Supplementary Information

Anaerobically Treated Leachate from a Composting Plant: Characterization and Evaluation as a Biofertilizer

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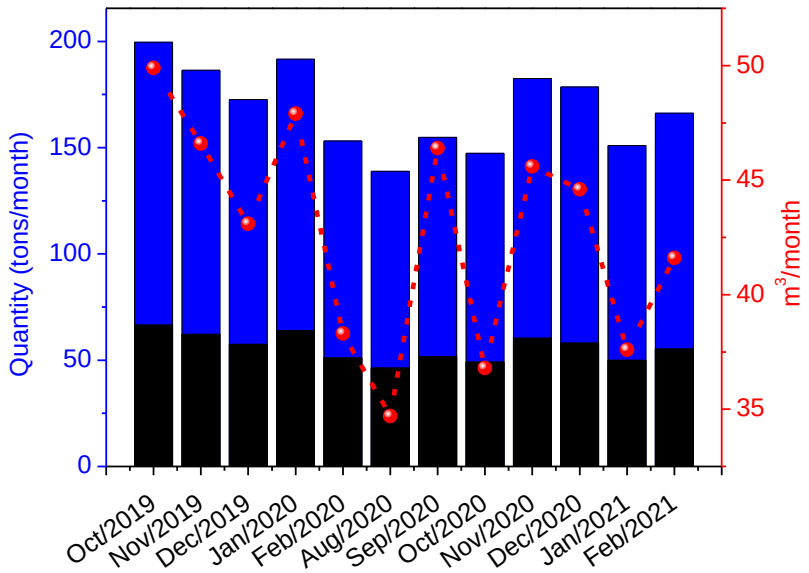

Figure S1. Amounts of waste composted (■), compost produced (■) and effluent generated (●) over 12 months at the composting plant.

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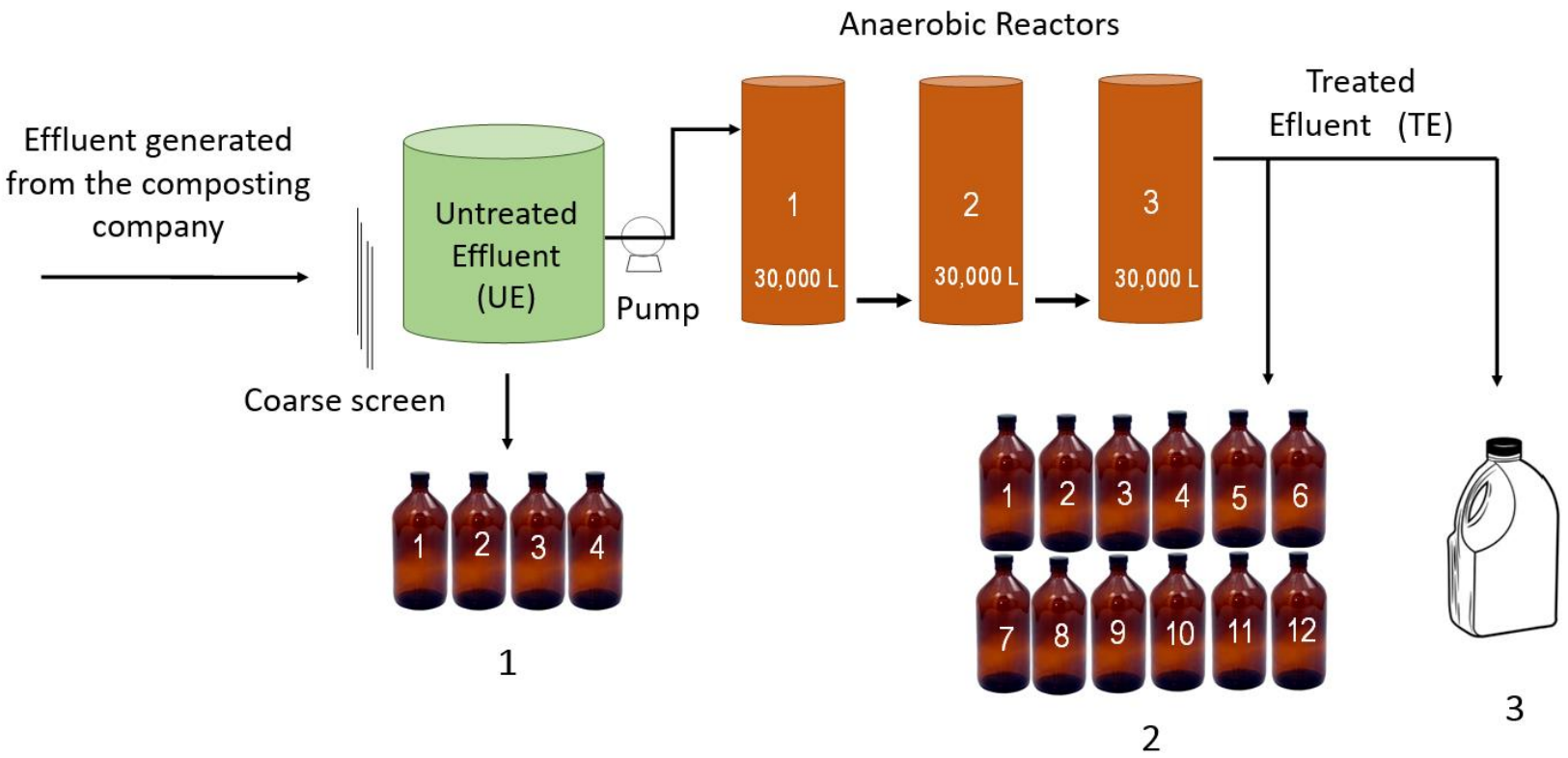

