

Vertical distribution of microannelids in relation to tillage and vertical gradients of soil organic matter in some European field soils

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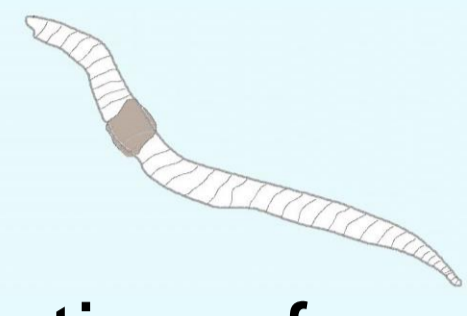
Background

The SoilMan Project aims at:

- relationships between soil management and the performance of soil organisms
- identification of soil management practices that improve soil conditions and sustain soil fertility.

We focus on:

- microannelids (mainly enchytraeids) → Mesofauna.
- Microannelids contribute to SOM decomposition and formation of aggregates, similar to earthworms, but at a smaller spatial scale.



Scope

Hypotheses:

- Enchytraeid vertical distribution depends on soil management (tillage).
- Enchytraeid vertical distribution is related to C_{org} vertical distribution.

Investigated treatments at three field trials in Germany (GE), Sweden (SW) and Spain (SP):

- conventional: ploughing (CT)
- minimum: shallow, non-inverting tillage (MT)
- direct seeding: no tillage (DS).

Sampling

- Randomized block design
- Plots per treatment: 3 (SW, SP) / 4 (GE)
- Sampling season: April-June 2017 / 2018

- Microannelids: soil corer samples (Ø 5 cm, 0-30 cm)
- Sample division in vertical sub-samples á 5 cm
- Stratified sampling of abiotic soil parameters (e.g. C_{org}): 0-10 cm, 10-20 cm, 20-30 cm

Material and Methods



Table 1: Site and soil characteristics of the field trial sites. C_{org} see figure 1.

Region	Exp. start	Conventional tillage (CT)	Minimum tillage (MT)	No tillage (DS)	Crop	Texture	pH _{H2O}
Germany GE (Lower Saxony)	1970	Mouldboard ploughing (25-30 cm)	Rotary harrow (6-8 cm)	-	winter wheat	silt loam	CT: 7.2 MT: 7.2
Sweden SW (Uppland)	2006	Mouldboard ploughing (23 cm)	Cultivator (10-12 cm)	Direct seeding	winter wheat	silt loam	CT: 5.7 MT: 5.5 NoT: 5.5
Spain SP (Andalusia)	2008	Mouldboard ploughing (25-30 cm)	-	Direct seeding	winter wheat	sandy clay loam	CT: 8.3 NoT: 8.2

