

Galvez A.^{1,2,*}, Sinicco T.¹, Cayuela M.L.³, Mingorance M.D.², Mondini C.¹

¹Research Group of Gorizia, CRA-RPS, Via Trieste 23, 34170 Gorizia, Italy.

²Instituto Andaluz de Ciencias de la Tierra (CSIC-UGR), Profesor Albareda 1, 18008 Granada, Spain.

³Dept. of Soil Quality, Wageningen University, PO Box 47, 6700 AA Wageningen, The Netherlands.

*Corresponding author: agalvezp@ugr.es

1. INTRODUCTION

One of the major threats for the sustainability of agricultural systems is represented by the decreasing availability of water for irrigation. In this context, wastewaters can constitute an important resource, not only for irrigation, but also for the supply of nutritive elements. Another problem faced by agricultural systems in the last decades is the loss of soil organic matter caused by the intensification of agricultural practices. An effective solution to this problem is represented by the application to soil of organic residues of different origin. While there are many studies regarding the effect of soil application of either wastewater or organic residues, the knowledge about the effects of the combined use of wastewater and amendments is still limited. However, in order to increase the efficiency of this strategy and to minimize the possible adverse effects, a thorough evaluation of the effects of wastewater on amended soils is necessary.

Aim: To investigate the effects of the combined application of wastewater and different organic residues on C and N mineralisation, CO₂ emissions and microbial biomass size and activity.

2. MATERIAL AND METHODS

INCUBATION EXPERIMENTS

DISTILLED WATER



OR

ARTIFICIAL WASTEWATER



TOC = 643 mg L⁻¹
TN = 216 mg L⁻¹
pH = 7
EC = 1148 μS cm⁻¹



IRRIGATION: 40% WHC



pH = 8.3
Clay = 3%
TOC = 11.7%
TN = 0.57%

AMENDMENT: Residues (0.5% w/w)



Pig digestate (37.9% TOC, 4.4% TN, 8.7 TOC/TN)

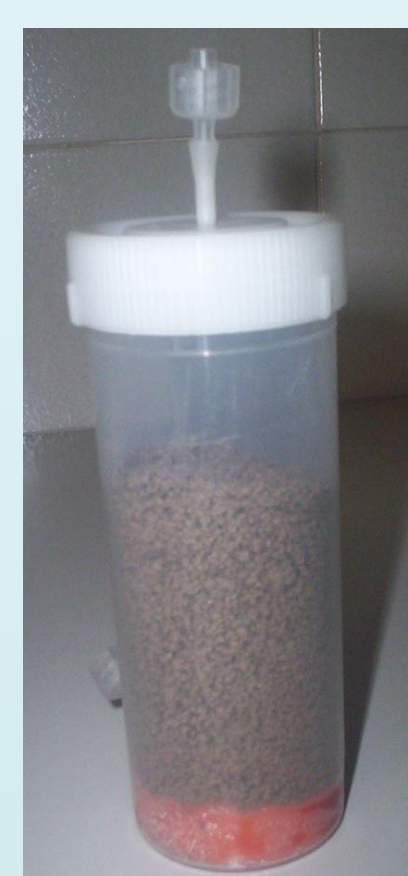


Rapeseed meal (45.9% TOC, 6.0% TN, 7.7 TOC/TN)



Household waste compost (34.4% TOC, 2.3% TN, 14.9 TOC/TN)

INCUBATION (30 days at 20 °C)



Soil CO₂ evolution
(gas chromatography)
(every 6 hours)

Enzymatic activity
(2, 7, 30 d)

