The Abdus Salam
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for Theoretical Physics

College on Soil Physics

25 February - 1 March 2013

List of ABSTRACTS

30th Anniversary
1983-2013

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PROCESS OF WEATHERING AND SOIL FORMATION ALONG THE EAST COAST, TAMIL NADU, CHENNAI TO CUDDALORE

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Some rock types around Chennai, Tamilnadu, exhibit different weathering patterns and these can be related to the climate and bedrock. In the present study, weathering types and tafoni have been studied from different sites: Pallavaram, Trisulam, Chennai Fort, Kovalam, Chengalpattu, kancheepuram, Mamallapuram which are formed from different parent rocks. The soils formed over different bedrock are vertisols which form a thin veneer draping the bed rocks. In order to assess weathering patterns and soil formation, soil physical properties such as bulk density, porosity, water content, volumetric water content, and water filled pore space were studied. It was noted that at Kovalam, very close to the sea the soil bulk density varies from 0.41 to 2.30 g/cm^3, the soil porosity varies from 0.13 to 0.43%, soil water content varies from 0.02 to 0.17g/g the volumetric water content varies from 0.03 to 0.22g/cm^3, soil water filled pore space varies from 4.05 to 171.53%. Around Chengalpattu region, nearly 65kms from the coast; the soil bulk density varies from 1.55 to 1.92 g/cm^3, the soil porosity varies from 0.22 to 0.41%, soil water content varies from 0.05 to 0.14 g/g, the volumetric water content varies from 0.08 to 0.24 g/cm^3, soil water filled pore space varies from 21.62 to 157.14%. In the Vennaugupattu area soil bulk density varies from 1.09 to 1.80 g/cm^3, the soil porosity varies from -36.08 to-51.65%, soil water content varies from 0.13 to 0.14 g/g, and the volumetric water content varies from 0.02 to 0.24 g /cm3. In the Pommiyarpalayam area bulk density varies from 56.32 to 103.02 g/cm^3, the soil porosity varies from 31.47 to 63.34%, soil water content varies from 0.01 to 1.19 g/g, the volumetric water content varies from 0.01 to 1.66 g/cm^3, soil water filled pore space varies from 0.00 to 0.00%. In the Cuddalore district Thiruvandhipuram area the soil bulk density varies from 57.12 to 97.34g/cm^3, the soil porosity varies from -30.26 to -64.33%, soil water content varies from 0.00 to 0.24 g/g, the volumetric water content varies from 0.00 to 0.46 g/cm^3, This area have a very less soil water filled pore space. The rock types and the vertisols exposed very close to sea are highly weathered. While away from the sea these are still in the process of alteration. The weathering processes near the sea front are also affected by sea salt water splays causing intense salt weathering along the coast.

Key words: Weathering, Tafoni, rock, salt, Chennai, Soil physical properties.

Application of fractal geometry and aggregate stability index to quantify soil aggregate stability as influenced by tillage and topography

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Abstract: In this research, the effects of tillage type and topography on soil aggregate stability were investigated. Soil samples were collected from two adjacent fields, one under up-down and the other under contour tillage, on a north- and south-facing hillside. For each face-field, three slope positions were selected and sampling was performed with three replicates from two depths of 0-15 and 15-30 cm. Soil samples were analyzed for their chemical and physical properties. Mean weigh diameter (MWD), geometric mean diameter (GMD), fractal dimension (D) and aggregate stability index (ASI) were determined as aggregate stability indices. Result of statistical analysis showed that slope aspect and position had just significant effects on ASI index, while tillage type had significant effects on all aggregate stability indices. Apparently more rate of organic matter in north face is a reason for more aggregate stability in this face. Fractal dimension, MWD and GMD showed high correlation to each other while had not any correlation with ASI. There was also a correlation between ASI and carbonate calcium equivalent. To do a spatial analysis of soil properties, 20 soil samples were taken from the middle slope positions of both hillslope faces along contour lines with 10 m interval. The results of this analysis showed a spatial dependency of soil properties along contour lines. This means that any comparison between adjacent fields to study the effects of cover or cultivation management on soil properties would consider this spatial variability.

Keywords: contour tillage, conventional tillage, organic matter, spatial variability.

A study of the Modified Fournier Index for the North Western Plain in Trinidad W.I.

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Abstract:

In the tropical island of Trinidad which is situated in a geographic cell of 10 to 11 ° North latitude and 61-62° West longitude, the Modified Fournier Index Approach was investigated. This established Index is an alternative approach to the standard soil erosivity R factor for data sparse regions such as the tropics. In this study, the available monthly datasets of 6 stations, which span an area of 400 km^2 in the Caroni Plain, Trinidad, was used to calculate the annual MFI. This was then categorized according to the CORINE classification system. In addition to the MFI classification, for each pluviometeric station, the annual MFI best fit probability distribution was determined using statistical Anderson- Darling Test at a significant level of 0.05. It was found that the MFI ranged from 117 to 342. These indices were classified into two levels: high and very high. Also, the best fit probability distribution for all the stations was grouped into two categories. One of these distributions was lognormal for station 1, 4 and 5 and the other was normal for 2, 3 and 6. These results indicated that this region was extremely vulnerable to rainfall aggressiveness.

Acknowledgement: The authors would like to recognize the Meteorological Office of Trinidad and Tobago, the University Field Station and Ms. Beharry of the EPL, Department of Physics for the monthly precipitation data for this study.

Keywords: MFI, soil erosivity, Trinidad, Anderson Darling Statistics.

EFFECTS OF TILLAGE SYSTEMS ON SOIL PHYSICAL PROPERTIES IN THE SOUTH OF BRAZIL

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Plowing and applying high fertilization rates at soil preparation affect soil properties of intensive strawberry production systems, resulting in temporal variations of physical, hydric and chemical attributes throughout the crop cycle. This work had the objective of assessing and understanding the temporal changes of physical, hydric and chemical soil attributes during the strawberry production cycle in Turuçu, RS, Brazil. Soil samples with undisturbed and disturbed structure were collected in the 0,00-0,20m top layer of 15 strawberry production areas at four different times to determine the following variables: aggregate mean weight diameter (MWD) and aggregate size distribution; total porosity (TP), macroporosity (MA) and microporosity (MP); soil water retention curve (SWRC), "S" parameter and available water capacity (AWC); pH, electrical conductivity of saturation extract (ECe), potassium, sodium, calcium and magnesium (determined in soil saturation extracts); and, available water capacity considering soil salinity (AWCs), calculated considering both ECe and SWRC in a combined approach through Groenevelt's model. The results have shown that although soil pore-solid relations are expected to adjust soon after seedbed construction, their variation was only evident after > 13 weeks. Even though values of TP and MA decreased with time, all the soils maintained their capacity to support root activity as indicated by critical values of Dexter's index (S > 0.03). The amount of relatively large aggregates (9.51–2.00mm) and AWC increased towards the end of the strawberry cultivation cycle, improving soil physical quality, in the way that strawberry development was benefitted. Considering ECe values, they were particularly high during the first crop stages, as a result of heavy fertilization at soil preparation, reducing water availability to strawberry plants. This study allows the recommendation for modifications on: a) fertigation strategy: if strawberry farmers gradually increase the amount of water through fertigation to a maximum value occurring at the end of crop cycle instead of applying water at a constant rate, water and energy use efficiency in agriculture would improve; b) soil fertilization strategy: by reducing fertilization rates at soil preparation and consequently increasing nutrient application through fertigation during strawberry fructification, where the crop shows higher nutrient extraction rates, it is possible to acquire lower ECe at early crop development. This approach might not only benefit initial strawberry development, but also increase fruit productivity and improve the use of water and nutrients in intensive strawberry production systems.

Effect of solute concentration on hydraulic property of three sodic soils

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ABSTRACT

Salt-affected soils deteriorate as a result of changes in soil reaction (pH) and in the proportions of certain cations and anions present in the soil solution and on the exchange sites. A laboratory study was carried-out to evaluate the water retention and transmission behavior of three waterlogged sodic soils; and to study the effect of water salinity on saturated hydraulic conductivity of three soils. The three sodic soils had ESP of 16.3, 70.5 and 27.4. Very high degree of dispersion (67.2 to 80.9 %) was observed in these soils. The pH ranged from 9.06 to 10.92 in soil-water suspension and from 8.25 to 10.0 in saturation paste extract. The highest ESP plot (70.5) had pH value of 10.92 in soil-water suspension. Sodicity had marked influence on water retention and various water constants. No change was observed in drainable water, but the available water was considerably influenced by soil sodicity. Concentration and composition of the water flowing through the soil showed a marked influence on saturated hydraulic conductivity of sodic soils. Passing 1 *M* solution each of NaCl, $CaCl_2$ and $MgCl_2$ gave hydraulic conductivity in the order $CaCl_2 > MgCl_2 >$ NaCl. Thus the Ca^{2+} salts had positive impact in improving the hydraulic conductivity of sodic soils. Passing of mixed salt solutions through these soils also resulted in varying hydraulic conductivity. A water with SAR 5 m $mol^{1/2}$ $L^{-1/2}$ and TEC 50 me L^{-1} resulted in higher saturated hydraulic conductivity as compared to SAR 50 m $mol^{1/2}$ $L^{-1/2}$ and TEC 5 me L^{-1}. Unsaturated hydraulic conductivity and soil-water diffusivity also revealed the same trend. Results clearly showed that waterlogged sodic soils are difficult to manage as the high amount of exchangeable sodium deteriorates soil structure and make soil prone to dispersion. For reclaiming these high-ESP soils, Ca^{2+} salts are necessary. Results also hint towards a possibility of use of saline waters on these highly sodic, impermeable soils. It is evident from the results that these soils can be ameliorated by physical, chemical and biological means.

Key words: Saturated hydraulic conductivity, Water retention, Sodicity, Sodium adsorption ratio, Total electrolyte concentration.

CARBON STOCKS IN SOILS OF TURKEY

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Emission of CO_2 influences climate change through its effect on the radiative forcing (IPCC,2007).The global carbon (C) cycle involves a continuous exchange of CO_2 among global reservoirs comprising of the atmosphere, ocean, and land through biotic processes moderated by microorganisms, plants, and animals and some abiotic processes in theses ecosystems. The C –sink capacity of two land-based reservoirs (soils and vegetation) is affected by anthropogenic activities. Drastic changes in land use and the attendant degradation of soil quality have depleted the C reserves in managed ecosystems of Turkey. Thus, soils of Turkey have low organic matter reserves. Therefore, there exists a vast potential to sequester C through restoration of soil quality and improvement in vegetation cover of different biomes of Turkey. Research results showed that, if proper cultivation and management systems are used cultivated soils can have a greater potential to restore atmospheric carbon dioxide (CO_2). Although Turkey has a enormous vegetative diversity and high agricultural potentiality it faces a dilemma of soil degradation salinization and desertification issues. For this reason the proportion of carbon sequestration in soils has a great importance for contribute to mitigation of greenhouse gasses emission and soil fertility.

Many factors such as climate, topographical features, vegetation, soil and soil management practices affect the organic carbon storage in forests, agricultural fields and in terrestrial systems including soil and plant. For these reasons, the effects of these factors must be considered in computing the amount of carbon in terrestrial ecosystems.

The aim of this study is to determine the surface soil organic carbon contents in the soils of Turkey under four different climate zones and to recommend new approaches to agricultural land use on the soil management systems in relation to

the current carbon reserves. For this reason, the organic carbon reserves were calculated for the different climate zones in Turkey as follows:

- Arid Climate zone has a total area of 1 528 750 ha.
- Semi-arid climate has a total area of 5 094 332 ha.
- Humid forest climate zone which includes transitions regions has total area of 23 779 962 ha.
- Mediterranean climate zone have total area of 2 841 801 ha.

Except for the climate zones the vertisols, alluvial soils etc. have a total area of 19 232 855 ha. The surface soil organic carbon contents were calculated as 42.8, 136.13, 806.14, 84.68 and 579.98 Tg respectively in arid, semi-arid, humid forest, Mediterranean climate and for other soils. As a result the total organic carbon contents of the surface (0-20cm) soils include 1649.73 Tg.

Results showed that the highest content of organic carbon takes place in soils located in the humid forest climate zone. The stock of organic carbon is estimated as 7.72 Pg (Amthor, 1998) and 6.8 Pg (Sakin, 2010). When the stock of organic carbon in surface soil was compared with these results, it can be concluded that the surface soils have lower organic carbon stock. The lower organic carbon content in the surface soils can be attributed to the current soil management systems e.g. conventional agricultural production practices.

RUNOFF AND EROSION SIMULATION IN CASE OF TORRENTIAL FLOOD WAVE FORMATION

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Abstract: Torrential (flash) floods occur in natural channels or watercourses with a small watershed, steep and irregular sections, extreme oscillation of the runoff with high peaks after rainstorms and snowmelt, high sediment transport and sedimentation. Specific characteristics of climate and relief, soil type and vegetation cover as well as changes of social-economical conditions such as population migration and land use perform a wide range of factors for torrential floods occurrence in Central Serbia. The annual distribution of precipitation is unfavourable, the circumstances are such that they occur mainly in the form of heavy rainfalls which result in sudden water concentration having torrential floods as a consequence. Many field experts agree that discharges with recurrence period of 100 years become events with recurrence interval of 20 years as a consequence of global changes.

