Conservation practices for dryland cotton production in South Africa

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ABSTRACT

For dryland cotton production, soil moisture conservation is an important practice, which can ensure consistently good yields, particularly on the heavier soils. The main objective of this study was to establish a system of cultivation and soil management practices whereby the available soil moisture could be utilized to obtain a higher cotton yield. In the long run, the influence of cultivation practices on soil structure and erosion would also be known. This study started in 1995/96 at Rustenburg, which is situated in the North-West Province. The following seasons, 1996/97 and 1997/98, this study was performed at three different localities situated in different provinces. Cultivar Tetra was used throughout this study at all the different localities. Four different water conservation treatments were evaluated. Small basins and tie ridges were constructed before planting. Straw was scattered over the plots or the high weed population was sprayed and left as an organic mulch. In the fourth treatment, the soil was left coarse after being ploughed. Square and boll counts were used throughout the growing season to estimate the potential yield as well as the total yield. The trials showed that organic mulching improved water infiltration and conservation and that improved water conservation had a positive influence on seed cotton yield. Ploughing and leaving the soil coarse gave nearly the same results. The small basins did conserve water when it rained more frequently but more water evaporated.

Introduction

Significant improvements in crop reliability and yield can only be achieved through the conservation of water (Twomlow *et al.*, 1994). A major problem in South Africa is the lack of water, coupled with high seasonal temperatures. Some farmers are compelled to produce under dryland conditions. Scarcity of water is one of the factors that most severely affect the growth of the cotton plant. The main objective of this study was to establish a system of cultivation and soil management practices whereby the available soil moisture could be better utilized to obtain a higher cotton yield. In the long run the influence of cultivation practices on soil structure and erosion will also be known.

Experimental procedure

This study started in the 1995/96 season at Rustenburg in the North-West Province. The following seasons (1996/97 and 1997/98) this study was performed at Rustenburg and at Potgietersrus in the Northern Province as well as at Makhathini (KwaZulu-Natal). The cultivar, Tetra, was used at the different localities throughout this study. Four different water conservation treatments were evaluated. Before planting, small basins of 30 cm x 30 cm were constructed. Tie-ridges of 8 m x 10 m were constructed across each plot. For the mulching treatment, straw was scattered proportionally over the plots. At Makhathini, during the 1996/97 season, the high weed population was sprayed with herbicide and left as an organic mulch. During the 1997/98 season, the previous seasons cotton stalks was scattered on the plots. With the ploughing treatment, the soil was left coarse after ploughing. A control treatment in the form of an uncovered, fine seedbed was also included. A neutron moisture probe was installed at a depth of 1.2 m for weekly measurement of the soil water content at Rustenburg. Seed cotton yield was determined at the different water conservation trials.

Results and Discussion

During the 1995/96 growing season, a layer of mulch conserved the highest percentage of water throughout the season. Basin tillage and the establishment of a rough soil surface through millboard ploughing also resulted in higher soil water content than the conventional cultivation practice. The yield results did not reflect the soil water content of the different treatments (Figure 1).

High rainfall during the season neutralized all treatment variation and contributed, with other factors, to the conflicting results. Rustenburg had a higher than normal annual rainfall while Makhathini and Potgietersrus experienced extremely dry conditions during the 1996/97 season. At Rustenburg, a layer of mulch gave the highest soil water content until week 14; where after basin tillage gave the highest soil water content. These two treatments realized the highest yields at Rustenburg (Figure 2). At Makhathini and Potgietersrus, establishing a rough soil surface through millboard ploughing and tillage throughout the season gave the highest yields the highest yields (Figure 3). The advantages of water conservation were clearly established in all the trials. At Rustenburg, during 1997/98, the yields were high for dryland cotton production. Although the moisture content of the control plots was much higher than that of the water conservation plots, moisture conservation practices resulted in higher yields (Figure 4).

Ploughing did conserve the most rainwater and therefore this treatment produced a good yield. At Potgietersrus, mulching and tie-ridges resulted in higher yields (Figure 5). Yields at Makhathini did not differ much from those of the control, but ploughing gave the highest yields (Figure 5).

Conclusion

The trails showed that organic mulching had a positive influence on water infiltration and conservation. Ploughing and leaving the soil coarse gave nearly the same results. At Makhathini, ploughing best reduced the problem of compact soil surfaces, which limit water infiltration. Construction of small basins did conserve water with more frequent rainfall, but the water evaporated. A combination of hoeing to loosen the soil and small basins should give much better results. Moisture content of the tie-ridges around each plot did not differ much from this of the control, which shows that water conservation is not very advantageous.

