Field homogeneity in OSCAR-MEE

WP 5 – Soil Ecological Impact

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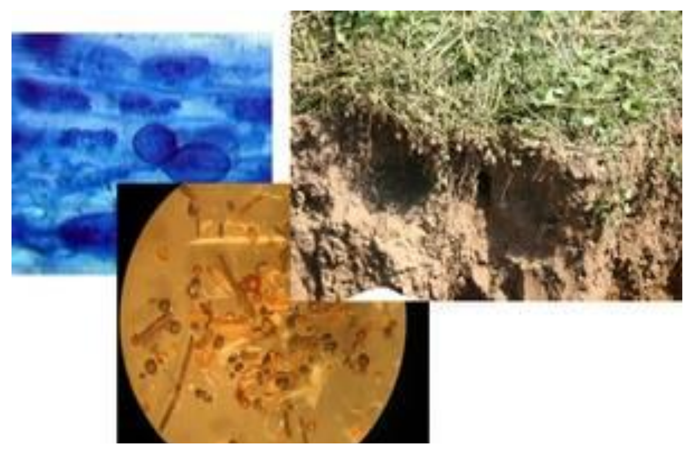
SEVENTH FRAMEWORK PROGRAMME

Aim

Soil properties at the beginning of the MEE were statistically analyzed in order to verify the field homogeneity. The initial soil properties represent the starting point to interpret the effect of CC and LM on soil fertility during crop cycle.

Materials and Methods

The experimental field have four replication for two tillage levels. Eight soil samples were collected in each block at soil tillage depth. Soil physical-chemical analysis were performed on air dried samples with the exception of nitrates and ammonium content (frozen samples). All biochemical assays were made on conditioned soil at 60% WHC



Soil properties

Soil physical-chemical properties: soil pH; Total CaCO3; soil texture (clay, silt and sand); total carbon and nitrogen, nitrate and ammonia content.

Soil biochemical properties: soil microbial biomass carbon and nitrogen, soil enzymatic activity (C,N,S,P cycles). Soil microbial quotient (qmic), synthetic enzyme index (SEI and SEIc) and microbial functional diversity (Shannon's Index - H') were calculated according to the following equations:

(1) qmic = Cmic /Corg (%) ;

(2) SEIc= sum of all enzyme activities involved in the C-cycle

(3) H' = Σpi log2 pi ;

where pi is the ratio of the activity of a specific enzyme on the sum of all activities

Results and discussion

1. Soil chemical properties of the field experiments were quite homogeneous at all sites. The most heterogeneous were: ORC and SLU at first cycle and SLU at second cycle.
2. C/N ratio was the most fluctuating property at the beginning of both cycles;
3. Microbial biomass size and activity (Enzyme activities involved in C cycle) varied within MOR2 field for the first crop cycle and SLU field at second crop cycle;
4. In the first cropping cycle soil properties widely varied among the Northern, Central European and Mediterranean countries:
   1. Total organic Carbon from 3.08% (SLU) to 1.23% (UNITUS);
   2. Soil pH (H_20) from 8.3 and 8.0 (MOR 1 and MOR2, respectively) to 5.7 (SLU);
   3. Clay content from 64% (MOR 2) to 30% (ART and SLU).
5. In the second cropping cycle soil properties widely varied among the North, Central Europe and Mediterranean countries:
   1. Total organic Carbon from 2.86% (SLU) to 1.24% (UNITUS);
   2. Soil pH (H_20) from 7.6 (MOR 1) to 6.1 (SLU);
   3. Clay content from 57% (MOR 1) to 29% (ART and SLU).

