PSS 2019

5TH GLOBAL WORKSHOP ON PROXIMAL SOIL SENSING

Linking Soil Sensing to Management Decisions

Wide-range assessment of spatial and temporal variability of soil attributes by an electromagnetic induction (EMI) sensor in Brazilian sugarcane fields

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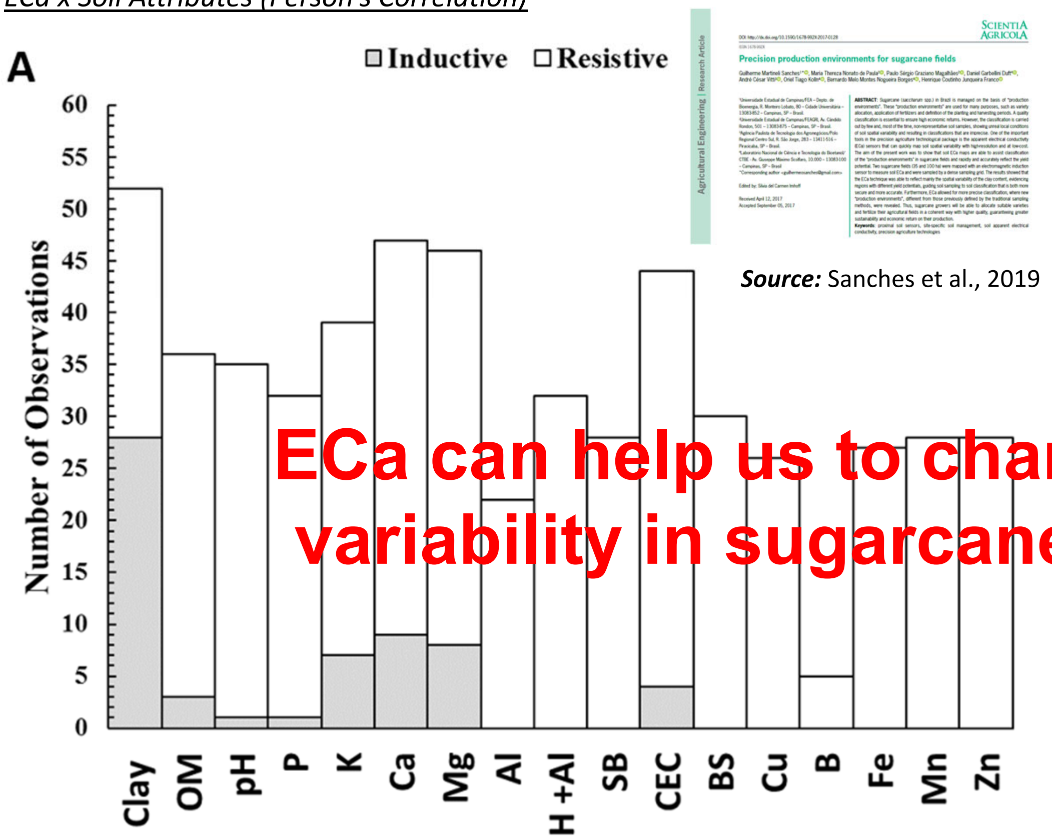
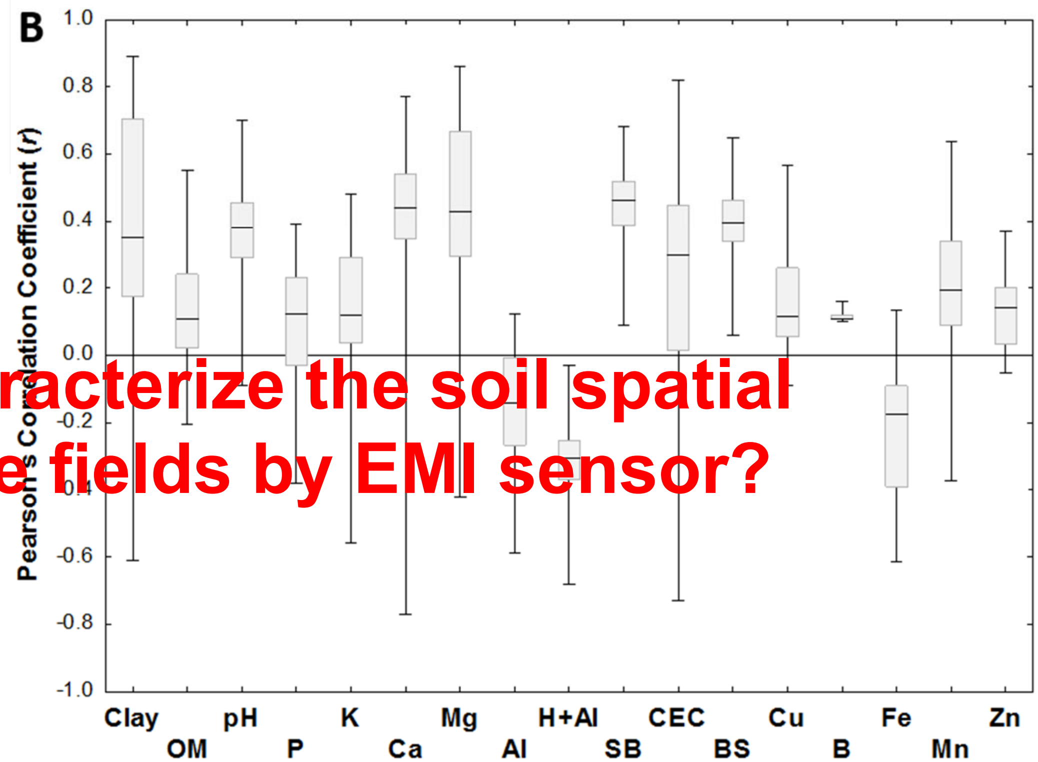
Our motivation!

