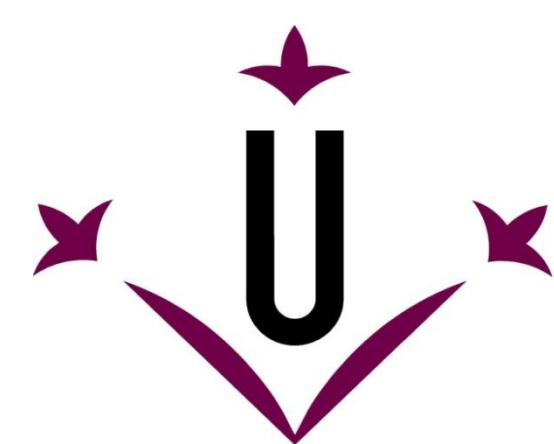


EVALUATION OF SOIL POROSITY AND FAUNAL ACTIVITY THROUGH IMAGE ANALYSIS.

INFLUENCE OF TILLAGE AND FERTILIZATION



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1. INTRODUCTION

- Porosity is a key factor in functionality of soils, and faunal activity is closely related to porosity and vice versa. Total porosity as well as pore size distribution, apparent pore diameter and roughness affects water movement and gas exchange in soils.
- Adequate tillage and fertilization practices can improve soil structure, increasing total porosity and faunal activity.

2. OBJECTIVE

Evaluate the effects of (1) pig slurry fertilization (PS) during 2 consecutive years (in comparison to mineral fertilizers) and (2) tillage (conventional tillage vs. no-tillage) on soil porosity, pore morphology and faunal activity.

3. MATERIAL AND METHODS

- This study was conducted in an experimental field in the middle Ebro river Basin (Zaragoza, Spain), in a loam textured soil.
- Crop: wheat, sprinkler irrigated.
- Experimental design was split plot with two factors:
 - Tillage:** direct sowing (NT) and minimum tillage with disc-harrowing (T).
 - Fertilization:** P0: mineral; P1 and P2: pig slurry at cereal tillering in different doses.

- Undisturbed samples were taken in the surface of the soil and analyzed with image analysis of thin sections: we photographed two areas in each thin section.
- Photographs with plane polarized light (Fig. 1a) and cross polarized light (Fig. 1b) were binarized to obtain the final image (Fig. 1c).
- Quantification of porosity associated to different pore size ranges and morphology were processed with different software (ImageJ and Quantim4).
- Morphology of pores was studied with these shape descriptors:

Table 1: Information about fertilizer treatments

Fertilization treatments	Total N (kg N ha ⁻¹)	N at tillering (kg N ha ⁻¹)	Mineral N at flag leaf (kg N ha ⁻¹)
P0	160	160 Mineral	0
P1	228	148 PS	80
P2	306	226 PS	80

$$\text{Circularity} = 4 \cdot \pi \cdot \frac{\text{Pore area}}{(\text{Pore perimeter})^2}$$

$$\text{Axis ratio} = \frac{\text{Longest axis}}{\text{Shortest axis}}$$

$$\text{Roundness} = 4 \cdot \frac{\text{Pore area}}{\pi \cdot (\text{Longest axis})^2}$$

$$\text{Solidity} = \frac{\text{Pore area}}{\text{Convex area}}$$

- Faunal activity will be visually evaluated by microscopy next year (Fig. 2).