Table 1: Soil properties of OSCAR-MEE at the beginning of cycle 1

	UNITUS Italy	TUM Germany	MOR (1) Morroco Sidi el Aidi	MOR (2) Morroco Sidi Allal Tazi	ORC United Kingdom	ART Switzerland	SLU Sweden
pH (H_2O)	**6.7** ± 0.1	**6.9** ± 0.3	**8.3** ± 0.0	**8.0** ± 0.0	**7.5** ± 0.0	**7.1** ± 0.0	**5.7** ± 0.1
pH (KCl)	**5.7** ± 0.1	**6.3** ± 0.4	**7.4** ± 0.0	**7.4** ± 0.0	**7.2** ± 0.0	**6.8** ± 0.1	**5.1** ± 0.1
Total $CaCO_3$ (%)	**0.4** ± 0.2	**2.0** ± 1.0	**15.5** ± 0.5	**15.8** ± 0.8	**4.6** ± 0.2	**1.0** ± 0.0	**1.4** ± 0.2
Clay (%)	**46** ± 3	**37** ± 0	**51** ± 0	**64** ± 0	**37** ± 2	**30** ± 0	**30** ± 2
Silt (%)	**21** ± 3	**63** ± 0	**28** ± 3	**35** ± 0	**20** ± 2	**17** ± 2	**11** ± 1
Sand (%)	**35** ± 3	**0** ± 0	**21** ± 3	**1** ± 0	**43** ± 0	**53** ± 2	**60** ± 1
Total Organic Carbon (mg C kg^{-1})	**12.3** ±0.5	**13.7** ± 0.2	**16.0** ± 0.2	**17.5** ± 0.2	**20.0** ± 0.3	**20.0** ± 0.2	**30.8** ± 0.7
Total Nitrogen (mg N kg^{-1})	**1.0** ± 0.0	**1.5** ± 0.3	**1.3** ± 0.0	**1.9** ± 0.0	**1.9** ± 0.0	**2.3** ± 0.1	**2.6** ± 0.2
C/N ratio	**11.5** ± 0.8	**10.2** ± 0.6	**12.0** ± 1.2	**9.5** ± 0.4	**10.2** ± 0.1	**8.9** ± 0.6	**12.5** ± 0.9
ug N-NO_3 g^{-1}	**18.7** ± 1.4	**5.7** ± 0.6	ND	ND	**8.8** ± 1.3	**19.9** ± 1.3	**8.4** ± 0.9
ug N-$NH_4 g^{-1}$	**2.8** ± 0.3	**3.4** ± 0.9	ND	ND	**3.2** ± 0.6	**4.0** ± 0.5	**5.6** ± 1.6
MBC (µg Cmic g^{-1})	**135** ± 6	**305** ± 19	**491** ± 14	**194** ± 9	**357** ± 16	**260** ± 7	**164** ± 6.0
MBN (µg Nmic g^{-1})	**36** ± 2	**60** ± 7	**67** ± 6	**82** ± 3	**104** ± 5	**94** ± 6	**35** ± 4
Cmic /Nmic ratio	**5** ± 0	**5** ± 0	**9** ± 1	**2** ± 0	**4** ± 0	**3** ± 0	**6** ± 0
SEI (nmol MUF g^{-1})	**1301** ± 33	**851** ± 53	**769** ± 40	**709** ± 40	**729** ± 17	**1155** ± 43	**1396** ± 22
SEI/TOC (nmol MUF mgC ^{1})	**106** ± 3	**62** ± 6	**48** ± 2	**40** ± 2	**36** ± 1	**57** ± 2	**45** ± 0
qmic	**1.1** ± 0.1	**2.1** ± 0.1	**3.1** ± 0.6	**1.1** ± 0.2	**1.4** ± 0.1	**1.3** ± 0.0	**0.5** ± 0.0
H' soil mass base	**1.90** ± 0.02	**2.30** ± 0.02	**1.66** ± 0.03	**1.58** ± 0.03	**2.07** ± 0.01	**2.05** ± 0.01	**2.13** ± 0.01
H' C mass base	**1.90** ± 0.02	**2.26** ± 0.04	**1.66** ± 0.03	**1.89** ± 0.02	2.07 ± 0.01	**2.01** ± 0.04	**2.13** ± 0.01

Table 3: Significant differences of soil properties among MEE blocks at cycle 1

	UNITUS	TUM	MOR (1)	MOR (2)	ORC	ART	SLU
Total Carbon (%)							*
Total Nitrogen (%)	*					**	***
pH (H_20)							
pH(KCl)							
Nitrate	*				**		
Ammonium							
C/N ratio	**				**	**	***
SEI					*		
SEIc			*				
Arylsulphatase							
Acid phosphatase					*		
Microbial biomass C				**			*
Microbial biomass N				***			
Cmic/Nmic ratio							
qmic				**	*		

Unitus n=32; Tum n=8; Mor (1) n=24; Mor (2) n=24; Orc n=32; Art n=32; Slu n=40

ANOVA: *, **, *** indicates significant difference at p<0.05, p<0.01, p<0.001 between blocks

