SHORT, NON-REFEREED PAPER

IRRIGATION SCHEDULING DEMONSTRATION TRIALS ARE AN EFFECTIVE MEANS OF PROMOTING ADOPTION: PONGOLA CASE STUDY

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Abstract

Accurate irrigation scheduling is not widely practised in the South African sugarcane industry, including the Pongola mill supply area, despite the availability of many scheduling tools. Ineffective scheduling leads to low irrigation water use efficiencies (IWUE) and increased production costs. Recent increases in electricity tariffs have generated renewed interest in irrigation scheduling, thus creating an ideal opportunity to promote adoption. An irrigation scheduling demonstration trial was conducted (started in 2014) on the Pongola research farm to demonstrate scheduling methods of varying sophistication. In the trial, surface drip irrigation was scheduled using a soil water capacitance probe; the weather-based MyCanesim® simulation system and a combination treatment, namely the MyCanesim® plus a capacitance probe. Standard farm practice (fixed irrigation cycles) served as the control treatment. Performance was evaluated in terms of cane yield and quality, irrigation applied and estimated cost saving. Substantially less water was applied where irrigation was scheduled using weather and soil water data, compared to a fixed schedule, without negatively affecting the cane yield or quality. Irrigation savings of 30% (400 mm), 39% (530 mm) and 52% (700 mm) were achieved for the capacitance probe, MyCanesim® and combination treatments, respectively. Increases in IWUE were observed in all irrigation scheduling methods, the highest being 19.9 tc/ha/100 mm irrigation for the combination method as compared to 9.5 tc/ha/100 mm irrigation for the standard farm practice. The combination method had the highest cost saving (R2501/ha) followed by the MyCanesim® (R1894/ha) and capacitance probe (R1429/ha) methods. Although the results only apply for the soil-climate scenario that occurred in the trial and for the specific economic scenario, the results highlight the importance of accurate irrigation scheduling and will be used to promote implementation of irrigation scheduling tools for profitable and sustainable sugarcane production in the Pongola region.

Keywords: Irrigation scheduling, sugarcane, capacitance probe, MyCanesim®, irrigation water use efficiency, demonstration trial, cost benefit

Introduction

Irrigation scheduling is not widely practised in the South African sugarcane industry, including Pongola, in spite of the many scheduling tools available to sugarcane growers (Jumman 2016). This leads to inefficient use of irrigation water, unnecessary costs and low yields. Dramatic increases in the electricity tariffs as well as shortages in irrigation water have generated interest in irrigation scheduling and the time is opportune to promote adoption. An irrigation scheduling demonstration trial was conducted to encourage the uptake/adoption of irrigation scheduling among the local community of farmers.

Past experience with the Komatipoort demonstration trials, linked with grower days, proved effective to promote irrigation scheduling methods in that region (Olivier and Singels, 2008). A large number of requests for further information with regards to scheduling methods were received after each grower day indicating the willingness of many growers to schedule. In the context of adoption of integrated pest management, results from grower surveys indicate that model farms and field days were ranked as the preferred method for knowledge dissemination (Cockburn *et al.,* 2012), while pamphlets and workshops were ranked the lowest. In addition, the ripening demonstration trials in the irrigated areas have also proved successful in encouraging the adoption of a best management practice (BMP) (Van Heerden *et al*., 2014) (Adendorff *et al*.), 2016). Following the results from the SASRI strip trials, the largest SASRI chemical ripener strip trial ever, were submitted to the service provider for application of chemical ripeners in the 2013/14 season (personal communications[1]).

Methodology

The trial was planted in November 2014 on the SASRI research farm at Pongola (27º24'58.370"S; 31º35'37.928"E) using variety N57 on a deep, red Hutton soil with 30% clay. The trial was irrigated with surface dripper lines in every interrow at 1.4 m spacing. Emitter spacing was 1 m and delivery 1 L/hour.

