Soil quality grouping variables in OSCAR-MEE
WP 5 – Soil Ecological Impact

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[a] UNITUS [b] Morroco 1 (ICARDA) [c] Morroco 2 (INRA) [d] ORC [e] SLU [f] ART [g] TUM [h] KU

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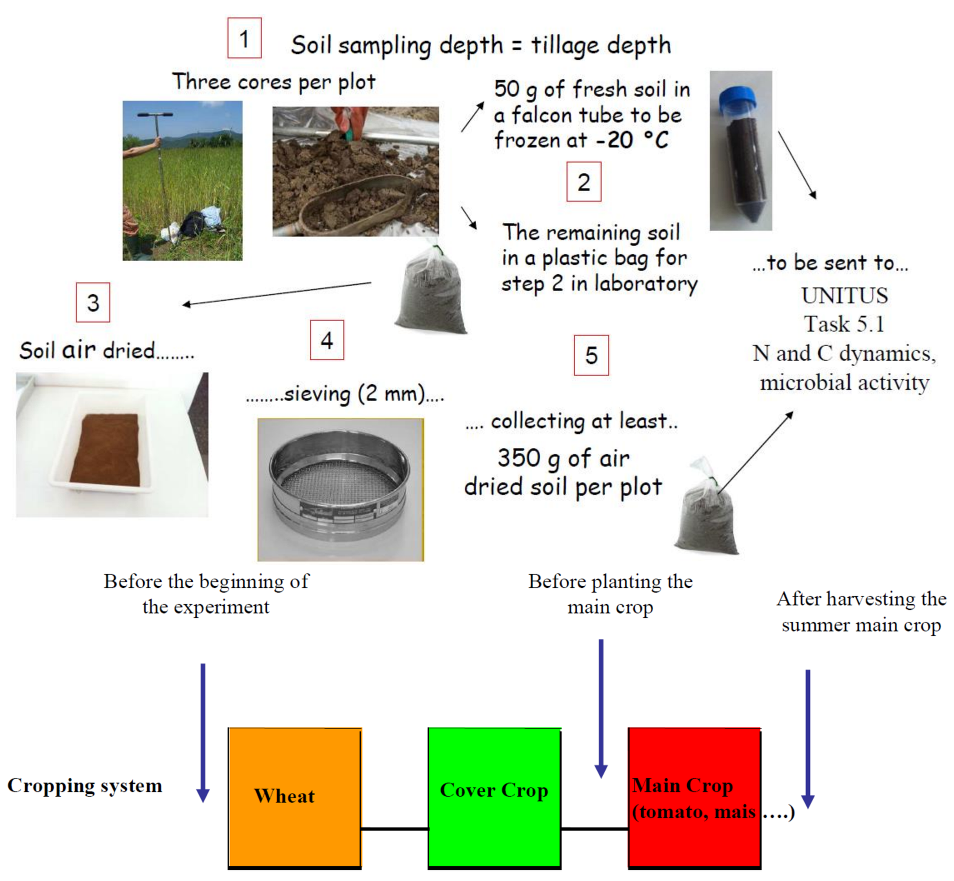
SEVENTH FRAMEWORK PROGRAMME

Aim

1. Which soil variables are strongly correlated?
2. Which variables separate the experimental sites according to different climate zones?