The processes taking place within the torrential watersheds are directly and nearly simultaneously manifested in the hydrographic network and the most important ones are the surface runoff (overland flow) and the soil erosion processes, which products (water and sediment) enter the watershed hydrographic network and continue their movement as a two-phase fluid. Since the intensive precipitation in a watershed represents the main cause of both processes, the geneses of flood waters and the large masses of eroded sediment are simultaneous. For the simulation of torrential flood wave occurrence under existing conditions and examination of the threshold of torrential flood occurrence, usage of models SHETRAN is envisaged. In this way it is possible to describe the hydrological and psamological behavior of the watershed during formation of torrential flood wave, therefore to show water and sediment movement on the surface and through hydrological network, surface runoff through unsaturated and saturated soil, taking into account and simulating the processes of interception and evapotranspiration as well.

Key words: runoff, erosion, sediment, torrential flood

Estimation of soil water evaporative loss after tillage operation using stable isotope technique

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Abstract

Application of stable isotope in soil studies has improved quantitative evaluation of evaporation and other hydrological processes in soil. This study was carried out to determine the effect of tillage on evaporative loss of water from the soil. Zero tillage (ZT) and conventional tillage (CT) were used. Suction tubes were installed for soil water collection at the depths 0.15, 0.50 and 1.0 m by pumping soil water with a peristaltic pump. Soil water evaporation was estimated using stable isotopes of water. The mean isotopic composition of the soil water at 0.15 m soil depth were -1.15‰ ($\delta^{18}O$) and -0.75‰ ($\delta^{2}H$) and were highly enriched compared with the isotopic compositions of the site's precipitation. Soil water stable isotopes ($\delta^{18}O$ and $\delta^{2}H$) were more enriched near the surface under CT while they were less negative down the profile under ZT. This suggests an occurrence of more evaporation and infiltration under CT and ZT, respectively. The annual evaporation estimated using the vapour diffusion equation ranges from 46-70 mm year^{-1} under ZT and from 54-84 mm year^{-1} under CT indicating more evaporation under CT compared with ZT. Therefore, to reduce soil water loss, adoption of conservation tillage practices such as zero tillage is encouraged.

Keywords: evaporative loss, tillage, isotopic fractionation, isotope technique,

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Methodological approach for the assessment and monitoring of desertification indicators (II)

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ABSTRACT

This study aims to formulate an integral methodological proposal to the evaluation and monitoring of indicators of desertification, that will be constitutes a practical tool for the assessment of this problematic at the regional and local levels. The formulation starts with a conceptual and contextual analysis of the state of art of desertification indicators, protocols and normativity at the global, national and local level, used for its evaluation and monitoring. The general structure has four stages: 1. Analysis of the conceptual and spatial framework: leads to a preliminary assessment of the study area, to delimit integral analysis units of desertification (IAUD). 2. Diagnostic of integral analysis units of desertification: that allows the generation of the basic model of operation of the system, for the identification and analysis of degradation processes and dominant variables. 3. Identification of indicators of desertification: serves the recognition, categorization, classification and evaluation of biophysical and socioeconomic indicators from dominant processes of degradation and according to the structural model PSR (pressure, state, response), based on reference data and critical points. 4. Integral analysis of desertification: allows characterization of integral analysis units of desertification (IAUD), differentiating areas with higher vulnerability to desertification or "hot spots" of areas less vulnerable or "bright spots". This methodology is part of the project "indicators of desertification risk in areas of the Valley of Cauca - Colombia" and is applied to a case study in the municipality of Palmira (Colombia) and be expected to contribute in the planning of conservation strategies and sustainable resource use in zones vulnerable to desertification.

Keywords: Indicators, land degradation, climate change.

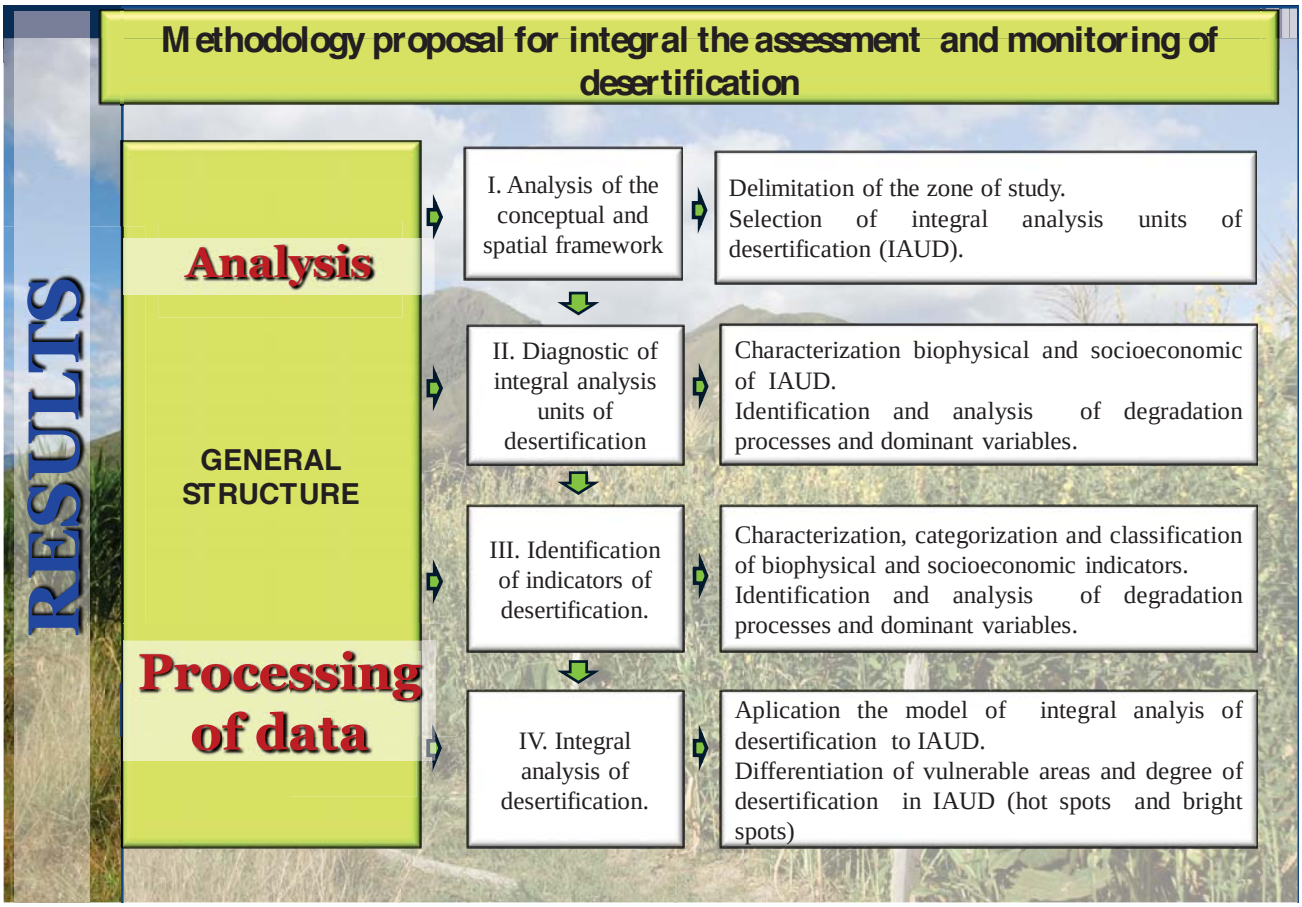

Figure 1. General structure of methodological approach for the assessment and monitoring of desertification indicators.

Effects of Olive mill waste water on the soil proprieties and barley yield

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Abstract

Olive oil extraction produces large amounts of waste water, known as olive mill waste water (OMWW) "Margines". This sludge has a high chemical oxygen demand and contains high level of phenolic compounds and is therefore a cause of environmental pollution. The exploitation of this waste without preliminary treatment is very limited considering its toxicity for soils and plants. In Tunisia, 700,000 tons of Margines, produced annually, are generating many types of pollution. They are dried in special basins and then put in heap to be used as compost while an important fraction of the product is poured directly in the natural channel (*wadi*) beds.

It is within this framework that this work has been carried out aiming at finding new technologies or processes for the treatment and the valorisation of this effluent. The spreading of Margines on sandy soil in Southern Tunisia represents an interesting alternative for this sewage .The major aim of this study was to investigate the use of Margines as a fertilizer for Barley cultivation. In fact, the application of 50 (T1), 100 (T2) and 200 (T3) m^3/ha of this wastewater resulted in a significant improvement of the soil fertility. Indeed, the ratio carbon/nitrogen increased from 9 for the control to more than 22 for the T3 treatment. The potassium content showed also a considerable improvement (From 300 mg/kg for the control to more than 1988 mg/kg for the treatment T3). Because of its binding and hydrophobic effects, the application of Margines resulted in a more stable soil and created mulch reducing the losses of water evaporation.

Regarding the production, compared to the control and after the spreading operation, a decreased seed yield has been recorded. In fact, compared to the control (1262.2 Kg/ha), the seed yield recorded a clear decrease for the treatment 100 m^3/ha (762.9 Kg/ha) and 200 m3/ha 362.2 Kg/ha). However, treatments of 50 m^3/ha recorded a light increase (1362, 2Kg/ha) without being statistically different from the control. It was concluded that the Margines applied with high doses (100 m^3/ha and 200 m^3/ha) reduce the production whereas the low doses (under 50 m^3/ha) improve the soil characteristics. Then, it is recommended that the Margines can be applied with amounts less than 50 m^3/ha for Barley cultivation.

Key words: margines, soil, Barley, seed yield.

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1-Introduction

Olive oil extraction produces large amounts of waste water, known as olive mill waste water (OMWW). This effluent has a high chemical oxygen demand, contains high level of phenolic compounds, and is therefore a cause of environmental pollution. The exploitation of this waste without preliminary treatment is very limited considering its toxicity for soils and plants. In Tunisia, 700,000 tons of OMWW, produced annually, are generating many types of pollution. They are dried in special basins and then put in heap to be used as compost while an important fraction of the product is poured directly in the natural channel beds (wadi). However, the richness of that sludge in mineral and organic compound raised to investigate other techniques to valorise this residue in agronomy. This work fits into this context and aims to study the impact of the spreading of OMWW on the physical and chemical soil properties and its effects on crop yields (Case of barley).

2-Materials and Methods

Experimental site: The experiments were conducted in the CFRA farmer which is located in the zone of El FJE, Medenine governorate.

Soil: It is a typical soil for the arid southern Tunisia which is characterise by a low content organic matter and a sandy texture. The soil is also characterized by a high level of the electrical conductivity which increases with the depth. Indeed, this parameter increased from 5 dS/m in surface layer to more than 8 dS/m in depth (see table 1). This salinity increase can be explained by an increase in the soil gypsum content since the bedrock is formed by the miopliocene clay and gypsum at the horizon 70-80cm.

Margines: This sludge was obtained from a local olive oil manufacture. Physical and chemical characteristics of the used effluent are presented in Table 2.

Plant materiel: The plant material is used with 2 barley varieties: Arthaoui (Hordeum vulgare) and Pakesteni (Introduced variety).

Depth (cm)	C	S	S*			Initial EC(ds/m)	CaCO3 Total (%)	Gypsum (%)	Organic matter (%).	pH
0-25	3,57	5,20	69,43	17,77	6,65	5,67	5,55	0,37	0,92	7,11
25-50	3,77	6,20	63,78	5,13	5,43	7,99	8,33	1,5	0,88	7,23
50-75	4,88	7,25	53,45	29,54	6,79	8,79	8,33	3,45	0,54	7,15
75-100	4,07	6,21	62,22	24,14	6,29	7,48	7,40	1,77	0,78	7,16

Table 1: The main physical and chemical characteristics of soil.
C=Clay; S=Silt; S*=Sand.

Table2: Principal physical and chemical properties of Margines used

pH	DR (%)	OM (%)	MM (%)	EC (ds/cm)
4,77	30	83	17	16,61

DR=dry matter; OM=Organic Matter; MM=Mineral Matter; EC=Electrical Conductivity.

Experimental design: The adopted experimental design is the randomized block with 4 treatments of *Margines (Control treatment: **T0=0m^3/ha; T1=50m^3/ha; T2=100m^3/ha; T3=200m^3/ha**)*, 2 varieties of barley **(*Arthaoui* and *Pakesteni*)** and 3 replications.

