ISMOM 2019
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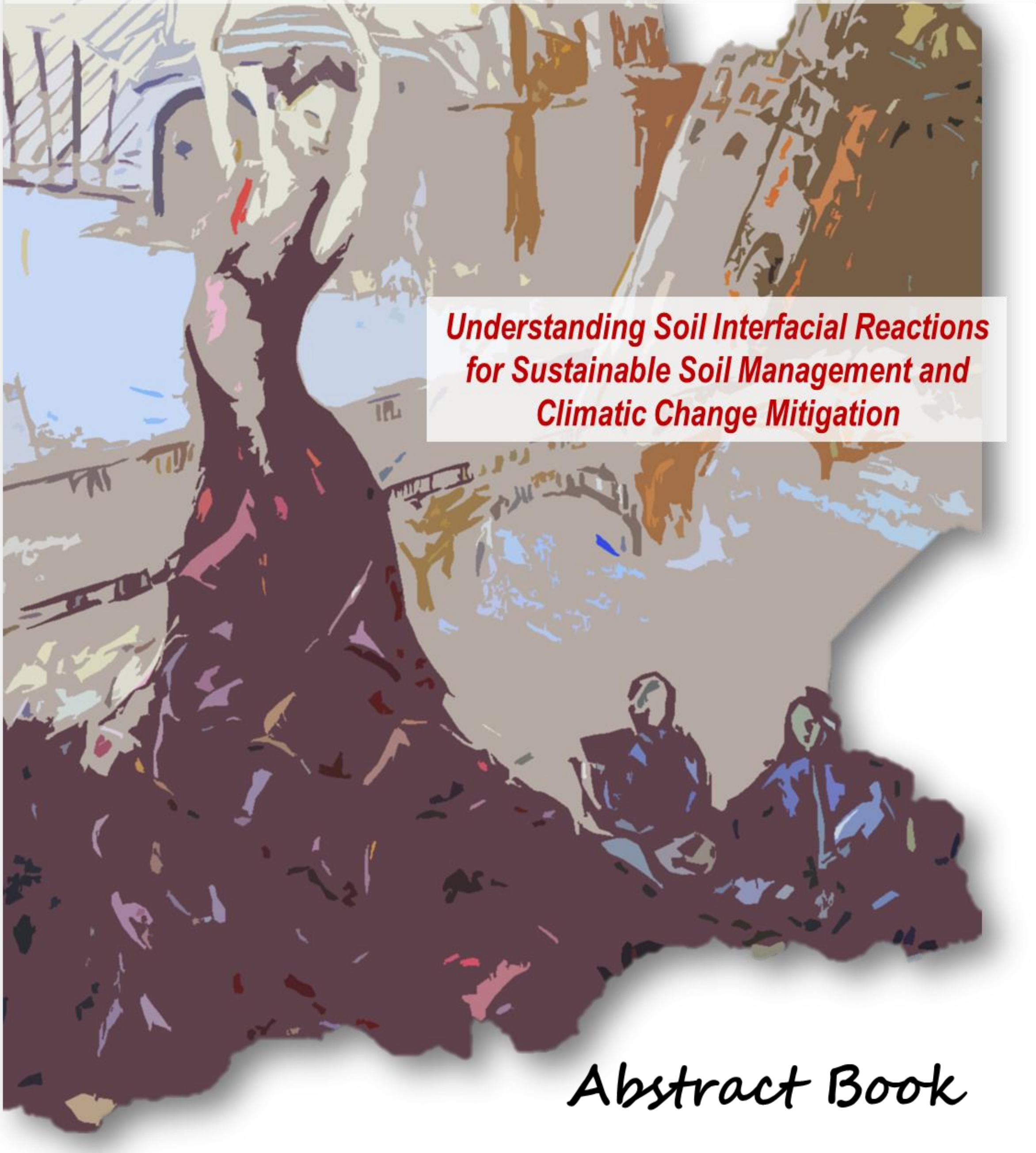

Understanding Soil Interfacial Reactions for Sustainable Soil Management and Climatic Change Mitigation

Abstract Book

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Understanding Soil Interfacial Reactions for Sustainable Soil Management and Climatic Change Mitigation

Plenary Session

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Understanding Soil Interfacial Reactions for Sustainable Soil Management and Climatic Change Mitigation

Dr. P. M. HUANG PRIZE TALK

ECOLOGICAL, CHEMICAL, AND PHYSICAL NATURE OF SOIL ORGANIC MATTER

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Organic matter (OM) in soil plays a fundamental role in ecosystem functioning and has strong control on biogeochemical cycling of various elements. Perhaps the biggest challenge in soil OM research is to untangle the complexity in (a) soil-climate-rock-biota interactions and feedback processes among them at macro scales, and (b) the interactions between microbe, OM of different decay stages, and a suite of soil minerals at finer space-time scales. In this talk, I will go over my (not-always-successful) attempts to untangle some aspects of this complexity.

At a macro scale, I have been examining the interactive effect of climate and parent material on soil OM-mineral-microbe interaction. This was achieved by comparing the forest ecosystems on the environmental matrix consisting of two contrasting rocks along an altitude (climate) gradient. With my colleagues, I was able to show the changes in the stock and chemistry of soil OM pools of three density fractions [1], organic coverage on soil mineral surface area by N_2 gas sorption approach[2], and microbial community composition by PLFA biomarker analysis[3]. Using soil OM concentration gradient induced by decadal soil management in Japan, I also examined the factors controlling the temperature sensitivity of soil OM decomposition by directly assessing soil C chemistry by solid-state NMR spectroscopy after distinguishing accessible low-density fraction and less-accessible organo-mineral fraction and by comparing microbial respiration with various soluble C pools and microbial biomass under different temperature treatments[4].

Some aspects of OM-mineral interaction were also examined at finer scales. By focusing on Fe oxides, we developed a method to quantify the amount of OM sorptively stabilized by Fe oxides[5]. We also reviewed the density fractionation studies with a focus on the fraction with high uncertainty (occluded LF) and proposed a conceptual model linking the fractions[6]. While size-based fractionation is another common approach, the physical distinction between soil particle and aggregate remains unclear especially for OM-rich, strongly-aggregated Andisols. By characterizing the micron to submicron-sized particles liberated after different dispersion energy levels, we were able to refine the 1980's concept of aggregate hierarchy and discussed its linkage to OM stabilization[7].

[1] Wagai et al. (2008) Geoderma 147: 23-33. [2] Wagai et al. (2009) Geoderma 149: 152-160. [3] Wagai et al. (2011) Ecological Research 26: 627-636. [4] Wagai et al. (2013) Global Change Biology 19: 1114-1125. [5] Wagai & Mayer (2007) Geochimica et Cosmochimica Acta 71(1): 25-35. [6] Wagai et al. (2009) Soil Science & Plant Nutrition 55(1): 13-25. [7] Asano & Wagai (2014) Geoderma 216: 62-74

PLENARY SESSION

Abstract number PS 1:

SOIL SCIENCE – A SCIENCE OF INTERFACES

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Soil is a complex multiphase, heterogeneous medium and its study requires a judicious blend of simplification and complexity. Commission 2.5 (**Soil chemical, physical and biological interfacial reactions**) of the IUSS, and its predecessor, the working group MO (**Interactions of soil minerals with organic components and microorganisms**) were conceived to break-down the boundaries between the traditional sciences, that had been the basis of much of the study of soil science. Interface is the key word. Interfaces within soil, between phases, between biotic and abiotic components. Interfaces between the traditional scientific disciplines of physics, chemistry and biology, and of mineralogy, microbiology and agronomy. I shall talk briefly about the evolution of Commission 2.5 and the history of the ISMOM conferences. I shall illustrate the complexity of studying soils and the importance of interfaces between minerals and organic matter, particularly proteins, to demonstrate that it is vital to promote multidisciplinary and interdisciplinary research.

Session 1:

Soil as a C and N sink – Who is the major player, soil minerals, soil organic matter quality, microbial activity or their interplay?

Abstract number: K 4

ORGANO-MINERAL ASSOCIATIONS IN WEATHERED SOILS AND THEIR IMPLICATIONS ON SOM STABILIZATION

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Weathered soils occur in tropical and subtropical zones of the globe and are characterized by a predominance of pH-dependable charge minerals. Considering that great part of these zones is under agriculture or will be used for agriculture expansion, identification of factors and mechanism for the stabilization of soil organic matter (SOM) is most relevant in order to preserve or even improve C stocks in these soils. In this context, the main purpose of this paper is to discuss results obtained with Brazilian soils from tropical and subtropical areas in light of stabilization factors and to highlight relevant aspects related to environmental conditions and mineralogy. Different studies with Brazilian Oxisols profiles have indicated that organo-mineral associations stabilize hydrophilic and biochemically labile structures of SOM through interactions with Fe-oxides, kaolinite and gibbsite. Organo-mineral interactions seem to enhance the effect of colder climate on SOM accumulation at surface layers as indicated by a study performed with a topossequence of subtropical Oxisols. However, with increasing soil depth influence of climate decreased and organo-mineral interactions assumed a more relevant role. On the other hand, in sandy Amazonian Ultisols under humid tropical climate SOM dynamics is strongly affected by climate and organo-organic interactions. In such environments, SOM presents a high contribution of microbial derived lipids and the effect of vegetation fire on SOM chemical composition tends to disappear within 2 or 3 years. The crystallinity of Fe-oxides plays also an important role on the stabilization of SOM, as indicated by the correlation found between Feo/Fed ratio with O-alkyl C groups of SOM in subtropical Entisols, Mollisols and Oxisols. A synergic effect of the SOM-Fe-oxides surface interactions was inferred: organo-mineral surface reaction not only stabilize SOM but also hinder further crystallization of variable charge minerals. Pedogenesis plays also an important role on SOM composition and content: while organo-mineral interactions were the main process for SOM stabilization in a well aerated Brown Oxisol, at the bottom of the topossequence, SOM hydrophobic sites lead to the preservation of encapsulated carbohydrate-like structures, via organo-organic associations. Our results evidence the combined and simultaneous effect of mineral type, mineral surface and organo-organic reactions and climate on the SOM dynamics in the tropics and subtropics.

AKNOWLEDGEMENTS: CNPq and CAPES (Brazil), IHSS, DAAD (Germany)

Keywords: ORGANO-MINERAL INTERACTIONS, HYDROPHOBICITY, CHEMICAL COMPOSITION

Abstract number: S 1

TILLAGE INCREASES SOIL ORGANIC CARBON IN LAND-USE CHANGE BETWEEN GRASSLAND AND UPLAND CROP

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Land-use change between grasslands and croplands has a significant influence on soil organic carbon (SOC). However, SOC change and net ecosystem carbon balance (NECB) in the transition period of the land-use change is poorly understood. Comparison of SOC and NECB with and without manure application was studied from 2005 to 2015 in a field used as an old permanent grassland (OG) which was tilled and converted to a cornfield (2010–2012) and then converted to a new grassland (NG) (2013–2015) in Southern Hokkaido Japan. Chemical fertilizer and manure (MF) and chemical fertilizer only (F) plots were established with four replicates in a randomized design. Cow manure (7t C ha^{-1}) was broadcasted in MF plot and additionally incorporated by tillage in cornfield. Chemical fertilizer was broadcasted in grassland and banded in cornfield at a recommended rate of ~150 kg N ha$^{–1}$. SOC in 0-30 cm soil depth was measured every two years in 16 - 20 replicates in both plots. NECB was estimated as difference between carbon input (manure + aboveground and belowground residues) and heterotrophic respiration (RH). The RH was measured using the closed chamber method.

In both F and MF plots SOC did not change in OG but increased after conversion from OG to cornfield by around 10 t C ha^{-1} yr^{-1} and did not change again in NG. After conversion from OG to cornfield RH (t C ha^{-1} yr^{-1}) increased from 6.7 to 8.9 in MF plot and 4.5 to 5.9 in F plot and declined by at least 20% after conversion to NG. Residue input (t C ha^{-1} yr^{-1}) was larger in OG (10.7 in MF and 9.9 in F) than cornfield (1.1 in MF and 1.0 in F) and NG (1.2 in MF and 1.4 in F) due to high belowground residue in OG. Therefore NECB in F plot decreased after conversion from OG to cornfield due to increase of RH and decreased residue input but MF plot showed stable NECB due to manure application. These findings indicate that organic matter addition only cannot increase SOC although it increases NECB while tillage only reduces SOC due to decrease of NECB. Combination of organic matter addition and tillage is required to maintain and increase SOC.

Keywords: LAND-USE CHANGE, MANURE APPLICATION, NET ECOSYSTEM CARBON BALANCE, SOIL ORGANIC CARBON TILLAGE

Abstract number: S 2

C4-ACCUMULATION BY MISCANTHUS INCREASES WITH SOIL ORGANIC MATTER CONTENT

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Miscanthus x giganteus is a highly productive energy plant with C4 photosynthetic pathway which can be cropped also on marginal sites. Its high productivity and a dense rhizome network suggest a high carbon sequestration potential but results on soil carbon stock effects are contradicting. Even though an increase in soil bulk $\delta^{13}C$ signature is always observed the effect of Miscanthus on net soil C sequestration seems to depend mostly on the previous land-use under similar climatic conditions. Earlier studies carried out on mineral soil indicated that Miscanthus fields tend to accumulate SOC after conversion from cropland. Here we report on a sequence of five paired sites in close vicinity to each other comprising a topsoil SOC gradient from 60 – 266 t ha^{-1} (0-30 cm) (corresponding to 1.3 – 17.9 % SOC). Miscanthus was cropped for 19 – 24 years preceded by cropland and C stocks and isotopic signatures were compared to the control sites without Miscanthus. We hypothesized net SOC accumulation and that accumulation of C4 (as recorded in $\delta^{13}C$ of bulk soil carbon) should be higher on sites with lower SOC content because of stabilization mechanisms of the mineral matrix. We find that Miscanthus cropping did not lead to a net SOC increase but an annual accumulation of C4-C of between 1.0 and 2.7 t C ha^{-1} in 0 – 30 cm. $\delta^{13}C$ signatures of SOC approached values of reference sites below that depth. Annual accumulation rates were positively and significantly related to SOC content indicating that organic soils provide better conditions for accrual of new C. Possible mechanisms for this will be discussed.

Keywords: ORGANIC SOIL, STABLE ISOTOPES, SEQUESTRATION, MISCANTHUS, LAND USE CHANGE

Abstract number: S 3

LAND-USE AND BIOGEOCHEMICAL DESCRIPTORS OF PRIMING EFFECT OF SOIL ORGANIC MATTER DYNAMICS AT A LANDSCAPE SCALE. A STUDY OF A RURAL AGRICULTURAL CATCHMENT IN BRITTANY, FRANCE

Marco Panettieri[1], Nicolas Chemidlin[2], Julien Guigue[3], Mathieu Thevenot[1], Jean Leveque[1], Anne-Lise Santoni[1], Pierre-Alain Maron[4], Stéphane Mounier[5], Valérie Viaud[6], Olivier Mathieu[1]

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A sustainable land management aims to guarantee adequate agricultural or husbandry productivity and to provide at the same time several ecosystem services. Among those services, the accumulation of soil organic matter (SOM) is one of the keystones. Soil has been identified as a possible carbon sink and the chemical and biological transformation of vegetal litter into soil organic matter is widely influenced by land-use and a plethora of biotic (interactions with plants microbes fungi microfauna) and abiotic factors (content of minerals water balance atmospheric conditions). However the increase of new carbon inputs to soil may trigger the mineralization of stabilized SOM a process called priming effect (PE).

The objective of the ANR project MOSAIC was to describe at a landscape scale which soil parameters are influencing the susceptibility of SOM to priming effect. To achieve this objective physical chemical and metagenomics analyses conducted on 88 sampled soils from Naizin Catchment (Brittany France) were combined with soil incubation for the measurement of carbon fluxes. Successively variance partitioning models were used to identify the significant descriptors of PE.

Priming effect induced by labelled wheat litter mineralized 3 per mil of SOM in 80 days. Results highlighted that PE is controlled by a complex network of biotic and abiotic factors, which include soil chemistry quality of SOM shape and abundance of microbial communities. Identified fluorophores in the dissolved organic matter seems to explain a large part of the measured variance for PE probably assuming the role of biomarkers. At least two different components leading to PE were identified one regarding the stoichiometry of litter and SOM and one regarding the abundance and distribution of microorganisms.

Among the variables referred to land-use the time of crop rotation devoted to grassland was selected as a descriptors. The introduction of grassland for 40-60% of the time of rotation achieved the lowest susceptibility to PE and higher indexes of microbial diversity whereas higher or lower proportions of time devoted to grassland resulted in an increase of priming effect and a decrease of bacterial evenness.

Keywords: SOIL CARBON WATER SOLUBLE ORGANIC CARBON GRASSLAND CROPLAND MICROBIAL COMMUNITIES

Abstract number: S 4

SOIL ORGANIC CARBON POOLS AND COMPOSITION IN RESPONSE TO LAND USES IN SOUTHERN BRAZIL

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Preserving organic carbon (OC) stocks in agriculture lands is essential to keep soil functions and meet the requirements to advance in food security. The adoption of conservation agriculture (e.g. no-till system) has been recognized as pivotal to achieve this goal but the potential of this system to increment OC quantity and quality and how this OC is stabilized in soils is not well established. In this study we evaluated the effect of land uses [native vegetation (NV) vs. no-till system (NT)] on OC stocks and chemical composition of organic matter (OM) and sought to understand the mechanisms that govern OC protection in the studied highly weathered soils. To achieve these objectives we used an OC fractionation scheme in a combination of solid-state ^{13}C NMR analyses in soils of six farms from the Southern region of Brazil. Our results showed lower OC stock (bulk soil) at NT than at NV in four of six sites. In addition the OC stock differences between land uses were higher in coarser textured soils and where conventional tillage was used before NT adoption. Among fractions particulate organic carbon (POC) represented only 8 % of whole OC stock but was the fraction most affected by land use. In contrast humus organic carbon (HOC) fraction contributed 78 % of the whole OC stocks and was little altered by land uses. Furthermore HOC stock had a linear relationship with OC stock in bulk soil (no saturation effect) indicating a great potential for further OC accumulation in these soils. Resistant organic carbon (ROC) represented 14 % of the whole OC stock and it was altered by land uses demonstrating that this fraction is not as inert as previously thought. Overall the OM chemical composition was quite similar between land uses being O-alkyl-C the predominant C type. This labile component was further highly correlated with OC stock and silt + clay content indicating that the accumulation of OC in these highly weathered soils is mainly a response to the association between labile C compounds with soil minerals.

Keywords: CARBON FRACTIONS CARBON STABILISATION MECHANISMS NO-TILLAGE SOLID-STATE ^{13}C NMR SPECTROSCOPY WEATHERED SOILS

Abstract number: S 5

USE OF COUPLED BIOCHAR AND STRAW MULCH AS A TECHNIQUE TO MITIGATE SOIL EROSION AND IMPROVE SOIL CARBON STOCKS IN BURNED SOILS OF SOUTHERN IBERIAN PENINSULA

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Wildfires typically increase runoff as well as soil erosion due to exposure of soil to direct raindrop impact. In addition, wildfires may cause a drastic alteration of soil structure by decreasing organic matter content and quality aggregate stability and carbon cycling.

Post-fire mulching is the most widely accepted measure to mitigate soil erosion effectively but unfortunately mulch materials and application rates can vary greatly affecting its effectiveness. Some mulch materials such as straw have been used widely but others such as biochar which can improve soil quality has never been used in burned areas and has the potential to mitigate soil losses and improve soil quality in burned areas.

While the CESAM group at the University of Aveiro has extensive experience in evaluating methodologies for erosion control the Organic Matter group from IRNAS-CSIC institution has studied soil quality and soil conservation strategies. This work aims to show examples of tools applied to mitigate post-fire erosion and their effects on soil quality.

A total of 40 microplots (1 m^2) were installed in September 2018 in two areas where wildfires burned at high severity (sandy and loamy soils) of southern Portugal and Spain respectively. Soil and sediment samples are being collected to assess soil erosion and carbon stocks via TG and DSC analysis. Treatments are: Burned (controls) Brushed (ash and stones removed) Straw mulch (at a rate of 1 Mg ha^{-1})

Straw+Biochar (at a rate of 1+15 Mg ha^{-1}) Pine slash and Marine algae. Preliminary results show that Straw and Straw+Biochar mulch strongly reduced soil erosion in 67-60% compared to Burned plots or the Brushed plots which did not differ from each other. These findings indicate that applying both Straw together with Biochar can be an effective way to increase not only the labile soil organic matter fraction (derived from mulch itself) but also retain more recalcitrant native soil organic matter fractions (derived from the lack of erosion) and possibly also increase recalcitrant organic matter derived from biochar.

Keywords: THERMOGRAVIMETRY, CARBON, SEVERE WILDFIRES, MEDITERRANEAN WATER EROSION

Abstract number: S 6

ABIOTIC INCORPORATION OF INORGANIC NITROGEN TO ORGANIC FORMS IN ANDISOLS

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Soils can be an important sink for excess nitrate (NO_3^-) but the problem remain poorly studied. Here we assessed the abiotic conversion of nitrate (NO_3^-) to organic N forms by the fast reaction in the presence of iron (Fe) in an Andisol. Based on the Ferrous Wheel Hypothesis we postulated that reduced soluble iron (Fe) (II) releases electrons (e^-) to reduces NO_3^- to nitrite (NO_2^-) and NO_2^- subsequently reacts with the organic matter to form dissolved organic N (DON). This process occurs via nitrosation (addition of -NO) in aromatic structures. During five days of incubation the abiotic reactions were measured in dissolved organic matter (DOM) in soils derived from volcanic materials under anoxic conditions at different NO_3^- concentrations. A subset of samples was treated with unlabelled NO_3^- and Fe(II) to test for the effect of e- acceptors and donors respectively on the transformation of DOM to DON. ^{15}N labelled NO_3^- added to DOM disappeared immediately after 15 min of incubation. The total recovery of ^{15}N added as NO_3^- fluctuated between 62.9 and 101.4% and the remaining NO_3^- was emitted as gaseous N. . At the end of incubation, about 24.8% of the added labelled nitrate to DOM was transformed to DON. The nitrates in the DOM fraction were intensively transformed to DON in the presence of high amounts of e^- donors Fe(II) and e– acceptor NO_3^-. Traces of N_2O and CO_2 provided further evidence of Fe reduction and DOM oxidation respectively. In addition Nitrate and Fe(II) added to soil stimulated the formation of organic N which increased up to 3.8 times from the initial concentration of 140 mg kg^{-1}. From these results, we propose a new N cycling conceptual model (including N_2O and CO_2 fluxes). We conclude that NO_3^- reacts with SOM to be incorporated as organic N forms. By this process mineral N losses decrease in humid temperate rainforest Andisols that receive high amounts of precipitation. Anoxic conditions intense rainfall events high amounts of dissolved organic C and high free iron content in the soil solution provide the ideal conditions to activate the Ferrous Wheel in highly reactive soil.

Keywords: NITRATE REDUCTION, NITROSOTION, N SEQUESTRATION, TEMEPERATE RAIN FOREST, FERROUS WHEEL

Abstract number: S 7

IS GRSP (GLOMALIN RELATED SOIL PROTEIN) A STABLE AND DISTINCT FRACTION OF SOIL ORGANIC MATTER?

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Soil organic matter has many roles including ensuring physical soil stability and sequestering carbon to limit greenhouse gas accumulation. In a context of mitigation of greenhouse gas emissions and adaptation to climate change the study of sequestration mechanisms is of great importance.

Operationally defined Glomalin-related Soil Protein (GRSP) is considered to be of fungal origin. However the strong correlation between GRSP and soil organic carbon SOC and the realization that the composition of GRSP is not as simple as first claimed leading to doubts as to its distinct character. Chronosequences following land-use change show that GRSP resists mineralization better than SOC. However the level of GRSP could be maintained by current land cover. We attempt to unravel these possible causes by studying the historical bare fallow plots known as the 42-Parcelles Versailles France set-up in 1928. If GRSP were a centennially stable fraction of SOC then it would represent an increasing proportion of SOC as the latter is depleted. We compared the trends in SOC and GRSP for five treatments; the controls with no inputs and four other treatments: manure to increase SOM; $CaCO_3$ to alkalinize $(NH_4)_2SO_4$ a strongly acidifying N-fertilizer and KCl a K-fertilizer with a clay-dispersive effect. Numerous studies have assessed the stability of organic matter in this 90-year old trial with various chemical physical and biological techniques.

A significant correlation between GRSP and SOC was observed including increasing SOC (manure-treatment) and progressive depletion. The trend in the proportion of soil C attributable to GRSP varied between treatments. The ratio GRSP/SOC increased over time for the manure treatments control and $(NH_4)_2SO_4$ treatments but decreased for the KCl and $CaCO_3$ treatments. These results do not confirm a systematic long-term stability of GRSP and indicate that pH may play an important role either because of physical stability or biological activity.

Keywords: GLOMALIN, CARBON MINERAL, MINERALIZATION LONGTERM, FIELD TRIAL

Abstract number: S 8

MICROBIAL UTILIZATION OF LITTER-DERIVED DISSOLVED ORGANIC CARBON IN TOPSOIL AND SUBSOIL

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Investigations on the interrelation between soil habitat conditions microbial pools and process rates and decomposition of organic matter (OM) are crucial for the understanding of carbon (C) cycling processes within soil profiles. We conducted a field experiment with ^{13}C-labelled leaf litter in a beech forest in Lower-Saxony Germany to trace the fate of litter-derived dissolved organic carbon (DOC) in different groups of microorganisms from the soil surface to deeper soil. Starting in January 2015 labelled leaf litter was applied on the soil surfaces surrounding three soil observatories where DOC fluxes and the abiotic habitat conditions were continuously measured in different soil depths. After almost 2 years of litter decomposition and input of $DO^{13}C$ into the soil the labelled litter was removed in November 2016 and the original non-labelled litter was applied to set a second (unlabelled) DOC pulse to follow the temporal and spatial development of DOC turnover and storage in different C pools. Soil samples were taken in 15 different soil depths down to 180 cm in three sampling campaigns (0 6 and 18 months after the second litter replacement). We followed the litter-derived C assimilation of specific groups of soil microorganisms (based on ^{13}C-phospholipid fatty acids) at different soil depths. Our results display a gradual migration of litter-derived C into microbial communities from topsoil to subsoil within the first 6 months. The generally higher ^{13}C-incorporation rates (%) into fungi than bacteria in both topsoil and subsoil indicate a prevalent dependence of fungal communities on (recent) litter-derived C as well as slower C turnover rates of fungal compared to bacterial decomposers. Our project allows novel insights into the dynamic interrelations between habitat conditions and microbial OM decomposition within whole soil profiles and provides the analytical basis needed to improve the parameterization of biogeochemical models.

Keywords: MICROBIAL COMMUNITY, DISSOLVED ORGANIC CARBON, TOPSOIL, SUBSOIL, DECOMPOSITION

Abstract number: S 9

EFFECT OF MATRIC POTENTIAL ON THE SOIL VOLUME INVOLVED IN THE BIODEGRADATION OF PLANT RESIDUES

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It is well established now that one of the main divers of soil organic matter (SOM) dynamics is the physical access of organic substrates to decomposers in the complex 3-D architecture of soils. The accessibility of substrates to microorganisms is controlled by transport processes in soils themselves being modulated by abiotic soil characteristics such as its pore size distribution and connectivity and the degree of pores saturation by water. As a result of these limited transport processes and of the spatially heterogeneous distribution of organic substrates and decomposers decomposition largely takes place as hot spots e.g. the detritusphere induced by plant residues which means that only a fraction of the soil volume is involved in the biodegradation of a given organic substrate.

Here the objectives were: (i) to determine the volume of soil actually involved in the biodegradation of an organic substrate and (ii) to evaluate the impact of water content on C dynamics at the scale of the biodegradation hot spot by monitoring the spatio-temporal evolution of microorganisms and their activity at the scale of the microbial habitat.

The experimental set-up was based on incubated soil microcosms with addition of localized complex organic substrates (a central layer of ^{13}C labelled maize residues) at three different matric potentials (-0.0031 MPa ; -0.031 MPa and -0.31 MPa). We monitored the ^{13}C and total carbon mineralization and on additional microcosms selected at 4 different dates (after 3 7 15 and 45 days of incubation) we separated soil layers with increasing distances from the residues in order to analyze the microbial community structure and its activity by processing PLFA and SIP-PLFA.

The mineralization from the residues and soil organic matter increased with the water content. The addition of fresh organic matter promoted a priming effect which is also affected by the water content with different time dynamics. Total and ^{13}C microbial communities were more stimulated in the vicinity of plant residues i.e. in the detritusphere than in the bulk soil. The succession of bacteria and fungi also dependent on the water content could explain the more pronounced priming effect at the lower water content.

Keywords: CARBON CYCLE, BIODEGRADATION, MATRIC POTENTIAL, SOIL ORGANIC MATTER, MICROBIAL HABITAT

Abstract number: S 10

RELATIVE DEGRADABILITY OF EXOGENOUS ORGANIC CARBON IN FUNCTION OF ITS CONCENTRATION AND THE INTERACTION WITH NATIVE SOIL ORGANIC MATTER CONTENT

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The soil environment impacts carbon (C) turnover in a multitude of ways. It has been shown that C emissions are higher when exogenous carbon is locally concentrated than when it is spread in the soil matrix. Hence the spatial separation between decomposers and their substrate may cause ineffective dispersion of the produced enzymes within the soil matrix. It is not clear however if and how lower doses of exogenous C also impact its degradability and if an interaction exists with native soil organic matter (SOM) level. Therefore a seventy-day incubation experiment with six varying exogenous OM doses (0-6 g C kg^{-1}) in soil mesocosms of loamy sand subsoil (WFPS 50%) with three different native SOM contents (i.e. 0.1 0.5 and 1.0 %) was carried out. CO_2 emissions and isotopic signature measurements of $^{13}CO_2$ by means of a CRDS-analyser were used to track the degradation of added maize shoots with a $\delta^{13}C=-12.7‰$ that contrasts to native SOM ($\delta^{13}C=-25‰$). Mineral N was added and the redox potential (Eh) monitored. Eh suggested that O_2 may have not become limiting for C mineralization even at higher doses but it did not clearly relate to the added C dose. Cumulative CO_2 emissions increased proportionally with C dose and so our hypothesis that a lower dose dispersion limits microbial activity was disproved. However a higher native SOM level led to higher relative degradability of added C for the highest doses (i.e. 3 and 6 g kg^{-1} soil). Furthermore a negative impact of OM doses above 1 g kg^{-1} soil on native SOM degradation was found. Growth of the microbial biomass was only stimulated proportionally above 1 g C kg^{-1} and this extra biomass was unexpectedly not involved in degradation of native SOM but instead exclusively in the decomposition of the added maize residues. Hence, we can conclude that positive priming of native SOM mineralization did not occur but rather negative priming effect was found for higher doses (> 1 g C kg^{-1}). The resulting disproportional response of microbial biomass carbon (MBC) and soil C mineralization at lower doses suggests that dose does impact the apparent microbial metabolic quotient (qCO_2). Ongoing PLFA analyses will further reveal the soil microbial community structure along the different treatments and help us interpret these observations.

Keywords: SOIL ORGANIC CARBON, CARBON TURNOVER, SUBSTRATE MINERALISATION, PRIMING EFFECT, CARBON ISOTOPES

Abstract number: S 11

POSITION-SPECIFIC ^{13}C LABELING AND ^{13}C-PLFA ANALYSIS REVEALS PREFERENCES FOR FREE, SORBED OR NECROMASS C

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Sorption to mineral surfaces is an important process contributing to soil organic matter (SOM) stabilization. It delays microbial uptake and therefore mineralization to CO_2. However recent findings have revealed increased metabolic efficiency from sorbed substrates.

We used position-specific labeling to compare the transformation mechanisms of sorbed and non-sorbed alanine in soil and we determined whether the higher metabolic efficiency is due to a metabolic shift in the whole microbial community or a result of microbial specialists adapted to sorbed SOM.

We added uniformly and position-specifically ^{13}C labeled alanine to a loamy Luvisol and incubated the soil samples for 10 days. Two different amendments were compared: i) alanine sorbed to sterilized soil and ii) free alanine in solution. Incorporation of C from individual alanine positions was evaluated in distinct microbial groups classified by ^{13}C-PLFA analysis.

Most microorganisms took up sorbed and free alanine equally. The metabolic pattern was also similar in most microbial groups: incorporation of C from carboxylic C-1 into PLFA was negligible whereas C from positions C-2 C-3 were preferentially incorporated into PLFA reflecting the basic microbial metabolism of C3 molecules.

Only fungi incorporated more C from sorbed than free alanine into their PLFA. Their metabolic pattern also revealed a more complex metabolization pathway.

While the incorporation into most microbial groups' PLFA remained stable or decreased over 10 days the ^{13}C in the PLFA of Actinobacteria increased up to 7 times from day 1 to day 10. This was explained by the uptake of secondary substrates (microbial necromass secretion products).

The results show that the more efficient metabolization of sorbed substrates is the work of microbial specialists: The higher incorporation of sorbed than free substrate into fungi is most likely a result of their colonization of particle surfaces and their higher demand for C to build up biomass.

Keywords: SORBED C, ^{13}C-PLFA NECROMASS, MICROBIAL BIOMASS, C METABOLIC PATHWAYS

Abstract number: S 12

EARTHWORMS ENHANCE THE MICROBIALLY MEDIATED BUILD-UP OF MINERAL-ASSOCIATED SOIL ORGANIC MATTER

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Earthworms as "ecosystem engineers" may profoundly affect soil organic matter (SOM) dynamics. Yet studies on effects of earthworms on heterotrophic soil respiration and organic carbon (OC) stabilization mostly neglect compositional changes of SOM and do typically not exceed a few weeks. Such studies find increasing respiration as well as larger amounts of OC stored in aggregates produced by earthworms. Earthworms thus have opposing effects on the stability of OC in soil; on the one hand stimulating CO_2 emissions and on the other hand transferring OC into a more stabilized form. Due to the limited number of long-term and molecular level studies though a mechanistic understanding of the net effect of earthworms on soil OC stocks is still lacking.

Here we combine long-term (33 weeks) incubations of earthworm affected and unaffected soil with spectroscopic molecular and isotopic methods to show that while negligibly affecting bulk soil OC contents earthworms highly change the composition of SOM associated with different soil fractions. Specifically particulate organic matter and mineral aggregate fractions were enriched in microbial compounds as compared to those derived from plants in the presence of earthworms. We argue that the stimulating effect of earthworms on microbial activity and abundance favors the microbially mediated buildup of stabilized SOM in aggregates and organo-mineral associations. This process may increase soil OC stability in the long-term and outweigh the short-term positive effect of earthworms on mineralization rates observed by many studies.

Keywords: EARTHWORMS, SOIL ORGANIC MATTER STABILITY, BIOMARKERS

Abstract number: S 13

SOME RECENT ADVANCES IN UNDERSTANDING, PREDICTING AND MANAGING ORGANIC CARBON STABILISATION IN NEW ZEALAND SOILS

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Soil organic carbon (SOC) sequestration is recognised as a potentially significant option to off-set the rise in global atmospheric CO_2 concentrations. It is widely accepted that a soil’s potential to sustainably sequester C is finite and dependent on its capacity to stabilise SOC although this theory has been challenged. The stabilisation of SOC has been attributed to several mechanisms but the formation of organo-mineral complexes in the fine fraction (silt and clay) is generally regarded as quantitatively most important. Several studies have shown that the mineral surface area but not the mass proportion of the fine fraction is an important predictor of SOC storage and stabilisation.

The SOC associated with the fine fraction has been reported to be relatively resistant to changes in management and is characterised by long turnover times. The maximum concentration of SOC in the fine fraction at a given surface area has been used to define the SOC stabilisation capacity of soil. The difference between the stabilisation capacity and the current SOC concentration in the fine fraction has been termed the saturation deficit. The SOC sequestration potential of a land area (i.e. t C ha^{-1} or Mt C for a defined region) can be estimated as a function of the SOC saturation deficit and bulk density of its specific soils and their associated land areas. This paper will review recent research to understand the relationship between mineral surface area and SOC stabilisation and its applications to predicting the soil C stabilisation capacity and sequestration potential of New Zealand soils. We will also discuss the role that mineral surface area and other factors play in affecting the vulnerability of soil organic C and N to mineralisation. Finally, this review will outline some current research efforts to increase SOC sequestration in New Zealand pastoral farming systems by enhancing SOC stabilisation in under-saturated mineral soils.

Keywords: SOIL ORGANIC CARBON, STABILISATION, SEQUESTRATION, VULNERABILITY TO LOSS, MINERAL SURFACE AREA

Abstract number: S 14

COMPOSITION AND STABILITY OF SOIL ORGANIC MATTER FRACTIONS EXPLAINED BY ASSOCIATIONS BETWEEN OM AND POLYVALENT CATIONS

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Composition of soil organic matter (SOM) is affected by site conditions land use and soil management. Functional groups characteristic for the organic matter (OM) preferentially interact with polyvalent cations and soil minerals. Using basic soil properties the knowledge on such interactions could perhaps explain site-specific composition of SOM and OM fractions. The aim of this study was to test a simplified model for the interactions between OM and polyvalent cations (i.e. Ca Mg Al Fe and Mn) by using data from soils from long-term field experiments. Additionally we are interested in the stability of OM. The test was carried out using data from long-term field experiments (Halle, Bad Lauchstädt, Rotthalmünster). The stability of OM was determined by δ^{13}C-analysis and by microbial decomposition rates of pyrophosphate (OM-PY) and water soluble OM (OM-W) using a micro assay. The composition of SOM OM-W and OM-PY (characterized the ratio between C=O and C–O–C absorption band intensities (C=O/C-O-C) obtained from Fourier transform infrared (FTIR) spectra) was compared with the content of exchangeable and oxalate-extractable polyvalent cations. The simplified model assumed that the availability of the cation's coordination sites for interaction with OM depends on three types of associations: (1) OM–cation (2) OM–cation-mineral and (3) OM–mineral associations. OM-PY is indicated by δ^{13}C-data to be less decomposable than OM-W but micro-assay data indicate no difference in their decomposability. Such contrasting rasults suggests interactions between OM-PY and soil minerals to cause the difference in decomposability since OM-PY used in the micro assay is without contact to soil minerals. When using site-specific contents of exchangeable and oxalate-extractable cations the assumed associations and the availability of the coordination sites explained most of the variations in the C=O/C–O–C ratios in SOM but fewer variations in OM-PY. The results suggested that a simplified model that considers the polyvalent cation content weighted by the number of coordination sites per cation according to the type of association could be used to improve the explanation of site-specific differences in the OM composition of arable soils.

Keywords: SOIL ORGANIC MATTER, POLYVALENT CATIONS, FTIR, OM-CATION ASSOCIATIONS, DECOMPOSABILITY

Abstract number: S 15

EFFECT OF ORGANIC MATTER ON MEAN SIZE OF CLAY MINERALS IN SOILS OF A TOPOSSEQUENCE FROM BASALT - BRAZIL SOUTH

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The interaction between the soil organic compounds and clay minerals can change the size and the reactivity of crystals. However, in soil environmental conditions this effect is still unclear because of limitations in the separation of pure mineral phases for conducting dissolution experiments. The soil organic matter (SOM) is composed by hydrophilic (C-O-alkyl carboxyl and N compounds) and more hydrophobic structures (aliphatic and aromatic groups). The organic hydrophilic groups can interact directly with the monocoordinated hydroxyls of the mineral surface. This process is very importante in soils with high content of Fe and Al oxides. In this study we evaluated the relationship between the mean crystallite size (MCS) of different clay minerals with SOM (content and chemical composition) from surface and subsurface horizons of soils from a toposequence in Brazil South region. Organic C and N contents were determined and the chemical composition of SOM were evaluated by FTIR spectroscopy. The MCS of minerals was analysed by X ray diffraction being performed on Fe-oxide free samples and on Fe-concentrated samples. The multivariate canonical redundancy analysis was used to correlate SOM information and MCS variations. As complementary analysis scanning electron microscopy coupled to X-ray emission (XRE) was used. The C and N content and the relative intensities of the FTIR spectra were considered as predictor variables and the MCS of hematite goethite kaolinite and gibbsite as predicted variables. The C and N content and carboxylic and C-O-alkyl groups showed significant effects on the variation of MCS. The crystallite dimension of the Fe-oxides and kaolinite was inversely affected by these SOM properties. In contrast the MCS of gibbsite was not affected by the SOM properties. The SOM influence on the MCS of Fe-oxides was attributed to surface complexation reactions and to surface redox reactions that promote a continuous dissolution-precipitation process.

Keywords: DISSOLUTION REDUCTION, COMPLEXATION CRYSTAL, CARBOXYL

Abstract number: S 16

COMPETITIVE ADSORPTION OF HUMIC AND FULVIC ACIDS ONTO OXIDE MINERAL

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Humic substances (HS) including humic acid (HA) and fulvic acid (FA) are major components of natural organic matter (NOM). Both HA and FA are simultaneously present in natural systems and bind strongly to oxide minerals (e.g. goethite). Due to the heterogeneous nature of HA and FA fractionation takes place during adsorption to oxides. However, there is no clear picture on the fractionation adsorption when HA and FA are present simultaneously. The objective of this study is to quantitatively investigate the mechanisms in the competitive adsorption of HA and FA to goethite using batch experiments and modeling. UV-Vis spectroscopy and high performance size exclusion chromatography (HPSEC) combined with UV-Vis and TOC analysis (HPSEC-UVA-TOC) were applied in the batch experiments to give more insights in the fractionation adsorption of HA and FA in relation to the aromaticity and molecular weight distribution of HA and FA.

Our results show that the larger HA particles adsorb stronger than the smaller FA particles to goethite when HA and FA are present separately. For both HA and FA a preferential adsorption of the size fraction of 1.0-10 kDa was observed which are largely enriched in aromatic structures and carboxylic groups.

However when HA and FA are present simultaneously in a 1:1 electrolyte background the presence of FA sharply undermines the adsorption of HA while little effect of HA on FA adsorption was observed which seems in disagreement with the stronger adsorption of HA than FA in the experiments with only HA or FA. The molecular weight distribution analyses suggest that fractions with an average molecular weight of 1.0-10 kDa are preferred to be adsorbed to goethite. Furthermore the pH dependency of HA and FA adsorption gets weaker in the HA plus FA system than in the HA or FA system.

With the help of LCD (ligand charge distribution) model the electrostatic interactions and chemical binding between HA and FA and goethite are simulated. The modeling results demonstrate that electrostatic force contributes more to the adsorption of HA than to that of FA whereas specific chemical adsorption plays a more significant role in the adsorption of FA than that of HA. The preferential adsorption to goethite is the result of a combination of factors such as density of reactive groups molecular size and pH.

Keywords: FRACTIONATION, ADSORPTION, HUMIC SUBSTANCES, OXIDE, MINERAL, HPSEC-UVA-TOC, HETEROGENEITY

Abstract number: S 17

EFFECTS OF ACTIVE AL AND FE AND DEGREE OF CARBON SATURATION ON ORGANIC MATTER ACCUMULATION

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Soil organic matter is stabilized associating with mineral components. Previous studies have shown that active Al and Fe extracted by acidic oxalate solution (Al_o and Fe_o) are important mineral components that control the accumulated amount of organic carbon (OC) in acidic soils. Little is known, however, about effects of Al_o and Fe_o on stabilization of added OC. Furthermore, more organic C may accumulate in soils with a low degree of C saturation (the ratio of the amount of OC to the OC storage capacity of each soil). The objective of this study was to clarify effects of Al_o and Fe_o and the degree of C saturation on the residual amount of the added OC.

Twelve soil samples, which were from Andosols Alisol and Cambisols in Indonesia were used. They had acidic pH (4.8–5.9) and various Al_o plus Fe_o (8 to 261 cmol kg^{-1}). The soil samples included surface and subsurface soils from the same site to have different degrees of C saturation. The degree of C saturation is defined as total C (mol)/(Al_o + Fe_o (mol)). Maize shoot of 13 mg (5.0 mg C) labeled with ^{13}C and pulverized with a ball mill (< 2 mm) was incorporated in 11 g of soil and incubated at 25°C. The residual amount of C from the maize after incubations for 3 6 and 12 months (C_{3m} C_{6m} C_{12m}) were calculated based on the atom% of ^{13}C in the soils after incubation the original soils and the ^{13}C labeled maize.

C_{12m} (1.5–3.7 mg) and C_{6m} (1.5–4.1 mg) were not different for each soil sample and C_{12m} is considered to be stabilized. C_{12m} tended to be high in the soils with high Al_o and Fe_o. C_{12m} was higher in the subsurface soil than the surface soil for each site. Besides the soils with low degrees of C saturation had higher C_{12m} ($r_s = -0.75$ $P < 0.01$). The results suggest that Al_o and Fe_o and degree of C saturation based on Al_o and Fe_o are important for accumulation of newly added OC.

Keywords: ^{13}C TRACER, ACTIVE AL AND FE, C SATURATION, INCUBATION, INDONESIA

Abstract number: S 18

THE “NANOCLICS” MODEL (NANOSIZED COPRECIPITATES OF INORGANIC OLIGOMERS WITH ORGANICS): AN ALTERNATIVE MODEL OF INTERACTIONS BETWEEN SOIL ORGANIC MATTER AND NON-CRYSTALLINE FE SI AL PHASES

Isabelle D.Basile-Doelsch, Nithavong Cam, Clément Levard, Emmanuel Doelsch, Bertrand Devouard, Jerome Rose

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Organo-mineral interactions are recognized as a key factor in stabilizing organic matter (OM) in soils and short-range order mineral phases are increasingly considered as key mineral phases in the control of OM dynamics (Rasmussen et al. 2018). Coprecipitation is the main mechanisms involved (Chen et al. 2014; Mikutta et al. 2014). A recent conceptual model proposes that coprecipitates form continuously upon soil mineral weathering in contact with organic compounds of the soil solution (Basile-Doelsch et al. 2015). For silicate minerals, this process imply that Si may also take part in the structure of coprecipitates. However only Fe and Al coprecipitates have been considered as coprecipitating cations in the literature.

