

TAXONOMIC DIVERSITY OF PROKARYOTIC COMMUNITIES IN A MEDITERRANEAN PADDY SOIL MANAGED WITH COMPOST AMENDMENT

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INTRODUCTION

- Paddy soils are highly managed agricultural soils showing unique ecological features. Soil characteristics and environmental factors can influence the prokaryotic communities, soil functioning and hence nutrient dynamics¹.
- Given the importance of rice cultivation for food provision worldwide, assessing the taxonomic diversity responses to soil management practice becomes decisive for adopting proper sustainable measures².
- Can the use of compost from municipal solid waste change the resilient prokaryotic communities in paddy soil?

MATERIALS AND METHODS

- Replicated experimental plots (10 x 10 m each) were arranged in a rice (*Oryza sativa* L. cv *Karnak*) paddy field during the 2022/2023 growing season in a farm located in the costal lowland of Crati river in Southern Italy (Sibari Plain, Cosenza, Calabrian Region). Amended plots were added with municipal solid waste (MSW) compost (8 t/ha), while no organic amendment was supplied to control plots. Soil was sampled 5 times during the rice growing cycle to monitor changes in taxonomic diversity of procommunity across increasing sampling times, from immediate to long-time.
- Soil-extracted DNA was amplified with tagged primers targeting the V1-V4 hyper-variable region of 16S rDNA and sequenced by MinION platform. Taxonomic classification and quantitative analysis of reads were performed by Kraken2 tool (v2.2.1).
- Abundance-based coverage estimators (ACE) index, Chao1 index, and Shannon diversity index were used to evaluate the α -diversity at phylum level.

Major physical and chemical properties of the paddy soil	
WRB classification	Calcari-Gleyic Fluvisols
Texture (USDA)	Silty clay loam
Bulk density (kg dm ⁻³)	1.24
pH _{CaCl2}	7.31
CE _{1:2} (dS m ⁻¹)	0.357
Total CaCO ₃ (g kg ⁻¹)	121.4
Active CaCO ₃ (g kg ⁻¹)	35.0
C _{org} (g kg ⁻¹)	17.1
N _i (g kg ⁻¹)	1.6
C _{org} /N _i	10.7
CEC (cmol kg ⁻¹)	22.02
Soil permeability (mm h ⁻¹)	4.0