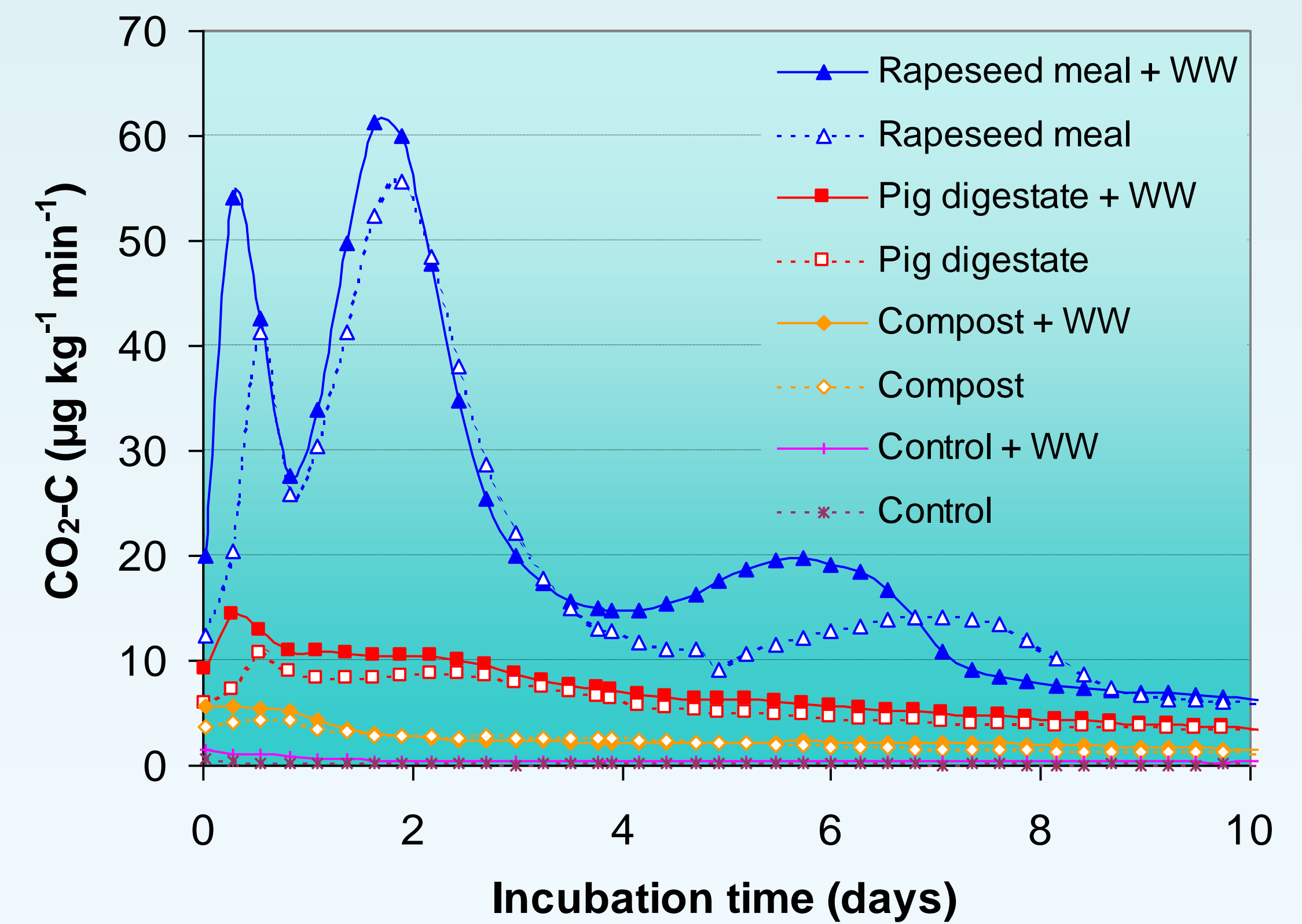
Soil microbial biomass
(2, 30 d)



NH₄⁺, NO₃⁻, EN, EOC
(1:4 (w/v) K₂SO₄ 0.5M extract)
(2, 7, 30 d)