Nanophases were precipitated from a solution containing ionic Fe Al Si Mg and Kobtained from a biotite-weathered leachate. TEM and Fe K-edge EXAFS showed that they were structured mainly by small oligomers of Fe together with Si and Al (Tamrat et al. 2018). By adding an organic ligand (DOPA initial M:C≈1) coprecipitates were structured by a loose and irregular 3D network of small oligmers of Fe Si and Al forming a highly reactive open-structured mineral skeleton on which OM was bond. A conceptual model of the nanometer-scale structure animated in 3D has been proposed (Tamrat et al. submitted) and named “nanoCLICs” for “Nanosized Coprecipitates of inorganic oLIgomers with organiCs”. It differs significantly from the previous models presented for Ferrihydrite and amorphous Al(OH)$_3$coprecipitates (Kleber et al. 2015).

We will present the main results that lead to the proposition of the nanoCLICs fine structure model as well as ongoing imaging of nanoCLICS at nanometer scale by TEM TEM-EELS and STXM.

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Rasmussen C. et al. 2018. Biogeochemistry 137 297–306.
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Keywords: ORGANO-MINERAL INTERACTIONS, NANOSCALE COPRECIPITATES, CONCEPTUAL MODEL, WEATHERING MINERALS

Abstract number: S 1.1

DYNAMICS STABILITY OF SOIL ORGANIC MATTER IN SALT-AFFECTED SOILS UNDER DIFFERENT AGRICULTURAL MANAGEMENT IN THE EGYPT'S NILE DELTA VALLEY

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Increasing sequestration capacity of soil organic carbon (SOC) without adversely affecting the ecosystems functions in salt-affected soils of the Egyptian dry-lands has been recently received special attention in arid regions. This work aimed to study different stabilization indices of soil organic matter (SOM) fractions in salt-affected soils to better evaluate the applicable management strategies in these ecosystems. The sound agricultural practices under these circumstances may increase SOC conservation by increasing the organic ligands in those very fragile soils of degraded lands. In the recent decades soil salinity became the main human-induced soil degradation causes in the Egypt's Nile Delta Valley (ENDV). Three different agro-ecological areas in the ENDV area were studied: Eastern (S1; S6) and Western (S3; S5) Delta regions dominated with Vertic Torrifluvents soils and Coastal region (S2; S4) dominated with Typic Calcitorrerts soils of high $CaCO_3$ contents. Moderate alkaline conditions were observed in all soils. Low salinity risk observed in S5 medium salinity in S3 S4 and S6 and high salinity risk in S1 and S2. Carbon in GRSP (C-GRSP) was positively correlated with SOC and dissolved organic carbon (DOC) in water extractable organic matter (WEOM) corroborating the contribution of GRSP to the active and stable fractions of soil organic matter (SOM). The highest activities of β-glucosidase phosphatase and protease soil enzymes were generally found in S1 S5 and S6 while the lowest values were in S2 and S4 intermediate values in S3. Factor analysis indicates that lingo-cellulosic and condensed aromatic structures of stabilized organic matter in soil increased significantly with the contents of calcium carbonates under high salinity. Intercropping with legumes intermediates the SOM transformation

and alleviate the salinity stresses. In calcareous soils severe alteration in SOC conservation was observed and negatively influenced the active constituents of SOM. In conclusion the considered SOM fractions in this study such as DOC extractable organic carbon GRSP C-GRSP together with the pyrolytic fragments of SOM ‘’SOM fingerprint parameters’’ and their metabolization indices can be considered as significant indicators in the dynamics stability of soil organic matter.

Keywords: CHEMICAL DEGRADATION, SOIL SALINITY, SOIL ORGANIC MATTER, SOIL ENZYMES, ALKALINE SOILS

Abstract number: S 1.2

AIR TEMPERATURE CHANGE OF 1°C AND RHIZOSPHERE AFFECT THE ORGANIC C ASSOCIATED WITH THE LIGHT FRACTIONS BUT NOT THE ORGANIC C OF THE HEAVY FRACTION IN EUROPEAN BEECH FOREST SOIL

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Forest soils represent a significant pool for carbon sequestration and storage but the dynamics of the soil organic matter (SOM) are controlled by several biological and environmental factors. We evaluated the influence of the altitude soil depth and rhizosphere on the amount and stability of SOM pools separated by density. The samples were collected from the A and AB horizons of European beech (*Fagus sylvatica* L.) forest soils located at two altitudes (800 and 1000 m) along 1° of latitudinal gradient in central Italy by using altitude as a proxy for air temperature change. Specifically we hypothesized that: *i)* larger amount of labile organic C was allocated in the rhizosphere than in the non-rhizosphere soil and *ii)* the air temperature had a stronger effect on the C pools in the rhizosphere than in the non-rhizosphere soil. At both altitudes we found more organic C (OC) associated to the light fractions of the rhizosphere than in those of the non-rhizosphere soil and specifically in the rhizosphere

free-light fraction larger OC contents were observed at 1000 m than at 800 m above sea level. These aspects have been attributed to root activity and turnover because they represent a source of particulate organic matter. Moreover root activity and turnover rates increase when the environmental conditions become more restrictive as it happens at higher altitude. Conversely the lack of rhizosphere and altitude effects on the OC associated to the heavy fraction explained the negligible sensitivity of this highly stable organic matter pool to external factors. The inertia of the organic C of the heavy fraction has been attributed both to its protection due to the tightly bounds to mineral particles and to its relevant degradation degree as indicated also by δ^{13}C values. The similar ^{14}C signature and the presence of modern C in all the density fractions from rhizosphere and non-rhizosphere soil of both A and AB horizons suggested the occurrence of a rapid incorporation of fresh organic matter into the mineral horizons followed by occlusion into the aggregates and adsorption on mineral surfaces. Further similar positive D^{14}C values observed in all soil density fractions at 800 and 1000 m should indicate that a temperature change of 1 °C is not sufficient to induce marked changes in the SOM cycling.

Keywords: RHIZOSPHERE EFFECT, ORGANIC C POOLS, MOUNTAIN SOILS, DENSITY FRACTIONATION, CLIMATE CHANGE

Abstract number: S 1.3

ADSORPTION OF SOIL-SOLUTION DISSOLVED ORGANIC MATTER ON ALLOPHANIC CONSTITUENTS

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Sorption of dissolved organic matter (DOM) to minerals is a key process in the preservation of carbon (C) in soils. Andosols and subsoil horizons of Podzols contain short-range ordered aluminosilicates also referred to as allophanic constituents. Although a high C retention capacity is ascribed to these phases the nature of their

interaction with DOM is still poorly understood. We therefore aim at assessing the effect of mineral properties and DOM composition on adsorption processes taking the kinetics into account. Furthermore, we want to identify both the operating mechanisms and fractionation of DOM. To represent DOM occurring in different soil horizons where allophanic constituents may form forest floor leachates and subsoil solutions from a Dystric Cambisol were acquired by lysimeters and suction cups respectively. Allophanic constituents with elemental ratios of aluminium (Al) and silicon (Si) between 1 and 2 were synthesized and used as adsorbents. Their structural properties were studied by ^{27}Al and ^{29}Si solid state NMR and FTIR spectroscopy. ^{27}Al NMR spectroscopy revealed that Al-rich allophanic constituents consisted mainly of octahedrally coordinated Al while in Si-rich phases Al tetrahedra contributed to the solid phase. Preliminary results from batch experiments imply that mineral properties govern adsorption of DOM. After 2 h of shaking Al-rich allophanic constituents adsorbed twice as much C as phases with higher Si content. Since differences in specific surface area and surface charge may be causative for this observation solid phases will be characterized for these properties. FTIR spectroscopy indicated that DOM from forest floor leachates contains more carboxyl groups and less polysaccharides compared to subsoil solution DOM. The consequences of this compositional variability for adsorption will be determined further. We will analyse adsorbed organic species by ^{13}C NMR and DRIFT spectroscopy. The modes of adsorption will be identified by DRIFT spectroscopy and studies on the long- and short-term kinetics the latter by stopped-flow conductivity measurements. Overall, this research will contribute to a better understanding of the fate of DOM in Andosols and Podzols.

Keywords: ALLOPHANIC CONSTITUENTS, DISSOLVED ORGANIC MATTER, ADSORPTION, ANDSOLS, PODZOLS

Abstract number: S 1.4

CARBON AND NITROGEN IN THE SOILS OF THE BARENTS SEA COASTAL AREA

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In undisturbed landscapes' soils of the Barents sea coastal area dominant quantitative regularities of C and N spatial distribution have been identified. Two groups of soils have been distinguished.

In saline marsh soils Tidalic Fluvisols formed under conditions by tidal and surging seawater the content of C_{org} varies across horizons from 5 to 75 N_{tot} – from 1 to 5 g/kg. The elements proportion of water-soluble forms is 0.3-13 %. The number of elements in soils and in water extracts from them are interrelated the trend equations are similar $\omega(N_{tot})=0.07\cdot\omega(C_{org})+0.13$ (r=0.99) $\omega(N_{tot)H2O}=0.07\cdot\omega(C_{org})_{H2O}$ (r=0.86). Fixation of N-containing compounds clay fraction (less than 0.001) of soils is confirmed $\varpi_{d<0.001} = 0.06\cdot\varpi\ (N_{tot})$ (r=0.75).

In soils of tundra ecosystems that are affected by deposition of marine aerosols organic carbon content is 430-470 total nitrogen content is 4-7 g/kg. Relevant figures for aqueous extracts of peat thickness horizons are equal to 4-10 ~0.3 g/kg. In the mineral part of the Histic Reductaquic Cryosols correlations were revealed: $\omega(N_{tot})=0.04\cdot\omega(C_{org})+0.17$ (r = 0.95) $\omega(N_{tot})_{H2O}=0.05\cdot\omega(C_{org})_{H2O}$ (r=1.00) and $\varpi_{d<0.001} = 0.06\cdot\varpi(N_{tot})-0.50$ (r=0.97).

The carbon content of inorganic compounds in the Tidalic Fluvisols varies between 0.4 and 1.8 g/kg (4-20 % of the element total content) in aqueous extracts – between 0.02-0.11 g/kg. Bicarbonate-ion accumulation is observed in the three upper horizons of the marsh primitive soils.

Affinity of C/N values of the studied soils and extracts from them has been proven taking into account that aboveground biomass parameters of dominated modern plant communities were the same. In the marsh zone Corg/Ntot of soils and their water-soluble fraction is 10-16. In peat horizons of tundra soils C/N_t = 64-95 in aqueous extracts of them - 20-50 C/N is reduced with a depth by 3-7 times. The value of C/N plants phytomass of saline habitats corresponds to the range of 12-21 lichens and mosses – 80-140 indicators of the substrates liquid phase are 4-18 and 30-60 respectively.

The work was done in frames of the Complex Program of Ural Branch Russian Academy of Sciences "Interdisciplinary synthesis – the key to understanding the functioning of Russian Arctic coastal ecosystems in the light of increasing threats of today" (project *No* 18-9-4-13).

Keywords: ORGANIC CARBON CONTENT, TOTAL CARBON AND NITROGEN CONTENT, COASTAL AREAS, MARSH AND TUNDRA SOILS, THE KHAIPUDYR BAY

Abstract number: S 1.5

ORGANIC MATTER COMPOSITION IN A SANDY LOAM AMAZONIAN ACRISOL AS AFFECTED BY SOIL MANAGEMENT

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The agricultural production in the State of Acre (Brazilian Amazon Southwest) is still very incipient and so far none investigation about the effect of soil management systems on organic matter (OM) is reported. The main goal of this work was to investigate the impact of conservation soil management systems after 10 years on the C content and OM composition in a sandy loam Acrisol Acre State. The experiment was conducted in split-plot design in a randomized complete block design with three repetitions for NT and CT (main parcels) employing the succession manioc/green manure/maize. For each system, three treatments (subparcels) were established: Control: slash and burn; green manures (*Mucuna aterrima Canavalia ensiformes Sorghum bicolor*) as cover crop; cover crop with addition of P-fertilizer and liming. Soil N and C contents were determined in samples collected in 6 layers within 100 cm depth and the OM composition was evaluated by ^{13}C NMR-CP/MAS spectroscopy and n-alkanes determination (GC-MS). C content in the 0-5 cm layer ranged from 13.9 to 16.5 g kg^{-1} and did not differ between treatments. As expected, it decreased with depth reaching values between 3.9 and 5.1 g kg^{-1}. The NMR spectra showed the same pattern regardless the treatment and depth and on average OM contained 34 to 40% O-alkyl 21 to 29% alkyl 19 to 26% aromatic 11 to 17% carbonyl. In comparison to OM of an agricultural subtropical Acrisol this OM composition is poorer in O-alkyl and richer in aromatic structures. The OM n-alkanes showed a unimodal and asymmetric distribution with a predominance of short chain n-alkanes ($1.1 \leq R_{S/L} \leq 3$) maximizing at n-C_{18-22} in all analyzed layers. The average chain length was around 21.5 pointing to a predominance of microbial derived lipids. The carbon preference index (CPI) values for both short ($C_n \leq 22$) and long chain n-alkanes ($C_n \geq 23$) indicated a strong OM degradation and a possible contribution of fossil-fuel derived OM. Our results showed that soil conservation management systems did not affect SOM content and composition in Amazonian Acrisol. High temperatures and precipitation associated to low protection of OM via organo-mineral interactions accounted for the lack of response to No-till and lead to a more recalcitrant and degraded OM in comparison to subtropical Acrisols or to clayey tropical Oxisols.

Keywords: MINERALIZATION, RECALCITRANT OM PROTECTION, CHEMICAL COMPOSITION, NO-TILL

Abstract number: S 1.6

DOES PODZOLISATION LEAD TO A SHIFT OF CARBON POOLS?

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Soil constitutes the largest terrestrial carbon (C) pool. Soil organic matter (SOM) consists of a multitude of organic compounds with different levels of resistance towards degradation. The aim of this study is to specify the distribution of C pools and their shifts throughout successive podzol development. We studied five soil profiles from initial podzolisation to a fully developed Podzol evolved from identical parent material. Physical and chemical SOM pools were fractionated into sand and stable aggregates (S+A) particulate organic matter (POM) silt and clay (s+c) resistant soil organic C (rSOC) and dissolved organic matter (Zimmermann et al. 2007). Samples were analysed for total C and N and C by a thermal method. DRIFT spectroscopy was applied and evaluated by an indicator of oxidative transformation of SOM (rP2930). Mass recovery after fractionation ranges from 97.4% to 109.9%. All fractions comprise about 98.7 % C combustible at 450 °C thus presumably easier decomposable. Relative C allocation in s+c increases with Podzol development in topsoil mineral horizons while the C share of POM strongly decreases. In the illuvial subsoils a proportional decline of POM and s+c with podzolisation is accompanied by a C pool shift towards S+A which represents the major C share in the most developed Podzol. These preliminary results should however be perceived with great care as high SOC contents in some s+c and rSOC fractions indicate the presence of POM in these fractions. The rP2930 as general reciprocal indicator of decomposition are in sum 11.3 (rSOC) 13.3 (s+c) and 18.0 (POM). Besides high SOC contents qualitative similarities of several s+c and

rSOC fractions with POM underpin the necessity for a second density fractionation of the s+c fraction. For the first time this study considers the changing patterns of various C pools by the outlined physical and chemical fractionation as a function of podzolisation to draw conclusions on translocation processes with Podzol development yet to understand.

Keywords: SOIL ORGANIC MATTER FRACTIONATION, PODZOL STABILISATION, DRIFT

Abstract number: S 1.7

REACTIVE SOIL MINERALS SHAPE MICROBIAL COMMUNITY COMPOSITION IN TOPSOIL AND SUBSOIL

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Dissolved organic matter (DOM) mobilized in topsoil and transported to deeper soil horizons is an important source of carbon (C) throughout the soil profile. During soil passage both organic matter (OM) quality and quantity can change markedly as a result of interactions with reactive minerals microbial transformation and preferential mineralization. We hypothesized that the microbial community adapts to the quantity and quality of bioavailable OM present at mineral surfaces; thus the microbial community composition might co-evolve with the formation of mineral-organic associations. To investigate the interactions between mineral surfaces OM and microorganisms within soil profiles we conducted a laboratory flow cascade experiment with undisturbed soil columns from three soil depths containing goethite (α-FeOOH) layers either with or without pre-sorbed ^{13}C-labelled OM. During this experiment, we found increases in bacterial abundance by up to 265% and an altered bacterial community composition associated with goethite in comparison to the surrounding bulk

soil reflecting the detected high C processing on mineral surfaces. More specifically the high availability of labile C compounds stimulated the growth of predominantly copiotrophic bacteria such as *Betaproteobacteria* at goethite surfaces while oligotrophic bacteria such as *Acidobacteria* decreased in relative proportions in the microbial communities under increased OC availability. Consequently, *Betaproteobacteria* may be initial colonizers of reactive mineral surfaces and the relative increase in this taxon might indicate a shift from *K*- to *r*-strategist-dominated microbial communities from bulk soil to goethite. Our results provide novel insights into the complex interactions between minerals and microbial communities. Obtained data suggest the important role of reactive minerals for providing available C sources and promoting the association of different microbial communities. We also suggest that microorganisms colonizing mineral surfaces actively participate in the remobilization of sorbed OM thus represent an integral factor for the DOM transport through soil profiles.

Keywords: MICROBIAL COMMUNITY COMPOSITION, REACTIVE SOIL MINERALS, ORGANIC MATTER, TOPSOIL, SUBSOIL

Abstract number: S 1.8

ESTIMATION OF N_2O EMISSION FACTOR FROM GRASSLAND APPLIED CATTLE MANURE, CATTLE SLURRY AND DIGESTED SLURRY

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Use of livestock waste as organic fertilizer is desired to reduce the cost of chemical fertilizer. Organic fertilizer application contributes to the increase of soil carbon but may increase greenhouse gas emissions. In Japan N_2O emission factor (EFN_2O) of organic fertilizer is not yet distinguished by the types of organic fertilizer. Therefore in this study effect of application of different kind of organic fertilizer on N_2O emission was studied and the EFN_2O was estimated. Five treatment plots no NPK fertilization (NF) chemical fertilizer (CF) cattle manure (CM) cattle slurry (CS) and digested slurry (DS) were established in a grassland in southern Hokkaido Japan. Fertilization was conducted according to regional recommendation. Application amount of organic fertilizer was limited by K due to high K contents of the organic fertilizers. Deficits of N and P in the organic fertilizer plots was supplemented by chemical N and P fertilizers. N_2O flux was measured by closed chamber method every week in a period from May 2017 to October 2018 (for 523days). EFN_2O of chemical fertilizer was obtained by dividing the difference between the N_2O emissions in CF and NF plots by the amount of chemical fertilizer N applied to CF plot. EFN_2O of organic fertilizer was obtained by dividing N_2O emission derived from organic fertilizer by amount of organic fertilizer N applied in organic fertilizer plots. Cumulated N_2O emission (kg N ha^{-1}) for 523 days was highest in CS plot (7.1±1.3) followed by CF (6.5±1.3) DS (5.4±1.3) and CM (4.7±1.3) plots and it was lowest in NF plot (1.1±1.3). EFN_2O of chemical fertilizer was 2.06 % and EFN_2O of organic fertilizer was -1.66% for cattle manure 1.44% for cattle slurry 0.21% for digested slurry. EFN_2O of organic fertilizer in each year was significantly negatively correlated with C/N ratio of organic fertilizer. These findings indicate organic fertilizer with high C/N ratio has a potential to reduce N_2O emission and application of digested cattle slurry produced by methane fermentation is better than direct application of slurry in terms of reducing N_2O emission.

Keywords: ORGANIC FERTILIZER, NITROUS OXIDE, EMISSION FACTOR GRASSLAND

Abstract number: S 1.9

ADAPTATION OF OLIVE CROPS MANAGEMENT SYSTEMS IN CLIMATE CHANGE SCENARIO

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Olive crop is one of the most important and a traditional agrosystems in wide areas of the Mediterranean areas. In Spain, these crops are mainly located in carbonated soils under Mediterranean type of climate in areas, which are able to suffer important climatic changes due to the current scenario of climate change. Projections of climate changes in Spain focus in the unpredictability of rainfall patterns and in the increase of aridity period. In this context, the analysis of water balance into the soil-plant system is a keystone in order to maintain olive production. This water balance is regulated by the macro porosity of the soil, which is close related to mineral-microbiome relationships.

We study four of the main production system in Spain: traditional production integrated agriculture organic agriculture and abandoned olive crops. The study is being carried out in four sites located in Madrid Ciudad Real Jaén and Seville (n=3 plot) each of one with a specific type of management system.

We focus in soil carbon cycle related to the formation of soil stable macroaggregates using different approaches analyzing: soil microbial biomass *in situ* soil respiration enzymatic activity (β-Glucosidase Urease Phosphatase Polyphenol-oxidase and Catalase) total and fractionated soil carbon of the soil as well as data of olive production and physical properties of the soil.

Management systems are close related to biological and specifically biochemical indicators and also with the capacity of the soil of water storage capacity. Structural stability of soil macroaggregates are related to the soil texture and Soil organic carbon.

Keywords: CLIMATE CHANGE, ENZYMATIC ACTIVITY, MICROBIAL BIOMASS, SOIL ORGANIC CARBON, SOIL RESPIRATION

Abstract number: S 1.10

IMPROVING FERTILIZATION METHOD COULD REDUCE APPARENT NITROGEN LOSS AND LEACHING POTENTIAL IN THE NORTH CHINA PLAIN

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Maize is one of the staple grain crops in the world and N fertilizer is an effective way to ensure its production and yield. However, nitrate leaching from excessive application of N fertilizer on maize and apparent N loss is a common phenomenon in China that has prompted social and political pressure to reduce nitrate leaching and apparent N loss. In our study, we compared 7 different N rate, 0, 75, 150, 225 kg ha^{-1} (N_0, N_{75}, N_{150}, N_{225}) and fertilization method (N fertilizer applied before sowing R_1; 1/3 applied before sowing; 2/3 applied at 12-leaf stage R_2) treatments on crop N uptake inorganic N residual in soil profile (0-200cm) after harvest and N loss within summer maize season in Wuqiao Experimental Station of China Agriculture University.

The results showed that crop N uptake in the R_1N_{225} treatment was significantly higher by 22.7 89.4 and 179.0% than in R_1N_{150} R_1N_{75} and N_0 treatment respectively. A similar trend can be found in R_2 and R_2 could slightly increase crop N uptake compared with R_1. N residual in the soil profile (0-200cm) was higher 429.5 and 526.28 kg N ha^{-1} in R_1N_{225} treatment than in R_1N_{150} and R_1N_{75} treatment respectively. N residual in the deeper soil layer (100-200cm) was higher 298.4 and 340.4 kg N ha^{-1} in R_1N_{225} treatment than in R_1N_{150} and R_1N_{75}. In addition N residual in the shallower soil layer (0-100cm) was higher 209 kg N ha^{-1} in R_2N_{225} treatment than in R_1N_{225} but N residual in the deeper soil layer (100-200cm) was lower 75.5 kg N ha^{-1} in R_2N_{225} treatment than in R_1N_{225}. Apparent N loss was 219.8 20.6 2.7 124.3 6.9 and -4.7 kg N ha^{-1} in the R_1N_{225} R_1N_{150} R_1N_{75} R_2N_{225} R_2N_{150} and R_2N_{75} treatment respectively.

The following consequences can be indicated that (a) increasing N input and times of fertilization could improve crop N uptake; (b) increasing N input could significantly enhance the N residual (0-200cm) especially in the deeper soil layer (100-200cm); (c) the twice-fertilization could significantly increase shallower layer N residual (0-100cm) but decreased deeper layer N residual (100-200cm); (d) decreasing N input and increaseing times of fertilization could decrease apparent N loss. In conclusion R_1N_{150} treatment was the best method for maize production under field condition due to slighter human input N residual (100-200cm) and apparent N loss with the sufficient crop N uptake.

Keywords: N FERTILIZER, NITROGEN LEACHING, NITROGEN LOSS, CROP N UPTAKE, MAIZE

Abstract number: S 1.11

DEPTH EFFECTS ON PLANT RESIDUE DECAY IN DIVERSE SOILS

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Decay of plant residues is important for many ecosystem functions affecting atmospheric CO_2 plant-available nutrients and microbial diversity among others. The rate of decay in turn is regulated by soil type and management location in the soil profile and environmental variables some of which may be changing in coming decades. Our objective in this study was to elucidate the effects of location in the soil profile on plant-derived C decay. To understand the importance of these variables across a broad scale we established a long-term study at two sites in Canada and one site in New Zealand. At each site labelled barley straw (^{13}C = 10.2 atom% ^{15}N = 8.3 atom %; C = 37.9%; N = 0.95%; C:N = 40) was installed at 3 depths (5-10 20-25 and 40-45 cm). Soil temperature and water content was logged at each depth. Samples were collected at different times over 5-6 year after application of the residues and analyzed for recovery of residue C and N and ^{13}C phospholipid fatty acid profiling.

Results show that substantial decay occurred in a short time (< 1 year) even deep in the soil profile. At each site, soil temperature and water content were similar at all depths in the profile. Thus, there was little effect of depth on C and N recovered after 6 year at all sites. Initial differences in decomposer abundance and community composition after 1 and 2 years did not affect longer-term residue retention at different depths. More residue-derived C was retained in the microbial biomass deeper in soil profile where SOC is less abundant.

Keywords: CARBON CYCLING, RESIDUE DECAY, ^{13}C, ^{15}N, PLFA, SOIL TEMPERATURE

Abstract number: S 1.12

EVALUATION OF SOIL CARBON FROM INTEGRATED CROP-LIVESTOCK-FOREST SYSTEMS BY LASER-INDUCED BREAKDOWN SPECTROSCOPY

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Soil organic matter (SOM) is considered a relevant soil quality indicator due to its direct relation with biological chemical and physical soil properties permitting to evaluate

agricultural management impacts. Soils under Integrated Crop-Livestock-Forest Systems (ICLF) have the potential to capture and sequester carbon in the form of increasing SOM content contributing to the mitigation of greenhouse gas emissions from agriculture. The use of photonic techniques such as Laser-induced Breakdown Spectroscopy (LIBS) makes it possible to quantify different key elements and plants nutrients present in the soil with greater simplicity faster and in a more sustainable way than the conventional methods available[1]. In this context this study aimed to quantify the carbon present in ICLF soils using the LIBS. For this samples of a dystrophic Red-Yellow Latosol (Oxisol) were collected from the experimental field of Embrapa Southeast of Brazil five years after the implantation of the ICLF systems and making comparison with soils from Native Forest (NF) area. Samples were collected at depths of 0-5 5-10 10-20 20-30 30-40 40-60 60-80 and 80-100 cm at different distances from trees lines: 0.0m 1.5m 3.0m and 7.5m. Pellets of the whole soil samples were prepared for analysis at the LIBS[2]. Previous studies employing Elemental Analysis and the Laser Induced Fluorescence Spectroscopy (LIFS) for these areas showed the ICLF system has higher amount of soil carbon and more stable organic material than the Native Forest[3]. Now recent results obtained by the LIBS showed that there was a good linear correlation with Elemental Analysis which varied from $R^2 = 0.85$; $R^2 = 0.73$; $R^2 = 0.75$ and $R^2 = 0.74$ by distances from tree lines 0.0m 1.5m 3.0m and 7.5m in ICLF soils respectively. Therefore based on the current results indicated LIBS as a sustainable and promising tool for the analysis of carbon in soils under the ICLF system allowing the creation of soil C maps with higher resolution and low financial cost.

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Keywords: SUSTAINABLE INTENSIFICATION, CARBON SOIL, CARBON SEQUESTRATION, PHOTONIC TECHNIQUE LIBS

Abstract number: S 1.13

HIGH CARBON STOCKS OF UMBRIC FERRALSOLS RESULT FROM DIFFERENT SCALES MASS MOVEMENTS

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Ferralsols represent the deeply weathered red or yellow soils of the humid tropics. Because they are enriched in Fe and Al oxides and are depleted of weatherable minerals strong retention of P as well as a low status of base cations and micronutrients are constraints for plant growth. The ecosystem has adapted to these edaphic constraints through rapid cycling of plant debris close to the soil surface thereby preventing released nutrients from making contact with the mineral subsurface. On average ferralsols contain about 10 kg C m^{-2} per 1 m depth but a subset of so called umbric ferralsols (UF) reach an average of 19 kg C m^{-2}. The reasons for such accumulation of C are not known. Here, we hypothesize that high C carbon accumulation in UF is most likely to originate from two mechanisms: A) an addition of soil material with similar proportions of fast intermediate and slow cycling C may increase C stock or B) UF may possess in addition to a sizable pool of fast cycling organic matter a large proportion of slow cycling organic matter. Option B would require a mineral matrix with a stronger capacity to retain C than that found in common ferralic horizons. Mechanism A would lead to a buildup of soil deposits aided by bioturbation or colluviation, while mechanism B should involve intense mineral-organic associations reflected in elevated C concentrations. To constrain the probability of either mechanism we tested whether C stocks correlate more strongly with with A horizon thickness (A) or with C concentration (B). UF had thicker A-horizons (112±58cm n=50) than average ferralsols (34±21cm n=153); $p<0.001$ but C concentrations did not vary between ferrasol types. 69 % of the variability of C stocks were explained by A-horizon thickness. We conclude that high C stocks of UF are predominantly a function of mass movements whether driven by bioturbation or colluviation. More work is required to confirm that carbon fluxes are in agreement with this assessment.

Keywords: TROPICAL SOILS, HUMIC HORIZON, C POOL, HUMIC OXISOLS, BIOTURBATION

Abstract number: S 1.14

RAPID CHANGES IN SOIL ORGANIC MATTER COMPOSITION DUE TO SHIFTING TO CONSERVATION TILLAGE

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Soil organic matter (SOM) is a mixture of various organic components hence cannot be chemically described adequately. Decomposition dynamics under crop fields are ruled by cultivation intensity and varies among various SOM pools. The most resistant SOM is presumed to be attached to the finest mineral particles (<20µm) whereas some other more mobile components are sheltered within aggregates without specific mineral phase associations. The former pool is characterized by small molecular weight components whereas the second pool is reported as complex macromolecules. The present study investigates SOM amount and composition of the same Luvisol under ploughing tillage (PT) conservation tillage (CT) and native forest (NF) land uses. Soil samples from the potentially tilled 0-10 cm layer of each cultivation type were fractionated according to Zimmermann (2007) separating SOM to aggregate sheltered- (aSOM) clay associated- (cSOM) and resistant (rSOM) fractions. rSOM is a subfraction of cSOM which was prepared using hypochlorite oxidation on cSOM. SOM amount was measured by dry combustion whereas SOM composition was estimated using DRIFT spectroscopy. In addition mineral composition of the fractions was characterized by ATR FTIR. Results indicated significant SOM decrease due to tillage in each fraction however shifting to CT significantly increased the amount of SOM compared to PT during 14 years. In this relation the amount of rSOM increased the most in the CT plot and even reached the original value under NF. The amount of particles <6µm was highest in cSOMs whereas no significant differences were found among land uses. Contrarily the kaolinite content was higher under NF than in the tilled samples. In the rSOM samples kaolinite was consequently higher than in the cSOMs referring the potential O-H bound destruction due to oxidation treatment. The abundance of phenol-based SOM components was highest in the rSOMs while aliphatic components were typical under the NF. In conclusion land use change affects the mineral-SOM complex compositions of each fraction. The study was supported by the NDRI Office via project K123953.

Keywords: CONSERVATION AGRICULTURE, SOIL ORGANIC MATTER, ORGANO-MINERAL COMPLEX, CLAY, CONVENTIONAL TILLAGE

Abstract number: S 1.15

THE ROLE OF CLAY MINERAL COMPOSITION IN THE STABILIZATION OF SOM IN SOILS UNDER FOREST IN HUNGARY

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The influence of soil texture and clay content on organic matter decomposition has been widely investigated. Clay minerals are generally considered as important stabilizers of soil organic matter (SOM) via the binding of organic matter to mineral surfaces. Quantifying the turnover of SOM in differently protected soil ecosystems is important to understand the role of SOM in nutrient cycling and soil structure maintenance.

Our previous study demonstrated that only the clay content does not explain entirely the different turnover times of SOM. We assume that beside clay content the quality and relative quantity of clay minerals play an important role in SOM stabilization. Therefore we studied 13 samples from forest soils with different clay mineralogy.

Bulk samples of the soils from 0 to 20 cm depth were collected. Bulk samples were analyzed with FTIR-ATR spectroscopy (Vertex 70 Bruker). Clay mineral versus organic matter rates were determined by the specified intensity rates of the characteristic wavelength ranges of the IR spectrum.

Clay fractions (< 2μm) were separated by sedimentation in aqueous suspension. Oriented and desoriented clay fractions were analyzed with Philips PW 1730 X-ray diffractometer for qualitative and quantitative measurements.

Our work studies the link between phyllosilicate mineralogy and soil C dynamic by reporting a qualified and quantified phyllosilicate data in connection with SOM turnover and stabilization.

This work was supported by the European Union and the State of Hungary co-financed by the European Regional Development Fund in the project of GINOP-2.3.2-15-2016-00009 'ICER' and the Development and Innovation Fund of Hungary [Nr. NKFIH 123953].

Keywords: SOIL ORGANIC CARBON, CARBON TURNOVER, CLAY MINERALOGY, SOIL TEXTURE, CARBON SEQUESTRATION

Abstract number: S 1.16

GREENHOUSE GAS BALANCES IN A TEMPERATE DECIDUOUS FOREST WITH DIFFERENT ABUNDANCE OF BEECH (FAGUS ORIENTALIS LIPSKY.)

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Beech (*Fagus*) is one of the most valuable industrial species in Iran which is present in combination with other tree species with different effects on soil C and N cycles (Bayranvand et al. 2017) and greenhouse gases (GHG) emission. There is a lack of information about the differences in dynamics of CO_2 CH_4 and N_2O emission along a gradient of increasing tree species diversity in a Hyrcanian mixed deciduous forest. For this four different forest types [i.e. *Fagus orientalis - Carpinus betulus - Acer velutinum - Alnus glutinosa* (FO-CB-AV-AG) *Fagus orientalis-Carpinus betulus-Acer velutinum* (FO-CB-AV) *Fagus orientalis-Carpinus betulus* (FO-CB) and pure *Fagus orientalis* (FO)] were considered in northern Iran. Ten replicates are regarded for each forest types. Litter and soil samples with an area of 25 cm × 25 cm were taken from 0-10 cm depth under each forest type and a composite sample for each plot (for litter and soil separately) was transferred to the laboratory for analysis. In addition, the seasonal changes in the emission of CO_2 CH_4 and N_2O were monitored over a year. Our results indicated that the studied forest types were different in terms of litter quality soil properties and GHG emission. The highest values of all gas emissions were

measured in August whereas the lowest were detected in February. Greater amounts of CO_2 and CH_4 emission (0.35 mg CO_2 m^{-2} d^{-1} and 0.14 mg CH_4 m^{-2} d^{-1} respectively) were recorded in the FO forest type. N_2O emission was higher in FO-CB-AV-AG and FO (0.26 and 0.23 mg N_2O m^{-2} d^{-1} respectively) than in FO-CB-AV and FO-CB (as the same 0.03 mg N_2O m^{-2} d^{-1}) forest types. This study demonstrated that strong impacts of tree species diversity change on soil-atmosphere trace gas exchanges.

Keywords: NATURAL FOREST, MIXED STAND, C AND N CYCLE, TOPSOIL, NORTHERN IRAN

Abstract number: S 1.17

PATTERNS AND CORRELATIONS OF IRON DISTRIBUTION AND SOM QUALITY IN A HYDROMORPHIC SOIL

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As a reservoir of C soil organic matter (SOM) plays an important role in the global C cycle. Hydromorphic soils are generally characterized by the accumulation of great amounts of SOM due to inhibited mineralization. Long-term water saturation and fluctuating redox (Eh) conditions have a significant effect on the evolution of SOM and pedogenic Fe minerals (oxyhydroxides). Adsorption of dissolved organic C (DOC) on the surface of Fe hydroxides and Fe-DOC coprecipitation are also known as important factors of SOM stabilization causing particular traits in the SOM quality and quantity of waterlogged soils.

In our study we investigated the characteristics of SOM and pedogenic Fe minerals of a sandy meadow soil (calcic Gleysol ferric loamic) located in a swampy area in the Danube-Tisza Interfluve Hungary. Eh and pH were measured by field monitoring station during the vegetation period. The mineral composition of the bulk soil and some separated Fe and carbonate concretions were studied by X-ray powder diffraction (XRD). Concretions were studied also with attenuated total reflectance Fourier

transform infrared spectroscopy (ATR-FTIR) and diffuse-reflectance FTIR spectroscopy. Total soil organic carbon (SOC) and nitrogen content were measured by an elemental analyser. SOM was characterized by UV-Vis spectrometry based on specific spectral absorbances (E4/E6 E2/E3) after alkaline extraction (Swift 1996).

Our results show that intensive SOM accumulation has taken place in the soil: high values of SOC were found even in the depth of 50-60 cm. Longer water saturation resulted higher E4/E6 values contrary to the more areated zones (located on higher elevations). Among the soil profiles the C/N and E4/E6 E2/E3 values reflect intensive humification resulting humic substances of higher aromacity. Quantity and quality of SOM seems to correlate also with Fe distribution. Fe oxyhidroxides were found to play an important role in C sequestration of the studied waterlogged soil. Fe-OM associations are widespread in the topsoil and in the rooting zone.

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Keywords: IRON OXYHYDROXIDES, SOM STABILIZATION, HYDROMORPHIC SOIL, CARBON SEQUESTRATION, REDOX POTENTIAL

Abstract number: S 1.18

CONTRIBUTION OF BACTERIAL BIOMASS TO SOIL PARTICLE WETTABILITY

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Soil particle wettability affects the liquid phase distribution and thus can have an impact on the diffusion of organic substrates and enzymes in the soil matrix. Low wettability (water repellency) was shown to reduce liquid film thickness and continuity which can cause a reduction in microbial activity and a decrease in organic matter decomposition. Soil water repellency is usually caused by plant- and microbial-derived organic compounds such as waxes fatty acids and free lipids but recent research also suggests a direct impact of bacterial cell envelopes on soil particle wettability. The finding that osmotic and water stress may affect the chemical composition and wetting properties of bacterial cells gives rise to a potential feedback between cell surface modification and microbe-induced water repellency.

To study the factors that contribute to changes in bacterial cell surface wettability we conducted a series of stress experiments with different Gram-negative and Gram-positive soil bacterial strains. It turned out that both osmotic and water stress lead to pronounced changes in cell surface properties. For *Bacillus subtilis* and *Pseudomonas fluorescens* we found a clear positive relationship between applied stress level and degree of cell surface hydrophobicity in terms of contact angle. Mineral coverage by cells of *B. subtilis* and *P. fluorescens* was found to increase the contact angle potentially rendering initially wettable minerals water repellent. The strength of cell-mineral interaction as a crucial factor in determining the persistence of these cell-mineral associations was assessed by calculating interaction free energies based on contact angle and zeta potential measurements.

To explore the conditions under which bacteria with water repellent surface properties are enriched in soil and how moisture history affects the activity and surface properties of soil bacteria we conduct an incubation experiment with soil from two mature beech sites with contrasting wettability and hydroclimatic conditions. The soils are incubated at different water potentials and part of them exposed to wetting-drying cycles. Results showed a clear relationship between moisture conditions and soil wettability. In addition we will present results on potential changes in microbial composition.

Keywords: BACTERIA, MICROBIAL BIOMASS, SOIL ORGANIC MATTER, WATER REPELLENCY WETTABILITY

Abstract number: S 1.19

BENEFICIAL EFFECT OF STRAW RECYCLING IN RICE PADDY: TRADE-OFF BETWEEN GREENHOUSE EMISSION AND SOIL CARBON STOCK INCREASE

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A 2-year field study was conducted in rice paddy to determine how straw incorporation influences net global warming potential (GWP) using the sum of CH_4 and N_2O fluxes and net ecosystem carbon budget (NECB) and greenhouse gas intensity (GHGI) using net GWP per unit of grain yield. Straw was applied over/inner soil during the dried fallow season and plowed right before flooding. In the control treatment, straw was removed for comparison. Soil organic carbon (SOC) stock changes were estimated by NECB which means the difference between C input and output. Net primary production and applied straw were considered as C input source and harvest C removal and heterotrophic respiration C loss were counted as C output. Straw removal depleted SOC stock within 0.24-1.12 Mg C ha^{-1} yr^{-1} but straw application significantly increased SOC stock with the rate of 1.48-2.82 Mg C ha^{-1} yr^{-1}. Straw spreading over soil was more effective than straw mixing with soil to increase SOC stock. However straw application markedly increased GHG emission in particular CH_4 emission by 27-263% over the control. Between two straw treatments annual CH_4 fluxes were 25-50% higher in straw spreading over soil than straw mixing treatment. However the net GWP was not big different between straw spreading and control treatments due to increased SOC stock. In comparison, straw mixing with soil could reduce the net GWP by 50-55% over the control. Straw application increased grain yields by 7-26% over the control. As a result, GHGI was not different between straw spreading and control treatments but significantly lower in straw mixing treatment. Conclusively straw application could be essential to increase SOC stock without GWP increase in rice paddy. In particular, the aerobic decomposition of straw during the dried fallow season by mixing with soil could reduce the net GWP by approximately 50-52% over no-straw application

Keywords: METHANE, NITROUS OXIDE, NET ECOSYSTEM, CARBON BUDGET, GREENHOUSE GAS INTENSITY, RICE

Abstract number: S 1.20

VEGETATION AND PH IMPLICATIONS ON THE DYNAMIC OF SOIL ORGANIC MATTER AT HIGH-MOUNTAIN SHRUBS ECOSYSTEMS FROM SIERRA NEVADA NATIONAL PARK (GRANADA, SPAIN)

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During the last decade soil organic matter dynamic and its determining factors have received an increased attention mainly due to the evident implication of these parameters in climate change understanding predictions and possible management.

High-mountain soil could be consider as hotspot of climate change dynamic since its high carbon accumulation and low organic matter degradation rates could be seriously altered by slight changes in temperature and rainfall regimens associated to climate change effects. In the particular case of Sierra Nevada National Park this threat could be even stronger due to its Southern character although its elevated biodiversity could shed some light on how could we predict and manage climate change in the future.

In this study we selected different sampling areas with distinct soil pH (area A with pH<7 and area B with pH>7) and vegetation (high-mountain shrubs and pine reforested area). Soil samples were collected under the influence of several plant species representatives of each vegetation series. Six different kind of samples were finally obtained (five replicates each); three were collected in area A under *Juniperus communis ssp. Nana* (ENE) *Genista versicolor* (PIO) and *Pinus sylvestris* (PSI) and other three were collected in area B under *Juniperus Sabina* (SAB) *Astragalus nevadensis* (AST) and *Pinus sylvestris* (PCA).

Quantitative and qualitative organic matter characterization and soil microbial biomass and activity were measure in order to evaluate the implication of soil pH and vegetation in soil organic dynamic at this particular high-mountain environment at Sierra Nevada National Park.

Keywords: ORGANIC MATTER, HIGH-MOUNTAIN ECOSYSTEM, PH, VEGETATION, SOIL RESPIRATION

Abstract number: S 1.21

EVALUATION OF LIMING EFFECT ON SOIL CARBON STOCK CHANGES ANALYZING NET ECOSYSTEM CARBON BUDGET (NECB) IN MAIZE UPLAND SOIL

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Agricultural liming is a common agricultural practice worldwide for improving crop productivity in acidic soils. The effect of liming practices on soil properties has been extensively studied with mainly focusing soil pH nutrient availability and crop productivity. but lime application can affect to soil carbon (C) stock changes still are poorly understood. The net effect on soil C stock can be the result of several factors. At the first liming can increase microbial activity in soil via ameliorating pH condition. Thus the improved biological activity can increase the mineralization of soil organic matter and decrease soil organic C stock. Secondly calcium containing lime can ameliorate soil structure increasing the stability of clay assemblages and clay-organic matter bonds which can bring an increase in the physical and physicochemical protection of soil organic C. Finally as liming improves soil conditions to plant growth plant biomass returning as an organic C input source can increase soil C concentration. However the net effect of these processes is not well understood yet. In this two-year field studies to evaluate the effect of liming on soil C stock changes $CaCO_3$ was applied with the rates of 0 and 2 Mg ha^{-1} yr^{-1} before maize seeding and soil C stock changes were estimated by analyzing net ecosystem C budget (NECB) which means the difference between C input and output. Liming application increased C input by 58-64 % over the control (no-liming) mainly due to 57-63 % increase of the net primary production (NPP) of maize. In comparison lime application significantly increased respired-C loss (CO_2 emission) by 60-63 % over the control. Approximately 97-98 % of C loss was originated from organic C decomposition but only 1.6-2.1 % from lime material dissolution. Since local farmers removed maize residues for cattle feeding this C removal was considered as a main C output source which covered 33-38 % of total C output. The NECB in the control treatment ranged within minus 2.8-2.9 Mg C ha^{-1} yr^{-1} which means this C level might be depleted. Particularly liming decreased the annual NECB by 57-64 % over the control mainly due increased respired-C loss. Therefore more additional input of organic C sources such as crop residues and cover crops are required in lands to sustain soil C stocks under liming.

