USING THE INTERNET-BASED CANESIM MODEL FOR CROP ESTIMATION IN THE UMFOLOZI MILL SUPPLY AREA

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Abstract

An accurate estimate of the size of the sugarcane crop in a mill supply area is essential to ensure efficient milling of the crop. This paper describes the use of the Internet-based Canesim model to forecast the 2002/03 crop in the Umfolozi mill supply area. The model uses near real time data from three automatic weather stations in the area, data representing a likely future weather scenario and an irrigation strategy, as well as crop cycle dates and available soil water capacity (TAM) to calculate fresh cane yield.

Yields at were calculated for three groups of growers for each month of the milling season. The TAM used for each group was determined by a calibration process on historic yield and weather data. Calculated yields were adjusted with a management factor also determined from historic data. Estimates made in March through to November were compared with actual cane deliveries. The value of the estimates and problems that were encountered, are discussed. Improvements to the system are recommended.

Keywords: sugarcane, yield estimate, crop model, weather data, rainfall, Canesim

Introduction

An accurate estimate of the size of the sugarcane crop in a mill supply area is essential to ensure efficient milling of the crop. Important decisions such as mill opening and closing dates are based on this information. Mill group boards (MGBs) make use of various sources of information to forecast the size of the crop, including field estimates by growers, scouting of fields by mill management and estimates from crop models. The Internet-based version of the Canesim model was used to forecast the 2002/03 crop for the Umfolozi mill supply area.

Methods

A simplified version of the Canesim model is available on the Internet at http://sasex.sasa.org.za/irricane/index.htm, and has been described by Singels *et al*. (1999). The model calculates fresh cane yield from weather and irrigation data, as well as crop cycle dates and available soil water capacity (TAM). Yields of future crops are calculated by using recent weather data (up to the previous day) and data representing a likely future weather scenario.

The model was used to estimate yields in the Umfolozi mill supply area for 81 annual crops. These were comprised of nine crops harvested monthly from April to December, for each of nine different combinations of site, soil and management (Table 1).

Data from three automatic weather stations were used: Glenpark near Hluhluwe (28°8'S, 32°17'E, 35 masl), Dangu near Mtubatuba (28°27'S, 32°13'E, 40 masl) and Monzi near St. Lucia (28°27'S, 32°17'E, 48 masl). Other inputs are summarised in Table 1.

Table 1. Model inputs for the different cropping scenarios. Scenarios consist of combinations of groups of growers with similar cropping situations as represented by automatic weather station (AWS), soil TAM and irrigation practices. The estimated area to be harvested in 2002 is given as a percentage of the mill total. The model calibration factor is given as a percentage (actual of modelled yield).

Group:	SSG1	SSG2	SSG3	TRAM1	TRAM2	ROAD1	ROAD2	ROAD3	ROAD4
AWS:	Glenpark	Dangu	Dangu	Monzi	Dangu	Glenpark	Glenpark	Dangu	Dangu
TAM (mm):	60	60	75	160	80	70	85	70	75
Irrigation:	No	No	Yes	No	Yes	No	Yes	No	Yes
Relative area (%)	15.75	29.78	0.79	21.7	18.33	1.91	2.87	2.12	6.76
Calibration (%)	92.2	92.2	92.2	80.5	80.5	57.6	57.6	57.6	57.6

Irrigation was simulated by applying 35 mm water every 10 days. The relative cane contribution to the mill from each cropping scenario was calculated by estimating the area to be harvested from each scenario.

The model was calibrated through a process of iteration by adjusting TAM so that the average difference between calculated and actual yields over the previous four seasons for each grower group (small scale growers – SSG; Umfolozi flood plain – TRAM; Umfolozi hill side – ROAD) was minimised. Further adjustments may be required as more comprehensive and reliable yield records become available.

MGB estimates are decided by considering (i) the estimates received from SASEX (Bezuidenhout *et al.*, 2002), (ii) growers' estimates and the (iii) estimates derived from the Internet-based Canesim model (WWW). Changes in WWW estimates from one month to the next, and from one year to the next, rather than absolute values, were used when formulating the MGB estimate.

