Bioturbations as quality indicators of Typic Argiudolls in the Southeast of Buenos Aires, Argentina. A micromorphological approach.

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Introduction

Biological activity

is expressed

BIOTURBATION = reworking of soil components by organisms (plant roots and faunal channels)
(Meysman et al., 2006).

in thin sections

Biopores

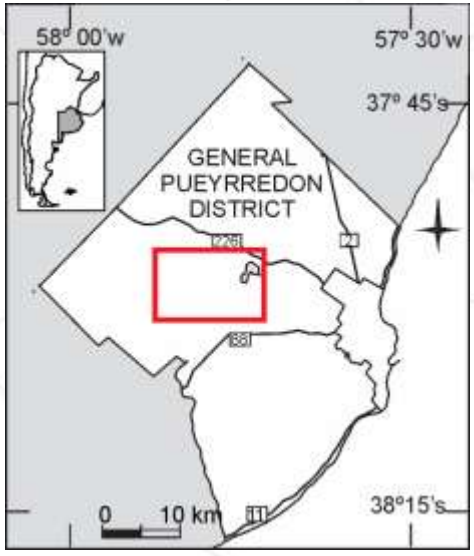
Density of biopores informs about the good soil structuring → SOIL QUALITY INDICATORS
(Lavelle, 1997).

Objective

Validate a methodology for the measurement of bioturbations based on the study of soil thin sections of surface horizons of Typic Argiudolls of Argentina, for its use as soil quality indicator.

Methodology

Study area



Soils: Typic Argiudolls:

- bulk density (BD) (Blake & Hartge, 1986)
- penetration resistance (RP) (Bradford, 1986), corrected
- IC = $a.W^b$ (Busscher et al., 1997)
- structural stability (SS) (Hénin, 1972)
- pH (1:1)
- organic matter (OM) (Walkey & Black, 1965)
- undisturbed samples: three thin sections 3.2 x 4 cm
  - porosity (ImageJ)
  - bioporosity (Metodhology 1 and 2, ImageJ)

R: natural

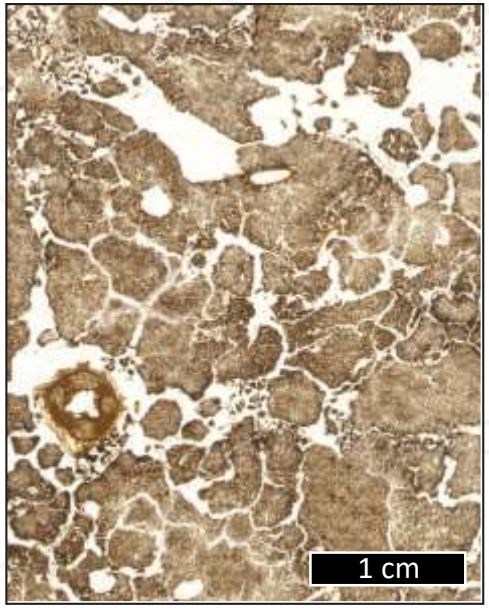
A: agricultural field (50 years)

E: *Eucalyptus globulus* forest plantation (60 years)

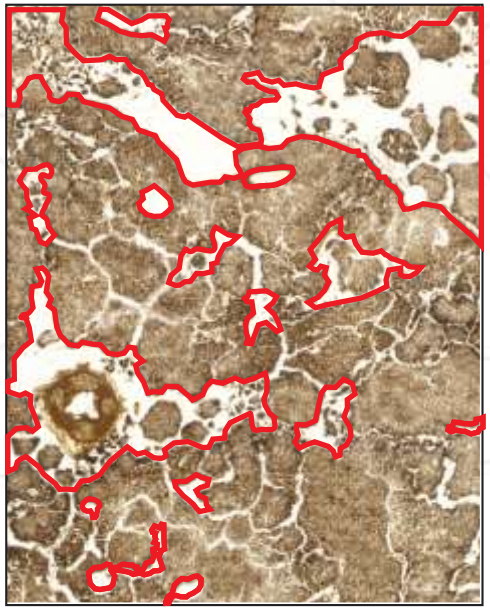
P: *Pinus radiate* forest plantation (40 years)

Methodology 1:

original image



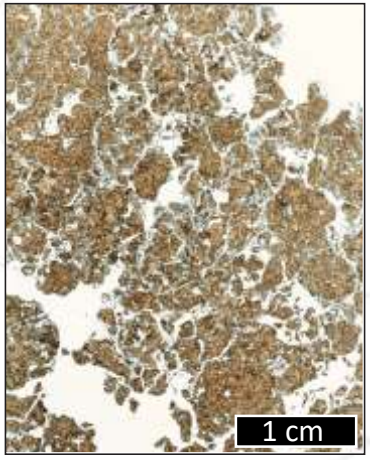
outline biopores



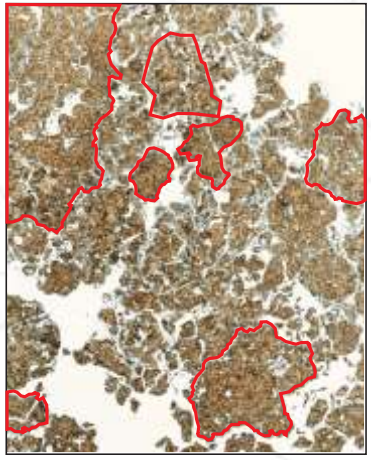
calculation % biopores image

Methodology 1:

