



CIRAD
UR Systèmes Canners
(Research Unit : Sugarcane Farming Systems)

Report on a Technical Visit to Brazil

23rd – 31st October 2006

Support Mission
Finalisation of adaptation of the Model to
Brazilian Conditions
Survey of potential uses
Partnerships with ESALQ and CTC

Jean-François Martiné (23-31/10/06)
La Bretagne Research Station
97400 Saint-Denis
Réunion, France

I would like to thank the following people:

- J.L. Donzelli, C. Suguitani and M. Bernardes for welcoming me at the Canavieira Technical Centre of Piracicaba (CTC) and at the 'Ecole Supérieure d'Agriculture Luis de Queiroz' (ESALQ), for their logistical support and instructive discussions during this mission,
 - J.P.F. Wander (CTC) for the presentation of CTC's work on mapping, remote sensing and GIS products and support to mills which could be associated with the model.
 - CIRAD's regional management team in Brazil (P. Petit-Huguenin) for facilitating our interaction with MAE (French Ministry of Foreign Affairs) and staff advice.
- And, most importantly, the French Ministry of Foreign Affairs for financial support.

Mission Framework

This mission was conducted further to those of Pierre Todoroff in December 2000, Roland Pirot in December 2002 and J.F. Martiné in March 2003, August 2004 and October 2005 (with B. Siegmund). A few studies and partnerships are complementary to those carried out by Jean-Louis Chopart on sugarcane rooting.

The October 2005 mission enabled us to do the following:

1. To examine data collected since October 2004, to begin presetting the Mosicas model (this was performed in Piracicaba).
2. To examine and schedule potential publications.
2. To formalise ongoing partnerships with ESALQ, CTC and UEL and to look for complementary partnerships with other universities and sugarcane research institutes.

Mission Objectives

The main objectives of this mission, planned and financed thanks to MAE, were:

To finalize adaptation of the model to southern Brazilian conditions

To train C. Suguitani on special uses of the model (calibration and sensitivity analysis)

To establish simplified protocols for future model adaptation studies (breeding)

To undertake a comprehensive survey of potential scientific studies applied to agricultural management, generated by this scientific and decision-making tool (model), and meeting Brazilian demand.

To draw up a few applied studies and meetings for 2007-2008 in order to improve, use and show the model

To re-examine partnerships with ESALQ and CTC according to this development plan.

People met

1. At the Canavieira Technical Centre of Piracicaba (CTC):

- J.L. Donzelli: Management of Research and Development.
- C. Suguitani: Breeding Program and Management of Jau Station. (PhD on modelling and model user)
- J.P.F. Wander. GIS and remote sensing studies.

2. At the 'Ecole Supérieure d'Agriculture Luis de Queiroz' (ESALQ):

- Professor Marcos Bernardes. (Agronomy)

1 Calibration and adaptation of the Mosicas crop growth model to Brazilian conditions.

A trial was set up in October 2004 to calibrate the parameters of four varieties (namely RB72454, SP832847, R570 and NCO376) under rain and irrigated conditions at the CTC experimental station in Piracicaba.

From 2004 to 2005, during plant crop, observations of aerial and root parts, as well as soil water content, were conducted by C. Suguitani and P. Lacau, respectively.

On this crop, the root parts and soil water content results improved the Ceres water balance of Mosicas. Thus, due to latosols, modifications of the growth root and uptake were achieved..

For plant crop, results obtained for aerial parts and components were used to calibrate the specific cultivar parameters of the four cultivars.

From 2005 to 2006, during the first ratoon, observations of aerial parts were conducted by C. Suguitani. The crop was harvested at the end of September, so all of the data were not available during this mission. The calibration will thus be carried out by C. Suguitani during the next months.

The model is now calibrated for crop plants of four cultivars in Brazilian conditions. The calibration for ratoons will be achieved by the beginning of next year.

The model should be validated with several of these cultivars on an already available but different dataset.

2 Simplification of the procedures and dataset needed to calibrate the model.

The first trial (discussed above) required detailed biomass monitoring.

