POSTER SUMMARY

HI-TECH IRRIGATION SCHEDULING ADVICE FOR SMALL-SCALE SUGARCANE PRODUCTION

SMITH M T, SINGELS A and NEEN J

South African Sugarcane Research Institute, *P/Bag X02, Mount Edgecombe, 4300, South Africa*
marc.smith@sugar.org.za, *abraham.singels@sugar.org.za*, *john.neen@sugar.org.za*

Abstract

The adoption of irrigation scheduling techniques in South African sugarcane production has been disappointing. A recent survey concluded that the main reason was the complexity and inappropriateness of technology in relation to practical constraints on the farm. This poster describes an attempt to address the problem. It describes (i) a hi-tech system to provide practical, real time irrigation advice and (ii) its pilot implementation on a small-scale irrigation scheme.

Introduction

Adoption of irrigation scheduling techniques in South African sugarcane production has been disappointing, leading to very low irrigation water use efficiency. A recent survey (Olivier and Singels, 2004) concluded that the main reasons for non-adoption were (i) the complexity of technology in relation to practical constraints on the farm, and (ii) the underestimation of the benefits of accurate scheduling. The challenge therefore is to provide practical and useful advice to farmers using state of the art technology, and to convince farmers of the benefits of irrigation scheduling by on-farm demonstration.

The purpose of this poster is to describe (i) a hi-tech system to provide practical, real time irrigation advice and (ii) its pilot implementation on a small-scale farm irrigation scheme in Pongola.

System description

The various components of the *My Canesim* system are shown in Figure 1. It consists of:

- A database of model inputs (weather, soil, crop and irrigation data) and outputs (crop water status, yield and irrigation advice).
- The Canesim model that estimates the recent, current and future water balance, crop status and yield.
- A module that (i) extrapolates the water balance at a reference position to various positions in the field and then determines the ideal irrigation schedule based on this, and (ii) automatically generates and distributes irrigation advice to farmers' cellular phones via short message service (SMS).
- An Internet based user interface for advisors and extension staff to enter field, crop and irrigation system data and to view simulation results.

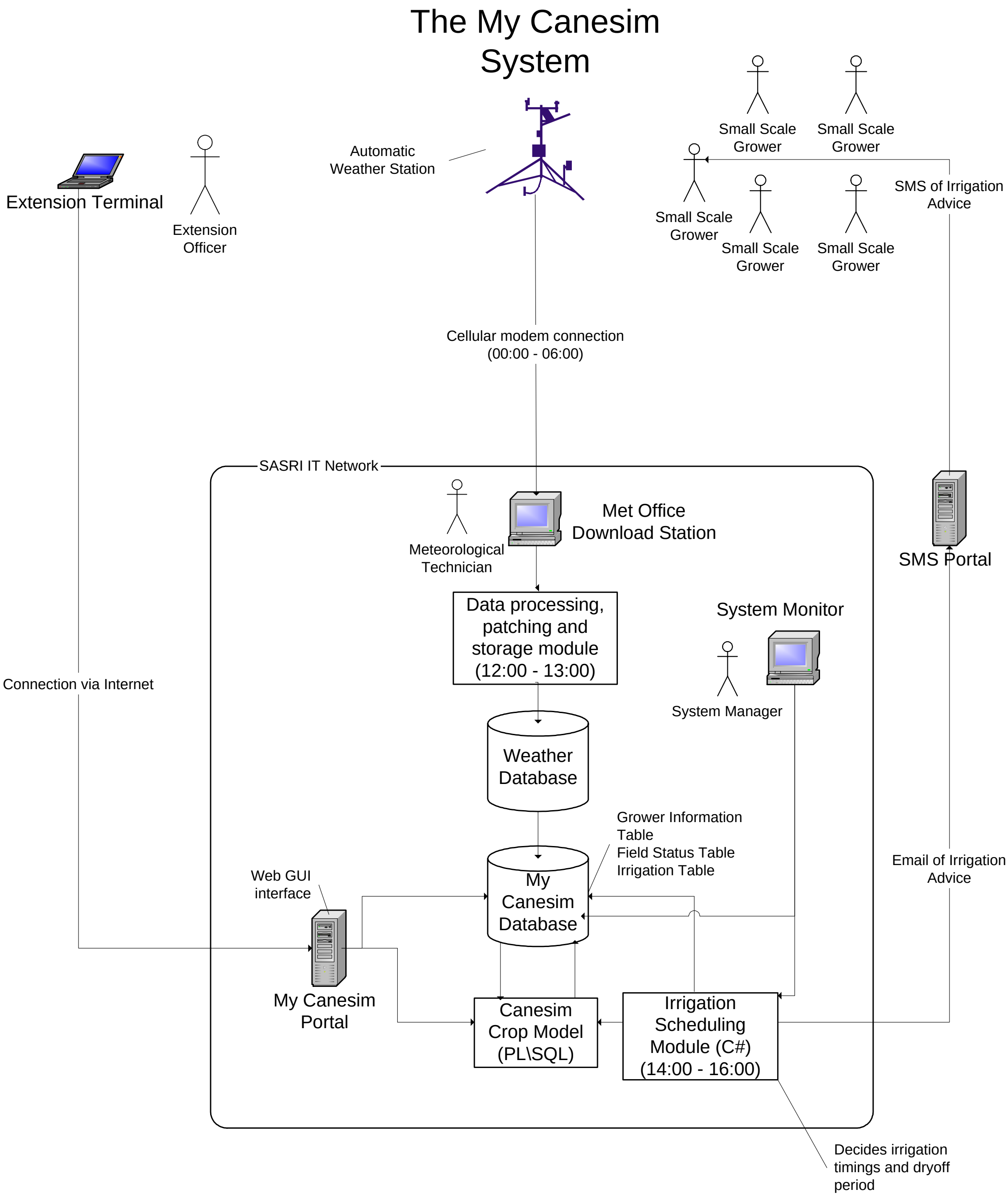

Figure 1. Diagrammatic representation of the *My Canesim* system.

