12th International Symposium on Earthworm Ecology (ISEE 12): Rennes, France - July 2022

RELATIVE PROPERTIES OF EARTHWORM-BIOTURBATED SOIL AND CRAB-BIOTURBATED SOIL COLLECTED FROM A WETLAND HABITAT

Ebenezer Olasunkanmi Dada[1]*, Olaide Olabimpe Fabiyi[1], Yusuf Olamilekan Balogun[1] and Emmanuel Olorunleke Oludipe[2]

[1]*Department of Cell Biology and Genetics, Environmental Biology Unit, Faculty of Science, University of Lagos, Akoka, Yaba, Lagos, Nigeria.*
[2]*Department of Food Science and Microbiology, College of Pure and Applied Science, Landmark University, Omu-Aran, Kwara State, Nigeria.*
**Corresponding author: eodada@unilag.edu.ng; Tel. +234-9075414242*

Abstract

Wetlands are rich in bioturbating animals, whose activities modify the physicochemical and nutrient states of their habitat soil. Although, bioturbation by earthworms and crabs have been separately investigated and documented, a comparative study of their impact on soil quality is desirable. We compared the physicochemical and microbial properties of earthworm-bioturbated soil and crab-bioturbated soil from the same wetland habitat. Soils separately bioturbated by earthworms and crabs were sampled within randomly placed 1m^2 quadrats, and analysed for microbial, enzyme and physicochemical properties, using standard procedures. Unbioturbated (undisturbed) soil from the same proximity served as the control. Bioturbated and unbioturbated soils exhibited significant differences ($p<0.05$) in all the measured parameters, with unbioturbted soil showing a higher proportion of sand and silt, but lower biochemical and microbial activities. Crab-bioturabted soil had significantly higher ($p<0.01$) moisture and water holding capacity, relative to earthworm-bioturbated soil. However, earthworm-bioturbated soil recorded significantly higher ($p<0.01$) percentage nitrogen (0.45±0.02%), organic carbon (1.26±0.02%), and total organic matter (2.18±0.04%). In addition, earthworm-bioturbated soil had significantly higher total bacteria, fungi, and actinomyces counts of 129.33±18.15x10^4 CFU/g, 46.22±6.04x10^{4}CFU/g, and 56.22±7.61x10^{4}CFU/g, respectively. These results imply that both earthworms and crabs positively influence soil quality, but earthworm activities impact better biochemical and microbial effects. Nevertheless, efforts should be geared towards conserving the populations of wetland earthworms and crabs, as their contributions are complimentary in soil enrichment.

Introduction

Bioturbation is the alteration, remixing, turning over, or reworking of sediments or soil structure by living organisms (Meysman *et al*., 2006). Several burrowing and non-burrowing vertebrate and invertebrate animals, play different roles in the process of bioturbation. Much attention has been paid to burrowing crabs as a major group of bioturbators in wetlands (Alberti *et al*., 2015; Xie *et al*., 2020). Similarly, the positive impact of bioturbating activities of earthworms on soil health and nutrient qualities, plant growth and crop yield are globally recognised (Owa *et al*., 2013; Dada *et al*., 2021). Though, more attention has been paid to the activities of earthworms in friable soil, some wetland or semi-aquatic earthworms also contribute immensely to the productivity of their respective wetlands habitats through their bioturbating activities, enzyme secretion, and vermicomposting actions (Owa *et al*., 2003). Bioturbation by earthworms and crabs have been separately studied and documented, however, research attentions have not been focused on their comparative contributions to wetland soil quality. This study therefore aimed to compare the physicochemical qualities and microbial activities of earthworm-bioturbated soil and crab-bioturbated soil in a wetland habitat.

Materials and methods

Sampling location: main campus of the University of Lagos, Nigeria.

Collection of soil samples: Soils separately bioturbated by earthworms (Figure 1: vermicasts) and crabs (Figure 2: dug out soil) were collected within three randomly placed 1m^2 quadrats,

Fig. 1: Cross-section of sampling location, showing mouldy casts of *Alma millsoni*

Fig. 2: Cross-section of sampling location, showing dug-out soil by crab

Physicochemical analysis of soil samples: Earthworm-bioturbated, crab-bioturbated, and unbioturbated (undisturbed) soil samples were analysed for physicochemical parameters using standard procedures.