Soil sampling details



Materials and Methods

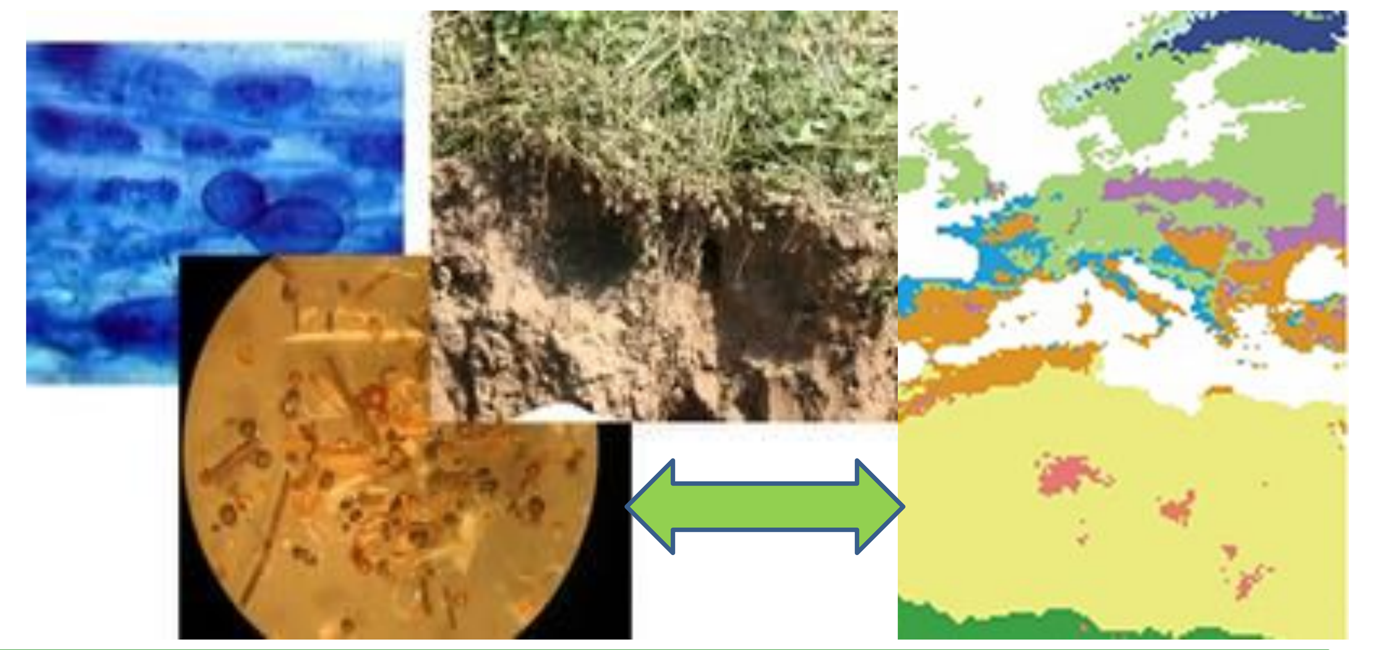
The experimental field have four replication for two tillage levels. Eight soil samples were collected in each block at soil tillage depth. Soil physical-chemical analysis were performed on air dried samples with the exception of nitrates and ammonium content (frozen samples). All biochemical assays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

Correlation Person coefficient and Discriminant Function Analysis (DFA) were performed using STATISTICA 10 (StatSoft Tulsa) for soil properties in order to: (i) verify the relationships between soil chemical and biochemical properties, (ii) to find out the grouping variables according to the maximum of the variance.

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: qmic = Cmic /Corg (%); SEIc= sum of all enzyme activities involved in the C-cycle; 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

Soil chemical properties affect microbial biomass and its activity according to the following results:

- Enzyme activities and microbial functional diversity (H') at the first cycle were strongly and negatively correlated with soil pH and clay content
- Enzyme activities and microbial biomass at the second cycle were strongly and positively correlated with total organic Carbon and Nitrogen.

DFA showed various separated groups according to the first and second discriminant functions (Root 1 and Root 2) as following:

- In the first crop cycle soil properties mainly separated among SLU and MOR 1, MOR 2 (Root 1). Conversely, ART, ORC, TUM and UNITUS were similarly correlated. The main variables that contributed to the separation were organic Carbon, pH, clay content and microbial biomass. Moreover, Root 2 separated UNITUS from the other sites according to the Nitrogen pools (total, extractable and microbial);
- In the second crop cycle soil properties separated MOR1 and MOR2 according to the Root1 from the others sites. Many variable were significantly involved (acid Phosphatase , Arylsulphatase, extractable and organic Carbon, microbial biomass C, total Nitrogen, pH and clay content). Moreover, Root 2 separated ART, UNITUS from ORC, SLU , in this case the main soil property involved was SEI c.

