Comparison of furrow and sprinkler irrigation systems for grain sorghum production in the Ord irrigation area

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Recent experiments at Kimberley Research Station have demonstrated that sorghum yields in excess of 9t/ha can be achieved with sprinkler irrigation and high nitrogen applications (1). In the traditional furrow irrigation system yields have rarely exceeded 6t/ha. This paper reports a direct comparison of the growth and yield responses of grain sorghum under sprinkler and furrow irrigation.

Methods

Sorghum (Texas 610 SR) was machine-planted into 75 cm ridges and either furrow or sprinkler irrigated (main plots), with urea applied at rates of 0,80,170 and 340 kg N/ha (sub-plots) in a split-plot design with 3 replicates. The urea was banded at sowing, 15 cm below and to the side of the seed. The "sprinkler" plots were irrigated weekly. Under the furrow system water was also applied weekly until lateral wetting of the surface soil was complete. Grain yields were estimated from quadrat harvests at physiological maturity.

Results and Discussion

Grain yields for both irrigation treatments at each nitrogen level are shown in Table 1.

Table 1. Yield of grain (t/ha at 14% moisture content) under sprinkler and furrow irrigation. Plant populations (plants m^{-2}) at harvest are shown in brackets.

	Nitrogen level kg/ha			
	0	80	170	340
Irrigation Method				
Sprinkler	4.2(35)	6.9(35)	8.8(34)	8.5(36)
Furrow	2.9(31)	4.7(28)	6.7(28)	5.2(18)

Sprinkler yields were significantly higher than "furrow" yields at all levels of nitrogen. Seedling mortality at the 340 kg/ha nitrogen level under furrow irrigation significantly reduced plant stand and contributed to the low yield level. The plants appeared nitrogen-deficient and plant analyses confirmed that nitrogen uptake under the furrow system was considerably less than under the sprinklers, indicating that nitrogen was either lost from the system and/or rendered unavailable. At crop maturity, substantial amounts of nitrate (up to 80 ppm) had accumulated in the top 5 cm of the ridge under all nitrogen levels of the furrow system and was apparently unavailable to the crop. This upward movement of nitrate was ascribed to capillary action driven by the very high evaporative conditions and lack of rainfall during the growing season. In contrast, the downward movement of water under the sprinkler system would have recycled surface accumulated nitrate back to the root zone of the crop. Differences in losses of nitrogen through ammonia volatilisation, denitrification and leaching under the two systems may also help to explain the yield increases. Experiments to assess the importance of nitrogen loss and movement under the two systems are in progress.

1. Foale, M.A., and Coates, D.B. 1980. In Proceedings of the Australian Agronomy Conference, Lawes April 1980 p.253.