T₀ 28/01/2022
After crop harvest



T₁ 26/05/2022
After compost amendment and tillage



T₂ 06/07/2022 - T₃ 21/09/2022
Rice crop

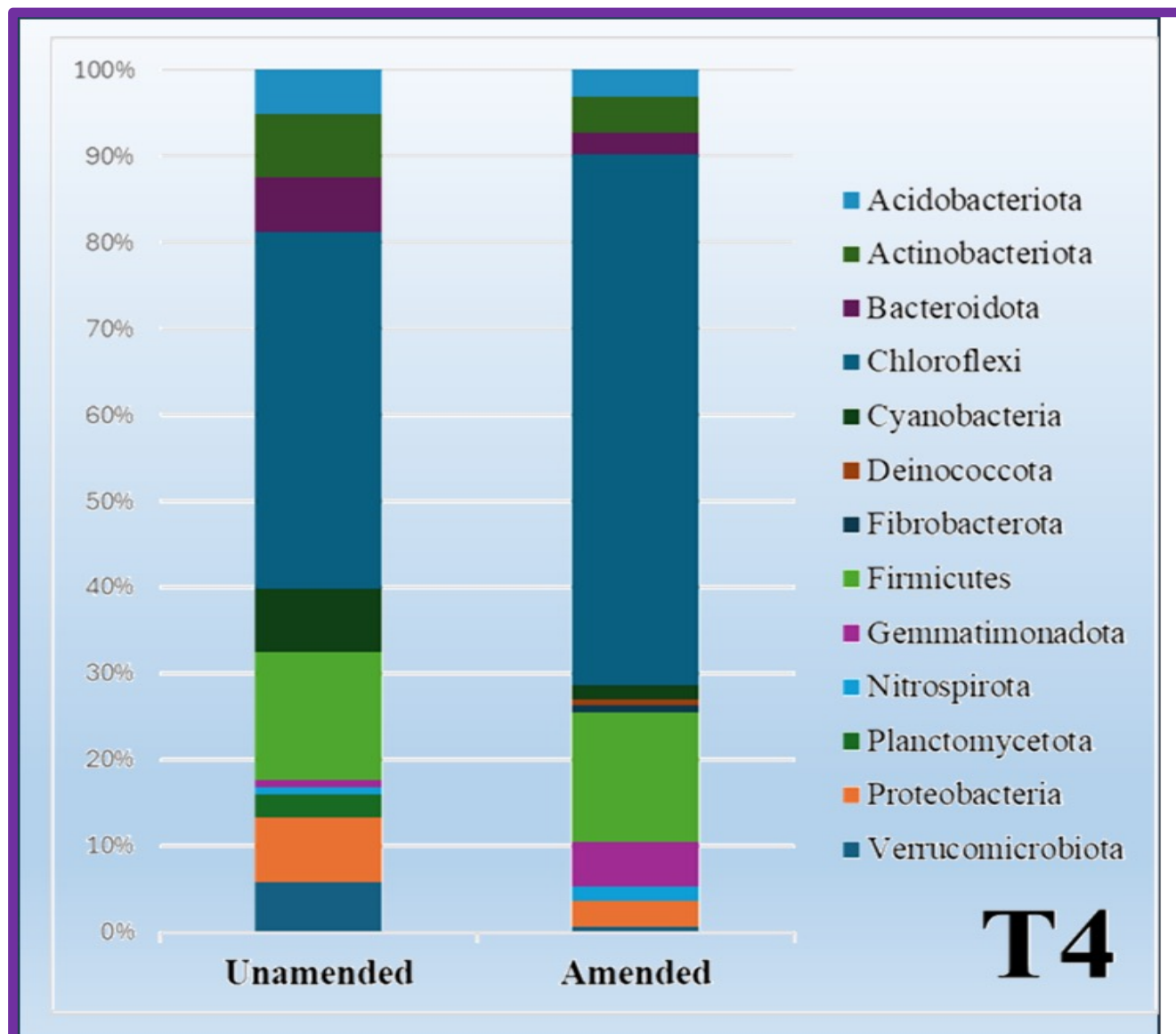