Figure S2. Representative scheme of anaerobic treatment tanks for the leachate generated from the composting process and sampling locations for untreated (1) and treated (2 and 3) leachate.

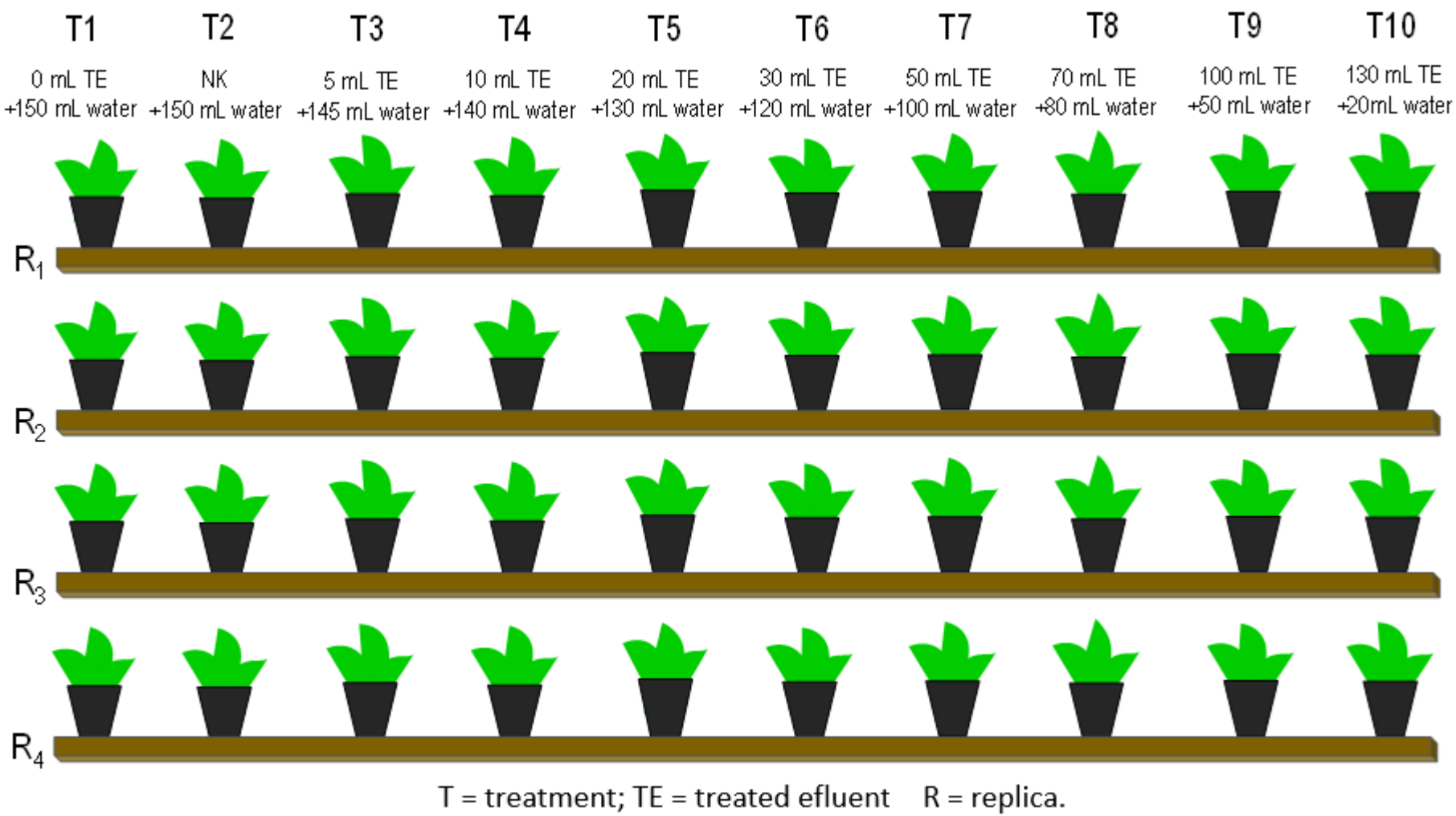

Figure S3. Scheme of treatments performed to evaluate treated effluent from a composting plant used as biofertilizer in lettuce crops.

Figure S4. Treated effluent samples from a composting company collected in different months, highlighting the unusual aspect of the September 2020 sample.

Table S1. Metals analyzed in the treated effluent samples and instrumental information from flame atomic absorption spectrophotometer such as linear working range (LWR), limit of quantification (LOQ) and maximum absorption wavelength (λ_{max})

Metal	LWR / (mg L^{-1})	LOQ / (mg L^{-1})	λ_{max} / nm
Cr	0.060-15.00	0.060	357.9
Cu	0.030-10.00	0.030	324.7
Mn	0.020-5.00	0.020	279.5