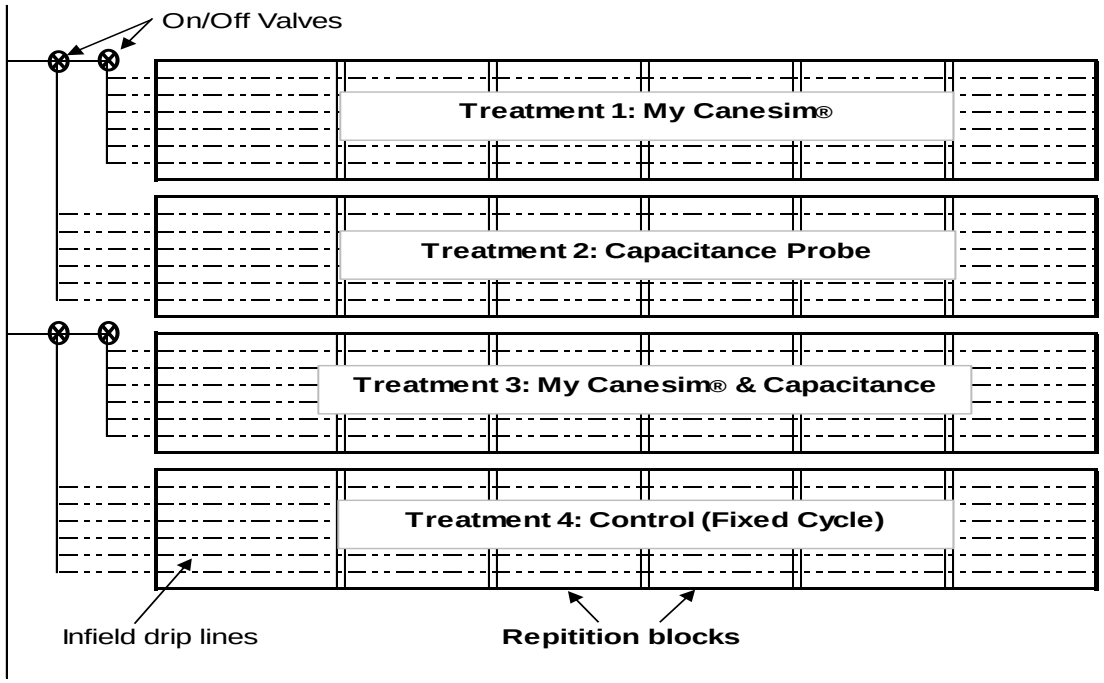

Figure 1. Illustration of trial layout and treatments (scheduling methods) applied.

In this trial, surface drip irrigation was scheduled using four irrigation scheduling treatments. Irrigations were scheduled using real time data from (1) a capacitance soil water probe, (2) the MyCanesim® simulation system (Singels, 2007) using weather data only, and (3) from the MyCanesim® system using weather and soil water data from the capacitance probe (Combination treatment). In each case, irrigation was initiated when available soil water was depleted. Fixed irrigation cycles of 6 mm daily (typical farm practice) served as the Control treatment.

[1] J Van der Merwe, RCL Foods, Pongola Sugar Mill, South Africa.
P Cronje, RCL Foods, Mpumalanga Regional Office, Mallelane, South Africa.

Each treatment was divided into six blocks, which were harvested and measured separately. Each plot was 6 rows wide and 20 m long. In each plot the outer row was excluded as a boundary row and the inner four were harvested and weighed, and samples from each plot were analysed for ERC (estimated recoverable crystal) content.

Treatment were evaluated in terms of (1) cane yield by weighing the cane from each plot, (2) ERC yield by analysing the cane at the Pongola mill room, and (3) water use efficiency by recording the total amount of irrigation applied compared to yield. The financial benefits were determined by calculating the cost saving in terms of water and energy use as well as yield gain. Irrigation water use efficiency (IWUE) was calculated in terms of cane yield and ERC yield by calculating the yield per hectare for every 100 mm irrigation water used.

Although the plant crop of the trial was exposed to drought conditions, irrigation scheduling was not seriously affected.

The trial was harvested in November 2015.

Results

The trial results regarding water use for the first harvest (plant crop) are summarised in Table 1 and the financial benefits in Table 2.

Table 1. Final cane yield, ERC%, ERC yield and water use obtained in the Pongola irrigation demonstration trial (plant crop).