Study sites

Results

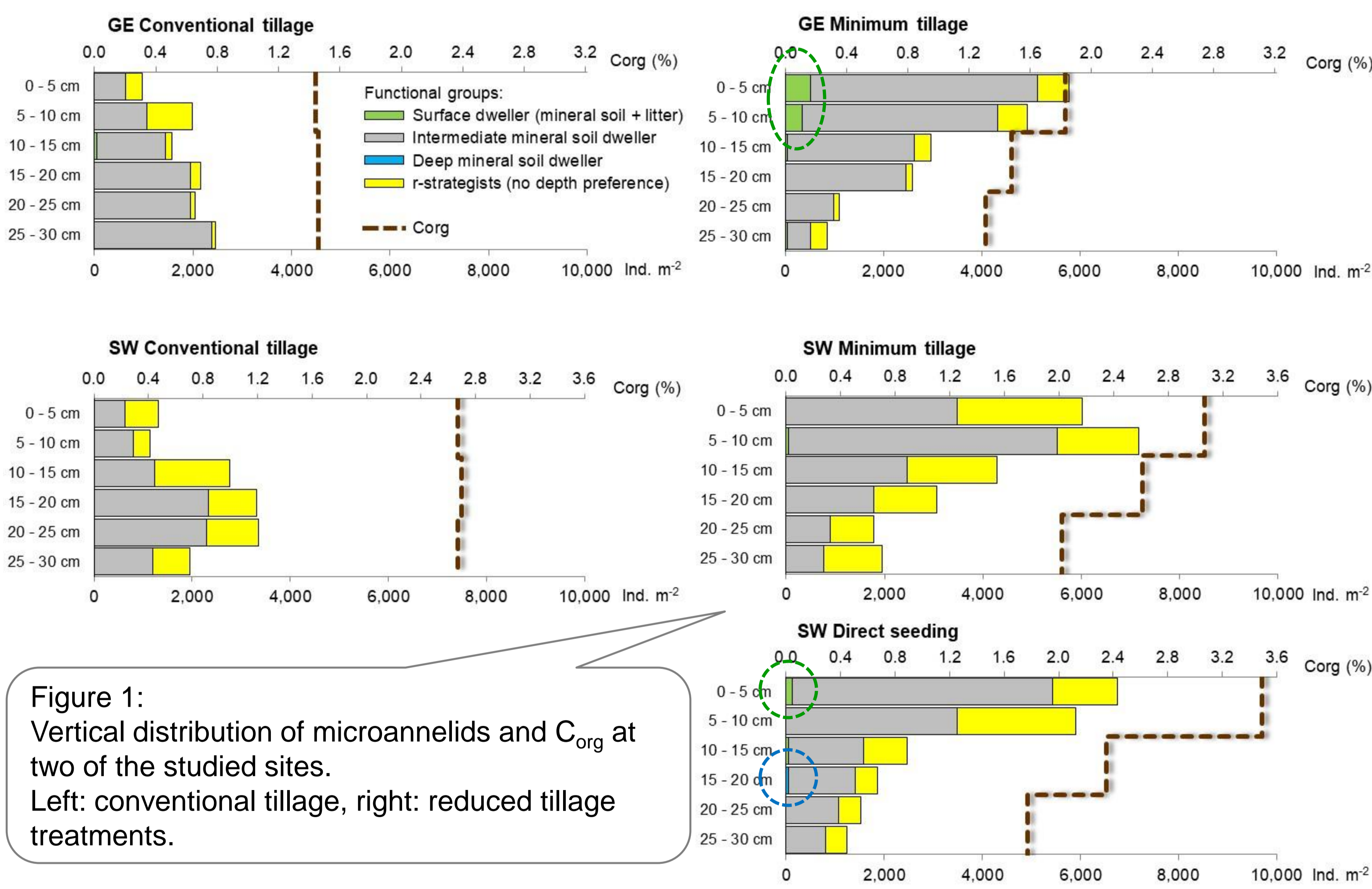


Figure 1: Vertical distribution of microannelids and C_{org} at two of the studied sites. Left: conventional tillage, right: reduced tillage treatments.