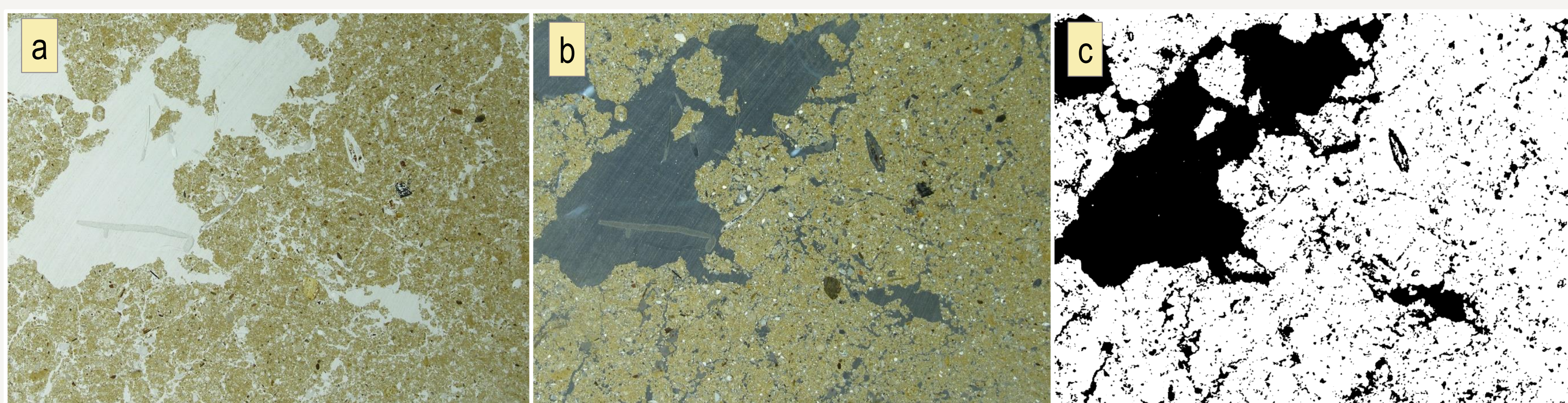


Fig. 1: Photograph with plane polarized light (a), cross polarizers (b) and their binarization (c).

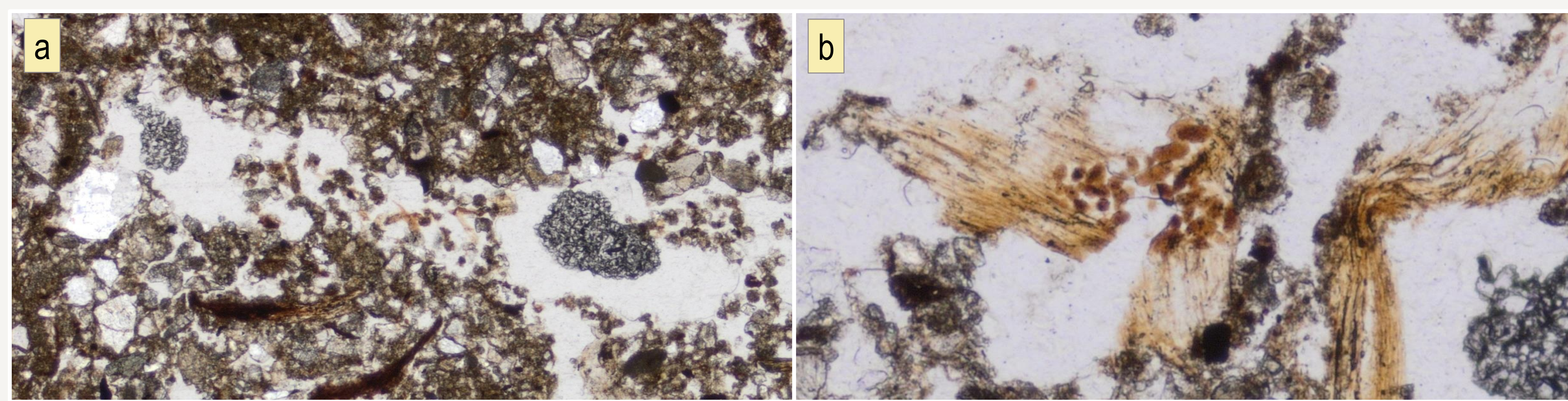


Fig. 2: Faunal activity is very active and can be identified in thin section.

4. RESULTS

- Differences in total pore volume (>15 μm), and intervals 100-200 μm, 200-400 μm and >400 μm between T and NT (Fig. 3).