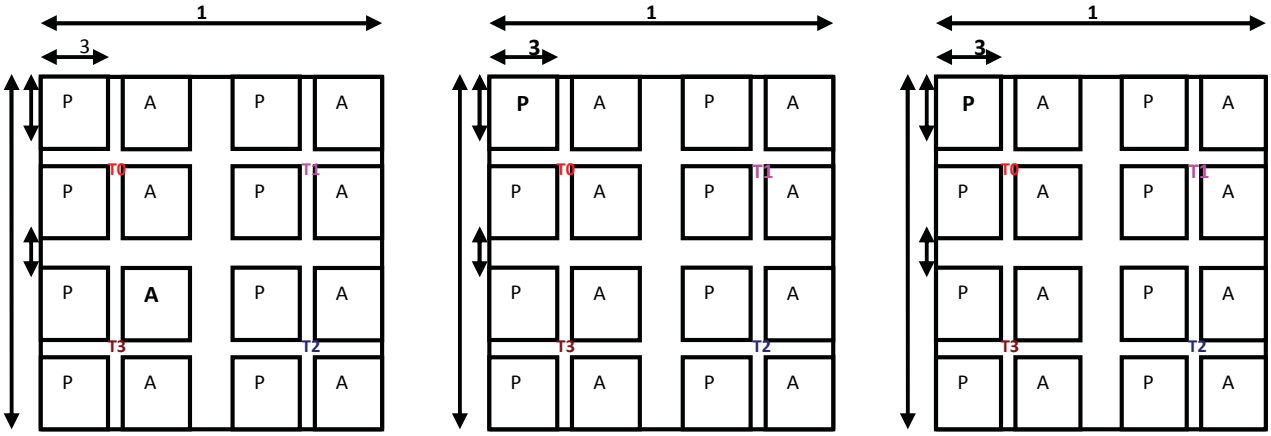


Fig1: Experimental design.

Studied parameters:

Effect of Margines on chemical and physical soil properties (organic matter, K exchangeable , electrical conductivity, pH and soil content in Sodium, Chloride and Sulfate).

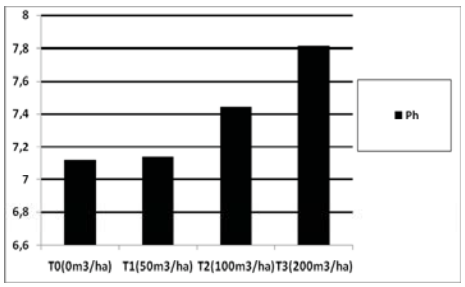
*Evaluation of Barley yield.

Statistical analysis:

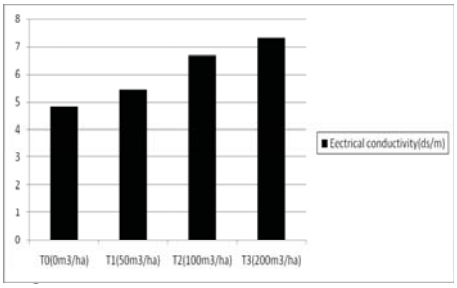
All statistical analysis was conducted using the SAS System for Windows version 9.00.

3-Results and discussion:

-Effect of OMWW on chemical and physical soil properties:



(a)



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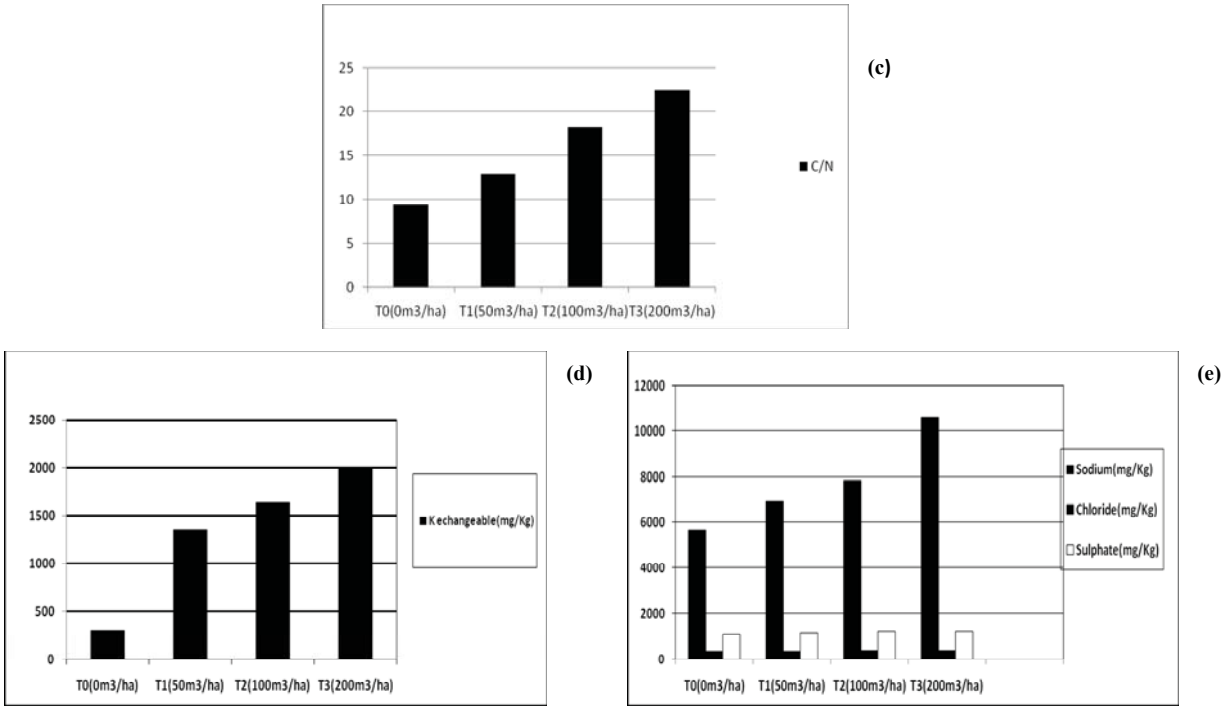
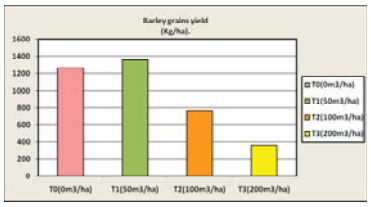


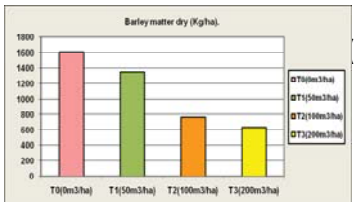
Fig. 2: Effect of OMWW on soil pH **(a),** on soil electrical conductivity **(b),** on soil ratio Carbon/Nitrogen **(c),** on soil K exchangeable concentration **(d)** and on soil Content in Sodium, Chloride.and Sulphate **(e).**

Margines application does not affect the soil pH because of the high concentration in limestone making a power buffer for the incorporated acidic products in the soil. The application of Margines on alkaline and limestone soils, frequent in the Mediterranean areas, do not affect the soil pH (Levi-Minzi et al 1992). Spreading Margines leads to a significant increase in soil salinity. Indeed, from an electrical conductivity less than 5 dS/m (The Control), the soil salinity increases to more than 7 dS/m for the plot that received the highest dose (T3: 200 m3/ha). The difference is statistically significant especially for higher doses (T2 = 100m3/ha and T3 = 200m3/ha).Sodium increases with the administrated Margines doses. Compared to the control (5662 mg/Kg), the Sodium content showed a considerable improvement for the treatment T2: 200 m3/ha (7837, 83 mg/Kg) and T3: 200 3/ha (10640, 8mg/Kg). However, Chloride and Sulphate recorded an increase in soil without beingstatistically different for the control. The rate of organic matter increases with the doses administrated. Indeed, the ratio carbon/nitrogen increases from 9 for the control to more than 22 for the T3 treatment. The potassium content showed also a considerable improvement (From 300 mg/kg for the control to more than 1988 mg/kg for the T3 treatment). Because of its binding and hydrophobic effects, the application of Margines resulted in a more stable soil and created mulch reducing the losses of water evaporation. The application of 50 (T1), 100 (T2) and 200 (T3) m3/ha of this wastewater resulted in a significant improvement of the soil fertility (Taamallah 2007).

-Effect of Margines on Barley yield:



(I)



(II)

Fig3: Effect of spreading Margines on Barley grain yield dry **(I)** and dry matter **(II).**

The results showed that the yield of both grain and dry matter was affected by Margines supplies. Regarding the production, compared to the control and after the spreading operation, a decreased grain yield has been recorded. In fact, compared to the control (1262.2 Kg/ha), the grain yield recorded a clear decrease for the treatment 100 m3/ha (762.9 Kg/ha) and 200 m3/ha 362.2 Kg/ha). However, treatments of 50 m3/ha recorded a light increase (1362, 2Kg/ha) without being statistically different from the control. The application of Margines has affected also Barley dry matter yield for treatments 100m3/ha(T2) and 200m3/ha(T3). Margines cause a light decrease of dry matter production for respectively 100m3/ha and 200m3/ha treatment (768,3Kg/ha and 637Kg/ha) compared to the control (1600Kg/ha).

Conclusion:

Containing many nutritive elements leading to an improvement of agricultural production, Margines can be considered as a fertilizer for Barley cultivation. Indeed, used with amounts less than 50 m3/ha, Margines do not present any risks for the soil salinity, the phenolic substances concentration, the potassium content and acidity. In addition, they generate an improvement of some physical and chemical soil properties and an increase in the barley yields whereas a spreading with strong amounts of the Margines causes an ionic imbalance and an increase in the soil salinity. It was concluded that the Margines applied with high doses (100 m3/ha and 200 m3/ha) reduce the production whereas the low doses (less than 50 m3/ha) improve the soil characteristics. It provides an economically acceptable production alternative for Barley cultivation and can reduce the problems caused by this sludge.

Bibliographic references :

Taamallah .H 2007=L'épandage des Margines en vergers d'oliviers =une alternative pour la valorisation de cet effluent.

Levi-Minzi R.,Saviozzi A.,Riffaldi R.,et Falzo L., 1992=L'épandage au champ des eaux de végétation ,effets sur les proprietés des sols Olivae (40) pp 20-25.

Soil-water-climate management systems in ancient cultures of Tropical Latin America

Fernando DELGADO

Venezuela

Since ancient times and in different parts of the world, the man has had the need to adapt to extreme land conditions to establish and to produce the food that they require. This presentation shows some examples of land use with extreme soil, water and climate limitations, in which ancient cultures of Tropical Latin America, on the basis of natural phenomena observations, have developed ancient techniques to adapt successfully and to produce food in such extreme conditions.

Examples of this, are the techniques of land use with excess of water, such in condition of high lands as well as in low lands: the use of the "Waru-Waru" in the Bolivian and Peruvian High Plateau (Altiplano), and the "Chinampas" in Mexico are examples for high lands and temperate climate, while the raised beds, mounds and drainage channels are examples of successful techniques used in the low lands and tropical climate of Venezuela, Colombia and the Bolivian Amazonia.

In the case of land with water scarcity, the use of the temporary lagoons system ("Qochas") to produce successful crop in land and with shortages water and cold weather have solved the food production near Lake Titicaca in the Bolivian Altiplano.

Finally, we highlight the use of terraces or "Andenes" for the successful and sustainable use of steep lands, based on the construction of structures designed to face severe limitations of topography, soils and climate.

IMPACTS OF FOREST HARVESTING OPERATIONS ON THE COMPACTION OF SOME SOIL CLASSES CROPPED WITH EUCALYPTUS

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ABSTRACT

The main source of soil structure degradation in forestry exploration is the traffic of the machines used in forest harvesting operations because they may cause soil compaction that affect the forest development. The hypothesis of this study is: the susceptibility to compaction and the compaction caused by forest harvesting operations differs in relation to the texture and can be determined through the load-bearing capacity models and precompression stress determined after the forest harvesting operations. The objectives of this study were a) to determine the susceptibility to compaction of some soil classes with different textures through the load-bearing capacity models and b) to determine by the use of these models and the precompression stress determined after forest harvesting operations, the number of passes of the equipment used in the forest harvesting that promote greater soil compaction. The uniaxial compression tests were performed using undisturbed soil samples collected in the layers of 0-3 cm and 10-13 cm of two typic dystrophic Red Latosol (LVd1 and LVd2) and an dystrophic Red Argisol (PVd) located in Capão Bonito, SP and a typic dystrophic Latosol (LVd3) and an dystrophic Red Latosol thick sandy (LVd4) located in Três Lagoas, MS. Soil sampling consisted of two phases, before and after the harvest operations. The assessments involved quantification of the impacts of harvest operations of eucalyptus trees made with Harvester and Feller Buncher and the wood transport made with Forwarder and Clambunk through the precompression stress determined after these operations. The soil classes of Três Lagoas, MS were more susceptible to compaction than the soil classes of Capão Bonito, SP. The use of the load-bearing capacity models and of the precompression stress determined after harvest operations and wood transport allowed to identify the number of passes greater than two of the Harvester and greater than six of the Forwarder; of the Feller Buncher equal to one and of the Clambunk equal to two as being the number of passes that promoted further structure degradation of the soil classes cropped with eucalyptus due to the fact that these number of passes have caused greater soil compaction .

