

COTTON RESPONSES TO WATER ON THE DARLING DOWNS

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INTRDDUCTION

Yield responses to increasing amounts of irrigation water have been demonstrated in the past by individual trials. In these trials watering occurred at varying deficits of soil moisture below field capacity.

The type of response has depended upon other factors as well as irrigation, for example crop variety, time of planting, adequate weed and pest management and seasonal conditions. So with all other factors equal there was likely to be quite a different response from say season to season or between farms.

By collecting district information over a period of years we can estimate the types of responses that will occur in different situations.

Irrigation scheduling techniques introduced in recent years have enabled the collection of daily soil moisture information from commercial crops on the Darling Downs. Funding received from the Cotton Research Council during the past two years has also supported additional irrigation trials.

This paper summarises the available information and makes some general conclusions about yield responses to water.

### SEASONAL WATER USE BY THE CROP

To compare crops between season and location, we need to estimate total water use by a crop not just the amount applied as irrigation. This total will include water from rainfall, stored soil moisture and irrigation.

A simple addition of the difference in root zone soil moisture between the beginning and end of the season, together with effective season rainfall and irrigation will give the desired answer. A measure of efficiency is the final crop yield divided by water use, in Kg/ha per mm of water.

Estimates of the factors making up total water use often need to be made. For example, few records are normally available of how much rainfall received was runoff. In this case runoff was calculated when soil moisture exceeded field capacity. Total irrigation was calculated by summing deficits from field capacity, prior to each irrigation.

### YIELD RESPONSES FROM FIELD SITUATIONS

#### 1. Dalby district

A number of commercial crops of Siokra have been monitored in the Dalby district during the past two summer seasons, by Mr G. McIntyre, QDPI Dalby. The crop water use and corresponding yields have been plotted in Figure 1. The level of management was of a high standard in each case.

The soil type irrigated was a self mulching heavy grey clay.

Yield increased in a linear fashion with total season water use. The average efficiency value for all fields was 2.26 Kg/ha lint per mm water.

## 2. Central Downs

Information collected from a commercial situation on the central Downs, on a similar soil type, is also shown in Figure 1. The variety used was Deltapine 90, and the data obtained over a two year period.

In addition to a different level of general crop husbandry, varying irrigation intensities occurred on different fields, due to difficulties with the operation of equipment.

As for the previous case, yield increased apparently linearly with water use. However, the absolute yields and the magnitude of the increase, over a similar range of water use, were much less. Some of this may be explained by a difference in variety and the slightly more favourable conditions for cotton at Dalby.

The average efficiency value for the four fields monitored was 0.975 Kg/ha lint per mm water.

## 3. Responses in other districts

Information collected from the Byee district is shown in Figure 2. This trial was run over two years on a self mulching light medium clay, by Mr P. Vance, QDPI Kingaroy. The variety used was Siokra.

The average efficiency value was 2.38 Kg/ha lint per mm water.

An irrigation trial at Biloela in 1963, on a clay loam alluvial soil gave the results shown in Figure 3. The variety used was Deltapine Smoothleaf. This trial was conducted on a Departmental research station and hand harvested. Information was provided by Mr I. Swann, QDPI Caboolture.

The yield figures have been reduced by an arbitrary 30% to approximate a commercial field situation.

The average efficiency value for the ten treatments was 1.99 Kg/ha lint per mm water.

#### 4. A summary of yield responses

Using the average efficiency values for each case, the difference between a partially and well irrigated crop is shown in Table 1. Based on information already presented, together with other commercial crops monitored on the Downs, a partially watered crop (1 to 2 irrigations) is estimated to use 600 mm total water use. A well watered crop (3 to 4 irrigations) would use approximately 800 mm.

Note: An average dryland crop is likely to use approximately 400 to 500 mm of total water, while the data in Figure 1 would indicate that approximately 150 mm is required before any yield is produced.

Table 1.

Likely yield increases from partial to full irrigation.  
(600 to 800 mm total water use)

Site	Efficiency Kg/ha per mm	Yield increase (Kg/ha)
Dalby	2.26	452
Byee	2.38	536
Biloela	1.99	398
Central Downs	0.975	195

Table 1 shows that worthwhile yield increases occur by using full irrigation, even under the lower level of management measured on the Central Downs.

The advantage of irrigating a smaller area well, rather than spreading a limited resource over a larger area is clear from this table.

#### THE UPPER LIMIT FOR WATER REQUIREMENT BY COTTON

As the data was largely collected from commercial fields, there were few cases of deliberate excess irrigation leading to reduced yields. At trial sites where treatments involved more irrigations than normal, total water use still did not necessarily increase.

For example at Byee in the 1986/87 season a 40 mm deficit treatment with 7 irrigations used a total of 754 mm, while a 90 mm deficit used 755 mm from 3 irrigations. The yield of the 40 mm deficit was reduced in relation to all other treatments.

