Agrotechnology
ISSN: 2168-9881

Research Article Open Access

Stability of Soil Organic Matter and Soil Loss Dynamics under Short-term Soil Moisture Change Regimes

Parwada C[1,2]* and van Tol J[1,3]

[1]Department of Agronomy, University of Fort Hare, Alice, South Africa
[2]Department of Crop Science, Bindura University of Science Education, Bindura, Zimbabwe
[3]Department of Soil-and Crop-and Climate Sciences, University of the Free State, Bloemfontein, South Africa

Abstract

Soil properties are known to be influenced Soil Organic Matter (SOM) resident time. However, there is limited information on the interactive effects of SOM quality and soil moisture on SOC and Microbial Biomass Carbon (MBC) hence on soil losses. Therefore, this study investigated the effects of different organic matter and soil moisture in soils with low (<2%) initial SOC content on the SOC, MBC and soil loss with time of organic matter incorporation. Six soils were incubated for 34 weeks at 25°C after adding high quality (C/N=23) *Vachellia karroo* leaf litter and low quality (C/N=41) *Zea mays* stover. The effect of SOM quality and soil moisture on the SOC content, MBC and soil loss was significantly (P<0.05) the same within but varied across soils. Soils that were continuously wet lost more SOC than under alternating wet-dry moisture conditions. Microbial biomass carbon was controlled by the availability of organic matter and moist soil conditions. Low MBC values corresponded to high SOC and soil loss. Continuously wet soils with high sand particles promoted rapid loss of SOC compared to alternating wet-dry soils. Therefore, continuously wet sandy soils are likely to contribute more to the climate warming than alternating wet-dry soil moisture. In the wake of the climatic change, addition of OM in continuously wet soils need to be regulated but to reduce soil loss re-application of fresh OM has to be more frequent under continuously wet sandy soils than in alternating wet-dry moisture regimes.

Keywords: Carbon emission; Conservation; erosion; Mineralization; Texture

Introduction

The interaction between climate change and the global carbon cycle is an important aspect of the global environmental changes [1]. Soil is the largest pool of terrestrial organic carbon in biosphere, storing more Carbon (C) [2]. Therefore, the Soil Organic Carbon (SOC) stock has an irreplaceable function in mitigating climate change as a key component of the biosphere carbon cycle. Meaning that changes in SOC content significantly influence climate change and a slight change in the SOC stocks can have a considerable effects on atmospheric carbon dioxide concentration, contributing to climate warming [3]. Changes of the climate, particularly the temperature and rainfall have more pronounced effects on the resident period of the SOC by accelerating SOC decomposition offsetting a portion of the SOC losses. However, many researches relating the climate change to SOC are biased towards revealing the trends and future projection changes in the SOC and its effects on the environment, ignoring the current climatic scenarios. The climate change is manifested by changes in temperature, precipitation and length of the season [4]. Precipitations that are punctuated by prolonged mid-season dry spells are now a common phenomenon in many parts of the world and could result to detrimental effects on soil microbial action on SOC hence soil losses through erosion. The climatic factors affect the soil microbial activities on the Soil Organic Matter (SOM) thereby influencing the SOM resident period [5].

The climate change modifies soil temperature and moisture simultaneously and, although many researches have attempted to determine the effect of litter quality or moisture on soil microbial biomass, there is still limited attempts to explore the combined effects of both factors [6,7]. The influence of soil moisture on soil carbon stocks has received relatively little attention, although it has a key role in regulating the soil microbial activity [8]. There is also very limited understanding of how intermittent soil moisture affects the soil organic matter decomposition, as the relationships between the intermittent moisture content and quality of soil organic matter are not consistent across different soils.

In addition to the climatic factors, the quality of soil organic matter should also affect the rate of decomposition [9]. Several studies have indicated that the chemical and biochemical quality of litter affects mass loss during decomposition [10,11]. The addition of higher quality substrate (lower C/N ratio of <24 and lower lignin content) resulted to increased SOC mineralization compared to the addition of lower quality (C/N ratio >24) substrate [12-14]. Since the soil microbes need N (and other essential elements) as well as C, if there is little N in the residue, decomposition is slow. When immature legumes are ploughed into the soil that had lower dry matter but higher N concentration and low C/N, decomposition was faster [10]. On the other hand, the high cellulose, hemicellulose and lignin contents of legumes ploughed in at a matured age reduced the speed of decomposition. The C/N ratio in plant residues is highly variable and increases with maturity. An ideal substrate material was found to have C/N ratio=24 to satisfy the N requirement of microbes [12,13]. If the C/N ratio of residue >24, available soil N is consumed by microbes and this retards decomposition rate. A number of authors have reported linear increases in SOC related to the amount of organic matter applied, whilst others, have reported that the rate of SOC accumulation is dependent on the source of organic carbon [14-16]. This greatly suggests

***Corresponding author:** Parwada C, Department of Agronomy, University of Fort Hare, Alice, South Africa, Tel: 2773394154; E-mail: cparwada@gmail.com

Received July 17, 2017; **Accepted** July 25, 2017; **Published** August 01, 2017

Citation: Parwada C, van Tol J (2017) Stability of Soil Organic Matter and Soil Loss Dynamics under Short-term Soil Moisture Change Regimes. Agrotechnology 6: 159. doi: 10.4172/2168-9881.1000159