3. RESULTS AND DISCUSSION

CO₂ EMISSIONS



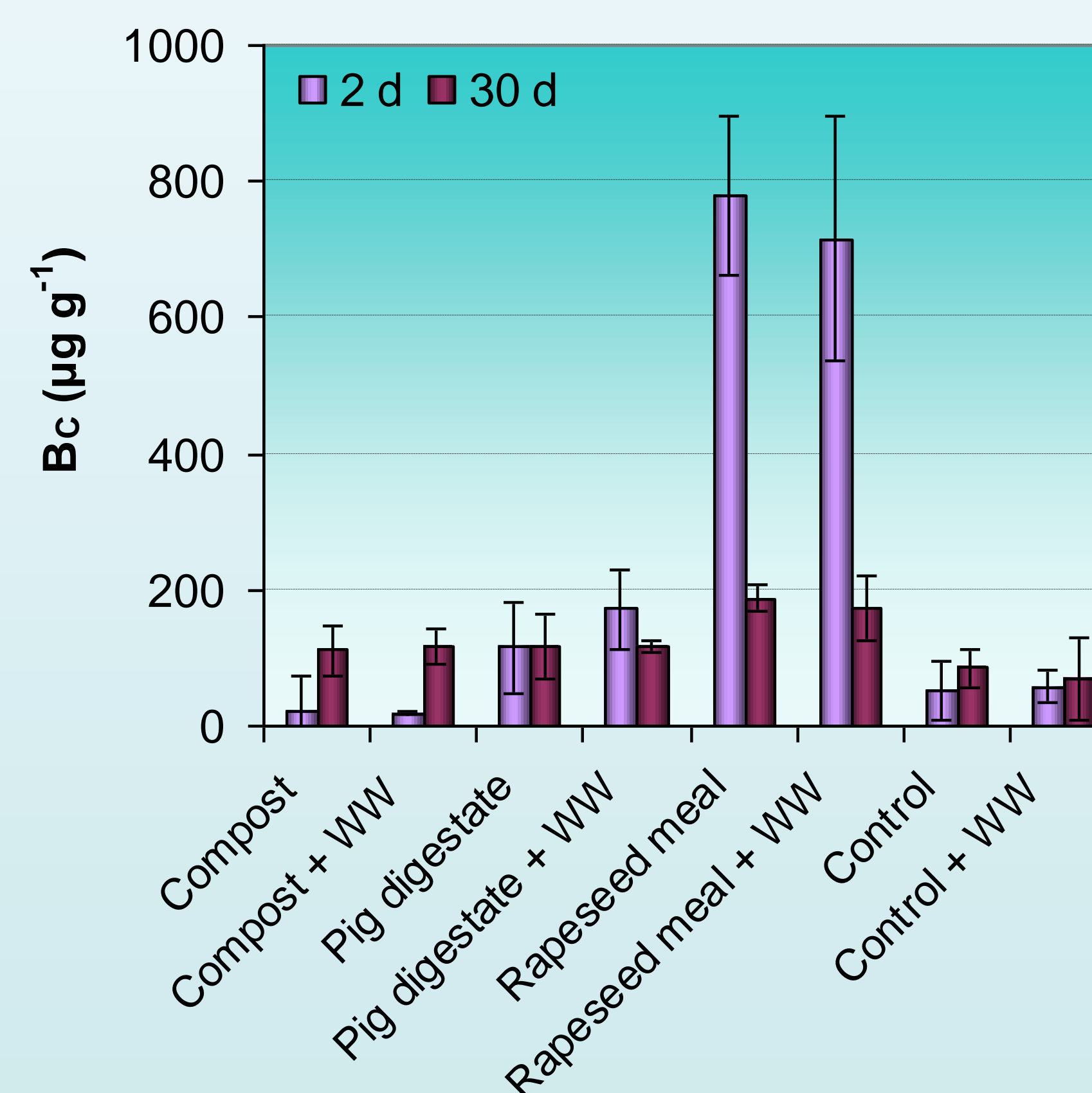
The addition of wastewater provoked a slight increase on the CO₂ emissions for all the residues during the first 10 days of incubation.