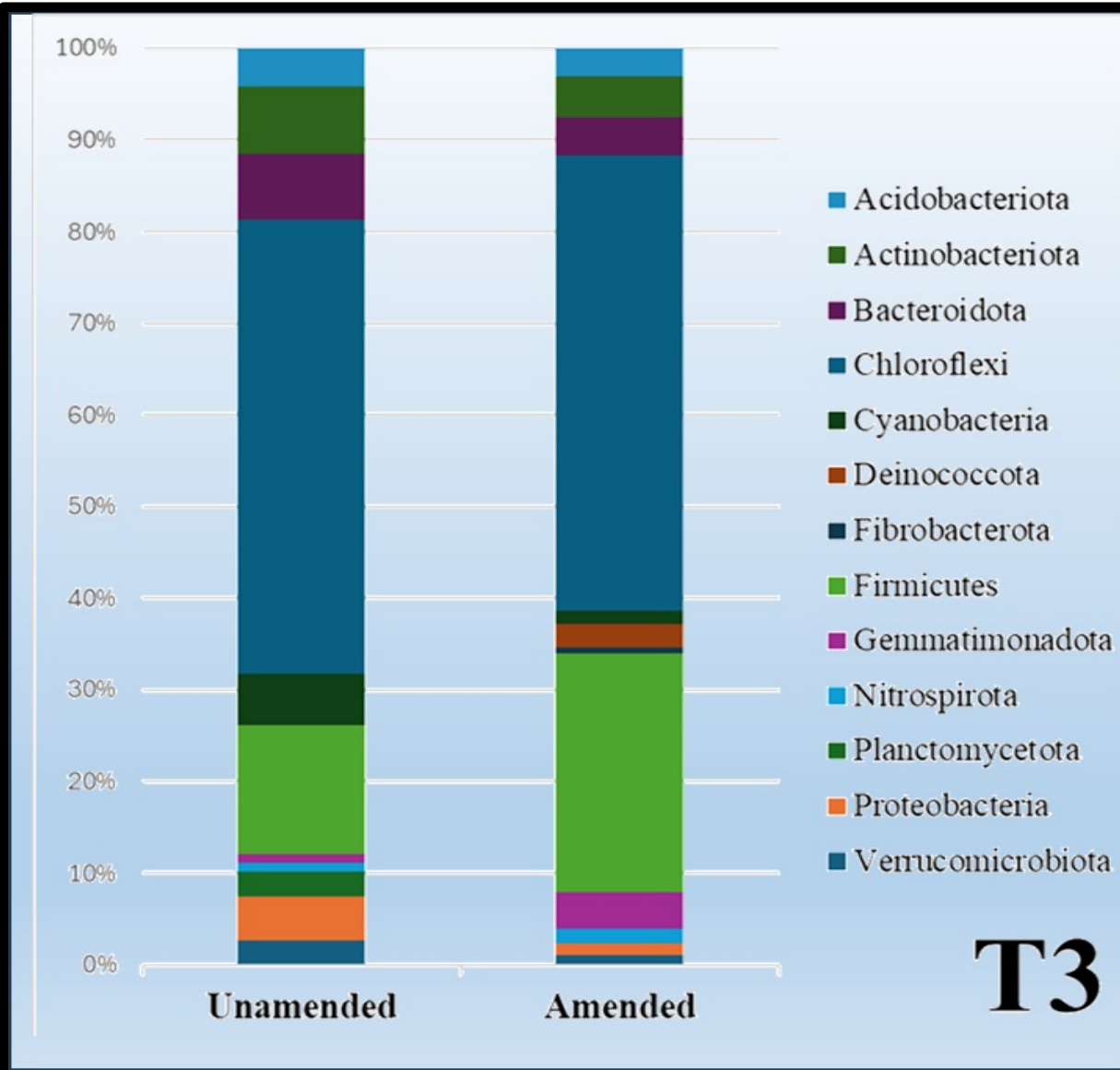
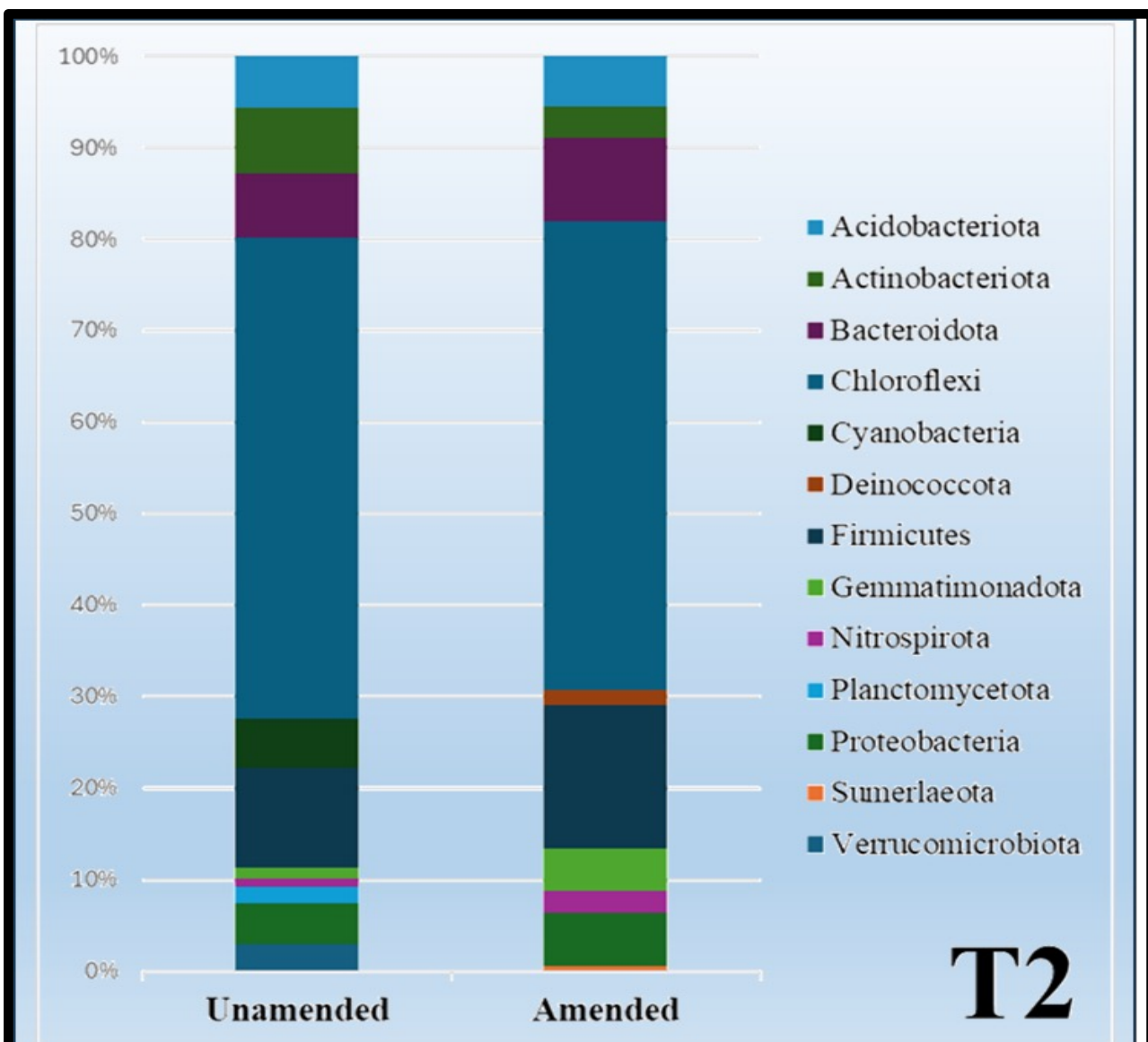