Fe	0.060-15.00	0.060	248.3
Cd	0.020-3.00	0.020	228.8
Pb	0.100-30.0	0.100	217.0
Zn	0.010-2.00	0.010	213.9
Ca	0.010-3.00	0.010	422.7
Mg	0.003-1.00	0.003	285.2
K[a]	0.040-5.00	0.040	–

The curves used presented a coefficient of variation = 0.9999. [a]Determined by flame photometry.

Table S2. Parameters obtained for samples of untreated effluent (UE) obtained from a composting industry in different months

Month/Year	pH	N(NH_3) / (mg L^{-1})	TKN / (mg L^{-1})	P / (mg L^{-1})	TOC / (mg L^{-1})	COD / (mg L^{-1})	BOD_5 / (mg L^{-1})
Nov/2020	5.7	684	1605	217	19239	50247	44200
Dec/2020	4.6	284	430	304	25181	57604	41650
Jan/2021	5.8	1647	2050	301	26856	87063	45900
Feb/2021	4.8	819	2098	333	26150	71438	26633
Average	5.2	859	1546	289	24357	66588	39596
Standard deviation	1.0	496	672	44	3014	14058	7635

TKN: total Kjeldahl N;TOC: total organic carbon; COD: chemical oxygen demands; BOD: biochemical oxygen demands.