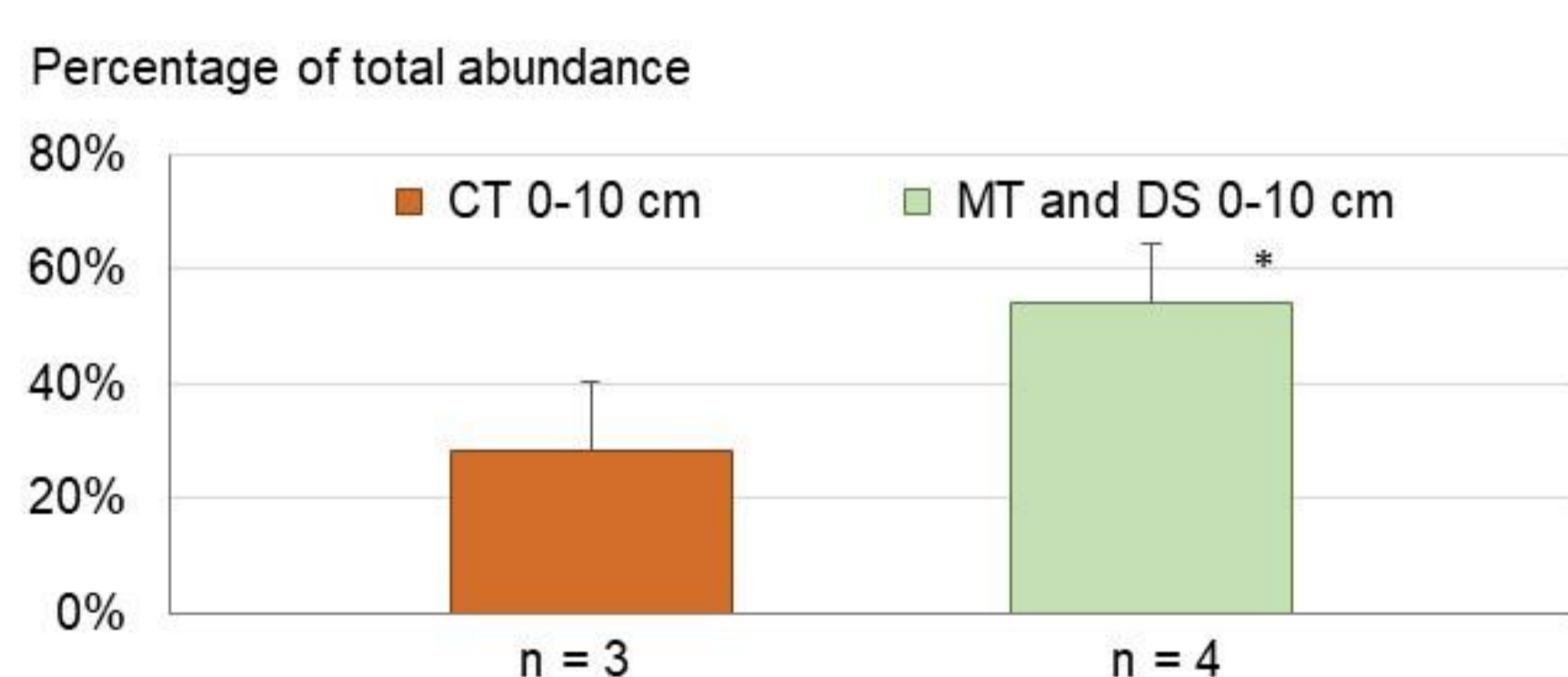


Figure 2: Percentage of microannelid abundance in the uppermost 10 cm for CT (conventional tillage) versus MT (minimum tillage + direct seeding). Mean of study sites; error bar: SD

- Vertical distribution of microannelids and C_{org} show similar patterns that differ between treatments (fig.1).
- Total C_{org} contents (0-30 cm) do not differ significantly between treatments.
- MT and DS can show a higher variety of functional groups compared to CT →
- In 0-10 cm of CT-treatments only ≤ 41 % of microannelids were found, while the percentage in MT treatments was significantly higher (fig.2).

Figure 3: Relation between abundance, C_{org} and depth for CT and MT treatments of the German study site (Garte Süd)