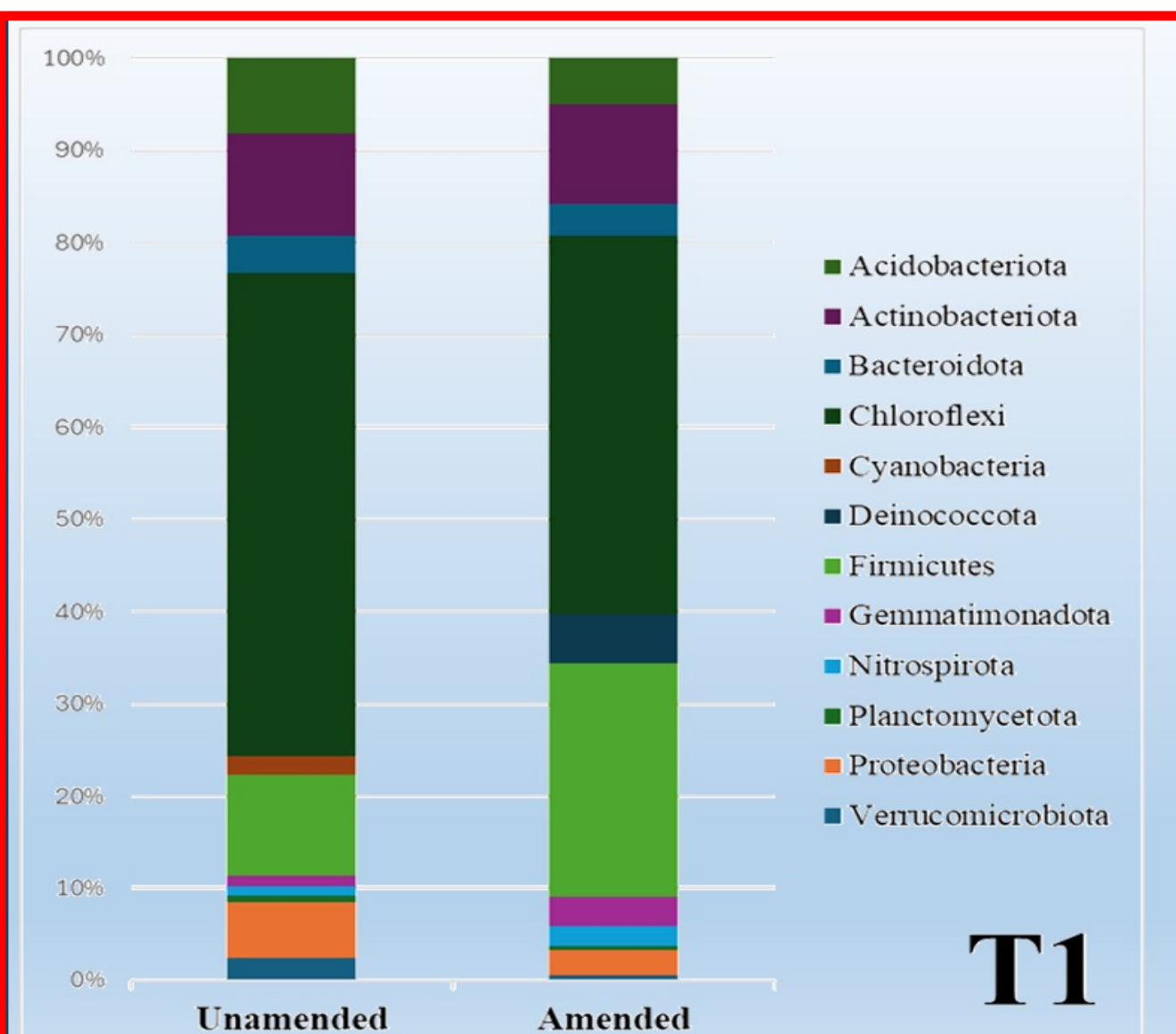
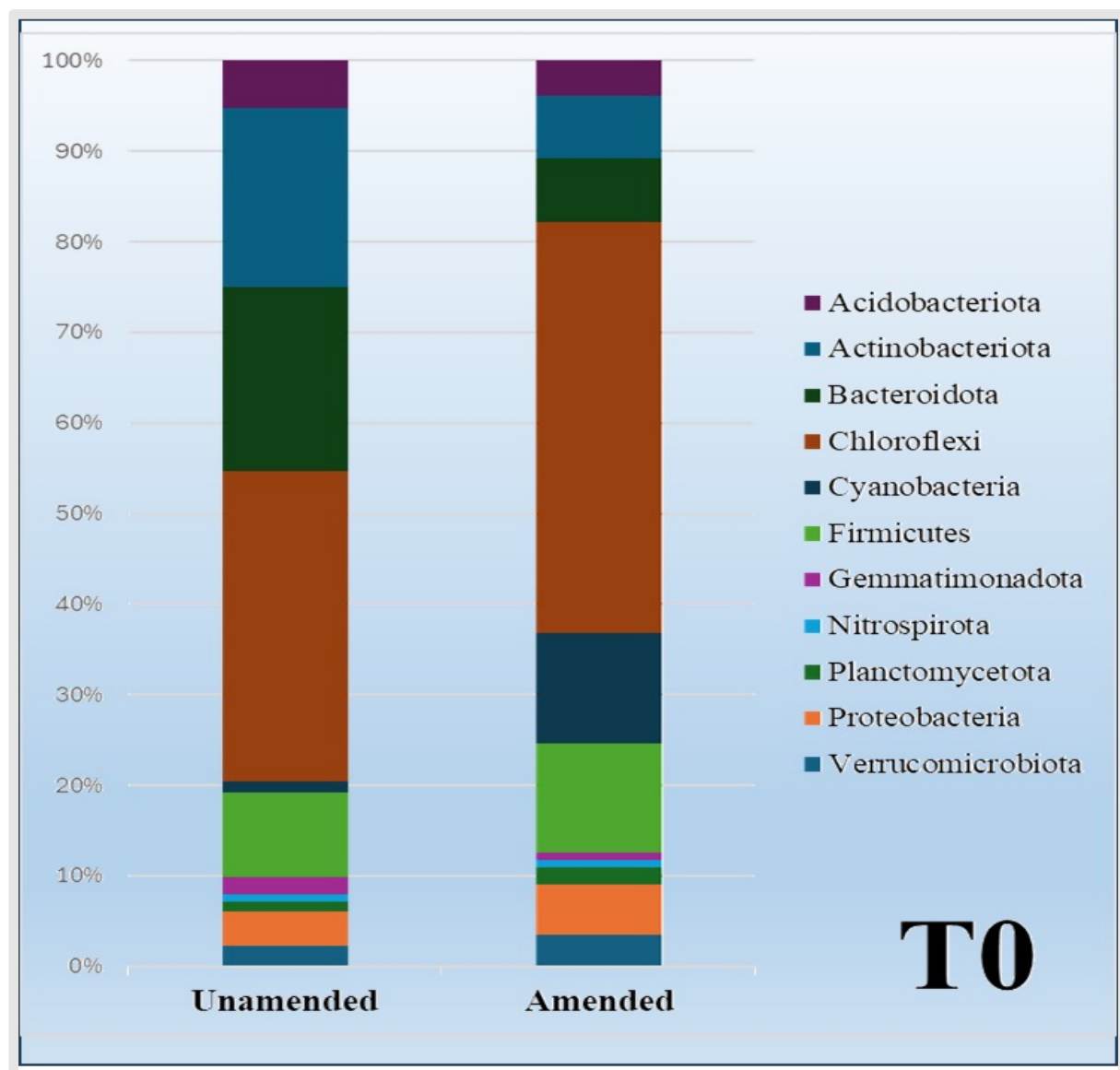