References

- Twomlow, S., Mashavira, T., Willcocks, T., Dhliwayo, H., Gapoza, W. and Hynes, P. (1994). Conservation-tillage practices for resource poor farmers in Zimbabwe. Productivity and conservation, University of Queensland, Brisbane, Australia, 7-11 February 1994.

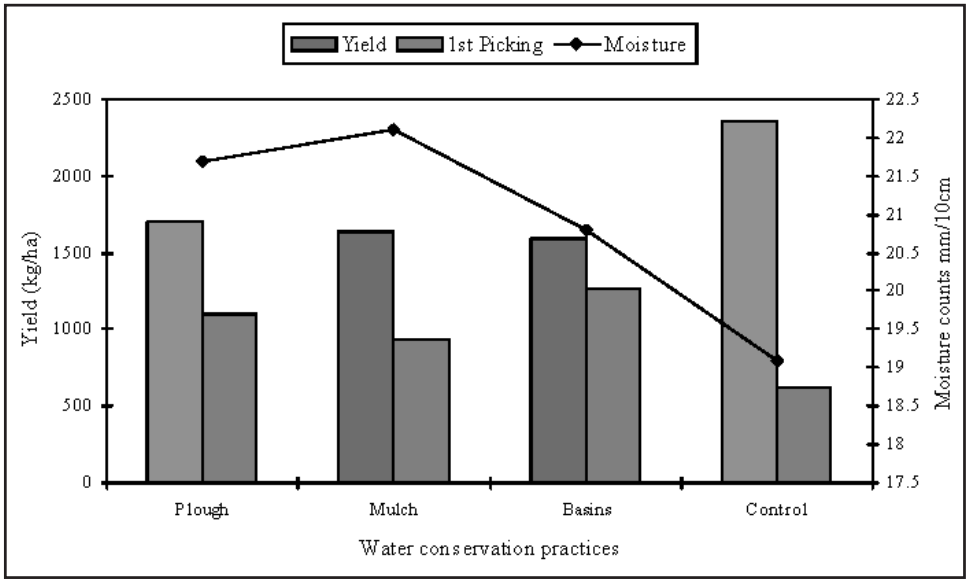

Figure 1. *Seed cotton yield as influenced by water conservation practices (Rustenburg, 1995/96).*

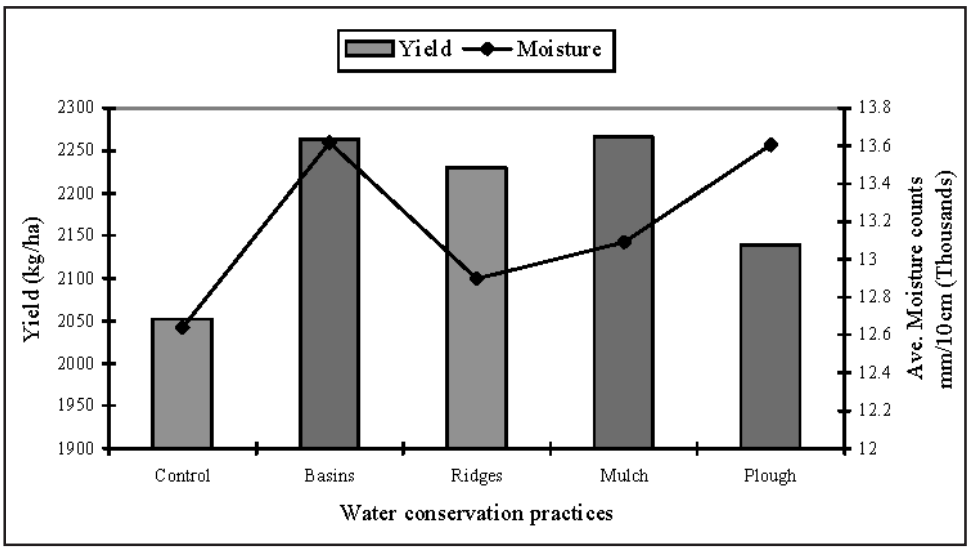

Figure 2. *Seed cotton yield as influenced by water conservation practices (Rustenburg, 1996/97).*