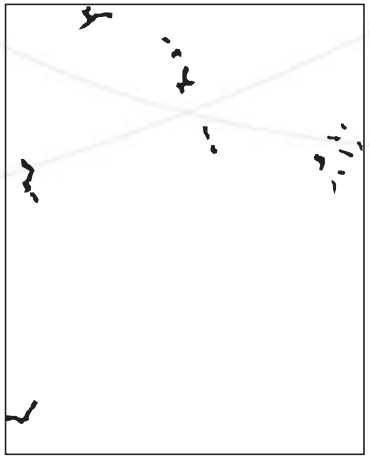
original image

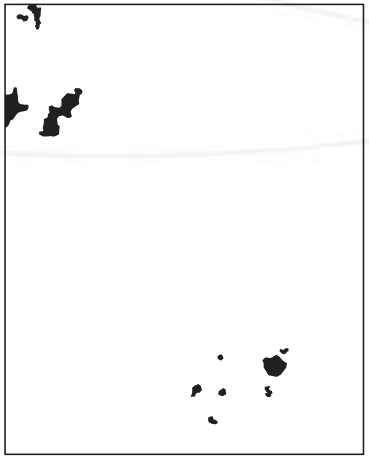


outline matrix



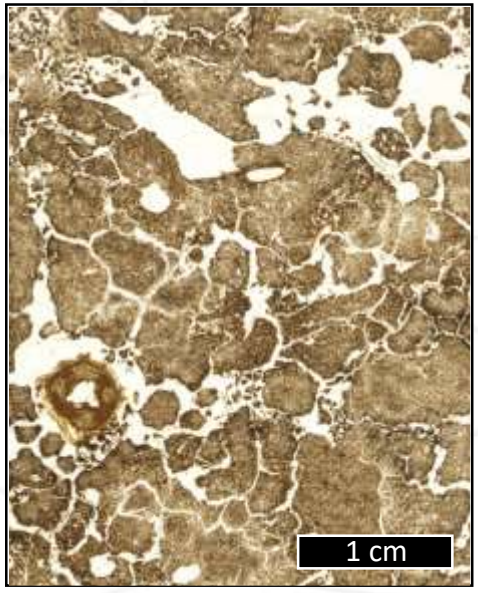
calculation
% biopores
image



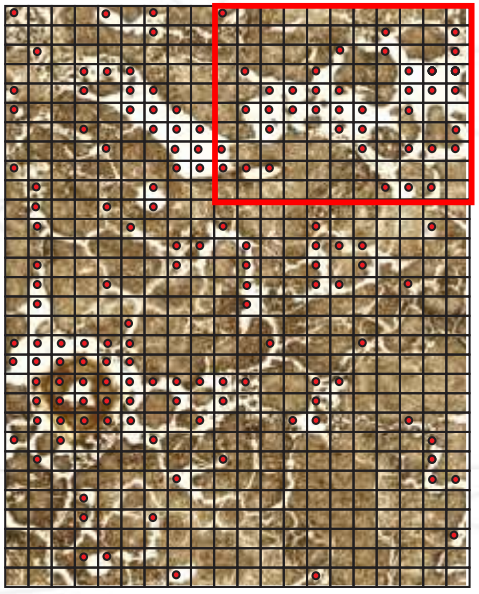


Methodology 2:

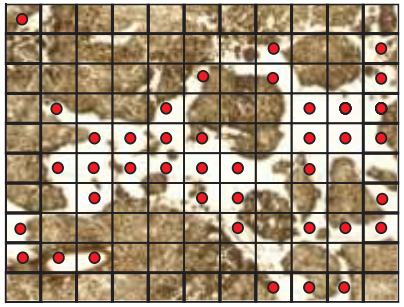
original image



planimetry method
and point couting



Calculation % biopores image



Results and Discussion

	Bulk Density (g/cm^3)	Penetration Resistance (MPa)	Structural Stability (%)	Organic Matter (%)	pH (1:1)
Reserve (R)	1.02 b	1.69 c	100 a	11.63 b	**6.03 a**
Eucalyptus globulus forest plantation (E)	0.73 c	1.83 b	99.85 a	**18.90 a**	5.09 b
Pinus radiata forest plantation (P)	0.91 b	1.79 b	99.38 a	9.99 c	5.25 b
Agricultural field (A)	**1.16 a**	**2.02 a**	**89.13 b**	8.42 d	5.05 b

