Soil Management and Quality in the Era of Sustainable Agriculture Intensification

School of Soil Biodiversity and Indication, XII Cycle

Organized by SISS (Italian Society of Soil Science) and Università Cattolica del Sacro Cuore. Piacenza, 16-18 June 2020.

Report prepared by Prof. Edoardo Puglisi (School chair) and Dott. Eren Taskin (School secretary)

The school was completely carried out in remote due to the COVID-19 outbreak, and focused on the relationships between soil management and quality, with a particular attention to the role of soil biodiversity in maintaining and achieving a Sustainable Agriculture Intensification (SAI). The challenging concept of SAI aims to achieve more food from the same land, while reducing environmental impact and providing social, economic and environmental benefits, which are the three main pillars of sustainability. Soils play a pivotal role in the SAI challenge, since increasing the future agriculture production without facing a depletion of resources in the short and long term is possible only through maximization of soil fertility. The school addressed this complex issue by providing a series of lectures, videos and training activities aimed at understanding the role played by soil biodiversity in sustaining fertility, the potential advantages of reduced or no tillage, the exploitation of novel biostimulants to reduce the agriculture dependence on chemical fertilizers and pesticides, the assessment of the impact of pesticides on soil biodiversity and quality, the agronomical practices that can be implemented to maintain and increase SOM. The aimed to make all participants familiar to the key concepts of soil biodiversity, fertility and to the possible solutions to achieve the strategic goal of SAI.

Total number of participants to the school was limited to 20 for this school in order to facilitate both intra-participants and participants-lecturer communications. School secretariat

received more than 40 participation requests from the members of various institutions all over the world from India, Nigeria, Turkey, Italy, England to Colombia. Commission therefore had to make a further selection to reduce the number to 20, paying attention to (i)backgrounds and career levels (ii) inclusion of international participants and (iii) parity of sex. Commission admitted total number of 20 participants that were mostly at MSc or PhD candidate levels, plus one laboratory technician. About 40% of the participants were international, and parity of sex were perfectly balanced.

The school was scheduled with hours dedicated to interaction times in order to ensure active interactions among participants themselves and between participants and lecturers. Participants were also divided into four working groups related to main themes of the school, namely (i) agronomy, (ii) soil microbiology, (iii) ecotoxicology and bioindicators, and (iv) metabolomics. The last day of the school was indeed completely dedicated to group work activities supervised by school lecturers in the morning and the presentations of the group activities in the afternoon. Anonymous participant feedbacks that were sent to participants after school's last day indicated satisfied participants upon their return to the organizers, showing overall a very good evaluation of the school activities.

Public Lectures of the School

The school opened its first and second day with public lectures that were made open to public. The number of participants in both lectures at their peak were about 70. Participant profile in these lectures can be described as MSc and PhD candidates, university professors and officials from public/ private institutions related to agriculture and environment, mostly Italian with a significant amount also from various other countries. Public Lectures were recorded and are made available online at the SISS YouTube channel: https://www.youtube.com/channel/UC8p2FI2B9lJSkDlUM3l64pw

Public Lecture 1 - Tuesday, 16 June 2020 - 14:30-15:30

THE IMPORTANCE OF SCALE FOR STUDYING SOIL MICROBIAL DIVERSITY

Christoph Tebbe, Thünen Institute, Germany ✉

https://www.youtube.com/watch?v=k2PmquX8O_g

Professor Tebbe presented results of his very recent research demonstrating that (i) microbial diversity is structured by interactions between micro-organisms and soil particle surfaces, (ii) soil aggregates represent spatial entities which reflect microbial community interactions much better

than analyses of the conventionally used gram-scale, and (iii) that there are several bacterial taxa which are characteristic for land-use in Europe, irrespective of their geographical region. Together these studies underline the strength of cultivation independent nucleic acid based microbial community analyses, but also point to further challenges of linking this structural diversity to functional parameters, as they are most relevant for understanding, protection and stirring soil microbial ecosystem services for the future.