553 observations from 20 manuscripts

ECa x Soil Attributes (Person's Correlation)



Source: Sanches et al., 2019



ECa can help us to characterize the soil spatial variability in sugarcane fields by EMI sensor?

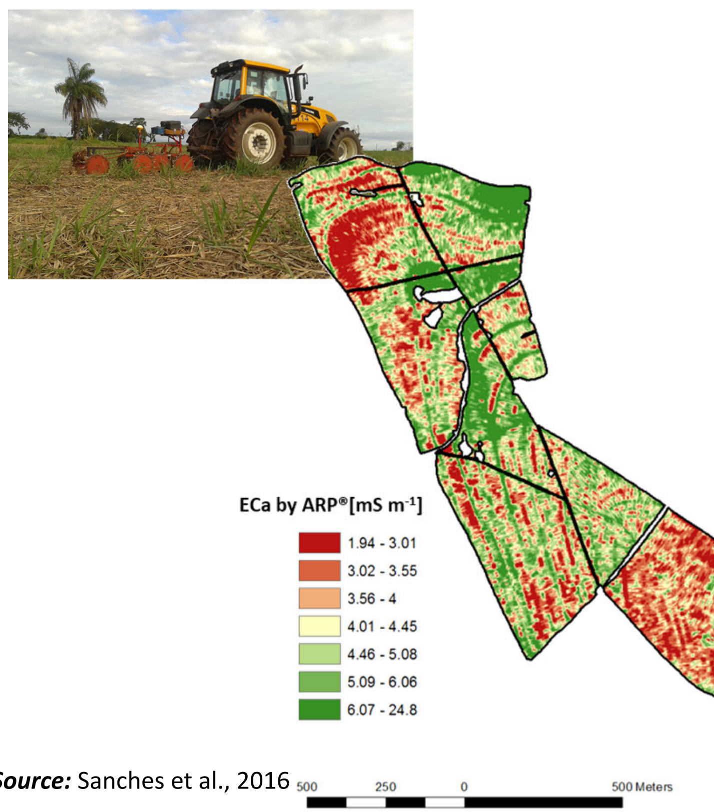
Objectives

The present study aimed to provide a wide-ranging assessment of the relationship between soil attributes (clay, K, Ca and Mg) and ECa at spatial and temporal level in Brazilian sugarcane fields by an EMI sensor.

How we measure!

Why EMI sensor?