A: > bulk density and resistance penetration > compaction < total porosity

< structural stability and organic matter < aggregation

	Methodology	Reserve	*Eucalyptus globulus* forest plantation	*Pinus radiata* forest plantation	Agricultural field
Total porosity (TP)		35.43 a	42.65 a	37.49 a	14.39 b
Biopores	1	34.82 b A	41.80 a A	36.51 b A	9.23 c A
Other pores	1	3.40 b	0.85 b	0.98 b	7.89 a
Biopores/TP	1	98.28 a	98.01 a	97.39 a	64.13 b
Biopores	2	28.39 a A	32.89 a A	30.44 a A	6.11 b A
Other pores	2	7.04 a	9.76 a	7.04 a	8.28 a
Biopores/TP	2	80.13 a	81.21 a	77.11 a	42.46 b

* Total porosity: E > P > R > A

* Biopores: E > P > R > A

* Biopores / TP: E > R > P > A

→ approximately 80% para E, R y P
40% para A

* Between methodologies:

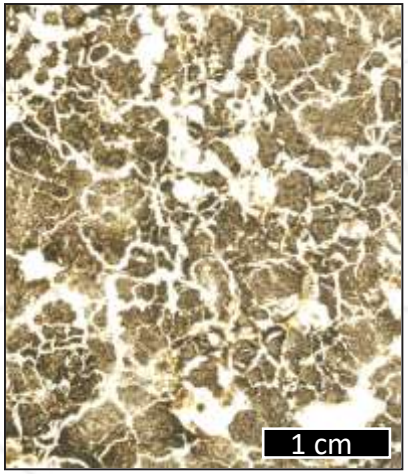
Methodology 1 > % biopores (3-7%), but not significant

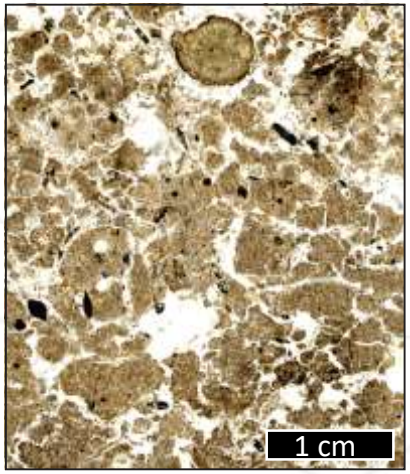
Natural

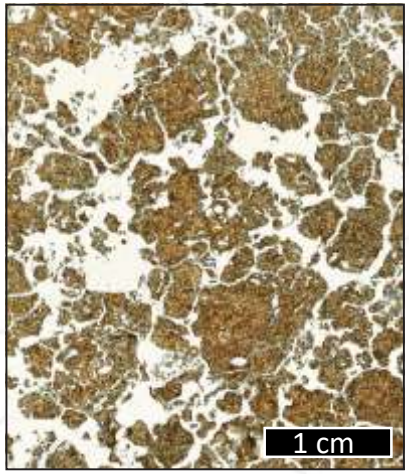
Eucalyptus globulus forest plantation

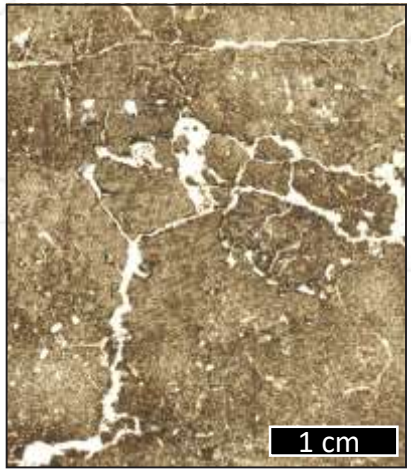
Pinus radiate forest plantation

Agricultural field









Bioturbations

Land use intensity

granular structure
> porosity, bioporosity
> OM
< BD, < RP
> pH
> SS

crumb structure
> porosity, bioporosity
> OM
< BD, < RP
= pH
> SS

fissures structure
< porosity, bioporosity
< OM
> BD, > RP
= pH
< SS

Conclusions

- Reserve and forested plots had both a higher porosity and bioporosity than the soil of the agricultural plot, which was less porous and with half of the bioporosity than the rest.

- Hence a greater biological activity can be estimated in R, P and E, in relation to the agricultural plot. This results in a more stable and complex microstructure in natural and forested soils with respect to cultivated ones.

- Bioturbations constitute good soil quality indicators of these Typic Argiudolls.

- The proposed methodologies for the measurement of bioporosity, in particular *Methodology 2*, represents a contribution to thin section description and quantification, since it is a simple and nonexpensive tool when evaluating soil quality in biological terms.


Thanks...