

**BUREAU OF SUGAR EXPERIMENT STATIONS  
QUEENSLAND, AUSTRALIA**

**FINAL REPORT**

**IRRIGATION WATER USE IN  
THE ETON IRRIGATION SCHEME**

by

**L S Chapman**

**TE94006**

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APPENDIX 1 SURVEY FORMS AND SHOW CARDS

## SUMMARY

The survey highlighted several key areas where canegrowers' irrigation management could be improved. There are opportunities to improve canegrowers' knowledge of the interactions between irrigation methods, sugarcane's water requirements, and the ability of various soil types to store plant available water. An extension program to demonstrate best irrigation practices on a range of benchmark soils is likely to be successful in increasing water use efficiency, thus leading to increased yields and profitability. Such an extension program has already commenced.

Evidence from this survey has quantified the inadequacy of the water supply and application equipment to meet the crop's peak water demand. Only 20% of canegrowers with irrigation had sufficient capacity in dry periods. The major benefit of irrigation has been to increase reliability of ratooning, thus providing security for canegrowers' returns. This survey confirmed that canegrowers regard this benefit from irrigation as very important.

Only 8% of canegrowers surveyed kept records of irrigation and one objective of this survey, to calculate water use efficiencies for farms, could not be achieved.

There are also opportunities for research and it is speculated that the low irrigation efficiencies could be a result of negative nitrogen by irrigation method interactions on some of the poorly drained duplex soils. Proposals for such research are being considered.

## 1.0 INTRODUCTION

The irrigation water use efficiency for farms supplied from the Eton Irrigation Scheme is lower than expected. Cane yield responses were only 3.0, 5.2 and 5.0 (mean 4.4) t/ML of water pumped in the dry years of 1982-83 (22 farms), 1988-89 (46 farms) and 1990-91 (60 farms), respectively. In the wetter years, for example 1985-86, 1987-88 and 1988-89, the yield responses from irrigation were negligible. These efficiencies of water use were calculated as the slope of the regression of cane yield on irrigation water used from Kinchant Dam (Chapman, 1994).

Kingston (1994) predicted the Australian cane yield response equation:

$$\text{tonnes cane/ha} = 12.21 (E_t/100) - 17.99$$

where  $E_t$  is the effective water applied to the crop. This equation can be used to estimate responses from irrigation. Kingston (1994) suggested that the experimental yield responses from effective water applied should be modified by a management factor of 0.7 to account for the differences between yields under commercial and experimental irrigation, and proposed the commercial model:

$$\text{tonnes cane/ha} = 8.55 (\text{effective rainfall} + \text{applied irrigation ML/ha}) - 12.59$$

Thus, the mean Kinchant cane yield response of 4.4 tonnes of cane per megalitre of irrigation water applied was only 53% of the commercial response predicted by Kingston. The reasons for the lower than expected responses in cane yield from irrigation are intriguing

for there have been extremely dry periods in the study period referred to above.

A cane yield response of 8 t/ML of irrigation water or better has been achieved by some canegrowers. If the irrigation practices used by these growers could be identified, and all Mackay canegrowers with irrigation were to adopt these practices and achieve an increase of 8.55 t/ML of irrigation water, then the production in Mackay in dry years would be increased by at least 0.53m tonnes of cane, valued at \$27m at the present price of sugar.

A survey of irrigation practices used by canegrowers who obtain their water from the Eton Irrigation Scheme was considered a first step in achieving this increased production from irrigation. The results of a survey of irrigation practices is the subject of this report.

## **2.0 OBJECTIVES**

The objectives of the survey were:

- ! to determine irrigation management strategies used by canegrowers;
- ! to determine water use efficiency for individual blocks;
- ! to identify irrigation practices which affect water use efficiency.

## **3.0 METHOD**

Survey forms and show cards were designed to assist in the interview process. These were tested and then modified after interviewing 10 canegrowers. The final versions of the survey forms and show cards are attached (Appendix 1). A total of 53 canegrowers was interviewed.

Questions were devised to ascertain details of canegrowers' experience (Q1, 2, 3); when canegrowers irrigated (Q4, 5, 6, 7); interaction of soil types by irrigation (Q8, 9, 10, 11, 12, 13); interaction of water requirements of cane by irrigation (Q14, 15); irrigation methods (Q16, 17); record keeping (Q18, 19); farm details and irrigation equipment (Q20, 21, 22, 23, 24, 25, 26); water supply (Q27, 28, 29, 30); quantitative yield data (Q31, 32); and effects of irrigation on social and other issues (Q33, 34, 35, 36).

## **4.0 RESULTS AND DISCUSSION**

As the survey progressed it was realised that the objective of determining water use efficiencies for individual blocks of sugarcane could not be achieved by the survey technique. Ninety-two percent of canegrowers had no reliable records of irrigation applications to individual blocks. Canegrowers were generally able to recall when blocks were irrigated but the amounts of water applied were unavailable. Thus the determination of water use efficiency was impossible. Because of this deficiency, the survey as planned was not completed and it was halted after 53 canegrowers had been interviewed.

The qualitative aspects of the survey produced valuable data which are summarised below.

### **4.1 Profiles of canegrowers' experience**

There was a wide range of experience in the canegrower group surveyed, with from 5 to 75 years farm experience (median 30 years). Management experience was less, with a 2 to 55 year range (median 18 years). Considering many of the farms were only recently irrigated, canegrowers claimed significant irrigation experience with a range of from 3 to 40 years (median 18 years). The profiles are shown in Figure 1.

