, 67, 90 mm. Storage and extraction of soil water was measured intensively with a neutron probe. The 45mm E-R treatment received 16 irrigations. Figure 1 summarises the progressive change in plant available water (P.A.W.) at the dry and refill points for 45 and 90mm E-R.

Fig. 1. Plant available water pre and post irrigation for two frequencies.



Water intake was always less than evapotranspiration which caused progressive drying of the profile and forced the use of deeper water. Even at 45mm E-R there was a gradual decline in P.A.W. following irrigation (Fig. 1), and for 90mm E-R the cumulative deficit of P.A.W. above 1.0 m was 60mm from Dec. 13 to Mar. 24. As the soil became drier, intake per irrigation increased but never equalled crop usage. This progressive extraction of P.A.W. was so thorough that prior to the final irrigation the 90 mm E-R profile above 1.0 m held only 16% P.A.W. and had reached the estimated wilting point to 800 mm. For the 45 mm E-R frequency, P.A.W. was always above 41%, despite complete depletion of the 300-600mm zone.

Dry matter yields did not closely reflect the distinct differences in water storage and extraction. The 90 mm E-R frequency suffered only a 7% penalty in dry matter yield which would indicate only mild stress in soil water supply. In this mild summer (evaporation exceeded 10 mm on 5 days only) maize was able to compensate fairly adequately for the severe cyclical stress in water supply above 800 mm soil depth by extraction below that depth.

1. Muirhead W.A. and Humphreys E. (Eds). "Root Zone Limitations to Crop Production on Clay Soils". Proc. A.S.S.S Griffith, 1984. CSIRO, Melbourne.