Public Lecture 2 - Wednesday, 17 June 2020 - 09:00-10:00

EXPLOITING THE NATIVE SOIL BIODIVERSITY TO PROMOTE CROP PRODUCTIVITY AND SUSTAINABILITY

Stefano Mocali, CREA, Italy✉ https://www.youtube.com/watch?v=lvo1cxPKqDI

Prof. Mocali presented his research in a public lecture in which he pointed out once again the crucial role of soil biodiversity in sustainable agriculture and its role on the restoration of natural ecosystem functioning and soil properties which is known to be a long-term process, dependent upon the time it takes to restore connections between different components of the community. In his presentation. the use of microbial inocula to enhance the native soil biodiversity and functioning which represents an intriguing strategy to promote a sustainable agriculture intensification was also presented as a case study.

Lectures of the School

Following lectures were dedicated to and attended only by, the 20 selected participants. These private lectures aimed to provide up to date information to the participants and stimulate critical thinking on the issues related to main theme of the school *"Soil Management and Quality in The Era of Sustainable Agriculture Intensification"*.

SOIL ORGANIC MATTER MANAGEMENT AND DYNAMICS IN THE ERA OF THE AGRICULTURAL SUSTAINABLE INTENSIFICATION

G. Renella[1] ✉, C. Marzadori[2] ✉ [1]University of Padua, Italy [2]University of Bologna, Italy

The lecture illustrated biochemical mechanisms linking microbial metabolic activity and SOM dynamics as fundamentals of the agricultural sustainable intensification, and how these soil properties are affected by soil management, and how the correct management of the physiological link between SMB and SOM may improve the nutrient availability on soil C turnover in terrestrial and agricultural soils.

EFFECTS OF NO-TILL ON AGROECOSYSTEM SERVICES: YIELD, CARBON SEQUESTRATION, WATER REGULATION, GHG EMISSIONS, SOIL BIODIVERSITY

Vincenzo Tabaglio[1] ✉, Cristina Menta[2]✉, Andrea Fiorini[1]✉ [1]Università Cattolica del Sacro Cuore, Italy. [2] University of Parma, Italy

This lecture aimed to show how agricultural management practices lead to qualitative and quantitative alteration of plant litter inputs and soil microhabitat, in terms of both soil physical and chemical qualities, thus impact on soil quality and biodiversity from soil fauna perspective. That are both important for their role in maintaining soil quality and health, as well as providing ecosystem services. During this lecture 10min long virtual-visit to the no till experimental fields at the CERZOO research station of Università Cattolia del Sacro Cuore. Issues of reduced tillage practices, cover crops, efficient water and nutrient management were addressed.

THE CENTRAL DOGMA AT THE ROOTS OF SOIL FERTILITY: OMICS TECHNOLOGIES TO ASSESS PLANTS, SOIL AND MICROBES INTERACTIONS AT THE RHIZOSPHERE LEVEL

Edoardo Puglisi ✉, Luigi Lucini ✉ Università Cattolica del Sacro Cuore, Italy.

This lecture presented how the so-called "omics" technologies can shed light on the complex interactions that take place at the rhizosphere level between microorganisms, soil constituents and plants and how soil microorganisms react to stressors, changes in agronomical practices and ecological conditions, at plant level. Several case studies dealing with the modulation of root metabolic processes in response to environmental factors, including biostimulant microorganisms, were also presented.

SCHOOL SECRETARIAT

Eren Taskin

LOCAL ORGANIZING COMMITTEE

Edoardo Puglisi (chair), Cristina Menta (co-chair), Giancarlo Renella (co-chair), Vincenzo Tabaglio, Luigi Lucini, Andrea Fiorini, Eren Taskin

SCIENTIFIC COMMITTEE

Paola Adamo, Edoardo Puglisi, Stefano Mocali, Cristina Menta, Giancarlo Renella, Claudio Marzadori, Vincenzo Tabaglio, Luigi Lucini