This would indicate that the information collected from the various districts did include an upper limit. For the Darling Downs a limit of 800 mm appears to be a realistic figure. The highest commercial yields measured on the Downs of approximately 2350 Kg/ha, would then have an equivalent efficiency of close to 3.0 Kg/ha per mm water used.

#### IDEAL WATER USE PATTERNS FOR DIFFERENT SEASONAL CONDITIONS

To be of practical use, an upper limit must include the different sources making up total water use. The amounts supplied by those sources will vary with seasonal conditions.

An estimate assuming good management, is given in Table 2. The values are again based on information collected in recent years.

Table 2.

## Ideal water use patterns - Darling Downs

SEASON	CHANGE IN STORED SOIL MOISTURE (mm) - to a depth of 1 m.	EFFECTIVE SEASON RAINFALL (mm)	NUMBER OF IRRIGATIONS (not including pre-irrig.)	EFFECTIVE IRRIGATION WATER APPLIED (mm)	TOTAL WATER USE BY CROP (mm)
WET	100	500	2 - 3	200	800
NORMAL	150	350	3 - 4	300	800
DRY	200	200	4 - 5	300	700

Total water use of 700 mm in a dry year includes an allowance for one less irrigation than that required, due to supplies running out at the end of the season.

SUMMARY

A yield response to increasing water can be determined from commercial crops and trials, if daily soil moisture is monitored. Allowance must be made for stored soil moisture, effective rainfall and irrigation, to calculate total water used by the crop.

Figures for the Darling Downs are compared with other districts. An estimate is made of the yield increase between partial and full irrigation. Available water from stored moisture, rainfall and irrigation is also estimated for different seasonal conditions.

