Effects of deep tillage and crop rotation on soil biological properties in the Humid Pampas (Argentina)

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Introduction

Soil biological properties are considered early indicators of changes in soil quality induced by management practices. However, the extent to which these properties can be affected by deep tillage and different crop sequences has not been investigated in detail in the grain producing region of Argentina.

Objective

To assess the impacts of deep tillage and crop rotation on selected soil biological properties in the 10th year of a long-term trial conducted under no-tillage.

Materials and methods

• The experiment was initiated in 1997 at INTA-Pergamino Experimental Station, Argentina (33° 56´ S; 60° 34´ W), on a Pergamino silty-loam (Typic Argiudoll).

• Three deep tillage treatments (main plots) and three rotations (subplots) were compared in a split-plot design with three replications:

Deep tillage treatments:

A: paraplow at the beginning of the study only
B: paraplow at the beginning of the study and then periodically
C: no paraplow

Crop rotation treatments:

a: wheat/sorghum-maize
b: oats+vetch (cover crop)/soybean
c: wheat/soybean-maize

• Composite soil samples were collected in november 2007 at depths of 0-5 and 5-20 cm to determine:

- Microbial biomass C (MBC)
- Microbial biomass N (MBN)
- Respiration (RESP)
- Metabolic quotient (qCO_2)
- Potential of N mineralization measured by 7-day anaerobic incubations (PNM-AI)

All the experimental units (n=27) were sampled, and also a pasture (tall fescue+white clover) established in 1998 adjacent to the trial which was used as a reference.

• Analysis of variance was performed on all variables and treatment means were compared using the LSD test (α<0,05).

Results and discussion

0-5 cm depth:

• The interaction deep tillage x rotation was not significant (p>0,05) for any of the studied variables.

• Deep tillage only affected MBN (p<0,05), the highest value being achieved by the C treatment (Fig. 1).

• Crop rotation had significant effects on MBC (p<0,05), MBN (p<0,05), PNM-AI (p<0,05) and RESP (p<0,01). Thus, the ***b*** sequence showed increases of 22, 43 and 29% for MBC, MBN and PNM-AI, respectively, whereas the ***c*** rotation resulted in a 24% decrease for RESP relative to the average of the other two treatments (Fig. 2).

5-20 cm depth:

• Effects of tillage and rotation, and the interaction between them, were not significant (p>0,05) for any variable at 5-20 cm depth.

Fig. 1. Effect of deep tillage treatments on microbial biomass N (MBN) at 0-5 cm depth.

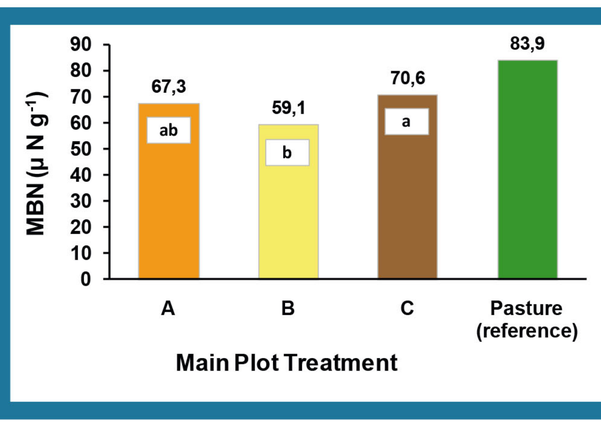
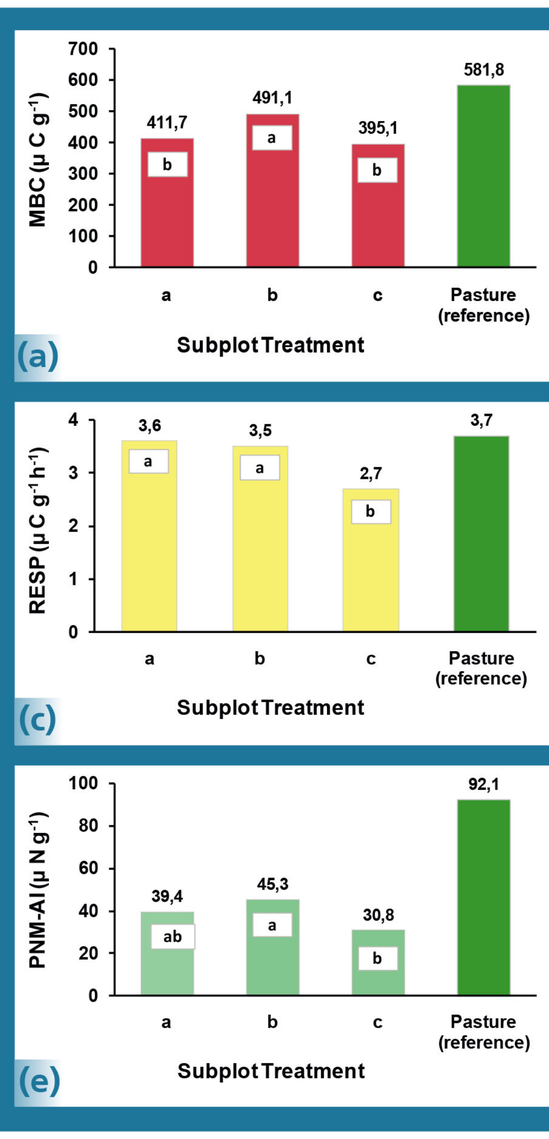


Fig. 2. Effects of rotation treatments on **(a)** microbial biomass C (MBC), **(b)** microbial biomass N (MBN), **(c)** respiration (RESP), **(d)** metabolic quotient (qCO_2), and potential of N mineralization (PNM-IA) at 0-5 cm depth.



Conclusions

◈ After 10 years of cumulative effects, the soil biological variables under study were affected by management practices only in the surface layer (0-5 cm). No treatment effect was observed at 5-20 cm depth.

◈ Soil biological properties were mainly affected by crop sequences. Among them, the ***b*** rotation (oats+vetch as a cover crop, followed by soybean) showed the most favourable values for the assessed indicators.

◈ The positive impact of the ***b*** sequence on soil biological properties at the soil surface might be associated with both the longer period of time during the year the soil is occupied by living roots and the quality of the crop residues under this rotation.

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