Key words: Structure degradation, soil compaction, traffic, and precompression stress.

Pressure heads and simulated water uptake patterns for a severely stressed bean crop

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Abstract

In modeling, actual crop transpiration as a function of soil hydraulic conditions is usually estimated from a water content or pressure head dependent reduction function. We compared the performance of the empirical pressure head-based reduction function by Feddes (FRF) and a more physically based reduction function using matric flux potential as main parameter (DRF), both available in the SWAP ecohydrological model. Model performance was evaluated by comparison of SWAP predictions and observed water contents and pressure head values in a field experiment with a Common Bean crop. For more than 50 days no rain occurred and the soil reached very dry conditions, pressure heads being of the order of -100 to -150 m. SWAP/DRF predicted values of pressure head and water content were less sensitive to root length density distribution than SWAP/FRF. No improvement of predictive performance could be identified when varying wilting pressure head. Root water uptake distribution over time and depth simulated with SWAP showed very different patterns depending on the reduction function used. Root water extraction estimated by SWAP/FRF showed smooth transitions in time and between layers, whereas SWAP/DRF, highly sensitive to hydraulic conditions, generally predicted uptake to be concentrated at a few depths. The order of magnitude of pressure head difference between root xylem and root surface, based on SWAP/DRF predicted uptake rates, root length density and reported values of root conductance was the same as the order of magnitude of the limiting root water pressure head, implying in the necessity to include root hydraulic resistance in the DRF.

Response of Sunflower Crop to Plant Spacing under Different Irrigation Regimes at Gezira Clay Soil. Sudan

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Abstract

The major agricultural use of water is for irrigation, which, thus, is affected by decreased supply. It is necessary to develop new irrigation scheduling approaches, not necessarily based on full crop water requirement, but ones designed to ensure the optimal use of allocated water. The experiment was conducted at Gezira Research Station, WadMedani, Sudan, in a randomized complete block design with three replications. In this study irrigation interval 10 days (W1), 15 days interval (W2) and 20 days interval (W3) were applied to study the effect of the deficit irrigation on yield and yield components of sunflower hybrid (Hysun 33) during the summer season (rainy season) 2012 and two plant spacing 30 and 40 cm. The results showed that the yield obtained from Irrigation every 15 days with spacing 30 cm (3654 kg/ha) was better than irrigation every 10 days (W1) with spacing 40 cm (3105 kg/ha) and irrigation every 20 days (W3) and plant spacing 30 cm (2425 kg/ha) .Total water applied during the growing season to W1 , W2, and W3 were 11634, 8912 and 7893 m^3/ha for spacing 30 cm and 11445, 8778 and 7123 m^3/ha for spaceng 40 cm respectively.

Keywords: Sunflower Hysun 33, Deficit irrigation, yield components, Plant spacing

Abstract

The eastern plains of Colombia covering about 26 million hectares of which 53% belong to the Orinoco well drained and the remaining to the Orinoco floodplain. The landscapes comprising include piedmont floodplain rivers altillanura orinoquenses and with different degrees of dissection. These areas, as well as extensive gallery forest margins have been traditionally used in extensive farming, with pastures of low nutritive quality and very low levels of productivity, a situation that has changed with the introduction of annual crops and modern systems of animal production.

However, detailed studies by organizations such as CIAT, COLCIENCIAS CORPOICA and field level show an increase in environmental degradation, such as increased soil erosion and loss of native species diversity as a result of the intensive use of resources and implementation of agricultural practices and proper preparation of soil and water management.

In response to questions generated in previous trials, in which, despite improved soil chemical, yields are not sustainable over time, the soil unit of the International Center for Tropical Agriculture (CIAT) in 1995 began an essay called "Yield decline" (falling yields) in the municipality of Puerto López –Meta, Ranch Matazul, to understand the causes and dynamics of the unsustainability of agriculture in the eastern plains.

These studies have confirmed that the degradation processes of these soils, are linked to the intensity of tillage primarily by the number of passes of harrow that apply on land over time, weakening the structure and giving rise to surface sealing and crusting affecting physical, chemical and biological.

Genesis and Characteristics of Regosols and Calcisols in the Hills of the South Danubian Plain

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Abstract

The primitive and shallow soils in the zone of Chernozems in Bulgaria occupy about 21% of the zone's area (Koinov et al., 1972). These soils have important ecological significance as they are susceptible to soil degradation processes. The aim of the study was to characterize the morphological, chemical, and physical properties and formation factors of the Regosols and Calcisols in Northern Bulgaria. The soil survey included 17 soil profiles from the region Lom-Svishtov.

Regosols and Calcisols in Northern Bulgaria are characterized with a weakly developed process of soil formation, shallow profile with primary AC structure, as well as no diagnostic horizons, except one calcic horizon in Calcisols. Profile development is minimal as a consequence of young age or slow soil formation. Most of Regosols and Calcisols correlate with the old Bulgarian soil classifications and are classified as eroded Chernozems. In the hilly region of the South Danubian Plain, Regosols and Calcisols are widespread in semi-arid areas on slopes and eroded terrains. These soil types lay-over regoliths (mainly loess), and they occupy an area of 485 000 ha. The area is increasing, mainly due to improper use and erosion.

The process of degradation (mainly landslides and erosion) is especially active in the Lom-Svishtov region, closest to the Danube River. In these parts of the hilly-plain, soil formation process is slow. Slope terrain is the major ecological-genetic factor that gives influence over soil structure. Parent rock and relief create specific morph-structural forms. Loess in the plain shows alkalinity. The main components that determine soil reaction are carbonates. South Danubian Plain loess contain between 18 - 25% carbonates and their distribution in vertical depth is unequal.

According to hydrothermal data, the Plain belongs to the semiarid zone. In this zone, the insufficient rain, temperature and potential evapotranspiration are limited factors for soil development process more than 200 days of the year. It should be noted that the region has a moderate continental climate with hot summers and cold winters and with maximum precipitation in May-June period. The annual amount of precipitation (500mm) is below the average for Bulgaria. The region is characterized by communities of xerothermic vegetation like steppe grasses, shrubs and perennial vegetation.

The studied soils are not texturally differentiated, which indicates a low degree of weathering. Regosols and Calcisols have relatively coarse texture and the clay content is about 15%. Silt and sand fractions are predominant in all profiles.

The relatively good water stability of soil aggregates in the surface horizons is due to the fact that they are not cultivated and they are covered with grass vegetation. The poor structure in depth can be explained by the absence of sufficient organic compounds, and the impact of soft structureless parent rock - loess. Cases with low water stability of soil aggregates in the surface horizons indicate that soils without vegetation are threatened by erosion.

The organic carbon content is low. The average amount of organic carbon in the surface horizons is 1.06%, and decreases in depth. The average ratio $C_{humic\ acid}/C_{fluvic\ acid}$ in the surface horizon is 2.11, which indicates the humic type of humus. These features indicate the "*steppe*" formation of organic matter, despite the low content of organic carbon.

The chemical composition of the studied soil shows that they vary slightly depending on parent material. *Si-Althic* type of weathering does not increase the degree of dispersion and accumulation of clay in the soil. The studied soils are characterized by a high content of calcium, which prevails over that of magnesium.

Regosols and Clacisols soils have good physico-chemical properties. The reaction varies from neutral to slightly alkaline. CEC is high and the degree of base saturation is 100%. In all horizons, calcium ions dominate in soil absorbing complex.

The mineral composition is inherited from the parent rock. Clay minerals are mainly smecktite, ilite, kaolinite and quartz. The mineral composition of the soil is stable. Clay formation insitu is not observed, consequently, the process of soil formation is minimal.

Regosols and Calcisols are spread in areas where natural vegetation is poor. The remaining natural vegetation suggests that in the past, the Danubian Plain was almost entirely occupied by large forests and steppes in the east. The plain has been cultivated since ancient times and the result is a significant impact on the state of soils and the environment. Forest and steppe areas have been developed into farmlands, whereas other parts had never been cultivated due to slope terrain. Forest vegetation is declining almost everywhere.

In conclusion, human activity, whether directly or indirectly, has a significant influence on soil degradation processes. All of the above processes determine the formation of weakly developed soils such as Regosols and Calcisols, which directly affects the image of the modern landscape.

Effects of rock fragments cover and slope on infiltration, runoff and soil loss in an Entisol.

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Abstract

In order to evaluate the effects of rocks fragments and slope classes on infiltration, runoff and soil loss processes, an Entisol was selected in the 'Sector Cucurucho' at the Tovar municipality in Aragua State, Venezuela, with a high prevalence of particles (silt + very fine sand + fine sand) that reflects a low stability to the impact of the drops. However it shows a high stability to wetting, with the proportion of rock fragments (by weight and by volume) highly variable.

The slope and rock fragment cover classes for this study were selected through a frequency analysis resulting from the determination of slope gradients and surface stoniness, using a clinometer and a 10x10 mesh, respectively. The slope classes were: <24, 24 - 36, 36-48 and > 48%, while surface stoniness classes selected were: <14, 14 - 28, 28 - 42 and > 42%.

Infiltration rate, surface runoff and soil loss in each slope class and rock fragment cover class were evaluated in plots (20 x 30 cm) using a portable rainfall simulator applying rainfall intensities of about 100 mm h^{-1} during one hour.

The effect of slope gradient was highly significant for runoff and soil loss, but not significant for infiltration rate, even though there was a slight tendency to decrease with slopes greater than 48%. The effect of rock fragment was not significant on infiltration rate, runoff and soil loss, which can be attributed to the variable rate of rock fragments within the soil volume. We found a positive association between runoff and soil loss (R = 0,857 **), while the infiltration rate showed a negative association with runoff (R = -0,562 **) and soil loss (R = - 0,445 *).

Key words: rock fragments, runoff, infiltration rate, soil loss, Entisol

ORGANIC MATTER AND STRUCTURAL STABILITY IN A SAVANNAH SOIL UNDER CONSERVATION SYSTEMS

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Abstract

Soil organic matter (SOM) is a key attribute of soil quality, and it is including in a minimum data set to define soil quality. The interrelationship between soil structure and SOM has been widely studied; but these studies have emphasized the relationship between aggregate stability and organic matter content, regardless of their quality. In order to evaluate the effects of cover crops (CC), on organic matter and soil structural stability in conservation management systems, a field experiment was performed in an Ustoxic Quartzipsament located in Guárico state (Venezuela). Three CC treatments were evaluated, as improved land fallows for the establishing of maize no-tillage system and grazing with ovine cattle: *Brachiaria dictyoneura* (BD), *Centrosema macrocarpum* (CM), spontaneous vegetation (SV), and its comparison with the natural savannah ecosystem (NS). Samples to three depths (0-5, 5-15 and 15-30 cm), and at three dates: 0 (initial), 286, and 1463 days after the establishment (dae), were taken. Parameters related to the aggregate stability and soil organic matter quality, were evaluated: total organic carbon (TOC), fulvic acid carbon (FAC), humic acid carbon (HAC), and particulate organic matter carbon (POMC), water stable aggregates (WSA), C and N in the different fractions from stable aggregates, and weighted mean diameter (WMD). Results show the CC establishment (286 dae), produced a transient effect on savannah soil structure, which recovered its initial conditions over a period of four years. This recovery was associated with the fraction HAC. The WSA showed a hierarchical distribution, with the highest proportion in 500-250 μm size. There were statistical differences between cover crops treatments within each aggregate size fraction, and similar trends at all depths. Differences in the content of C and N in different WSA sizes for each CC were found. These differences were attributed to the quantity and quality of supplied residues.

Key words: *Cover crops, no-tillage, soil organic matter quality.*

Soil erosion processes and sediment transport mechanisms

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Abstract

Soil erosion is recognized as a serious eco-environmental threat and a land degradation problem. Modelling soil erosion contributes to understand the erosion processes and needs to describe the dynamics of eroded sediment to better understanding of sediment transport mechanisms. The particle size distribution of sediments is a key parameter that greatly affects erosion processes, sediment transport and deposition. If the factors affecting size distribution of eroded soil can be better defined, the performance of existing transport models will be improved. This study was carried out using a tilting flume to investigate the effect of different flow hydraulic conditions affecting soil erosion as well as sediment transport. The experiments were done making several flume slope gradients and inflow rates to produce various stream powers in a range that no rill was initiated. The results showed that hydraulic conditions play an important role in the selectivity of sediment transport. For the studied soil, a bimodal distribution in sediment size was observed, so that for the first peak (finer particles), suspension- saltation was found to be the dominant transport mechanism, whereas, for the second peak (larger particles), bed load was the main transport mechanism. Moreover, with increasing stream power, the selectivity of fine particles declined in order that, both fine and large particles were transported by the flow, simultaneously. In other words, at higher stream powers, the relative importance of transport as suspension decreased and other supplementary mechanisms such as rolling occurred. The findings of this research reveal that sediment size distribution can be satisfactorily attributed to transport mechanisms depend on hydraulic conditions.