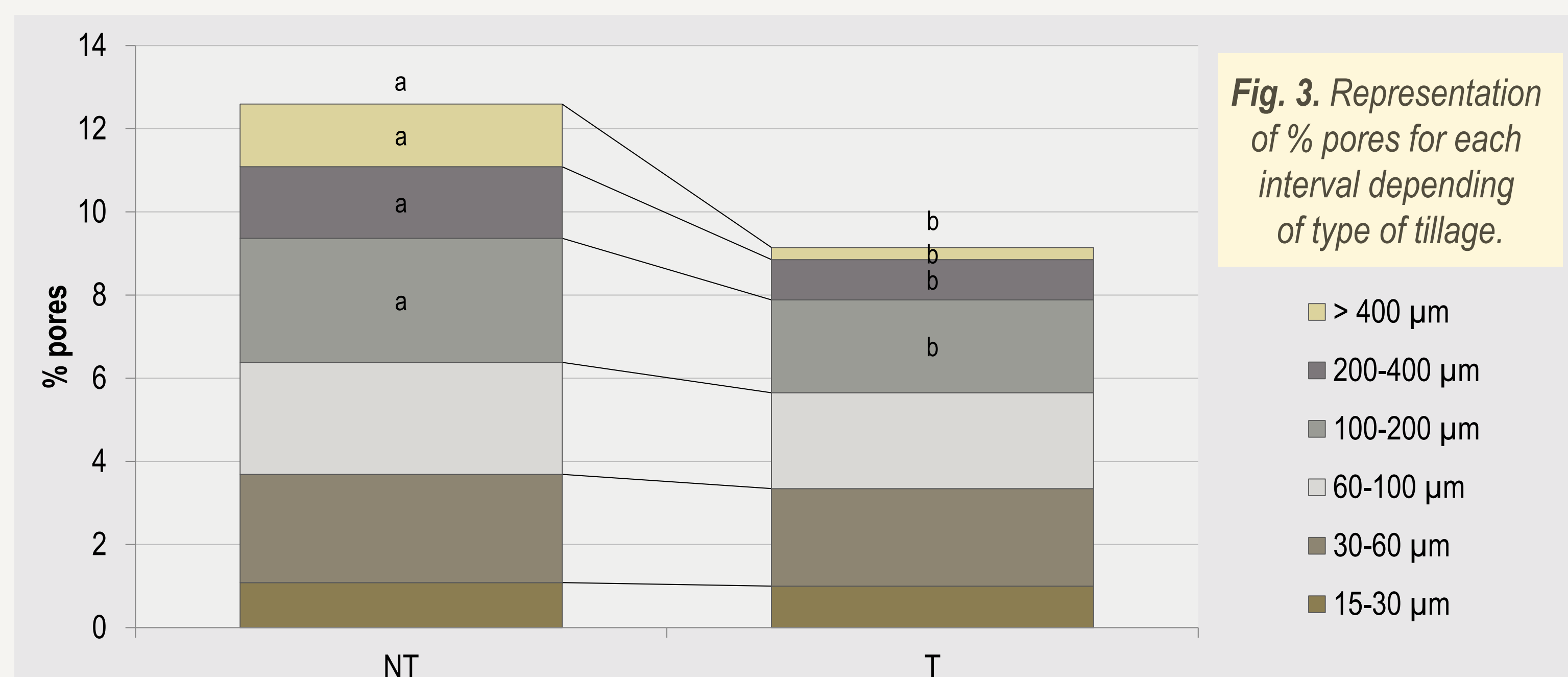


Fig. 3. Representation of % pores for each interval depending of type of tillage.

- A possible increment of fauna in NT would promote the development of >100 μm pores.
- Significant differences in the range of 100-200 μm pore sizes in all shape descriptors between PS (P1 and P2) and non PS (P0) treatments, with opposite behavior between T and NT treatments (Fig. 4).