More straightforward monitoring, especially destructive monitoring of biomass, will be required to set the crop parameters of many other Brazilian cultivars or to use the model in specific trials. A simpler calibration procedure will be given.

In addition to this minimum dataset, but not compulsory for the model calibration, root monitoring may be achieved in accordance with J.L. Chopart's protocol. Soil water content monitoring, if possible, should be undertaken to fit the water balance.

Once the data are available, crop parameters specific to each cultivar will have to be set. For this, a calibration protocol was re-examined and clearly developed. This calibration procedure is perfectible, particularly the numbers of parameters and processes to calibrate. This simplification is being studied in Réunion.

3 Training

The Mosicas crop growth model is a powerful but complicated software tool which can be used on two levels:

- Complex: calibration and sensitivity analysis

- Simplified: Uses of the model for development questions (potentialities, forecasts, etc.. (cf Appendix 1)

These levels require perfect handling of the software by one or more researcher or engineer.

C. Suguitani, who has already been trained on all of these uses, is the only Brazilian person able to run it. This is somewhat risky, and it would be better if several researchers, students and agronomists (ESALQ, CTC) would learn how to use it.

In a first step, C. Suguitani will likely quickly train Marcos Bernardes and two students, according to their availability.

In a second step, during another mission, I could supervise a special training session using a few interesting case studies suited to Brazilian demand.

For this reason, the software will be soon adapted for Portuguese-speaking users following translation of the help files by C. Suguitani.

4 Publications and Diplomas

Based on the results of the trial carried out at the Piracicaba CTC station, two diplomas were obtained in 2007:

- Laclau P. 2006. Balanço hídrico e crescimento de raízes da cana-de-açúcar sob disponibilidade de água contrastante comparados ao modelo MOSICAS. Master Universidade de São Paulo, Escola Superior de Agricultura “Luiz de Queiroz”, 88 P.
- Suguitani C. 2006. Entendendo o crescimento e produção da cana de açúcar: avaliação do modelo Mosicas. Tese (Doutorado) Universidade de São Paulo, Escola Superior de Agricultura “Luiz de Queiroz”, Piracicaba, 60 P.

Other diplomas could be issued to specialists on this topic. This will depend on future studies that will be conducted in partnership with EALQ and CTC. These studies may be inexpensive and just require already gathered data.

The significant results gave rise to two papers on modelling which will be presented at the next international ISSCT congress on sugarcane to be held in July 2007 in South Africa. These two proposals have been accepted. They are:

- Bernardes M., Suguitani C., Laclau P., Martiné J.F., Chopart J.L. Evaluation of the MOSICAS model for estimating sugarcane growth and yield under Brazilian environmental conditions.
- Suguitani C., Bernardes M., Martiné J.F. MOSICAS model to improve selection of parents and varieties in sugarcane breeding programs.

These publications supplement those already proposed on root topics by J.L. Chopart..

If further studies are undertaken on the use of the model, they could also be proposed for publication, depending on their originality.

In the same way, according to comparisons of modelling results obtained at several sites (Brazil; Réunion, etc.) with the same varieties, other publications will be proposed.

5 Studies and collaboration projects.

The CTC, due to research program reorganization and budgetary restrictions—recently drew up a list of priorities and gave up some programs like modelling. CTC is still highly interested in integrating these results and decision-making approaches but modelling cannot be the focus of a full program. In this setting, CTC still wants to continue with modelling and thus asked millers to invest in this approach. A first mill (Daba mill of the Cosan group close to Jau city) is willing: 1) to set up a trial to calibrate the model for its own cultivars; and 2) to immediately use the model, in collaboration with CTC, to support production forecasts.

ESALQ introduced an FAPESP sugarcane research project in 2004. This project, which included an important subproject on modelling, was taken over by UNICAMP. This initially important modelling subproject was reduced and handed back to ESALQ. The remaining funds (M. Bernardes) will be used to organize a workshop and finance the modelling activities of one or two students.

Faced with this slight decommitment concerning modelling, it was necessary to again highlight the current potential of modelling as a research support, while stressing real study cases that have been achieved or are under way and potential future key areas of support. These model uses are summarized in Appendix 1. Indeed, many uses of the model require only light training, then already gathered data, and time to collect, input, simulate and analyze the results. The potential of model has been showcased at CTC.