Microbial counts in soil samples: Total bacteria, total fungi and total actinomyces were enumerated following the standard pour plate technique as described by Collins *et al.* (1989).

Statistical analysis of data: ANOVA; $p < 0.05$; IBM SPSS (version 26).

Results

Table 1: Physicochemical properties of soil samples

Physicochemical parameters	Soil type			
	Unbioturbated	Crab-bioturbated	Earthworm-bioturbated	F
pH	7.81±0.05^a	7.74±0.03^b	6.85±0.06^c	1136.04**
Moisture (%)	29.22±0.56^a	50.48±0.66^b	39.16±0.43^c	2192.92**
Water holding capacity (%)	42.42±1.39^a	53.67±2.16^b	48.25±2.04^c	52.84**
Electrical conductivity (mS/cm)	1.86±0.06^a	0.93±0.32^b	1.07±0.03^c	1139.12**
Cation exchange capacity (cmolkg^{-1})	35.55±0.79^a	25.95±2.22^b	25.44±0.14^b	104.80**
Phosphorus (mg/kg)	78.05±1.82^a	87.01±2.20^b	126.44±9.04^c	132.84**
Nitrogen (%)	0.08±0.00^a	0.09±0.00^a	0.45±0.02^b	2883.87**
Organic carbon (%)	0.65±0.02^a	0.78±0.02^b	1.26±0.02^c	1379.90**
Total organic matter (%)	1.13±0.04^a	1.35±0.03^b	2.18±0.04^c	1386.63**