T₄ 23/03/2023
Before new crop cycle

Main properties of the municipal solid waste compost TERRASANA-BIO®	
pH	8.5±0.6
CE (dS m ⁻¹)	3.7±0.4
C _{org} (%)	22±2
N _i (%)	1.9±0.2
C _{org} /N _i	12±2
C _{umico} + fulvico (%)	8.4±1.0
N _{org} /N _i (%)	94±6
Germination index (%)	93±10
Cd (mg kg ⁻¹)	0.63±0.18
Cr _{VI} (mg kg ⁻¹)	<0.1
Hg (mg kg ⁻¹)	0.19±0.07
Ni (mg kg ⁻¹)	28±5
Pb (mg kg ⁻¹)	32±10
Cu (mg kg ⁻¹)	81±14
Zn (mg kg ⁻¹)	221±49
Salmonella (MPN 25 g ⁻¹)	absent
Escherichia coli (UFC g ⁻¹)	< 100

RESULTS

- Prokaryotic soil communities were largely (> 50%) dominated by oligotrophic *Chloroflexi*, which are characterized by autotrophic, heterotrophic and mixotrophic taxa.
- Amendment with MSW compost stimulated a significant and rapid increase of copiotrophic *Firmicutes*, which was not persistent over the long term.
- Gemmatimonadota and Proteobacteria showed an opposite response to the compost amendment, being more or less abundant, respectively, in amended or in unamended plots from T1 sampling.
- The α -diversity indices confirmed the marked and transient variation in major taxa, especially at the 2-day (T1) sampling.



Absolute prokaryotic phyla abundance

- RED BORDER: dry soil
- BLACK BORDER: flooded soil
- VIOLET BORDER: still wet but not flooded soil

CONCLUSIONS

- The addition of MSW organic matter seems to act in three way over prokaryotic community: I) it favors a quick development of copiotrophic microorganisms in the short term; II) It does not affect the dominant phyla across the 14 months long experimental period; III) It increases or depletes minor phyla adaptable both to oligotrophic and copiotrophic conditions but responding in a opposite way to the amendment.
- This finding suggests that, besides ephemeral compositional changes due to compost-derived substrates and nutrients, soil type and repeated crop cultivation created ecological conditions conducive to a resilient bacterial community.

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