Table 2: Soil properties of OSCAR-MEE at the beginning of cycle 2

	UNITUS Italy	MOR (1) Morroco Sidi el Aidi	MOR (2) Morroco Sidi Allal Tazi	ART Switzerland	ORC United Kingdom	SLU Sweden
pH (H_2O)	**6.7** ± 0.1	**7.6** ± 0.1	**7.3** ± 0.1	**6.9** ± 0.1	**7.2** ± 0.0	**6.1** ± 0.1
pH (KCl)	**6.0** ± 0.1	**7.0** ± 0.1	**6.8** ± 0.1	**5.9** ± 0.3	**6.8** ± 0.0	**5.1** ± 0.1
Total $CaCO_3$ (%)	**1.0** ± 0.0	**20.0** ± 0.4	**17.8** ± 0.5	**4.5** ± 1.3	**2.8** ± 0.1	**3** ± 0.0
Clay (%)	**33** ± 0	**57**± 1	**49** ± 0	**29** ± 1	**36** ± 0	**29** ± 0
Silt (%)	**13** ± 1	**31** ± 1	**31** ± 1	**13** ± 1	**17** ± 0	**13** ± 0
Sand (%)	**53** ± 1	**12** ± 2	**20** ± 1	**58** ± 2	**47** ± 0	**57** ± 0
Total Organic Carbon (mg C kg^{-1})	**12.4** ± 0.4	**14.5** ± 0.8	**15.2** ± 0.3	**21.6** ± 0.3	**23.2** ± 0.4	**28.6** ± 0.3
Total Nitrogen (mg N kg^{-1})	**2.7** ± 0.1	**1.0** ± 0.1	**1.1** ± 0.0	**1.4.** ± 0.0	**2.2** ± 0.0	**2.2** ± 0.0
C/N ratio	**8.92** ± 0.3	**12.15** ± 0.2	**12.12** ± 0.1	**10.43** ± 0.1	**9.71** ± 0.2	**13.06** ± 0.3
ug N-NO_3 g^{-1}	**5.9** ± 0.2	ND	ND	**4.7** ± 0.4	**4.4** ± 0.7	**6.5** ± 0.4
ug N-NH_4 $^{-1}$g	**0.6** ± 0.0	ND	ND	**2.6** ± 0.5	**0.6** ± 0.0	**3.0** ± 0.3
MBC (µg Cmic g^{-1})	**68** ± 9	**220** ± 16	**105** ± 12	**274** ± 36	**344** ± 48	**283** ± 23
MBN (µg Nmic g^{-1})	**10** ± 1	**8** ± 1	**12** ± 2	**35** ± 3	**26** ± 4	**16** ± 1
Cmic /Nmic ratio	**5** ± 0	**20** ± 2	**15** ± 4	**9** ± 1	**13** ± 0	**20** ± 2
SEI (nmol MUF g^{-1})	**223** ± 10	**505** ± 28	**382** ± 16	**721** ± 27	**827** ± 13	**1095** ± 44
SEI/TOC (nmol MUF mg C $^{-1}$)	**18** ± 0	**35** ± 3	**25** ± 1	**148** ± 20	**36** ± 1	**38** ± 1
qmic	**0.54** ± 0.1	**1.54** ± 0.1	**0.70** ± 0.1	**1.40** ± 0.2	**1.51** ± 0.2	**1.00** ± 0.1
H' soil mass base	**1.98** ± 0.01	**1.60** ± 0.02	**1.50** ± 0.02	**2.03** ± 0.02	**2.05** ± 0.00	**2.24** ± 0.00
H' C mass base	**2.04** ± 0.02	**1.60** ± 0.02	**1.50** ± 0.23	**2.03** ± 0.02	**2.05** ± 0.00	**2.24** ± 0.00

Table 4: ANOVA analysis of soil properties in OSCAR-MEE at cycle 2

	UNITUS	MOR (1)	MOR (2)	ART	ORC	SLU
Total Carbon (%)						***
Total Nitrogen (%)			*			
pH (H_20)						
pH(KCl)						
Nitrate						
Ammonium						
C/N ratio			*	**		*
SEI						
SEIc		*				
Arylsulphatase						***
Acid phosphatase						*
Microbial biomass C						
Microbial biomass N						
Cmic/Nmic ratio						
qmic						

Unitus n=32; Mor (1) n=24; Mor (2) n=24; Orc n=16; Art n=32; Slu n=40.

*, **, *** indicates significant difference at p<0.05, p<0.01, p<0.001 between blocks

Conclusions

- ✓ Soil properties of the fields were quite homogeneous at the beginning of crop cycles (first and second);
- ✓ The soil properties of the experimental fields in the selected areas showed a wide variety of pedons to be used for the comparison of CC and LM effect in different climate zones.
- ✓ Soils from the Northern European sites are more acid and richer of nutrients and organic matter with respect to the soils in Southern sites.

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