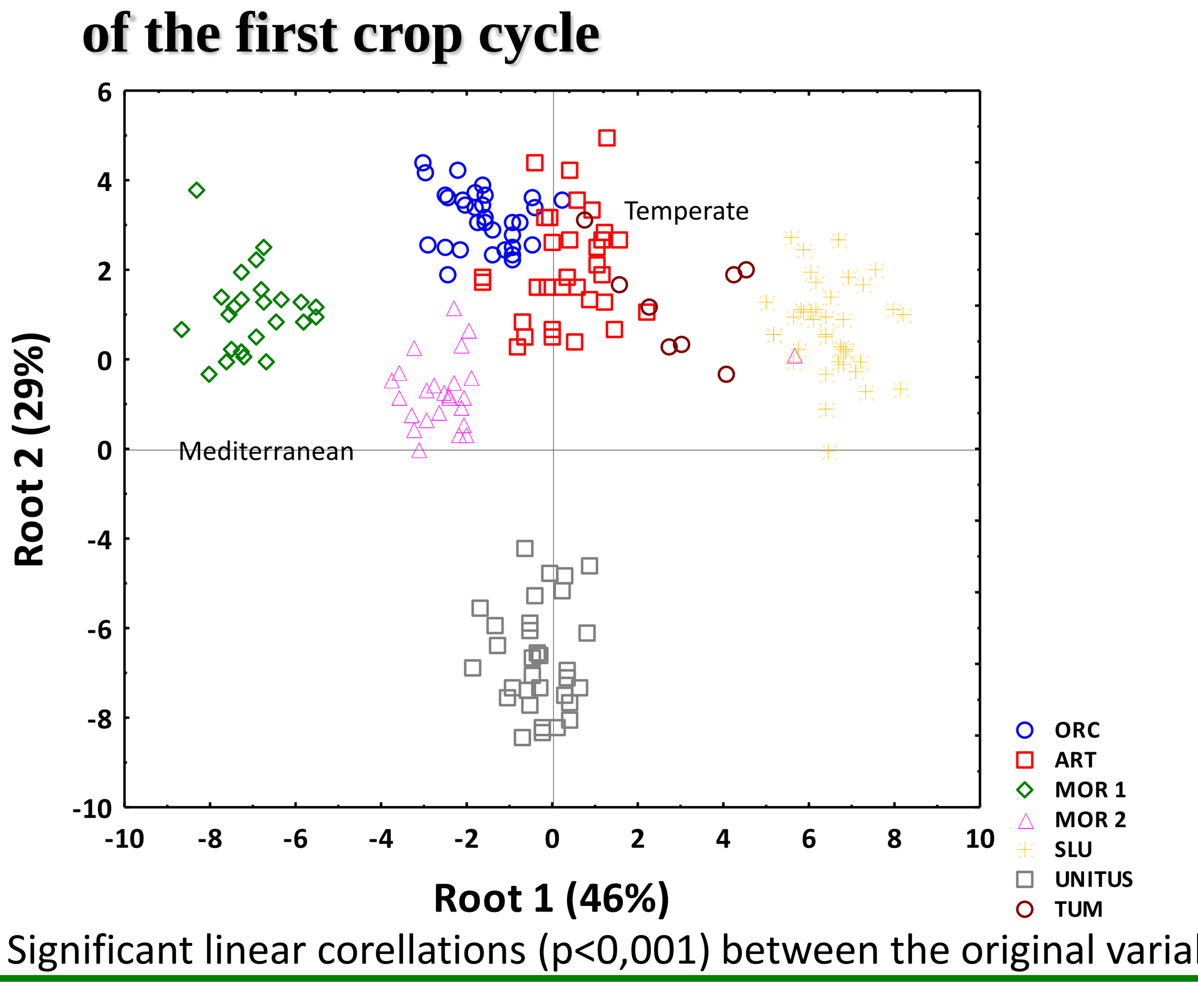
Figures 1 and 2 show a climate gradient, from South and Central Mediterranean areas (Morroco and Italy) to north and Central Europe temperate countries (Switzerland, Germany, United Kingdom and Sweden).

Table 1: Corellation matrix between chemical and biochemical soil properties at the beginning of the first crop cycle

	pH (H_20)	pH (KCl)	Clay	TN	TOC	C/N
SEI	***(-)	***(-)	**(-)		*	
SEI C	**(-)	**(-)	**(-)		*	*(-)
Acid phosphatase	***(-)	***(-)	*(-)			
Arylsuphatase	***(-)	*(-)	***(-)	**	*	
Microbial biomass C	***	***				
Microbial biomass N	**	***				
Cmic /Nmic ratio	*(-)	*(-)			**	
qmic	***	**		*(-)	**(-)	
H' (soil mass base)	***(-)	**(-)	***(-)			
H' (C mass base)	***(-)	*(-)	**(-)			

Person's coefficient significance (n= 24) : *, **, *** at p<0.05, p<0.01, p<0.001, respectively

Figure 1: DFA of soil properties in OSCAR-MEE at the beginning of the first crop cycle



	Root 1	Root 2
SEI c	.3844	
Acid phosphatase	.5121	-.4149
Arylsuphatase	.3793	.2553
Extractable C	-.4014	.4792
Microbial biomass C	-.6489	.5541
Microbial biomass N	-.3521	.4562
Extractable N		.4223
Total Organic Carbon	.7659	.5193
Total Nitrogen	.4360	.4962
pH H_20	-.9459	
pH KCl	-.8227	.4298
Clay	-.6363	