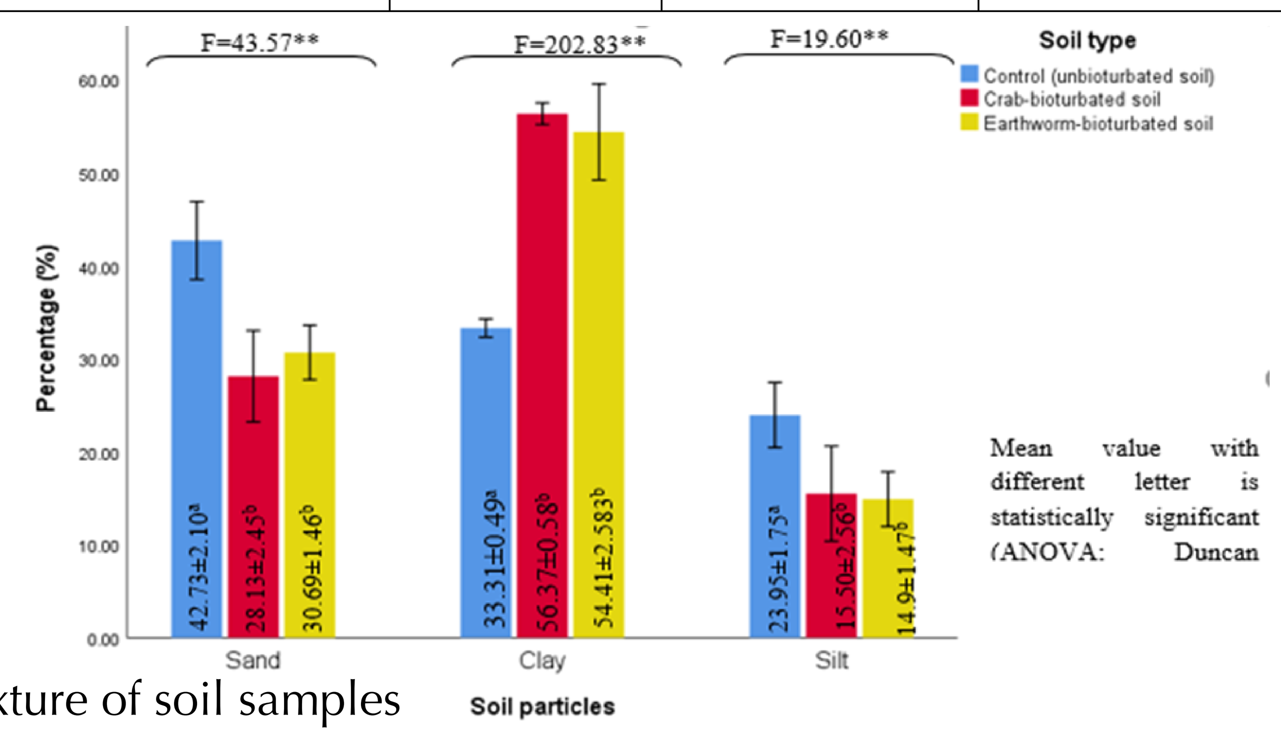

Fig. 4: Texture of soil samples

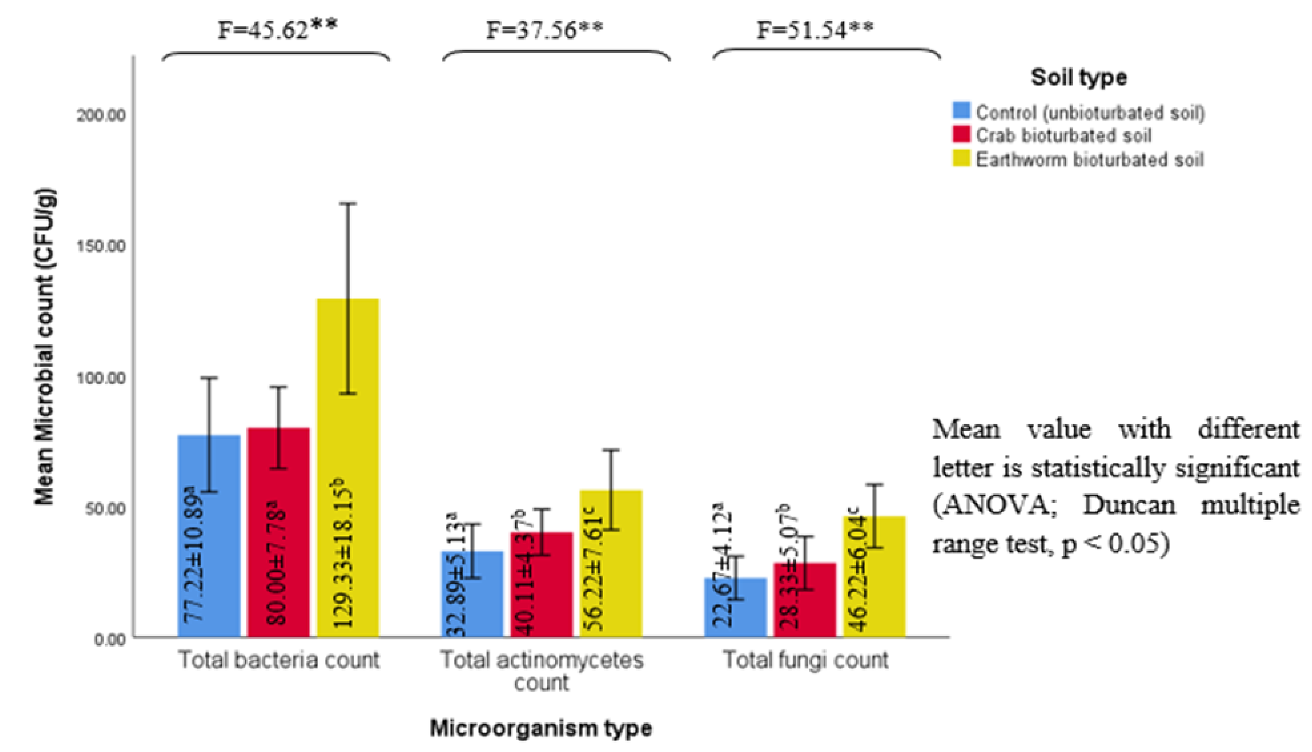

Fig. 5: Microbial counts in bioturbated and unbioturbated soil samples

Conclusion

Earthworm bioturbated, crab-bioturbated, and unbioturbated soils were collected from the same wetland habitat and analysed for microbial and physicochemical properties, for the purpose of comparative appraisal. Bioturbated soils were generally better in microbial and nutrient quality, than unbioturbated soil; but earthworm-bioturbated soil exhibited improved quality, relative to crab-bioturbated soil. Thus, we conclude that both earthworms and crabs positively influence wetland soil quality, but earthworm activities impact better effects. Efforts should be geared towards conserving the populations of wetland earthworms and crabs, as their contributions are complimentary in soil enrichment.