C AND N MINERALIZATION

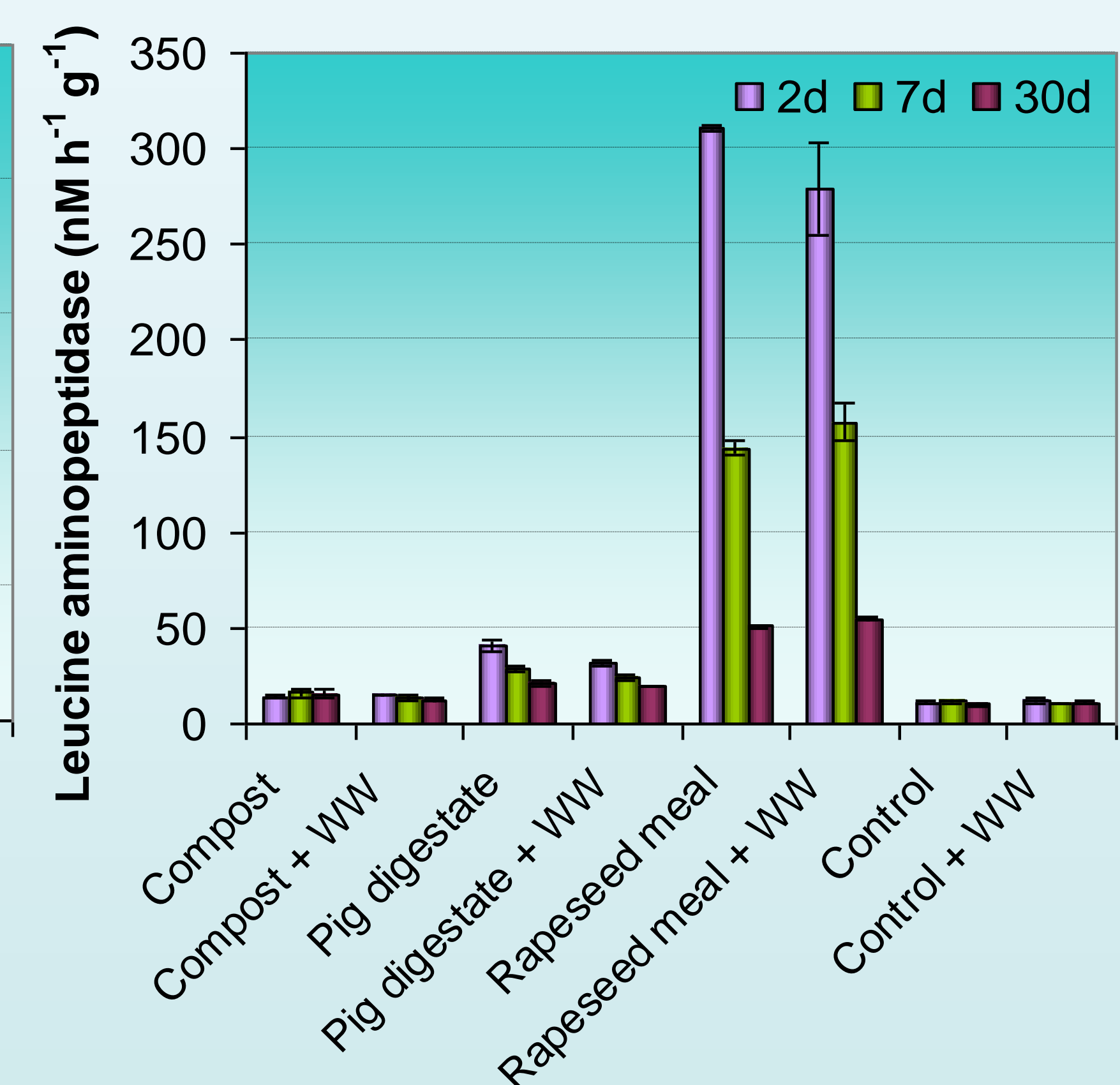
Residue	Extra CO ₂ -C		Net mineral N	
	(μg g ⁻¹)	(% of added C)	(μg g ⁻¹)	(% of added N)
Rapeseed meal	338	14.7	135	38.5
Rapeseed meal + WW	375	15.6	157	40.8
Pig digestate	123	6.5	46	17.9
Pig digestate + WW	136	6.8	76	25.9
Compost	44	2.6	-8	-6.2
Compost + WW	51	2.8	16	9.6
Control + WW	8	7.2	25	69.4

The addition of wastewater caused an increase in cumulative respiration in all the treatments. Due to the N contained in the wastewater, its addition to the soil increased the net mineral N.

MICROBIAL BIOMASS C



ENZYMATIC ACTIVITY



The addition of wastewater did not cause significant variations in the soil microbial content and did not significantly affect the enzymatic activity.

4. CONCLUSIONS

This study clearly indicates that the application of wastewater to an amended soil may increase the rate of mineralisation and the content and activity of soil microbial biomass. Furthermore, the wastewater provides additional nutritive elements to the nutrients added with the organic amendments. In the case of the soil amended with rapeseed meal and pig digestate the addition of wastewater stimulated soil organic matter mineralisation (endogenous and/or exogenous), with benefits related to the release of nutritive elements and the availability of readily degradable substrates for the microbial biomass. Therefore, the use of wastewater for irrigation of amended soils appears as an effective strategy for the recovery of wastewaters.

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