Keywords: CALCIUM CARBONATE, SOIL CARBON STOCK, SOIL RESPIRATION, NET ECOSYSTEM CARBON BUDGET, NET PRIMARY PRODUCTION

Abstract number: S 1.22

QUALITY OF SOIL ORGANIC MATTER IN ARCTIC AND SUBARCTIC ENVIRONMENTS: FROM BULK TO WATER-EXTRACTABLE ORGANIC MATTER CHARACTERIZATION

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Soil organic matter in Arctic and Subarctic regions plays a key role for the global carbon cycling. The objective of this study was to evaluate the structure and fate of soil organic matter in the high latitudes by jointly quantifying and characterizing both bulk and water-extractable organic matter in surface soil samples. We compared two study sites with similar tussock tundra ecosystems and distinct mean annual air temperature and permafrost conditions: Abisko Sweden (−1 °C discontinuous permafrost) and Toolik Alaska USA (<−8 °C continuous permafrost). Both sites presented different bulk soil organic matter compositions: higher C/N and alkyl C/O-alkyl C ratios were reported at Abisko (27.1±8.6 and 0.57±0.17 respectively) compared to Toolik (17.4±2.3 and 0.44±0.11 respectively). These patterns were attributed to either distinct decomposition stages linked to climate conditions or distinct organic matter inputs with local vegetation influences. Extractable fractions indicated higher water-extractable organic matter concentrations in the colder site (i.e. at Toolik with 4.38 mg g_{soil}^{-1} of water-extractable organic carbon and 0.25 mg g_{soil}^{-1} of water-extractable total nitrogen) that we attributed to a higher pool of potentially mobilizable matter from a more preserved soil organic matter. Overall the most significant result is that the intra-site heterogeneity of soil organic matter quality was higher than the inter-site heterogeneity in the bulk as well as in the water extractable fractions. Finally the qualities of both bulk and extractable fractions were not directly linked together: some specific patterns observed in the bulk fraction (e.g. locally lower alkyl C/O-alkyl C ratios) were not observed in the extractable one and reciprocally (e.g. singular fluorescence signature).

Keywords: SOIL ORGANIC MATTER, TUNDRA, HIGH LATITUDES, ^{13}C NMR, 3D FLUORESCENCE

Abstract number: S 1.23

CHANGES IN SOIL ORGANIC MATTER AFTER LONG-TERM FERTILISATION OF CALCAREOUS SOIL WITH PIG SLURRY

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Soil organic matter (SOM) maintenance in agricultural systems is crucial to keep soil quality and plant productivity over time. Pig slurry applied as fertiliser increases crop yields. Nevertheless it is expected that slurry would increase the amount of SOM while inducing changes in its molecular composition despite its low concentration in dry matter content. The aim of this work is to characterise the SOM from a calcareous soil and to evaluate changes in its chemical structure linked to the use of pig slurry as fertiliser. From a long-term fertilisation experiment (14 years old) three treatments distributed in a randomized block design were chosen: two mineral N fertilisation treatments (0 and 120 kg N ha^{-1} yr^{-1} referred to as M00 and M120 respectively) and a pig slurry treatment applied at a rate of 40 Mg ha^{-1} yr^{-1} (PS170 equivalent to 170 kg N ha^{-1} yr^{-1}). Fertilisers were applied at cereal tillering (February). Organic carbon content in soil samples was quantified previously to winter cereal sowing (September). Humic acid-like substances (HAL) were isolated by alkaline extraction followed by acid precipitation. Fourier transformed mid-infrared spectroscopy (FTIR 4000–400 cm^{-1}) was used in the structural characterisation of HAL. The soil organic carbon content of 10.8 g C kg^{-1} in PS170 was not statistically higher ($P > 0.05$) than in M120 and M00 treatments (9.5 and 10.2 g C kg^{-1} respectively). The FTIR spectra of the HAL showed a prominent aliphatic C–H stretching peak (2920 cm^{-1}) but differences between treatments were just found in the alkyl bending band (1460 cm^{-1}) showing a significant ($P < 0.05$) tendency to increase after application of slurry. Such an aliphatic enhancement induced by the application of pig slurry suggests structural changes characteristic of a short-term or temporary effect. This is interpreted as HAL from slurry does not represent a stable source of SOM. Then it is not expected to contribute to SOM accumulation in the long-term C pool.

Keywords: SLURRY FERTILISATION, MINERAL FERTILISATION, ORGANIC CARBON, INFRARED SPECTROSCOPY, CARBON RESERVOIR

Abstract number: S 1.24

CONTROL OF MINERAL ASSOCIATED ORGANIC MATTER ON SORPTION OF ORTHO-PHOSPHATE AND VICE VERSA IN ACID SANDY SOILS

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The mobility of ortho-phosphate (o-P) in the environment strongly depends on interactions with mineral surfaces. Especially in acid sandy soils with very low clay% and historical excessive P-fertilization as in North Belgium Al- and Fe-(hydr)oxides are the most important o-P adsorbents. A competition with native soil OM for these binding sites could be pertinent. If so o-P saturation degree (PSD) could exert an important control on accumulation of soil OM. Analogously soil OM status of these acidic sandy cropland soils could determine P-availability and proneness for leaching.

Our objectives were: i) to test if the silt+clay fraction OM content affects de novo o-P-sorption in sandy cropland plough layer soils; ii) to test if soil OM biochemical composition has an impact on o-P-sorption; iii) to test if PSD affects sorption of selected OM-building blocks. To address objectives i) and ii) o-P-sorption characteristics were measured for 50 sandy cropland soils at constant P-sorptive capacity (PSC) granted by pedogenic Fe and Al. An extensive soil-P Fe and Al dataset was used to uniquely select a soil set with no co-variation in PSD and silt+clay OC content. Py-MBMS was also used to probe the silt+clay OM molecular-level composition. For objective iii) sorption characteristics of ^{13}C labelled glucose octanoic acid and guaiacol were measured for three groups varying in PSD but otherwise comparable PSC.

The co-variation of Langmuir model Qmax and k parameters with soil OM level and ratio of OM to pedogenic Fe and Al and fine clay was assessed for high and low PSD classes. In soils with high PSD the impact of OC% on o-P sorption was hypothesized to be larger because then available mineral surface would be more limited but no supportive evidence was found. Likewise at low PSD soil OM level did not exert any

impact on o-P sorption. We could not confirm a lesser control of more hydrophobic compared to hydrophilic OM on P sorption as hypothesized since carbohydrates and proteins and not lipids are known to be selectively bound to pedogenic oxides. We did find some evidence that high PSD indeed affects sorption of OM in these sandy P-saturated soils: Soprtion of guaiacol and octanoic acid was constrained by high PSD but only until 400 mM conc.

Keywords: OM SORPTION, PHOSPHATE SATURATION DEGREE, PY-MBMS, PEDOGENIC (HYDR)OXIDES, SANDY SOIL

Abstract number: S 1.25

MOLECULAR CARBON STRUCTURE IN A MERIDIONAL PEAT BOG FROM DOÑANA NATIONAL PARK (SW-SPAIN)

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In less than 50 years the area occupied by peat bogs in the Gulf of Cádiz (SW-Spain) has been reduced drastically by more than 90% and the peat bog studied here may well be considered as relict and one of the last and more Meridional still in existence in the Northern hemisphere. The vertical molecular composition of a 85 cm peat bog from Ribetehilo lagoon (Doñana National Park; SW-Spain 37° 7'30.81"N; 6°37'50.19"O) is studied using analytical pyrolysis (Py-GC/MS) and solid state NMR (CP/MAS ^{13}CNMR).

The results obtained by the two techniques were similar and showed neat differences in the organic matter (OM) molecular structure with depth. In the shallow layer (0-10 cm) OM composition was dominated by carbohydrate and a conspicuous high relative amount of polyphenolic compounds were also detected in the pyrograms (c. 40% and 20% respectively). Down core the OM composition was found gradually dominated by lipids and unspecific aromatic compounds. These results suggest that while shallow OC reflects the molecular signature of a more or less fresh material OC in deeper bog samples underwent a severe chemical alteration resulting in a selective preservation

of the most recalcitrant molecules lipids (polyesters) and aromatics both representing more than 80% of relative abundance of compounds in OM. This is probably the result of a high microbial activity in an anoxic environment supported by lower conductivity and basic pH values (~10 µScm-1 and ~8 respectively) as well as a lighter C isotope composition (δ13C < -29‰ VPDB) found in depth. The aromatic pool included PAHs from the middle of the core to the bottom layers this may be due either to the existence of older wildfires or to a transport (lixiviation) from upper layers.

Our results show the occurrence of i) intense microbial activity combined with large water front fluctuations occurring along the year; and of ii) anaerobic processes. The lack of peat preservation in depth is probably a sign of bog degradation processes probably linked with climate changes to which Mediterranean wetlands are especially responsive.

Keywords: PYROLYSIS, NUCLEAR MAGNETIC RESONANCE, BIOMARKERS, CARBON PRESERVATION.

Abstract number: S 1.26

SOIL EASILY-EXTRACTABLE GLOMALIN (EEG): MOLECULAR CHARACTERIZATION

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Easily Extractable Glomalin (EEG) is an operational term applied to a soil organic fraction supposed to contain mainly glomalin-related soil protein (GRSP) a glycoprotein abundantly found in soils that are produced in the hyphae and spores of arbuscular mycorrhizal fungi (AMF). This fraction is a significant component of SOM which effectively has multiple ecological functions including the facilitation of soil aggregate formation and its stability and resilience to degradation contributing to SOC storage. Given its potential as soil perturbation indicator here a detailed molecular characterization "fingerprint" was performed using analytical pyrolysis (Py-GC/MS) of the EEG fraction extracted from a Mediterranean soil beneath different plant covers (pine and shrubs) affected and unaffected by forest fire and at different times.

Soils (16) under pine and shrub covers from Gorga (NE Alicante Spain) were studied. Surface soil (2.5 cm depth; A horizon) samples were taken immediately after a forest fire that occurred in July 2011 and 4 8 and 12 months after the fire. EEG was extracted and measured using the Bradford assay and the lyophilized extracts analysed by Py-GC/MS.

A total of 139 compounds were identified and grouped according to their probable biogenic origin. Py-GC/MS did not show any clear differences between samples. Only minor differences could be detected between samples under pine and shrub covers regardless of the effect of fire. This fact indicates that the EEG is a structurally stable soil organic fraction very homogeneous and highly resistant in soil if temperatures remain below 200-250ºC. The main compounds found were polysaccharides (PS); polyphenols (LIG); proteins and polypeptides (PRO); non-specific aromatic compounds (ARO); hydro-aromatics (HAR); lipids (LIP); polycyclic aromatic hydrocarbons (PAH) and terpenes (TER). Surface density plots (also known as 3D van Krevelen diagrams) were built up from average values of pyrolytic products. The spatial distribution of these compounds supports similar pyrolytic patterns for the main factors studied: vegetation and fire. The results provide insight into the role of EEG in soils under high-level perturbations such as fire events. Due to their chemical similarity with humic acids EEG may play a relevant role in soil carbon storage.

Keywords: GLOMALIN, BURNT SOILS, PYROLYSIS, SOIL ORGANIC MATTER

Abstract number: S 1.27

CARBON STABILIZATION MECHANISMS IN HIGH MOUNTAIN VOLCANIC SOILS FROM TEIDE NATIONAL PARK (TENERIFE, SPAIN)

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Volcanic soils accumulate soil organic matter (SOM) usually through the formation of organo-mineral complexes. In terms of residence time SOM quality depends on

whether it is free or associated to the mineral fraction forming metal (non-allophanic andosols) or allophane complexes (allophanic andosols).
Here the main carbon sequestration mechanisms acting in high mountain volcanic ash soils are investigated. Diagnostic A horizons (19) representative of the main parent materials vegetation and climatic conditions were sampled in soils from Teide National Park Tenerife Canary Islands. Physical and chemical properties possibly controlling SOM accumulation were analysed including an estimation of the metal active forms (Alo Feo and Sio) and organometallic complexes (Cp Alp Fep and Sip). This allowed an estimation of the organic carbon complexaton forms present in the soil i.e. in the form of Al-humus Fe-humus or associated to allophane ferrihydrite or halloysite. In addition two density soil fractions (δlight < 1.9 g ml-3 < δheavy) were separated with a tungsten salt solution. The molecular SOM structure was studied in detail by direct analytical pyrolysis (Py-GC/MS) at 500º C in the bulk soil and in the two density fractions. In search of molecular markers also different parts of the predominant plants and of decaying litter were also analysed.

Our findings point to the occurrence of two distinct mechanisms for SOM protection dependent on soil type 1) In allophanic soils SOM seems to be mainly associated to non-crystalline organo-mineral complexes is rich in polysaccharides and N-compounds probably from chitin. 2) In non-allophanic soils a selective preservation mechanism is observed SOM composition is dominated by relatively unaltered plant components related to a protective effect of amorphous minerals favoring organo-metal complexes/coatings and SOM preservation more or less unaltered in a sort of inherited humin.

Keywords: ANDOSOLS, ANALYTICAL PYROLYSIS, ALLOPHANES, ORGANO-MINERAL COMPLEXES

Abstract number: S 1.28

DOES SUBSOIL MIXING WITH TOPSOIL INCREASE THE CAPACITY OF SOILS TO SEQUESTER CARBON?

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Soil erosion was thought to be a carbon source to the atmosphere because of soil loss and the exposure of previously physically protected subsoil on the eroding slope. Recent research however has revealed that carbon deposited in soil at the base of an eroding slope may be sequestered from decomposition resulting in a net carbon sink. As topsoil depth decreases with erosion subsoil is mixed with surface topsoil. This may expose new mineral surfaces that could have a greater ability to physically stabilize carbon. The researches on the deep ploughing soils also show that the new topsoil mixed with subsoil store larger amount of SOC than non- till soil. In this work we hypothesize that a carbon sink can be produced on the eroded zone of the slope by mixing of subsoil and topsoil from ploughing and/or root growth into soil that was previously less affected by biology. A 20 days' incubation experiment was carried out and the main variables (pH water content TC Labile C CO_2 flux) involved in aggregation and the aggregate stability of aggregates after the addition of organic matter (green barley powder) was measured. Contrary to our hypothesis, a carbon source was produced by mixing the topsoil and subsoil. The mixed soil respires significantly higher amounts of CO_2 than the average of CO_2 respiration from topsoil and subsoil. The level of CO_2 respiration from the mixed soil is equal to that from topsoil. The aggregates of size between 3 ~5 mm was scanned by X- ray CT before and after incubation to quantify the shape change of the aggregate cluster as well.

Keywords: CO_2, ERODED SOIL, AGGREGATE STABILITY, X-RAY SCAN, CARBON INCUBATION

Abstract number: S 1.29

STORAGE AND QUALITY OF SOIL ORGANIC CARBON AS REFLECTED BY HUMIC ACID MID-INFRARED SPECTRAL PATTERNS

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It is well known that soil organic matter (SOM) forms several types of complexes with soil minerals in which the nature and strength of the bonds largely depends on the molecular composition of the SOM. Nevertheless, studies on the influence of the SOM structure on the nature and stability of its interactions with the soil matrix are quite scarce. In this study, the information on the chemical composition of soil humic acid (HA) provided by resolution-enhanced infrared spectroscopy (IR) was used in the exploratory assessment of the different C sequestration potential of the soils. Partial least squares (PLS) regression was used to predict the soil organic carbon (SOC) content using as descriptors the intensities of the IR spectral points (4000–400 cm^{-1}). A prediction models was also calculated for E4 optical density of the HA that is an index classically related to its aromaticity and maturity. In a second stage the HA chemical characteristics more significantly correlated with the SOC levels were also identified from digital data treatments of the IR spectra. The subtraction of IR spectra obtained by averaging spectra of HAs from soils in the upper and lower quartiles of the SOC distribution showed that aromatic carboxyl and amide groups were predominant in HAs from soils with low SOC content whereas the lignin-derived structures are characteristic of soils with high SOC content. The significance of the differences found was checked by calculating the Student's *t* for all IR spectral points.

In conclusion a relationship was found between the molecular composition of soil HAs and SOC levels and even a much more significant PLS model was obtained to predict the E4 values. The results were confirmed by principal component analysis (PCA) and multidimensional scaling (MDS) showing that the intensity of bands produced by carbonyl and amide structures is significantly more intense in HAs from soils with low C content. Conversely soils with high SOC levels showed a conspicuous band pattern suggesting structural units of plant lignins which points to SOM storage processes based on accumulation of fresh plant residues.

Keywords: CARBON SEQUESTRATION, HUMIC ACID, HUMUS QUALITY, SOIL ORGANIC MATTER, PARTIAL LEAST SQUARE REGRESSION

Abstract number: S 1.32

PARENT ROCKS OR PARENT SHELLS: SOIL FORMATION IN MARITIME ANTARCTIC

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Less than 0.5% of Antarctica is ice-free. However even this relatively small area is not completely covered with soils due to an extremely cold and dry environment. Favorable climate conditions and therefore well-developed soils are typical for only a few regions of Antarctic and Maritime Antarctic is one of them.

In this study, we have investigated soils from the Argentine Islands (Wilhelm Archipelago). Most of them were Leptosols strongly affected by seabirds. The most obvious type of this impact is the accumulation of guano. A less obvious but also important process is the accumulation of the shells of Antarctic limpet (*Nacella concinna*) on the islands. It is caused by the feeding activity of the kelp gull (*Larus dominicanus*) according to the food-chain: plankton + microbenthos → *Nacella concinna* → *Larus dominicanus* → guano + pellets (shells of *Nacella concinna*) → soil. Often soils were formed not on parent rocks but on the thick 2-3 cm layer of mollusk shells.

All the studied soils formed on mollusk shells had higher biodiversity of microorganisms near-neutral pH values and higher content of water-soluble organic matter in comparison to the soils formed on volcanic parent rocks. Also soils formed on or containing mollusk shells were preferable substrates for *Deschampsia antarctica* which is one of the two flowering plants and an important ecosystem engineer in the Antarctic. Accumulation of mollusk shells strongly affects physical chemical and biological properties of soils in Maritime Antarctic. The biogeochemical flow of calcium from the ocean to terrestrial ecosystems supports not only soil forming and development but also biodiversity and stability of Antarctic tundra in general. Also this phenomenon makes these ecosystems and soils in particular more vulnerable to global issues like global climate changes and ocean acidification.

Keywords: MARITIME ANTARCTIC, ANTARCTIC SOIL, NACELLA CONCINNA, ARGENTINE ISLANDS, GUANO

Abstract number: S 1.31

DESIGNING MICROBIAL INOCULANTS FOR THE RESTORATION OF DEGRADED SOILS BY DROUGHT

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Soil degradation represents a pressing worldwide problem that is being accelerated by the processes of erosion depletion of soil organic matter soil compaction acidification salinization and drought. Soil aggregation is a key predictor of soil fertility and is negatively affected by degradation processes. Soil microorganisms can influence soil aggregation via a range of mechanisms such as the production of exopolysaccharides (EPS) and other extracellular matrix polymers as biofilms. In this work we seek to use microorganisms to restore soil aggregation. We isolated bacteria (120 strains) and tested for its ability to grow under drought salinity tolerance rapid growth biofilm and EPS production. Ten strains were able to growth at 40% of Polyethylene Glycol (PEG) 6000 (34 Mpa) after 24 h. And two strains did growth at 10% of salinity (281 dS/ m) after 48 h. Four strains were strong biofilm producers after 24 h. And four strains produced EPS (28 to 37 ug/ml) in media supplied with 2% of sucrose We are currently assessing the ability of these strain to improve soil structure when added to a degraded soil by drought. Twenty four strains holding specific traits have being tested in sterile soil supplied with organic matter and two levels of water (56 and 45% of field capacity). The soil is incubated at 25 °C per 6 weeks. The water holding capacity will be tested and the aggregation by the Mean Weight Diameter (MWD) using the technique of wet sieving.

Keywords: AGGREGATES, SOIL BACTERIA, ORGANIC MATTER DROUGHT

Abstract number: S 1.33

ASSESSMENT OF THE ORGANIC CARBON SEQUESTRATION POTENTIAL OF THE FOREST SOILS OF THE CENTRAL MIDDLE ATLAS OF MOROCCO FACING CLIMATE CHANGE

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The international scientific community is unanimous on the subject of climate change. This is a real phenomenon whose effects are already being felt in some areas of the world and will have economic social and environmental consequences for the societies. Thus, forest ecosystems are at the heart of the climate change debate and issue because of their dual role as carbon sinks and sources. The forests of the

Moroccan Central Middle Atlas store significant amounts of carbon (C) in the form of soil organic C. However the integrity of these COS stocks is threatened by climate change but also by changes in forest composition and the nature of the lithological material. Indeed each tree species has different functional characteristics allowing it to have a singular influence on its environment and on the processes of storage and release of organic carbon. The objective of this study is to explore the influence of forest composition and the nature of the lithological material on the total amount of organic carbon sequestered in the forest soils subject to this study. The results obtained show that these soils have a high carbon sequestration capacity and that the above factors have a significant impact on the spatial variability of the organic carbon stock in the studied area. Therefore, knowledge of soil carbon stock dynamics in forests is fundamental to predicting and mitigating the consequences of such changes.

Keywords: SEQUESTRATION, CLIMATE CHANGE, CARBON, FOREST COMPOSITION, LITHOLOGICAL MATERIAL

Abstract number: S 1.34

OCCURRENCE OF SOIL FUNGI IN ANTARCTIC IN THEIR RELATIONSHIP WITH C AND N OF SOIL

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The extreme conditions that coexist in Antarctica produce a strong selective pressure that could lead to the evolution of novel mechanisms for stress tolerance by indigenous microorganisms. For this reason in recent years research on cold-adapted microorganisms has increased driven by their potential value for applications in biotechnology. Cold-adapted fungi in particular have become important sources for the discovery of novel bioactive secondary metabolites and enzymes. Here we studied the fungal community structure of 12 soil samples from Antarctic sites including King George Island (including Collins Glacier) Deception Island and Robert Island. Culturable fungi were isolated and described according to their morphological and phenotypical characteristics and the richness index was compared with soil chemical properties to describe the fungal community and associated chemical parameters of soils. We isolated 19 genera belonged to *Penicillium Pseudogymnoascus Lambertella*

Cadophora Candida Mortierella Oxygenales Geomyces Vishniacozyma Talaromyces Rhizopus Antarctomyces Cosmospora Tetracladium Leptosphaeria Lecanicillium Thelebolus Bjerkandera and an uncultured Zygomycete. Among the culturable strains 55% were psychrotrophic and 45% were psychrophilic and most were Ascomycetes occurring in their teleomorph forms. Soils from the Collins Glacier showed less species richness and greater species dominance compared with the rest of the sites whereas samples 4 7 and 10 (from Fildes Bay Coppermine Peninsula and Arctowski Station respectively) showed greater species richness and less species dominance. Species richness was related to the C/N ratio whereas species dominance was inversely related to C and N content. Thus the structure of the fungal community was mainly related to soil chemical parameters more than sample location and altitude.

We thank to INACH RT_06-17

Keywords: ANTARCTIC, FUNGI DIVERSITY RICHNESS, C/N

Abstract number: S 1.35

EVALUATION OF LONG-TERM LAND MANAGEMENT PRACTICES ON SOIL CARBON STOCKS AND STABILISATION UNDER CONVENTIONAL AND ORGANIC AGRICULTURAL SYSTEMS

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Agricultural activities have provided essential products for human living but have paid the price of significant environmental adverse impacts including substantial soil carbon (C) loss. The potential to increase soil C storage may be achieved through the implementation of recommended agricultural management practices for instance with the use of organic agriculture over non-organic (conventional agriculture) and practices such as organic amendments and a more diverse crop rotation scheme. Changes in agricultural management and practices can also affect other soil properties altering decomposition process and therefore soil C stabilisation. However the current literature findings comparing conventional *vs* organic soil C stocks are often contradictory and mostly do not consider soil C stabilization. To improve understanding of these practices on soil C stocks and its stabilisation we sampled long-term field trial (2011 and 2018) soils from the 0-0.6 m depth interval combining mineral fertiliser for conventional agriculture and compost amendments for organic with conventional and organic crop rotation schemes. The Nafferton Factorial Systems Comparison (NFSC) trial is located at Newcastle University’s Nafferton Experimental Farm UK. Preliminary results suggest that compost fertilisation under both conventional and organic rotation scheme can lead to an increase of soil C stocks over the years (i.e. from 2011 to 2018) in the top 0-0.3 m as well as in the subsoil 0.3-0.6 m layers. The use of thermal analysis combined with differential scanning calorimetry and a quadrupole mass spectrometer (TG-DSC-QMS) further indicated that there is potential soil C stabilisation occurring in the subsoil layers. In conclusion soil C stocks can be improved through fertilisation strategies within conventional and organic rotation scheme. Our results also demonstrate that the assessment of subsoil layers (0.3-0.6) might be important for soil C stabilisation.

Keywords: SOIL CARBON, AGRICULTURE, C STABILISATION, LAND MANAGEMENT, THERMAL ANALYSIS

Abstract number: S 1.36

CARBON DYNAMICS IN SOILS: EVOLUTION OF ORGANO-MINERAL INTERACTIONS AFTER A FOREST TO VINEYARD TRANSITION

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Organo-mineral interactions are known to play a key role in stabilizing organic matter (OM) in soils because bonds between organic compounds and mineral surfaces minimize microbial degradation of organic compounds. A better understanding of the mechanisms that control the OM stabilization is therefore necessary especially of those responsible for the destabilization of the nano-organo-mineral complexes following a forest to crop transition. Indeed it is assumed that the mineral surfaces are not stable in time but subject to weathering that leads to the formation of organo-mineral nano-complexes called " Short Range Order minerals- Organic Matter" (SRO-OM) here after.

The hypothesis is that most of the stabilized soil organic matter are consist int these complexes. The idea is to show that the latter are destabilized by a land use change.

In that frame a pair site approach consisting in two adjacent plots with different land uses forest and vineyard respectively was chosen. Poorly differentiated soils on granite were sampled at Plan de la Tour (83) in the Maures Massif (France). The two plots are located on the same agricultural terrace. Analyses of aerial photos and cadastral data shows that these two plots have experience the same land use for at least 100 years. Two soil profiles 15 m apart were described and sampled on pit. Chemical particle-size distribution and mineralogical characterizations were performed to determine the degree of similarity of the two soils. The distribution of organic carbon contents and stocks in soils is highly contrasted between the two land uses. A tangential filtration physical fractionation method allowed to isolate the SRO-OM in the 10kDa - 200 nm size ranges of some horizons in order to understand if the differences in organic carbon contents and stocks observed in both profiles were related to differences in nature or quantity in these SRO-OM.

Keywords: SOIL CARBON SEQUESTRATION, LAND USE CHANGE, CARBON DYNAMICS, ORGANO-MINERAL INTERACTIONS, SHORT RANGE ORDER MINERALS

Abstract number: S 1.37

FROM CHARCOAL TO BIOCHAR: 10 YEARS OF PROGRESS IN RESEARCH ON PYROGENIC CARBON IN SOILS AT IRNAS-CSIC

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Charred biomass residues derived from incomplete combustions including wildfires significantly contribute to the pyrogenic carbon (PyC) or as it is also referred to as “Black Carbon” pool of soils [1].The production of PyC from vegetation fires could account for up to a quarter of the residual terrestrial C sink. Nevertheless its quantitative importance in the global C balance remained during decades contentious and thus PyC was rarely considered in global C cycle and climate studies [2]. From 2008 to 2011 researchers of the Pyrolysis team at IRNAS-CSIC developed several methods for the detection and quantification of PyC that were successfully applied to

soils and sediments [3-5]. Furthermore they delved into the composition structure and properties of contrasting forms of PyC. Subsequently using pioneering ^{15}N labelling experiments the fertilizing properties of N-enriched PyC materials were demonstrated [6]. These works were the prelude to the application of biochar (biomass that has been heated in a low oxygen environment in order to serve as soil amendment). During the last years the group has focused its efforts on: i) studying the relationship between the pyrolysis conditions and the properties of the produced biochars especially those of agronomic interest [7] ii) the risks (such as the polycyclic aromatic content [8] or microbial degradation [9]) and benefits of its application to different soils under Mediterranean climate conditions [10-11]. This knowledge is strictly needed to avoid potential long term damage in the ecosystems and to ensure its sustainability.

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Keywords: PYROGENIC C, SOIL C SINK, BIOCHAR, AGRONOMY

Abstract number: S 1.38

NEMATODES AND MICROBIAL COMMUNITY AFFECT THE SIZES AND TURNOVER RATES OF ORGANIC CARBON POOLS IN SOIL AGGREGATES

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Soil aggregates provide microhabitats for nematodes and microorganisms but how nematodes and microbial community interactively drive the dynamics of soil organic carbon (SOC) pool remains unclear. Here we examined the relationships between bacterivorous nematodes microbial community and the sizes and turnover rates of three SOC pools in a red soil under four fertilization regimes. The abundance and community composition of nematode and bacterial communities were examined within aggregate fractions including large macroaggregates (LMA) small macroaggregates (SMA) and microaggregates (MA). The sizes of SOC pools in soil aggregates increased with decreasing aggregate size while the turnover rates of SOC pools followed the opposite trend. The ratios of bacteria to fungi (B/F) and Gram-positive to Gram-negative bacteria (GP/GN) were higher in the MA fraction than in the SMA and LMA fractions. The assemblages of bacterivorous nematodes in the LMA fraction were significantly different from those in the MA and SMA fractions primarily because of the higher abundance of the dominant genus Protorhabditis. Results of structural equation modelling indicated that the ratios of B/F and GP/GN showed stronger positive correlations with the sizes and turnover rates of SOC pools in the MA fraction compared with the LMA fraction. Conversely, bacterivores exhibited indirect relationships with the sizes and turnover rates of SOC pools through the B/F ratio in the SMA and LMA fractions. Taken together these results highlight the functional role of nematodes and microbial community in controlling SOC pool dynamics at the aggregate scale.

Keywords: AGGREGATE FRACTIONS, BACTERIVORE, PREDATION, MICROBIAL COMMUNITY COMPOSITION, ORGANIC CARBON POOLS, SIZE AND TURNOVER RATE

Abstract number: S 1.39

CARBON AND NITROGEN STOCKS AND SOIL HEALTH INDICES IN SUBTROPICAL SOILS OF ARGENTINE

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The objective of this study was to evaluate the effect of deforestation and the subsequent cultivation of tea (*Camellia sinensis* L.) on the potential accumulation of carbon and nitrogen and to evaluate the soil health through biological quality indexes in subtropical soils of Argentine. A completely randomized design was used, with twelve plots under subtropical rainforest (S) and twelve plots under tea plantation of 40-60 year-old in red soils of Misiones (Argentine). For each plot, composite samples were collected at 0-0.10; 0.10-0.20 and 0.20-0.30 m depths. The following variables were measured: texture, silt+clay (Li+Arc) pH, bulk density (Bd), total porosity (TP), equivalent humidity (HE), air space (Ea), soil organic carbon (SOC), total organic matter (OM) and total nitrogen (Nt), respiration of soil (RES), particulate organic matter (POM), cation exchange capacity (T), and potentially mineralizable nitrogen (PMN). Carbon and nitrogen stocks (CS and NS) as well as POM and organic matter associated of mineral fraction soil (MOM) stocks were calculated (with masses correction) from 0 to 0.30 m. Then, ten biological indices were developed to 0-0.10 m: PMN /Nt, PMN / POM, PMN /RES, POM /RES, POM /OM, POM /Li+Arc, MOM/Li+Arc, MOM/OM, T/OM and T/RES. The results obtained were analyzed through ANOVA, LSD Test ($P < 0.05$), and a Pearson correlation. Removal of the subtropical rainforest and subsequent tea cultivation reduced CS and NS by 31% and 37%, respectively. The biological indicators and their indices indicated that tea land-use over average 50 years disturbed the natural balance of native red soils. Land-use changes resulted in a negative organic balance, a decrease in NPM (65%), in RES (41%) indicators to 0-0.10 m, and it also affected the functioning of the system, as observed in POM /Li+Arc, MOM/Li+Arc, PMN /RES, PMN /Nt, and PMN/POM. The indicators more sensitive were Bd, HE, CS, NS, PMN, RES and MOM. The correlation of RES with OM, POM, Nt, HE, Ea, and TP, as well as the MOP/Li+Arc index were shown to be positive and significant across, but negative with Bd. The PMN were shown to be positive and significant with T, OM, Nt and MOM. In the future research on MOM structures are necessary. The subtropical rainforest elimination for Tea land-use resulted in a decrease of CS and NS, degradation of biological soil quality, and modification of soil functionality.

Keywords: TEA LAND-USE, CARBON AND NITROGEN ACCUMULATION, SOIL QUALITY FUNCTIONAL INDICES, SUBTROPICAL SOILS

Session 2: New physical, chemical and biological analytical approaches – How can they lead us to a better understanding of soil interfaces?

Abstract number: K1

POTENTIAL AND APPLICATIONS OF MAGNETIC RESONANCE IMAGING FOR UNDERSTANDING SOIL CONTAMINATION

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The importance of soil for the fate of environmental contamination is not only related to soils but it also affects the aquifer and thus important water resources. Thus understanding the fundamental processes ruling how and why contaminants move inside and bind to soils is paramount to environment human health and the preservation and persistence of life. Physical phenomena such as advection with the flow of water that infiltrates in the soil adsorption molecular diffusion and the interactions of contaminants with soil organic matter (SOM) at soil interfaces strongly determine the transport and retention of contaminants in soils. However the complexity of soils and the lack of powerful techniques capable to obtain detailed information of the phenomena occurring inside the samples in a non invasive and destructive manner hinder the complete understanding of processes controlling soil contamination. For instance models currently used to predict the fate of contaminants in soils are generally based on the determination of the partition coefficient of the contaminant between the water and the soil and the mechanisms are inferred from breakthrough curves (evolution of concentration as a function of pore volume or time) after injection of particles into a column of soils (or model porous media). For this reason soils with regards to contaminant transport are a “black box” system. As an accurate prediction of pollutant transport also requires local information on the processes governing the transfer magnetic resonance imaging (MRI) has emerged in the last few years as a viable solution allowing to open the soil “black box”. In general MRI enables visualising within space in both a non-destructive and non-intrusive manner a wide array of physical information such as water content displacement speed signal relaxation time molecular diffusion phase transitions etc. Several MRI applications on model porous media and soils will be discussed during this talk to provide a perspective of the potential of MRI to study soil contamination.

Keywords: MRI SOILS

Abstract number: T 1

HYDROPHOBIC SOILS AND THE STRUCTURING OF SOIL ORGANIC MATTER AT THE MOLECULAR LEVEL

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Hydrophobic soils have been observed around the world under different climates and land uses1. It is estimated that southern Australia alone has between two and five million hectares of agricultural land affected by hydrophobic soils2. Non-wettable soils cause both environmental and economic problems including increased surface runoff enhanced erosion rates and chemical leaching3 decreased nutrient storage and decreased plant-available water. This hydrophobicity is caused by hydrophobic and amphiphilic organic compounds deposited in the soil that originate from plant materials. Our experimental studies of this phenomenon are complemented by computer modelling of the structuring and interaction of organic species on different soil types to identify key driving forces for this phenomenon [1-3]. This study examines intermolecular interactions of monolayers of hexadecanol (CH3(CH2)15OH) and hexadecanoic acid (CH3(CH2)14COOH) on different soil surfaces as a function of surface density using classical molecular dynamics simulations. The computer simulations presented in this study clearly indicate quite different packing and interfacial interactions between wax molecules on clay and sand surfaces respectively. Even for a low level of coverage (2.35 molecules nm-2) wax molecules on the quartz (sand) surface adopt a multi-layered arrangement. In the first layer the wax molecules lay flat on the surface rendering most of the surface hydrophobic. A second disordered layer forms on top of the first layer accentuating the hydrophobicity of the first layer. In comparison wax molecules on a kaolinite (clay) surface adopt a semi-ordered tilted packing arrangement such that coverage of 2.35 wax molecules nm-2is insufficient to completely transform the particles from hydrophilic to hydrophobic. Consequently higher levels of wax material are required to render clay particles hydrophobic compared with sand particles.

Keywords: BIOLOGICAL

Abstract number: T 2

USE OF THERMAL ANALYSIS FOR THE CHARACTERIZATION ORGANIC MATTER PROPERTIES IN DENSITY FRACTIONS OF ATLANTIC MINERAL SOILS SUBJECTED TO DIFFERENT SOIL BURNT SEVERITIES

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Changes in soil organic matter (SOM) contents and chemistry after wildfire have been investigated but information on the influence of heating on the quantification and distribution and quality of SOM fractions is scarce.

To address this aspect we sampled three forest soils, which had been burnt recently at different soil burn severities (SBS) intermediate and high SBS.

Fractionation of SOM density fractions (free particulate OM [FLF] occluded particulate OM [FOF] and mineral-associated OM [HF]) was performed to assess changes in the distribution and quality of SOM across physical soil fractions. Thermal analyses were applied for the quantification and the characterization of OM in these fractions whereas CPMAS^{13}C NMR spectroscopy was used to determine their compositions.

Atlantic Forest soils very rich in OM are characterized by high proportion of LF with respect HF reflecting the great input of litter and the moderate decomposition rate. The SOM stock of the unburnt soils was dominated (60-75 %) by particulate organic matter (LFF) very rich in thermolabile compounds such as O-alkyl C and alkyl-C. The heating

led to the loss of the three physical fractions being proportional to the level of SBS. However, the greatest losses were found for the FLF (50-70 %) and the lowest for HF (7-10 %). In the three physical fractions, the resulting OM lost most these labile compounds and contained large proportion of aromatic C structures. Consequently in the high SBS (300 ºC) the resulting OM was much richer in mineral-associated OM (40-60 % in the HF) with a high degree of carbonization (63 % of aromaticity; 395- 470 ºC value of T50 in TGA). Due to the low rate of replenishment of this fraction the changes in SOM have important long-term implication for soil structure (a property linked to the LF) but also with the dynamics on N and P (which are dependent the HF). Due to the low turnover rate, this physically protected OM may be act as a long-term sink for C storage.

Keywords: THERMAL ANALYSIS, SOIL BURNT SEVERITY, 13C NMR SPECTROSCOPY, SOM QUALITY, FOREST FIRES

Abstract number: T 3

MATRIX APPROACH TO THE MOLECULAR PROPERTIES STUDY OF THE KUBAN SOILS ON THE RICE AGROCENOSIS

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A matrix approach is proposed in the study of the molecular properties in the soil. The soil is considered as a matrix system in which interactions are carried out not over the entire surface but on active centers contacts. Contact interactions form structural bonds in the soil. The number and strength of the contacts determine the degree of interparticle contact in the soil and the physical properties of the aggregates. The matrix approach is to determine the surface properties of the total mineral mass in the soil. The soil mineral matrix (SMM) is a surface layer of soil particles (after heat treatment at 450 °C). Its functioning consists in the organization of ions molecules and particles in a certain order around itself. It allocated the active elements - the centers which occupy 0.1-15% of the surface. The matrix is characterized by the number and

strength of active centers. The purpose of the present work is the study of the mineral matrix of rice soils of the Kuban and the evaluation of its transformation.

Objects of study: meadow-chernozem and meadow-marsh soils of Kuban rice agrocenoses. Research methods: The spectrum of acid centers is determined by the method of thermoprogrammed ammonia desorption with mass spectrometric analysis using a USGA-101 instrument (“UNISIT” Russia) and a thermogravimetric soil analysis using an SDT-Q600 derivatograph (TA instrument).

Results and conclusion. The acidic properties of the mineral matrix of meadow chernozem and meadow bog soils have total adsorption capacity in the range of 32-61 μmol NH_3/g. The lowest acidity of the SMM was noted in the conditions of permanent rice cultivation for 80 years (32-33 μmol NH_3 /g). The total acidity of the mineral matrix in heavy loamy and clay meadow-bog soils is 51-53 μmol NH_3/g in medium-loam meadow-chernozem soils - 34-45 μmol NH_3/g. In rice meadow-chernozem soils with a less acidic matrix the content of Fe^{3+} increases and the amount of Fe^{2+} decreases. An inverse regularity has been found in meadow-bog soils of depressions. The proportional relationship of the humus content with the acidic properties of SMM was established. However, the high yield of rice did not correlate with humus content and was in inverse connection with the acidity of the mineral matrix.

Keywords: SOIL MINERAL MATRIX, ACID CENTERS, RICE SOIL

Abstract number: T 4

MICRO-SCALE PHYSICOCHEMICAL AND BIOLOGICAL INTERACTIONS CONTROL BIOFILMS FORMATION AND ECOLOGICAL FUNCTIONS IN SOILS

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Microbial biofilms sessile microbial communities enveloped in a self-produced extracellular polymeric substance (EPS) are ubiquitous in the natural environment. In soil systems, the sessile state dominates in microorganisms and protects them physically chemically and biologically. Soil microbial biofilms play a vital role in the formation and stability of soil aggregates weathering of minerals degradation and sequestration of organic carbon and controlling bacterial pathogens invade. Therefore, there is a critical need to understand the progressive formation of microbial biofilms

and their ecological functions in soils. Firstly, we will report the growth biofilm formation and virulence gene expression of the pathogenic bacteria *Escherichia coli* O157:H7 after exposure to montmorillonite kaolinite and goethite three common soil minerals in the clay size fraction. Our results showed that montmorillonite could stimulate the rapid growth of *E. coli* O157:H7 but inhibit biofilm formation through decreasing CA production and increasing bacterial motility. Kaolinite is preferential for *E. coli* O157:H7 attachment and colonization. Goethite detrimental for *E. coli* O157:H7 not only promoted the development of biofilm primarily through triggering the CA production to encase cells but also decreased the production of toxins. Secondly, we will present the social interactions between pathogen *V. parahaemolyticus* and two representative soil isolates e.g. *B. subtilis* and *P. putida* through transcriptomic analysis. Our results showed that the different influences on a pathogen by different types of interactions can be modulated by chemicals and medium fluidity. Finally, artificial soil was employed to investigate the soil biofilm formation and corresponding impacts on microbial activities and community structure. The results showed that soil biofilm sustained 40-times more active microbes than that without biofilm, which contributed to increased organic turnover rate. Meanwhile the diversity and evenness of soil with biofilm was significantly higher than that without biofilm. The above findings provide novel insights about the environmental prerequisite for soil biofilm formation, which sustain a diverse and robust community to drive soil biogeochemical and ecological processes.

Keywords: BIOFILM, SOIL MINERAL, MICROSCALE INTERACTIONS, BACTERIAL PATHOGEN

Abstract number: T 5

SYNTHESIS OF EXTRATERRESTRIAL SOIL ANALOGUES IN THE HADEAN EON AT > 1000 K

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Metorites are valuable specimens which were ultimately formed early in the history of the solar system when the Earth was formed 4.54 billion years (Ga) ago. These are

among the very few available remnants with direct connection to the Hadean which is the geologic eon more ancient than 4 billion years ago (4 Ga); very few other geological traces from this epoch remain on Earth. Of special interest to chemical evolution are carbonaceous chondrites a subclass of chondritic meteorites which comprise <5% of the observed falls. These are considered the most primitive i.e. least altered objects from the early solar system and might contain up to 5% of carbon of which a sizable proportion are allotrophs of carbon itself. In the last decade it became more and more clear that carbonaceous chondrites exhibit an extremely high compositional diversity of organic compounds (CHNOS) which sizably exceeds that of known biomolecules (1). This rich diversity and molecular complexity of organic matter observed in meteorites reflects its history of formation and enables an unprecedented detail view of the extreme environments from which the early solar system emerged and evolved. Our group has discovered a previously unknown chemical class namely dihydroxymagnesium carboxylates [(OH)2MgO2CR]- in meteoritic soluble organic matter (2). Several hundreds of CHOMg compounds were identified in a set of 61 meteorites of diverse petrological classes. These materials exhibit substantial thermal stability which was corroborated by their higher abundance in thermally processed meteorites (2). Intriguingly these CHOMg compounds are indicators of thermal and shock stress during meteorite formation i.e. they are the first identified geomolecules to relate organic molecular diversity and conditions of meteorite formation. CHOMg compounds in meteorites can be seen as conceptual soil analogues which existed at the time of the formation of the earth and even several millions of years before that. They connect the previously known set of CHNOS molecules and the mineral phase. Thermostable CHOMg compounds might have selectively preserved specific organic molecules through organo-mineral-interaction over geologic time scales and are therefore relevant in origin of life studies.

Keywords: EXTRATERRESTRIAL SOIL, ORGANOMAGNESIUM COMPOUNDS, THERMAL STRESS, MASS SPECTROMETRY, ORIGIN OF LIFE

Abstract number: T 2.1

INITIAL SOIL FORMING PROCESSES IN ANDOSOLS IN ANTARCTICA

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Chemical weathering process and organic matter formation were studied in *Skeletic Andosols* (Deception Island DI-4). As a product of weathering feldspars and volcanic glass were determined. Crystalline thickness and size distribution of different minerals was measured by BWA (Bertaut-Warren-Averbach) technique. Significant differences in mineral composition in size fraction vertical and horizontal position were determined by X-ray diffraction (XRD) quantitative analysis. Digital microscope KeyenceVHX-6000 was applied to inspect a soil objects from different angles and using advanced 2D/3D measurements (see Fig. 1). Due to the low intensity of chemical weathering different minerals were determined as the phases of parent rock. Results showed that Clinoptilolite has hydrothermal origin. Moreover, ornithogenic activities caused significantly higher content of phosphate minerals and organic matter. Basic soil properties were evaluated and results indicated that poorly developed Antartic´s soils are characteristic mainly by mechanical (physical) and chemical weathering processes accompanied with low intensity of biological activity.

Dedication: Financial support from the National Agricultural Grant Agency project Earth No QK1810233 is highly acknowledged. This work was supported by the infrastructure obtained from project CZ.02.1.01/0.0/0.0/16_017/0002334.

Keywords: SOIL FORMING PROCESSES, ANTARCTIC´S SOILS

Abstract number: T 2.2

ESTIMATION OF BACTERIAL COMMUNITY TOLERANCE TO CU BACKGROUND IN NON-POLLUTED SOILS

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The use of Pollution Induced Community Tolerance (PICT) is showing as a promising tool for soil Cu pollution assessment under laboratory conditions. In those circumstances soils are experimentally polluted by spiking a soil with a Cu allowing to know the background level of tolerance to Cu (tolerance in not spiked soil). However, when bacterial community tolerance to Cu is determined in a field, polluted soil the background Cu tolerance is unknown since the bacterial community tolerance in natural soils may differ as function of soil characteristics. Therefore, the evaluation of background bacterial community tolerance in natural soils differing in soil characteristics is needed for future applications of PICT to asses Cu impacts in polluted areas. In the present study, bacterial community tolerance to Cu is determined in 18 non-polluted soils depending on soil characteristics such as parent material soil texture pH organic matter content etc. To this soils developed from granite (6) limestone (6) and schist (6) showing a pH range from 3.8 and 7.8 and total carbon contents from 3.7 to 14.2% were selected. PICT to Cu was performed using the ^{3}H Leucine incorporation method as bacterial community growth proxy. The logIC$_{50}$ (logarithm of Cu concentration inhibiting 50% of bacterial growth) was calculated for each soil and used as a metal tolerance index. LogIC$_{50}$ values ranged from -5.8 to -4.3 and no significant differences among the three parent materials were observed. Following a linear multiple regression LogIC$_{50}$ values could be predicted ($R^2 = 0.834$) as function of soluble organic carbon (SOC) soil pH and available phosphorus. As conclusion, these three parameters would seem enough to estimate a bacterial community tolerance to Cu background level in a field polluted soil using PICT.