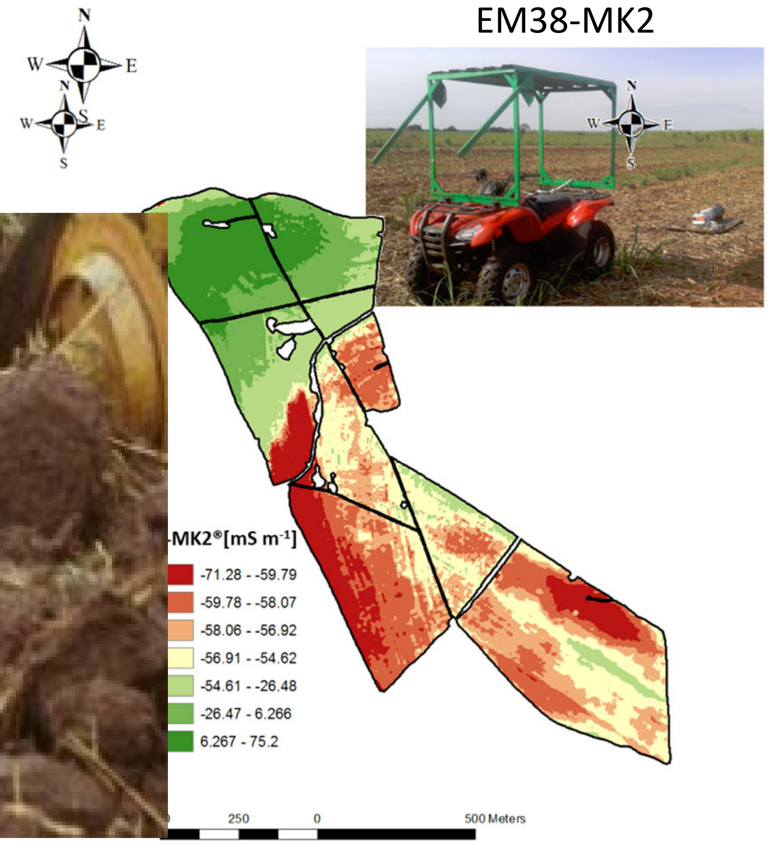
Resistive
ARP



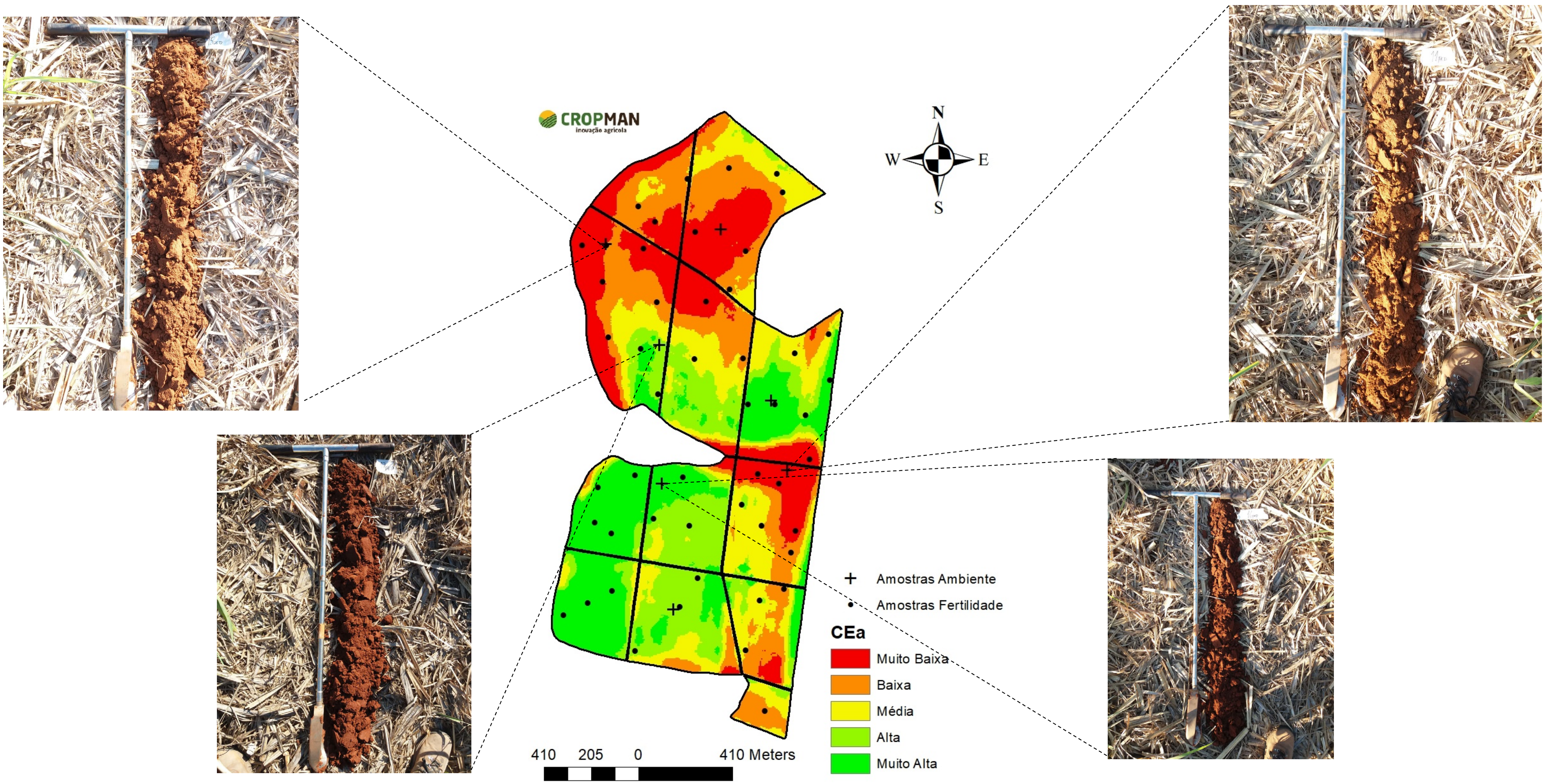
Source: Sanches et al., 2016

Resistive
Veris

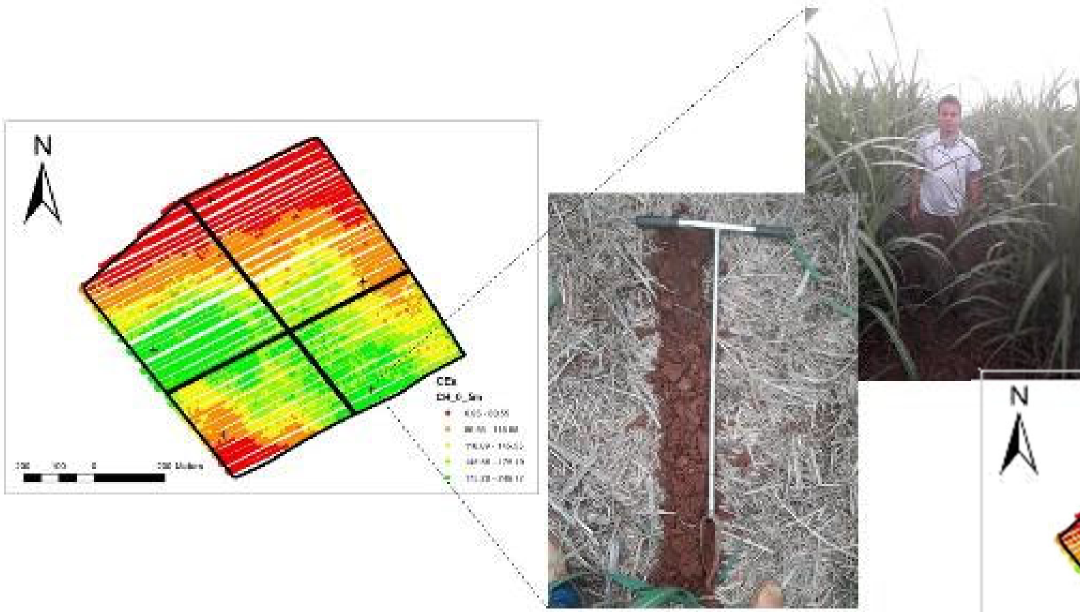
Inductive
