Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.14270

Effects of Tillage and No-Tillage Agronomic Practices on Soil Carbon Content, Nutrient Dynamics and Microbial Community Change: Field study to Genomics

DR. ARNAB MAJUMDAR, PH.D.[1,2], PRADEEP KUMAR DUBEY[3], MUNISH KUMAR UPADHYAY[4], BISWAJIT GIRI[5], ASHISH KUMAR SRIVASTAVA[6] AND TARIT ROYCHOWDHURY[1]

[1]Jadavpur University
[2]Indian Institute of Science Education and Research (IISER) Kolkata
[3]Banaras Hindu University, Varanasi
[4]Indian Institute of Technology Kanpur
[5]IISER Kolkata
[6]Bhabha Atomic Research Center

Presenting Author: arnabmajumdar891@gmail.com

Globally, there is a dilemma in using tillage practice[1] and here we establish that using tillage is beneficial for maintaining soil quality. Consecutive four seasonal rotations (two wintery and two monsoonal in two years) during rice cultivation in India have compared a tilled field (TF) to a non-tilled field (NTF). The novelty of our study lies in the combination of the alternate wetting-drying (AWD) cycle in this tillage/no-tillage practice[2]. Before the field trial started, we conducted a survey of literature and farmers to set the optimal degree of tillage, 5 cm from the top in this case. The analyzed parameters are soil pH, redox potential, conductivity, total soil organic carbon (SOC), labile carbon (LC) content, and microbial biomass (MB), followed by a thorough assessment of nutrients[3] like total nitrogen (N), phosphorus (P), potassium (K), iron (Fe), calcium (Ca), magnesium (Mg), copper (Cu), zinc (Zn). Further, we used metagenomics and high throughput sequencing to define the total microbial community change[4] during tillage and non-tillage practices. Using genomics, we found that genes responsible for nutrient modulation in soil were actively expressed under tilled soil in many of these microbial species. Clear differences in SOC and LC content, microbial biomass and nutrient bioavailability were found[5] in TF and NTF by 9.87%, 13.69% and 14.25% respectively when AWD was applied (**Figure 1**). Nutrients were higher in TF due to the 'Birch effect', which enriched the soil and induced the microbial genus Nitrospira, Bacillus, Pseudomonas, Azospira, and Bradyrhizobium. These genera contribute significantly to nutrient modulation and availability. Gene ontology, KEGG Pathway and Panther Pathway analyses showed a higher gene expression and greater metabolic activities were maintained in TF-AWD microbes (**Figure 2**) resulting in better soil quality under tillage practice proving the benefit of surface tillage practice.

[1]Mondal, S., et al., 2020. Land Degradation & Development, 31(5), pp.557-567. [2]**Majumdar, A.,** et al., 2020. Arsenic in Drinking Water and Food, pp.425-443. [3]Wang, H., et al., 2020. Archives of Agronomy and Soil Science, 66(11), pp.1509-1519. [4]**Majumdar, A.,** et al., 2021. Journal of Hazardous Materials, 409, p.124443. [5]Liu, X., et al., 2022. Soil and Tillage Research, 215, p.105188.

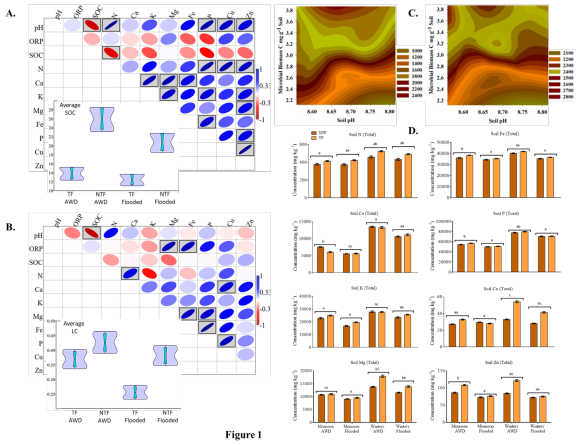

Figure 1

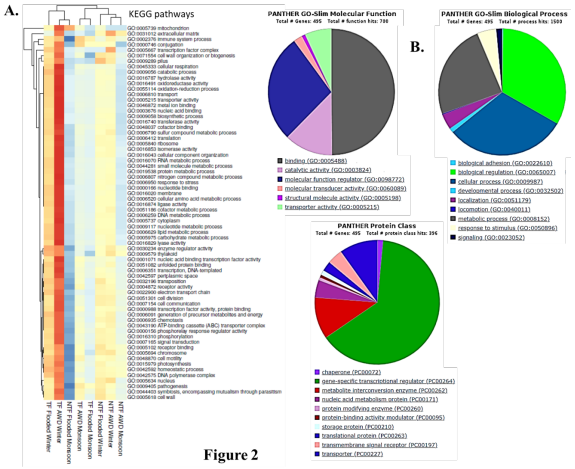

Figure 2