System input data

- *Weather data:* Daily data is obtained from 24 automatic weather stations situated throughout the South African sugar industry.
- *Soil data:* Plant available water capacity and plant available water at the start of the crop.
- *Crop data:* Cultivar, row spacing, plant or ratoon date and planned harvest date.
- *Irrigation system:* Type of system, irrigation cycle, and net irrigation amount per application.

User interface

Extension specialists, consultants and other agents can access the system through a web-based interface, allowing interactive management and observation of the system from remote locations. In addition, a PC-based Windows application was developed as an education tool to dynamically illustrate the crop water balance and crop growth as influenced by irrigation and rainfall. The application graphically displays simulated data from the *My Canesim* database for various sections of a user-specified field.

Irrigation scheduling by the system

The aim was to maintain available soil water (SW) within a predetermined target range. The lower limit of this range is named the depletion. In practice, large fields are managed as units with a single irrigation system such as centre pivot, or, as was the case here, a set of dragline sprinklers. One irrigation event may take several days to complete, causing significant spatial differences in water status. This was accommodated by using the concept of a dynamic depletion level (DDL), which accounted for the crop extraction during the last irrigation cycle. Irrigation is scheduled by comparing simulated SW with the DDL.

SMS advice

An SMS is sent to the farmer on a weekly basis, or when some irrigation action is required. It contains the following information in the language of choice: date, farmer's name, current yield estimate, yield estimate at harvest, and irrigation action required.

System evaluation

Simulation study

A simulation study (Singels and Smith, 2004) for the Pongola area in northern Kwazulu-Natal (27°24'S, 31°35'E, 308 m asl) indicated that adhering to advice from this system leads to large reductions in irrigation water applied (33%), deep drainage (64%) and irrigation costs. Yields are not affected significantly, and water use efficiency and profitability is enhanced considerably. The main impact is to reduce irrigation during winter and when the crop is young.

Field evaluation

The system was implemented on a limited scale at the Pongola small-scale sugarcane irrigation scheme. Typically, growers on this scheme farm between 7 and 15 ha, and have 20 dragline or semi-solid sprayers which are moved from 20 to 28 positions each. Irrigation stand time is 11.5 h (two moves per day), giving a net application of 42 mm. The irrigation cycle varies from 8 to 14 days.

Wetting depth was monitored continuously with wetting front detectors, rainfall and irrigation were recorded daily, and crop growth was monitored weekly.

Irrigation results are shown in Table 1. It is notable that the final advised irrigations are all above the allocation of 1000 mm. This is due to the exceptionally low rainfall and higher temperatures that occurred during 2004/05. If growers continue to follow the irrigation advice for the rest of the season, a 20% saving in irrigation application would be realised over their normal practice. Growers mostly followed the advice given, except for Mthembu (Table 1), who ignored advice in the early part of the season and over-irrigated his crop. Observations from wetting front detectors suggested that model calculations of SW were adequately accurate.

Table 1. Total amount of water applied by each grower from the start of the crop to 12 April 2005, compared with standard practice and what was advised by the *My Canesim* system. Irrigation information projected for the entire growing season is given in brackets.

Grower	TAM (mm)	Expected yield (t/ha)	Ratoon start date	Standard irrigation (mm)	Advised irrigation (mm)	Actual irrigation (mm)
Mthembu	90	131	24/4/04	2400 (2460)	1320 (1380)	1711 (1771)
Nhleko	90	125	11/8/04	1050 (1512)	756 (1092)	756 (1050)
Simelane	50	125	3/8/04	1092 (1554)	840 (1218)	882 (1260)
Dube	200	141	24/11/04	588 (1386)	378 (1008)	420 (1050)
Nene	180	133	29/10/04	714 (1470)	504 (1050)	504 (1008)

Based on recordings of stalk population, stalk height and general crop appearance, crops grew exceptionally well, except on very shallow soils where stress occurred.

From the workshops held, it was concluded that regular interaction with growers is crucial to fully understand their needs and preferences, and to explain to and remind them of the benefits of scheduling. Growers indicated that they preferred simple advice at weekly intervals. It is also clear from field visits that a feedback of irrigation and rainfall data to the system is necessary for accurate simulations of the water balance.

Future work

It is planned to develop a facility to enable rainfall and irrigation data to be sent by SMS from the grower to the system. Further improvements to the system interface are also envisaged.

It is planned to expand the service in 2005 to all willing growers in Pongola and a small group in Makhathini. The service has potential to be implemented in other schemes, including commercial growers using overhead irrigation.

Conclusions

A hi-tech system to provide real time irrigation was developed and implemented successfully as a pilot project. The study showed that:

- Irrigation and deep drainage could be reduced by following advice from the system.
- Small-scale growers are following advice from the system and are keen to continue to participate.
- Further refinements to the system are still required. These include refinements to the user interface and a need for data feedback from the grower.

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