Sustainable Irrigated Maize on Sodic Soils in the Lachlan Valley

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Abstract

Growth, yield and water use efficiency of maize grown under different irrigation methods were measured in order to provide information towards the formulation of guidelines for best irrigation practice management. Border Check (B) irrigation used 6.3ML of water; drip (D) irrigation reduced this volume by 52% and furrow (F) and permanent bed (P) irrigation had intermediate water requirements. From 15 DAS crop LAI and dry matter were lowest in B and highest in D compared with other irrigation methods. Despite the large differences in crop growth, grain yields were similar in all treatments except B where it was reduced by up to 15%. The water use efficiency of yield ranged from 1.80 (in B) to 4.05 (in D) t/Ml due to the large differences in the quantity of water applied to each treatment.

Key Words

Sustainability, irrigation, drip, maize, tillage, sodic soil.

Introduction

Irrigated maize production in the Lachlan Valley of NSW is characterised by low water and nitrogen use efficiency. Soils are often sodic, slowing infiltration of irrigation water, causing plant stress, and increasing run off which can result in soil erosion and eutrophication of surface water (1, 2). In addition to these agronomic constraints, farmers are expected to respond to a changed regulatory environment that will reduce the quantity of water available for cropping and increase the cost of that water to the producer.

We established a field experiment to examine ways of improving the efficiency of water and nitrogen use by irrigated maize crops on sodic soils in the Lachlan Valley. Treatments consisted of factorial combinations of tillage techniques (zero, minimum and conventional) with and without legume cover crops nested within four irrigation methods (border check: B, furrow: F, permanent beds-furrow: P, permanent beds-surface drip: D). Here we report the effects of irrigation methods on growth, yield and water use efficiency of a maize crop in the 1999/2000-irrigation season.

Results

Established crop population densities were up to 10% lower in B (76000/ha) than in F (85000/ha) and 15% lower than in D and P (89000/ha). Maximum LAIs of 4.0 and 5.7 occurred at 60 and 70 DAS in B and D respectively (Fig 1a). Crop dry matter peaked at about 85 DAS in all treatments but it was 67% greater in D compared to B (Fig 1b).

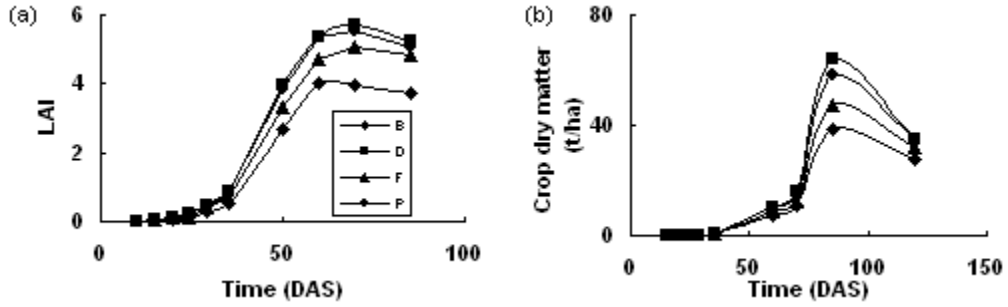
The only significance in grain yield was between border check and furrow (Table 1). Some irrigation methods dramatically reduced the amount of water applied. For example, surface drip irrigation on permanent beds used 52% less water than border check (Table 1). As a result, the crude water use efficiency of yield (t grain/ML applied) for border check was 56% less than for surface drip irrigation on permanent beds (Table 1).

Differences between irrigation methods in soil physical properties were becoming apparent by the end of the season. For example, prior to sowing in November, soil bulk densities were similar in all treatments averaging 1.29. However, following harvest of the crop in May bulk density in B was 1.33, significantly higher than in D (1.19, lsd 5% = 0.04).

Table 1. Effect of irrigation method on water applied, yield and water use efficiency of a maize crop.

	Border Check (B)	Surface Drip (D)	Furrow (F)	Permanent Bed (P)	l.s.d. (5%)
Water (ML/Ha)	6.27[a]	2.98[c]	6.11[a]	4.21[b]	0.769
Yield (T/Ha)	11.26[d]	12.08[de]	13.23[e]	12.01[de]	1.437
WUE (T/ML)	1.80	4.05	2.17	2.85	

Figure 1. Effect of irrigation method on (a) crop LAI and (b) dry matter accumulation of maize.



Conclusions

These results demonstrate that growers can dramatically reduce water applications to crops without penalising grain yield. Of the methods tested in this experiment, drip irrigation confers the greatest efficiency of water use. However, growing crops on permanent beds can achieve significant water savings without the immediate expense for installation of drip irrigation technology.

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