Figure 1

## Yield response to total water

## Darling Downs

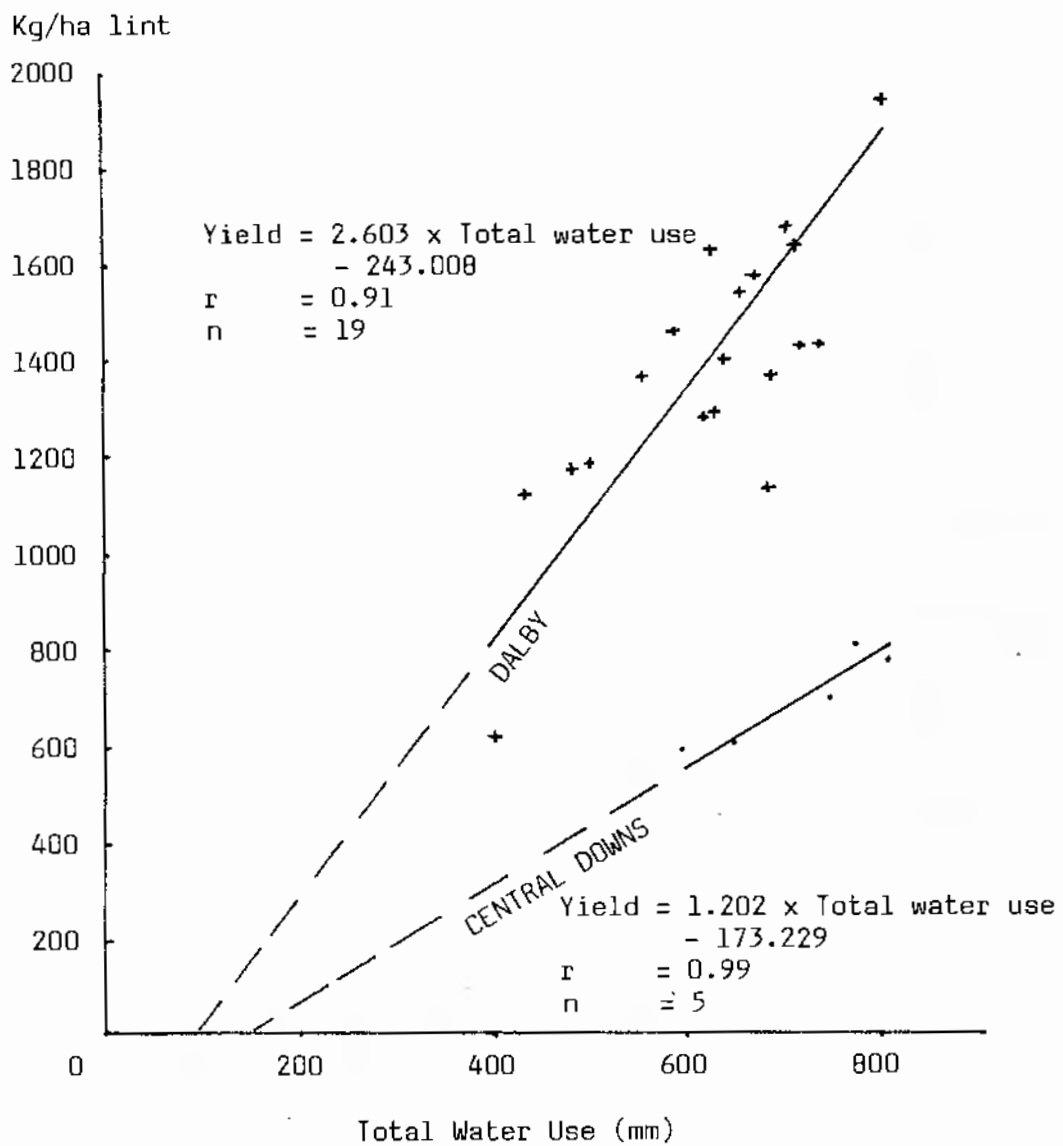


Figure 2

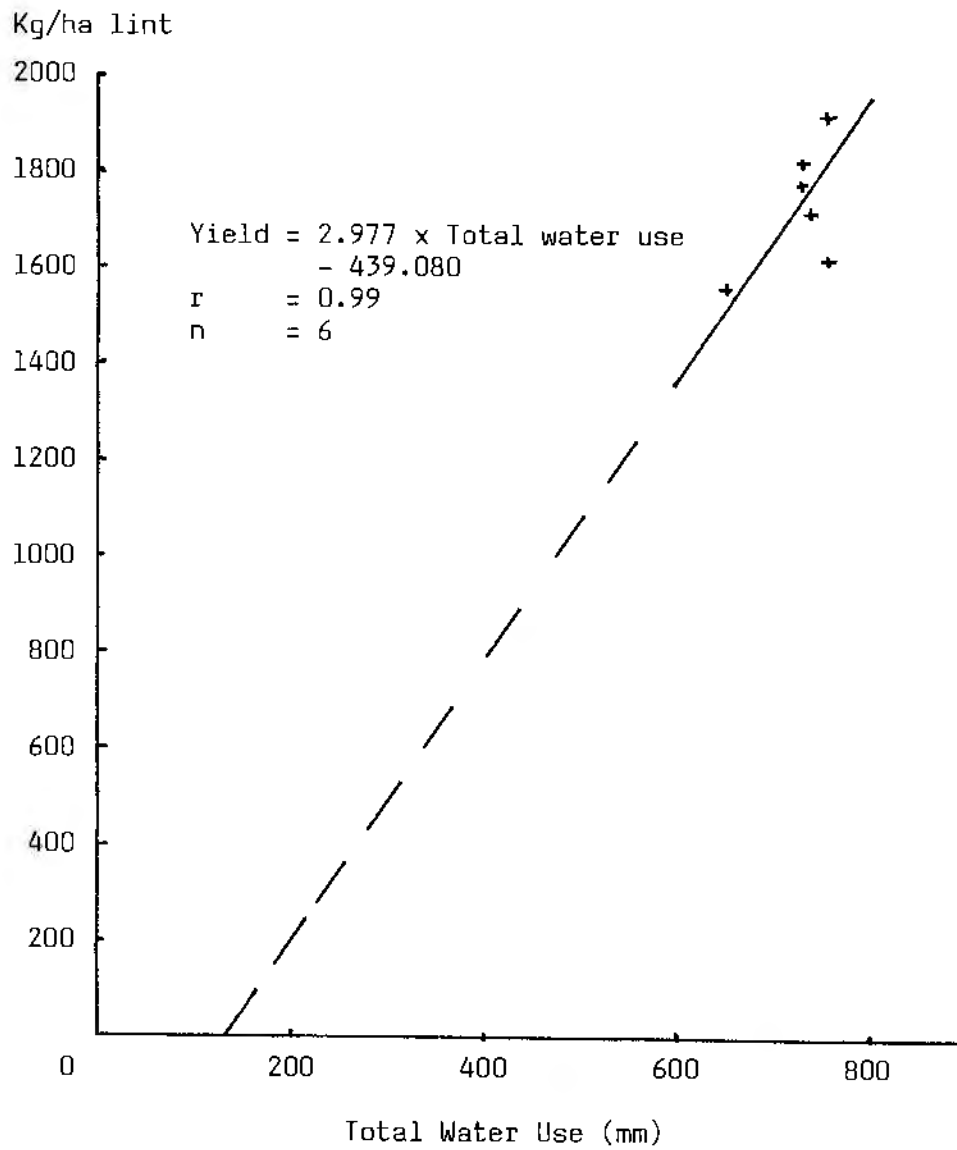
Yield response to total waterByee

Figure 3

Yield response to total waterBiloela