Acknowledgements: This study has been funded by the projects CTM2015-73422-JIN and ED431F 2018/06. David Fernández Calviño holds a Ramón y Cajal contract (RYC-2016-20411) financed by the Spanish Ministry of Economy Industry and Competitiveness.

Keywords: TOLERANCE, BACTERIAL COMMUNITIES, PICT, POLLUTION COPPER

Abstract number: T 2.3

DETERMINATION OF THE SPATIAL VARIABILITY OF SOIL WATER CONTENT USING ELECTROMAGNETIC INDUCTION

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Soil water content (θ) in the root zone varies in space and time. It is a critical factor for crop development and irrigation management. Thus understanding its variability is of a great importance in agriculture. In Tolima region-Colombia irrigation systems are facing mounting pressures on soil and water use because farmers are still applying water volumes homogeneously without considering the heterogeneous characteristics of the soil profile. The inefficient use of soil and irrigation water is affecting the productivity of rice corn and cotton considered to be the main potential income-generating cropping system in the region. Conventional methods used for estimating and monitoring (θ) are laborious and time-consuming. To overcome the limitations of intensive soil sampling especially in large areas non-destructive electromagnetic induction (EMI) techniques based on measurements of apparent electrical conductivity (EC_a) have proven to be useful for estimating the spatio-temporal variation of (θ). However an effective site-specific calibration is always required to develop a relationship between (θ) and (EC_a) data measured by EMI sensors. The objective of this study was to provide effective tools for improving soil and water management by developing enhanced methodologies to estimate the spatio-temporal variability of (θ) for optimal irrigation management in Tolima. Field measurement campaign was performed in a 3.5 ha of bare soil meant for maize production under both dry and wet conditions using a Geonics “EM38-MK2” device in vertical (EMV) and horizontal (EMH) operation modes providing an effective measurement depth of ≈ 1.5 m and 0.75 m consequently. The sensor was mounted on a wooden cart pulled behind a tractor, which carried a GPS receiver and data collection computer. Empirical calibration equation was developed based on a multiple linear regression model to predict the depth-integrated (EC_a) readings from (θ) values measured in field by thermogravimetric method within three different depth intervals (0-20; 20-40 and 40-

60 cm). A specific noise filtering procedure was applied to the original (EC_a) data series, which enabled empirical calibration to be improved.

Keywords: SOIL WATER CONTENT, APPARENT ELECTRICAL CONDUCTIVITY, ELECTROMAGNETIC INDUCTION, EM38-MK2, TOLIMA REGION

Abstract number: T 2.4

MAGNETIC NANOPARTICLES BASED SOLID PHASE EXTRACTION COUPLED WITH VOLTAMMETRY FOR DETERMINATION OF VANADIUM SPECIES

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Vanadium is widely distributed in the earth's crust it is often present in low abundance. The most stable vanadium species include V(IV) and V(V). Research on the possible biological and metabolic roles of vanadium in organisms has increased over the last three decades and recent reviews on vanadium suggest that vanadium is essential for higher animals and humans. Vanadium may be an important cofactor in vanadate dependent haloperoxidases and vanadium nitrogenases in biochemical processing. Although vanadium is widely distributed in the earth's crust it is often present in low abundance. The most stable vanadium species include V(IV) and V(V). Research on the possible biological and metabolic roles of vanadium in organisms has increased over the last three decades and recent reviews on vanadium suggest that vanadium is essential for higher animals and humans. Vanadium may be an important cofactor in vanadate dependent haloperoxidases and vanadium nitrogenases in biochemical processing.

Commonly dispersive solid phase extraction (DSPE) molecularly imprinted solid phase extraction (MISPE) matrix solid-phase dispersion extraction (MSPDE) and magnetic solid phase extraction (M-SPE) have been the most commonly used methods for separation and preconcentration of inorganic and organic species. Recently *magnetic* nanoparticle-*based* solid phase extraction has gained interest because it presents various operational advantages over classical solid-phase extraction.

A simple and fast solid phase microextraction method using magnetic dextran (Sephadex G-150) as a sorbent was developed for the extraction separation and speciation analysis of chromium ions. The retained V(V) ions on the magnetic dextran sorbents were eluted and detected *by* linear sweep voltammetry at the gold nanoparticles modified screen- printed carbon electrode. The linear range detection limit quantification limit and preconcentration factor of the established method for V(V) and V(IV) were calculated to be 0.5–80 μM. Vanadium (IV) concentration was determined after conversion of V(IV) to V(V) by H_2O_2 in alkaline media (NH_4OH). The method was successfully applied to the speciation and determination of V(IV) and V(V) in artificial and tap water samples using the standard addition method.

Keywords: VANADIUM SPECIATION, PRECONCENTRATION, VOLTAMMETRY DETERMINATION

Abstract number: T 2.5

NEW PHYSICAL APPROACHES FOR SOIL STRUCTURE CHARACTERIZATION

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This research aims at testing and evaluating new physical approaches for studying soil structure formation and stabilisation in soils.

Firstly we applied *in situ* freeze coring for extracting monoliths (up to 62.5 cm long and 25 cm wide) in unconsolidated sandy soils.

Secondly 3D X-ray Computed Tomography (X-ray CT) at intermediate medical resolution (1 mm voxel size) was then used for identifying undisturbed zones within each frozen monolith a critical precondition for any subsequent assessment of soil structure. Finally X-ray CT allowed a description of the spatial arrangement of macropores within a frozen soil volume and 3D quantitative measurements of soil structure elements especially of soil pores and pore network features (length volume and connectivity of root galleries and earthworm tunnels). However it was not possible at this resolution to disentangle the effects of roots from those of earthworm.

In controlled experiments X-ray CT was also relevant for determining the impact of soil texture of roots and earthworms on structure formation and stabilization on pre-frozen or not pre-frozen soils.Finally we applied X-ray CT at very high resolution (10 microns voxel size) for characterization of casts and macro-aggregates produced under controlled conditions by different species of earthworms. The different components (organic matter mineral grains voids) were differentiated and quantified by CT and/or chemical analyses.

In addition, X-ray CT proved to be a very powerful and non-destructive tool that allows describing and quantifying the temporal dynamic of the structuration process on the same soil sample. To conclude the combination of these methods is very promising and could be easily applied for studying the resilience of soils subjected to different types of disturbance (compaction melting of permafrost and sealing in urban areas).

Keywords: X-RAY COMPUTED TOMOGRAPHY, SOIL FREEZE CORING, SOIL STRUCTURE, ALLUVIAL SOIL LIMITATION

Abstract number: T 2.6

ANALYSING METALS IN ORGANIC AMENDMENTS WITH PORTABLE X-RAY FLUORESCENCE

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Portable X-ray fluorescence instruments (PXRF) can be used for non-destructive and very fast determination of metals in soils and sediments. Nevertheless the use of this technique for quantitative determination of metal contents of compost biochar and other organic amendments is limited due to several constraints one of them being sample heterogeneity. The applicability of PXRF in relation to pseudototal contents (determined by acid digestion/ICP or analogous method) and the influence of sample positioning on the measurement window were assessed.

Two different samples one compost and one sewage sludge sample dried and finely ground were measured several times in different positions on the measurement window using two different PXRF calibration methods (Soil and Mining). The samples were placed in XRF containers capped with propylene film. The Relative Standard

Deviation (RSD standard deviation x 100/ element average) was used as indicative of sample repeatability.

In the sludge sample the measurements of Fe Ca Sr Cl Zn Ti Cu S Pb Zr K showed high repeatability (low RSD) among replicate runs in the same position. Despite the sample was finely ground the elements Fe Sc Sr Zn Zr P Si Ca Cu Mn and Cl showed significant differences among the different positions of the container. Additionally to these elements K Ti and Cr also varied among positions in the case of the compost sample. Results for Fe Mn Pb Cr and Sr obtained by the PXRF-Soil method agreed to the pseudototal contents while Cd and Ni contents were lower than their corresponding PXRF detection limits.

These results suggest that there is a great potential for widespread evaluation and quantification of elemental concentrations in organic samples and that considering the speed of analysis of the instrument (90-120 s per scan) the evaluation of heterogeneous materials by repeated measurements is feasible.

Keywords: COMPOST, HEAVY METAL, XRF, PSEUDOTOTAL, SAMPLE HETEROGENEITY

Abstract number: T 2.7

INFLUENCE OF BIOCRUSTS IN BACTERIAL COMMUNITY STRUCTURE ALONG A SOIL DEPTH GRADIENT IN SEMIARID ECOSYSTEMS

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The biocrusts are key organisms in arid and semiarid ecosystems covering the 70% of their surface composed by lichens mosses algae cyanobacteria and other bacteria. Biocrusts have been considered as engineering communities in drylands ecosystems due to their act efficiently in the primary productivity soil stability and fertility where they can be influencing the physico-chemical soil properties and soil microbial community structure in the immediately underlying soil layers. The aim of this work is to analyze the influence of biocrusts in soil microbial community structure in a gradient of soil depth from two semiarid ecosystems. For it soil samples were took in two study areas

Amoladeras (AMO) and Balsa Blanca (BB) located at Cabo de Gata-Níjar Natural Park (SE of Spain). The three samples of biocrusts dominated by the lichen Diplochistes diacapsis (C1) were sampled and once the biocrust layers were isolated three samples were collected from two different depths (S2: biocrust-to-1.5 cm and S3: 1.5-to-contact with the regolith at 10-15cm). Three bare soils samples in surrounding areas were also sampled (BS). DNA from samples was extracted using a commercial kit and pyrosequencing analysis of the V4-V5 16S rRNA gene region was carried out in order to investigate the bacterial community structure. The biostatistical treatment was undertaken using Mothur and CHIMERA-UCHIME. The results showed that bacterial communities at genera level with greater abundance in C1 (Psychrograciecola Segetibacter Microvirga) progressively decreased with the depth of the soil and its abundance was also very low in BS. On the contrary the most abundant soil bacteria in S3 (Rockubacteria Gaillelalles Acidimicrobia sp.) progressively decreased as they approached the surface layers (C1) colonized by biocrusts. The relative abundance of these communities was in turn very similar between BS and the S3 soil layers.
Acknowledgements: CGL2017-88734-R (BIORESOC) Research Project and RYC-2016-21191.

Keywords: BIOCRUSTS, SOIL BACTERIA, DRYLANDS, BACTERIAL COMMUNITY, SEMIARID ECOSYSTEM

Abstract number: T 2.8

A METAGENOMIC WINDOW INTO DRIVING MECHANISM OF SOIL BIOGEOCHEMICAL CYCLING PROCESSES

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Soil microorganisms play an essential role in the global biogeochemical cycles characterizing the microbial drivers of biogeochemical cycling processes promotes our ability to understand soil ecological functions. The majority of microorganisms have not been cultured which mostly restricted our understanding of soil function. The metagenomic break through the limitation of soil microbes culture-dependent and provide insight into driving mechanism of soil biogeochemical cycling processes. In this study, we explored functional characteristics of biogeochemical cycling processes of key elements such as carbon, nitrogen, phosphorus, sulfur and iron in soil and the main driving microbial taxa through metagenomics across ~3000 km in Eastern China. We found that the functional diversity in soils decreased with latitude rising with different biogeochemical cycling processes have different response to latitude gradient. Furthermore, the microbial community mediated these key biogeochemical cycling processes varied with latitude gradients. Overall, these results constructed the relationship between vital biogeochemical cycling processes and their driving soil microorganisms furthered our knowledge of driving mechanism of soil biogeochemical cycle.

Keywords: METAGENOMICS, BIOGEOCHEMICAL CYCLING PROCESSES, MICROBIAL DRIVERS, FUNCTIONAL DIVERSITY, LATITUDE GRADIENT

Abstract number: T 2.9

INFLUENCE OF PHYSICAL VOLUME OF RICE PLANTS ON CALCULATING SEASONAL METHANE FLUX IN CLOSED CHAMBER METHOD

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In rice paddies the closed chamber method is broadly used to estimate methane (CH_4) flux mainly due to low installation costs. Rice plants significantly affect CH_4 dynamics so it is recommended to plant rice inner the closed chamber to evaluate CH_4 fluxes. Methane emission rate is calculated with the increase of CH_4 concentration inner the chamber. The headspace of chamber can be significantly decreased with plant biomass growth and this volume change might affect CH_4 emission rates. However the influence of rice plant volume on CH_4 emission rates was not evaluated yet. In this field study to determine the effect of chamber headspace changes via rice plant growing on CH_4 flux five representative rice cultivars in Korea were cultivated in a typical paddy soil. The recommended acrylic closed chamber (Volume 0.43 m^3 H. 1.2 m x W. 0.6 m x L. 0.6 m) was installed to determine CH_4 emission rate during cropping season. A total of eight rice seedlings were transplanted singly in each hill inner the chamber with 30 cm x 15 cm interval. Plant biomass volume was periodically estimated using water displacement method. Irrespective with cultivars rice biomass volumes were gradually increased after tillering to panicle initiation stage and thereafter slightly decreased.

Methane emission rates were low at the initial growing stage dramatically increased with plant growth by flowering stage and thereafter slightly decreased to the background level. In the early growing stage which has low plant biomass growth the influence of physical biomass volume on CH_4 emission rates was negligible. Its influence was apparently increased with plant growth. At panicle initiation stage physical volume of rice biomass made CH_4 emission rate overestimated by the maximum 0.53-0.65%. However during the whole cropping season rice plant biomass inner the closed chamber caused seasonal CH_4 fluxes to be overestimated within 0.07-0.32% which might not be bigger than other errors in the gas sampling and analysis process. In conclusion rice plant biomass inner the closed chamber caused seasonal CH_4 flux to be slightly overestimated to less than 1% during cropping season and therefore the error due to physical biomass changes might be negligible in estimating CH_4 flux in rice paddy.

Keywords: PLANT BIOMASS VOLUME, RICE PADDY, METHANE EMISSION, RICE CULTIVAR, WATER DISPLACEMENT

Abstract number: T 2.10

SYNTHESIS OF BORATE NANOPARTICLES AND ITS APPLICATIONS AS A POTENTIAL FOLIAR SPRAY BORON FERTILIZER IN LETTUCE (*LACTUCA SATIVA*)

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Boron (B) is an essential micronutrient for plants however the role of B in plant is still least well understood of all mineral nutrients. It is suggested that the primary effect of B is to allow the normal functioning of the apical meristems changing membrane structure cell wall synthesis metabolisms of auxin and sucrose transport. In addition this element is relatively immobile then is necessary to increase their efficiency and transport into the plant using new technologies approaches that could include nanotechnology. In this context the development of a foliar spray nano-fertilizer could increase the B application efficiency in plant. The aim of this study were the creation and evaluation of a foliar spray B nano-fertilizer on the growth and physiological aspects of Lettuce (*Lactuca sativa*). The nano-fertilizer was synthesized using $CaCl_2$and $Na_2B_4O_7$through co-precipitation method. The nanoparticles were characterized using infrared spectroscopy (FTIR) scanning electron microscopy (SEM) and the evaluation of some physiochemical properties (B concentration size z-potential etc). The foliar application of the B nano-fertilizer was carried out in a hydroponic culture using lettuce plants and comparing their effect with a commercial B fertilizer (Bortrac^{tm}) during 61 days. The nano-fertilizer produces an increase in the biomass production of lettuce (more than 2 times compared with control plants) in the same way physiological parameters such as water potential and nutrient accumulation were improved due to the application of the nano-fertilizer. These results indicates that new and more efficient fertilizers could be created under this methodology.

Keywords: BORON, NANOFORMULATE, FOLIAR FERTILIZATION, HORTICULTURE, PLANT NUTRITION

Abstract number: T 2.11

EXTRACT AND IDENTIFY THE BIOMARKER MOLECULES OF ORGANIC MATTER FROM SOILS UNDER THE LONG-TERM RICE CULTIVATION

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All the organic matter in the soil was originally derived from biology and soil organic matter should include a collection of metabolites of a series of biological activities in the soil. In the different periods vegetation and soil animals will leave some clues in the molecular composition of soil organic matter and those clues are able to trace back no matter how the ecosystem replaced or how much time the replacement cycle is.

Based on the assumption that we want to find a way in another vision to describe the source of soil organic matter biological contribution rate and turnover behavior. The biomarker was a good tool, which can reflect the biological origin and the contribution rate of the organic molecules under soil biological participation. In the different soil under specific ecosystems there should be have series of specific composition and pedigree of biomarkers' molecular. In structures of the same soil, the differences in the molecular pedigree of the biomarker composition can reflect the changes about the soil environment in different periods.

For this purpose, this study improved the extraction method of biomarkers according to the properties of paddy soil and made the following research schemes. This was a matter of great significance to adapting the extraction method of biomarkers to match with different soils without considering the level of organic matter.

Keywords: SOIL ORGANIC MATTER, BIOMARKER, PADDY SOIL, GC-MS, LONG-TERM RICE CULTIVATION

Abstract number: T 2.12

XRD AND ELECTRON MICROPROBE INVESTIGATION OF CLAY MINERALS IN HAPLIC LUVISOL

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The character of parent material and organic material is an important factor of the geochemical and pedogenic formation. Together with climatic conditions they directly influence weathering transformation processes elements release and forming of soils. The character of clay minerals and humus stratigraphy were studied in *Haplic Luvisol* developed on loess (Litovelské Pomoraví protected area the Czech Republic). Soil chemical properties were determined using standard analytical methods. The crystalline thickness and size distribution of different minerals were measured by BWA (Bertaut-Warren-Averbach) technique. Significant differences in mineral composition in size fraction vertical and horizontal position were determined by X-ray diffraction (XRD) quantitative analysis. Digital microscope KeyenceVHX-6000 was applied to

inspect the soil from different angles and using advanced 2D/3D measurements. Due to illimerization soil forming process illuvial clay and organic coating are visible as darker and shinier surfaces of aggregates.

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Keywords: SOIL FORMING, ILLIMERIZATION, HAPLIC LUVISOL,, XRD ANALYSIS, BWA TECHNIQUE

Abstract number: T 2.13

METAGENOMIC STUDY IN TWO CRUSTED SEMIARID ECOSYSTEMS WITH DIFFERENT DEGRADATION STATE

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The biocrusts occupy 12% of the planet surface. They are highly representative in arid and semiarid zones where are adapted to extreme conditions as there are sporadic precipitations high solar radiation and extreme temperature. Biocrusts provide diverse ecosystem services such as water regulation carbon sequestration or increase soil fertility and play an essential role in the nutrients provision and regulation of microbial community structure. Biocrust are very sensitive to degradation which could indirectly affect the structure of their soil microbial communities. Two study areas were selected in southeast of Spain: Amoladeras (AMO) and Balsa Blanca (BB) being the first one considered the most degraded ecosystem. Three soil samples in the first 1.5 cm of soil underlying the biocrusts (S2 layer) and subsequent soil layer from S2 to the regoliht contact with a depth of 10-15 cm (S3 layer) were collected and the abundance and diversity of their bacterial communities were compared between both ecosystems. DNA from soil samples was extracted by using a commercial kit and bacterial communities were studied by Miseq (Illumina) massive sequencing. Mothur and CHIMERA-UCHIME were used to realize the biocomputer treatment and the elimination of chimeras. The results showed that although the diversity indexes (Margalef Shannon and Simpson) did not present significant differences ($p<0.05$) in the S2 layers between both study areas the Phyllum most abundant in AMO was Acidobacteria (17.27%) and in BB was Cyanobacteria (16.68%). Nevertheless the Phyllum Acidobacteria presented similar abundance in S3 layers both in AMO and BB (24.66% AMO and 24.82% BB) although no significant differences were found for the diversity indexes studied between these layers.

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Keywords: BIOGICAL SOIL CRUSTS, MICROBIAL COMMUNITY COMPOSITION, SEMI-ARID ECOSYSTEM, DNA ANALYSIS, SOIL BACTERIA

Abstract number: T 2.14

INFLUENCE OF PHYSICO-CHEMICAL SOIL PROPERTIES IN SOIL MICROORGANISMS FROM CRUSTED SEMIARID ECOSYSTEMS

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Biocrusts are widely spread in drylands colonizing the first few millimeters of the soils. They act in physico-chemical increasing organic matter nitrogen soil moisture and stability etc. Numerous studies have shown that physico-chemical properties have a key influence on soil bacterial communities. Nevertheless little is known about the influence of biocrusts in soils parameters and bacteria communities' composition in underlying soils. The present work target was to study the correlation between physico-chemical soil parameters and soil bacteria communities in soils colonized by biocrusts. To do this soils underlying biocrusts-dominated by the lichen *Diplochistes diacapsis* (three replicate) were sampled in two crusted semi-arid ecosystems Amoladeras (AMO) and Balsa Blanca (BB) located in SE of Spain (Almería). In each soil samples electrical conductivity (CE) pH total organic carbon (TOC) and carbonate content were determined. In parallel DNA of soil samples was extracted by using a commercial kit and illumina MiSeq platform (Reagent Kit v3 -2x300 cycles) was used for pair-ended sequencing of amplicon libraries of 16S V4-V5 rRNA gene. The 16S rRNA data was processed with the MOTHUR v. The results showed a high number of significant correlations ($p < 0.05$ $r > 0$) between soil bacteria and physico-chemical soils

parameters. A first bacteria group composed by *Acidobacteraceae Subgroup 1 Pseudonocardia Caldilineacea Actynomycespora* and *Acidipila* showed negative correlations with pH (r≈-0.700) and carbonate content (r≈-0.400) and positive with TOC (r≈0.700) and CE (r≈0.050). Conversely a second group led by *Rhodotermaceae Euzebyaceae* and *Caldilineacea* presented positive correlations with pH (r≈0.220) carbonates (r≈0.440) CE (r≈ 0.700) and negative with TOC (r≈-0.200).

Acknowledgements: CGL2017-88734-R (BIORESOC) Research Project and RYC-2016-21191.

Keywords: BIOCRUSTS, SOIL PROPERTIES, SEMIARID ECOSYSTEMS, SOIL BACTERIAL COMMUNITIES

Abstract number: T 2.15

SPECTROFLUOROMETRIC CHARACTERIZATION OF ALKALI-EXTRACTABLE SOIL ORGANIC MATTER: THE APPLICATION OF EMISSION EXCITATION MATRIX SPECTROSCOPY, FLUORESCENT AND UV-VIS INDICES

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UV-Vis and fluorescent spectroscopy is a fast and reliable option to acquire information about aromaticity and some other properties of the soil organic matter (SOM). Nowadays these applications are primarily used to the qualitative evaluation of the water-soluble fraction (DOM) but the characterization of the stabilized SOM can also be an option.

The present study focuses on the applicability of fluorescent indices for organic material characterization. 72 arable soil samples were extracted using the method of the International Humic Substances Society. Two fractions were separated from each sample using this procedure: 1./ organic matter fraction that precipitated in acidic medium and 2./ organic matter fraction that remained dissolved in both acidic and alkali medium. UV-Vis (E2/E3 E4/E6 SUVA254) fluorescent (HIX BIX FI) indices and the Coble peaks were determined from the light absorption and EEM spectra. The molecular size of the organic matter fractions was measured by photon correlation spectroscopy the organic carbon content was determined by TOC analyser.

The EEMs have clearly shown that the redshift of fluorescent radiation was such high that the measured values were outside the calculation range of indices. Our results suggest that humification index (HIX) without the application of the EEMs are not applicable for the characterization of SOM. Furthermore, the presence of high molecular size organic compounds in the organic fraction cannot be determined by fluorescent indices because of the redshift. Both FI and BIX are able to characterize alkali-extractable SOM. EEM spectra provide an option to determine the presence of fluorophores aliphatic content of the SOM as well.

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Keywords: SOM CHARACTERIZATION, HUMIFICATION INDEX, FLUORESCENT INDEX, BIOLOGICAL INDEX, ARABLE SOIL

Session 3: Ecological disturbances – How do mismanagement of soils (overgrazing, erosion etc.) or natural disasters (fire, flooding etc.) affect the interplay between soil minerals, SOM and microorganisms?

Abstract number: K 3

SPELEOTHEMS FROM VOLCANIC CAVES AS RECORDS OF ENVIRONMENTAL CHANGES

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Speleothems are secondary mineral deposits formed in caves, such as stalactites and stalagmites, due to water-rock interactions. They are typically used as climate archives in karstic caves, as their formation depends on the amount and geochemistry of water dripping into the cave. Likewise, soil minerals and organic matter from the surface are transported along bedrock discontinuities and deposited on speleothem surfaces during rain events. Hence, speleothems may provide information on local climate and other variables, such as changes in vegetation, precipitation and the occurrence of floods, droughts or fires. In volcanic islands, the most common caves are lava tubes, but they were considered of little interest and scarcely studied. Thus, siliceous speleothems are rarely used in paleoenvironmental studies due to their low carbon content. However, they can give us important information on past environmental disturbances.

Forests in volcanic islands have been frequently affected by wildfires, which alter the physical properties of volcanic-ash soils (andosols) and drastically decrease their water retention capability, leading to extensive soil erosion after torrential rains. These changes may promote the genesis of speleothems in the underground environment which may grow extremely fast once the overlying andosol is burnt. For instance, in lava tubed from La Palma Island (Canary Islands, Spain), we found unusual black

speleothems with gelatinous texture in caves located below a laurel forest burnt in 2012. For unveiling their origin and composition, we conducted FESEM-EDS, XRD, isotope analysis, ^{13}C NMR and analytical pyrolysis (Py-GC/MS). We demonstrated that these gelatinous speleothems are entirely composed of highly hydrated non-crystalline materials. We described them as aluminum silicate gel coated with charred vegetation and thermally degraded resins or triterpenoids from the overlying burnt forest. This demonstrates that environmental changes in volcanic regions may change the underground environment.

In this presentation we will show examples of how the combined use of contrasting and complementary analytical tools allow us to successfully discern environmental changes using speleothems found in volcanic caves from the Canary Islands (Spain) and Easter Island (Chile).

Keywords: LAVA TUBES, SUBSURFACE, SILICEOUS SPELEOTHEMS, ORGANIC MATTER, PALEOENVIRONMENTAL CHANGES

Abstract number: D 1

AGRICULTURE CHANGES SOIL ORGANIC MATTER STOCKS AND MICROBIAL ACTIVITIES IN SOILS OF THE GALAPAGOS ISLANDS

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At the Galápagos Islands natural forest vegetation has been converted to arable land to meet the increasing demand of agricultural produce during the last decades. In our study we assessed the impacts of agricultural land use on the islands of Santa Cruz and San Cristobal. The site on Santa Cruz was called El Cascajo (EC Leptosol 5 years after conversion to intensive agriculture) and on the oldest island of the Galápagos archipelago San Cristóbal Cerro Verde (CV Ferralsol 15 years after conversion). At both sites we compared arable soils to soils under forests within the adjacent Galápagos National Park which had formed on the same parent materials. Several soil properties showed a significant impact of the arable use. Soil C_{org} stocks were relatively high at both sites (between 94 ± 28 and 142 ± 10 t/ha). At CV the stocks were 25% lower in arable plots compared to the natural forest while the observed decrease at EC was not significant. As both sites exhibited high clay and Fe-oxi-hydroxide contents it is likely that the stabilisation capacity of the soils for C_{org} has still not been exhausted. Many other parameters like N_t and several Mehlich-III extractable nutrients were closely correlated with the changes in C_{org}. Microbial biomass carbon (C_{mic}) and dissolved organic carbon (DOC) were significantly lower in the arable plots compared to forest at both sites. At EC C_{mic}/C_{org} even dropped by a factor of 1.9. Changes in pH and the use of agrochemicals evidenced by pesticide residues detected in the soil might be a possible explanation. Ammonium-N decreased and nitrate-N increased tremendously in the arable plots on both islands.

Keywords: AND MANAGEMENT, SOIL ORGANIC CARBON, SOIL FERTILITY, PESTICIDES, MICROBIAL ACTIVITY

Abstract number: D 2

EFFECTS OF CULTIVATION ON SOIL ORGANIC MATTER STORAGE AND ORGANO-MINERAL INTERACTIONS IN TROPICAL SOILS OF WESTERN UGANDA

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Increasing human population is driving agricultural intensification in the Kabarole district of Uganda. This region is located within the Albertine branch of the African Rift Valley and supports a great diversity of soil types. The objectives of this study were (1) to determine the influence of intensive agriculture on soil organic matter (SOM) dynamics and organo-mineral interactions and (2) to assess whether some soil types were inheritently resistant or sensitive to cultivation-induced SOM losses due to their different mineralogy.

We compared 32 soil profiles representing six catenas evenly distributed between agricultural and forested land use. Forested areas were part of the Kibale National Park, which was delineated in 1932 and formally established in 1993 from previously managed forest and extensive rangelands. Soil samples were analyzed for mineralogy (X-ray diffraction) geochemical composition (X-ray fluorescence and selective extractions) as well as SOM content (CHN elemental analysis) and type (density fractionation Rock-Eval pyrolysis and fluorescence of pyrophosphate extracts).

Results showed that agriculture decreased SOM content but only as a third-order control. Most of the variation in SOM content was associated with differences in mineralogy or topographical position. Density fractionation revealed that 78 (topsoil) to 95% (subsoil) of SOM was present in the heavy fraction i.e. associated with minerals. This was confirmed by the quantification of pyrophosphate-extractible organic carbon, which is thought to represent organic compounds complexed by Fe and Al.

Iron oxides were the most important predictor of SOM content both in cultivated and forested plots. Organic matter in iron oxides-rich soils (Plinthosols Plinthic Ferralsols) had a very specific signature as revealed by measures of fluorescence on the pyrophosphate extracts. Taken together these findings suggest that mineralogy is a prime determinant of SOM persistence following soil disturbance. More specifically iron oxides appear to be involved in the preservation and accumulation of specific organic compounds; this protection could limit cultivation-induced SOM degradation. Results have practical implications as they could help inform land use decision in the region.

Keywords: SOIL MINERALOGY, SILICATES OXIDES, ORGANIC MATTER STABILIZATION, AFRICAN RIFT VALLEY

Abstract number: D 3

SOIL PROPERTIES IMPACTED BY RESIDUE REMOVAL AND NITROGEN TYPE

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In agricultural systems removing crop residue could reduce soil organic matter (SOM) build up deteriorate soil quality/health and increase soil erosion potential. This study evaluates the influence of three residue removal levels (0% 50% and 80%) and two nitrogen sources (cattle beef manure M; and synthetic fertilizer F) on soil organic carbon (SOC) using full combustion method and microbial community size and structure via ester linked-fatty acid methyl ester (EL-FAME) profiling on a no tillage irrigated continuous corn study site. The experiment design is a randomized strip with four replications. The study was established in 2011 in Tribune Kansas. Manure addition and 0% residue removal treatment improved SOC compared with synthetic F and residue removal treatments of 50% and 80%. After 7 years of management the 0% residue removal exhibited higher microbial community size compared with other removal treatments. The microbial communities decrease with depth (0-5 cm > 5-10 cm > 10-15 cm) regardless of residue removal amount or nitrogen type. Our data shows that complete residue removal could have a negative effect on the soil quality/health indicators used. However, the addition of organic amendments such as manure could help to compensate for the residue removal.

Keywords: RESIDUE MANAGEMENT, ESTER LINKED-FATTY ACID METHYL ESTER (EL-FAME), SOIL ORGANIC CARBON, MANURE FERTILIZER

Abstract number: D 4

ECOLOGICAL CONSEQUENCES OF INVASIVE E. COLI CARRYING SHIGA TOXIN INTO THE SOIL

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The presence of *Eschericia coli* (*E. coli*) leads to potential outbreaks of disease demonstrating the importance of understanding how such organisms survive in secondary environments such as soils in which native community also possesses resistance and resilience to exotic species invasion. Here we created two dilutions for diversity gradient of soil microbial communities and evaluated the survival of three *E. coli* O157:H7 strains: Shiga toxin-producing *E. coli* its mutant without stx genes and strain without virulence genes in four soils. The *E. coli* O157:H7 survival time decreased in all treatments ranging from 8.23 ± 5.42 to 62.33 ± 35.80 days. The fastest decline was with the Shiga toxin-producing strain at 10^{-1} dilution whereas the strain without virulence genes persisted the longest 178 days in the γ sterilized treatment. Path analyses showed that soil pH exerted a critical role on the persistence of *E. coli* O157:H7 higher pH values produced longer survival time for each strain. With the invasion of *E. coli* O157:H7 the alpha diversity of soil microbial community decreased. Beta diversity of all soil communities exerted a recovery tendency after 120 days cultivation and the shorter invasion time caused the quicker native community recovered. *E. coli* O157:H7 invasion led to functionality shifts of resident communities in utilizing carbon sources and community niche also the higher soil biodiversity was the greater influence was. These conclusions are of relevance for agricultural situations where anthropogenic influences lead to decreased soil diversity increased soil pH and resource input through manure application, which can potentially increase the survival time of *E. coli* O157:H7 and then leave legacy effects on resident community.

Keywords: E. COLI O157:H7 INVASION, SURVIVAL, METABOLIC POTENTIAL, COMMUNITY, NICHE

Abstract number: D 5

THE ENCROACHMENT OF *AMORPHA FRUTICOSA* L. ALTERS SOIL C AND N CYCLES IN NATURAL DRY GRASSLANDS

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Biological invasions are a massive plague of our time. Exotic invaders have no more barriers to spreading and persistence: invaders diffuse rapidly and successfully compete with autochthonous species altering biodiversity and nutrient cycling. N_2-fixing plants are among the most successful invasive species worldwide mainly due to their surplus availability of the most important macro-nutrient. In particular woody N_2-fixing species may produce great impacts on C and N cycles. Large areas in the North East of Italy are being increasingly colonized by the woody and N_2-fixing invader *Amorpha fruticosa* L. (false indigo-bush). The species is driving the complete substitution of plant communities with monospecific populations of the species in natural dry grasslands along riversides where significant changes of soil nutrient cycling are expected. We collected soils along four rivers in the Friuli region in uninvaded dry meadows and in invaded patches with 50% and 100% cover of *A. fruticosa* respectively. Parameters that may indicate perturbations in the C and N cycles were investigated: soil organic C its isotopic ratio $^{13}C/^{12}C$ microbial biomass C and soil respiration soil organic and mineral N contents $^{15}N/^{14}N$ isotopic ratio nitrification and ammonification rates. Soil organic C was stable or slightly decreased during invasion whereas total N in soil increased gradually from uninvaded to 100% covered grasslands. Changes in the isotopic fingerprint indicated an enrichment in ^{15}N under monospecific populations of the species while ^{13}C abundance did not show clear variations. Deviations from this framework could be probably referred to soil age duration of the invasion or original litter quality that can significantly alter microbial activity in soil. *A. fruticosa* invasion has a strong potential impact on soil C and N cycles and this makes the fate of ecosystem restoration and re-colonisation by native plants uncertain.

Keywords: BIOLOGICAL INVASION, N-FIXATION, N CYCLE, C CYCLE, SOIL MICROBIAL BIOMASS

Abstract number: D 6

TOTAL POPULATION OF FUNGI AND BACTERIA IN DIFFERENT FRACTIONS OF AGGREGATES UNDER CONTRASTED SOIL MANAGEMENTS

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Soil aggregates are massive microbial incubators. Research on the population of bacteria and fungi in different fractions of soil aggregates can help to understand the interaction between microhabitats in soil aggregates and important functions of microorganisms as soil aggregation and carbon storage under different soil managements. The hypothesis of this work was that conventional tillage compared to direct seeding and undisturbed soil (the control) can (i) alter the majority of the soil microhabitats modifying the aggregate size distribution and as a consequence (ii) alter the content and distribution of fungi and bacteria and their functionality. The main objective of this work was to evaluate the total bacteria and total fungi content as well as the fungi/bacteria ratio (F/B) together with other soil quality parameters in four aggregate fractions separated by wet sieving (i.e. between 8 and 2 mm; between 2 and 0.25 mm between 0.25 and 0.053 mm and the fraction <0.053 mm).

The study was carried out in a Calcium Haploxeralf from a long-term experimental field (22 years). Samples were taken at two depths of 0-5 cm and 7-12 cm. The pH EC organic carbon and Kjeldahl nitrogen were analyzed both in the bulk soil (<8mm) and in the four aggregate fractions. The DNA was extracted and 16S rRNA sequences (as an estimation of total bacteria) and ITS sequences (as an estimation of total fungi) were quantified in each of the fractions of the aggregates by qPCR.

Conventional tillage destroyed part of macroaggregates (>2mm) which only constituted 16.7% of soil at 0-5 cm depth compared to 50.7% in the control. The high abundance of bacteria in the undisturbed soil was equally distributed in the four aggregate fractions. However in direct seeding the bacteria were concentrated only in the two largest fractions of aggregates. While in conventional tillage the bacteria were

concentrated in a single fraction of aggregates (between 0.25 and 0.053 mm) which indicates the restriction of bacterial microhabitats. Fungi were antagonisms with bacteria and in many cases, the highest abundances of fungi coincided with the lowest abundances of bacteria. The measures of fungi bacteria and the F/B ratio in aggregates> 2mm showed numerous significant correlations with the rest of soil quality parameters.

Keywords: FUNGI/BACTERIA RATIO, C SEQUESTRATION, AGGREGATION, DIRECT SEEDING, MICROHABITATS

Abstract number: D 3.1

DETERMINATION OF WASTE ACID DRUGS IN THE RESIDUAL WATER USED IN THE AGRICULTURAL ZONE OF THE "ADJUNTAS" TO IRRIGATION WATER, IN THE STATE OF GUANAJUATO, MÉXICO

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Over the past five years global drug sales have increased by 25%. The Inappropriate management of all the waste of medications Is what is originating from one form or another the pollution of aquifers or water from the drainage system or of all the Soils of municipal garbage receivers. This type of chemical waste is Despite being present at relatively low concentrations of nanograms per liter (ng/L^{-1}) comes to bioaccumulate and they originate from adverse effects on the ecosystems to which they are thrown. Due to their chemical stability, they are not completely removed from the drainage waters. In such a way that they remain and are transported in this type of water. In Mexico, the "sewage" is used as irrigation water in agricultural areas as is the case of the "Las Adjoinas" area in the state of Guanajuato located in the center of the country where the residual water of its neighboring city of Queretaro is occupied. for the irrigation of the crops which is conducted there through the channels of what used to be freshwater rivers. Up to this time in this country, there is no regulation in the minimum permissible concentrations of emerging pollutants in wastewater as in this case whose purpose is the irrigation of agricultural crops. The purpose of this project was to evaluate the presence of Eight Emerging pollutants specifically acidic drugs in the residual water of the city of Queretaro. For which it was required to develop the technique of preparation of cleaning extraction and derivatización of residual water in order to be able to detect the residues of the acidic drugs by CG-MS. We found the concentration of: acid clofíbrico a 0.001 µG/L; Diclofenac 0.0395 µG/L; fenofibrato a 0.0141 µg/L; fenopreno a 0.0141 µg/L; gemfibrozil a 0.46741; Ibuprofen 0.0337 µg/L; Indomethacin 0.3739 µg/L and naproxen 0.4365 µg/L. One of the consequences of these chemicals being found in this irrigation water is its accumulation over time especially in the agricultural soil. The concentrations in which these wastes are accumulated cOmo is the case in the area of Agricultural In the "Attached" is unknown until this moment. There are also no reports at the national level about the detection of this type of waste drugs. In residual water or of the others as is the case of the basic drugs with which we could compare the results that we report here.

Keywords: TOXIC ELIMINATION DRUG

Abstract number: D 3.2

TAXONOMIC AND FUNCTIONAL ANALYSIS OF A SOIL CONTAMINATED WITH HEAVY METALS

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Accumulation of heavy metals caused by mining activities profoundly alters soil microbial communities. Whereas metal toxicity eradicates some groups of microorganisms others adapt to these conditions using metal resistance mechanisms. Thus these microorganisms can be used in bioremediation. We aim to investigate the effect of high metal (Cu As) concentrations on the microbial communities of contaminated soils. A whole-metagenomic sequencing approach was used to investigate the functional potential and structural diversity of the soil microbial communities along a metal contamination gradient in soil samples collected from an abandoned copper mine located near Madrid. Results showed that differences in soil metal concentrations considerably affected the composition of Bacteria Fungi and Archaea domains. *Actinobacteria* and *Proteobacteria* were the most predominant bacterial phyla. Abundance of *Proteobacteria* (especially *Alphaproteobacteria*) increased in highly contaminated areas whereas *Actinobacteria* dominated in the non-contaminated area. Regarding Fungi Ascomycete and Basidiomycete were the main phyla detected. Abundance of Basidiomycete did not exhibit differences among areas whereas Ascomycete (*Eurotiomycetes*) increased in areas with moderate metal concentrations. The most predominant phylum of Archaea was *Eurychaeota* (*Halobacteria*) with higher abundance at intermediate contamination levels. Shannon index revealed a greater alpha diversity in the non-contaminated area decreasing with higher levels of contamination. Interestingly a functional analysis showed that the abundance of genes involved in Cu metabolism was directly proportional to its concentration along the gradient. However, genes related to As metabolism did not follow a clear trend. In summary structure composition and function of soil microbial communities were significantly affected by metal concentrations, which acted as relevant selective factors for the adaptation of some taxonomic groups

Keywords: CONTAMINATED SOILS, METAGENOMIC MICROORGANISMS, FUNCTIONAL GENES, ARSENIC

Abstract number: D 3.3

IMPACT OF THE SIMULTANEOUS APPLICATION OF HERBICIDES AND ORGANIC AMENDMENTS ON SOIL MICROBIAL COMMUNITY IN A FIELD TRIAL

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The impact of the simultaneous application of pesticides and organic amendments on soil microbial communities under field conditions has been scarcely studied. The objective of this work was to evaluate the effect of the join application of two different organic amendments (spent mushroom substrate-SMS and green compost-GC) and three herbicides (chlorotoluron flufenacet and diflufenican) on the soil microbial abundance activity and structure under field conditions. The herbicides were applied as commercial formulations in unamended SMS- and GC-amended soils (Soil Soil+SMS and Soil+GC respectively). Unamended and amended soil samples were taken from the 0–10 cm topsoil of experimental plots (three replicates/treatment). Soil dehydrogenase activity (DHA) and soil microbial biomass and structure determined by the profile of phospholipid fatty acids (PLFA) were monitored at 0 45 145 229 and 339 days after herbicides´ application. The soil DHA values tended to be lower in the plots treated with herbicides in comparison with their respective controls. The soil microbial activity presented a progressive decrease over time in the unamended soil treated with the herbicides while it was constant in the amended soils with and without herbicides. In amended soils higher values of concentrations of PLFAs were recorded. Total soil microbial biomass decreased over time regardless of the organic amendment or the herbicide. The herbicide application produced a significant decrease in microbial population and a significant modification of microbial structure in unamended soil. In contrast, no significant differences of microbial biomass and structure were detected in Soil+SMS and Soil+GC untreated or treated with herbicides. The use of SMS and GC as organic amendments demonstrated certain buffer effect on soil DHA and on soil microbial communities after herbicide application. In conclusion, the application of SMS and GC to soil decreased the impact herbicides have on soil microbial biomass structure and activity.

Keywords: HERBICIDE, ORGANIC AMENDMENT, SOIL MICROBIAL COMMUNITY, FIELD

Abstract number: D 3.4

INFLUENCE OF NOTHOFAGUS PUMILIO FOREST MANAGEMENT ON HG CONTENT AND ACCUMULATION IN ORGANIC MATTER RICH SOIL HORIZONS

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Forest soils play an important role as mercury pool (Hg_{TRes}) in its biogeochemical cycle within terrestrial ecosystems. Mercury accumulation occurs primarily in the uppermost soil layers (O and A horizons) which receive the input of atmospheric Hg through wet and dry deposition as well as litterfall. However, forest management could substantially modify soil ability to store Hg.

This study assess the effect of elapsed time (1 5 and 50 years) since the management of *Nothofagus pumilio* forests from Tierra del Fuego (Argentina) in the accumulation of Hg in organic-C rich soil layers (O A). For each time period three representative lenga forest plots were selected in which three composite samples were taken from the 0-10 cm soil layer. Soil samples from an unexploited forest plot (control) close to those managed were sampled similarly (three composite samples of the 0-10 cm layer). Thus total Hg (Hg_T) was determined using a DMA-80 analyzer in a total of 54 soil samples from 9 managed forests and 9 control plots.

Average of Hg_T was 250 ng g^{-1} (range 159-441 ng g^{-1}) being significantly higher ($p<0.05$) in samples from forest plots managed 1 year ago than their corresponding control samples (282 and 231 ng g^{-1} respectively). In soil samples from forest plots managed 5 and 50 years ago no significant differences were observed in Hg_T compared to those samples from control plots. An analysis of variance revealed that Hg_T in uppermost soil layers (0-10 cm) does not vary significantly ($p>0.05$) in the managed forests considering the time elapsed since exploitation but it is closely correlated to total organic C ($r=0.680$ $p=0.000$) and total N ($r=0.719$ $p=0.000$).

Soil Hg pool (Hg_{TRes}) in the 0-10 cm layer was similar in plots managed 1 year ago and their controls (10.2 and 9.9 mg m^{-2} respectively) but it was somewhat higher than controls in the case of plots managed 5 years ago (9.8 and 9.0 mg m^{-2} respectively). The opposite occurs in the forests managed 50 years ago where Hg_{TRes} is lower in managed than in control forest plots (9.2 and 11.2 mg m^{-2} respectively). These results suggest that Hg_{TRes} in the studied soil layers does not depend too much of the recovery degree of the forest rather than soil organic matter dynamics.

