

# SERDAF, A SOIL-SPECIFIC NUTRIENT MANAGEMENT EXPERT SYSTEM FOR SUGARCANE FERTILIZATION IN REUNION ISLAND

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## INTRODUCTION

The sugarcane sector is a major pillar of Réunion Island's economy and covers 54% of arable lands. An expert system was developed since the late 90's to improve nutrient management practices in local sugar industry. The so-called SERDAF (Système expert d'interprétation des analyses chimiques des sols réunionnais) aims at promoting sustainable soil and nutrient management and balanced crop nutrition. The expert system provides local fertilisation guidelines on the basis of soil analysis by mobilizing pedological and agronomic knowledge gained over the last 40 years in Réunion Island.

## TOOL DESCRIPTION

### Soil fertility diagnosis

The soil fertility diagnosis is established by comparison of the physical-chemical proprieties of soil samples with threshold values. Threshold values were built from agronomic experiments and statistical processing of the laboratory soil database. There are six different packs of threshold values corresponding to the six main types of soil identified in the island: i.e. ferralsols, andosols (two types), vertisols and cambisols (two types). The soil classification was determined from morphopedological studies and chemical distribution of about 10000 soils analysed by the laboratory. The soil sample localisation allows the expert system to identify the type of soil and to use the corresponding threshold values. A basic fertilizer application can be recommended when the soil diagnosis suggests that soil organic matter content, soil acidity, P content and sometimes K content are not able to support crop production.

### Crop fertilisation guidelines

Crop nutrient requirements are calculated by the expert system from expected crop yield (informed or spatially deduced). The expert system considers the outputs from the soil diagnosis and annual crop requirements to determine the amount of N, P and K and sometimes micronutrients to supply as maintenance fertilization. The management of crop residues and organic fertilization are also accounted for in this computation. Fertilizer formulations are proposed by SERDAF in accordance with the commercial availability. The soil diagnosis and the fertilization recommendation are hosted on the Web platform Margouill@.

## RESULTS, DISCUSSION & PERSPECTIVES

### Current usage of SERDAF

About 1000 soil fertility diagnosis are delivered yearly by the CIRAD laboratory thanks to soil sample analyses and the Serdaf application. About 90% of these analyses are performed for sugarcane farmers and are therefore supplied with soil-specific sugarcane fertilization guidelines.

### Improving the soil type assignment with an updated soil map

The assignment of a soil sample to a given soil type has a major effect on the soil fertility diagnosis. Feder and Bourgeon (2009) however already highlighted some failure in the definition of soil types and in their localization on the west part of the island. Recent works, done on the east and south parts of the island and based on spectral analyses combined with soil descriptions, confirmed that some soil units of the current soil

map were misleading. Soil spectral profile will be thus used to update the soil classification, the spatial soil distribution and the associated soil properties (Ph.D of M. Ramos, 2018-2021).

### Questioning N processing by Serdaf

The amount of N fertilizer proposed by the expert system accounts for soil N provisions. Differences in soil N fertility among soil types in La Réunion is considered by Serdaf through the use of a specific coefficient of soil N mineralization for each soil type. A recent study highlighted that the use of soil N availability indices to predict soil N provisions or sugarcane N requirements is still challenging (Mariano *et al.*, 2017). A suitable index should thus be determined to establish the soil mineralization rates of the newly defined soil types (Ph.D of M. Ramos, 2018-2021).

### Future extension to other crops and areas

The soil diagnosis module of Serdaf, which is based on the rendition of soil physical-chemical analyses, is *per se* generic and consequently applicable to soil grown with any crops of interest. However, to date, crop requirements were referenced only for sugarcane, thereby focusing the fertilization guidelines on sugarcane fertilization. Nevertheless, another tool, Ferti-Run, co-developed by the Agricultural Office of Réunion and Cirad, references the requirements for a substantial list of crops including 20 market-garden crops, 6 fruit-growing crops, and pasture crops in addition to sugarcane. Consequently, the coupling of Serdaf with Ferti-Run<sup>1</sup> is envisaged within the framework of the SolAgriDOM project (submitted in April 2018 to the CasDAR call).

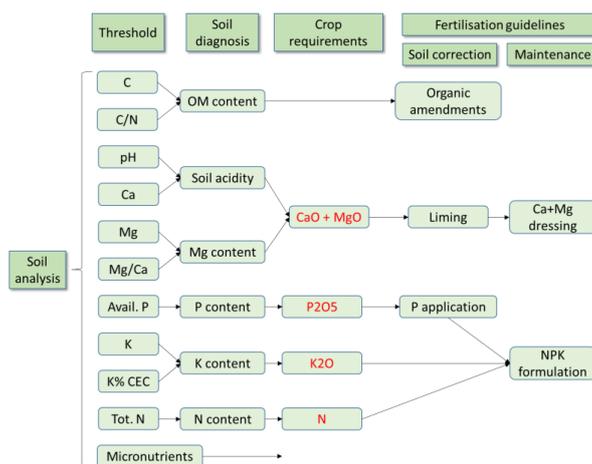


Figure 1. Operating diagram of the expert system SERDAF

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### REFERENCES

Feder F., Bourgeon G., 2009. Mise à jour de la carte des sols de l’île de la Réunion - Démarche suivie et problèmes rencontrés. *Etude et Gestion des Sols*, 16, 85–100.

Mariano E., Otto R., Montezano Z.F., Cantarella H., Trivelin P.C.O, 2017. Soil nitrogen availability indices as predictors of sugarcane nitrogen requirements. *European Journal of Agronomy*, 89, 25-37.

<sup>1</sup> <http://www.mvad-reunion.org/spip.php?article107>