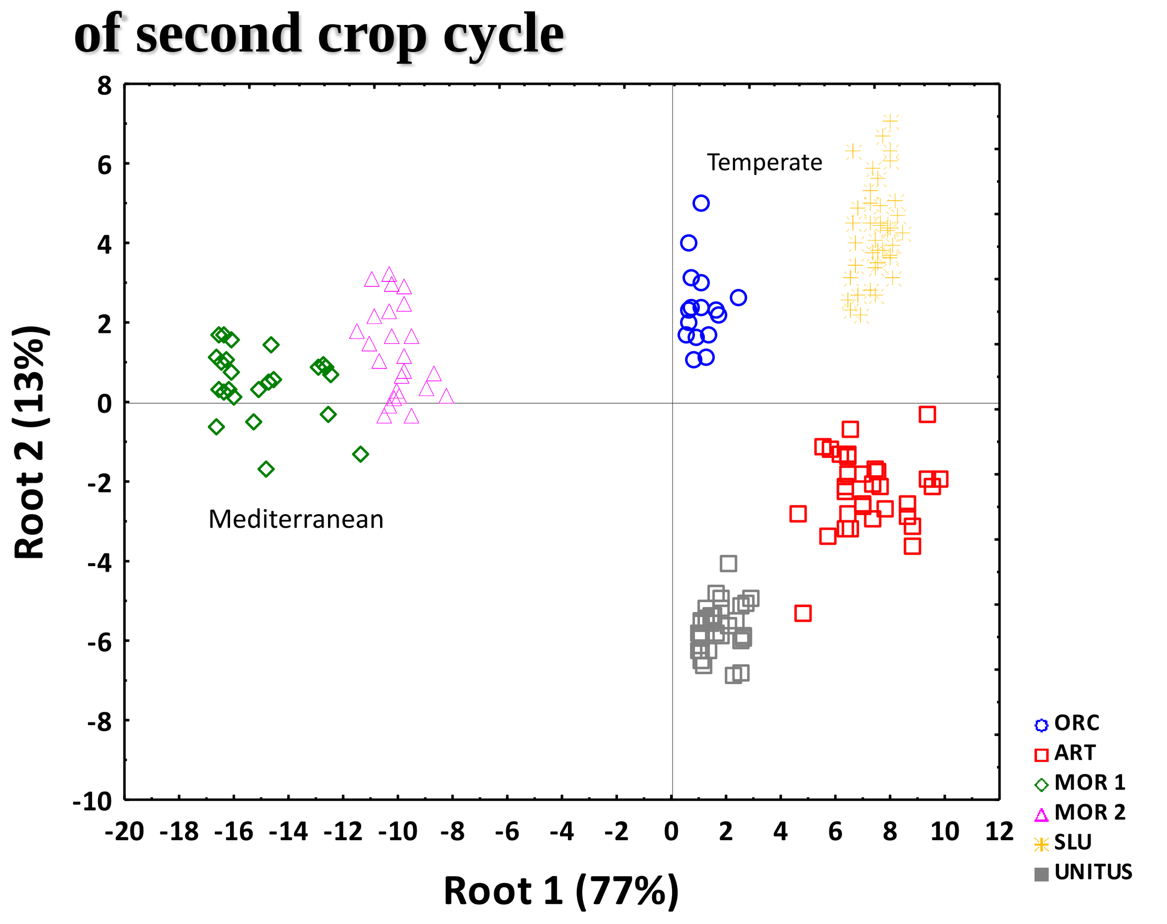
Significant linear corellations (p<0,001) between the original variables and discriminant functions

Table 2: Corellation matrix between chemical and biochemical soil properties at the beginning of the second crop cycle

	pH (H_20)	pH (KCl)	Clay	TN	TOC	C/N
SEI	* (-)	* (-)	* (-)	***	***	
SEIc	** (-)	* (-)		*	***	
Acid phosphatase				*		*** (-)
Arylsuphatase	* (-)	* (-)	*** (-)	***	***	
Microbial biomass C				***	***	
Microbial biomass N			* (-)	***	*	*** (-)
Cmic /Nmic ratio						
qmic				*		
H' (soil mass base)	*** (-)	*** (-)	*** (-)	**	***	
H' (C mass base)	*** (-)	*** (-)	*** (-)	**	***	

Person's coefficient significance (n= 24) : *, **, *** at p<0.05, p<0.01, p<0.001, respectively

Figure 2: DFA of soil properties in OSCAR-MEE at the beginning of second crop cycle



	Root 1	Root 2
SEI c	.2782	.7293
Acid phosphatase	.7243	.5577
Arylsuphatase	.7125	.4783
Extractable C	-.6684	.6217
Microbial biomass C	.2277	.3819
Microbial biomass N	.3677	
Extractable N	.5187	
Total Organic Carbon	.6075	.6944
Total Nitrogen	.5190	.4762
pH H_20	-.7209	-.1731
pH KCl	-.7714	
Clay	-.9918	

Significant linear corellations (p<0,001) between the original variables and discriminant functions .

Conclusions

- ✓ Soil chemical properties were correlated with microbial biomass and its activity. Different correlations were found at the beginning of the first and second cycles, respectively.
- ✓ Soil samples were grouped with respect to the different climate zones. The main variables that separated the countries were organic Carbon, total Nitrogen, pH and clay content.

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