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Keywords: MERCURY POOL, UPPERMOST SOIL, LENGA EXPLOITATION

Abstract number: D 3.5

P DETERMINATION OF WASTE ACID DRUGS IN THE RESIDUAL WATER USED IN THE AGRICULTURAL ZONE OF THE "ADJUNTAS" TO IRRIGATION WATER, IN THE STATE OF GUANAJUATO, MÉXICO

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In Mexico the "sewage" is used as irrigation water in agricultural areas as is the case of the "Las Adjuntas" area in the state of Guanajuato located in the center of the country where the residual water of its neighboring city of Queretaro is occupied for the irrigation of the crops which is conducted there through the channels of what used to be freshwater rivers. Up to this time in this country there is no regulation in the minimum permissible concentrations of emerging pollutants in wastewater as in this case whose purpose is the irrigation of agricultural crops. The purpose of this project was to evaluate the presence of eight emerging pollutants specifically acidic drugs in the residual water of the city of Queretaro. For which it was required to develop the technique of preparation of cleaning extraction and derivatización of residual water in order to be able to detect the residues of the acidic drugs by CG-MSQQQ.

We found the concentration of: acid clofíbrico a 0.001 µG/L; Diclofenac 0.0395 µG/L; fenofibrato a 0.0141 µG/L; fenopreno a 0.0141 µG/L; gemfibrozil a 0.46741; Ibuprofen 0.0337 µG/L; Indomethacin 0.3739 µG/L and naproxen 0.4365 µG/L. One of the consequences of these chemicals being found in this irrigation water is its accumulation over time especially in the agricultural soil. The concentrations in which these wastes are accumulated is the case in the area of Agricultural In the "Attached" is unknown until this moment. There are also no reports at the national level about the detection of this type of waste drugs in residual water or of the others as is the case of the basic drugs with which we could compare the results that we report here.

Keywords: TOXICITY ELIMINATION, MEDIC CONTAINS, AGRICULTURE, WASTE WATER

Abstract number: D 3.6

IMPACT OF THE AGRICULTURAL SYSTEM SOYBEAN-COVER CROPS AND PGPR INOCULATION ON RHIZOSPHERE MICROBIAL COMMUNITIES

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The challenge of modern agriculture is to increase the productivity of crops that provide food with environmental awareness; reducing the use of pesticides and chemical fertilizers and favoring agricultural sustainability. Knowledge of the rhizosphere microbial ecology and use of quality microbial bio-inputs are tools to achieve those objectives. Therefore the impact on the rhizosphere microbial communities (RMC) of cover crops (CC) inclusion in succession with soybean and PGPR inoculation was evaluated. Under field conditions four randomized complete block trials with factorial arrangement in sub-divided plots were performed. Nitrogen fertilization (0 and 45 Kg/ha; CC (oats and rye) and control; two CC drying times with glyphosate and inoculation with Azospirillum brasilense and Pseudomonas fluorescens; three sampling times (ST) were included. Before the application of glyphosate the highest counts of RMC and the greatest functional diversity and absence of differences between physiological profiles were observed. The RMC were modified by CC according to the application in tillering or jointing stages and the three ST (before after the glyphosate and soybean harvest). The physiology and structure of RMC were altered even after the cultivation of soybean. Thus the impact of the glyphosate was not reverted to the previous situation. The inoculation produced an increase of rye biomass but did not negatively affect native RMC. Agronomic and environmental relevance of these results is highlighted with respect to the microbial ecology and the nature of the work done including cultural and molecular techniques for four field-conditions trials. The generated knowledge could help to improve the management of CC-Soybean agricultural system. The information obtained allows connecting processes that occur in the aerial portion of the system with those that take place underground. This contributes to agricultural sustainability because it is in line with the concepts of the new green revolution, which are applied through the bioeconomy.

Keywords: SOYBEAN, COVER CROPS, AZOSPIRILLUM BRASILENSE, PSEUDOMONAS, FLUORESCENS, RHIZOSPHERE

Abstract number: D 3.7

IMPORTANCE OF BIOGENIC SILICON IN PEDOLOGICAL SEQUENCES, AS A DETERMINANT OF THE EDAPHIC PROPERTIES OF AGROECOSYSTEMS OF THE ARGENTINIAN PAMPEAN PLAINS

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Silicon (Si) is the second element of importance in the litosphere found mostly as silicate and biogenic silica essential for many organisms. Particularly amorphous silica biomineralizations of vegetal origin (silicophytoliths) can be found in many plant families being the grasses (wild types and crops) their major producers with sizes between 5 and 50 mµ. After plant decomposition this biomineralizations are incorporated pre-sin and postpedogenetically into the soil modifying its physicochemical mineralochemical and biological properties. Minerachemicaly was analyzed by petrographic and scanning electron microscopy MEB and EDAXs while Si in soil solution was measured by UV-VIS spectrophotometry all trough routine techniques. Results from the physicochemic mineralochemic and biological analysis proves the presence of different well-preserved silicates and also a relevant amount of silicophytoliths in the southeastern Argiudolls of the Buenos Aires province explained by the dominant coverings of grasses in the meadows of the extensive Cenozoic. From the physical point of view the silt fraction is a major component of the skeletal fraction of the aggregates which confer structural stability providing favorable physical conditions such as porosity infiltration and transport that will lastly affect the mobility of soil solutions. Silicophytoliths constitute a relevant textural fraction to which the conservative managements applied during last decades had contributed to preserve since they allowed high amounts of them to be incorporated into the soils. On the other side the irrational managements had drastically modified and depleted the soil profiles from silicophytoliths stocks. Therefore managements are considered the main controllers of these biomineralizations stocks that will lastly contribute to the aggregate’s stability preservation since they will enrich their matrix with amorphous silica associated to the soil organic matter. Finally as biomineralizations are an

important component of the organic-inorganic soil phases it`s considered relevant to plan adequately the use of silicophytolith´s supplier crops as a tool for the mitigation of the negative effects suffered over hundreds of years and the improvement and preservation of edaphic properties.

Keywords: MINERALOGY, BIOMINERALIZATIONS, SILICOPHYTOLITHS, SOM, SOIL MANAGEMENT

Abstract number: D 3.8

EFFECT OF WIND EROSION ON SOIL ORGANIC MATTER ON AGRICULTURAL LAND

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The problem of wind erosion occurs in many parts of our planet. As noted in the «Global Warming Report 1.5º C» prepared by an intergovernmental group of experts at the United Nations climate change in Russia is occurring several times faster than the world average. This contributes to accelerated development of various degradation processes of soil cover.

Studies were conducted on agricultural land of the Republic of Bashkortostan - southern federal subject of Russia. Over the past decades has been observed a decrease in precipitation and gradually increasing aridity of climate. Cases of hurricane winds leading to increased development of wind erosion are becoming more frequent. Wind erosion most often occurs in areas with unstable and insufficient moisture. It is indicates likely development of destructive processes in unprotected areas of plants.

The latest comprehensive studies of deflation processes of the republic date back to the 80s of the last century. This determines need to conduct actual research using new technologies such as geoinformation technologies (GIS) and remote sensing data.

As a result, the work revealed a strong destructive effect of wind erosion on agricultural lands. The transformation of soil microaggregates was studied and defined them movement and zones of accumulation. The correlation between soil organic matter of the soil the nature of the vegetation cover orographic features of the relief the methods of mechanical tillage and the development of wind erosion processes has been studied. GIS methods of deflation modeling and soil transport and deposition modeling were applied and tested.

Keywords: EROSION, SOM HUMUS MICROAGGREGATES, GIS

Abstract number: D 3.9

EVIDENCE OF BIOLOGICAL FEATURES IN ALGERIAN GYPSIC SOILS

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Gypsic soils are very common in semi-arid and arid regions. They accumulate in different forms that are favored by specific environments (climate with a very high rate of evaporation highly mineralized groundwater geomorphological depressions of endorheic type). The morphological and analytical study of gypsic formations in the region of Ouargla (Algeria) shows significant thicknesses ranging from a few tens of centimeters to several meters. The gypsum content is very high with values higher than 50%. Macroscopic observations (binocular loupe and optical microscope) show the presence of centimetric greenish spots in the mass of the gypsic material. Ultramicroscopic observations (scanning electron microscope and chemical elemental probe) show the presence of biological forms associated with gypsum crystals. It is difficult to determine the exact nature of the biological species observed without a thorough genetic determination. Through a comparative and bibliographic approach the presence of cyanobacteria that are relatively common in arid and semi-arid environments can legitimately be deduced. On the other hand, it is also possible to hypothesize that gypseous crusts were formed during a period when the weather conditions are wetter than those currently prevailing in the Ouargla region.

Keywords: GYPSIC SOIL, CYANOBACTERIA, MICROSCOPY, ARID ZONE, ALGERIA

Abstract number: D 3.10

SOIL MICROBIAL BIOMASS RESPONSES TO ESSENTIAL OILS EXTRACTED FROM DIFFERENT MEDITERRANEAN HERBS

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Essential oils (EOs) extracted form herbs contain terpenes terpenoids and polyphenols which show inhibitory effects on seed germination and seedling growth of weeds. Therefore EOs are potential sources for the development of new bioherbicides. A previous study carried out by the authors has found EOs extracted from *Thymbra capitata* (L.) Cav. *Mentha x piperita* L. and *Santolina chamaecyparissus* L. were able to reduce the emergence and seedling growth of many weeds. However due to their potential antimicrobial activity EOs could affect all soil processes mediated by microorganisms. Since EOs impacts seem to be rather complex as they have been found not only to inhibit but also stimulate microbial activities thus elucidating the interactions between soil microorganisms and EOs was the goal of this study.

To this end the EOs extracted from *T. capitata M. piperita and S. chamaecyparissus* were applied to a soil at different concentrations.

Before applying the EOs soil aliquots were moistened up to 2/3 of 50% of their water holding capacity (WHC). Then they were brought up to 50% of their WHC by adding a solution containing the EOs so reaching a concentration of 31 67 93 µl/mL 100 g^{-1} of soil for *M. piperita and S. chamaecyparissus* and 93 123 154 µl/mL 100 g^{-1} of soil for *T. capitata* EO.

Fitoil was used to emulsify the EOs at a concentration of 0.05% (v/v). The soil used was the topsoil (0-10cm) collected in a citrus orchard never treated with herbicides. Four replicates per treatment were run.

Soil samples were analyzed to determine microbial biomass C and N and microbial community structure (through ELFAs fingerprints) after one week one month and two months of incubation. In parallel glass jars with 20 g of soil were incubated to measure CO_2 released by soil respiration for 60 days.

Preliminary results reveal that EOs were able to kill some soil microorganisms thereby providing substrate easily decomposable by the surviving ones but also that EOs were assimilated by some soil microorganisms as C and energy sources.

Keywords: ESSANTIAL OILS, SOIL MICROORGANISMS, MEDITERRANEAN HERBS

Abstract number: D 3.11

EVALUATION OF URBAN SOILS UNDER TWO DIFFERENT LAND-USE TYPES: URBAN AGRICULTURE AND URBAN PARKS

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Considering growing urbanization in major cities preserving green open spaces such as urban agriculture and parks has been highlighted in urban planning as a promising way to maintain or enhance different ecosystem services related to urban environments. However, the effect of these services varies depending on the type and management of land-use. The objective of this project was to evaluate the influence of land use (urban agriculture and urban parks) on microorganism activity and soil properties related to soil fertility as an important regulating ecosystem service. The most Probable Number (MPN) method was used to estimate populations of bacteria capable of nitrification. Furthermore soil chemical analysis (total N organic N fraction organic C C/N bioavailable P cation exchange capacity (CEC) and pH) as well as other physical parameters (particle size distribution bulk density) allowed to compare three urban farms and three urban parks in the city of Geneva (Switzerland). Relatively higher nitrification activity was found in the urban agricultural soils as compared to the urban park soils but variations were also observed within types of land use (farms and parks). Organic C organic N C/N ratio and CEC were significantly higher in the urban parks soils than in urban agricultural soils. No significant differences between land uses were found with regard to bioavailable P and pH. Concerning physical analyses bulk density was significantly higher in the urban agricultural soils. This evaluation of land use management of urban soils will allow actors to integrate the notion of soil fertility as an important regulating ecosystem service into future urban development policies.

Keywords: URBAN SOILS LAND-USE ECOSYSTEM SERVICES SOIL FERTILITY NITRIFICATION

Abstract number: D 3.12

THE TERMINATION METHOD OF WINTER COVER CROPS DETERMINES THE SOIL BIOLOGICAL PROPERTIES

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Replacement of bare fallow by winter cover crops (CC) in annual rotations promotes agroecosystem sustainability by enhancing soil health. However, benefits may be reduced or vanished depending on CC termination method. The roller crimper is a promising method to terminate CC in organic and conservation systems but when combined with glyphosate to ensure termination may adversely affect soil microorganisms. We assessed the effect of the CC termination method on biological soil properties under Mediterranean conditions where an effective CC termination is crucial to avoid water competition. The experiment was conducted in a rotation with irrigated maize and with a mixture barley/vetch as CC. Three termination methods were assessed: i) CC residue incorporation (INC); ii) roller-crimper (RC); and iii) glyphosate+roller crimper (GRC). The field study was set in two adjacent sites in 2016-17 and 2017-18. We sampled roots and rhizosphere soil at 43-48 days after maize seeding. Root colonization and external hyphae length were measured as mycorrhization indicators. DNA was extracted from the soil and specific sequences were used to quantify total bacteria total archaea total fungi as well as selected fungal phylum. The different CC termination methods did not show a clear effect on root colonization and hyphae length likely because of different weather conditions and differences in maize development. Both years INC increased total fungi and archaea abundance whereas total bacteria abundance was affected by year with higher values under RC in 2017. Interestingly GRC decreased Glomeromycota genes in both years. Compared to RC GRC also decreased total fungi abundance and hyphae length in

2017. Our results show that combining RC with glyphosate may harm some soil biological indicators although others might be favored depending on particular campaign conditions. Further research is needed to clarify interactions between CC termination and environmental variables.

Keywords: ROLLER-CRIMPER, GLYPHOSATE, EXTERNAL HYPHAE LENGTH, GLOMEROMYCOTA, ROOT COLONIZATION

Abstract number: D 3.13

CHARACTERIZATION OF SOIL MICROBIAL COMMUNITIES FROM A THREATENED WOODLAND HABITAT (EUROPEAN HABITAT DIRECTIVE, CODE 9230) LOCATED BETWEEN THE TEMPERATE AND MEDITERRANEAN BIOREGIONS UNDER A GLOBAL CHANGE SCENARIO

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Bacterial and fungal soil biodiversity express the degree of conservation and functionality in natural habitats allowing monitoring variations related to environmental changes. Thus, the characterization of soil communities in threatened woodland habitats of European interest (defined by the EU Directive 92/43/CEE or “Habitat Directive”) is of great importance in the face of global change. In north-western Iberian Peninsula subtemperate/submediterranean woodlands develop at the border between the Temperate and Mediterranean regions: the “Galicio-Portuguese oak wood” (Habitat Directive code 9230). In this work we have studied fungal and bacterial communities from the forest soils of 9230 habitat by sequencing the ITS and 16S rRNA regions using the Illumina MiSeq platform. This is the first time that soil communities from this habitat are studied using next-generation sequencing. Within fungal communities ectomycorrhizae are predominant especially the genus *Russula* (≈ 50%) along with *Amanita Lactarius* and *Laccaria* and to a lesser extent the genera *Boletus* and *Xerocomus*. Saprotrophs mainly represented by the genus *Mortierella* (≈ 5%) were also found. Regarding the fungal communities our data are similar to those documented for temperate *Q. robur* forests from other European regions. Bacterial communities are co-dominated by Acidobacteria and Proteobacteria in similar proportions with smaller percentages of Actinobacteria Planctomycetes Bacteroidetes and Verrucomicrobia. Somewhat higher percentages of Acidobacteria than Proteobacteria have been reported for temperate broadleaved European forests whereas Proteobacteria seem more important in Mediterranean forest communities. Our results show an intermediate situation for the Galicio-Portuguese oak wood bacterial soil communities under current climatic conditions. Future studies could assess to what extent global change can affect the soil microbial communities and the internal balance in the 9230 habitat.

Keywords: MICROBIAL DIVERSITY, SOIL, EUROPEAN HABITAT, NGS, ENVIRONMENTAL CHANGES

Abstract number: D 3.14

THE IMPACTS OF BORON ON THE BIOMASS, COMPOSITION AND ACTIVITY OF THE SOIL MICROBIAL COMMUNITY

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Climate change has forced the use of desalinated seawater as a new way to combat water scarcity in semi-arid agroecosystems around the world. The high boron (B) content in desalinated seawater is a concern for crop development. However despite the importance of the soil microbial community in soil fertility the below-ground impacts of B are still unknown. Here in a soil-ryegrass model system we evaluated the activity biomass and diversity of the soil microbial community in response to irrigation with: i) 0.3 mg B L^{-1}; ii) 1 mg B L^{-1}; and iii) 50 mg B L^{-1}. We assessed two different compounds of boron: boric acid (H_3BO_3) and disodium tetraborate decahydrate ($Na_2B_4O_7 \cdot 10H_2O$).

Overall the intermediate dose (1 mg B L^{-1}) was identified as the threshold limit that did not irreversibly harm soil sustainability. In contrast the highest B dose had an important impact on the nitrogen (N) cycle of the soil as demonstrated by the water-soluble N content and the urease activity. Analysis of the phospholipid fatty acids (PLFAs) revealed that the effect of B on the soil microbial biomass was dependent on the chemical form used. High B doses reduced soil microbial respiration and influenced the composition of the bacterial and fungal communities with fungal diversity being diminished as revealed by sequencing approaches.

Keywords: BORON, SEMI-ARID SOIL, SOIL MICROBIAL COMMUNITY, DESALINATED SEAWATER DIVERSITY

Session 4: Dynamics of pollutants at soil interfaces – What is new and how can environmental biotechnology be beneficial for soil restoration and bioremediation?

Keynote Lecture

Abstract number: K 3

REMEDIATING SOILS POLLUTED BY TRACE ELEMENTS: THE GUADIAMAR CASE STUDY (SW SPAIN)

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The remediation of soils polluted with trace elements (TE) is a difficult task, because of the toxicity, immutability and relative immobility of these elements in the soil. Most conventional remediation techniques based on expensive physical and chemical methods which immobilise or extract the contaminants, alter drastically soil properties, leaving it unfertile and no longer suitable for the cultivation or the development of plants, and pose an important deterioration of the environment. A feasible and cost-effective technique is the assisted natural remediation (ANR) that through the application of organic (manure, composts) or inorganic (lime, zeolite, phosphates, Fe oxides rich stuff) amendments enhances the natural remediation (NR) processes (sorption, precipitation, complexation) that occur naturally in the soil, thus reducing the mobility and bioavailability of TE. Lime increases soil pH giving rise to the adsorption and precipitation of cationic TE. Zeolites, phosphates and Fe oxides favor the adsorption of TE, especially those of anionic nature. Organic matter also increase soil pH and at the same time immobilised TE by a series of mechanisms (chelating by soluble phase, adsorption by solid phase, formation of ternary complex mineral-organic matter-trace element). The establishment of a natural or induced vegetation in the amended soils also favors soil remediation (phytoremediation). An example of ANR is the remediation of soils (4286 ha) of the Guadiamar river valley contaminated by TE (As, Bi, Cd, Cu, Pb, Sb, Tl and Zn) by the spill (sludge and acid water rich in TE) in 1998 of the tailing-dam of the Aznalcóllar-Los Frailes mine. Affected soils were restored removing the sludge deposited on the soil surface, applying sugarbeet lime, composts and iron oxide-rich red soil, and by the afforestation of ca. 2700 ha with native shrubs and trees. After the restoration, the availability of TE decreased in the amended soils throughout the area, that was colonized by autochthonous vegetation; in general grass tissues showed normal concentrations of TE except for Cd. Different tree species differ in their suitability for soil remediation; the more effectives are those increasing soil pH, accumulating TE in the rhizosphere, and having low TE translocation from roots to leaves and fruits. Field, containers, pots and microcosms experiments provided information on the efficacy of different amendments. Assisted natural remediation proved to be a successful and reliable technique for remediation of a trace-element contaminated soil at large scale with minimum maintenance.

Abstract number: P 1

TREE SPECIES EFFECT ON SOIL ORGANIC MATTER AND SOIL MICROORGANISMS IN TRACE ELEMENT CONTAMINATED SOILS

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In forest stands different tree species might have contrasted signals on soil organic matter due to their leaf litter and rood exudates thus leading to species-specific interactions with the microbial communities in the soils underneath. In trace element-contaminated soils organic matter is also associated with the dynamics of these elements in the soil-plant system.

In a trace element contaminated area in SW Spain different native tree species were planted in order to reduce the mobility of these contaminants. After 15 years of tree growth we evaluated whether different tree species had specific influences on: 1) trace element stabilization in soil 2) the quality of soil organic matter and 3) the functioning of the soil microbial community.

Two areas with different soil bedrock and contamination level (North and South) were selected in the Guadiamar Green Corridor. Soils and leaf litter were collected underneath three native tree species: white poplar stone pine and wild olive as well as in a treeless soil covered by herbaceous plants. Main soil chemical properties were analysed as well as soil microbial biomass and enzyme activities. The signal of different chemical groups in litter and soil particulate organic matter (POM) was analysed by Fourier-transform infrared spectroscopy (FT-IR).

Soil trace element availability was significantly higher in the North area due to the acidic soil pH and lower soil organic matter. Soils underneath pine trees in the North area presented higher acidification, which was linked to a more intense signal of those peaks characteristic of acid functional groups (pectin resins and waxes) in the litter and the POM underneath this species. The comparison of FT-IR spectra of POM in both

areas suggested a higher degree of transformation of the POM in the South area. Microbial biomass was however similar underneath the trees in both areas but lower in treeless soil. The effects of trees on enzyme activities depended on the enzyme however in general enzyme activities were highly driven by soil acidification and contamination. In conclusion we found that trace elements availability increased underneath pine trees which are not beneficial due to their acidification effect through leaf litter deposition.

Keywords: FOURIER-TRANSFORM INFRARED SPECTROSCOPY LEAF LITTER PHYTOSTABILISATION SOIL ACIDIFICATION SOIL ORGANIC MATTER

Abstract number: P 2

IMPACT OF BIOCHAR APPLICATION ON SOIL QUALITY AND MICROBIAL COMMUNITIES IN A TRACE ELEMENT POLLUTED SOIL

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Microorganisms play a key role on soil organic matter decomposition nutrient cycling and soil health. High concentrations of trace elements in soils can negatively affect soil microbiological properties[1]. Recent studies have shown that biochar can act as an effective tool for the remediation of soils contaminated with trace elements[2]. This work evaluates the effects on soil microbial community of two different biochars used as amendment in two trace-element contaminated *Typic Xerofluvent* soils. They were sampled in a site affected by the breaching of a tailings dam in 1998 flooding 4.286 ha of lands close to Aznalcóllar (SW Spain). The soils used for this study have two different levels of contamination: a) moderately polluted (MPS) and b) highly polluted (HPS). Rice husk and olive pit biochars (RHB and OPB respectively) were produced in a continuously feed reactor (500 ºC average residence time 12 min; N_2 atmosphere). The remediation potential of these biochars was tested by applying 0 and 8 t ha^{-1} to the topsoil layer in plots of 1 m^2. Microbial communities were studied in the amended and unamended soils by DNA-based analyses. For comparison purposes dehydrogenase (DHA) β-glucosidase (BGA) enzymatic activities and soil respiration

(6400-09 Soil CO_2 Flux Chamber LI-COR) were measured for all the plots. Finally FESEM-EDS analysis was performed to appraise changes produced on biochar particles throughout the field experiment time.

FESEM images showed the presence of filamentous microbial structures on biochar surfaces Ca-S particles in OPB and high content of Si in RHB. Amendment of the MPS with RHB decreased soil respiration and DHA. In contrast OPB amendment increased BGA in MPS after 6 months. Preliminary results showed a greater stability of RHB than OPB which may be of relevance for its use in the restoration of soils contaminated with trace elements.

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Keywords: BIOCHAR, SOIL AMENDMENT, SOIL MICROBIOTA, ENZYMATIC ACTIVITIES, SOIL REMEDIATION

Abstract number: P 3

THE BACTERIAL AND ARCHAEAL INTERACTOME DURING PCP DECHLORINATION IN NATURAL FLOODED SOIL UNDER METHANOGENIC AND SULFATE-REDUCING CONDITIONS

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The enhancement of *in situ* reductive dechlorination is typically accomplished through the provision of various exogenous electron donors. However in mixed microbial communities such as soils the addition of electron donors may stimulate the activity of soil indigenous dechlorinating microorganisms but also inevitably affect naturally

coexisting soil redox processes and stimulate co-occurring populations that compete for electron donors. In this study we examined the chemical and microbial interactions between typical soil redox processes and PCP degradation in naturally flooded paddy soils amended with different electron donors (including formate acetate pyruvate and lactate) in two different reducing conditions—namely methanogenic and sulfate-reducing conditions. Among the tested electron donors pyruvate was most effective in facilitating PCP dechlorination. Together with the Illumina sequencing data on bacterial and archaeal responses in the soil the co-occurrence network analysis was first applied to study the impact of different electron donors on the bacterial and archaeal interactome processing PCP dechlorination in different soil-reducing conditions. The addition of exogenous fermentative electron donors facilitates change in the bacterial and archaeal communities by increasing the relative abundances of the core functional microbial community assembled by the fermenting bacteria (*Clostridia*) potential iron reducers (*Natronincola* and *Geosporobacter*) sulfate reducer (*Desulfuromonadaceae*) functional methanogen (*Methanosarcinaceae*) and PCP dechlorinators (*Desulfitobacterium*) thus strengthening their connections. Our results provide a comprehensive (and new) perspective on optimum regulating and facilitating strategies in the degradation of PCP in anaerobic environments.

Keywords: ELECTRON DONORS, REDUCTIVE DECHLORINATION, REDOX PROCESS, CO-OCCURRENCE NETWORK, MICROBIAL INTERACTOME

Abstract number: P 4

MOLECULAR DYNAMICS SIMULATIONS OF SOIL CONDENSED PHASES

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Soil condensed phases are mainly represented by two types of materials – soil organic matter (SOM) which is a result of decomposition of (bio)organic material and soil minerals. Clay minerals such as kaolinite and Smectite families predominate the clay-sized fraction of many soils. It is of utmost importance to understand interactions and

formation of SOM-mineral aggregates at the molecular scale to explain e.g. sorption and buffer functions of soils and important stabilization mechanisms of SOM.

In this work, we characterized the behavior of the kaolinite-water interface in the interaction with ions glyphosate and model aggregates of humic substances (HS) by means of classical molecular dynamics simulations. The models of HS aggregates were generated by a modeler developed in our group - Vienna Soil-Organic-Matter Modeler (VSOMM).[1] Because of the nature of the modeled systems interfacial phenomena play an important role in interface processes. Therefore properties such as density profiles polarization and dielectric properties residence times etc. are in the center of our interest. We observed that electrostatic phenomena seem to be the main driving force for adsorption at the clay-mineral interface consequently leading to strong interactions with clay mineral surfaces characterized by hydrogen bonding and/or inner/outer surface complexation. This offers the possibility to deepen our understanding of the complex behavior of soil processes at an atomistic level leading to explanations of phenomena at the macroscopic scale with application in environmental science and engineering.

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Keywords: MOLECULAR DYNAMICS, SIMULATIONS, KAOLINITE-WATER, SOIL ORGANIC MATTER, SOIL INTERFACE, CLAY MINERALS

Abstract number: P 5

BINDING MECHANISMS AND MODELLING OF HEAVY METALS AT THE INTERFACE OF MINERAL-MICROORGANISM COMPLEXES

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Clay minerals bacteria and humic substances are the major abiotic and biotic components in soil system. The complexation and aggregation of these components govern a series of soil processes including the behaviour and fate of heavy metals.

The mechanisms of the binding and competitive adsorption of heavy metals on bacteria-associated clay mineral complexes have been poorly understood. Very few models are available regarding the adsorption of heavy metals on bacterial complexes. Batch sorption ITC EXAFS and μ-XRF were applied to investigate the binding characteristics of Cd and its competition with Pb on montmorillonite (Mont)-humic acid(HA)-bacteria composites. Additive sorption and non-additive Cd(II) sorption are observed for the binary Mont-bacteria and ternary Mont-HA-bacteria composite respectively. Cd is mostly bound to bacterial surface functional groups by forming inner-sphere complexes. Presence of HA depressed the total binding of Cd but enhanced the transfer of Cd to the bacterial fraction in the composites. The decreased coordination of C atoms around Cd and the reduced adsorption enthalpies and entropies for the binary mixtures suggested the transformation of bidentate Cd-carboxyl complexes into monodentate ones. Stronger competition was observed on clay mineral than on bacteria–clay composite due to more non-specific sites for heavy metal adsorption on clay mineral. Both competing heavy metals tended to react with bacterial fractions in the composite, which was verified by the higher correlation of Cd (and Pb) with the distribution of Zn than with other elements. The CA method is limited to low bacterial and Cd concentrations in simulating Cd adsorption on bacteria-iron oxides composites and over predicted by approximately 8% on the 1:1 composite at high Cd concentration. The deviation could be corrected by adding the site blockage reactions between *P. putida* and goethite. Both CA and “CA-site masking” models for Cd adsorption onto the composites were in line with the ITC data. The understanding on the binding mechanism and modelling of heavy metals at the bacteria–mineral interfaces from a molecular and thermodynamic view would have an environmental significance for predicting the behavior of heavy metals in complex soil systems.

Abstract number: P 6

CO-TRANSPORT OF PHENANTHRENE AND PENTACHLOROPHENOL BY NATURAL SOIL NANOPARTICLES THROUGH SATURATED SAND COLUMNS

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Mobile colloids such as nanoparticles (NPs) are often considered to affect the fate and transport of various contaminants by serving as carriers. Many studies have focused

on the effect of engineered NPs on contaminant transport. To date very little information is available on the co-transport of natural soil NPs with typical organic contaminants. This study investigated the co-transport of phenanthrene (PHE) and pentachlorophenol (PCP) with three soil NPs through saturated sand columns. Soil NPs with high organic matter and particle concentration were the most effective in transporting PHE through columns. In addition soil NPs significantly increased the transport of low-level PHE (0.2 mg L-1) but there was no obvious increase at 1.0 mg L-1 PHE. This is attributed to a higher ratio of NP-associated PHE to total PHE at a low-level than at a high-level during transport. In contrast to PHE the chemical speciation of PCP determined its mobility which was highly dependent on solution pH. At pH 6.5 anionic PCP became dominant and soluble in the effluent. This could account for the negligible effect of soil NPs on PCP mobility. At pH 4.0 however neutral molecular PCP dominated and as expected decreased mobility of PCP occurred. Soil NPs considerably enhanced the transport of neutral PCP in NP-associated forms compared to controls due to the high hydrophobicity and sorption affinity of PCP to NPs. The findings implied that highly mobile soil NPs may be effective carriers for organic contaminants and can pose a threat to the ecological environment.

Keywords: SOIL NANOPARTICLES PHENANTHRENE PENTACHLOROPHENOL CO-TRANSPORT COLUMN EXPERIMENTS

Abstract number: P 7

HYSTERESIS ASSOCIATED WITH SORPTION-DESORPTION ON SOILS AND SOIL COMPONENTS: HOW MUCH WORK IS NEEDED TO CREATE IT?

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Soil sorption interactions are well recognized to control multiple biogeochemical processes at soil interfaces and therefore affect distribution of various compounds both well-defined pollutants and natural components with poorly known chemical structure in the soil-water-air-plant continuum. Sorption-desorption hysteresis is probably most puzzling feature of interactions with soils (or soil components including clays and soil organic matter) specifically when artifacts (e.g. biological or chemical degradation

precipitation or loss of sorbent material) or slow kinetics mechanisms (such as intra-organic matter or intra-pore diffusion or chemical reactions) are accounted for. One mechanism proposed in the earlier literature for explanation of so-called "true" hysteresis in sorption phenomena of organic compounds by soils suggested formation of metastable states along sorption branch and their persistence during desorption. Following this general idea of appearance and persistence of metastable states a novel approach is proposed to quantify the extent of hysteresis in terms of work needed to create these metastable states. This approach is based on simple thermodynamic treatment of experimentally determined sorption-desorption sequence and provides quantitative measures for hysteresis in contrast to multiple empirical indices widely used in the literature and generally having limited (if at all) mechanistic justification. As an example different sorbates may demonstrate sorption-desorption hysteresis differing in terms of work needed to develop metastable states but being characterized by the same values of the commonly used relative indices. The proposed approach is demonstrated using experimental data on aqueous sorption of polyaromatic hydrocarbons and some pesticides on various sorbents including soils sediments and clays for different types of sorption-desorption behavior i.e. including Freundlich model-like and more complicated trends. It is expected that the proposed methodology should be useful for relating the hysteresis associated with formation of metastable states to sorbate molecular structure and composition and architecture of sorbent phases and interfaces.

Keywords: HYSTERESIS, DESORPTION, ORGANIC MATTER, CLAY, METASTABLE STATE

Abstract number: P 8

SORPTION OF CIPROFLOXACIN ONTO HUMIC ACID, FERRIHYDRITE AND ITS COMPOSITE. EFFECT OF ANIONS AS ELECTROLYTE

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Humic acid/ferrihydrite composite (HA-DIG/Fh) ferryhidrite (Fh) and humic acid (HA-DIG) extracted from a volcanic ash derived soil were evaluated under controlled pH (7.0) ionic strength (0.1M) and temperature (25°C) to establish the influence of NO_3^- or PO_4^{3-} in the CIPRO adsorption both common anions in the soil solution. All materials were characterized by isoelectric point (IEP) while the composite and ferrihydrite were also characterized by Mössbauer spectroscopy. Batch kinetic and adsorption studies were carried out using as analytical method cyclic voltammetry (in KH_2PO_4) and square wave voltammetry (in KNO_3) which allowed to electrochemically evaluate CIPRO concentration in the supernatant. Kinetic experiments were performed out at fixed concentration to establish the optimum equilibrium time. The application of kinetic models for both anions allowed to fit (R2=0.970) Fh to a pseudo second order model; while that HA-DIG (R^2=0.950) and HA-DIG/Fh (R^2=0.993) were fitted to pseudo first order. The adsorption results showed the dependence from anion used as electrolyte mainly in Fh where different shapes curves (H-type in KNO_3 and C-type in KH_2PO_4) and maximum experimental adsorbed amount Cm were obtained. This behavior can be explained considering the different values of IEP obtained (7.6 in KNO_3 and 3.2 in KH_2PO_4) changing in magnitude and even the sign of the surface charge of Fh at pH=7.0 ((+) in KNO_3 and (-) in KH_2PO_4) modifying the shape of the adsorption curve establishing the presence and importance of electrostatic interactions between adsorbate-adsorbent. In conclusion Fh in KNO_3 media can be projected as potential environmental remediators to remove antibiotics from natural matrices while that HA-DIG seems to be the best option in KH_2PO_4 media which may imply that if same adsorption is maintained over soluble organic matter (SOM) contents then there’s a potential risk of antibiotic transport in depth in the soil profile.

Acknowledgements: Support from Fondecyt project 1130094 Puente 2018 (P1811) and Basal Funding for Scientific and Technological Centers of Excellence FB0807 CEDENNA.

Keywords: CIPROFLOXACIN, SOIL HUMIC ACIDS, IRON OXIDES, ISOELECTRIC POINT, SORPTION MODELS

Abstract number: P 9

MOLECULAR MECHANISMS FOR DISSOLVED BLACK CARBON SORPTION ON SOIL

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Black carbon of natural or anthropogenic origins is of great relevance to the cycling of a range of elements and contaminants and it is gaining increasing interest in agricultural and environmental fields. Dissolved black carbon (DBC) the water-soluble fraction of black carbon can be readily mobilized from its parent materials and dispersed into soil environments and finally transported to aquatic environments. About 26.5 Tg of charcoal or black carbon-derived DBC was released into aquatic environments annually accounting to ~10% of the global riverine flux of dissolved organic carbon (DOC). DBC involves in many biogeochemical processes in both terrestrial and aquatic environments. Yet its adsorption behavior and mechanisms on soil are poorly understood. Here we examined the molecular composition variations of DOC induced by the sorption of two black carbon-derived DBCs (pyrolyzed at 300^{o}C and 500^{o}C) on three contrasting soils. The DBCs were adsorbed mainly through competitive displacement of soil surface functional groups and co-sorption with soil indigenous DOC which varied with soil properties and the aromaticity of the DBCs. Ultrahigh resolution mass spectrometry analysis indicated that compounds with rich oxygen content or unsaturated structures such as tannins and unsaturated aromatics from both DBC and soil DOC were preferentially adsorbed on the soils in the presence of DBC. In contrast compounds with high aromatic structures including condensed aromatics and lignins were concentrated in the aquatic phase. DBC could bind with organic contaminants as sorbents due to its rich aromatic structure and the enrichment of aromatic fractions of DBC after sorption could facilitate the translocation of contaminants as carriers in the soil and water environments. Our results suggest that DBC sorption on soil altered DOC molecular composition and decreased DOC molecular diversity at the soil-water interface which have important implications for understanding the behaviors of DBC and the associated contaminants in the environments.

Keywords: DISSOLVED ORGANIC CARBON, MOLECULAR COMPOSITION, SOIL SORPTION, BLACK CARBON

Abstract number: P 4.1

THE REACTIVITY OF [FE(III)]/[FE(II)] COUPLES FOR 2-NITROPHENOL REDUCTION IN VARIOUS MINERAL SURFACES: THE INTERFACIAL REACTIONS AMONG FE, AL AND SI

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Nitroaromatic compounds and their derivatives (NACs) are highly toxic and recalcitrant chemicals and have been listed as priority pollutants. The environmental fates of NACs are determined by many factors among which mineral-bound [≡Fe(III)]/[≡Fe(II)] couples has been proven to play a critical role in the reduction of NACs into the corresponding nitroso/amino compounds under abiotic conditions. And the reductive reactivity of the [≡Fe(III)]/[≡Fe(II)] couples are closely correlated with its surrounding conditions like reaction pH reaction temperature co-existence organic compounds the properties of adsorbing surfaces soil use types and so on.

Silica aluminum and iron are the second third and fourth most abundant elements in the Earth’s crust respectively. Hence to compare the features of reactive Fe(II) surface complexes under the impact of soluble Si(IV) and further on the reduction of NACs by mineral-bound [≡Fe(III)]/[≡Fe(II)] couples are important for us to understand the interfacial reactions among silica aluminum iron and NACs in real subsurface environments. In this study experiments were conducted at different conditions to investigate the effects of Si(IV) on the reactivity of [≡Fe(III)]/[≡Fe(II)] couples for 2-nitrophenol (2-NP) reduction in γ-Al_2O_3 suspensions.

Kinetics results revealed that chemical adsorption is the rate limiting step in Fe(II) and Si(IV) adsorption processes and the reduction of 2-NP is an endothermic reaction. Furthermore the peak oxidation potential (E_P) and the adsorbed Fe(II) density ($\rho_{Fe(II)}$) were proved to be two key factors in the inhibiting effects of Si(IV) on the reductive reactivity of Fe(III)/Fe(II) couples on γ-Al_2O_3. Moreover, the increase of Si(IV) concentration resulted in the gradually change in the composition of the adsorbed Fe species from pure $\equiv AlOFe^+$ (γ-Al_2O_3 surface-bound Fe(II) species with higher reductive reactivity) to a mixture of $\equiv AlOFe^+$ and $\equiv SiOFe^+$ (SiO_2 surface-bound Fe(II) species with lower reductive reactivity) whereas the negative effects of Si(IV) on the reductive reactivity of the adsorbed [≡Fe(III)]/[≡Fe(II)] couples on a mineral surface mainly by modifying the properties of the adsorbed [Fe(III)]/[Fe(II)] couples through changing the above two key factors under various reaction conditions.

Keywords: [FE(III)]/[FE(II)] COUPLES, SOIL MINERALS, PEAK OXIDATION POTENTIAL, ADSORBED DENSITY LINEAR COMBINATION FITTING

Abstract number: P 4.2

BACTERIAL COMMUNITY TOLERANCE TO ANTIBIOTICS IN CU POLLUTED ACID SOILS.

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Copper pollution in acid soils may cause harmful effects on soil microbes. One of them is the increase of soil bacterial communities tolerance (PICT) to Cu an effect usually observed in Cu polluted soils like those devoted to vineyard. Moreover Cu pollution may also increase the bacterial community tolerance to other pollutants such as different heavy metals (Zn Cd Ni) or antibiotics (tetracycline tylosin or vancomycin). The aim of this study is to check the potential of Cu pollution to cause an increase of bacterial community tolerance to 3 antibiotics (tetracycline oxytetracycline and chlortetracycline) in two acid soils. One of these soils has clay loam texture a pH of 4.7 and an organic carbon content of 5.3%. The other one was sandy clay loam in texture with a pH of 4.5 and an organic carbon content of 11%. Tests on PICT to Cu and the three selected antibiotics were performed using the ^{3}H Leucine incorporation method as bacterial community growth proxy. Both selected soils were incubated during 42 days with different Cu concentrations (0 125 250 500 750 and 1000 mg/kg). After incubation soil bacteria were extracted from soils and bacterial growth determined in presence of different Cu concentrations in the bacterial suspensions. Results show significant increases of bacterial community tolerance to Cu in soil samples polluted with Cu concentrations $\geq$ 500 and $\geq$250 mg/kg for soil with the lower and higher carbon content respectively. Significant increases were also found for bacterial community

tolerance to the three studied antibiotics but just for Cu concentrations ≥ 1000 mg/kg in both soils and for the three studied antibiotics. Therefore we can conclude that these acid soils highly polluted with Cu present an important risk of increasing bacterial community tolerance to tetracycline oxytetracycline and chlortetracycline regardless of the content of organic matter.

Acknowledgements: This study has been funded by the Galician Government (Consellería de Economía Emprego e Industria) through the project ED431F 2018/06; and by the Spanish Government through the project CGL2015-67333-C2-1-R y -2-R. David Fernández Calviño holds a Ramón y Cajal contract (RYC-2016-20411) financed by the Spanish Ministry of Economy Industry and Competitiveness.

Keywords: PICT, COPPER, TETRACYCLINE, OXYTETRACYCLINE, CHLORTETRACYCLINE

Abstract number: P 4.3

RETENTION OF ENROFLOXACIN IN AGRICULTURAL SOILS

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Enrofloxacin (ENR) an antibiotic widely used in veterinary medicine reaches the soil primarily through the spreading of organic wastes from animal husbandry. Currently ENR can be considered as an emerging pollutant. Once in the soil adsorption-desorption are the main processes that determine its mobility thus conditioning its possible transfer to surface- and ground-water. Therefore, the objective of this work is to study both the ENR adsorption kinetics and the adsorption-desorption at equilibrium in agricultural soils with different characteristics. For this purpose, batch experiments were carried out.

ENR adsorption kinetic was fast reaching equilibrium after 8 hours in all cases. In addition for 3 of the studied soils equilibrium was reached after only 2 h of contact. Results corresponding to ENR adsorption/desorption at equilibrium showed that this compound is strongly retained by soils with percentages of adsorption higher than 76%

in all cases (average of 94%) while the amount of desorbed ENR was always lower than 7% (average 2%) in relation to that previously adsorbed i.e. ENR adsorption in soils is highly irreversible. ENR adsorption data were satisfactorily described by Freundlich's model for all the studied soils (R^2 higher than 0.7 in all cases) showing K_F parameter values between 190 and 3000 L^n μmol^{1-n} kg^{-1} (average of 1717) and n parameter values between 0.4 and 1.1 (average of 0.6). K_F was significantly and positively correlated with total soil nitrogen organic carbon and clay contents. On the other hand K_F was negatively correlated with both the percentage and the amount of ENR desorbed indicating that the soils with the highest adsorption are those suffering the lowest desorption.

Based on these results we can conclude that the ENR antibiotic is not easily susceptible to being transported from soil to other environmental compartments especially in the case of soils with high organic matter and clay contents. However this antibiotic can pose a risk in soils poor in organic matter and with low clay content where the ENR is more mobile and hence with a higher risk of causing human health hazards and overall environmental degradation.

Acknowledgements: This study has been funded by the projects CGL2015-67333-C2-1-R y -2-R and GRC ED431C 2017/62.

Keywords: ENR, ANTIBIOTIC KINETICS, ADSORPTION, DESORPTION

Abstract number: P 4.4

IDENTIFICATION OF BACTERIA IN SOILS OF MERCURY MINING AREAS OF QUERETARO, MEXICO

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The Sierra Gorda of Queretaro Mexico has a rich mining history of mercury extraction due to its geological origin. These activities left mining wastes scattered in the region remaining together with their tailings in open air and exposed to environmental weathering with diverse mercury concentrations (Hg). This mercury has been incorporated into the soils where it has undergone diverse chemical transformations by chemical and biological processes the latter mediated by soil microorganisms such as bacteria that can transform and convert mercury ions by oxidation-reduction processes to other chemical forms where volatilization is included. The objective of the work was to identify the soil bacteria present in soils of mining areas with mercury. The study area was in the San Joaquin mining region in the Sierra Gorda of Queretaro México. Soil samples were taken at sites in the mining area with agricultural and forestry use determining some physical and chemical properties. were taken 0.5 g of soil that were mixed with 1 mL NaCl to 1.0% this dilution was taken 100 µl deposited in Petri dishes with Luria Bertani agar (LB) enriched with 50 mg/L $HgCl_2$ and incubated at 35 °C for 24 h. Isolated strains were determined the minimum inhibitory concentration of Hg (50 to 300 mg/L $HgCl_2$). Its identification was processed in the VITEK MS Plus (bioMériux France). Each sample was processed with the two system databases (MS-ID version): the IVD clinical use v 3.0 database (*In Vitro Diagnostics*) y Saramis v 4.10 RUO (*Reasearch Use Only*). The results showed that soils are in pH ranges of slightly neutral to slightly alkaline (7.7 to 8.5) high content of organic matter (4.8 to 16.2%) high cation exchange capacity (45 – 60 cmol/Kg) and high mercury content (6 to 297 mg/kg) above that the Mexican legislation. Isolated bacteria were identified as *Bacillus simplex* in all sites studied. It is necessary to know and identify the bacteria that inhabit the soils with mercury to deepen on the participation that they have en processes such as the emission of Hg to the atmosphere.