EFFECTS OF A CHISEL PLOW TREATMENT AS A GRASSLAND RECOVERY SYSTEMS AT THE CARIBBEAN SOILS: A case study of Northern Colombia

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ABSTRACT

Soils and grasslands degradation is a strong constrain for livestock production systems in the low tropic of Colombia. This is reflected in low biological and economic efficiency of the production system (Mejía *et al.*, 2008; Cajas-Girón *et al.*, 2002). The effect of grassland recovery using a chisel plow system was evaluated for two years on a colosuana pasture (*Bothriochloa pertusa*) at two locations in the North Coast of Colombia. Soil properties like infiltration rate (*Ir*) and mechanical resistance (*Rm*) were assessed before treatments (to determine a baseline) and then a year later. *Ir* changed from 4.5 mm h^{-1} (low) to 19.9 mm h^{-1} (medium) and 20.6 mm h^{-1} (medium) to 81.3 mm h^{-1} (high) one year later at locations Sampues and San Pedro, respectively. The *Rm* showed a clear reduction in the first 20 cm depth at both locations, having lower values than those found before the recovery treatment, (3.5 and 2.0 MPa). The increase in *Ir* and lower *Rm* indicated a positive effect on recovery grassland and improvement of physical soil and hydrological properties. It is recommend to continue these type of evaluations, including other on recovery land and resilience of soil properties.

Key words: Grassland recovery, Soil Physic, Soil hydrology, grasslands, Livestock

MEASUREMENT OF TEMPORAL COHERENCE OF VISIBLE CW LASER SOURCES USING INTERFEROMETRIC METHODS

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ABSTRACT

The use of the Michelson interferometer to measure the coherence function for the determination of the temporal coherence of visible continuous wave Nd:YAG and Diode laser sources is presented. The application of this method is important particularly when dealing with weak coherent light sources where information about their coherence properties may be useful. Fringe patterns were formed, modulated and measured by point detection and observation on an oscilloscope and used to obtain the fringe visibility as a function of the length difference between the arms of the interferometer. The visibility function indicatively measured the modulus of the temporal coherence function of the laser sources. By Fourier transforming the square of the modulus of the temporal coherence function, the auto – correlation of the frequency distribution of the laser sources were obtained.Their mode structures, coherence lengths and coherence times were then estimated from this distribution. The results also showed a steady decrease of visibility as the length difference between the arms of the interferometer was made very large for both sources, which is consistent with theory.

Key words: Fringe visibility, coherence function, temporal coherence,

Auto – correlated frequency

Abstract of the current research of Carlo Montes

Within Mediterranean regions, decision making tools for water management require knowledge of water and mass exchanges between land surface and atmosphere, where evapotranspiration is the main component of the hydrological cycle. Recent advances, in terms of modeling and remote sensing, mainly at the subregional extent for full canopies, allow to foresee the regional extent for complex landscapes such as row crops. This work aims to propose and calibrate a versatile modeling at the regional extent over a vineyard watershed, where calibration relies on optical remote sensing. A literature review allows to select a SVAT model, which considers the soil-plant-atmosphere continuum (micrometeorology and soil physics), with a regional vocation and a limiter number of parameters. Model implementation is motivated by versatility and further inclusion into a simulation platform. Meantime, evapotranspiration is spatialized by synergistically using thermal infrared data from ASTER and Landsat remote sensors. Obtained time series for evapotranspiration are next used for calibrating the selected SVAT model. These investigations are conducted over the Peyne watershed, within the framework of the OMERE Observatory for Environmental research.

Key words: land surface-atmosphere exchanges, regional extent, SVAT modeling, optical remote sensing, parameterization and calibration, numerical calculus

Estimating deep drainage from bare-field plots at a semi-arid ecotope in South Africa

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Abstract

The ability to estimate deep drainage is important in field water balance studies. Accurate estimates of the drainage component of the field soil water balance are required for the achievement of improved management in crop production systems and obtain improved estimates of crop water use (ET) from soil water measurements. Estimating drainage for numerous soil types and field conditions requires the use of simple, yet accurate, drainage equations that contain easily measured parameters. The Wilcox drainage model is a relatively simple mathematical equation with a high degree of accuracy and applicability to field conditions. The objective of this study was to develop Wilcox-type drainage rate equations for the estimation of drainage component of the field water balance for the University of Venda-Shortlands ecotope which was earmarked for in-field rainwater harvesting (IRWH) crop production technique. Bare soil was irrigated, covered to prevent evaporation, and water content of the profile measured periodically to a depth of 1500 mm. Total water was plotted against drainage time on log-log scales, and the linear regression equation relating the two variables was determined. These linear equations of total profile water ($\log_{10}$) vs. drainage time ($\log_{10}$) were used to develop Wilcox-type drainage equations in which drainage rate (dW/dT in mm/day) is expressed as a function of soil profile water content (in mm). Equations developed in this study can be used to estimate the drainage component of the field water balance under numerous field management conditions and more accurate estimates of ET from soil water measurements.

Key words: field water balance, in-field rainwater harvesting, Wilcox drainage rate equation

State-space estimation of soil aggregate stability in a teak (*Tectonia grandis*) plantation in northern Nigeria

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Abstract

Forest ecosystems are vital for abating soil structural degradation and decelerating climate change. In order to gain additional knowledge and better understand forest soil management at small scale, spatial statistical analytical tools were employed to examine the spatial heterogeneity in the stability of soil aggregates and other selected soil properties (such as bulk density, moisture content, clay particles, soil organic carbon and its fractions, dithionite and pyrophosphate iron, exchangeable sodium, potassium, calcium and magnesium sand); to assess the possible relationships between aggregate stability and the rest soil properties. First order state-space approach and classical multiple regression approach were employed to analyze the properties of forest soils collected along a 300-m transact in the Nimbia Forest Reserve. Bi and multivariate autoregressive state-space analysis were used to evaluate the soil properties; to determine properties affecting distribution of mean weight diameter. Results of cross- and auto- correlation patterns indicate a strong spatial dependence in most of the soil properties. The autocorrelation function showed significant spatial correlation from 1 lag in bulk soil organic carbon up to 19 lags in organic carbon concentration in 5-2 mm soil aggregate fraction ($C_{5\text{-}2}$). Multivariate state-space analysis showed that mean weight diameter (MWD) at position i was weighted on MWD, clay, total phosphorus (Total-P), Fe_d, Fe_p, moisture content (θ) and the five fractional organic carbon contents at previous position i – 1. The state-space models better estimated aggregate stability (MWD) with selected soil properties, than the classical multiple regression model and; are recommended for analysis of forest soil properties.

Is nutrient release from soil affected by biochar application?

Hints from a soil-water contact approach

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ABSTRACT

Biochar is the carbon-rich product obtained from pyrolysed biomass (vegetal, waste). Since biochar can be produced from different types of biomass and pyrolysis it is critical to investigate how the raw material and the pyrolysis method may influence the performance of biochar amendments in soil. For that reason, the main aims of this study were to: (i) determine whether biochar can improve soil aggregate stability and change the soilwater pH; (ii) analyse whether biochar obtained from different biomasses and types of pyrolysis can modify nutrient release during soil-water contact and (iii) estimate if slaking is a regulator of nutrient release from soil to water. To accomplish these study objectives, a greenhouse experiment was set up, in which soil was amended with six types of biochar. The soil was sampled one month (short-term) and one year (mid-term) after the beginning of the trial. A method to test soil aggregate stability, based on the Le Bissonnais fast wetting test (1996), was implemented. Aggregate size distribution and stability were calculated and pH, NO_3^-, NH_4^+, K^+, Ca^{2+} and SO_4^{2-} resulting from soil-water contact were measured. Our results showed that biochar soil amendments were able to improve soil resistance to slaking processes in some wet-sieving sizes, but in general, biochars have decreased soil aggregate stability. Biochar application clearly increased soil pH and nutrient release and (iv) slaking was a regulator of nutrient release from soil to water. These findings should be taken into account when choosing the biochar to be used as soil amendment.

SPATIAL VARIABILITY OF SOILS UNDER VETIVER GRASS STRIPS: FOCUS ON COMBATING LAND AND ENVIRONMENTAL DEGRADATION.

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This research focused on the safe use of vetiver grass system for combating land degradation in view of its numerous advantages. The spatial variability of soil under the influence of the Vetiver Grass Strips (VGS) were quantified using conventional statistics, and then RUSLE was used in evaluating the annual soil loss and threshold values for conservation purposes. The VGS studied was established at 20 m spacing 2 years earlier. The results of the effects of VGS on soil properties showed that clay and bulk density were lesser on parcels of land bounded by VGS than without; 83.3 g kg^{-1} clay with VGS and 90.5 g kg^{-1} without VGS at 0 – 5 cm depth was observed. Also, organic C and Total N were higher in parcels of land bounded by VGS than those without. It was concluded that since VGS did not cause any significant difference in soil physical properties it could be safely used as an environmentally-friendly natural resource to improve and protect farmlands and infrastructures, but in combination with mechanical measures in built up areas/cities.

Variability of soil C and physical properties in eroded and non-eroded soils under different land uses in Ifite-Nanka, Orumba North L.G.A. of Anambra state.

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Abstract

This research was conducted in decades of gully erosion site in Ifite-Nanka, Orumba North L.G.A. in Anambra state, Nigeria. The aim of the research was to evaluate the effect of three land use types and three gully erosion sites each adjacent to each of the land use types on soil organic C and physical properties and how soil OC affected them. Horizon variability of these soil parameters were also determined. The result showed that soil OC was higher in eroded soils than in non-eroded soils. As a result, AS and WSA were higher in eroded in eroded sites and this was because od sediment deposition by runoff water. Along the profile, SOC was higher in A horizon and so was the WSA and AS.

Introduction

The degradation of soil quality as influenced by land management is one of the important resource concern (NRCS, 2003). Among the numerous components of soil quality, soil organic carbon deserves special attention and is strongly affected by land use (Murage *et al*., 2000). Soil organic carbon is not only a major regulator of various processes underlying the supply of nutrients and creation of favourable environment for plant growth but also regulates various processes governing the creation of soil-based environmental services (Vanlauwe, 2004).

Rapid decline in soil organic matter are experienced with continuous cultivation of crops in West Africa (Bationo et al., 1995). Accelerated mineralization following land clearing has been reported to decrease SOC by up to 30% (Gregorich *et al*., 1998; Nandwa, 2001).

Soil erosion is a naturally occurring process but is intensified by various human activities leading to serious environmental and agricultural problems (Blanco *et al.,* 2010; Toy *et al.,* 2002). Unsustainable agricultural practices are the single greatest contributor to the global increase in

erosion rates (Committee on the 21st Systems Agriculture, 2010). Erosion in effect affects all soil properties. It selectively removes soil particles rich in organic matter and nutrient, changing the environment of the remaining topsoil by increasing the bulk density, reducing total porosity and infiltration rate (Fisher, 1995).

Land use types and erosion have significant impact on soil characteristics including soil C, chemical and physical properties. This research evaluated the impact of different land use types and longtime eroded lands on soil C and soil physical properties (% clay, % total sand (TS), water stable aggregates (WSA), mean weight diameter (MWD), aggregate stability (AS), bulk density (BD), hydraulic conductivity (Q) and total porosity (TP) and the relationship between soil carbon and these soil physical properties.

Key words: Land use types, eroded soils, soil carbon and soil physical properties

Materials and site description

This research was done at Ifite-Nanka, Orumba North L.G.A. of Anambra state- longtime gully erosion site. Nanka is located within latitude $6^0\,01^1$ to $6^0\,06^1$ N and longitude $7^0\,02^E$ to $7^0\,08^1$E. A reconnaissance survey of the area was done using a topographic map (Fig 1) obtained from Department of Geology, University of Nigeria, Nsukka. During the reconnaissance survey, three major land use types were observed namely arable farmland, cashew and oil palm plantations and three gully sites adjacent to each of the land use types. These six units constituted the specific area for this research.