EM38-MK2



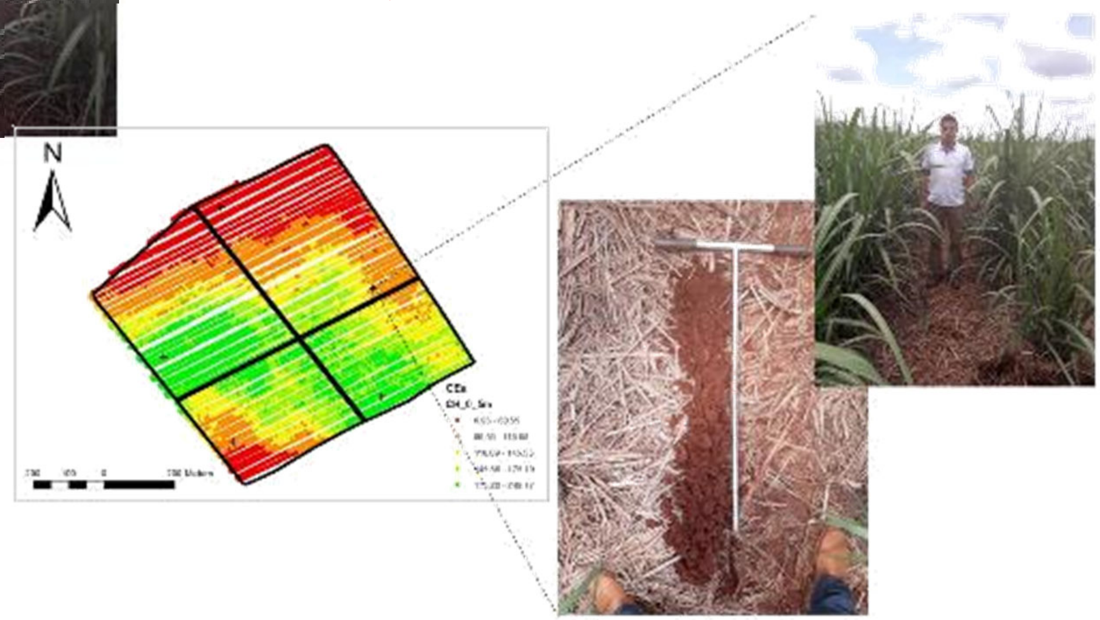
ECa


CROPMAN
inovação agrícola
N
W
E
S
Amostras Ambiente
Amostras Fertilidade
CEa
Muito Baixa
Baixa
Média
Alta
Muito Alta
410 205 0 410 Meters