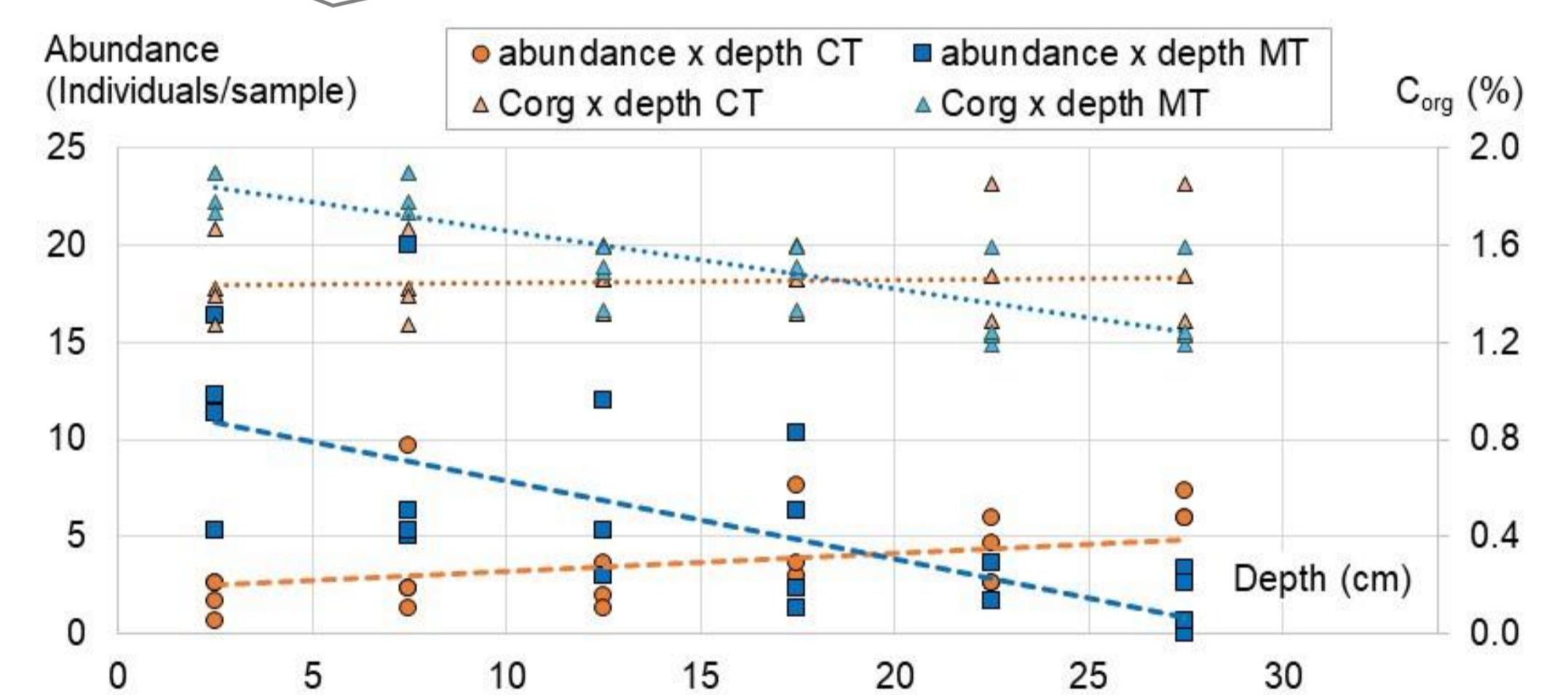


Table 2: Spearman correlation coefficients r_s for C_{org} , sampling depth and abundance. **strong correlation > 0.8** / **considerable correlation 0.55 – 0.8**

r_s	Germany (GE)		Sweden (SW)			Spain (SP)	
	CT	MT	CT	MT	DS	CT	DS
Corg x depth	-0.029	-0.816	-0.053	-0.835	-0.860	-0.686	-0.911
Corg x abundance	-0.348	0.597	-0.129	0.674	0.691	0.197	0.321
Abundance x depth	0.425	-0.752	0.531	-0.844	-0.767	-0.669	-0.351

- Distinct negative correlation of microannelid abundance and C_{org} with depth at MT / DS in GE and SW
- Positive correlation of microannelid abundance with C_{org} at MT / DS in GE and SW; no correlation at CT

Conclusion

- Tillage treatments affect vertical distribution of C_{org} and microannelids.
- Sampling down to 30 cm is essential in ploughed soils to properly estimate microannelid abundance and species diversity / diversity of functional groups.
- Taking mixed samples of the plough layer for abiotic soil properties (e.g. C_{org}) masks gradients relevant for biotic processes.