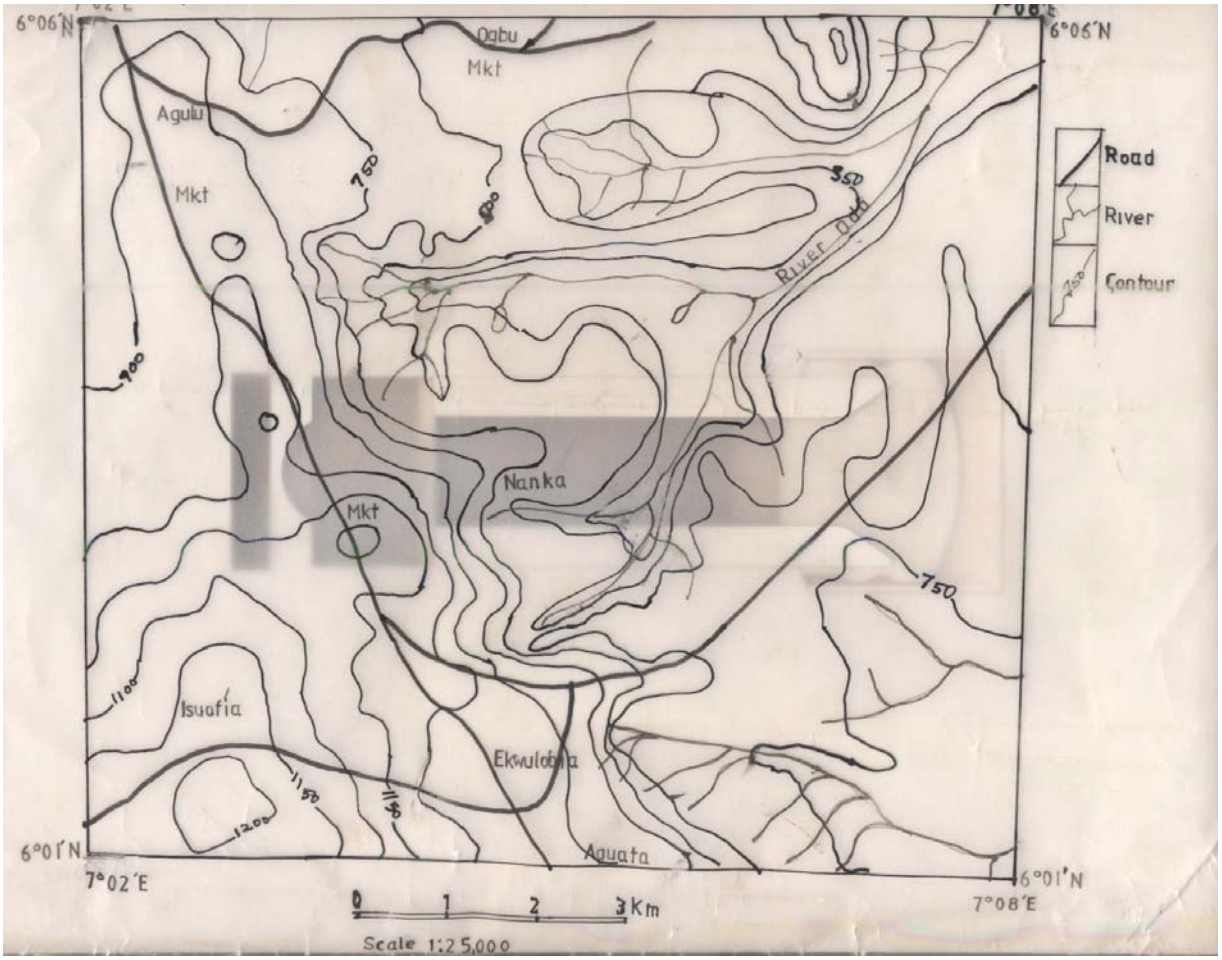

FIG. 1: Topographic map of the study area

Experimental design: This research was a 6 x 3 factorial in completely randomized design (CRD), comprising of the six soil conditions (arable farmland, cashew oil palm plantations, eroded 1, 2 and 3) and their A, B and C-horizons as factor B.

Procedure: Composite soil samples were collected from the top 0 – 10 cm soil depth of each of the six conditions. Then profile pits were dug in each of the land use types and soil samples collected from horizons A, B and C. The gully sites were cleaned up and soil samples collected from each horizon. All these were replicated thrice. These were studied. In addition, undisturbed core samplers were collected on top soils of each of the soil conditions.

Laboratory analysis: the standard laboratory methods were undertaken in analysis of the soil chemical and physical properties.

Statistical analysis: Analysis of variance (Anova) for factorial in completely randomized design (CRD) was used to detect significant treatment effects and mean separation by duncan's multiple

range test. Regression analysis was also undertaken to determine % contribution of SOC in the soil physical properties. SAS package (1999) was used for the analysis.

Results and Discussions

Topsoil characteristics: Table 1 shows the physico-chemical characteristics of the soils of the study area. The soils are loamy sand, neutral in reaction (6.1), low in total nitrogen and moderate available P (Landon, 1991). In addition, all the soil had low exchangeable cations dominated by Ca (1.0 cmol/kg - 1.6 cmol/kg) and Mg (0.4 cmol/kg - 1.2 cmol/kg). Among the three land uses, arable soil had better soil physical properties (Table 2).

Table 1: Top soil properties of the non-eroded sites

Soil properties	Land use types		
	Arable	cashew	Oil palm
Clay (%)	13.2	9.2	9.2
Silt (%)	3.28	3.28	5.28
Sand (%)	83.52	87.52	85.52
Textural class	Loamy sand	Loamy sand	Loamy sand
pH in water	6.1	6.1	6.2
TN (%)	0.24	0.154	0.14
OC (%)	1.06	0.71	0.65
AVP ($mgkg^{-1}$)	10.26	3.73	2.8
Ca($cmolkg^{-1}$)	1.6	1	1.2
Mg($cmolkg^{-1}$)	0.4	1	1.2
K($cmolkg^{-1}$)	0.13	0.11	0.14
Na($cmolkg^{-1}$)	0.04	0.04	0.06
EA($cmolkg^{-1}$)	0.6	2.02	0.6
ECEC($cmolkg^{-1}$)	2.77	4.17	3.2
CEC ($cmolkg^{-1}$)	40.4	32	35.6

Table 2: Some selected soil physical properties

Soil properties	Land use types		
	Arable	cashew	oilpalm
WSA	13.78	13.76	12.51
MWD	0.96	0.95	0.99
AS (%)	32.61	19.77	17.83
FC	26.19	20.34	21.90
BD	1.67	1.85	1.78
Q	21.1	21.5	10.5
TP	33	30.0	32.7

Effect of soil conditions on soil C and physical properties: Fig 2 shows the effect of the six soil conditions on soil C and soil physical properties. Soil C was significantly highest ($p < 0.05$)

in eroded site 2 (0.64 %), followed by eroded site 3 (0.57 %), oil palm (0.51 %), arable (0.46 %), eroded site 1 (0.44 %) and least in cashew (0.28 %). Clay content (39.2%) and FC (26.19 %) had significantly ($p< 0.05$) highest value in arable land while cashew plantation soil had significantly highest values of total sand (77.52 %) and BD (1.85). This goes in line with research findings that high total sand causes poor aggregation and this leads to high bulk density (Salako *et al*., 2002). Eroded site 1 had significantly highest values of AS (36.96 %) and TP (41.3 %) while Q was highest in eroded site 1.

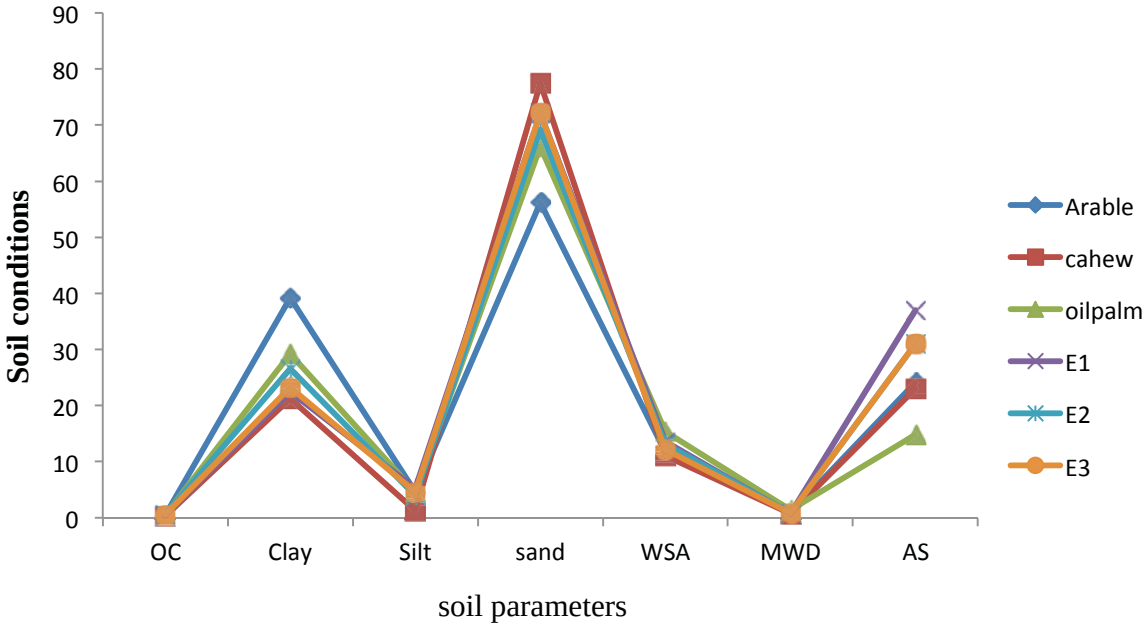

Fig 2: Effect of soil conditions on soil C and some physical properties

Variability of soil C and physical properties of six soil conditions along the horizons

As shown in fig 3, in all the six soil conditions studied, OC had the significantly highest value in horizon A, followed by horizon B and least in horizon C. This is in accordance with research and natural occurrence because of organic matter that are deposited on the top soil, OC is usually higher at the top soil than down the profile. Values for Clay content occurred significantly highest in B-horizon in all the treatments while total sand % had highest value in A horizon. This shows the extent of erosion that had occurred in such a place that had leached most of clay minerals to horizon B. WSA and AS followed the trend to that total sand percentage, having significantly highest value in A horizon. Regression analysis shows some significant relationship between soil OC and some soil physical properties.

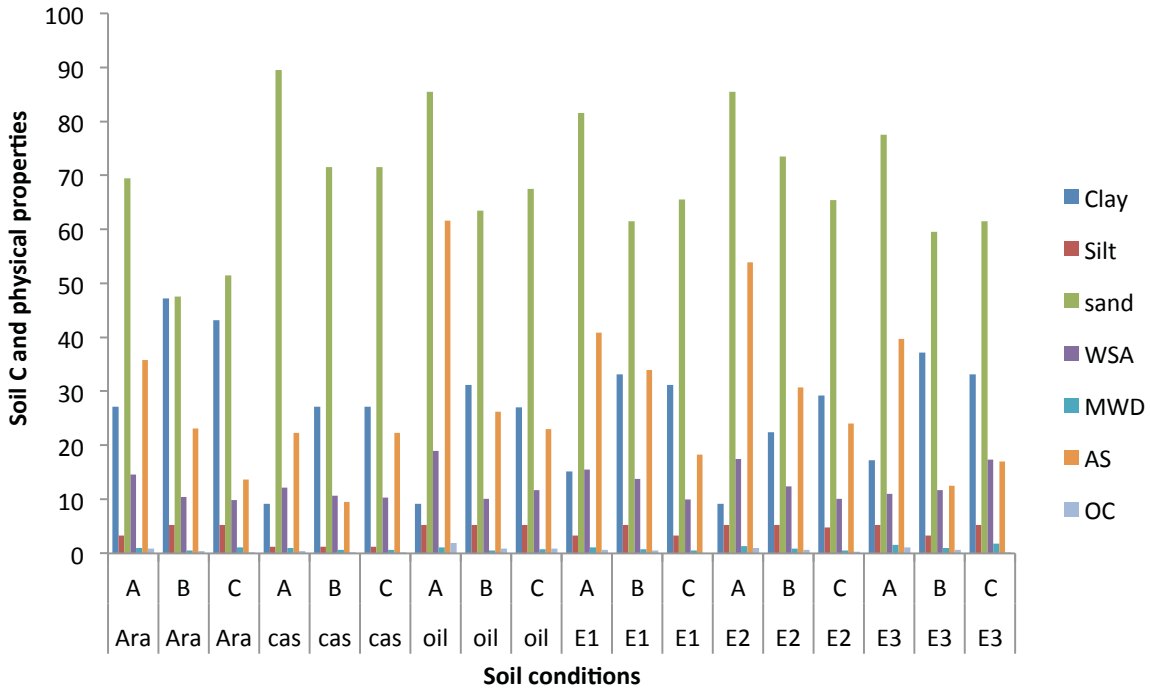

Fig 3: Variability of soil C and physical properties along the horizons

Conclusions

Comparing the three land use types, soil OC had significantly highest value in oil palm plantation soils followed by arable farmland and cashew plantation soil, more so SOC was also high in eroded soils. Aggregate stability was higher in eroded soil than in non-eroded soil but within the profile, AS was higher in A-horizon than in B and C -horizons. Soil OC contributed 31 % changes in clay content and WSA, 5% changes in MWD and 66% changes in AS.

References

Bationo, A, Buerkert, A, Sedogo, M.P., Christianson, B.C and Mokwunye, A.U. (1995). A critical review of crop residue use as soil amendment in the West African semi-arid

Blanco, H. and Lal, R. (2010). "Soil and water conservation". *Principles of Soil Conservation and Management*. Springer. p. 2. ISBN 978-90-481-8529-0.

Committee on 21st Century Systems Agriculture (2010). *Toward Sustainable Agricultural Systems in the 21st Century*. National Academies Press. ISBN 978-0-309-14896-2.

Fisher, R.F. (1995). Amelioration of degraded rain forest soils by plantations ofnative trees. *Soil Sci. Soc. Am. J*. 59, 544-549.