Treatment	Cane yield	ERC	ERC yield	Irrigation volume	IWUE*	IWUE*
	(t/ha)	(%)	(t/ha)	(mm/ha)	(t cane/ha /100mm)	(t ERC/ha /100mm)
Control	127.8	11.2	14.5	1350	9.5	1.1
Capacitance probe	130.6	12.1	15.8	950	13.7	1.7
MyCanesim®	140.2	12.2	17.1	820	17.1	2.1
Combination	129.4	12.1	15.7	650	19.9*	2.4*

*Significant differences
Please note: This trial is ongoing and the above results are preliminary (from the first harvest only).

Substantially less water was applied to all three of the irrigation scheduled treatments, using weather or soil water data, compared to standard farm practices, without negatively affecting the cane yield or quality. Irrigation savings of 30% (400 mm), 39% (530 mm) and 52% (700 mm) were achieved for the treatments scheduled with the capacitance probe, My Canesim® model and the Combination method, respectively.

Increases in irrigation water use efficiency (IWUE) were observed in all irrigation scheduling treatments in terms of cane yield and ERC yield, with a significant improvement for the Combination treatment. In terms of yield, the Combination treatment resulted in an improvement of 109%, the MyCanesim® 80% and the capacitance probe 44% over the Control treatment. In terms of IWUE and ERC yield, the improvement was 54.5% for the capacitance probe treatment, 90.9% for the MyCanesim® and 118% for the Combination treatment (See Table 1).

Table 2. Financial benefits from treatments obtained in the Pongola irrigation demonstration trial (plant crop).

Treatment	Water cost	Electricity cost	Total cost	Cost Saving due to scheduling	ERC* gain	Combined benefit (Saving + RV[1] gain)
Control	R1485	R3771	R5256	-	-	-
Capacitance probe	R1045	R2782	R3827	R1429	R5720	R7149
MyCanesim®	R902	R2460	R3362	R1894	R11 439	R13 333
Combination	R715	R2040	R2755	R2501	R5280	R7781

*RV price at the time of the trial = R4399.75/ton

The improved IWUE resulted in cost savings in terms of water and electricity use. The Combination treatment had the highest cost (water and electricity) saving (R2501/ha) followed by the Canesim® (R1894/ ha) and Capacitance probe (R1429/ha) treatments (see Table 2).

Both cane yields and ERC yields were higher with all three scheduling treatments; however, the increases were not statistically significant. The highest increase in income due to higher ERC yields was with My Canesim® (R11 439), followed by the Capacitance probe (R5720) and the Combination (R5280) treatments.

The combined benefit of cost saving and improved yield ranged between R7149/ha, for the capacitance probe treatment, and R13 333/ha, for the Canesim® treatment (the latter due to a high ERC yield).

Conclusions

It is important to acknowledge that the above results are preliminary, reflecting a plant crop in a specific rainfall season for a specific site. The results will likely differ for other crop cycles, soil profiles and/or rainfall seasons. The results show the benefit of irrigation scheduling in terms of IWUE and cost saving. Substantial savings of water and energy can be realised without compromising yield. Although not statistically significant, yields were improved by scheduling irrigation. The combined benefit of cost savings and improved yield resulted in substantial improvement in income.

Although the results only apply for the soil-climate scenario that occurred in the trial and for the specific economic scenario, all three methods of irrigation scheduling resulted in cost savings as well as improved yield, showing that all three methods are effective scheduling tools.

The trial was planned to stretch over three growing seasons to show repeatability. The trial will continue up to the 2017-2018 season.

The results of the first season of the trial were used to promote irrigation scheduling in a newsletter, a grower day and a working group session. The combined results in cost saving and impact on yield over three seasons will be used to promote irrigation scheduling amongst growers in Pongola in a number of different ways, including grower days, newsletters and workshops. The trial represents local conditions and will provide a platform for farmers to experience the practical realities, in addition to confirming and gaining confidence in the benefits of the different scheduling tools. As an additional outcome, the cost benefit of irrigation scheduling can also be used to promote upgrades in irrigation systems.

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