Results and Discussion

The progression of estimates for the 2002/03 season is shown in Figure 1. Estimates of all types decreased from March (65 to 68 t/ha) to June (59 to 64 t/ha), after which WWW estimates increased from 59 t/ha in June to 66 t/ha in July. This could be ascribed to the fact that several incorrect zero rainfall recordings for the Dangu and Monzi stations were corrected during this period. During the same period, grower and MGB estimates decreased and the SASEX estimate increased only marginally. From October to November, WWW, MGB and grower estimates continued to decrease slightly, while SASEX estimates remained constant. In November the WWW and SASEX yield estimates were 64.6 and 62.0 t/ha respectively, while the MGB estimate was 59.0 t/ha compared with the actual yield of 67 t/ha.

The November MGB discrepancy of −13.6% was due partly to an overestimation of the SSG area that would be harvested. More than 2000 hectares of very poor quality cane were eventually carried over to the next season, thereby pushing up the average yield of the mill. The November WWW discrepancy changed from –3.7 to 0% after making the necessary adjustment to the relative contribution from SSGs.

In retrospect, it became clear that WWW yield estimates could also have been used to adjust growers' estimates of area to be harvested. The simulations for the SSG2 cropping scenario suggested that late season yields were going to be too low (less than 30 t/ha) to be harvested profitably and would probably have to be carried over. The area under cane for each group could have been adjusted accordingly, and would have resulted in a more accurate production estimate. The impact on harvest age for the following milling season should also be noted.

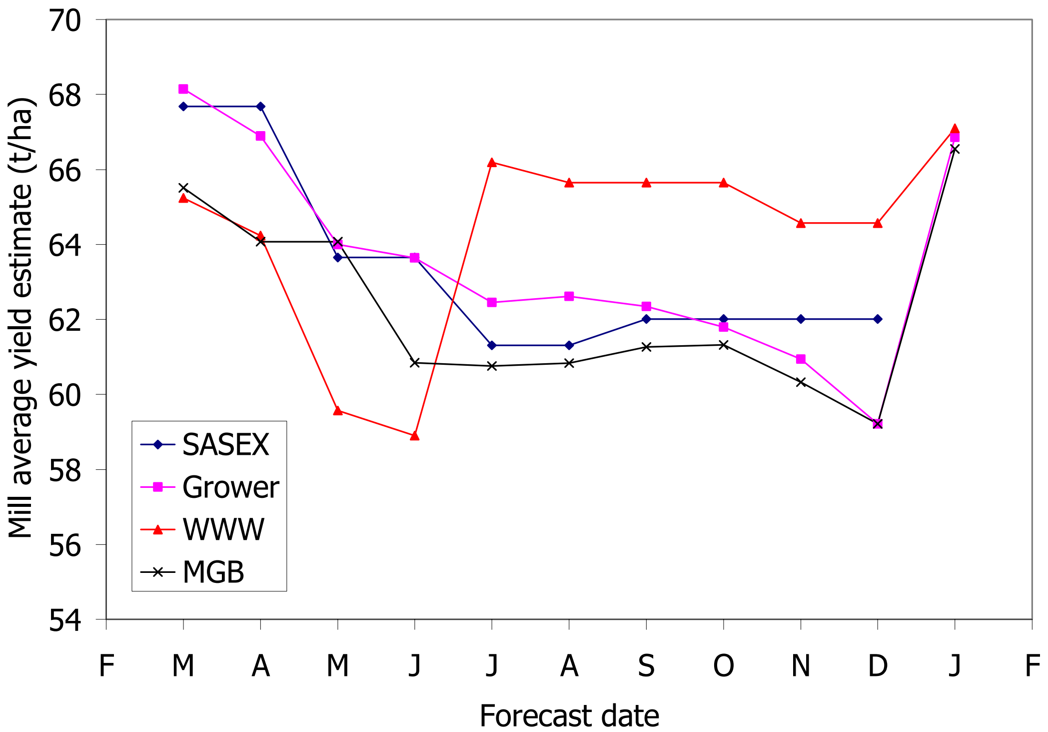

Figure 1. Progression of crop estimates for the 2002/03 season. The estimates are from the Canesim model as applied by SASEX, from the growers, from the Internet-based Canesim model as applied by Umfolozi mill management (WWW), and from the mill group board (MGB). The MGB estimate for January 2003 could be considered the true value.