ECa



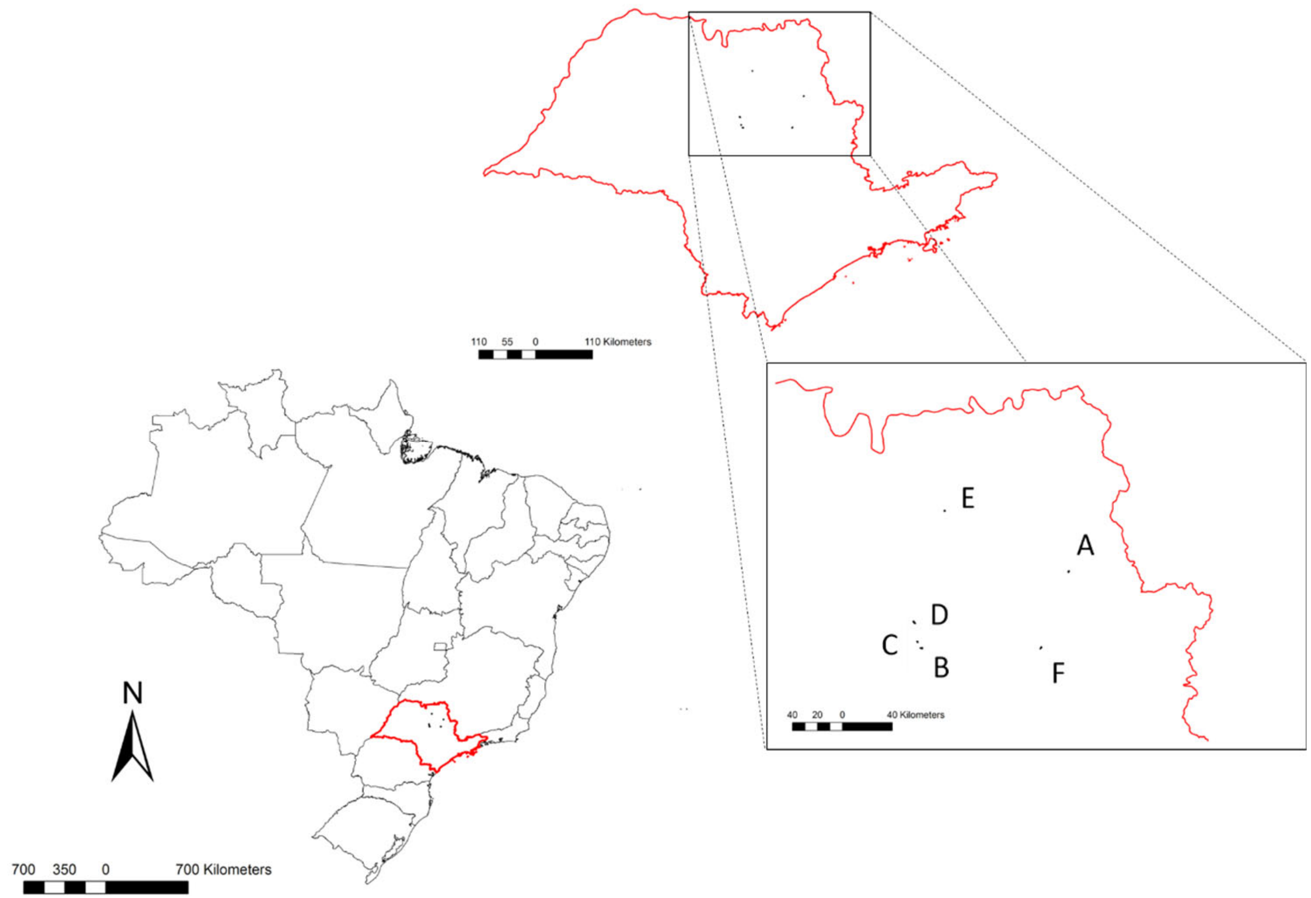
High relationship with
Yield potetntial



Material and Methods

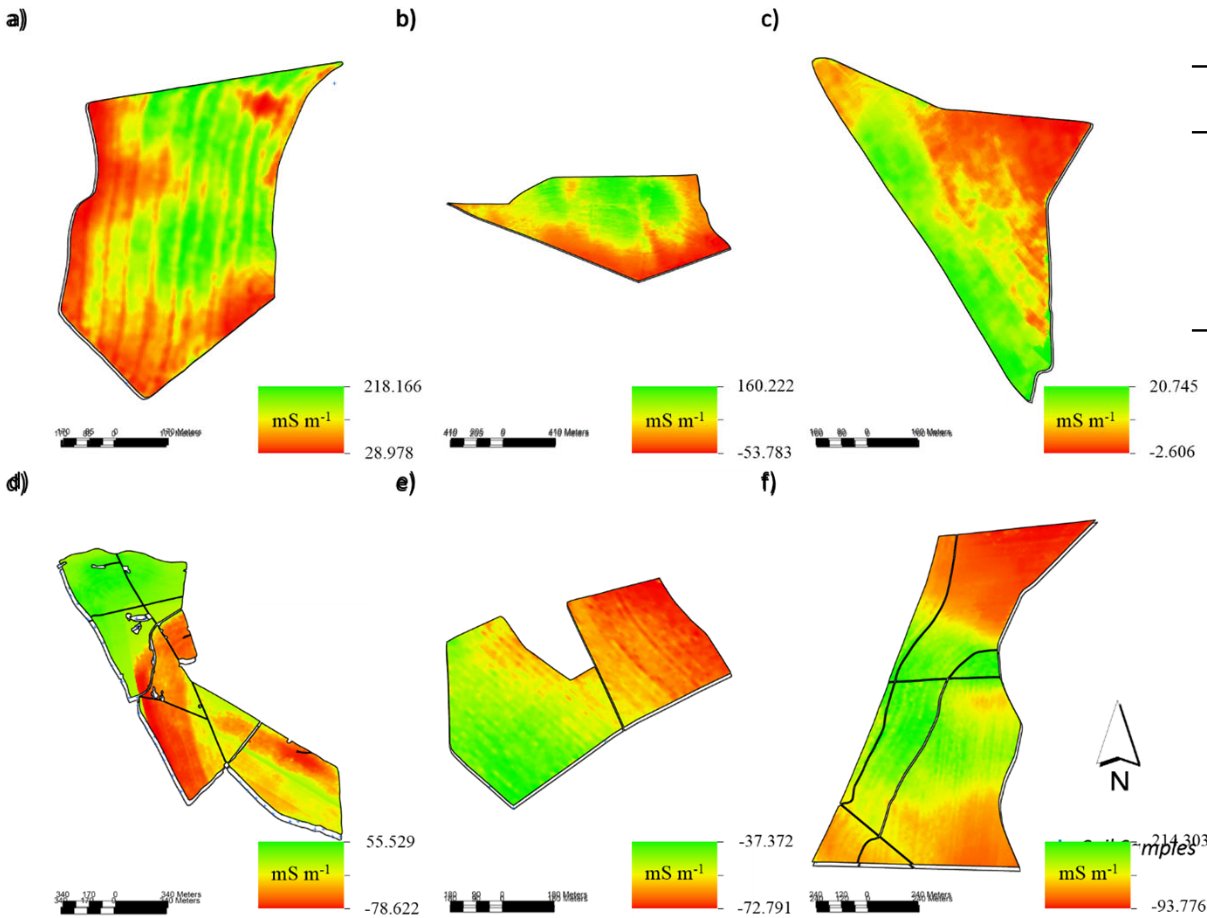
6

fields assessed



Material and Methods

Soil and ECa Dataset



Field	Area [ha]	Years	Grid [m]	Samples	Dens. [samples ha^{-1}]
A	52.57	2011, 2012, 2013 and 2014	50 x 50	204	3.88
B	95.88	2014	50 x 50	303	3.16
C	34.81	2014	50 x 50	128	3.68
D	102.06	2016 and 2017*	50 x 50	424	4.15
E	37.50	2017	75 x 75	66	1.76
F	90.04	2017	100 x 100	119	1.32