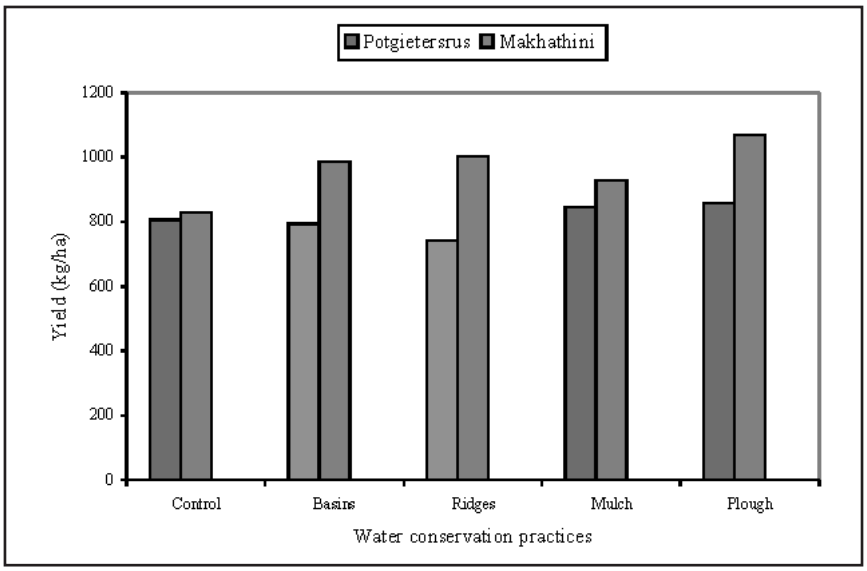

Figure 3.
Seed cotton yield influenced by water conservation practices (Potgietersrus and Makhathini, 1996/97).

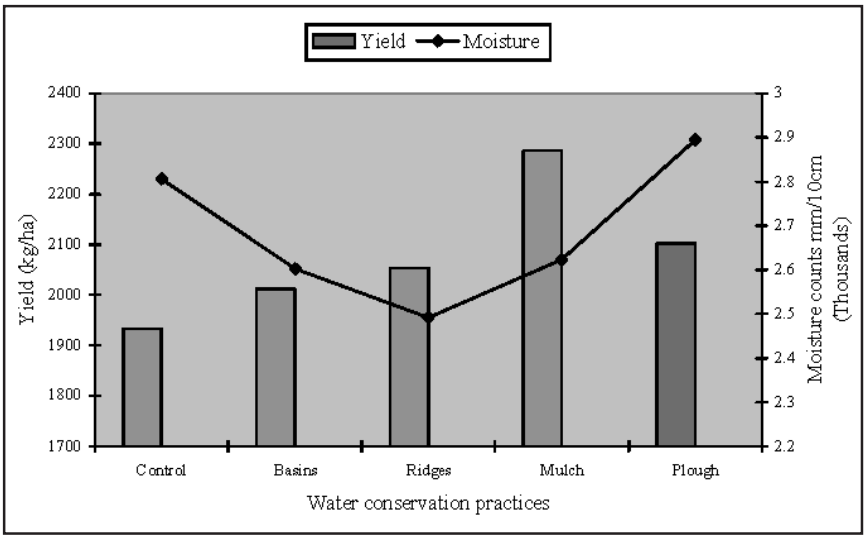

Figure 4.
Seed cotton yield influenced by water conservation practices (Rustenburg, 1997/98).

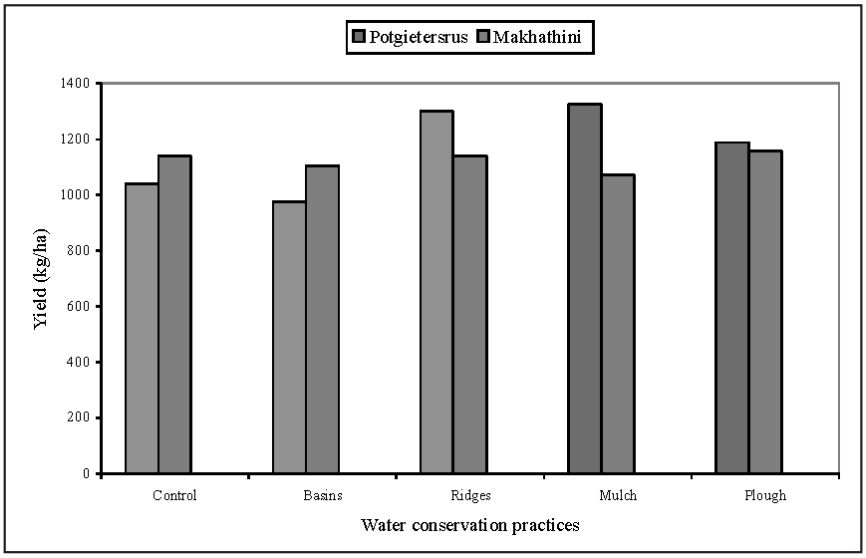

Figure 5.
Seed cotton yield influenced by water conservation practices (Potgietersrus and Makhathini, 1997/98).