The reliability of WWW estimates could be assessed by comparison with actual yields from the past. Such a comparison is shown in Figure 2, and it is clear that there is very good agreement between estimated (not adjusted for management) and actual yields. The mean management calibration factor that resulted from this comparison was 67%.

Some problems were identified during the course of this project. Firstly, it is important to be aware of the impact that missing weather data can have on simulations. A data patching algorithm fills in missing data, but enters zero values for rainfall. This could lead to serious discrepancies should significant amounts of rain fall during periods when weather stations are out of order. A solution is to manually patch missing rainfall using data from raingauges in the vicinity. Secondly, the current WWW system does not allow the user to save model settings in order to repeat runs at a later stage. Hence, the user is forced to re-enter input data for each cropping situation (81 in this case) while on-line. This is expensive and time consuming. Efforts are under way to develop a personalised Internet-based version of the model that will allow the user to save model settings and receive automatic updates of simulation runs as new weather data become available. This will minimise time spent on-line.

It is further suggested that the effects of a water table on crop growth be taken into account in the model. Cane on the Umfolozi flood plains is subjected to waterlogged conditions during wet periods, and favourable growing conditions during dry spells. An attempt was made to account for this by using a very high TAM value (160 mm), but this amendment did not represented reality adequately.

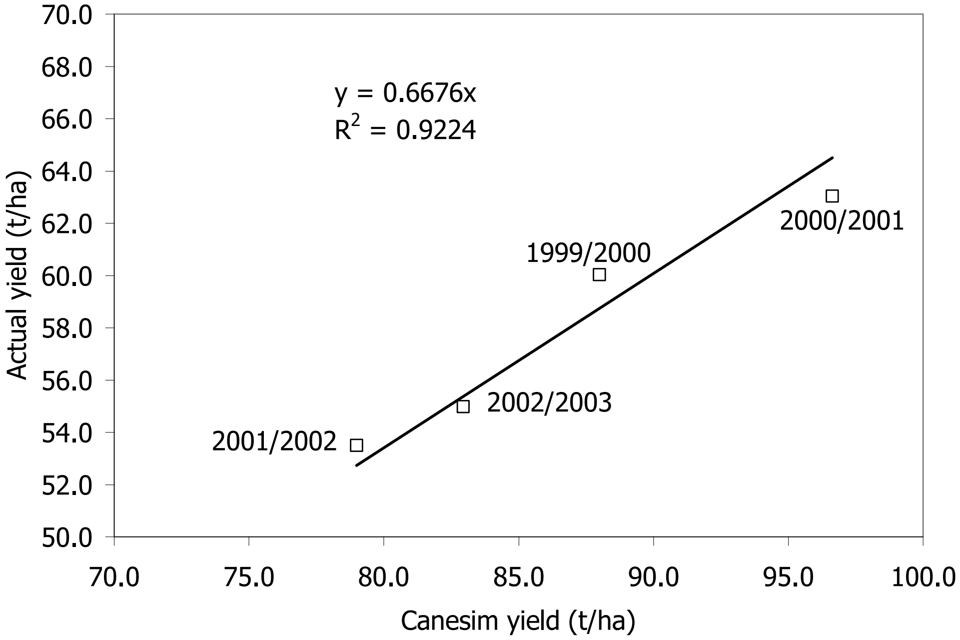

Figure 2. Actual and Canesim calculated mill average yields for the 1999 to 2002 milling seasons. For this comparison calculated yields were not adjusted for management.

Conclusion

The Internet-based Canesim model was a useful tool for generating information on crop status, to assist in formulating MGB yield estimates for the Umfolozi mill supply area. The system can be used in all mill areas with sufficient automatic weather stations. Mill areas that have operational automatic weather stations linked to the system are Malelane (4), Komati (3), Pongola (1), Umfolozi (3), Felixton (1), Maidstone (1), Noodsberg (1) and Eston (4).

Acknowledgements

Two of the automatic weather stations used in this project are owned by Umfolozi and Monzi cane growers respectively, and the third by St. Lucia Chennells Holdings. The SASEX Extension office at Umfolozi manages the Monzi and Dangu stations, and the Institute of Soil, Climate and Water of the Agricultural Research Council maintains all three stations.

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