Following this presentation, CTC and ESALQ declared that they are increasingly interested in this approach and impressed by recent advances. The recent withdrawal of interest was likely due to the lack of real case studies in Brazil using the model. This point is very important. However, such case studies could not be undertaken since the first stage (calibration of the model under the Brazilian conditions) had not yet been carried out.

Practical case studies therefore must be undertaken in Brazil using the model, and the results presented to decision makers.

After this report, the plans are:

to undertake two studies using Mosicas:

- one on the potential of cropping sugarcane in rainfed and irrigated conditions in order to estimate the trends concerning potential gains from irrigation under several weather situations in Brazil.
- another one on preharvest production forecasting in one or two areas that supply sugar mills. These studies will be carried out using already gathered data.

to organize a workshop (cf. Appendix 2), with the following main objectives:

- scientific exchanges on modelling
- a presentation and talk with decision makers on the assets of modelling based on the results achieved in Brazil (studies quoted above)

This workshop will be organized by ESALQ (Prof. Bernardes) through the FAPESP project.

to initiate other studies on topics like maturity and cane quality forecasts, which ESALQ is already working on, using gathered weather and agricultural data.

to use the model to support breeding initiatives. This could be achieved by C. Suguitani who knows the model and is involved in the CTC breeding program.

to train teachers, researchers and students involved in studies or projects which require the model as a tool.

Substantial participation of C. Suguitani is required to carry out these studies and training initiatives.

Appendix 1: Model Applications for Sugarcane (Uses)

Production Level (decision support tool)

Potential assessments and mapping (zones, farms, plots)

Analysis of production, gaps and limiting factors

Optimization of agricultural practices and strategies by determination of the yield response (“What If?” questions)

- Irrigation (frequencies, amounts, thresholds)
- Harvest dates and cycle lengths
- Plantation dates
- Row spacing

.....

Forecasting of sugarcane production (estate, farm and plot levels)

Forecasting of sugarcane quality (estate, farm and plots levels)

Linkage of the model with remote sensing

Production Level (real-time management tool)

Irrigation (real-time water management tools, including water balance)

Research Level (research support tool)

Integration of trial results

Analysis of multi-location and multi-annual trials: large trial datasets (recommended improvements and tuning)

Breeding support

Appendix 2: Workshop on sugarcane modelling proposal

Dates: from 10 to 13 April 2007 or from 7 to 10 May 2007

Location: Piracicaba

Day 1 (modellers)

1. Presentation of models and results (state of the art of the models)
 - general assumptions of the model
 - purpose of the model (why it was created)
 - general calibration in Brazil
 - applications
 - potential assessments
 - forecasting
 - optimization of agricultural practices (irrigation, fertilization, weeding)
 - crop zoning
 - research (integration of research, analysis of large trial datasets)
2. Possible cooperative research and application studies
 - Similarities, differences and complementarities of the models
 - Data sharing
3. Conclusions
 - Follow-up initiatives
 - Description of important research areas without results
 - Selection of priorities for cooperative studies

Days 2 and 3 (modellers and users)

1. Inventory of applications of general and sugarcane-specific models
2. Brief presentations of the models (15 min per model)
 - General assumptions
 - Purposes
 - Main results and applications
3. Feedback from users
4. Needs of users and possible solutions with models

Day 4 (modellers and users)

1. Defining research programs
2. Establishing some applications for short-term initiatives (zoning, etc.)
3. Considering initiatives of the International Consortium of Sugarcane Modeling (ICSM)
4. Agenda for the next workshop
5. Review of publications
6. Source of funding for future research and applications
7. Conclusions

First proposed participants

ESALQ (M. Bernardes, D. Dourado Neto, E.F. Beauclair, A.R. Pereira, P. Sentelhas)
CTC (J.L. Donzelli, C. Suguitani, J.P.F. Wander)
COSAN ()
CIRAD (J.F. Martiné, J.L. Chopart)