Table S3. Parameter results for the treated effluent (TE) samples

Month/Year	pH	$N(NH_3)$ / (mg L^{-1})	TKN / (mg L^{-1})	P / (mg L^{-1})	TOC / (mg L^{-1})	COD / (mg L^{-1})	BOD_5 / (mg L^{-1})
Oct/2019	8.18	923	996	15	–	2435	–
Nov/2019	8.02	941	1319	10	–	3602	412
Dec/2019	8.09	1044	1153	15	–	2281	329
Jan/2020	7.96	880	1004	8	652	1573	–
Feb/2020	7.95	1054	1043	10	1130	2917	461
Aug/2020	8.62	1765	1936	5	972	2208	445
Sep/2020	7.15	1728	1140	103	22301	21917	–
Oct/2020	8.76	902	1007	5	1367	2174	143
Nov/2020	8.72	1134	1291	4	1363	2059	119
Dec/2020	8.68	1179	1177	5	1210	1651	118
Jan/2021	8.59	1210	800	5	1048	1770	32
Feb/2021	7.75	1599	1160	9	1397	1322	48
Average[a]	8.2	1197	1169	8[a]	1142[a]	2181[a]	234
Standard deviation[b]	0.5	322	280	4[a]	236[a]	619[a]	166

$N(NH_3)$: ammoniacal nitrogen; TKN: total Kjeldahl nitrogen; TOC: total organic carbon; COD: chemical oxygen demand; BOD_5: biochemical oxygen demand. [a]The average and standard deviation values were calculated disregarding the values referring to the sample for the month of September (these values were considered outliers). [b]Through the method used for TOC analysis, it was not possible to detect inorganic carbon dioxide in the samples for the months of October, November and December 2019. The BOD_5 analyzes for the months of October/2019, January/2020 and September/2020 could not be completed due to the absence of oxygen (formation of white precipitate in the analysis).

Table S4. Solid analysis results for the treated effluent sample

Month/Year	TS / (mg L^{-1})	TSV / (mg L^{-1})	TSF / (mg L^{-1})	TSS / (mg L^{-1})	VSS / (mg L^{-1})	FSS / (mg L^{-1})
Oct/2019	10028	2903	7125	2360	1447	913
Nov/2019	10570	2517	8053	903	497	407
Dec/2019	10718	2235	8483	640	345	295
Jan/2020	9751	1542	8209	257	175	82
Feb/2020	9160	1773	7387	320	277	43
Aug/2020	11109	1973	9136	167	152	15
Sep/2020	57657	15750	41907	103400	22333	81067
Oct/2020	10734	1777	8958	52	40	12
Nov/2020	10457	1704	8752	138	127	12
Dec/2020	10414	1628	8787	91	82	9
Jan/2021	10113	1296	8818	77	61	15
Feb/2021	9431	1003	8428	74	57	16
Average[a]	10226	1850	8376	462	296	165
Standard deviation[a]	567	515	611	653	388	269

TS: total solids; TSV: total volatile solids; TSF: total fixed solids; TSS: total suspended solids; VSS: volatile suspended solids; FSS: fixed suspended solids. [a]The average and standard deviation values were calculated disregarding the values referring to the sample for the month of September (these values were considered outliers).

Table S5. Comparison of the average amounts of fresh (FM) and dry (DM) matter production in lettuce treated with mineral fertilizer (T2) or different volumes of TE. Values in each column followed by the same letter are statistically equal (Dunnet's test, $\alpha = 0.05$; coefficient of variation 9.24)

Treatment	TE dose / mL	FM / g	DM / g
T2	–	223.75 a	15.09 a
T1	0	128.66 b	10.85 b
T3	25	132.22 b	11.02 b
T4	50	156.77 b	12.56 b
T5	100	173.51 b	12.73 b
T6	150	179.41 b	12.87 b
T7	250	204.77 a	13.92 a
T8	350	208.95 a	13.98 a
T9	500	214.77 a	14.45 a
T10	650	172.08 b	12.60 b

FM: fresh matter; DM: dry matter; NK: nitrogen and potassium. "a" and "b" represent groups in which the treatments do not differ statistically from each other.