Keywords: MERCURY, SIERRA GORDA, BACILLUS SIMPLEX, SOIL EMISSION, MINING SITES

Abstract number: P 4.5

ADSORPTION OF LEAD AND COPPER BY BENTONITE AND IN THE BIO-MINERAL SYSTEMS

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Interactions of clay minerals organic compounds and microorganisms have enormous impact on reactions and processes critical to environmental quality and ecosystem health (Huang 2002). Microorganisms are active participants of biogeochemical cycles of trace elements due to their biosorption bioaccumulation biotransformation as well as modification of soil solid component surfaces (Perelomov and Chulin 2014). The lead and copper adsorption by calcium bentonite living and destroyed cells of the gram-positive bacteria *Bacillus subtilis* as well as in systems including mineral and one of biotic component within the element concentration range of 25–250 μM at different pH values was studied. The effect of acidity on the biosorption of the studied trace elements is demonstrated. Solution pH is the key factor in biosorption because determines the charge on the surface of microorganism cells during their electrostatic interaction with trace element cations. The maximum biosorption of lead and copper of 0.72 and 0.52 mM/g dry matter respectively is observed at pH 6. Biosorption by destroyed cells also reached maximum values at pH 6: 0.81 mM/g (Pb) and 0.71 mM/g (Cu). Accumulation of trace elements by living and destroyed cells is an order of magnitude more than their adsorption by calcium bentonite. Three-component bio-mineral systems including bentonite and bacterial cells or bentonite and cell fragments showed an increase of lead and copper adsorption as compared to bentonite. The adsorption of trace elements by a mixture of bentonite and cell fragments was lower than the additively calculated sorption by individual components both for lead and for copper at all studied concentrations. Similar tendency was observed in the bentonite–living cell system for copper and in the same system for lead at its low concentration in the sorption solution. The calculated sorption of lead by bentonite and cells was slightly lower than the experimental one, which can be explained by the formation of new specific sorption sites under the influence of living cells.

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Keywords: HEAVY METALS BACTERIA CLAY MINERALS ADSORPTION ACIDITY

Abstract number: P 4.6

FACET-MEDIATED ADSORPTION FRACTIONATION OF DOM ON HEMATITE SURFACES

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Interactions between dissolved organic matter (DOM) and iron oxyhydroxides have important environmental and geochemical implications. The present study employed two hematite nanocrystals to investigate the adsorption and molecular fractionation of SRFA and SRHA using electrospray ionization coupled with Fourier-transform ion cyclotron resonance mass spectrometry (ESI-FT-ICR-MS). Hematite with a predominant exposure of {100} facets induced more pronounced adsorption and molecular fractionation of DOM than {001} facets indicating that the interfacial adsorptive fractionation process of DOM was mediated by exposed facets of hematite. Further exploration of the surface OH groups of the two hematite nanocrystals confirms that the facet-mediated molecular fractionation of DOM was attributable to the abundance of singly iron-atom coordinated -OH sites on the hematite surfaces. Molecules with a high oxidation state and high aromaticity such as oxidized black carbon polyphenol- and tannic-like compounds preferentially formed ligand-exchange complexes with singly-coordinated -OH groups on the hematite surfaces inducing the selective binding and molecular fractionation of DOM at the mineral-water interface. These results demonstrate that singly iron-atom coordinated -OH sites determine DOM adsorption and mediate molecular fractionation on hematite surfaces and this contributes substantially to our understanding of the molecular mechanisms of iron oxyhydroxide-mediated molecular exchange of DOM in soils and/or sediments.

Keywords: ADSORPTION, CRYSTAL FACETS FRACTIONATION, ESI-FT-ICR-MS, SURFACE HYDROXYL GROUPS

Abstract number: P 4.7

CO-ADSORPTION OF ZINC AND CHLORTETRACYCLINE ONTO MONTMORILLONITE AT DIFFERENT PH

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Heavy metals and antibiotics often coexist in soil environment due to widely-used animal wastes in agriculture and other sources of inputs to soil. The interaction and relation between many antibiotics and heavy metal ions in soil solution can affect their individual speciation and consequent environmental behaviors. However the mechanism on how the changed characteristics of soil by heavy metals on the adsorption of antibiotics have not been appropriately understood. This study was aim to evaluate the interaction of Zn and chlortetracycline (CTC) regarding to their adsorption and cosorption on montmorillonite at different pH ranging from 3 to 10 using integrated batch adsorption experiments. Results indicated that the adsorption isotherms of Zn and CTC onto montmorillonite spiked with different contents CTC or Zn varied from 0 to 0.2 mM were well fitted with the Freundlich equation. The Zn sorption increased with an increase of solution pH while the CTC sorption decreased as the pH increased until 4.5 and then increased with an increase of pH which might result from the presence of Ca(II). The presence of CTC enhanced Zn adsorption on montmorillonite at pH<7.5 which was ascribed to the formation of the positive charged complexes of Zn and CTC with greater sorption affinity to montmorillonite than Zn itself. However the presence of Zn suppressed the adsorption of CTC on montmorillonite at pH from 3 to 9 due to the competition of Zn with CTC and CTC-Zn complexes.

Keywords: COSORPTION, ZINC, CHLORTETRACYCLINE, MONTMORILLONITE, SOIL

Abstract number: P 4.8

PESTICIDE RETENTION AND BIOLOGICAL AFFECTED PROPERTIES IN SOILS AMENDED WITH COMPOST AND BIOCHAR

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Pesticide overuse is a common practice in intensive agricultural systems and leads to increasing levels of residues of such chemicals in soils and water posing a high risk to public and ecological health. In soils sorption and desorption processes are key factors that control the behavior of agrochemicals in the soil-water environment and are related with soil physical and chemical properties organic amendments and agricultural practices. Studying pesticide sorption can improve prediction of the mobility and availability of pesticides in soils and their effect on soil microbial communities. The Poll-

Ole-GI SUDOE project proposes the installation green infrastructures (GI) in agricultural fields with a double purpose: to improve habitat conditions for higher biodiversity and to create a natural barrier to soil pollution by pesticides and excess nutrients. In this context the application of compost and biochar into GI would increase the capacity of soils to retain pesticides and other xenobiotics. The aim of this work was to test the effect of a mixture of seven pesticides added at field application rate on soil biological properties including three fungicides (Azoxystrobin Cyproconazole and Epoxiconazole) two herbicides (Oxyfluorfen and Pendimethalin) and two insecticides (Cypermethrin and Esfenvalerate). The Ap horizons of two contrasted soils were used: a sandy-loam Eutric fluvisol with low organic matter (OM) content and a silt-loam Calcaric cambisol with higher OM content. Five replicate mixtures of these soils with 0 0.5 and 2 % (w/w) of vermicompost or biochar were incubated at 22ºC in the presence or in absence of pesticides and soil basal respirometry microbial biomass content and metabolic quotient ($q\mathrm{CO}_2$) were measured after 48 hours 30 and 90 days. A burst in respiration rate and in $q\mathrm{CO}_2$ values was observed at 48 hours after the addition of pesticides. This effect was increased by the application by the lowest doses of both compost or biochar and persisted after 90 days of incubation only in the soil with lowest OM content. Soil microbial biomass showed a decreasing trend with incubation time being lowerwith pesticides than without them and reaching minimum values after 30 days of incubation for the E. fluvisol and 90 days for the C. cambisol.

Keywords: BASAL SOIL RESPIRATION, MICROBIAL BIOMASS, METABOLIC QUOTIENT, ORGANIC AMENDMENTS, SOIL PROTECTION

Abstract number: P 4.9

SELF-REGULATION OF THE MICRONUTRIENT COMPOSITION OF THE SOIL PROFILE IN THE ZONES OF DEVELOPMENT OF SULFATE-REDUCING BACTERIA (DONBASS)

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The technogenic influence in mining regions causes intensive processes that occur in soil profiles and in aeration zone and leads to transformation and re-accumulation of metals and their compounds which come from outside.

This soil profile plays a crucial role in the sharp reduction or complete cessation of migration of heavy metals - their transformation and accumulation on the geochemical barriers preventing to penetration of many toxic elements in aquifers.

Due to the influence of bacteria redox reactions significantly facilitate to transition elements in ionic state (available for plants and toxic in drinking water and groundwater) and recovery of metals to stable complex form.

As a result of complex geochemical and microbiological studies in the zone of influence of coal mining on the soil and aeration zone in the South-Eastern Donbass zones of self-cleaning of mine water and dumps wastewater are fixed. The zones have a sublatitudinal stretch and are associated with the development zones of sulphate-reducing bacteria.

Thus the intensity of the transformation of rocks extracted to the surface and the dynamics of technogenic geochemical anomalies in this area is closely dependent on the content of sulfate ion in the soil solution aeration zone and mine waters.

According to a microbiological study sulfate-reducing bacteria zones were recorded in the zones of intersection of sublatitudinal thrust zone of the south-eastern Donbass and submeridional faults where biological self-cleaning of discharged mining and waste waters from heavy metals is observed - the ecosystem self-regulates. This indicates that redox systems play a significant role in geochemical equilibrium in the soil profile: a) development of sulphate-reducing bacteria which are in mining waters leads to the formation of metal sulfides b) to a process of purification of waste mining water and the formation of sulphides in soils in the direction of movement of waste and mining waste water from the dumps.

The investigations allow to predict and control the processes in the soil profiles of technological-affected areas and along highways so you can minimize the negative impact of technogenic influence.

Keywords: SOIL SULFATE-REDUCING BACTERIA HEAVY METALS TECHNOGENIC DONBASS

Abstract number: P 4.10

UNSTEADY STATE LEACHING PATTERN OF METALLIC ELEMENTS (CU, ZN, AS, CD, AND PB) FROM LONG TERM WEATHERED MINE RESIDUE UNDER DIFFERENT DRYING-WETTING CONDITIONS.

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Leaching potential of several metallic elements (Cu Zn As Cd and Pb) from two mine residues collected from long term abandoned mine sites was evaluated under different drying-wetting conditions (e.g. consecutive wetting intermittent air-drying and intermittent freeze-drying) during batch decant-refill leaching procedure. For leachates aqueous pH and redox potential were measured. Leachate concentrations of sulfate Fe2+/Fe3+ toxic metallic elements were determined. In addition sequential extraction procedure (F1 – F5) was conducted for the tailings to assess the fractional re-distribution of metallic elements in solid phase after leaching experiments. Labile metal fractions in mine soils were assessed by the initial two extractable fractions (e.g. F1+F2) of sequential extraction procedures (SEPs) before and after leaching experiment. Two mine residues were highly contaminated with metallic elements however most of the elements were strongly bonded with the solid phase. During consecutive leaching steps leachate phase maintained acidic (pH 3-4) and oxic (Eh 340-550 mV) conditions. Concentration of the elements in leachate phase was enhanced after intermittent air-drying and was highly correlated with leachate sulfate concentration. The observation indicates the release of elements from sulfide/sulfate minerals via oxidation processes. Labile fractions of metallic elements were also remained relatively constant. Result with intermittent freeze-drying treatment was not significantly different from consecutive wetting treatment. The result of this work indicates that repeated drying-wetting cycle during abandoned period may lead to an increase in the leachable pools of metals in the mine residues thereby enhancing the concentration of dissolved toxic elements in mine leachate.

Keywords: MINE RESIDUES HEAVY METALS DRYING-WETTING MINE LEACHATE.

Abstract number: P 4.11

OXIDATIVE COUPLING OF BROMOPHENOL MEDIATED BY REDUCED GRAPHENE OXIDE AND BLACK CARBON

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Reduced graphene oxide (rGO) and black carbon had been widely used as superior adsorbents to remove pollutants from water. In this study we investigated the oxidative coupling reactions of bromophenol during the water purification with rGO and black carbon. Results showed that both rGO and black carbon significantly promoted the oxidative coupling of bromophenol. Reaction products were identified as the dimer trimer of bromophenol. Dissolved oxygen and the electron conductivities of rGO and black carbon played important roles in the reaction of bromophenol. It is proposed that dissolved oxygen was transformed to reactive oxygen species on rGO and black carbon surface through electron transfer which then oxidized bromophenol into the oligomers.

Keywords: OXIDATIVE COUPLING BROMOPHENOL REDUCED GRAPHENE OXIDE BLACK CARBON MEDIATION

Abstract number: P 4.12

DIASTEREOISOMER- AND ENANTIOMER-SPECIFIC DISTRIBUTION AND METABOLIZATION OF HEXABROMOCYCLODODECANES IN SOIL-PLANTS SYSTEMS

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Soil is the main disposal and landfill receptor for plastic wastes as well as organic contaminants. HBCDs have been frequently detected in soils and high concentrations

were found in soils at sites near contamination sources. The occurrence concentrations and distribution of HBCDs in soils caused by plastic waste treatment as well as their influence on HBCD accumulation in plants was reported diastereomer and enantiomer profiles and metabolization of HBCDs were further analyzed. The total HBCD concentrations in soils followed in the order of plastic waste recycling site > road soil ≥ farmland soil. Significant correlations ($P < 0.05$) between the total HBCD concentrations in the soils from the plastic waste treatment sites with those in the nearby farmland and road soils indicating that plastic waste treatment caused the HBCD contamination of the surrounding environment. γ-HBCD presented as the dominant congener in soils while more α-HBCD was accumulated in plants. Few samples exhibited diastereomeric ratios similar to that in technical products indicating the inter-transformation and variable degradation of the different HBCD isomers in soils and plants. Significant enantio-selectivity ($P < 0.05$) of HBCD manifested in the farmland soil and all plant samples. The enantiomeric analysis revealed that (–)α- (+)-β- and (–)-γ-HBCDs preferentially enriched in the farmland soils while more (−)-α- (−)-β- and (+)-γ-HBCDs were accumulated in most plant samples compared to their corresponding antipodes. Debrominated metabolites of pentabromocyclododecene (PBCDe) were frequently detected in soils whereas hydroxylated metabolites OH-HBCDs were commonly detected in plants. This study for the first time reported diastereomer and enantiomer profiles of HBCD in soils caused by plastic waste treatment as well as their influence on HBCD accumulation and metabolization in plants.

Keywords: SOILS AND PLANTS HBCDS DISTRIBUTION METABOLIZATIO PLASTIC WASTE TREATMENT

Abstract number: P 4.14

EFFECT OF CONTAMINATION SOURCES ON THE RATE OF SOME POTENTIAL TOXIC ELEMENTS DESORPTION FROM DIFFERENT SOIL ECOSYSTEMS

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Soil is substantive component of biosphere which is exposed to superfluity of contaminants including potential toxic elements (PTEs). The source of soil

contaminants is very critical in controlling both contaminants release and hazards of in different soil ecosystems. Three groups including 6 surfaces (0-30 cm) cultivated and uncultivated soil samples (2 soils from each group) were collected from Abo Rawash Kombora farmlands (Giza Governorate) and El-Khasha site (Kafr-Elsheikh Governorate). The first two groups were irrigated with sewage effluents for more than 40 years and varied in their land use and soil characteristics. The third group samples however irrigated with industrial effluents mixed with Nile water for not less than 80 years. Three kinetic models used in the current work for describing contaminants desorption from the studied soil ecosystems were Modified Freundlich equation (MFE) Elovich 1st order and parabolic diffusion equations represent both empirical and theoretical models. According to the coefficient of determination and standard error (SE) all models successfully well-described desorption of Cu Ni and Zn the most dominant PTE contaminants in these groups. The (R^2) values were over than 0.96** except that calculated in the parabolic diffusion model for Zn release. The rate values of PTEs release of MFE indicated that the higher desorption rates of contaminants were calculated in Kafr El-sheikh group followed by Kombora and the lowest ones were found in Abo Rawash group of soils. From the results it seems reasonable to concluded that soils contaminated with industrial effluents were more affected group by potential toxic elements (PTEs) compared to other groups contaminated with sewage effluents regardless the type of land use. Also the successions of more than one model in describing the kinetic data impled that different mechanisms were taken place in sorption of these contaminants their distribution in soil system and subsequently their release from different groups of trailed soil ecosystems. Different mechanisms of contaminants reaction in different groups were discussed.

Keywords: CONTAMINATED SOIL ECOSYSTEMS KINETIC MODELS PTES SEWAGE EFFLUENTS INDUSTRIAL EFFLUENTS

Abstract number: P 4.15

SORPTION AND DESORPTION OF METHYLENE BLUE ON HUMIC ACID AND METHYLATED HUMIC ACID AND THERMOGRAVIMETRY

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Humic substances represent a wide range of organic compounds generated by gradual decomposition of plant residues and dead organisms in ecosystems. They are among the most widespread compounds in the world that contain a huge amount of carbon in its structure. Is contains a lot of functional groups and mainly carboxyl COOH group.

Humic substances are able to bind various pollutants from Industrial production agriculture and other human activities (like heavy metals pesticides herbicides dyes etc.). The interaction possibilities can be different: ion exchange hydrogen bridge formation coulombic interactions hydrogen bridges van der Waals interactions hydrophobic interactions absorption etc

Via selective methylation we block carboxyl groups and interactions with pollutants are prevented at these active sites.

The purpose of this work is to map the decrease of selected initial concentrations of selected organic dye (methylene blue) with sample HK and methylated sample of same humic acid (mHK).

The obtained samples of humic acids/methykleted humic acids were subjected to a desorption experiment under the same conditions. The output of the work was a comparison of the ratio between the amount of adsorbed and desorbed dye methylene blue and as well compare results with thermogravimetry (TGA DSC). The results provide more details on the stability of dye complexes and humic substances as well as the movement of dyes in humic-containing systems.

Keywords: HUMIC SUBSTANCES, SORPTION, DESORPTION, METHYLENE BLUE, THERMOGRAVIMETRY

Abstract number: P 4.16

COMPARISON OF PREFERENTIAL ADSORPTION BETWEEN HUMIC AND FULVIC ACID TO GOETHITE: KINETICS AND EQUILIBRIUM

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Humic substances (HS) are very heterogeneous and preferential adsorption of certain components takes place during its interaction with iron oxides but so far no consensus regarding the preference of particle size and chemical structure has been reached and the mechanism of preferential adsorption is still unclear and there is little information available regarding the kinetics of the preferential adsorption of HA and FA to iron oxides. This study investigated the preferential adsorption of humic acid (HA) and fulvic acid (FA) onto goethite based on kinetics and equilibrium experiment using TOC analysis UV-Vis spectroscopy HPSEC ^{13}C NMR XPS FTIR as well as surface complexation modeling.

Results indicated that the adsorption of HA and FA to goethite was fast and reached a steady state in about 6 h. The intermediate sized HA particles (3.6-12.0 kDa) were adsorbed quickly and part of them was replaced by somewhat larger particles (> 50 kDa) subsequently. While for FA preferential adsorption of relative large particles (3.6-18.2 kDa) took place quickly and there was a limited substitution by particles with higher aromatic. At intermediate pH (pH 5-7) particles of about 3.5-15 kDa are preferred in the adsorption for both FA and HA. These particles are relatively large for FA but are medium in size for HA. They represent particles enriched in aromatic structure and acidic groups which provide efficient charge neutralization on goethite and form more inner-sphere complexes with the surface sites. At pH above the PZC (pH=9.2) of goethite large particles and rich in aliphatic structure are preferentially adsorbed for both HA and FA which can be attributed to increased role of hydrophobic interactions when the electrostatic force between NOM and goethite is repulsive. The results of HPSEC ^{13}C NMR XPS FTIR analysis as well as the Ligand and Charge Distribution (LCD) model are consistent and support the above conclusions. The results show that the dominant HA and FA fractions that influence a wide range of processes e.g. in water treatment soil and sediment remediation are dependent on conditions such as pH.

Keywords: HUMIC ACID, FULVIC ACID, PREFERENTIAL ADSORPTION, SIZE EXCLUSION CHROMATOGRAPHY (SEC), LCD MODEL

Abstract number: P4.17

A SOIL AGGREGATES SCALE APPROACH TO INVESTIGATE THE DENSITIES OF METALS AND PROTON REACTIVE SITES OF ORGANIC MATTER AND CLAY PHASES IN SOILS

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Determining the density of metal reactive sites in major soil phases remains a difficult task. This study aimed to show that the densities of reactive sites in the soil can be assessed by a fractionation procedure based on the spatial organization of the soil into aggregates. The method is described with copper as a model trace element and a common silty loam soil after applying a low energy fractionation method to maintain the integrity of soil aggregates. The proton and copper reactivity of five soil size fractions (> 250 250-63 63-20 20-2 and < 2 µm) was quantified by acid-base titration. The total proton sorption capacity was attributed to the total concentration of copper reactive sites and adjusted to a linear combination of the relevant data for each phase reactivity namely the total content of organic carbon copper and acid extractable aluminium. Acid-base reactivity was linearly related to copper distribution and differences between fractions were used to reconstruct the distribution of acid-base sites and copper-complexing sites between clay organic and low-reactive residual phases. In accordance with our assumption that the key reactive phases are mainly organic and clayey we used this method to determine site densities for (i) two size classes of particulate organic matter (ii) highly reactive organic matter (e. g. humic and fulvic acids in soil) and (iii) clay. The site densities and copper distributions obtained were used to validate our conceptual model for predicting the overall reactivity of soil to metals.

Keywords:

SOIL AGGREGATES ORGANIC MATTER CLAY REACTIVE SITES METALS AND PROTONS

ISMOM 2019
Seville, Spain, June 23-28

8th International Symposium of Interactions of Soil Minerals with Organic Components and Microorganisms

Understanding Soil Interfacial Reactions for Sustainable Soil Management and Climatic Change Mitigation

Session 5: Soil amendments (biochar, composts and digestates) – How do they affect interactions at soil interfaces?

Abstract number: K 3

LESSONS FROM THE TERRA PRETA DE ÍNDIOS OF THE AMAZON REGION FOR THE UTILISATION OF CHARCOAL AS SOIL AMENDMENT

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Most of the soils in the Amazon are acidic, with low cation exchange capacity (CEC), low fertility, and low production potential. In this environment, where soil fertility is a limiting factor for sustainable agricultural development, the very fertile "*Terra Preta de Índios*" (TPI) soils occur. These are also known as Amazonian Dark Earths, Anthropogenic Dark Earths, Indian Black Earths, or Archaeological Dark Earths. TPI are soils that have an archeoanthropedogenic horizon; that is a surface horizon of varying depth in soil profiles that feature elevated organic matter (OM) contents and ceramic pieces or lithic artefacts. These occur in isolated patches, most of which do not exceed 2 ha, but larger sites, with areas up to 350 ha, have also been reported. TPI soils have developed on virtually all soil types and can be found in all eco-regions and landscapes of the Amazon basin. TPI soils are commonly found near rivers and streams, but due to the lack of interior road systems, it has been difficult to access areas remote from rivers. For that reason, although the abundance of TPI sites is high, there are no reliable data for the total TPI area in the Amazon.

It is now generally accepted that TPI soils are of pre- Columbian origin, although there are several hypotheses with regard to the processes of their formation. It is not clear whether the soils resulted from intentional soil improvement processes, or it was by products of the agricultural and household activities of the indigenous populations, however evidences point out to a not intentional process. Human activity in the pre-Columbian past has resulted in the accumulation of plant and animal residues, as well as large quantities of ash, charcoal, and various chemical elements, such as P, Mg, Zn, Cu, Ca, Sr and Ba, representing the geochemical signature of human occupation. These accumulations probably contributed decisively to the formation of fertile soils, with higher pH, Ca and Mg, P, CEC and base saturation, compared with the adjacent non anthropogenic soils. Besides this high fertility, these soils exhibit a peculiar resilience to intense degradative use. These properties can be explained by the peculiar organic matter of these soils, partially composed by aged charcoal, i.e. polycondensed aromatic structures with carboxyl groups attached directly to the aromatic C backbone. These peculiar structures are not only extremely recalcitrant, which is important for C sequestration, but also reactive, with a high CEC, which is important to soil fertility. These findings inspired the researches to mimic the peculiar organic matter found in TPI, as well as its high and resilient fertility, using carbonized biomass (charcoal; biochar).

In this presentation will be showed the evolution, from the discovery of TPI; the structural elucidation of their peculiar organic matter that explain their high fertility and resilience as well as empirical evidences that nothing exceptional, other than the disposal of ash and charcoal and its weathering, is needed to recreate soil with similar properties to TPI; the synthesis of similar compounds; and some medium/long term experiment with biochar and some of its positive and negative effects.

Abstract number: A 1

CORNCOB-DERIVED BIOCHAR PROTECTS SOIL ORGANIC (C) AND IMPROVES C USE EFFICIENCY AND SOIL QUALITY IN A LOW-FERTILITY STATUS ALKALINE CALCAREOUS SOIL

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Biochar is a carbon rich product derived from pyrolysis of organic material, which improves soil biogeochemical properties and crop production. Biochar increases the carbon (C) status in the soil-plant systems. This incubation study investigated the effects of corncob-derived biochar on native and fresh organic matter (corncob residue) decomposition in nutrient poor Aridisol. The surface soil (0-15 cm layer; <0.1% organic matter) used in the experiment was collected form an agricultural field under wheat cultivation. The treatments included: 1) Unamended control 2) Residue (2% w/w) 3) Biochar (2% w/w) and 4) Residue + Biochar (1% each w/w). Rate of biochar and corncob residue application either alone or combined was equivalent to 45 tons/ha. Each treatment was replicated four times and microcosms were incubated in an incubator following completely randomized design (CRD) at 70% water holding capacity and 25 °C for 54 days. Soil C mineralization was quantified by measuring soil respiration. At the end of the experiment soil samples were analyzed for soil C and N mineralization indicators and some physico-chemical properties. Application of biochar had significant effects on soil chemical and biological properties. Biochar reduced decomposition of fresh organic matter and decreased cumulative respiration by inducing negative priming effect. Decrease in C mineralization in biochar amended soil could be due to the strong adsorption of soluble soil C nutrients and microbes on the surface of biochar resulting in enhanced C use efficiency and reduction in activity of C mineralization enzymes. Another mechanism for the reduced rate of C mineralization could be CO_2 adsorption on biochar surface as carbonate. The decrease in mineral N after biochar incorporation could indicate that organic N was assimilated into microbial biomass rather than being mineralized. In conclusion, biochar could decrease C mineralization but enhanced microbial C use efficiency. It therefore offers an important management strategy to improve C sequestration in nutrient and organic C deficient alkaline soil by altering mineral associated & particulate organic matter. Higher N retention in biochar amended soil could lead to reduced rates of N_2O emissions and N leaching due to N immobilization and fixation by microorganisms.

Keywords: BIOCHAR, SOIL ORGANIC CARBON, C USE, EFFICIENCY, SEMIARID, SOIL QUALITY,

Abstract number: A 2

THE SURFACE BEHIND BIOCHAR SLOW-RELEASE FERTILIZERS

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Biochar is a carbon-rich material that due to its inherent resistance to decomposition is primarily developed with the aim of sequestering carbon in soil. Despite the convincing benefits of biochar as a climate mitigation solution it has not yet advanced much beyond the research stage notably because its effect on yield are too modest. Therefore, there is a need for win-win biochar solutions benefiting both food production and climate mitigation. Such a solution is the development of biochar fertilizers, which capitalizes on the capacity of biochar to capture and release nutrients. This effect is largely attributed to the porous structure and large surface area of biochar with surface charges and ash content also appearing to play a role. The nutrient-retaining capacity of biochar appears to vary among studies investigating different types of biochar exposed to different types of nutrients (mineral anions and cations organic molecules) under different conditions. In the present study we will report on a meta-analysis of published biochar properties that are associated with controlling the sorption of nutrients. As biochar properties largely depend on pyrolysis conditions and feedstock properties this work contributes to the selective design of biochars for the purpose of improving nutrient use efficiency.

Keywords: BIOCHAR SORPTION NUTRIENT SLOW RELEASE FERTILIZER

Abstract number: A 3

BIOCHAR AND NITROGEN ON EXTRACELLULAR ENZYMES, MICROBES AND ORGANIC MATTER DYNAMICS IN SEDIMENTS

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Biochar addition to soils affects the dynamics of soil organic matter (SOM). In this study sediments were amended with 0 (the Control) 0.5 1.0 and 2.0% of biochar and incubated at 25 °C in laboratory incubator for 90 days. After the incubation enzyme activities including phenol oxidase (PHO) peroxidase (POD) β-glucosidase (GLU) *N*-acetyl-glucosaminidase (NAG) and acid phosphatase (ACP) microbial abundance (both bacteria and fungi) and the increased percentage of sediment organic C content were measured. Both increase (PHO and GLU) and decrease (NAG and ACP) of selective enzyme activities were observed after biochar treatments but only POD activity showed a significant decrease ($p < 0.01$) comparing to the Control. Moreover the activities of all enzymes tested were significantly related to the amounts of biochar addition ($p < 0.05$). On the other hand the abundance of both bacteria and fungi under biochar treatments was significantly lower than the Control ($p < 0.001$) and a significantly negative relationship ($p < 0.05$) between the bacterial abundance and the amounts of biochar was established. Additionally an increase of organic C gradually was associated with biochar addition rate, which provides a direct evidence for biochar application to mitigate climate change by emission of greenhouse gases. Given the importance of microorganisms and enzyme activities in cycling of organic matter the increased C sequestration might be explained by the decrease of microbial abundance and POD activity after biochar amendment.

Keywords: BIOCHAR, NITROGEN, EXCELLULAR ENZYMES, C SEQUESTRATION MICROBIAL ABUNDANCE

Abstract number: A 4

BIOCHAR AND DENITRIFICATION: EXAMINING THE EFFECT OF A BIOCHAR TEMPERATURE SERIES ON THE KINETICS OF GASEOUS N TURNOVER. WHICH PROPERTIES MATTER?

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Biochar has been shown to reduce nitrous oxide (N_2O) emissions from soils in many instances. However the suppressive effect is highly variable across soil and biochar types and the mechanisms are under debate. The objective of the present study was to explore how chemical properties of biochars affect N_2O emissions from denitrification by interfering with the biological reduction of dissolved nitrogenous oxyanions (NO_3^- NO_2^-) and gaseous N oxides (NO N_2O) to N_2. We studied the effect of biochar produced from corn cob at 372 416 562 and 796 °C and its feedstock dried at 105 ^oC in two contrasting arable soils a carbon-rich peat (pH 5.1) and a mineral soil (pH 5.9). Denitrification was measured in anoxic batch incubations with stirred soil-biochar slurries amended with nitrate. Both soils accumulated consistently less N_2O and NO in the presence of high-temperature chars (BC562 and BC796) whereas with low-temperature chars the effect differed between soil types; N_2O accumulation was suppressed in the mineral soil but enhanced in the peat soil. Overall high-temperature chars stimulated reduction of denitrification intermediates to N_2 particularly in the acid peat. This effect appeared to be strongly linked to the degree of biochar carbonisation as predicted by the H:C ratio of the char. In addition biochar surface area and pH were identified as important factors whereas ash content and CEC played a minor role. The variable effect of low temperature chars was likely due to its labile carbon content which resulted in N immobilisation in the mineral soil while stimulating denitrification and N_2O emission in the peat soil. We conclude that biochar with a high degree of carbonisation high pH and high surface area is best suited to supress N_2O emission from denitrification while low temperature chars risk supporting incomplete denitrification.

Keywords: BIOCHAR, DENITRIFICATION, NITROUS OXIDE, GREEN HOUSE GASES, INCUBATION

Abstract number: A 5

FATE OF THE CARVONE ENANTIOMERS AFTER THE ADDITION OF BIOCHAR TO AN AGRICULTURAL SOIL

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In this work we investigated how amending a sandy loam agricultural soil with biochar (BC) at a rate of 2% (w:w) affected the sorption dissipation and leaching processes of the two enantiomers of the monoterpene carvone (R-carvone and S-carvone). Sorption of carvone in unamended and amended soil was a non-enantioselective process and the addition of the amendment enhanced the sorption capacity of the soil for both enantiomers. In addition carvone enantiomers showed greater resistance to be desorbed in BC-amended soil than in unamended soil. Dissipation of carvone in the soil was microbial-mediated and enantioselective with S-carvone being degraded more quickly than R-carvone. Furthermore the addition of BC increased the persistence of both enantiomers in the soil. Leaching of R- and S-carvone through soil columns was scarce for unamended soil (< 7%) and null for BC-amended soil for which much of the applied R- and S-carvone remained in the (amended) top 0-5 cm soil layer. Total recoveries of both enantiomers were greater for BC-amended soil columns than for unamended soil columns indicating reduced degradation in BC-amended soil. Our findings show that addition of biochars could help increase the persistence of carvone enantiomers in the topsoil where they may exert biological functions.

Acknowledgment: Project AGL2017-82141-R from the Spanish Ministry of Science Innovation and Universities and JdC contract IJC-2015-23309.

Keywords: MONOTERPENES, BIOCHAR, SOIL AMENDMENT, SORPTION, ENANTIOSELECTIVITY

Abstract number: A 6

IMPLANTATION OF THE SEPARE MANAGEMENT OF BIOWASTE: CHALLENGES FOR THE COLLECTION AND TREATMENT SYSTEMS

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Abonos Orgánicos Sevilla - Management

In the city of Seville MSW is managed in a public private collaboration. Lipasam a municipal public company is in charge of collection and Aborgase a private company is in charge of the treatment and disposal in the Montemarta-Conica Environmental Complex. The current treatment has been based in the separation and composting of organic fraction from the gross MSW since the sixties.

In 2017 motivated by the new legislation and the stablished environmental objectives within the European Union Spain and the Andalusia region biowaste has started to be separately collected and treated in order to produce a better-quality compost to be used in agriculture.

The process to implement the separated collection has been carried out by Lipasam in a step by step approach starting with big generators (markets hotels etc) and afterwards containers on the streets starting in just one area of the city as pilot experience.

The treatment of the biowaste has been carried out by Aborgase separately from the gross waste. Segregated areas has been destinated for the waste reception fermentation and maturation. A first batch of finished compost has been produced and analysed.

The presentation will focus on the effort of both parties in the process of implantation preliminary conclusions and identified challenges.

Keywords: BIOWASTE COMPOST CIRCULAR ECONOMY N.A. N.A.

Abstract number: A 7

FUNCTIONALIZED BIOCHAR ALTERS NITROGEN AND PHOSPHORUS DYNAMICS IN SOILS

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Biochar a form of pyrogenic carbon develops reactive surfaces with aging in soils. However there is a limited understanding on the role of surface functionalised biochar on nutrient dynamics in the soil. Here we functionalised a eucalyptus wood biochar produced at 550° C through oxidation with 5% 10% and 15% H_2O_2. The original and oxidised biochars were characterised by chemical and spectroscopic techniques. Nutrient sorption behaviour was examined by conducting ammonium (NH_4^+) and phosphate (PO_4^{3-}) sorption experiments. We also examined biological nitrogen fixation (BNF) and nitrogen recovery by conducting pot experiments. Chemical oxidation increased negative functional groups and decreased positive surface functional groups. These changes in biochar properties altered its ion adsorption behaviour with contrasting results observed for PO_4^{3-} and NH_4^+ ions. The fraction of N derived from symbiotic fixation was slightly lower in the fresh biochar however oxidation reduced total BNF. Nitrogen recovery was greater in the oxidized biochar with NH_4^+-N application while biochar treatment did not affect N recovery when NO_3^--N was applied. The reduced BNF and greater N recovery in oxidised biochars were possibly due to a greater retention of NH_4^+-N at the cation exchange sites. We also observed increased bioavailability and leaching of P with oxidized biochar. Altogether our results show potential effects of biochar on nutrient dynamics in the long-term.

Keywords: BIOCHAR AMMONIUM PHOSPHATE OXIDATION NITROGEN FIXATION

Abstract number: A 8

DIFFERENT MECHANISMS CONTROLLING THE SOIL BACTERIAL AND FUNGAL COMMUNITY IN RESPONSE TO LONG-TERM ORGANIC MANURE FERTILIZATION

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Long-term fertilizer additions are well known to affect soil C cycling, which is driven by soil microorganisms, but the intrinsic mechanisms are poorly understood in agroecosystems. Here we investigated soil microbial taxonomic and functional compositions within different aggregate-size fractions (macroaggregates; microaggregates; silt+clay) under three fertilization regimes (no fertilizer; NPK fertilizer; NPK + swine manure) from a 26-years experiment. The bacterial and fungal community compositions and functional genes associated with carbon cycling were examined by high-throughput sequencing and Geochip, respectively. Our results show that long-term swine manure additions could significantly increase soil C content and alleviate soil acidification, which was induced by chemical fertilization. Soil bacterial community compositions were mainly altered by chemical fertilization and were related to the changes in soil pH whereas fungal community compositions were preferentially controlled by swine manure additions and were correlated with the shifts in soil C. The differences in the phylogenetic composition of the bacterial and fungal community in response to fertilization regimes resulted in concurrent changes in C-cycling related functional genes. Long-term swine manure application and greater soil aggregation with higher C content have negative effects on bacterial and fungal chitin degradation genes (microbial-derived C) while positively influence the bacterial degradation genes of cutin and vanillin/lignin and fungal degradation gene of hemicellulose (plant-derived C). Our study provides insights on how swine manure additions affect the soil bacterial and fungal community and C-cycling functional genes in agroecosystems.

Keywords: MICROBIAL COMMUNITY, ORGANIC MANURE, C CYCLING, BACTERIA, FUNGI

Abstract number: A 9

MAKING FERTILISER FROM LEAVES: CAN NOVEL GREEN MANURES INCREASE AGRICULTURAL SUSTAINABILITY?

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Green manures are plants grown on agricultural land which when incorporated into soil provide nutrients to the following crop. Many green manure species have symbioses with nitrogen-fixing microbes and therefore add nitrogen (N) to soil without the carbon dioxide emissions, which result from industrial nitrogen fixing. This process however can have similar environmentally detrimental effects to adding inorganic N specifically emission of the greenhouse gas nitrous oxide (N_2O) and the leaching of nitrate (NO_3^-).

Here the use of alternative N-fixing species *Alnus glutinosa* (Alder) *Gunnera manicata* (Gunnera) and *Ulex europaeus* (Gorse) combined with a novel method of plant tissue addition was investigated for their provision of N to crops and potential pollution by N_2O and NO_3^- in comparison with use of the conventional green manure *Trifolium pratense* (red clover). These alternative species are adapted to growing on low quality land from where leaf tissue can be harvested and applied to agricultural soil giving the added advantage of increasing land use efficiency.

A “crop” of *Lolium perenne* (ryegrass) was pot-grown for one year in soil supplied prior to sowing with the equivalent of 200 kg ha^{-1} N as leaf tissue of alder gunnera gorse and red clover. The experiment included a range of N-rates of ammonium nitrate fertiliser and no addition (control) treatments.

Results indicate that novel green manures are effective as fertiliser with lower pollution levels than traditional clover. Gunnera treatment resulted in delayed ryegrass growth compared to other treatments but with a significantly higher overall mean biomass per pot (shoot + root) of 13.28 g dry weight compared to 9.45 g (clover) 9.66 g (alder) and 9.88 g (gorse) ($P<0.001$). In addition potential for leaching of nitrate was shown to be lower for novel green manures with nitrate in soil solution peaking at 15.8 mg N l^{-1} after the alder treatment 16.7 mg N l^{-1} (gunnera) and 22.7 mg N l^{-1} (gorse) compared to 131.3 mg N l^{-1} after clover. Emissions of N_2O from novel green manures were considerably lower than those from clover and ammonium nitrate with applied N lost as N_2O-N from gunnera being 0.34% alder 0.61% and gorse 1.20% compared to 5.3%

from clover and 2.23-3.58% for the different ammonium nitrate fertiliser rates ($P<0.001$).

Keywords: GREEN MANURE, NITROGEN, NITROUS OXIDE, NITRATE, ARABLE SOIL

Abstract number: A 10

IMPACT OF MAIZE RESIDUE INPUT ON REDUCTIVE DISSOLUTION OF FE AND CONSEQUENT CO-RELEASE AND MINERALISATION OF PADDY SOIL NATIVE ORGANIC MATTER

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Predominately anaerobic conditions make that decomposition of organic matter (OM) in submerged rice paddies leads to abundant reduction of soil Fe^{3+} mainly from pedogenic oxides. As shown previously consequent partial dissolution of Fe^{2+} from pedogenic oxides also co-releases native soil OM into solution. It may thus be expected that addition of exogenous OM in turn promotes co-dissolution of native soil OM by stimulating microbial activity and Fe reduction. However it is unknown if this positive feedback stimulates native soil OM degradation and whether this process is affected by irrigation management or soil OM/Fe ratio.

In a six-week pot experiment with living rice plants we firstly investigated the effect of irrigation regime on the degradation of maize residues and native soil OM. In particular two Bangladeshi young floodplain paddy field soils with contrasting soil OM/Fe_{ox} ratio were either kept under a regime of Alternate Wetting and Drying (AWD) irrigation or were Continuously Flooded (CF). The $\delta^{13}C$ values of emitted CH_4 and CO_2 (measured by CRDS) were used to infer the decomposition of added maize shoots ($\delta^{13}C$ = -13.0 ‰) and of soil OM ($\delta^{13}C$ = -25.4 ‰ and -22.7 ‰).

When maize was added E_h was incrementally higher under AWD than under CF. Maize addition also stimulated the reduction of Fe and Mn and Fe^{2+} and Mn^{2+} were then more reoxidised under AWD compared to CF. However native soil OM dissolution was not affected by the irrigation treatment and moreover the contribution of Fe reduction as positive priming mechanism during SOC dissolution was probably limited while other positive feedback mechanisms were more important. CH_4 emissions were higher under CF and peaked after adding maize with an initially increasing contribution of maize to C emissions followed by a gradual decrease. This contribution did not depend on irrigation management but the total priming effect was higher under CF.

Keywords: PADDY SOIL, MAIZE RESIDUE ADDITION, Fe REDUCTION, ANAEROBIC DECOMPOSITION, PRIMING EFFECT

Abstract number: A 11

MICROBIAL TAXA DISTRIBUTION IN SOIL ORGANIC MATTER FRACTIONS WITH ECOLOGICALLY DIFFERENT FUNCTIONS

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In a previous study (Zaccone et al. 2018) a preliminary evaluation of potential ecological partition of total bacterial and plant DNA across soil organic matter (SOM) fractions linked to conceptual stabilization mechanisms was provided. Here we investigated if different ecologically meaningful SOM fractions share the same microbial communities. To test this hypothesis DNA was recovered from SOM pools that differ in quality and level of physical and chemical protection from decomposition: free SOM located between aggregates (FR) SOM occluded within macro (MA) and microagreggates (MI) and mineral-associated SOM (MIN) (Plaza et al. 2012). Bacterial communities were then assessed by amplification of V3-V4 region of 16S rDNA while fungal communities by amplification of ITS region. NGS was performed by Illumina Miseq platform and the sequences analysis carried out using QIIME2 v2018.6.0.

Bacterial communities show a clear separation among the different SOM fractions independently from the soil amendment (i.e. biochar municipal compost). In particular FR fractions were dominated by *Firmicutes* (70-80%) followed by *Actinobacteria* (10-

20%) and *Proteobacteria* (5%). On the opposite MA had a lower level of *Firmicutes* (ca. 40%) and higher level of *Actinobacteria* (30%) and *Proteobacteria* (20%). The dominance of spore forming taxa in all fractions is of interest and might be due to the better preservation of microbial DNA in the spore structure. Interestingly the anaerobic spore-forming *Clostridium* spp. were mainly found in MA and MI and less in the MIN whereas the most abundant taxa in FR were aerobic spore-formers (*Bacillus* spp. *Brevibacillus* spp.). These data clearly depose for a selection of the microbial taxa according to the level of physical and chemical protection of SOM with O_2 availability as one of the main possible drivers. Although at a less extent also fungal population was related to the SOM pool with MIN and FR differing from MA and MI.

In conclusion different microbial taxa (mostly bacterial) seem to be specifically associated to SOM fractions linked to conceptual stabilization mechanisms.

Funding information: The present research has been financed by the Fondazione Puglia (Project title: “DNA occurrence in organic matter fractions isolated from amended agricultural soils”).

Keywords: DNA, NEXT GENERATION SEQUENCING, PHYSICAL FRACTIONATION, SPORE-FORMING TAXA FIRMICUTES

Abstract number: A 12

BioAgenasol® - A purely plant-based fertiliser rich in organic substances which sustainably improves the soil structure.

Ingolf Sonnleitner

AGRANA Stärke GmbH, Vienna, Austria

BioAgenasol® improves the soil structure, enables effective water storage and offers a high level of washout protection. Furthermore, BioAgenasol® activates the soil micro-organisms and allows a fast release of nutrients. This causes a needs-based mineralisation which leads to more powerful root growth. A crumbly soil structure is the result, which promotes soil life as well as soil health. This soil optimisation leads to a balanced pH value.

An experiment over several years in Austria confirmed that when you use BAS, there is barely any washout of nutrients. The ability of the soil to store water is also supported sustainably – which was also confirmed in experiments, and this can be an advantage when using it in dry areas.