2,000

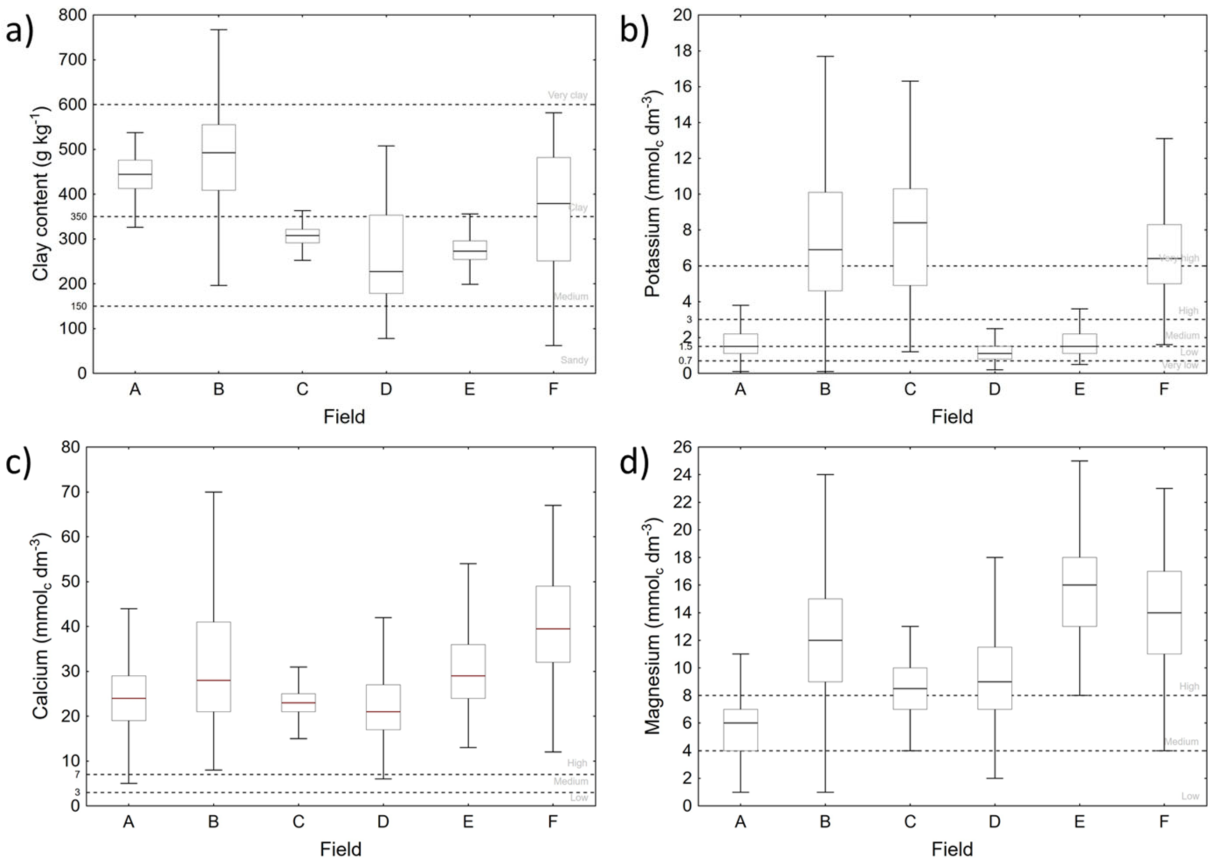
soil samples collected

400

hectares mapped

Material and Methods

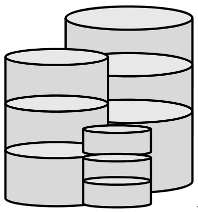
Soil Dataset



- The present study comprised experimental fields with wide clay content variability;
- Fields assessed were from
  - very sandy (clay < 150 g kg^{-1})
  - until very clayey (clay > 600 g kg^{-1})
- Fields B and F showed the greatest clay content variability, while fields C and E the smallest;

Material and Methods

Data set



x_i samples

k soil attributes;

y fields;

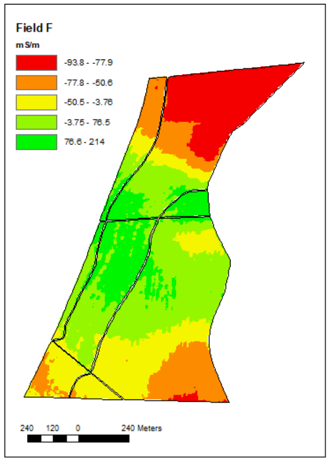
w years;

Outliers Detection → Data Standardiz. →

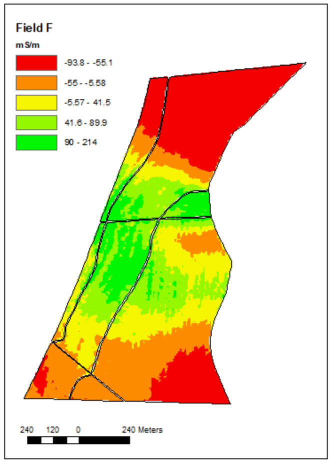
By soil attribute, field and year

ECa Classification Method Testing

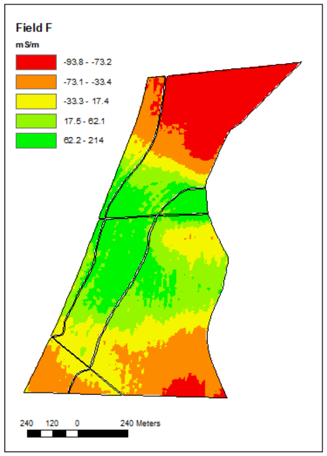
By geometrical interval



By natural breaks (jenks)