Gregorich, E.G., Greer, K.J., Anderson, D.W and Liang, B.C., (1998). Carbon distribution and losses: erosion and deposition effects. Soil Tillage Research 47, 291–302

Murage, E.W., Karanja, N.K., Smithson, P.C. and Woomer, P.L. (2000). Diagnostic indicators of soil quality in productive and non}productive smallholders' fields of Kenya's Central Highlands. *Agriculture*, *Ecosystems & Environment*, **79**: 1-8.

Nandwa, S.M. (2001). Soil organic carbon (SOC) management for sustainable productivity of cropping and agro-forestry systems in Eastern and Southern Africa. Nutrient Cycling in Agroecosystems 61, 143–158.

National Resources Conservation Service, United States Department of Agriculture. 1996. Soil Quality Institute Technical Note No.2

Salako, F. K., Tian, G. and Kang, B. T. 2002. Indices of root and canopy growth of leguminous cover crops in the savanna zone of Nigeria. *Tropical Grasslands* 36: 33-46.

SAS Institute. 1999. SAS user's guide. SAS Inst., Cary. N.C.

Toy, T. J. (2002). *Soil Erosion: Processes, Predicition, Measurement, and Control*. John Wiley & Sons. p. 1. ISBN 978-0-471-38369-7.

Vanlauwe, B., (2004). Integrated soil fertility management research at TSBF: the framework, the principles, and their application. In: Bationo, A. (Ed.), Managing Nutrient Cycles to Sustain Soil Fertility in Sub-Saharan Africa. Academy Science Publishers, Nairobi, Kenya.

College on SoilPhysics, ICTP,Trieste, February –March 2013

Poster

Title : Impact assessment of WH in the dry areas of Tunisia using SWAT model

Authors : M. Ouessar, F. Abdelli, A. Bruggeman, D. Gabriels

Abstract

Rainfed farming in Tunisia is mainly supported by the various water harvesting techniques (WHT) developed since the antiquity. In the arid regions of the country, considerable investments are being made in maintaining the old WHT and introducing new ones to capture the scarce amount of rainwater (100 to 230 mm annually) for agricultural and domestic purposes.

The GIS-based watershed model SWAT was adapted and applied for the study area. Adjustments have been made first for the adaptation to the local dry conditions and particularly with the incorporation of the water harvesting techniques. The sensitivity analysis indicated that the model was mostly sensitive to CN and flow fraction (FLOWFR) and then to AWC and K_{chan}. The calibration of the model was performed based on the 38 runoff events recorded at the Koutine station between 1973 and 1985. The model performance indices (R^2=0.77 and 0.76, E=0.73 and 0.43, respectively for calibration and validation) indicate that the model can reasonably reproduce the observed events but some discrepancies remained mainly due to highly variable behavior of the environment and uncertainties in the rainfall (inadequate coverage by rainfall stations) and runoff data, and some of the model assumptions and parameters. The adjusted version of the model was named SWAT-WH (*SWAT for water harvesting*).

The adapted SWAT model (SWAT-WH) was applied for assessing the long term effects (30 years) of land use changes, associated mainly with the intensification of WH works, on the main water balance components. Besides the base scenario (SC1) (land use before 1991), two other scenarios were considered: the first one concerned the intensification of the WH works (installation of new tabias in the plain areas and gabion recharge check dams in the main wadis) (SC2) while in the second one, there was a partial silting up of the recharge structures (SC3). Another theoretical scenario was simulated is the natural situation (SC0) whereby all water harvesting and crops have been removed and only the natural vegetation (rangelands) was kept in the watershed.

Compared to the theoretical scenario (SC0), the land use changes induced a significant reallocation of the rainfall water to ET (+22%) and percolation (+8%) at the expense of outflow (-18%) and transmission losses (-13%). The intensification of the water harvesting works in the study watershed resulted in an increase of 2% in percolation from the soils and ET (147 mm to 151 mm) and 1% in seepage from the diversion structures. However, the land use changes induced a decrease of outflow (from 4 mm to 0 mm, 2%) and transmission losses (8.2 to 3.1 mm, 3%). The partial silting up of the gabion check dams (SC3) did not induce a significant effect on the water balance components since it has an effect only on seepage which decreased from 1.1 mm to 0.9 mm. In the area covered by the water harvesting structures (new tabias), the ET was found to increase by 5 to 10% during wet years, when comparing SC2 to SC1. The presence of the various WH structures reduced drastically the discharge rate. The number of hydrological years producing runoff at the outlet of the watershed dropped from 56% (SC1) to only 10% (SC2).

Wetland Utilisation and Land Cover change in the Upper Ewaso Ngiro Basin, Laikipia County, Kenya

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Land use changes in Upper Ewaso Ngiro basin has undergone significant transformation in the past 100 years, from nomadic communal grazing land before 1900, large scale ranching up to early 1970s to small scale farming from 1990s. The later change has been accompanied by increased food crop and horticultural cultivation that is geared towards both domestic and commercial needs by migratory agrarian communities from humid regions. Due to the arid nature of the basin, cultivation mainly involves irrigation of dry land or farming in the several wetlands in the basin upon draining. Lack of clear legal framework (*draft wetland policy*) has resulted in severe degradation of wetlands ecosystem with wetland area reducing by ca. 80%. Although the wetlands ecosystem renew themselves significantly annually during the long rains through excessive flooding regaining exploited soil fertility, the cumulative impact of anthropogenic effect is reflected mainly in vegetation change. Farming is characterised by recurrent losses, food crop and finances due to a combination of low farming inputs and poor market access, which further limit resources input for land and soil management. This results in sustained low food production and continued agricultural resource degradation.

Keywords: transformation, wetlands, small-scale, farming inputs, degradation

Is soil aggregate stability a useful input predictor for estimating soil hydraulic properties?

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Abstract

Spatial and temporal variation of hydraulic properties of soil acts as an eliminating factor against measuring them in large scale with limited number of samples. Therefore, precise estimation of them by pedotransfer function (PTF) has been an important subject of interest during the last two decades among soil physics researchers. The routine soil input predictors for deriving a PTF are sand, silt and clay percentages, bulk density and organic matter content. These routine predictors lack an adequate description of soil structural properties. Soil aggregates and their stability, however, have a strong influence on physical properties of soil. This study was carried out to identify the impact of soil aggregates stability as an extra input predictor on the performance of PTFs derived to estimate water retention curve. A data set containing 135 samples, collected from different part of Turkey, is used. Eight *pseudo continuous* neural network based PTFs were derived using different combination of input predictors. Result shows the lowest error belongs to a PTF in which AS has been employed on top of other extra input predictors. Sensitivity analysis also shows the moderate effect of aggregates on water content. However contribution of aggregates caused increase in RMSE values in some cases as well so more researches is needed to confirm the positive impact of aggregates as an input predictor.

Keywords: data mining, pseudo continuous PTF, point PTF, water retention curve.

LANDSLIDE SUSCEPTIBILITY AND RISK ASSESSMENT IN THE CARAMACATE RIVER BASIN, VENEZUELA.

Pineda MC, Viloria J, Martínez-Casasnovas JA, Puche M, Fonseca F, Pla I

ABSTRACT

The Venezuelan highlands have a large susceptibility to mass movements, which result from the joint action of different and complex factors, both environmental and human, that control their dynamics. This study proposes the identification of factors that influence mass movements in a sector of the Cordillera de la Costa of Venezuela (Metatobas El Chino-El Caño and Metalavas El Carmen), considering that this type of phenomenon is part of the processes that contribute to the landscape modelling and the spatial variability of soil properties. Each factor considered was analyzed through a set of variables, spatially modelled as a continuum represented by a grid of cells of equal size. This allowed modelling the abrupt and gradual changes that occured throughout the landscape and performing quantitative assessments. The landslide susceptibility was evaluated based on erosion scars identified on remote-sensing images from 1941, 1971, 1992 and 2008. Since the relationship between the landslide susceptibility and its determining factors is non-linear, the analysis was based on logistic regression models. The models obtained allowed the identification of both the conditioning and activating variables of landslides and their spatial distribution. To assess the risk of landslide, rainfall data from 1958 to 2000 and the SOMORE model were used. This allowed to determine probabilities of occurrence of the events: total soil moisture (HTS) greater than water content at saturation (SAT) and total soil moisture (HTS) greater than field capacity (CC), taking into account climate, soil and time. The highest probability of both events occurred in the wet season (May-October), particularly in July. The highest probability of the condition HTS> SAT occurred in the highly-susceptible areas of the geological formation Metalavas de El Carmen, whereas the highest probability of HTS status> CC appeared in the highly-susceptible areas of the two geological formations compared (> 50%). In the Metatobas El Chino-El Caño, the most influential factors on landslides were the relief and the vegetation cover. Here soil conditions contribute to the movement of water through the soil profile and landslides are deeper. Conversely, in the Metalavas El Carmen, relief, parent material and vegetation cover had the most influence. In these soils, the presence of a C horizon with very low hydraulic conductivity produces an over saturation of the surface soil and facilitates sliding. It is concluded that in the study area there are different mechanisms of activation of landslides and these mechanisms change over time.

Sprinkler irrigation management for rice crop: water consumption and yield as a function of soil water tension

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Rio Grande do Sul is the largest rice producer in Brazil, where irrigation is mostly done by continuous flooding. However, rice farmers have had problems with water availability in reason of the high water consumption demanded by this method and the drought periods faced by the state in the past years. In this context, sprinkler irrigation has been used by some farmers and has shown to be economically viable with meaningful water savings in rice cultivation. This work aimed to: (i) compare the water consumption in rice crops irrigated by sprinkler and flood irrigation methods; and (ii) evaluate the effect of three levels of soil water tension over rice yield under sprinkler irrigation. An area of 3200 m^2 belonging to Embrapa Clima Temperado (Capão do Leão– RS, Brazil) and irrigated by sprinkler using a Valley linear system was divided in three plots (20 m width and 40 m length each one). In each plot, 12 Watermark sensors were installed at a depth of 10 cm to monitor soil water tension. The following irrigation management strategies (treatments) were established: a) T1- Irrigation for average soil water tension 20 kPa during all crop cycle; b) T2- Irrigation for average soil water tension 40 kPa in the vegetative stage, and 20 kPa in the reproductive stage; c) T3 – Irrigation for average soil water tension 40 kPa during all crop cycle. An area where rice was irrigated by flooding was used to compare the water consumption between this method and sprinkler irrigation. Rice seeding was done in November 2011 with the cultivar BRS Pampa, and the irrigation water depth applied was of 6 mm during the vegetative stage and 9 mm in the reproductive period. To fit the water-yield model, the crop cycle was divided in four periods L1 - first 30 days of the vegetative stage; L2 - period until panicle differentiation (R1); L3 - first 30 days of the reproductive period; and L4 - period until harvest. Data were adjusted to the Jensen (1968) model, replacing the variable ET (evapotranspiration) for soil water tension. Results showed that the total water consumption (irrigation water applied + precipitation) was 613, 595 and 553 mm in T1, T2 and T3, respectively. When rice was irrigated by flooding, the use of water was 877 mm, so even at the highest volume of irrigated water applied (T1) there was a saving of over 40% in water consumption. The fitting of the water-yield model indicates that the initial phase of the reproductive stage is the most sensitive to soil water deficit, and also that rice yield decreases significantly with an increase in soil water tension.

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The use of gamma ray computed tomography to study the representative elementary area in measurements of soil bulk density

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The concept of representative elementary size (RES) deals with the definition of a minimum size or physical point of a sample which is needed to represent its characteristics of interest, that is, the size in which the measured parameter becomes independent from the sample size. Techniques that generate images such as computed tomography (CT) can be a useful tool to study RES. CT has been proved as an efficient method to study soil structure, and it has become more important as the new generations of tomographs exclusively dedicated to the study of materials. The technique has become so successful due to the fact that it is a non invasive method, that is, it does not damage the structure of the sample under analysis. In this study, the representative elementary area (REA) was determined for density (d_s) measurements of a Brazilian soil of clay texture, from data obtained via gamma ray first generation CT. Tomography images with millimetric resolution were used for both qualitative and quantitative analyses. Soil samples were collected at soil surface and their volumes varied from 50 to 100 cm^3. The tomograph is equipped with a gamma ray source ^{241}Am (59.54 keV), approximate activity 3.7 GBq, and a 7.62 cm x 7.62 cm NaI(Tl) detector. Consecutive concentric quadrangular areas (18) were selected in the CT images in order to evaluate the REA. The initial area was obtained from a square matrix of 1 x 1 (1.1 mm x 1.1 mm). For each area the d_s average value was obtained. The following criteria were used to determine the REA: i) relative deviation of d_s average value between the last and each of the other areas not superior to 5%, 4%, 3%, 2% and 1% and ii) that at least three consecutive areas cannot present different d_s values, using the variation criterion in item i. Using 2D images of soil clod samples, it was possible to determine the REA for d_s measurements with 4% reliability, based on the d_s CV measurements obtained through the paraffin sealed clod method, adopted as a standard method. For the clayey soil studied, cross section areas of 640.1 mm^2 are enough to provide representative values of this soil physical property.