KEYWORDS: BIOAGENASOL, ORGANIC FERTILISER, WASHOUT PROTECTOR, WATER STORAGE

Abstract number: A 5.1

IMPACT OF INNOVATIVE AND SEA-SHELL AMENDMENTS IN BRADYRHIZOBIUM AND SOYBEAN SYMBIOTIC RELATIONSHIP

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In a context of preserving the quality of the environment, the development of innovative and sustainable agricultural practices is a major challenge. The use of products to better utilize native soil flora through its activation has developed in recent years. The optimization of the microbial functioning of the soil represents a considerable potential because of the involvement of microorganisms in many biogeochemical processes at the base of the ecological services rendered by the soil. Several ameliorating and fertilizing products marketed by TIMAC AGRO of the Roullier Group have a positive impact on soil microbial communities. Focusing on the stimulation of the biological activity of soils the range allows an increased efficiency of the use of the fertilizing resources already present in the soil. The objective of this project is to evaluate innovative and sea-shell amendments on rhizobia and soybean symbiosis. For this purpose 14 amendments developed by Roullier Group and control treatment were applied to exclusively N_2 fixing soybean plants. Together with the agronomic and metabolite profile determinations carried out in nodules roots and shoots in order to quantify the impact of amendments in nodule performance plants were labeled with $^{15}N_2$ enriched. Such labeling enabled the determination of nodule N_2 fixation capacity and the management of such N in the different plant organs. Obtained results highlighted the target impact of the different amendments in nodule functioning and plant growth.

Keywords: AMENDMENTS, NODULE, N_2 FIXATION, SOYBEAN

Abstract number: A 5.2

AERATED STATIC WINDROW WITH A SEMIPERMEABLE FILM AS A PROMISING COMPOSTING TECHNOLOGY

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The composting of green waste (GW) is an effective method for recycling of organic waste and generating a useful product. The GW used in this study originated from the maintenance of the urban green landscape. Conventional composting method however is time consuming generates odor and produces an immature compost. The objective of this research was to study the evolution of physico-chemical parameters during composting GW by aerated static windrow with a semipermeable film at industry-scale. The technology greatly improved the composting conditions and compost quality in terms of temperature bulk density moisture pH electrical conductivity carbon dynamics organic matter degradation nitrogen transformation humification total phosphorous total potassium and cation exchange capacity. In addition results obtained showed that the use of aerated static windrow with semipermeable film in GW composting reduced the composting period as compared to traditional open windrows.

Keywords: AERATED STATIC WINDROW, GREEN WASTE, PHYSICO-CHEMICAL PROPERTIES, SEMIPERMEABLE COVER, COMPOSTING

Abstract number: A 5.3

EFFECTS OF BIOCHAR AND POULTRY MANURE ON COCOYAM (XANTHOSOMA SAGITTIFOLIUM SCHOTT) PRODUCTIVITY UNDER SANDY SOIL CONDITION

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Sustainable agriculture in sandy soil generally faces large constraints due to high bulk density low water holding and nutrient retention capacity and accelerated mineralization of soil organic matter. Recent studies have shown that biochar and poultry manure can affect soil physical and chemical properties in arable soils. However, biochar and poultry manure effects have not been studied on sandy soil grown with cocoyam in the forest-savanna transition zone of southwest Nigeria. In this study field experiments were conducted over two years 2017 and 2018 to evaluate the effects of biochar (B) and poultry manure (PM) on soil physical and chemical properties growth and cormel yield of cocoyam. The experiment each year consisted of 4 x 2 factorial combinations of biochar (0 10 20 and 30 t ha^{-1}) and poultry manure (0 and 7.5 t ha^{-1}). Results of the study indicated that application of biochar and poultry manure alone and in combination improved soil physical and chemical properties growth and cormel yield of cocoyam. In both years, the application of biochar and poultry manure alone or their combination significantly increased the soil pH and concentrations of organic carbon (OC) N P K Ca and Mg as well as plant height number of leaves leaf area and cormel yield of cocoyam compared with the control. In both years there was a significant interaction effect of biochar and poultry manure (B x PM) and this was attributed to the ability of the biochar to increase the efficiency of the utilization of the nutrients in the poultry manure. It was found that combination of 30 t ha^{-1} biochar and 7.5 t ha^{-1} poultry manure (B_{30} + $PM_{7.5}$) gave the highest cormel yield of cocoyam. Averaged over the two years application of biochar at 30 t ha^{-1} and poultry manure at 7.5 t ha^{-1} (B_{30} + $PM_{7.5}$) significantly increased cormel yield of cocoyam by 51 64 80 and 104% as compared with biochar alone at 30 t ha^{-1} biochar alone at 20 t ha^{-1} biochar alone at 10 t ha^{-1} and no application of B or PM (control) respectively. The combination of 30 t ha^{-1} biochar and 7.5 t ha^{-1} poultry manure (B_{30} + $PM_{7.5}$) exhibited the highest impact and is therefore recommended for soil sustainability and cocoyam productivity on sandy soil.

Keywords: BIOCHAR, POULTRY MANURE, SOIL PHYSICAL AND CHEMICAL PROPERTIES, COCOYAM, CORMEL

Abstract number: A 5.4

SYNERGY OF ORGANIC MATTER IN SOIL, NUTRIENTS AND BIOLOGICAL ACTIVITY

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In the year 2017 an experiment was made at three sites where was carried out deep application of organic matter to the soil in the form of different types of compost. Two experiments were solved in South Moravia on two vineyards with different soil characteristics and third experiment were solved in central Bohemia in apple orchard.

In the vineyards three variants of the experiment were established: I. control - without compost II. compost (30 t / ha) III. compost + Lignohumax 20 (30 t / ha). Four variants of the experiment were set up in the orchard: I. compost - separated digestate cow manure grass (30t / ha) II. compost - separated digestate pond mud grass (30t / ha) III. compost - separated digestate Lignohumax 20 grass (30t / ha) IV. control - no compost. In the experiment were monitored the soil humus content and its quality in relation to biological activity and supply of organic matter in the form of different types of composts.

From the obtained results from year 2018 was found that variants in the vineyards without the compost application had reduced total N content worse quality of humus and reduced degree of humification compared with the results from establishment of the experiment in year 2017. In the orchard in year 2018 were also found worse quality of humus and reduced degree of humification in the control variant. The microbial activity determined on the basis of the soil biomass content has been evaluated lower in the control variants both on vineyards and in orchard. As for variants with different types of compost the best results are from vineyard A variant II (with compost) vineyard B variant III (with compost + Lignohumax 20) and from orchard variant I (with separated digestate cow manure and grass). Defects of the humification process and quality of humus substances is due to a demonstrable decrease N in soil in the supply of organic matter in the soil in the non-compost variants.

Keywords: CHEMICAL PROPERTIES, CARBON, NITROGEN, SOIL BIOMASS, COMPOSTS

Abstract number: A 5.5

DIFFERENT RESPONSE OF PLASTIC FILM MULCHING ON GREENHOUSE GAS INTENSITY (GHGI) BETWEEN CHEMICAL AND ORGANIC FERTILIZATIONS IN MAIZE UPLAND SOIL

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Plastic film mulching (PFM) utilization is rapidly expanded in intensive farming fields. PFM is very effective to increase crop productivity via improving soil temperature and moisture regimes. However since PFM can deplete soil organic carbon (SOC) stock and increase greenhouse gas (GHG) emission the utilization of PFM is still debating. In these two year-field studies to determine the effect of PFM on global warming impact PFM and no-mulching treatments were installed in maize cropping field under chemical and organic fertilizations. In organic fertilization plots cover crop was cultivated during the last fellow season and the whole biomass was recycled as green manure before maize seedling. Crop productivity and net global warming potential (GWP) were analyzed during cropping seasons. To estimate net GWP two GHG (N_2O and CH_4) fluxes and SOC stock changes were determined. SOC stock changes were analyzed by net ecosystem carbon budget (NECB) which means the difference between C input and output. GHG intensity (GHGI) was calculated using net GWP per unit of grain yield. PFM significantly increased maize grain yields by 54-76% over no-mulching under the same fertilization but it was more effective in organic fertilization than chemical due to higher nutrient input. In contrast PFM significantly increased seasonal CH_4 and N_2O emissions by 132-263% and 4-11% over no-mulching under the same amendment respectively. PFM depleted SOC stock 23-27% and 65-69% more in chemical and organic fertilization than no-mulching respectively. Irrespective with fertilization and mulching background net GWP was decided by SOC stock change which covered 76-92% of net GWP. PFM differently influenced net GWP and GHGI between chemical and organic fertilizations. In chemical fertilization PFM increased net GWP by approximately 30% over no-mulching but decreased GHGI by 20-30%. However in organic amendment PFM highly increased net GWP and GHGI by 150-180 and 45-70% over no-mulching respectively. Therefore, PFM in chemical fertilization system could be very powerful tool to decrease global warming impact via crop yield increase. However, in organic farming system, PFM should be carefully selected to increase crop yields due to highly increased global warming impact.

Keywords: SOIL CARBON STOCK CHANGE, NET ECOSYSTEM, CARBON BUDGET, METHANE, NITROUS OXIDE, GLOBAL WARMING POTENTIAL

Abstract number: A 5.6

LEAD SORPTION IN TROPICAL COMPOSTS: INFLUENCE OF LIQUID-TO-SOLID RATIO

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Soil and water contamination by potentially toxic elements (such as lead - Pb) alters the physical chemical and biological equilibrium of ecosystems. Consequently remediation strategies for treating soil and water are required. The main goal of this study was to evaluate the potential ameliorative effect of organic amendments with composts on Pb immobilization. Tropical composts derived from the organic fraction of municipal solid wastes synthesized in Brazil via wire mesh composting bin (in internal and external conditions) were the assessment. Briefly batch equilibrium tests were carried out mixing the composts (2.0 g and 0.5 g) with 50 mL aliquots of aqueous 400 mg L^{-1} Pb solution (prepared using $PbCl_2$) at two fixed liquid-to-solid ratio (1/25 and 1/100) and contact time of 24h. Results indicate similar and satisfactory lead sorption in both composts. Internal compost for the 1/100 ratio exhibited 99.93% or 39.761 mg g^{-1} better removal efficiency than 84.71% or 7.687 mg g^{-1} for the 1/25 ratio. Similarly external compost for the 1/100 ratio revealed 91.32% or 36.664 mg g^{-1} better removal efficiency than 71.12% or 6.445 mg g^{-1} for the 1/25 ratio. The mean pH values of solutions before and after agitation varied between 5.8 and 8.7 and between 5.0 and 7.2 in the first ratio (1/25) and the second ratio (1/100) respectively. The solutions containing internal and external compost for the same ratio did not show significant variation (less than 0.1 in relation to the mean). This increase in pH may be associated with the predominant sorption mechanisms indicating that there was an increase in the amount of negatively charged surface groups allowing greater retention of the cationic contaminant. It is concluded that the feasible application of composts to Pb immobilization seems justified because of its Pb sorptive capacity. Moreover as the binding reactions may be reversible implying in phytotoxicity and environmental risks further work is required to evaluate the Pb sorption-desorption behavior and measure bioavailability over time. This complemental information would allow greater security

in the development of more sustainable remediation technologies and with lower environmental risks.

Keywords: ORGANIC FRACTION OF MUNICIPAL SOLID WASTES, WIRE MESH COMPOSTING, BATCH EQUILIBRIUM TESTS, PH, SOIL REMEDIATION

Abstract number: A 5.7

BEHAVIOR OF THE HERBICIDE MESOTRIONE IN SOIL AMENDED WITH FRESH AND AGED BIOCHAR.

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The ability of biochars to sorb pesticides has been widely studied due to the potential effects on their fate in soil and interest in the adoption of biochar as a “low-cost” soil amendment. However the sorption capacity of biochars can be altered with time affecting pesticide behavior in soils. The purpose of this study was to assess the sorption degradation and leaching of the herbicide mesotrione in soil amended with fresh and aged biochar when added to the soil at a rate of 2% (w/w). The aging process was performed by burying the fresh biochar (BCf) at 10 cm in three soils located in different sites in USA [Wisconsin (BCW) Colorado (BCC) and South Caroline (BCSC)] for six months.

Biochars slightly increased the sorption of mesotrione in soils. Only Wisconsin aged biochar removed greater amounts of herbicide from the solution which was attributed to water-soluble components of this biochar. As a consequence neither the fresh biochars nor Colorado and South Caroline aged BC had impact on mesotrione persistence while Wisconsin aged BC slightly increased mesotrione half life. Similar effect was observed in leaching experiments which was null for Wisconsin aged biochar and high for the rest of the treatments. The outcomes from this work demonstrate temporal variability of biochar sorption capacities due to soil exposure which can alter the behavior of mesotrione. These effects should be considered in order to optimize the performance of this herbicide in biochar-amended soils with time.

Keywords: MESOTRIONE, SOIL SORPTION, BIOCHAR AGING

Abstract number: A 5.8

PRODUCTIVE PARAMETERS AND BIOLOGICAL ACTIVITY AS INDICATORS OF THE INFLUENCE OF BIOCHAR ON THE SOIL-PLANT-MICROORGANISMS SYSTEM

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Biochar is the carbon-rich solid product obtained from the carbonization (or slow pyrolysis) of biomass which is commonly heated up to temperatures between 300° to 1000 °C under low (preferably zero) oxygen concentration. The viability of an agricultural production system does not depend only on its productive balance but also on the efficiency of the resources used. From the point of view of the energy invested in biomass production one of the ways to improve the energy efficiency of agricultural systems is to return to the soil part of the biomass produced by crops. In this sense biochar can be used to close an agronomic circle through enhanced yields reduced energy outputs minimized carbon emissions and decreased irrigation demands. Nevertheless a number of factors significantly affect the properties of produced biochar as well as it influence on the different edaphic properties [2]. For all the reasons above-mentioned the specific aim of this study is to investigate the influence of the physicochemical properties of biochar obtained via pyrolysis of vine shoots (*Vitis vinifera* L.) the application rate of biochar to soil and the type of soil on the soil-plant-microorganisms system behavior. An agronomic trial using sorghum crop (*Sorghum bicolor* L.) was conducted for this purpose. A randomized factorial block design was adopted in which the following factors were taken into account: soil type (clay and sandy) final pyrolysis temperature of the biochar used (400 and 600 °C) and rate of added biochar (0 20 and 40 t ha^{-1}). The number of replicates for each treatment was 5 so a total of 50 containers of 650 cm^3 were planted. The duration of the trial was 13 months during which the crop completed two production cycles. The productivity of

the crop has been evaluated from measurements of plant growth height weight diameter and photosynthetic activity. Regardless of the soil type the production of total biomass significantly increased when the biochar produced at 400 °C was applied at the highest rate. However a decrease in the production of biomass was observed when the biochar produced at 600 °C was applied. Several physical chemical and biological indicators have been selected and are being analyzed to evaluate the influence of the type of biochar on a number of fertility components of the tested soils.

Keywords: BIOCHAR, MYCORRHIZA, SOIL BIOLOGICAL ACTIVITY, PHOSPHATASE ACTIVITY, VITIS VINIFERA

Abstract number: A 5.9

SMART MANAGEMENT OF COVER CROP BIOMASS TO MITIGATE METHANE (CH_4) EMISSION IN RICE PADDY

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Cover crop cultivation is strongly recommended during fallow season to increase soil organic carbon stock and reduce chemical fertilization in rice paddy soil. However since its biomass recycling as a green manure can dramatically increase greenhouse gas (GHG) emission in particular methane (CH_4) during rice cropping season smart cover crop management strategy should be developed. We hypothesized that aerobic decomposition of its biomass before flooding might decrease labile organic carbon concentration and then reduce CH_4 emission during the flooded cropping season. In this three-year field studies to evaluate the effect of earlier incorporation of its biomass on reducing CH_4 emission the mixture of barley and hairy vetch as cover crop was cultivated during the dried fallow season and then its whole biomass was incorporated 0-30 days before flooding for rice transplanting. The used biomass was harvested at the same day and the same dose of dried biomass was applied in all treatments. Aerobic decomposition of cover crop biomass before flooding significantly decreased CH_4 emission during rice cultivation. Ten days of aerobic decomposition before flooding decreased seasonal CH_4 flux by approximately 25-60% over the control treatment in which was immediately flooded after biomass recycling. Longer aerobic decomposition of its biomass decreased more CH_4 emission but it was not statistically different from 10 days to 30 days of aerobic decomposition. The labile organic C concentration in the flooded soils showed highly positive correlation with CH_4 emission rates. However rice yield properties were not significantly different among treatments. In conclusion the aerobic decomposition (minimum 10 days) of cover crop biomass before flooding can be very useful management strategy to reduce CH_4 emission in rice paddy without yield loss.

Keywords: COVER CROP, METHANE, PADDY, AEROBIC DECOMPOSITION, LABILE CARBON

Abstract number: A 5.10

EFFECT BIOCHAR OF RHIZOBACTERIA AND ON GROWTH OF SOYBEAN AND CONTENT OF MINERAL SUBSTANCES IN SOIL

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Background. Plant growth promoting rhizobacteria (PGPR) have been extensively documented for their positive impact on plants but if added with biochar enhancement of crop growth also help in preventing fertilizer run-off and helping plants. We studied the effect of rhizobacteria and biochar levels on the growth of soybean and content of mineral substances in soil.

Methods. The effect of rhizobacteria on growth of soybean experiments was carried without biochar (soil) and with biochar (levels of biochar 1 and 3%) in pot experiments. The plants were grown in greenhouse conditions at 24 °C day and 16 oC night for 1 month. Plants were harvested 1 month after planting. The nodule number root length shoot length root dry weight shoot dry weight of soybean were determined. The nitrogen (N) phosphorus (P) and potassium (K) content in the soil (before planting and after harvesting) were determined.

Results. According to the results 3% biochar increased nodule number the root length shoot length root dry weight and shoot dry weight of soybean compared to control. B.

japanicum USDA110 increased the root length by 20% shoot length by 41% and root dry weight by 22% compared to control of 3% biochar. The combination with B. japonicum USDA110 and P. putida TSAU1(3% biochar) significantly increased N content by 80% and K content by 58% compared to control of 3% biochar. Co-inoculation with B.japonicum USDA110 ва P. putida TSAU1 significantly increased the most benefits the growth of soybean the number of nodule the N P and K contents compared to all other treatments.

Conclusion. Hence it can be concluded that both biochar and co-inoculation of with B. japonicum USDA 110 and P. putida TSAU1 strains are effective treatments for a sustainable soybean production in agriculture.

Keywords: RHIZOBACTERIA, BIOCHAR, SOYBEAN, CONTENT OF MINERAL SUBSTANCES IN SOIL, PLANT GROWTH

Abstract number: A 5.11

LONG-TERM EFFECTS OF ORGANIC AMENDMENTS ON MICROBIAL COMMUNITIES IN A DEGRADED MEDITERRANEAN SOIL

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Addition of organic amendments is a common practice to restore fertility and to increase productivity of degraded soils. Long-term effects of this practice on Mediterranean soils are controversial with previous works showing contrasting results about the durability of the organic material added and its effects on the structure of microbial communities. In this work we evaluated the long-term effects of different amendments (leonardite and biosolid compost) on soil microbial functioning and diversity in an area contaminated by trace elements in SW Spain. Thirteen years after the addition of these amendments the structure and composition of the soil microbial community was significantly affected by the treatments. The addition of both amendments favored the increase of the fungi/bacteria ratio in the soil community although a correlation between the fungi/bacteria ratio and the C/N of amendments was not found. Analyses conducted 17 years after the start of the experiment showed that in general differences in chemical and biochemical properties between control and treated soils were still very evident. Both amendments increased soil multifunctionality as evaluated by a suite of enzyme and substrate-induced respiration assays. Further studies are being conducted in order to evaluate whether the addition of these amendments promoted a higher resistance of soil functioning to drought in this drought-prone ecosystem.

Keywords: POLLUTED SOIL, SOIL FUNGI, LEONARDITE, BIOSOLID COMPOST, DROUGHT

Abstract number: A 5.12

SOIL RESPIRATION AND ORGANIC CARBON EVOLUTION IN RECENT RESTORED SOILS WITH ORGANICS AMENDMENTS IN A CALCAREOUS QUARRY UNDER SEMIARID CLIMATE

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The soils degradation in arid and semi-arid zones due to extractive activities such as mining leads to the CO_2 emission from soils. The soil restoration with organic amendments favours the recovery of soil fertility and vegetation cover contributing the carbon fixation in the soils. However, the addition of amendments could produce a rapid CO_2 emission known as the "priming effect" which has barely been studied. The objective of this work was to study the evolution of Soil Organic Carbon (SOC) and CO_2 emission processes in restored soils with different organic amendments in short-term from their application. Experimental plots were installed in degraded soils by mining in the Gádor Mountains (Almería) located in a semi-arid zone. Different treatments were applied (3 plots for each treatment) consisting of the addition of stabilized Sewage Sludge (SS) Vegetable Compost from Gardening remains (VCG) Vegetable Compost from Greenhouse crop residues (VCI) and mixtures of amendments (VCG+SS and VCI+SS) and plots without treatment used as controls. Soil respiration (SR μmol CO_2 m^{-2} s^{-1}) measurement campaigns were conducted (6 from July to December 2018) using PPsystem EGM-4 since the amendments were applied and the SOC (%) was analysed in soil samples (3 replicates) in the first and last campaigns. SR was higher just after the addition of the amendments. The SS treatment presented the significantly ($p<0.05$) higher values of SR and SOC (5.40 ± 3.55; 6.51 ± 1.85 respectively) followed by VCG+SS (3.27 ± 1.66; 5.56 ± 0.54). VCG had lower SR and SOC than the other treatments (0.57 ± 0.17; 3.43 ± 0.90) besides did not present significant differences ($p<0.05$) with the control plots which presented the lowest values of SR and SOC (0.43 ± 0.09 m^{-2} s^{-1}; 0.34 ± 0.20). In the following campaigns there was a significant decrease of SR and SOC in SS (2.59 ± 1.65; 2.67 ± 0.5) and VCG+SS (1.43 ± 0.71; 2.45 ± 0.18) while VCG maintained its SR and SOC similar to the first campaign carried out after the amendments (0.54 ± 0.24 1.71 ± 0.19). The control plots showed values of SR and SOC lower than those obtained in the first campaign (0.14 ± 0.05 0.46 ± 0.17).

Acknowledgements: CGL2017-88734-R (BIORESOC) Research Project and RYC-2016-21191.

Keywords: SOIL RESPIRATION, ORGANIC AMENDMENT, SOIL ORGANIC CARBON, SOIL RESTORATION, SEMI-ARID ECOSYSTEM

Abstract number: A 5.13

FROM WASTES TO RESOURCES: CITRUS HYDROLATES AS NATURAL BIOSTIMULANTS OF SOIL MICROORGANISMS

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The hydrolates result from the industrial extraction process of the essential oils through cold pressing of the citrus peels. Today they are considered a waste to be disposed of. However due to the presence of water soluble compounds (sugars polyphenols acids) hydrolates could be reused instead of being due to the high economic burden a problem in the disposal of the same charged to the company.The aim of this work was to evaluate the effects of citrus hydrolate when directly applied as irrigation water on soil microbial biomass activity and structure community. The soil used for the experiment was collected from the topsoil (0-10 cm) of a citrus orchard air-dried and sieved at 2 mm. Then 450 g of soil were placed in 1L plastic bottles and moistened up to 50% of the water holding capacity (WHC) by applying hydrolates and/or water. The tested hydrolates were obtained from three citrus species: *Citrus Sinensis Citrus Limon* and *Citrus Reticulata*. The hydrolates were applied at three different doses to reach 1/3 2/3 and 3/3 of the 50% of soil WHC. Respectively 35 70 and 105 mL of hydrolate were added to 450 g of air-dried soil. Distilled water was added when necessary to complement the 50% of WHC. Control soil was moistened up to 50% of its WHC with distilled water only. At the same time 20 g of soil per each treatment were similarly incubated in 200 mL jars sealed with rubber stopper holding silicon septa to monitor the emission of CO_2. Four replicates per treatment were run. Soil samples were incubated in the dark at constant temperature (23.0 ± 0.5°C) and their humidity weekly adjusted up to 50% of WHC by adding distilled water. Microbial biomass C was determined according to the fumigation-extraction method after 1 4 8 12 and 16 weeks of incubation. At the same time soil fatty acid methyl esters were determined and used as indicators of the main microbial groups. The CO_2 accumulated in the headspace of the jars was measured at days 2 5 7 during the first week then weekly for the following month and finally bi-weekly until day 112. The preliminary results provided evidence that the three hydrolates at different extent stimulated the activity of soil microorganisms and affected soil microbial biomass and community structure.

Keywords: HYDROLATES BIOSTIMULANTS SOIL MICROORGANISMS CITRUS

Abstract number: A 5.14

IMPLICATION OF ORGANIC FARMING PRACTICE IN CHANGE OF PHYSICAL-CHEMICAL PROPERTIES OF PLOUGH PAN LAYER IN PADDY SOILS, INDONESIA

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The lack of information concerning the impacts of organic farming practice on change of physical-chemical properties of the plough pan layer still there particularly in paddy soils from Indonesia. Study was conducted by making nine soil profiles from three farming systems namely: conventional semi-organic and organic fields located in Sragen District Central Java. The results revealed that the formation of the plough pan resulted in an increase in soil penetration of 65.18% modulus of rupture of 147.79% and bulk density of 12.73% and decrease in soil porosity and soil permeability respectively by 11.54% and 89.71%. The content of Fe Al and Mn on the plough pan increased by 4.28% 9.92% and 5.78% respectively. After 10 years organic farming practice decreased the thickness of plough pan from 10-20 cm to 4-7 cm the soil penetration of 1.21% and modulus of rupture of 36.85%. In contrast, the thickness of the plow layer become 40-50 cm from 20-25 cm in conventional one the content of SOM and CEC increased from top soil to the plough pan layer. The content of Fe-humic and Mn-humic also increased by 4.74 and 2.73 times respectively compared to the conventional system.

Keywords: CONVENTIONAL-ORGANIC FARMING PLOUGH PAN LAYER
MODULUS OF REPTURE SOIL PENETRATION FE-HUMIC

Abstract number: A 5.15

COMPOSTING OPTIMIZATION OF WHEAT STRAW FOR CARRIER MATERIAL DEVELOPMENT

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Large amounts of harvesting residues are produced each year due to the increase of agricultural activities in order to maintain food security. These lignocellulosic materials may have valuable properties as carrier material for smart fertilizer development. The aim of this study was to optimize a co-composting procedure to generate wheat straw carrier material suitable for smart fertilizers with high porosity and organic matter stability. We varied wheat straw size (fine: < 1 medium: 1-2 and large: >2 cm) charge of *Trichoderma harzianum* inoculum (0 7 and 14 discs) and nitrogen addition (0 0.95 and 1.95 gkg^{-1}). During 128 days of composting we monitored pH temperature total acidity and index of humification degree in NaOH extractable material (E_4/E_6). We used a principal component analyses and multiple surface response methodology in order to optimize the water holding capacity (WHC) of the end product as an indicator for porosity and the C:N ratio as an indicator of the end product stability. Additionally we used microscopic and spectroscopic analyses to follow morphologic and chemical alterations of the material. Our results suggest that composting (aerobic degradation) was a suitable practice to obtain a highly modified material in terms of physicochemical properties. Optimized material was characterized by a higher WHC (91.7%) as compared to fresh wheat straw associated to structural changes and slightly increased stability as indicated by C:N ratio of the 61.5. We conclude that the optimal treatment to obtain a suitable WS carrier material for smart fertilizers included co-composting of WS with fine particle size (< 1 cm) with *T. harzianum* (14 discs) and 0.85 g kg^{-1} of NH_4NO_3.

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Keywords: OPTIMIZATION LIGNOCELLULOSIC MATERIALS COMPOSTING CARRIER MATERIAL SMART FERTILIZER

Abstract number: A 5.16

SOIL MICROBIAL BIOMASS, PHOSPHORUS CONCENTRATION, AND NUTRIENT CONTENTS ARE IMPROVED BY CATTLE MANURE AND LEMON PEEL APPLICATION ON SOIL

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The applications of crop residues and cattle manure on soil are strategies that increase nutrient availability and P recovery improving soil fertility. An incubation experiment was conducted to investigate changes in soil microbial respiration soil microbial community and changes in P concentration on soil amended with cattle manure and lemon peel. For the experiment cattle manure (CM) at a rate of 5% and lemon peel (LP) at a rate of 40% were added to the soil. The treatments were: Soil + CM Soil + LP Soil +CM +LP and soil without amended was used as a control. All amended treatments increased soil microbial respiration while Soil microbial biomass (SMB-C) was significantly influenced by cattle manure or by lemon peel application but the interactive effect of cattle manure/lemon peel increased more than 4-fold SMB-C compared with control soil. The SMB-N was not significantly affected by lemon peel treatment but the interactive effect of cattle manure/lemon peel increased from 79 mg kg^{-1} to 221 mg kg^{-1} respect to control soil. The SMB-P only showed variation with cattle manure treatment. However SMB-P was higher when cattle manure/lemon peel was applied ranging from 0.25 mg kg^{-1} to 1.47 mg kg^{-1} compared with soil control. Besides content of available nutrients were significantly modified after applying cattle manure and lemon peel to soil. Available Ca Mg Na and K concentrations were significantly higher ($P < 0.05$) when lemon peel and cattle manure were applied. The pH was significantly influenced by cattle manure or by lemon peel application but the interactive effect of cattle manure/lemon peel increased 0.8 pH units compared with control soil. Olsen P levels increased 1.2-fold in soil treated with lemon peel and 1.7-fold when cattle manure and lemon peel were applied in combination.

Keywords: CITRUS RESIDUES, CATTLE MANURE, MICROBIAL BIOMASS, PHOSPHORUS AVAILABILITY, NUTRIENT AVAILABILTY

Abstract number: A 5.17

PESTICIDE RETENTION IN TROPICAL AGRICULTURAL SOILS AMENDED WITH RICE HUSK BIOCHAR

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Agricultural production in tropical regions continues to advance with the assistance of pesticides. However if improperly managed its contamination to soil and water may cause detrimental effects to human health and the environment. To prevent this from happening pesticide leaching can be reduced by amending soils with biochar. Biochar is a carbonaceous material produced from the thermochemical conversion of biomass in a low oxygen environment. Studies have observed that biochar’s potential to reduce leaching is determined by the physicochemical properties of the biochar pesticide and soil. The aim of this study was to determine whether pesticide leaching is reduced in rice husk biochar amended tropical agricultural soils. Batch microcosm studies were conducted using OECD 106 guidelines for the testing of chemicals. The absorption of diuron and atrazine in loam sandy silt loam and clay loam tropical soils amended with rice husk biochar was determined. Leachate aliquots were analyzed using high performance liquid chromatography. Results showed that the loam soil amended with rice husk biochar had the highest absorption distribution coefficients for both atrazine and diuron. This was followed by clay loam and silt loam biochar amended soils. These results showed that rice husk biochar amended soils increased the absorption of atrazine by 95.5% and diuron by 99.9% when compared to soils without biochar amendment. These results are important especially since these pesticides are widely used in tropical agricultural soils that are highly vulnerable to pesticide leaching. In conclusion the in-situ application of rice husk biochar is proven to be an effective method to reduce the environmental impacts of pesticides in tropical agricultural soils.

Keywords: RICE HUSK, BIOCHAR, TROPICAL AGRICULTURAL SOILS, PESTICIDES LEACHING, ABSORPTION

Abstract number: A 5.18

HOW DOES COMBINED USE OF POULTRY MANURE AND PHOSPHATE ROCK AMENDMENTS AFFECT SOIL P DYNAMICS, PLANT BIOMASS PRODUCTION?

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Phosphorus (P) is one of the major limiting nutrients for plant growth in many agroecosystems and continuous application of phosphate fertilizer is required to support agricultural production. Improved managements of P fertilizers may include

recycling of organic waste materials. Poultry manure (PM) has a high P concentration. Due to simultaneous input of organic matter it may (1) increase soil organic carbon sequestration and (2) reduce the amount of phosphate rock (RP) needed when applied in combination. The aim of the study was to investigate the effect of PM and phosphate rock (RP) on soil P dynamics and biomass production and P uptake of ryegrass growing in two soil types with contrasting pH. We carried out an experiment under laboratory conditions during seven weeks with four treatments: unamended soil soil amended with PM (14 t ha^{-1} RP (0.84 t ha^{-1}) and a mixture of both PMRP (9.8 t ha^{-1}/0.5 t ha^{-1}). Chemical P fractions biomass production and nutrient concentrations were measured to calculate plant uptake and nutrient use efficiency. Our results showed that both soils increased highly the inorganic and organic P concentration in the readily available fraction in PM treatments. Moreover we found that increases on biomass production was strongly correlated to the readily available inorganic P (r= 0.94 for shoot biomass in the alkaline soil and for root biomass in both soils). Additionally we found that for both soils the P use efficiency were higher using both PM treatments as compared to RP alone. We conclude that poultry manure combined with phosphate rock has the potential to significantly enhance soil P availability and plant P uptake as compared to the use of phosphate rock alone.

Keywords: POULTRY MANURE PHOSPHATE ROCK RYEGRASS BIOMASS SOIL P AVAILABILITY P UPTAKE

Abstract number: A 5.19

EVALUATING ORGANIC AMENDMENTS AS PHOSPHORUS SOURCE ON THE PRODUCTION OF A PERMANENT GRASSLAND GROWN IN AN ANDISOL FROM SOUTHERN CHILE

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Nowadays it is necessary to reduce phosphorus (P) demand due to a depletion on phosphate reserves its high production cost and the monopoly of this finite resource. In agricultural systems one of the most important limiting factors is the phosphorus (P) availability for plants. A strategy for increase phosphorus use efficiency in agriculture is the use of farm wastes as P sources is necessary for future sustainability of crops. A field experiment was carried out in an Andisol Barros Arana series with 10 mg kg^{-1} of P. Poultry manure (PM) and cattle manure (CM) were evaluated in combination or not with inorganic fertilizer (TSP) and phosphoric rock (PR) to a final maximal amount of 100 kg P ha^{-1}. *Lolium perenne* cv Nui plants were cultivated in parcels of 12 m^2 and a basal fertilization of 46 kg N 77.5 kg K_2O 22.5 kg S y 22.5 kg MgO ha^{-1}. The chemical characterization of soil and pasture yield and nutrient quality was assessed. The highest PM treatment showed the highest P uptake and production of ryegrass during the first season. This performance was not sustained in the second season where TSP treatment showed to be slightly higher. However PM treatment remains to be the most significant ($P \leq 0.001$) due to that during all the experiment accumulated around 15 ton ha^{-1} of ryegrass production which represented 47% more than the control treatment (without fertilization) during the same period. Moreover it is highlighted that the seasonal distribution showed that PM treatment was 35% higher than control in winter but during summer CM was 41% higher than control.

Keywords: CATTLE MANURE, POULTRY MANURE, NUTRIENT AVAILABILITY, INORGANIC FERTILIZER, BIOMASS PRODUCTION

Abstract number: A 5.20

STUDY OF HORTICULTURAL POST-HARVEST WASTE COMPOST AMENDED WITH ZEOLITES AS A SOIL FERTILISER

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Province of Almería has the largest intensive area of horticultural crops under plastic in Spain generating a large amount of fresh post-harvest waste. One of the most valid alternatives for the recycling of this waste could be the production of compost to be applied as soil fertilisers in soil restoration. However composting processes can present problems due to losses from volatilization of nutrients mainly nitrogen in the form of ammonia and contamination by heavy metals. A good option to minimize these problems is the addition of zeolites which are tectosilicates that allows the adsorption and storage of water and nutrients without changes in its internal structure. Then they are able to retain the losses of ammoniacal N lost during the composting process and to retain heavy metals preventing them from being absorbed by plants.

In this work an own elaborated compost from fresh horticultural post-harvest waste with a zeolite amendment (C1) was compared with a commercial compost also form horticultural remains (C2). For this purpose a physico-chemical characterization of the composts and a quantification of the humic fractions were carried out as well as phytotoxicity tests through germination experiments of seeds and vegetative growth of plants.

Results showed that compost with zeolite addition (C1) presented better physico-chemical properties with lower salt contents (6.37 ± 2.26 dS/m vs 1777 ± 2.81 dS/m in C2) higher organic matter (59.15 ± 11.2% vs 17.08 ± 7.48% in C2) and also with higher fulvic (9.61 ± 2.25% vs 5.69 ± 1.2% in C2) and humic acids (14.95± 4.56% vs 4.67 ± 2.15% in C2) fractions. From the point of view of fertility of soils compost C1 also showed better results with important differences in germination index (94.67% ± 6.11 in C1 vs 50.67% ± 11.55 in C2).

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Keywords: AMENDMENT, ZEOLITE, COMPOS,T POST-HARVEST WASTE

Abstract number: A 5.21

ADDITION OF NANOPARTICLES AND BIOCHAR TO AGRICULTURAL WASTE COMPOSTING: EFFECTS ON COMPOSTING PROCESS AND CO_2-CH_4 EMISSIONS

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Little is known about the impact of inorganic nanoparticles as additives in composting systems. The objective of this research was to evaluate the effects of iron oxide/halloysite nanoparticles and biochar as additives in the main physical and chemical properties and greenhouse gas (GHG) emissions of agricultural waste composting. Wheat straw and beef manure were mixed (2:1 w/w; C/N: 25) and co-composted with iron oxide (CFe) and halloysite (CHa) nanoparticles (2% w/w) oat-biochar (CB) (7% w/w) and their combination (CBFe CBHa). Changes in pH and EC organic matter (OM) losses NH_4-NO_3 concentration C/N and E_4/E_6 ratio and the emissions of CO_2 and CH_4 were analyzed. Additionally the initial mixtures and end-products were characterized by nuclear magnetic resonance (^{13}C NMR). Additives slightly affected pH (final pH about 8.0) and increased the electroconductivity of mixtures. Nanoparticles biochar and their combination reduced the OM and C losses (about 15%) compared to control without additives. A decrease of C/N ratio between initial and end-products were also observed in all treatments and lower differences were observed in treatments with additives. Nitrate concentration increased as composting progressed. CHa showed the higher mean concentration of NO_3 (2500 mg kg^{-1}) and NH_4 (120 mg kg^{-1}). Conversely CBFe and CBHa showed the lower mean concentration of NH_4 (60 mg kg^{-1}). Nanoparticles significantly decreased the final E_4/E_6

ratio (<6) and the addition of biochar and its combination with nanoparticles increased the aromaticity (twice) the alkyl-C/O alkyl-C ratio and the hydrophobicity which are parameters associated to stabilized end-products. Clear relative diminution of O alkyl-C region (50%) associated to carbohydrates was observed in treatments with additives suggesting an active composting process. Furthermore the addition of biochar (CB) significantly decreased the mean emission of both CO_2 (~400 g CO_2 m^2 d^{-1}) and CH_4 (4.5 g CH_4 m^2 d^{-1}) during the process. These results suggest that the addition of iron oxide/halloysite nanoparticles biochar and their combination as co-composting additives had important effects on composting process GHG emissions and chemical composition of the end-products.

Acknowledgments to FONDECYT/CONICYT Project N° 3170677.

Keywords: BIOCHAR, CO-COMPOSTING, HALLOYSITE, IRON OXIDE, WASTE MANAGEMENT

Abstract number: A 5.22

SHORT-TERM RESPONSES OF SOIL RESPIRATION INDUCED WITH BIOCHAR AND LIME IN ACID SOIL

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Biochar can have a positive effect on a number of chemical biological and physical soil properties and because of that it is often used as a soil amendment to enhance soil quality. Also its long-term sequestration of carbon is often highlighted. Ways to preserve carbon in soil are beginning to play an important role since climate change is one of the main challenges facing humanity. Also one of the biggest problems of agricultural producers in Croatia are acid soil because about majority of agricultural land in the Republic of Croatia are determined as acid. Currently mostly used and well researched soil conditioner for acid soils in Croatia is sugar factory waste lime. Since biochar can also be used as soil amendment on acid soils (rises soil pH values) the main aim of this research is to see if there are differences between soil respiration levels in both aforementioned amendments. The two-year research was carried out on stationary field trials at two dominant acid soil types Gleysol and Stagnosol in Croatia. The soil samples were taken six times during experiment on maize and winter wheat. The treatments were: C - control B1 - 5 t ha^{-1} B2 - 10 t ha^{-1} B3 - 15 t ha^{-1} of biochar and L - optimal dose of sugar factory waste lime that was calculated for each field trial location. For measuring soil respiration the 24-hour rapid CO_2 “burst” method was applied. The average soil respiration over the entire experiment was 6.48 mg CO_2-C g^{-1} C_{org}. Soil respiration was significantly affected by soil type and treatment. On Stagnosol a 6777% higher soil respiration then Gleysol was recorded. The most intensive average soil respiration was measured on the liming treatment (9.54 mg CO_2-C g^{-1} C_{org}) and was significantly higher in relation to the other treatments among which no significant differences were observed. Soil respiration was positively correlated with soil organic carbon and soil reaction while the $CaCO_3$ content did not significantly correlated with soil respiration. Thus it can be concluded that biochar in comparison to lime was stable in soil and achieved carbon sequestration which is an important fact for global carbon cycles

Keywords: BIOCHAR, LIMING, CARBON SEQUESTRATION, SOIL RESPIRATION, ACID SOIL

Abstract number: A 5.23

BIOCHAR AMENDMENTS INDUCED NEGATIVE PRIMING IN SOIL ORGANIC CARBON BY REGULATED COMPETITIVE INTERACTION WITH KEYSTONE TAXA

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Biochar amendments have been widely proposed as a conventional and efficient strategy to promote soil organic carbon (SOC) sequestration via negative priming. Unfortunately the extent and biological mechanisms responsible for biochar-induced negative priming are still not fully understood. Despite traditional explanations focused on the environmental filtering mechanisms of biochar amendments on microbial biomass and community composition underlying the priming effect on SOC dynamics whether and how a biochar-induced competitive network structure with keystone taxa determines SOC mineralization in natural ecosystems has been minimally explored.

Here we paid particular attention to the relationships between the diversity and network structure of soil bacterial and fungal communities and SOC mineralization. A 3-year field experiment was conducted comprising five treatments: no fertilization conventional fertilization and conventional fertilization with three rates of biochar amendments. Biochar amendments considerably increased soil moisture and pH and subsequently shaped the composition and co-occurrence networks of soil bacterial and fungal communities. Importantly network analysis coupled with stable isotope probing incubations consistently determined that biochar amendments reshaped the competitive modular structure with putative keystone taxa in the bacterial and fungal networks. Structural equation modeling suggested that the biochar-induced competitive modular structure with keystone taxa promoted bacterial and fungal diversity and consequently reduced carbohydrate catabolism and soil metabolic quotient. Our study revealed that biochar-induced competition with keystone taxa stimulated the bacterial and fungal diversity and consequently decreased SOC mineralization. The comprehensive understanding of the unexplored biological mechanisms underlying the biochar-induced negative priming may provide crucial implications for enabling SOC sequestration. Biochar amendments considerably increased

Keywords: BIOCHAR, COMPETITIVE INTERACTION, KEYSTONE, TAXA, BACTERIAL AND FUNGAL DIVERSITY, SOIL ORGANIC CARBON, MINERALIZATION

Abstract number: A 5.24

COMPETITIVE INTERACTION WITH KEYSTONE TAXA INDUCED NEGATIVE PRIMING UNDER BIOCHAR AMENDMENTS

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Our study revealed that biochar-induced competition with keystone taxa stimulated the bacterial and fungal diversity and consequently decreased SOC mineralization. The comprehensive understanding of the unexplored biological mechanisms underlying the biochar-induced negative priming may provide crucial implications for enabling SOC sequestration. Biochar amendments considerably increased.

Keywords: BIOCHAR COMPETITIVE INTERACTION KEYSTONE TAXA BACTERIAL AND FUNGAL DIVERSITY SOIL ORGANIC CARBON MINERALIZATION

Abstract number: A 5.25

EFFECTS OF CHARRED SEWAGE SLUDGE ON CARBON SEQUESTRATION AND NITROGEN AVAILABILITY AT A MEDITERRANEAN SOIL

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The thermochemical carbonization of sewage sludge (SS) through hydrothermal carbonization (HTC) or dry pyrolysis has been proposed to achieve SS hygienization and increase its biochemical stability. Paneque et al. (2017) showed a higher presence of aromatic and heterocyclic N compounds in pyrolyzed-SS than in HTC-treated SS. This suggest a lower degradability, thus a lower C-sequestration potential, of the former compared to the latter. In addition, the transformation of peptide-like N of SS into heterocyclic aromatic N during thermal treatments is expected to reduce N availability, limiting the use of this residue as a direct source of N for plants. Therefore, the main goal of this work was to study the biodegradability and N availability of pyrolyzed and HTC-treated SS along the time after their addition to a soil.

Thus, we performed a 10-month greenhouse incubation experiment, using a Mediterranean Cambisol as matrix and tested the following treatments: control (soil alone), raw SS, SS-hydrochar (HTC 200 °C, 30 min) SS-pyrochar (dry pyrolysis, 600°C, 1 h). The SS was produced in a pilot-scale waste-water treatment plant and enriched with ^{13}C and ^{15}N by the addition of $^{15}NH_4Cl$, $K^{15}NO_3$ and ^{13}C-glucose during the treatment. The distribution of ^{13}C and ^{15}N among the soil and plants was monitored after 1 and 3 months, as well as at the end of the experiment. Our results confirmed that both C and N in the pyrochar were biochemically more stable than those in the hydrochar. However, HTC was able to reduce the amount of very labile compounds that otherwise would be degraded within the first month. In addition, the hydrochar showed a slightly lower amount of plant available N than raw SS, whereas the amount of N derived from the pyrochar used for plant growth was negligible. This study confirmed that dry pyrolysis achieved a more effective stabilization of SS than HTC, and hence that pyrochars are more appropriate to increase the C sequestration potential of soils. However, both HTC and, in a greater extent, HTC limit the use of the N contained in SS for plant growth.

Paneque M., De la Rosa J.M., Kern J., Reza M.T., Knicker H. (2017) Hydrothermal carbonization and pyrolysis of sewage sludges: What happen to carbon and nitrogen? Journal of Analytical and Applied Pyrolysis, 128, 314-323.

Key words: SEWAGE SLUDGE, HYDROCHAR, PYROCHAR, ^{15}N AND ^{13}C STABLE ISOTOPES

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Session 6: Nutrient availability in soils – Can our knowledge on soil interfaces improve biotechnological approaches or soil management to decrease the need for artificial fertilizers?

