Interpretation of microbial indicators as a function of crop yield and organic carbon in Cerrado soils

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Introduction

One of the major challenges in soil quality assessments using microbial indicators is the difficulty in interpreting their individual values. Unlike the chemical indicators of soil fertility, for which the reference levels (low, medium, adequate and high) are relatively well defined for each element and soil type, it is difficult to simply measure and interpret a series of microbial indicators independent of a comparative control or treatment.

Objective

To develop an interpretative framework for microbial biomass carbon (MBC), basal respiration and the activity of soil enzymes β-glucosidase, cellulase, arylsulfatase and acid phosphatase based on the use of the principles of soil nutrient calibration tests.

Materials and Methods

Local:
Three long-term field experiments (completely randomized block with three replicates), located at the Embrapa Cerrados Research Center, Planaltina, DF, Brazil.

Soil: Very fine, mixed isothermic Rhodic Haplustox (a Typic Dystrophic Red Latosol, according to the Brazilian soil classification system).

Treatments: 24 treatments, in which P fertilization management was used to modulate crop yields and soil organic carbon (SOC).

Soil sampling: January 2011, at the corn tasseling stage.
0 to 10 cm depth

Microbial Analyses: MBC (Vance et al, 1987), basal respiration (Lopes et al., 2013) and the activity of soil enzymes: cellulase (Schinner and Von Mersi ,1990), β-glucosidase, arylsulfatase and acid phosphatase (Tabatabai, 1994).

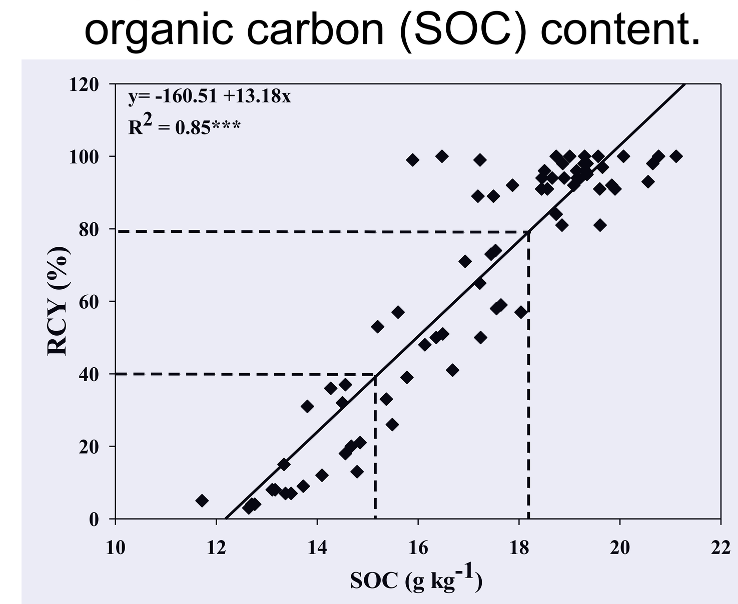
Chemical Analyses: Soil Organic Carbon, SOC (Walkley-Black) and available P (Mehlich-1 extractant and colorimetry) .

RCY: Relative cumulative yield: calculated to express **the cumulative yield** of corn and soybean as a percentage of the greatest cumulative yield obtained in each of the three experiments.

Interpretative framework :
- Regression equations expressing the relationships between the RCY and SOC and the individual soil microbial indicators.
- Regression equations expressing the relationships between SOC and the microbial indicators.
- Adequacy classes for each microbial indicator as a function of the RCY and SOC defined based on criteria similar to those used in soil nutrient calibration tests: ≤40%: low; 41 to 80%: moderate; and >80%: adequate.