Table S6. Macronutrient contents in the aerial part of lettuce after treatment with treated effluent

Treatment	N / (g kg^{-1})	P / (g kg^{-1})	K / (g kg^{-1})	Ca / (g kg^{-1})	Mg / (g kg^{-1})	S / (g kg^{-1})
T1[a]	[c]	3.7 ± 1.8	17 ± 6	5.0 ± 1.8	2.1 ± 0.7	1.3 ± 0.5
T2[b]	36 ± 21	3.9 ± 0.9	30 ± 15	5.6 ±0.6	2.8 ± 0.4	1.9 ± 0.2
T3	21 ± 11	4.3 ± 0.6	19 ± 1	5.9 ±0.6	2.6 ± 0.3	1.5 ± 0.1
T4	23 ± 14	4.2 ± 0.8	21 ± 1	4.8 ± 0.5	2.5 ± 0.3	1.7 ± 0.2
T5	30 ± 16	3.9 ± 0.7	21 ± 3	4.7 ± 0.5	2.3 ± 0.5	1.6 ± 0.3
T6	41 ± 26	3.8 ± 0.5	20 ± 2	4.5 ± 0.3	2.5 ± 0.6	1.9 ± 0.2
T7	31 ± 15	2.9 ± 0.3	23 ± 3	4.0 ± 0.5	2.1 ± 0.5	1.8 ± 0.2
T8	35 ± 2	3.3 ± 1.2	32 ± 11	3.8 ± 0.3	2.3 ± 0.5	2.0 ± 0.3
T9	40 ± 20	3.6 ± 0.6	35 ± 12	3.3 ± 0.2	2.0 ± 0.3	1.9 ± 0.4
T10	45 ± 10	3.3 ± 0.3	25 ± 14	3.6 ± 0.4	1.9 ± 0.1	2.4 ± 0.1

[a]T1: witness; [b]T2: mineral fertilizer (nitrogen and potassium); [c]there were problems with this review.

Table S7. Results of the parameters used in monitoring the treated effluent sample used in the fertilization of the lettuce crop (biological test)

Month/ Year	$N(NH_3)$ / (mg L^{-1})	TKN / (mg L^{-1})	P / (mg L^{-1})	TOC / (mg L^{-1})	COD / (mg L^{-1})	TS / (mg L^{-1})	TSV / (mg L^{-1})	TSF / (mg L^{-1})	SST / (mg L^{-1})	SSV / (mg L^{-1})	SSF / (mg L^{-1})
Aug/2020	1765	1936	5.0	907	3354	11045	1957	9089	135	75	60
Sep/2020	1746	1892	5.0	1393	3146	10571	1484	9087	198	128	70
Oct/2020	1831	1979	5.6	1158	2226	10862	1528	9334	288	205	83
Nov/2020	1784	1218	4.6	1003	1455	11073	1208	9865	208	168	40
Dec/2020	1447	891	5.9	999	2176	10967	1313	9653	175	132	43
Jan/2021	1532	868	6.6	1094	1540	11165	1371	9794	228	168	60
Average	1684	1464	6	1092	2253	10947	1477	9471	205	146	59
Standard deviation	142	486	1	156	662	192	239	318	47	41	15

$N(NH_3)$: ammoniacal nitrogen; TKN: total Kjeldahl nitrogen; TOC: total organic carbon; COD: chemical oxygen demand; TS: total solids; TSV: total volatile solids; TSF: total fixed solids; TSS: total suspended solids; VSS: volatile suspended solids; FSS: fixed suspended solids.