Abstract number: N 1

EFFICIENCY OF LEONARDITE IRON HUMATE/SYNTHETIC CHELATES MIXTURES IN SOYBEAN *NUTRITION*

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Iron fertilizers based on humic substances are an ecofriendly and afordable option to correct iron chlorosis in calcareous soils even though they are less efficient than synthetic iron chelates. Some authors have proposed to replace part of iron synthetic chelate FeEDDHA with humic substances in order to reduce the chelate application and to improve iron uptake when these treatments are applied to orange trees. We hypothesize that the labile iron bonded to the leonardite can be easily chelated by the synthetic ligand and transport it to the roots by the shuttle effect ameliorating in this way the soybean iron nutrition. Therefore the aim of this work is to evaluate the contribution of mixtures of an iron leonardite humate with synthetic iron chelates (EDDHA/Fe or FeHBED) to the iron nutrition of soybean chlorotic plants.

Two pot experiments (short and long term) applying different doses of mixtures of a commercial iron leonardite humate and iron synthetic chelates (FeEDDHA or FeHBED) to soybean (*Glycine Max* commercial variety) chlorotic plants were carried out under controlled conditions. Stable isotopes (^{56}Fe and ^{57}Fe) were used as tracers to study iron source uptake (chelate or leonardite fertilizer) and their distribution in plants and soils fractions.

Plants treated with mixtures of iron leonardite fertilizer and FeEDDHA showed the best iron nutrition at short term but at the end of the long-term experiment no significant differences between treatments and doses were found. In the soil fraction iron chelates remained in the soluble fraction while iron leonardite fertilizer mostly remained in the available fraction. Consequently the hypothesized increase in the iron shuttle effect was only appreciable at the first days not been relevant for the final outcome of the experiment. In previous works on field grown citrus a positive long lasting effect of the Fe leonardite was observed.

The use of ^{57}Fe and ^{56}Fe showed that the direct contribution of iron from a leonardite fertilizer to the plant nutrition in the presence of iron chelates is small. Then mixtures mask the real contributions of the individual products. While the synthetic chelate has a fast effect the Fe leonardite fertilizer provides increasing iron availability in the roots soil interface that allows a slow uptake of Fe by the plants.

Keywords: IRON HUMATES, LEONARDITE, IRON, STABLE ISOTOPES, CALCAREOUS CONDITIONS, SOYBEAN

Abstract number: N 2

FORMATION OF BINARY AND TERNARY COMPLEXES OF SOIL HUMIC ACIDS FROM DIFFERENT ORIGINS WITH CALCIUM AND PHOSPHORUS

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Soil organic matter controls the sorption of cations and influences the mobility and bioavailability of cationic nutrients. Earlier studies have conclusively demonstrated the formation of ternary complexes between humic acids (HA) and phosphorus (P) via iron or ferrihydrite bridging. Less attention has been given to P sorption to HA via calcium (Ca) binding although this mechanism may compete with the formation of Ca phosphate minerals in calcareous soils and therefore facilitate the mobilization of P. Thus soil P retention could be reduced by organic matter amendments while organic-rich riparian zones could act as a source of colloidal P entering water bodies. The main objectives of this study were to (1) investigate the formation of binary complexes of Ca with soil HA from two different origins and (2) determine if the binary HA-Ca complexes can incorporate P at circumneutral pH (6 and 8.5) hence forming ternary HA-Ca-P complexes. Humic acids were extracted from an agricultural organic soil (AOS) and a riparian soil (RS) in Ontario Canada. Distributions of functional groups were analyzed by solid ^{13}C NMR spectroscopy and the proton and Ca binding capacities were measured with potentiometric titrations. The formation of ternary complexes (HA-Ca-P) was analyzed by size fractionation using molecular weight cut-off (MWCO) tubes (size: 3000 dalton). Overall HA from RS (RSHA) more strongly binds P than HA from AOS (AOSHA). Proton and Ca binding capacities of RSHA are higher than for AOSHA and pH have a weaker effect on Ca binding to RSHA. These differences are consistent with the lower proportion of aromatic groups in RSHA than AOSHA. Together the NMR titration curve and MWCO data imply that Ca binds to RSHA through monodentate covalent bonds and electrostatic attraction. Approximately 2.6 mmol P gC^{-1}are bound to RSHA via ternary complexes at pH 6.0. Our results illustrate that the formation of ternary HA-Ca-P complexes is strongly affected by the properties of the HA and they illustrate that sorption to soil organic matter may play an important in the fate and mobility of P.

Keywords: ORGANIC MATTER, PHOSPHORUS, CALCIUM, BINARY COMPLEX, TERNARY COMPLEX

Abstract number: N 3

NITROGEN USE EFFICIENCY IN CONSERVATION MANAGEMENT OF PADDY FIELDS: SOIL ORGANIC MATTER AND MICROORGANISMS AS KEY FACTORS

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Lowland soils represent 4 to 6% of the earth's surface occupying an area of 7 to 9 million km^2. Many of these areas can be used with irrigated rice cultivation as a paddy field. The traditional system of rice cultivation based on intensive soil disturbance and rice monocropping decrease the soil fertility requiring high inputs of fertilizers to ensure high yields. On the other hand, soil conservation management systems such as integrated crop-livestock systems (ICLS) may increase the soil fertility and consequently improve rice nutrition. Therefore, our study aimed to evaluate the nitrogen (N) use efficiency by irrigated rice five years after the adoption of different paddy-farming systems in an Albaqualf soil from southern Brazil. For this, a long-term experiment of ICLS located in Cristal county Rio Grande do Sul Brazil was used. The systems consisted of two ICLS under no-tillage (NT) in comparison to the traditional system (S1) of irrigated rice cultivation with soil disturbance rice monocropping and winter fallow. The ICLS systems were based in: rice production in the summer season and pasture (annual ryegrass) with cattle grazing in winter season (S2) and crop rotation (rice and soybean) in summer season and livestock production in winter season (S3). Undisturbed soil samples were collected and a greenhouse experiment was carried out using fertilizer containing ^{15}N isotope in order to verify how much of N used by the rice came from fertilizer or soil. It was verified higher N use efficiency in the two ICLS compared to the S1. The S1 requires more N supplied by fertilizer to obtain high yields. More efficient systems have been those with greater capacity to provide N in adequate amounts coupled with the greater synchronism between their release and the rate of absorption / demand of the crop. Thus, ICLS are more efficient due to large source of N from soil organic matter with more N labile forms and microorganisms play a fundamental role in ensuring synchronism between the release and demand of N by rice.

Keywords: SOIL FERTILITY ,^{15}N ISOTOPE, IRRIGATED RICE, INTEGRATED CROP-LIVESTOCK SYSTEMS, RICE NUTRITION

Abstract number: N 6.1

ADDITION OF DIVERSE PHOSPHORUS COMPOUNDS TO IMPROVE NUTRIENT AVAILABILITY IN AGRICULTURAL SOILS OF CUATRO CIENEGAS BASIN, MEXICO

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Cuatro Cienegas Basin (CCB) located at the Chihuahuan desert in North of Mexico is characterized by its low nutrients' availability in the soil mainly P. Despite this, CCB soils have been widely used for the production of alfalfa contributing to soil degradation and the subsequent abandonment of agricultural lands. An alternative to improve the fertility of these sites is the addition of organic matter (OM) but its effects depends on chemical composition of added organic compounds. Since the availability of P is a limited nutrient for agriculture production in CCB the aim of this work was to analyze which kind of organic and inorganic phosphate molecules increase the availability of P and N as well as the microbial activity in agricultural soils of the CCB. To this end, soil was collected from an agricultural plot of alfalfa from the CCB. Soil incubations were carried out using an experimental design of a factor that consisted of 6 different treatments. The treatments consisted of adding different P sources to the soil: AMP RNA calcium phosphate (CP) ammonium monophosphate (MAP) phytic acid (F) and a control (c). Biogeochemical analyzes and quantification of enzymatic activities before and after incubation were carried out. The results showed significant differences between treatments in the biogeochemical analyzes. Treatments AMP and RNA helped to increase the mineralization of C but soil microbial community immobilized less C in microbial biomass. An increase in nitrification was also observed in these treatments. The treatments AMP and RNA also influenced to have a lower concentration of organic C dissolved in the soil but the RNA treatment helped to have a higher concentration of dissolved organic P and higher dissolved organic N although for the latter to a lesser extent than the CP treatment. In the soils treated with CP greater enzymatic activity was also observed for N-acetylglucosaminidase and a higher concentration of COD.

Keywords: PHOSPHORUS, FERTILITY, BIOGEOCHEMISTRY, NUTRIENTS, MICROORGANISMS

Abstract number: N 6.2

ROOT EXUDATES INVOLVEMENT IN TOMATO PLANTS RESPONSE TO LOW P LEVELS

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Phosphorus (P) is an essential macronutrient required by plants but in most soils its concentration can be very low as its use efficiency is determined by abiotic processes (adsorption on mineral surfaces and precipitation as insoluble salts) that immobilize P reducing its mobility and limiting the fertilizers diffusion. Plants have evolved several strategies to exploit localized sources of P and to optimize growth and productivity. Among these the production of exudates that compete with P for the same adsorption sites a higher production of electron-rich species which can reduce iron oxides and cause the release of phosphate and a higher production of phosphatases and phytases which can hydrolyse organic P-compounds. Also strigolactones (SL) have been suggested to be involved in plants response to P availability. They are signalling molecules and phytohormones involved in the regulation of plant architecture the response to nutrient availability the establishment of symbiosis with AM-fungi and have a role in the plant response to low P conditions. In the context of the European project named TOMRES we are studying the root exudates involvement in plants response to low P conditions: we grew up wild-type (WT) tomato plants and plants with gene for SL synthesis silenced (SL-). After a period of growth in normal nutrient conditions plants were kept in P stress regimen. Root exudates were collected and analysed for inorganic P total C N and P organic acids polyphenols and SL contents and tested for hormone-like activity. Plants biomass parameters were measured and roots and shoots were analysed for total C N and P content as well. Our results highlighted differences in WT and SL- plants biomass in P distribution between roots and shoots and in exudates composition. In particular the main diversities were spotted in the organic acids and polyphenols amount and composition. Some of the exudates were found to have gibberellic-like or indolacetic-like hormonal activity. As in soils P is often adsorbed onto iron (Fe) (hydr)oxides surfaces or precipitated in the form of Fe salts we are now testing the ability of some of the organic acids and polyphenols identified

in the exudates to dissolve P-Fe systems either by complexation or reductive dissolution enabling P uptake by plants.

Keywords: PHOSPHORUS, STRIGOLACTONES, ROOT EXUDATES, NUTRIENT

Abstract number: N 6.3

THE EFFECTS OF FOLIAR APPLICATION OF DIFFERENT COMPOUNDS ON THE ENZYMES ACTIVITY AND DROUGHT TOLERANCE AT THE END OF SEASONAL GROWTH IN PISHGHAM WHEAT VARIETY

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Drought stress is a major limiting factor in crop production at arid and semi- arid areas. It is well known application of plant growth regulators and nutrients could be useful to improving plant tolerance to water stress condition. In this research the effects of these type of compounds as foliar application was investigated on enzyme activity and tolerance in terminal drought stress at Pishgam wheat cultivar. A field experiment in Ajabshir region in 2016-2017 was designed as a randomized complete block design (RCBD) with eight treatments in three replications. The results of ANOVA clarified that treatments had significant ($P \leq 1\%$) effects on wheat morphological traits including harvest index number of spikes per m^2 number of fertile tiller and seed proteins and were significant on TKW and peduncle length at 5% probability. The effect of compounds foliar application on moisture traits of flag leaf such as relative water content (RWC) Relative water deficit (RWD) membrane stability index and flag leaf protein were significant at 1% probability. In terms of physiological traits at flag leaf such as a-chlorophyll b-chlorophyll total chlorophyll malondialdehyde and catalase guaiacol peroxidase and ascorbate peroxidase enzymes were significant at 1% probability. Also ANOVA results showed that there is not significant between foliar applications vs. control in biological yield grain and straw yield. But yield differences were considerable value between urea salicylic acid and folic acid foliar applications vs. control. Foliar application of urea could increase biological grain and straw yield 3219 kg.ha^{-1} (19.8%) 2704 kg.ha^{-1} (42.4%) 512 kg.ha^{-1} (5.4%) respectively. This could be explained by increasing number of fertile tillers (29.4%) and decreasing number of non-fertile tillers (36.6%) in plant and therefore existence of nice source to remobilization of photosynthesis materials and consequently increasing harvest index (20.5%) in urea treatment. Grain yield increased 2054 kg.ha^{-1} (32.2%) 1962 kg.ha^{-1} (30.8%) respectively in salicylic acid and folic acid treatments. So it would be concluded that foliar application of salicylic acid folic acid and urea could be introduced as alleviator of drought stress negative effects on the wheat plant.

Keywords: WATER STRESS, WHEAT, ENZYMATIC ACTIVITY, FOLIAR APPLICATION, YIELD

Abstract number: N 6.4

ALUMINUM-FLUORIDE-OXALATE INTERACTIONS IN ALPINE TUNDRA SOIL

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Anion exchange between ubiquitous low molecular weight organic acids (LMWOA) such as oxalate and surface retained inorganic anions such as F^- SO_4^{2-} and OH^- can play a critical role on Al bioavailability and transport in acidic alpine tundra soil. A series of batch equilibration and soil column leaching studies were conducted to examine anion exchange reactions between F^- oxalate and OH^- and the impact of increased soil solution F^- concentration on Al transport. The addition of either F^- or oxalate to soil suspensions resulted in significantly higher solution pH suggesting F^- and oxalate exchange with surface –OH groups. Distinct stages of OH^- release were observed for all soil horizons leached with 25 mg L^{-1} F^- with OH^- release decreasing in the order O/A1~A2>> Bw. Similar OH^- release pattern was observed in the O/A1 horizon for the 100 mg L^{-1} oxalate treatment suggesting that both F^- and oxalate may be competing for common exchange sites in the O/A1 horizon. Fluoride displacement by oxalate in batch equilibration experiments was observed for both the 25 and 100 mg L^{-1} treatment. Individual soil horizons leached with 100 mg L^{-1} oxalate exhibited increased

F^- leaching in the order O/A1>A2~Bw with pulsed F^- movement being observed in the O/A1 horizon. Soil columns eluted with 25 mg L^{-1} F^- exhibited increased Al solubilization and transport with Al leaching increasing in the order Bw>A2>O/A1. Sequential leaching of soil columns in the order: D. I. H_2O → 25 mg L^{-1} F^- →D.I. H_2O → 100 mg L^{-1} oxalate indicated that previously adsorbed F- could be displaced by oxalate. Displacement of F^- by oxalate increased in the order O/A1 > A2 > Bw. Hydroxyl displacement by both F^- and oxalate may be an important source of acid neutralization in a soil wetting front.

Keywords: LOW MOLECULAR WEIGHT, ORGANIC ACIDS, HYDROXYL RELEASE, ALUMINUM SPECIATION, ANION EXCHANGE, ALUMINUM BIOAVAILABILITY

Abstract number: N 6.5

INTERACTIONS OF SOME ORGANIC ACIDS WITH MINERALS AND A RED LATOSOL

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Certain cultures have specificity in the assimilation of some ions that are or are not available in the soil. Minerals play a fundamental role in the presence of these elements, which often come from the weathering process of rocks along with decaying organic matter. The objective of this work was to study the extraction and / or solubilization of some chemical elements present in the studied minerals and in a red latosol by the action of some organic acids produced from the decomposition of the ligno-cellulosic matter being able to have the participation of the microbiota present in the hoping to contribute in some way to the understanding of soil fertility mechanisms and consequently to the mineral nutrition of plants. The minerals used and examined by XRD were: manganite hematite pyrolusite kaolinite goethite bentonite and magnetite commonly occurring in humid intertropical regions and a sandy latosol (LV) with a sandy texture representing more than 20% of the area of the state of São Paulo. Solution of the following acids: acetic butyric citric phenolic lactic malic oxalic propionic and tannic separately for 53 days weekly shaking and conditioned under aerobic conditions.The concentrations of lithium sodium potassium magnesium calcium barium vanadium molybdenum manganese iron cobalt nickel copper zinc cadmium mercury boron aluminum silicon lead phosphorus arsenic sulfur and selenium in the solutions of the experimental systems by Inductively Coupled Plasma (ICP) aiming to evaluate the amount of these extracted and / or solubilized ions by the organic acids of the studied minerals and soils. The results obtained suggest that in most systems the chelation of the metal ions by the organic molecules favoring the formation of a salt of the respective minerals. Probably there is substitution of Mn and Fe for Ba in the minerals pyrolusite manganite and magnetite. The results also demonstrated that manganese is a highly dangerous element because of its toxicity to plants and can reach a very high level in the solution although it is an essential element. Significant amounts of chromium can be released in the presence of citric malic and butyric acids. There may be isomorphic substitution of Zn by manganese in manganite by Al in bentonite and by Fe in magnetite.

Keywords: SOIL ORGANIC MATTER, HUMIC ACIDS, MINERALS, ORGANIC ACIDS

Abstract number: N 6.6

EFFECT OF BIOLOGICAL SOIL CRUSTS ON THE IMPROVEMENT OF SOIL CHARACTERISTICS AND ON THE PRODUCTION OF PHENOLIC COMPOUNDS IN SAHARAN PLANTS

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The present work is a contribution to the study of the relationship between soil biological crusts and Saharan plants (*Zygophyllum album* L.). The results obtained show an increase an increase in the concentrations of some nutrients in the soil (nitrogen carbon phosphorus ...) and in the concentration of polyphenols tannins and flavonoids in the ethanolic extract of the soil/growing plant near the live crust compared to the soil/growing plant near the dead crust. The rate of increase recorded is 2.77% and 2.47% successively for polyphenols and tannins and it reaches 14.28% for flavonoids. These results confirm by analysis by HPLC, which shows a variation in the content of the phenolic compounds between the two extracts.

In the light of the results obtained biological soil crusts have an influence on the productivity of plants in arid ecosystems. These crusts can help plants establish and survive by providing moisture and nutrients.

Keywords: BIOLOGICAL SOIL CRUSTS, ZYGOPHYLLUM ALBUM, POLYPHENOLS, SOIL NUTRIENTS, SAHARA

Abstract number: N 6.7

MICROBIAL PHOSPHORUS DYNAMICS AFFECTED BY SALINITY IN AN OMANI DATE PALM SOIL

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The effect of increasing soil salinity in the dynamics of soil microbial biomass (SMB) respiration and substrate-induced respiration (SIR) microbial biomass phosphorus (MBP) and soil phosphatase activity (Pase) was assessed for an Omani date palm farm soil from Al Batinah region. The study was conducted under eight increasing NaCl doses ranging from no added salt (ECe of 2.1 dSm^{-1}) to a maximum ECe of 34.2 dSm^{-1} generated by adjusting moisture to 25% (v/v) with a 10% NaCl solution. All treatments were incubated for five days at room temperature before analysis. The carbon sources used in the SIR analysis were glucose and common root exudates (citric oxalic malic and succinic acids) added at 30 µg/g of dry soil. The results showed that soil bacterial and actinomycetes biomass had an 83% decrease at maximum salinity whereas and fungi biomass was decreased by 73%. The addition of NaCl increased the proportion of actinomycetes only to EC levels below 10 dSm^{-1}. Soil respiration was increased by 27% and the metabolic coefficient was increased by 631% at maximum salinity level. On the other hand SIR was strongly reduced by salinity showing that the microbial community under salt stress is less responsive to external carbon stimuli in comparison to the low salinity control soil. Moreover soil MBP extracted by anion exchange membrane after chloroform fumigation showed an initial decrease of 37% at salinity levels up to 7 dSm^{-1} and continuously increased (up to 22% of initial MBP) with increasing salinity levels. Furthermore phosphatase activity was nearly halved at all salinity levels indicating eider a lack (less intense) of P starvation or a lower priority on spending energy on phosphorus scavenging mechanisms when under salinity disturbances.

Keywords: PHOSPHORUS, SOIL SALINITY, PHOSPHATASE, RESPIRATION, MICROBIAL BIOMASS

Abstract number: N 6.8

IMPROVEMENT OF PLANT GROWTH, NODULATION AND YIELD OF COMMON BEAN (PHASEOLUS VULGARIS L.) AND CHEMICAL PROPERTIES OF SOIL BY MICROBIOLOGICAL PREPARATIONS

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Background. Rhizobia-legumes symbiosis play an important role in increasing of crop yields reducing use of chemical nitrogen fertilizers increasing soil fertility decreasing the production cost and reduction of environmental pollution. A field experiment were conducted to study the effect of microbiological preparations (rhizobium 3 rhizobium 9 and PlantaStim) on plant growth nodulation and yield of common bean (Phaseolus vulgaris L.).

Methods. The experiment were carried out in randomized block design with three replications a field experiments of Institute of Genetics and Plant Experimental Biology Kibray district Tashkent region Uzbekistan. Experimental treatments included of uninoculation control inoculation with rhizobium 3 rhizobium 9 and PlantaStim. Plant growth parameters such as plant height root length dry biomass nodulation and yield components (number of pods plant-1 pods length weight of pods plant-1 number of grains plant-1 number of grains pod-1 weight of grains plant-1 and 1000 grains weight) were measured. The nitrogen phosphorus and potassium contents in soil (Common bean plant before sowing and after harvesting) were analysed.

Results. The results showed that PlantaStim inoculation increased the number of pods plant1 by 23% number of grains plant1 by 8% and weight of grains plant-1 by 16 % compared to control. Rhizobium 3 inoculation rose the height of plant by 24% length of root by 45% dry weight of root by 31% number of pods plant1 by 34% number of grains plant1 by 48% and weight of grains plant-1 by 80%. Inoculation with Rhizobium 9 significantly increased the number of nodules number of grains plant-1 number of grains pod-1 weight of grains plant-1 and 1000 grains weight of bean compared other treatments. Rhizobium 3 and rhizobium 9 had enhanced total N content P content and K content of soil compared to control and without PlantaStim.

Conclusion. It is concluded that a significant positive effect of inoculation with rhizobium 9 on growth nodulation and yield of common bean plants compared to control and PlantaStim.

Keywords: COMMON BEAN, MICROBIOLOGICAL PREPARATIONS, CHEMICAL PROPERTIES OF SOIL PLANT, GROWTH YIELD

Abstract number: N 6.9

AMORPHOUS SILICA BIOMINERALIZATIONS AS A SILICON SOURCE AND ITS ROLE ON THE NUTRIENT AND MICRONUTRIENTS DYNAMICS ON SOUTHEASTERN BUENOS AIRES AGROECOSYSTEMS

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Silicon (Si) in soil proceeds from minerals of lithogenic origin and amorphous silica biomineralizations. Grasses are the main producers of these biomineralizations known as silicophytoliths. Recently Si has been recognized as a beneficial element being important for the agricultural sustainability and environmental preservation. Southeastern Buenos Aires has Argiudolls characterized by its high fertility and aptitude for crop development. Ultimately the agricultural practices had been grown and consequently the level of soil degradation has been improved due to the increase in the content of trace metals (MT) and the decrease of nutrient contents among others. The aim of this work was to analyze the Si effects on the phosphorus and heavy metals contents in the soil-crop system. To that purpose Si fertilizers were applied to the soil before sowing the wheat plants. Soil and plant samples were taken on September and December. Si content available phosphorus (P) and HM ((Cu Cd Pb Mn Zn Fe Ni Cr) contents were determined in soil solution as well as the silicophytoliths and HM contents on different organs of the plant material (leaf stem and infructescence) all them through standard methodologies. In soil solution an inverse relationship between Si and P was observed (Si increases 215umol/L while P decreases 7ppm) as well as between Si and HM (Si raised 13mg/L Si while HM dropped 0.24mg/L). On wheat plants there was a positive relation between silicophytoliths and HM contents registered (augment of 193mg/g silicophytoliths and 129ug/g HM respectively). Is worth nothing that the values obtained here are between those allowed by FAO and UE. Concluding Si could improve the P bioavailability for the crop and also some phytoremediation processes as it diminishes de HM content in the soil solution and promotes their capture by the plant but without trespassing the threshold values which allow the farmers to continue with its economic exploitation as usual. Thus will be relevant to continue evaluating the Si application since it would improve the development of a sustainable and profitable agriculture.

Keywords: SILICOPHYTOLITHS, FERTILITY, PHYTOREMDIATION, CROPS PAMPEAN PLAIN

Abstract number: N 6.10

STUDY OF THE BIOLOGICAL CRUSTS OF THE SOIL FOR ITS POTENTIAL USE IN THE CONTROL OF DESERTIFICATION

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Biological soil crusts (BSC) are formed on the soil surface and are composed of cyanobacteria algae fungi lichens and bryophytes attached to and associated with different minerals. The BSC perform diverse ecological functions such as: favor the aggregation of particles of the soil reducing the wind and water erosion increase the stability of the soil by improving the water infiltration and catalyze the fixation of C and N in the soil.

One of the objectives of the experiment was to study the factors that promote the development of CBS in the Atacama Desert Chile as a protective cover of the edaphic surface in arid environments.

The methodology consisted of developing artificial cultures of CBS in soil samples from three coastal sectors between 23° and 24° S: La Chimba (CH) soil Paposo soil (P) and UCN soil (U). External environmental factors that influence the growth of the BSC were controlled: sunlight nutrients (NH4NO3 and KH2PO4) and humidity for a period of 90 days.

The effect of the different treatments was determined by measuring the pH electrical conductivity (EC) humidity organic carbon (OC) organic matter (OM) total phosphorus (PT) and chlorophyll a in different incubation times (0 30 60 and 90 days). The soils studied presented pH values between 7.2 and 8.2 and CE between 1.29 and 6.71 mS/cm. While the OM content varied between 1.57% and 3.70% and the PT values ranged between 244.2 mg P/kg and 7088.5 mg P/kg. It can be highlighted that in the initial period there were differences in the production of chlorophyll a in the different soils where P registered the maximum chlorophyll a (0.08 μg/g soil) being attributed to the presence of cyanobacteria in the soil. At the end of the experiment a decrease in OC and OM was observed compared to its initial values especially in the P samples with a maximum of 2.1%. It is proposed that the decrease of these parameters could be attributed to the consumption of the biomass of the BSC by microorganisms present in the soil. The colonization time of the BSC are long caused mainly by the limiting environmental factors to which they are exposed. The control of some parameters such as humidity and solar radiation could eventually facilitate the development of a BSC in a desired location and thus favor the protection of the soil.

Keywords: BIOLOGICAL SOIL CRUST CONTROL OF DESERTIFICATION ARID SOIL BIOFERTILIZER FOR ARID SOILS REMEDIATION OF ARID SOILS

Abstract number: N 6.11

EXPLORING TAXONOMIC AND FUNCTIONAL PROFILES OF MICROBIAL COMMUNITIES ASSOCIATED WITH CYANOBACTERIA BIOCRUSTS IN DRYLANDS

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Drylands cover nearly 41% of the Earth. In these ecosystems biocrusts dominated by cyanobacteria occupy an important extension and are suggested to play crucial roles in the biogeochemical processes of soil and hence as essential elements contributing to improve the soil wetting and fertility. In spite of their significance little is still known about the microbial communities associated with cyanobacteria and their metabolic pool. This work therefore aimed to investigate the taxonomic and metabolic diversity of the microbiome related to cyanobacteria biocrusts. Soil DNA of samples presenting incipient colonization of cyanobacteria (IC) and mature cyanobacterial biocrusts (MC) collected in the Tabernas desert (SE Spain) were sequenced using a shotgun metagenomic approach (NexSeq Illumina) and analysed by MG-RAST server and STAMP software. The most abundant phyla were Actinobacteria (>20%) followed by Proteobacteria and Cyanobacteria in accordance with what was already described in other arid ecosystems. No significant differences were however observed between the IC and MC samples. At genus level the microbial structure also showed a predominance of actinobacterial genera (Rubrobacter Conexibacter Streptomyces Frankia and Mycobacterium among others). Nevertheless, significant differences in the

taxonomic abundance were observed suggesting differential metabolic roles between IC and MC microbiomes. As expected the functional structure was similar in IC and MC samples highlighting the huge presence of dehydrogenases (>10%) followed by permeases among others. It remarked the prevalence of the H2 metabolism and transmembrane export and import functions in these microbial communities and ultimately their fundamental role in the biogeochemical cycles. Acknowledgements: CGL2017-88734-R (BIORESOC) Research Project and RYC-2016-21191.

Keywords: BIOCRUST, CYANOBACTERIA DESERT

Abstract number: N 6.12

BORON AND ZINC SPRAYING IS ASSOCIATED TO AN IMPROVED PERFORMANCE IN HAZELNUT (CORYLLUS AVELLANA) PLANTED IN ACID SOILS

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Chile has over 4000 ha of hazelnut in acid soils (pH ≤ 5.5) where low boron (B) and (Zn) availability may be a restrictive factor for plantations. Agronomical managements consider B and Zn spraying however studies about rates and application time has been not developed both on plant performance and production. An experiment was carried out in the 2016-17 season in La Araucanía region Chile (39° 00` S 72° 31` W). Nine-years-old plants cv. Tonda di Giffoni were sprayed with B at 800 and 1600 ppm and Zn at doses of 400 and 800 ppm according to the following treatments: control (water) B800+Zn400 and B1600+Zn800 applied in October 15th and 30th (P1) and November 15th and 30th (P2). Leaf water potential (MPa) was significantly improved after two spraying in P2 in comparison to the control plants whereas stomatal density (stomata mm-2) was increased under both B and Zn treatments in P1 and P2 ($P \leq 0.05$). The application of B1600 +Zn800 in P2 increased 29 times the concentration of foliar B (265±21 mg kg-1 DW) in comparison to the Control and by 34% with respect to the same treatment included in P1 ($P \leq 0.05$). In relation to Zn under treatment B1600+Zn800 in P1 and P2 increased their concentration from 8 and 11 times respectively in relation to Control leaves (53±3 mg kg-1 DW) ($P \leq 0.05$). The early application of B800 +Zn400 (P1) significantly increased the yield of marketable fruit by 91% compared to the control (767±113 kg ha-1) whereas B1600+Zn800 showed a 33% higher than the Control treatment ($P \leq 0.05$). However treatments in P2 did not show differences between them increasing the yield by 81% with respect to the control ($P \leq 0.05$). The fruit weight (g DW) did not show differences between treatments and program whereas seeds (Kernel) presented a 10% higher weight under B1600+Zn800 in Programs ($P \leq 0.05$). In kernels radical scavenging activity (DPPH) showed higher activity with treatments in P2 than in Control. In conclusion the later application regardless of the dose influenced fruit yield in trees planted in soil with low B and Zn availability. However a high concentration of B and Zn in leaves as a result of a higher dose improved the kernel/shell ratio indicating that quality parameters of the fruit were more related to the B and Zn doses than the application time.

Keywords: BORON, HAZELNUT, ACID SOILS, ZINC SPRAYING

Abstract number: N 6.13

QUALITY AND HEALTH OF SOIL IN CITRUS PRODUCING AREAS IN COLOMBIA AFFECTED BY THE WINTER WAVE DURING 2010 – 2011 SEASON

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During 2010-2011, Colombia faced one of the winter seasons of greatest impact. The most affected department was Bolivar; heavy rains caused the increase of water in the Magdalena River, causing the thus overflow in some municipalities, including San Fernando and Margarita situated in the south of the department. The impact on agriculture was drastic, the death of more than 300 hectares of citrus was generated. The objective of this work was to evaluate the quality of the soil through the determination of some physical, chemical and biological components of the soil and their interactions, within the affected, and not, citrus areas by heavy rains. Three citrus zones were sampled in the Momposina Depression, the first corresponds to the area affected by heavy rains, the second corresponds to the area considered susceptible to flooding but which was not affected and the third corresponds to the area that has never been affected by floods from the river. A simple random sampling was carried out. The methodology used for the evaluation of the soil quality was the one proposed by the Department of Agriculture of the United States of North America (USDA, 1999). Soil quality variables were determined and the effects of the sources of variation and their effect on the productivity and physiological variables of plants were determined. Soil quality variables determined to have a greater effect on productivity were mainly potassium (K), phosphorus (P), sulfur (S), Calcium (Ca), Sodium (Na) and NO_3 content. On the other hand, the physical properties that most influenced the soil quality was the resistance to penetration (RP). Comparing the sampled areas, significant differences were found ($p < 0.05$) between the physical and chemical properties and number of mycorrhizal spores between the zones. Higher concentration of nutrients was found in the affected areas, shoeing also a better infiltration, higher number of spores of mycorrhizae and a better structural stability, probably due to the higher content of clays and OM present in these areas (38.31% and 4.91% respectively). However, soils can have problems of cementing because more than 80 % of the aggregates are greater than 2mm, which is an indicator of cemented soils.

Keywords: PHYSICAL, CHEMICAL AND BIOLOGICAL PROPERTIES OF THE SOIL, QUALITY AND HEALTH OF THE SOIL

Abstract number: N 6.14

RELATIONSHIP OF SOIL ORGANIC MATTER WITH INTEGRATED CROP-LIVESTOCK SYSTEMS ON THE PADDY FIELDS

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Lowland soils represent 4 to 6% of the earth's surface occupying an area of 7 to 9 million km^2. Many of these areas can be used with irrigated rice cultivation as a paddy field. The traditional system of rice cultivation based on intensive soil disturbance and rice monocropping decrease the soil fertility with the reduction of the contents and the quality of the soil organic matter (SOM). On the other hand soil conservation management systems such as integrated crop-livestock systems (ICLS) may increase the soil fertility through improve of SOM quality. In line with this idea our study aimed was evaluated the quality and contents of the SOM of a paddy field after 5 years of the adoption of different ICLS in an Albaqualf soil from southern Brazil. A long-term experiment of ICLS was used and this system consisted of four ICLS under no-tillage with different arrangements containing different intensities and frequencies of the animal and of cash crops in the system in comparison to the traditional system of irrigated rice cultivation with soil disturbance rice monocropping and winter fallow. For evaluate the quality of the SOM soil samples were collected in March 2018 and an evaluation of the soil organic carbon content was carried out correlating with the cations exchange capacity at pH 7.0. In addition, ^{13}C nuclear magnetic resonance (NMR) analysis was performed to characterize the functional groups of SOM. The NMR analyzes are still being processed but the pre-results already indicate higher quality SOM under ICLS. The different animal residues (manure) and pasture plants with lower C/N ratios in addition to increased plant root production possibly alters the dynamics of humification producing a SOM with more reactive functional groups in the soil.

Keywords: SOIL FERTILITY, ^{13}C NUCLEAR MAGNETIC RESONANCE, IRRIGATED RICE, INTEGRATED CROP-LIVESTOCK SYSTEMS, SOIL ORGANIC MATTER

Abstract number: N 6.15

INFLUENCE OF PHYSICAL AND CHEMICAL PROPERTIES OF ÑADI SOIL (AQUANDS) ON STRUCTURE OF NITROGEN-TRANSFORMING BACTERIAL COMMUNITIES UNDER DIFFERENT LAND USES IN SOUTHERN CHILE

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Microorganisms in the course of their growth and metabolism interacts successively in the recycling of nutrients such as Nitrogen (N). This element takes different reduced and oxidized states forms in soils. Rhizobacterial communities may play a crucial role in these transformations. However our knowledge of how physical and chemical properties of Ñadi soil (Aquands) modulates bacterial communities in pastures and forests is still poor. The Ñadi soils (Aquands) are located in southern Chile (38°30'–43°00' S) and dominated by grasslands that support the major livestock production and consequently one of the most relevant grassland agro-ecosystems. Moreover, these soils present extreme and contrasting water content conditions depending on the water table height. Here we investigated the influence of physical and chemical properties of Ñadi soil on Nitrogen-transforming bacterial communities' structure under different land uses. Sizes and diversities of bacterial communities were studied using Illumina MySeq platform to sequence 16S rRNA gene and denaturing gradient gel electrophoresis (DGGE) for analysis *amo*A *nir*K genes. DNA extractions were taken from soil samples (Naturalised Pasture-PN Evergreen Native Forest – *Nothofagus dombeyi*– BN1 and Conifer Native Forest – *Fitzroya cupressoides*- BN2) during winter and summer. Our preliminary results showed that pH organic matter and gravimetric water content have a significant influence on bacterial communities. Moreover DGGE showed a higher diversity of bacterial communities harboring *nir*K and *amo*A genes in the forest samples (BN1 and BN2) during the winter season than pasture samples (PN). This preliminary study contributes to understanding the N-transforming bacterial communities, which are also relevant considering the potential consequences of climate change in southern Chile (increase in soil temperature and reduction in rainfalls on water and temperature dynamics as well as microbiological activity on these soils.
Acknowledgment: FONDECYT POSTDOCTORAL GRANT no. 3170505

Keywords: SOIL PROPERTIES ÑADI SOIL NITROGEN BACTERIA TRANSFORMING PASTURE FOREST

Abstract number: N 6.16

A NEW BIOFERTILIZER DESIGN FOR FOOD SECURITY AND SUSTAINABLE AGRICULTURE IMPROVING PHOSPHORUS AVAILABILITY AND PHOSPHORUS UPTAKE IN RHIZOSPHERIC PROCESSES

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Crop production often is limited by low available P due to more than 50% of P is organic P (P_o) which remain mainly recalcitrant in volcanic soils. Thus biotechnological tools are needed in order to enhance P availability. The aim of this study was to determine the effect of cattle manure (CM) activated with C (glucose) and N (urea) on P fraction and design of new biofertilizer. We carried out a soil incubation experiment (Chilean Andisol Barros Arana Series) with C (400 mg kg^{-1}) N (30 mg kg^{-1}) or a combination in plastic bags and was incubated at 20 ºC by 60 days. Soil respiration P fractions phosphatase (P-ase) and bacteria community of assayed soils were determined periodically until 60 days. The results indicated that soil respiration was very high in the treatments with CM (10-15 fold higher) and also increased with C and N and interesting the effect was very permanent in a time studied. In contrast soils without CM soil respiration was increased by C and /or N the first day only and later was reduced respect to soil (control). P-ase activity were increased for all the treatments in almost all sampling times and the proportion of labile P fractions ($NaHCO_3$-Pi and Po) and NaOH-Pi were incremented with manure G or N for all sampling times and a reduction of the residual P were observed from 57 to 30%. Therefore we concluded that primed respiration induced by either manure and C and N promote a higher soil respiration increasing P-ase activity that enhanced soil P availability making a P priming effect. After our results, we propose a new biofertilizer with CM bacteria consortia and nanoclay and we tested in a greenhouse assay using ryegrass plants. The new biofertilizer designed increased P shoot concentration in ryegrass *(Lolium perenne*) up to 100% respect to the control fertilized with triple superphosphate. The biomass increased over 40% meanwhile was observed an increment around 159% of P uptake by the plants with respect to the control. We conclude that the design of new

materials based on natural sources highly contribute in the sustainable agriculture and improve the P uptake in rhizospheric processes.

Keywords: BIOFERTILIZER, AVAILABLE P, PRIMING, NANOCLAY, BACTERIA CONSORTIA

Abstract number: N 6.17

CHEMICAL COMPOSITION OF DUST STORMS IN AGRICULTURAL AREAS OF ARID LAND

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The elemental concentrations of deposited dust are often used to assess the level of contamination and for monitoring air pollution. Therefore this paper gives an overview of the chemical composition of dust storms in agricultural areas of arid land. Samples were collected from 18 positions in the Qassim region. The concentrations of As Cd Co Cr Cu Pb Ni Ba and Zn were determined in the deposited dust. The means of As Co Cr Cu Pb Ni Ba and Zn concentrations in dust were 9.72 14.4 109 31.6 14.o 59.3 437 and 75.5 respectively. The concentrations of the previous elements in dust samples were not in the toxicity values range. Also data indicated that positions D1 D2 D3 D12 and D14 were higher in silicon but lower in aluminum iron Ca and Mg. Conversely the other positions were lower in silicon but higher in aluminum iron calcium and magnesium. However all positions recorded almost the same amount of the alkali elements potassium and sodium.

Keywords: DUST STORMS, ARID CHEMICAL COMPOSITION, ELEMENTS .

Abstract number: N 6.18

VALORIZATION OF IRON ORE TAILINGS AS FERTILIZERS (HBED/FE SIDERITE, HBED/FE HEMATITE-GOETHITE, AND HS/FE SIDERITE, HS/FE HEMATITE-GOETHITE)

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Iron chlorosis is a prevalent problem in plants grown in alkaline soils. The application of synthetic iron chelates is the most effective solution to correct this problem but in accordance with sustainable agriculture practices natural resources should beefficiently used to improve crop yield. This study deals with particle analysis of iron oxides and carbonates (hematite-goethite and siderite) from mining residues in northern Tunisia (Jerissa) and their potential for agricultural valorization. The aim ofthis work was to study the effectiveness of iron chelates and complexes prepared with iron ore tailings (hematite-goethite or siderite) HBED and humic substances (HS) to provide Fe to Soybean plants grown in calcareous soils.

The mining residues were geochemically characterized. Batch experiments were conducted to determine the soluble chelated or complexed iron fractions from the tested iron ore tailings along pH interval in the presence of chelating and complexing agents. Selected iron chelates and complexes (HBED/siderite HBED/hematite-goethite HS/hematite-goethite and HS/siderite) were applied as iron source on soybean (Glycine max.) grown on calcareous soil on pot experiment. The SPAD chlorophyll index iron content in leaves and roots were determined at the end of the trial. Soil parameters such as pH electric conductivity and soluble Fe were followed up in order to evaluate the iron chelate/complex behavior in the soil-plant system.

The geochemical and mineralogical characterization of the mining residues of iron reveals these residues have very high iron content (53% siderite and 40% hematite-goethite) and they are relatively rich in organic matter and clay fraction. Batch experiment showed that EDTA and HBED extracting solutions were able to chelate large amounts of iron from siderite and hematite/goethite. The iron chelated fraction by HBED confirm the potential valorization of these residues as mineral fertilizers.

Keywords: MINING RESIDUES, IRON FERTILIZERS, IRON ORE, HEMATITE-GOETHITE, SIDERITE

Abstract number: N 6.19

ACID RAIN AND COS OF THE NORTHEASTERN REGION OF POPOCATEPETL

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The effect of acid rain on ecosystems is presented through indirect mechanisms such as the acidification of the soil this paper will serve as a generator of knowledge of the levels of pollution in this region (taking the rain as an indicator of) air quality) seeing the possible interactions between rain and the COS will allow to establish preventive measures and implement possible measures of buffer before the degradation of soils. Methodology. Rain sampling took place during the year 2017. A soil profile is selected in each area to be sampled at two depths (0-10 and 10-20 cm) determining pH MOS (NOM-021-SEMARNAT-2000). Results. The higher acidity in rain was from July to October coinciding with the registered emissions. The MOS content is low in most troubled points and high for the preserved sites which is attributable to an effect of rain. Seen one pH ranges are within the registered for Andisols and not found a significant difference between the evaluated sites and depths. Conclusions: confirmed the presence of acid rain during 2017 with an effect on the content of organic carbon in soils.

Keywords: CARBON, ACID RAIN,VOLCANIC MEXICO

Abstract number: N 6.20

CHEMICAL CHARACTERISTICS OF DIFFERENT HUMUS OF EARTHWORMS, THEIR IMPORTANCES IN THE FERTILITY AND STRUCTURING OF SOILS IN A MAINTAINABLE PROCESS

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The use of the organic matter in decomposition as remains of fruits green vegetables as food for earthworms in arable areas or no as well as the sewer mud and other disposable organic matters can be used for the production of humus of earthworms an excellent organic fertilizer quickly usable in several vegetable cultures being also an important maintainable process being obtained an organic fertilizer capable to provide improvements in the qualities physics chemistry and biological of the soil. Besides the action of the earthworms in the soil can promote better aeration facilitating the penetration of the roots and contributing in his/her development; they guarantee the porosity of the soil and they aid in the decrease of erosions avoiding the degradation and the loss of nutrients there presents besides aiding in the structuring of the soil and in the readiness of minerals. The present work had as objective the study of the chemical characteristics of the humus produced by earthworms treated with rabbit manure ovine horse ox ostrich and chicken separately where it was researched the personal computer quality and macronutrients. The results demonstrated a high concentration of minerals in all of the obtained humus assuring the viability of the use of those humus as organic fertilizer of excellent quality.

Keywords: HUMUS OF EARTHWORMS, ORGANIC FERTILIZER, STRUCTURING OF THE SOIL, FERTILITY, SOIL OF CHEMISTRY

Abstract number: N 6.21

HOW INTERNAL STRIGOLACTONES LEVELS AFFECTS PHOSPHORUS ACQUISITION EFFICIENCY IN WHEAT

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Inorganic phosphorus (Pi) fertilizers are expected to become scarce in the near future; so, breeding for improved Pi-acquisition related root traits would decrease the need for fertilizer application. Strigolactones are a novel class of plant phytohormones that have been shown to function as regulators of plant development/architecture and as signaling molecules in the rhizosphere to recruit arbuscular mycorrhizal fungi. Thus, it can be an important trait to be considered in breeding programs. This work aimed to analyze the SL content in two commercial wheat cultivars (Crac and Tukan) with contrasting Pi-acquisition efficiencies and their relationship with Pi-starvation responses. For that, one week of Pi-deprivation was applied to 3-week-old plants grown under hydroponic system. Before harvest, synthetic SL (GR24) were spiked on half of the plants of each treatment reaching a final concentration of 10 nM and let grow for another day. After harvest, SL content in roots was determined by germination bioassays and UHPLC, and gene expression of SL biosynthesis pathway (TaD27 and TaCCD8) and two phosphate transporters (TaPht1;2 and TaPht1;10) by qPCR analysis. SL levels of both plants were induced by Pi-deprivation. Crac presented higher internal levels regardless of the Pi treatment, being 80% higher under Pi-deprivation. Expression of TaD27, TaPht1;2, and TaPht1;10 were increased in both genotypes under Pi-starvation, being the highest levels observed in Crac. SL spiking affected both genotypes differently: increasing Tukan basal low responses for one side, and lowering Crac high responses on the other side. Based on this differential

response we propose that Pi-starvation responses related to SL signaling depends on a concentration range for optimal responses; increasing SL signal in less efficient genotypes would increase Pi-responses, while further increase SL signal, which is already on the optimal range would hamper the responses.

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