### **4.2 Factors considered before irrigating**

Canegrowers ranked previous rainfall, wind and evaporation rate as very important factors they considered before deciding to irrigate. The likelihood of rain and the temperature were ranked as not very important to fairly important by the majority.

Only 29% of canegrowers required more information on weather as an aid to irrigation decision making, yet 70% responded that more accurate weather forecasts were very important. Canegrowers ranked local evaporation data as fairly important and indicated that improved knowledge of weather effects on cane growth was very important (Figure 2). This response indicates that an extension program on this issue would be very welcome.

Factors ranked as very important when considering to irrigate (Figure 3) were availability of water, early and severe signs of stress, and soil moisture levels. The effort to irrigate and the priority for other jobs were considered unimportant. The time elapsed since irrigation, soil type, soil depth, crop height, cane variety and past experience had a range of rankings.

### **4.3 Soil types by irrigation**

Ninety-one per cent of growers had a range of soil types on their farms with heavy clays being the predominant soil type (27%). The next most common soils were sandy loam surface soils with well-drained clay subsoils (20%) and sandy soils with poorly drained clay subsoils (15%). The majority of canegrowers (94%) indicated that different soils required a different irrigation frequency (Figure 4).

Most growers indicated that light soils required more frequent irrigation, but surprisingly

over 40% of canegrowers responded that heavier irrigations were applied to light soils than to heavy soils. Some responded that up to 250 mm of irrigation water were applied to sands in one irrigation with a mean application of 180 mm (Figure 5). These soils are obviously over-irrigated as they can only hold small amounts (<50 mm) of plant available water in the root zone.

There is clear evidence of the need for an extension program to demonstrate the need to adjust irrigation applications taking into account soil water holding capacity and crop water use. This need for extension services is emphasised in Q13 (Figure 6) where growers responded that a 50 mm irrigation lasts for 30 days, or more than twice as long as 50 mm on sands, which lasts for 12 days. Soil type has little influence on how long 50 mm of irrigation water would last.

#### **4.4 Water requirements of cane by irrigation**

The effect of cane height on crop water use appears to be poorly understood by most growers who responded that 50 mm of irrigation would last for 20 days for small cane (300 mm) but 15 days for mature canes (2100 mm). The mean response on rooting depth of cane indicates an understanding of the greater root development with larger cane compared to small cane, but the overall rooting depth predictions are too low for most soils (Figure 6).

#### **4.5 Irrigation methods**

Most canegrowers recognise the problems with winch irrigation, but have little option but to use winch irrigation (Figure 7).

#### **4.6 Record keeping**

Virtually no canegrowers keep irrigation records (Figure 7) and it is for this reason that no quantitative data on water use efficiency could be collated in this survey.

#### **4.7 Farm details and irrigation equipment**

A total of 55% of canegrowers in the survey had access to other irrigation water and 83% of these used this water regularly. The other water supplies ranged from 8 to 75 L/s with a median of 22 L/s.

Canegrowers estimated the time to irrigate their whole farm at from 5 to 49 days with a median of 22 days. To maintain active growth at the peak irrigation time would require an irrigation frequency of 10 to 14 days, or less on sandy soils (Figure 8). Thus only 12% of canegrowers could irrigate their farms to maintain active growth during the active growth period in dry weather. This situation is also demonstrated in Figure 9, which indicates that the area irrigated from each pump ranged from 15 to 400 ha, median of 50 ha, and the area irrigated by each irrigator ranged from 25 to 320 with a median of 100 ha.

The age of the oldest ratoon peaked at 5th ratoon and Q136 was the most popular variety as

the oldest ratoon followed by Q124, H56-752 and CP44-101 (Figure 10).

#### **4.8 Quantitative yield data**

One of the main objectives of this survey was to estimate water use efficiency but this objective could not be achieved because of the lack of farm records.

#### **4.9 Effect of irrigation on social and other issues**

Canegrowers identified that access to irrigation had a very important effect on the reliability of ratooning and therefore their security. They also rated highly the benefit on lengthening of the crop cycle, but admitted that it increased work load and farm management effort. Access to Kinchant irrigation water was regarded as not very important with regard to debt, social contact, stress within family, personal stress and amount of fertiliser used.

### **5.0 CONCLUSIONS**

Some irrigation management practices identified by the survey are clearly inadequate, particularly with regard to matching irrigation applications to plant available water capacity of soils, and crop demands for water.

A more comprehensive extension program for irrigators is a high priority. The objectives of this program should be:

- ! fine-tune data on plant available water for benchmark soils;
- ! develop best irrigation practices on the benchmark soils, having regard to the supplementary nature of irrigation because of limited water supplies;
- ! demonstrate that these best irrigation practices will lead to improved water use efficiency.

An extension officer, funded by Mackay Sugar and directed by BSES, has been appointed at Mackay and is working towards achieving the above objectives.

Another area of concern is the possibility of a negative nitrogen by irrigation method interaction in the poorly drained duplex soils in the irrigation area. In other crops grown on clay soils, it has been demonstrated that prolonged flooding can lead to increased losses of fertiliser-N by the process of denitrification. This aspect also requires a research effort, particularly where trash conservation from green cane harvesting is practised. If such interactions occur they would contribute to reduced yields because of inadequate nitrogen supply for the crop and reduced water use efficiencies.

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