The use of visual field assessment to evaluate soil structural quality in soils of contrasting characteristics

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Abstract

Field assessments of soil structure have been developed to satisfy the requirement of a simple and repeatable methodology for monitoring soil degradation and soil organic matter (SOM) decline, to evaluate small areas in detail and large areas quickly (McGarry, 2006), as well as a methodology well related to crop growth and soil aeration, strength and density measurements (Ball and Douglas, 2003). According to Batey (2000), the advantages of making assessments of soil physical conditions including soil structure directly in the field are: the relatively short time consumed and the immediate availability of the results, the use of simple equipment such as spade, knife or auger, the observation of slight changes in physical conditions that may be difficult to determine by other means, and the flexibility to deal with a wide range of situations. Until now, visual field assessment methods have been tested for temperate soils. This survey pretends i) to contribute to the validation of these methods by assessing and comparing the performance of three of such methods in tropical conditions, ii) to identify which soil physical properties are most closely related to field visual assessment. In a first experiment, six different Venezuelans soils were evaluated using the soil quality scoring procedure (SQSP), the visual evaluation of soil structure (VESS), and the visual soil assessment (VSA) method. The three methods were sensitive to distinguish between compacted soils and well-structured soils. For soils with moderate condition of soil quality as determined by VESS and VSA, the SQSP tends to overestimate the soil quality. For the SQSP, the assessment of the rooting system was limited by the absence or the stage of the roots in soils with a non-established crop. Regarding VESS, a crucial factor to identify the score in some soil blocks was the photograph of the shape of the aggregate fragments. When using VSA, identifying the potential rooting is difficult in heavy soils. Rating of earthworm numbers is not based on tropical conditions. High similarities were found between scores of visual methods and bulk density, plant available water capacity, relative field capacity and silt content. It is concluded that the simple visual methods were sensitive enough to evaluate soil structure under different conditions in Venezuelan soils and the scores were related with important indicators of soil quality.

Key word: soil structure, quality, indicators, field assessment, SQSP, VESS, VSA

INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS

COLLEGE ON SOIL PHYSICS
25 February - 1 March 2013.
TRIESTE, ITALY

Predicting the spatial distribution of soil depth: A case study from the South Ecuadorian Andes

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ABSTRACT

The current interest to obtain quantitative data on the spatial distribution of soil types or their attributes has grown significantly, driven by the advancement of geographic information systems and new developments in soil science. However, there are still many gaps in the landscape modeling, especially in poorly studied environments where the Páramo ecosystem is involved. The present study had the goal of catching a glimpse of new knowledge about the prediction of an important physical-morphological attribute like is the soil depth. The study was developed in the area of the Quimsacocha Páramo, which is an area of approximately 13 km^2. In this area, 807 drillings were studied, that were the basis for the implementation of a soil depth prediction model, based on topographic attributes: altitude, slope, aspect, curvature, catchment area, over flow distance, topographic roughness index and topographic wetness index. To implement the model, the CART model (Classification and Regression Trees) was used. The result of modelling was shown to be not efficient under the criterion of Nash-Sutcliffe coefficient, which is explained by the low correlation between predictor attributes and predicted variable. This could be explained due to the relatively uniform topography of the study area.

Key words: *páramo, topographic attributes, soil depth.*

Nitrogen and water use efficiency in early coffee growth

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Coffee (*Coffea arabica* L.) is one of the most traded commodities in the modern world and the major agricultural product grown in many highland and mountainous areas of Colombia, where the most important limiting factors for its production are nitrogen (N) and soil moisture. Early growth development directly affects the long-term productivity of coffee plants, but little is known about how seedlings respond to different levels of N and water availability. Therefore, developing practices to improve N and water use efficiency (NUE and WUE) without compromising crop yield is a priority.

We studied the response of coffee seedling in terms of biomass, WUE, NUE, ^{13}C discrimination as a measure of water stress, and N recovered from urea fertilizer under four N levels (0, 0.4, 0.8 and 1.2 g plant^{-1}) and four soil water contents (0.1, 0.3, 1 and 2 bar) under greenhouse conditions.

Although there were no significant effects due to an interaction between soil moisture and N, there were significant effects of individual treatments on measured parameters. WUE increased as the soil moisture level decreased, whereas NUE decreased with increasing N application. Similarly, leaf weight was increased by increasing soil moisture and N, whereas root biomass was significantly reduced by increasing N rates. In contrast, no significant effect of water or N levels was observed on leaf ^{13}C discrimination. Neither was there any effect on the proportion of plant N derived from urea, although as N rate increased the proportion of fertilizer N recovered in the foliar components was reduced. The observed effects may be part of an acclimation process to water stress.

These findings contribute to a better understanding of the important processes at work in the soil-plant system and can be used to improve recommendations for increasing plant growth potential and the efficient use of critical resources during early growth of coffee crops.

Keywords: soil water content, coffee seedlings, biomass, ^{13}C discrimination, N recovered

Singh

Research Abstract

The group is working on problems related to heat transfer through porous and dispersed systems and their emerging applications. The research work carried out is of experimental as well as theoretical in nature. Resistor model, lattice model and porosity correction factor have been proposed by the group to evaluate thermal physical properties of porous systems. Group's recent work has been to model highly porous foams like systems, which is used to estimate various heat transfer coefficients. Numerical models has also been developed using artificial neural network (ANN) technique to estimate accurate thermophysical properties of building/soil like materials.

Soil moisture variability over South America, as derived from the Global Land Data Assimilation System

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This works explores the main modes of variability of the root zone soil moisture in South America, with an emphasis on two particular regions of interest: the continental portion of the South Atlantic Convergence Zone (SACZ) and southeastern South America (SESA). This particular choice responds to the well documented see-saw pattern that characterizes warm season precipitation: positive (negative) rain anomalies over SACZ occur concomitantly with negative (positive) ones over SESA. To accomplish this, 10 years of soil moisture and other variables characterizing the surface state, together with precipitation, have been obtained from the Global Land Data Assimilation System. Very interesting differences show up, starting from distinct annual cycles: SESA does not exhibit a clear annual cycle, while SACZ is characterized by a "dry" period that starts by the beginning of June and ends by mid November. Still, the day to day variability is larger over SESA. Intraseasonal variability is also of interest and denotes years with very different behavior: some of them are characterized by the expected see-saw behavior, but some others are embedded in a longer time trend. This is confirmed with the aid of a spectrum analysis, which shows a clear peak around 70 days in both regions, and another one around 25 days. Soil moisture anomalies at SESA exhibit interannual variability in the range 2-5 years. Previous works addressing rainfall year-to-year variability in the same region, exhibits dominant activity in the same range of periods. That rainfall variability has been related to large-scale phenomena, like ENSO, SAM and the Indian Ocean Dipole. These preliminary results suggest that the analysis of soil moisture variability, may provide useful hints to further understand the role of soil states in driving part of the observed precipitation variability.

HYDRAULIC CONDUCTIVITY AND MACRO-AND MICRO-AGGREGATE STABILITY OF FINE-TEXTURED SOIL UNDER INTENSIVE CATTLE GRAZING

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ABSTRACT

Soil parameters controlling soil water storage and infiltration need to be increasingly studied to provide information for sustainable soil management. Hydraulic conductivity, aggregate stability of a fine-textured, submerged soil under intensive cattle grazing for 15 years was studied. Hydraulic conductivity ranged from slow to very slow in the top 0-25 cm soil and attained zero permanently before a depth of 100 cm.Wet trampling and compaction by the cattle reduced water movement within 25-75 cm depth.

Positive and negative functions of biological soil crusts in the change of soil moisture and temperature in semiarid environment

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Biological soil crusts (BSCs) are extensively developed and are widely distributed in arid and semiarid environment. The ecological functions of BSCs and their potential effects on desertification are attracting more attention, and recently, they have been recognized as a major influence on desert terrestrial ecosystems. However, their effects on soil moisture and temperature, which play very important roles in many ecological processes, are seldom reported or the results are contradictive. To provide more insight into this issue, we conducted a long-term monitoring experiment with automatic measurement for soil profile moisture and temperature with and without BSCs on semiarid environment on the Loess Plateau of China. The results showed that: (1) BSCs increased soil moisture by up to 7.6% at 5 cm by their higher water holding capacity; and decreased soil moisture by up to 3.1% at 15 cm, 5.2% at 30 cm, and 8.1% at 50 cm by their decreasing effect on water infiltration and increasing effects on surface evaporation; and increased soil moisture by up to 2.2% at 120 cm and 1.7% at 150 cm; (2) BSCs decreased soil temperature in summer by up to 11.8 ^{o}C, 7.5 ^{o}C, 5.4 ^{o}C, and 3.2 ^{o}C at surface, 5 cm, 15 cm, and 30 cm, respectively, by their fast evaporation and higher heat capacity; while in winter BSCs increased soil temperature by up to 4.2 ^{o}C, 2.1 ^{o}C, and 1.4 ^{o}C at 5 cm, 15 cm, and 30 cm, respectively, possibly by their mulch effects and dark color; (3) BSC's effects on soil moisture and temperature were closely correlated with each other, and both of them were driven by air temperature and soil wet conditions. We concluded that BSC's effects on soil moisture were positive at surface, negative at shallow soil, and again positive at deep soil; whereas BSC's effects on soil temperature were positive, which was decreasing effects in summer and increasing effects in winter. These results would be useful for understanding the ecological and hydrological functions of BSCs in semiarid environment, and could be helpful for the management of BSCs and desertification control on the Loess Plateau of China and similar regions all over the world.

Keywords: Moss crust; Hydrological function; Ecological restoration; Desertification control; Loess Plateau of China.

Time changes of suction, porosity distribution and available water due to application of superabsorbent polymers

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Abstract

Nowadays, application of superabsorbents is one of the strategies to combat water deficiency in arid and semiarid regions. This study was carried out to investigate the effect of two polymers on temporal variability of suction, porosity distribution and available water of two contrasting soils. The experiments were carried out as factorial based on complete randomized design, with three replicates. The treatments were included of Tarawat and Stockosorb polymers, each at five levels (0, 2, 4, 6 and 8 g/kg) and two soils (loamy sand and sandy loam). For each treatment, moisture content at seven suctions including 0, 0.3, 0.5, 1, 5, 10 and 15 bar in addition to temporal variability of moisture during two weeks were measured. Variation result of suction-time showed that for greater amounts of the polymers, the required days to reach the corresponding suction increased, significantly. Also, the influence of polymers on increasing soil moisture was more effective at higher suctions. Overall, the application of polymers particularly Tarawat led to a significant increase in moisture retention, especially for the loamy sand soil. Compared to the control, the highest application rate of Tarawat and Stockosorb in the loamy sand soil resulted in 105.2 and 89.5 % increases in capillary porosity and 56.8 and 41.1 % increases in aeration porosity, respectively. These values for sandy loam soil were 54.7 and 37.8 % for capillary porosity, whereas 99.6 and 102.9 % increases were obtained for aeration porosity, respectively. For sandy loam soil, the highest rate of Tarawat and Stockosorb resulted in 1.9 and 1.6 folds increase in available water compared to the control. The increase for loamy sand soil was 3.3 and 3.7 folds, respectively. With respect to available water, Stockosorb was more efficient polymer for loamy sand soil, whereas Tarawat found to be more suitable for sandy loam.

ENFI

Potential of Moroccan soils to sequester carbon and mitigate the climate changes

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Abstract

The decline in carbon sinks has a significant direct effect on the soil properties and a negative impact on the soil environmental and productive qualities, by the reduction in its organic matter content. Thus, the decline in carbon sinks constitutes a serious menace for economic development, the food safety and the amplification of the climate changes negative impact, especially in the developing countries. These countries have simultaneously a deterioration of their natural resources and an increase in their demography. Several researches confirm the evident relation between the de decline in carbon sinks and the climate change. However, these sinks depend largely on the land use types. Many previous studies noted the obvious contribution of the land use types to reduce the negative impact of climate change. The quantification of this contribution can be detected through an evaluation of the various carbon sinks for several land uses. Thus, we want through this research to quantify the carbon stock in various reservoirs for the Cedrus atlantica and the Quercus Rotundifolia at different stage of forest degradation (natural forest (N), grazing (G) and cultivated land (C)). The impact of the various land use types on the soil physical quality indicators (bulk density and wet aggregate stability) is significant under Cedrus and Quercus ecosystem. Carbon stocks are higher under N than G and C. This carbon stock is estimated to 394 Mg ha^{-1} and 259 Mg ha^{-1} for N, to 358 Mg ha^{-1} and 258 Mg ha^{-1} for G, and to 76 Mg ha^{-1} and 130 Mg ha^{-1} for C under Cedrus and Quercus respectively. The quantification of carbon stock in different pools (biomass, necromass and soil) showed that the soil has the biggest potential to sequester carbon under six land uses studied. The degradation of natural forests by the overgrazing is responsible of 34% and 28% of carbon loss under Cedrus and Quercus, respectively.