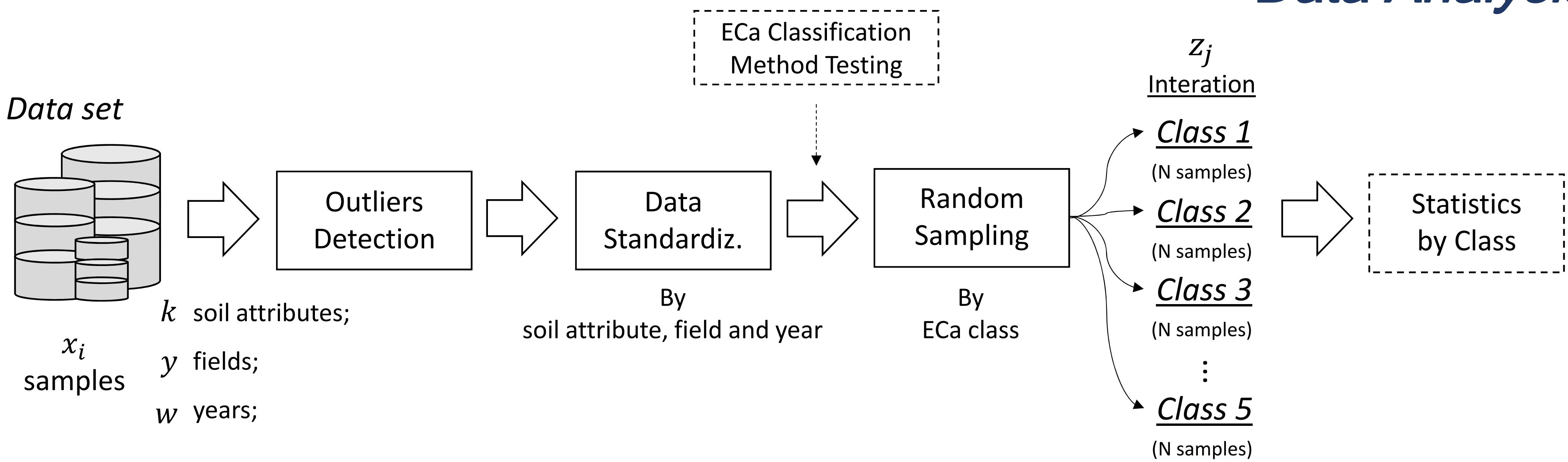
By quantil



Data Analysis

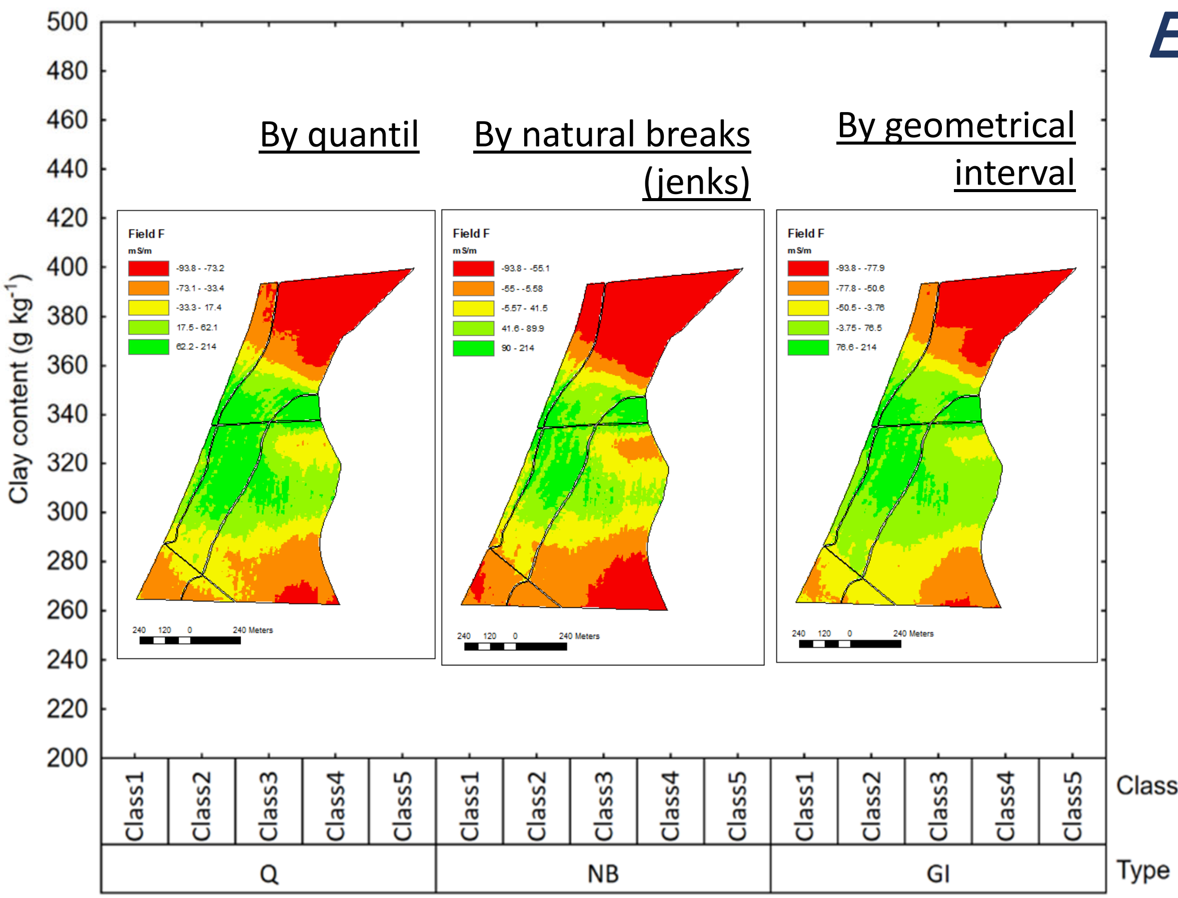
Material and Methods

Data Analysis



ECa classes can reflect the spatial and temporal varibility of soil atributes?

Results



ECa Classification Method Testing

Quantil classification method showed the best division of clay content for ECa classes.

All iterations produced, for NB and GI methods, overlap of classes 3 and 4.

We assumed that the Quantil method was the most suitable for separation and classification of ECa data into classes.

Results

Spatial Variability Assessment

Trend of growth content from class 1 to 5;

Low ECa evidenced sandy areas with lower contents of K, Ca and Mg

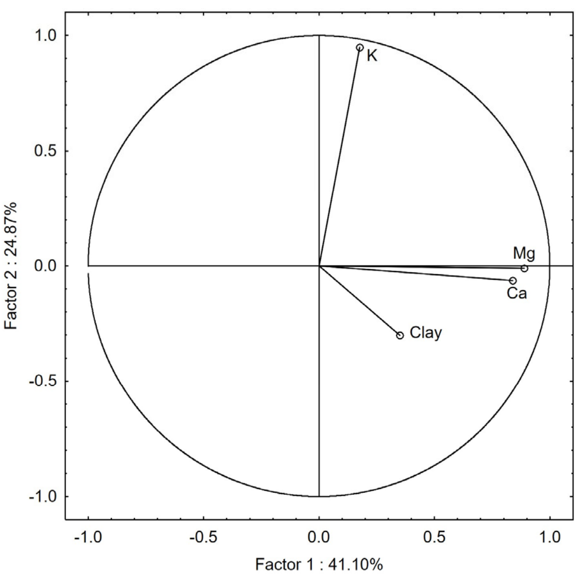
CV showed that the less conductive classes presented greater variability in the contents, with a decrease trend from class 1 to 5;

Temporal Variability Assessment – Field A (4 years)