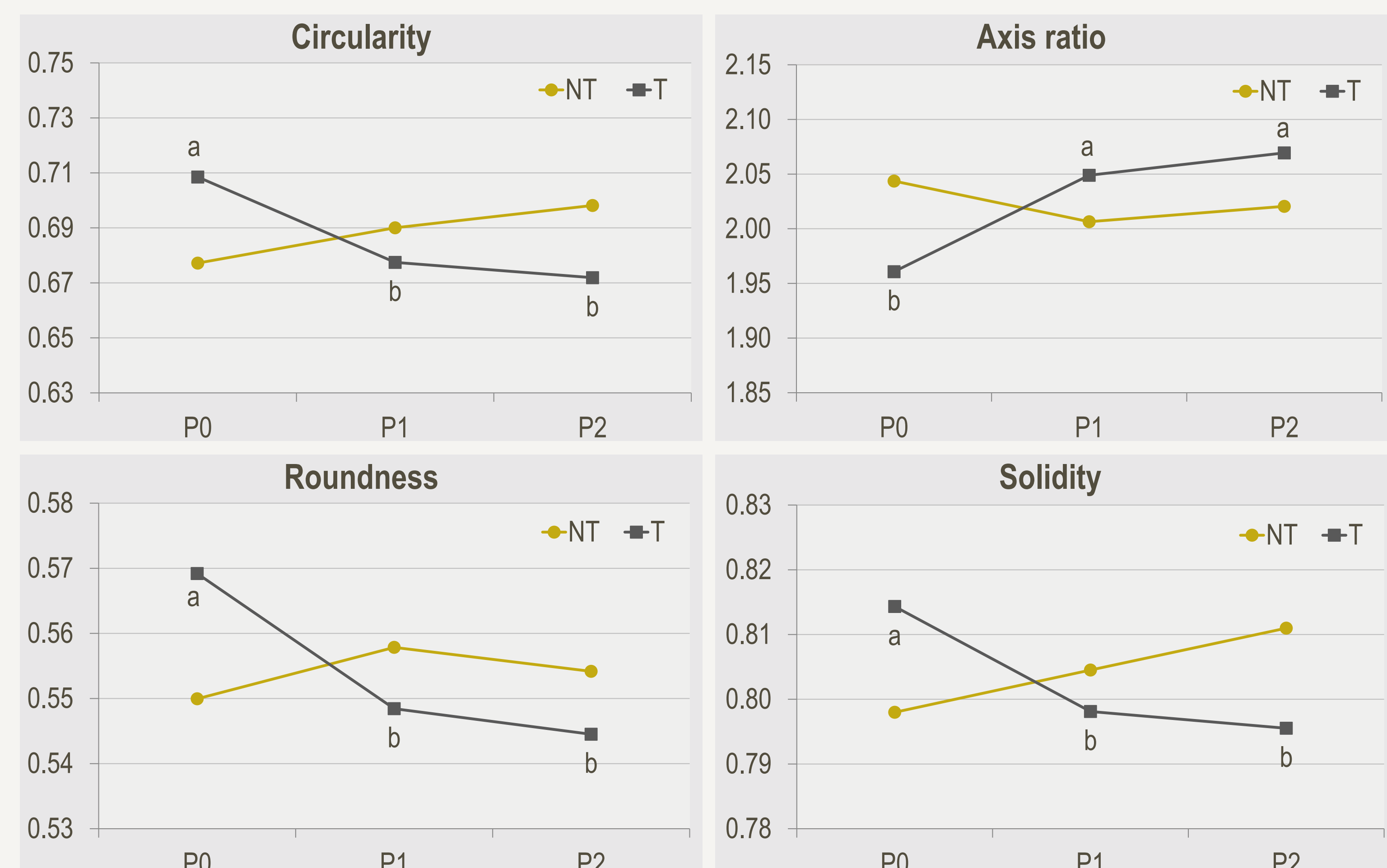


Fig 4. Values of each shape descriptor in 100-200 μm fraction based on fertilizer and tilling treatment.

- Less circular, round and solid pores (faunal channels) in T when PS is applied.

5. CONCLUSION

- Tillage affected total soil porosity (> 15 μm) and pore size distribution: no tillage increased the percentage of macropores (>100 μm).
- Pig slurry application during 2 consecutive years did not affect pore volume but did affect the shape of pores in the range 100-200 μm. The effect of PS application on the pore shape interacted significantly with tillage.