



Microbial uptake and utilization of low molecular weight organic substrates in soil depend on carbon oxidation state

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Table 1

Table 1 Selected soil properties.

Sand	Silt	Clay	Moisture content	pH	Total C	Total N	C-to-N ratio
(g kg ⁻¹)	(g kg ⁻¹)	(g kg ⁻¹)	(%)		(g kg ⁻¹)	(g kg ⁻¹)	
48.2±1.3	33.6±0.9	18.2±2.1	32.9 ± 0.5	5.40±0.03	32.2±1.2	3.2±0.3	10.6±0.3

Soil texture was determined by laser diffraction. pH was measured in 1:2.5 (w/v) soil:distilled water extracts. Total C and N were determined by dry combustion. Values represent the means ± SE ($n = 4$).

Table. 2

Table 2 Single first order kinetic coefficients describing the depletion of individual carbon substrates from soil solution over time.

Substrate	C oxidation state	Pool a_1 (%)	Pool a_2 (%)	k (min^{-1})	Half-life, $T_{1/2}$ (min)
Glucose	0	11.9±4.3	91.6±7.0	0.18±0.03 ^d	3.85±0.12 ^a
Fructose	0	13.9±4.4	91.1±6.9	0.18±0.01 ^d	3.76±0.12 ^a
Formic acid	+2	8.9±0.9	91.0±2.1	1.12±0.11 ^a	0.62±0.08 ^e
Malic acid	+1	12.3±1.6	87.4±3.8	0.68±0.08 ^b	1.03±0.08 ^d
Succinic acid	+0.5	10.9±2.2	88.5±4.9	0.49±0.06 ^{bc}	1.42±0.09 ^c
Alanine	0	7.7±1.9	93.6±4.1	0.46±0.05 ^{bc}	1.51±0.07 ^c
Glycine	+1	12.0±2.4	86.8±5.1	0.35±0.05 ^c	1.97±0.09 ^b

a_1 is an asymptote to which ^{14}C activity falls in single exponential curves, a_2 is an estimated pool size for uptake, and k is an uptake rate constant. Half-life ($T_{1/2}$) values are derived from the parameter values for k . Values represent means \pm SE ($n = 4$). Letters reflect significant differences between the substances, confidential interval = 84%. For a_1 and a_2 no significant differences were found.

Table. 3

Table 3 Double first order kinetic coefficients describing the depletion of individual carbon substrates from soil over time.

Substrate	Pool <i>a</i> (%)	Pool <i>b</i> (%)	k_a (h ⁻¹)	k_b (h ⁻¹)	$k_a T_{1/2}$ (h)	$k_b T_{1/2}$ (h)
Glucose	14.3±0.7 ^d	85.6±0.5 ^a	0.88±0.12 ^{ab}	0.0024±0.0003 ^c	0.79±0.10 ^{bc}	288.8±0.09 ^a
Fructose	17.1±0.5 ^d	82.9±0.3 ^b	1.01±0.08 ^{ab}	0.0028±0.0002 ^b	0.68±0.06 ^{bc}	247.6±0.05 ^b
Formic acid	82.8±2.5 ^a	17.2±1.9 ^g	0.87±0.07 ^b	0.0270±0.0070 ^a	0.80±0.05 ^b	25.7±0.19 ^e
Malic acid	44.6±1.4 ^b	55.4±0.9 ^d	1.33±0.14 ^a	0.0044±0.0008 ^b	0.52±0.08 ^c	157.5±0.13 ^d
Succinic acid	49.4±2.5 ^b	50.6±1.6 ^e	1.11±0.17 ^a	0.0039±0.0020 ^{bc}	0.63±0.11 ^{bc}	177.7±0.31 ^c
Alanine	23.9±1.5 ^c	76.0±1.0 ^c	0.86±0.15 ^{ab}	0.0028±0.0007 ^{bc}	0.81±0.11 ^{bc}	247.6±0.18 ^b
Glycine	26.7±1.2 ^c	73.0±1.0 ^c	0.52±0.06 ^c	0.0044±0.0007 ^b	1.34±0.07 ^a	157.5±0.11 ^d

Pool *a* and *b* are the estimated pool sizes for the fast and slow mineralization phases respectively, while k_a and k_b are the rate constants describing the rate of turnover of these two pools. $T_{1/2}$ values are the half-times for pools *a* and *b* determined from k_a and k_b respectively. Values represent means ± SE ($n = 4$). Letters reflect significant differences between the substances, confidential interval = 84%.