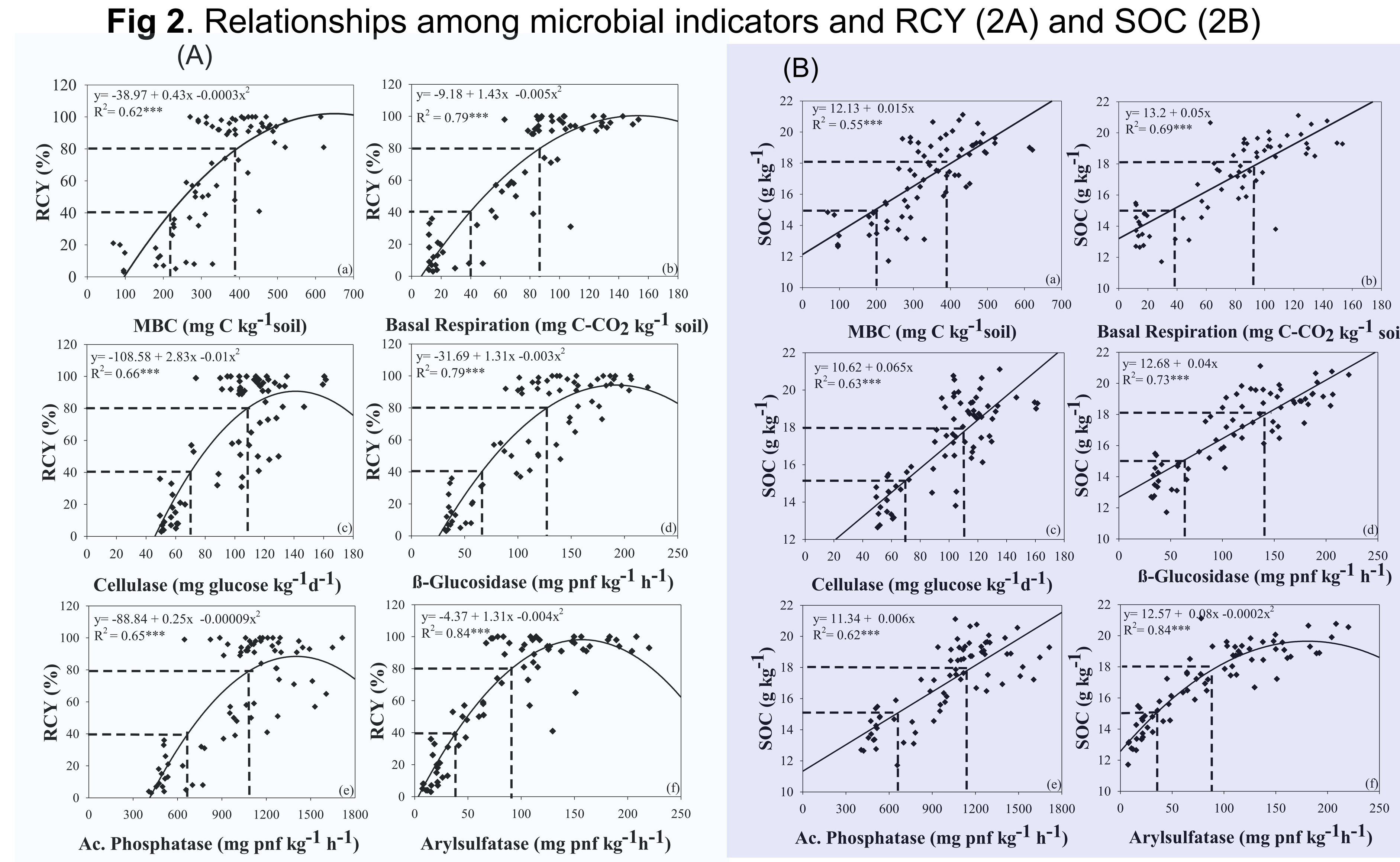
Results and Discussion

Fig 1 . Relationship between the relative cumulative yield (RCY) and soil organic carbon (SOC) content.



Important in order to define the critical levels for SOC:
80% of RCY= 18.2 g kg^{-1}
40% of RCY= 15.2 g kg^{-1}

Fig 2. Relationships among microbial indicators and RCY (2A) and SOC (2B)



Good agreement between interpretations based on RCY and SOC.

Table 1. Interpretation of the microbial indicators as a function of the SOC

Indicator	Interpretative classes as function of SOC		
	Low	Moderate	Adequate
MBC	≤205	206–405	>405
Basal Respiration	≤40	41–100	>100
B-glucosidase	≤70	71–115	>115
Cellulase	≤60	61–140	>140
Ac. Phosphatase	≤640	641–1150	>1150
Arylsulfatase	≤35	36–90	>90

Conclusions

- The use of RCY was key to minimize the influence of factors not related to soil quality and reflected, more accurately, all of the changes in the soil throughout the duration of the three long-term field experiments.
- Considering that it is easier to assess the SOC of a given area than its RCY, the interpretation strategy based on the SOC has more practical use.
- The interpretation tables generated were specific for the clayey Oxisols of the Brazilian Cerrado. Future studies will evaluate the use of this interpretative framework for other conditons.

References

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