1st year

2nd year

At time level, factor 1 showed the same growth trend from class 1 to 5



3rd year

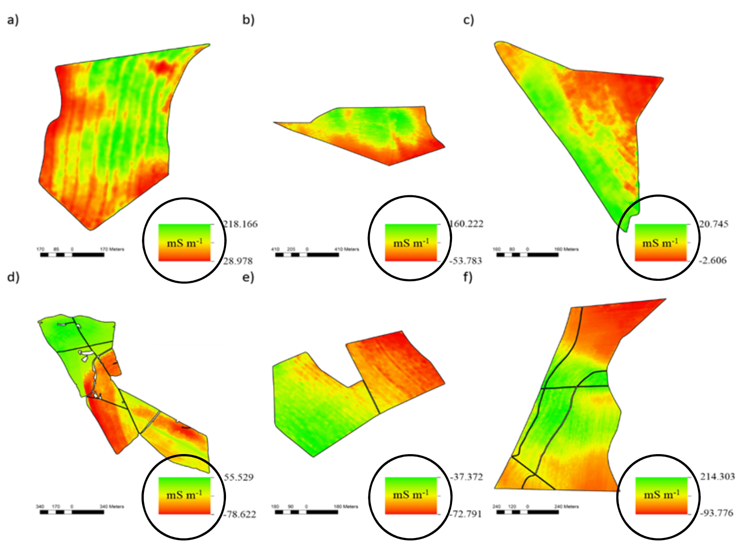
4th year

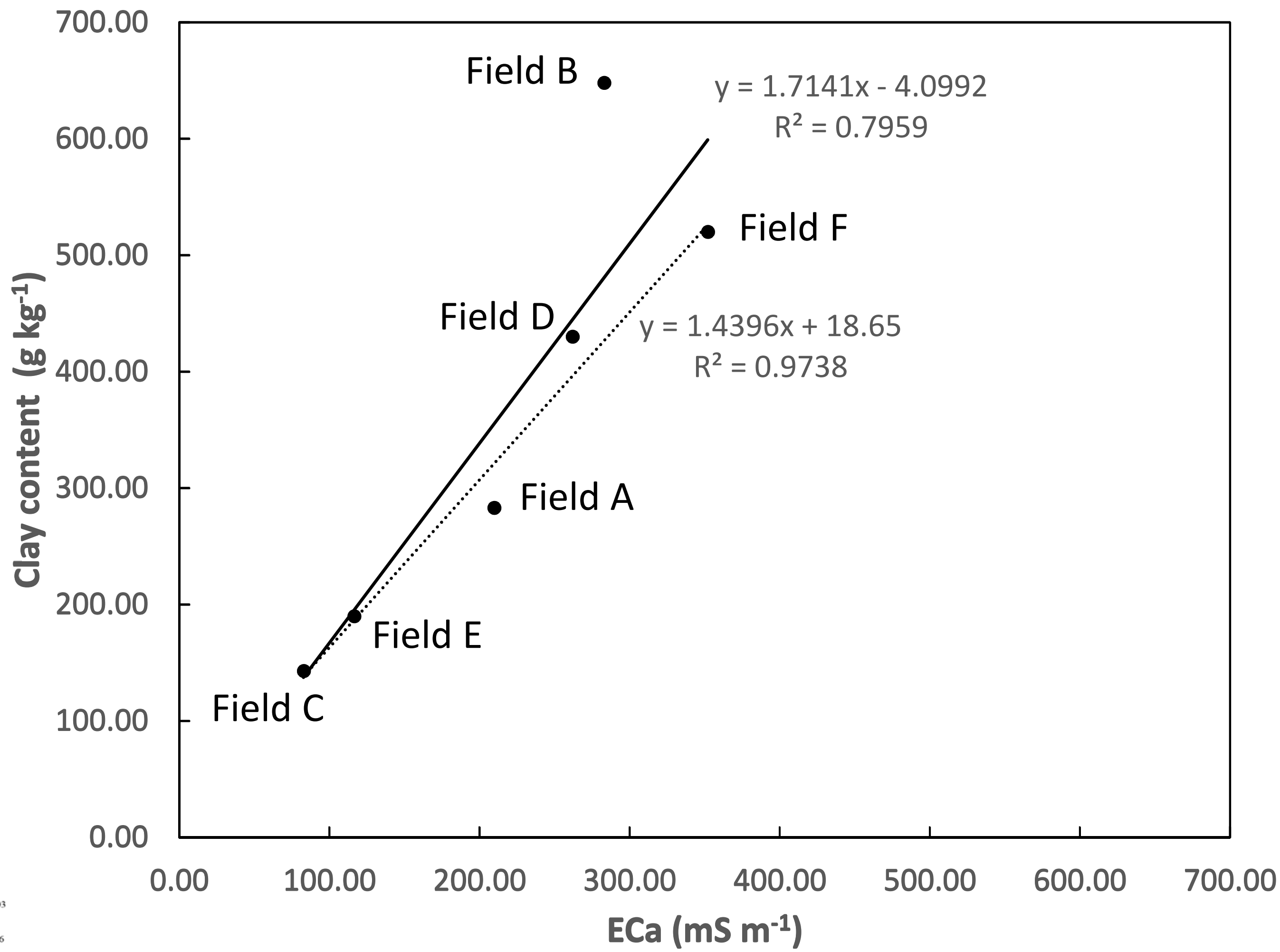
Patterns founded at spatial variability level, were temporarily remained, where class 1 showed smaller average contents than class 5

Results

Linear Adjustement

The results showed that ECa, measured by an EMI sensor, shows a high correlation with soil texture variability of fields assessed (R^2 = 0.97)





Conclusion

- ECa classes, defined by quantil method, showed that the low electrical conductivity sites tend to present lower Clay, K, Ca and Mg contents.

- Higher ECa classes showed smaller CV for all soil attributes assessed, i.e., sites that can be characterized with smaller amounts of samples to an adequate soil mapping than lower ECa classes.

- Clay content variability was directly proportional to the ECa variability (R^2 = 0.97).

- The EMI sensor is an excellent tool for defining the spatial variability of soil fertility and can be used for site-specific management of sugarcane fields

Thank you

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