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Soil Research

Supplementary Material

Priming of carbon decomposition in 27 dairy grazed soils after bovine urine additions

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Supplementary Information:

Table S1: Summary of soils and their soil properties. Values in brackets indicate the standard error of the mean.

Soil Name	Soil Order ^a	Bulk Density	WHC ^b	Porosity ^c	Total C ^d	Total N ^e	pH ^f	EC ^g	MBC ^h	GPS
		(g cm ⁻³)	(%)	(%)	(%)	(%)		(dS m ⁻¹)	(mg kg ⁻¹)	
Ohaupo	Allophanic	0.67 (0.04)	109	75	8.59 (0.23)	0.90 (0.02)	5.8 (0.1)	0.216 (0.019)	309	-37°91'S 175°29'E
Tirau	Allophanic	0.68 (0.03)	146	74	9.86 (0.32)	0.96 (0.04)	6.4 (0.1)	0.279 (0.022)	273	-37°99'S 175°88'E
Egmont	Allophanic	0.72 (0.02)	125	73	9.87 (0.28)	0.97 (0.03)	5.6 (0.1)	0.187 (0.014)	247	-39°62'S 174°36'E
Stratford	Allophanic	0.76 (0.02)	111	71	8.68 (0.34)	0.94 (0.03)	5.6 (0.1)	0.232 (0.021)	296	-39°46'S 174.22°E
Lowgarth	Allophanic	0.69 (0.01)	129	74	8.56 (0.78)	0.88 (0.08)	5.8 (0.1)	0.268 (0.035)	287	-39°39'S 174°22'E

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Oaonui	Allophanic	0.51 (0.03)	196	81	14.57 (0.27)	1.44 (0.03)	5.7 (0.1)	0.368 (0.040)	325	-39°39'S 173°88'E
Awatuna	Allophanic	0.56 (0.02)	172	79	12.35 (0.23)	1.17 (0.01)	5.5 (0.04)	0.172 (0.006)	346	-39°32'S 173°81'E
Warea	Allophanic	0.54 (0.01)	170	79	13.52 (0.84)	1.31 (0.06)	5.3 (0.1)	0.217 (0.011)	230	-39°32'S 173°82'E
Waitara	Allophanic	0.71 (0.01)	148	73	9.76 (0.41)	1.00 (0.04)	6.1 (0.05)	0.227 (0.031)	318	-39°00'S 174°27'E
Hopai 1	Gley	0.78 (0.02)	112	71	7.86 (0.49)	0.79 (0.05)	6.4 (0.1)	0.237 (0.041)	352	-37°32'S 175°51'E
Hopai 2	Gley	0.63 (0.04)	157	76	8.03 (0.42)	0.82 (0.03)	5.6 (0.1)	0.417 (0.022)	174	-37°26'S 175°51'E
Elstow	Gley	0.86 (0.02)	116	67	6.21 (0.13)	0.64 (0.01)	5.4 (0.1)	0.242 (0.004)	249	-37°42'S 175°50'E
Waitoa 1	Gley	0.77 (0.03)	101	71	5.18 (0.27)	0.50 (0.03)	6.3 (0.1)	0.213 (0.011)	302	-37°65'S 175°67'E

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Waitoa 2	Gley	0.74 (0.02)	102	72	6.01 (0.48)	0.58 (0.04)	5.1 (0.1)	0.231 (0.012)	225	-37°92'S 175°74'E
Wharepiana	Gley	0.61 (0.05)	150	77	8.16 (0.58)	0.78 (0.05)	5.3 (0.1)	0.322 (0.027)	247	-38°51'S 176°35'E
Rahotu	Gley	0.71 (0.01)	127	73	7.80 (0.19)	0.76 (0.01)	5.4 (0.03)	0.200 (0.034)	250	-39°37'S 173°80'E
Kairanga	Gley	1.04 (0.03)	88	61	4.48 (0.11)	0.44 (0.01)	5.7 (0.1)	0.150 (0.024)	117	-40°74'S 175°12'E
Shannon	Gley	0.96 (0.08)	79	64	4.37 (0.15)	0.40 (0.01)	5.5 (0.1)	0.152 (0.003)	208	-40°77'S 175°18'E
Papamoa	Brown	0.83 (0.01)	84	69	5.82 (0.65)	0.51 (0.05)	6.0 (0.1)	0.227 (0.021)	147	-37°98'S 177°35'E
Opouriao	Brown	0.95 (0.04)	85	64	4.23 (0.34)	0.43 (0.03)	5.7 (0.1)	0.188 (0.032)	285	-38°06'S 177°28'E
Silverdale	Brown	0.80 (0.06)	109	70	8.02 (0.85)	0.83 (0.09)	5.4 (0.2)	0.245 (0.020)	252	-37°78'S 175°32'E

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Kukumoa	Recent	0.94 (0.02)	89	64	3.72 (0.04)	0.36 (0.01)	6.5 (0.04)	0.181 (0.004)	251	-38°00'S 177°27'E
Kopeopeo	Recent	0.83 (0.03)	103	69	6.35 (0.19)	0.57 (0.02)	6.8 (0.1)	0.155 (0.021)	274	-37°96'S 176°92'E
Motuiti	Recent	1.08 (0.09)	54	59	2.40 (0.45)	0.25 (0.04)	4.9 (0.1)	0.281 (0.055)	39	-40°78'S 175°09'E
Rangitikei	Recent	1.22 (0.03)	76	54	2.53 (0.05)	0.28 (0.01)	6.2 (0.1)	0.109 (0.001)	134	-40°79'S 175°18'E
Manawatu	Recent	1.25 (0.03)	62	53	2.48 (0.10)	0.26 (0.01)	5.5 (0.1)	0.089 (0.004)	125	-40°53'S 175°34'E
Waitatuna Valley	Recent	0.79 (0.01)	116	70	5.36 (0.17)	0.58 (0.01)	5.7 (0.1)	0.202 (0.001)	296	-37°87'S 175°83'E

^aNew Zealand soil classification (Hewitt, A.E., 1993. New Zealand Soil Classification. Manaaki Whenua Landcare Research, Lincoln, New Zealand, 133 pp).

^bWater holding capacity, gravimetric

^cPorosity, determined as $1 - (\text{bulk density}/2.65)$. 2.65 assumed to be particle density.

^dLECO combustion furnace on air dried (35°C) soils

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^c1.25 soil:solution (weight/volume) in water on air dried (35°C) soils

^d1.5 soil:solution (weight volume) in water on air dried (35°C) soils

^eEstimated by substrate-induced respiration (Anderson, J.P.E., Domsch, K.H., 1978. Physiological method for quantitative measurement of microbial biomass in soils. *Soil Biology and Biochemistry* 10, 215-221).

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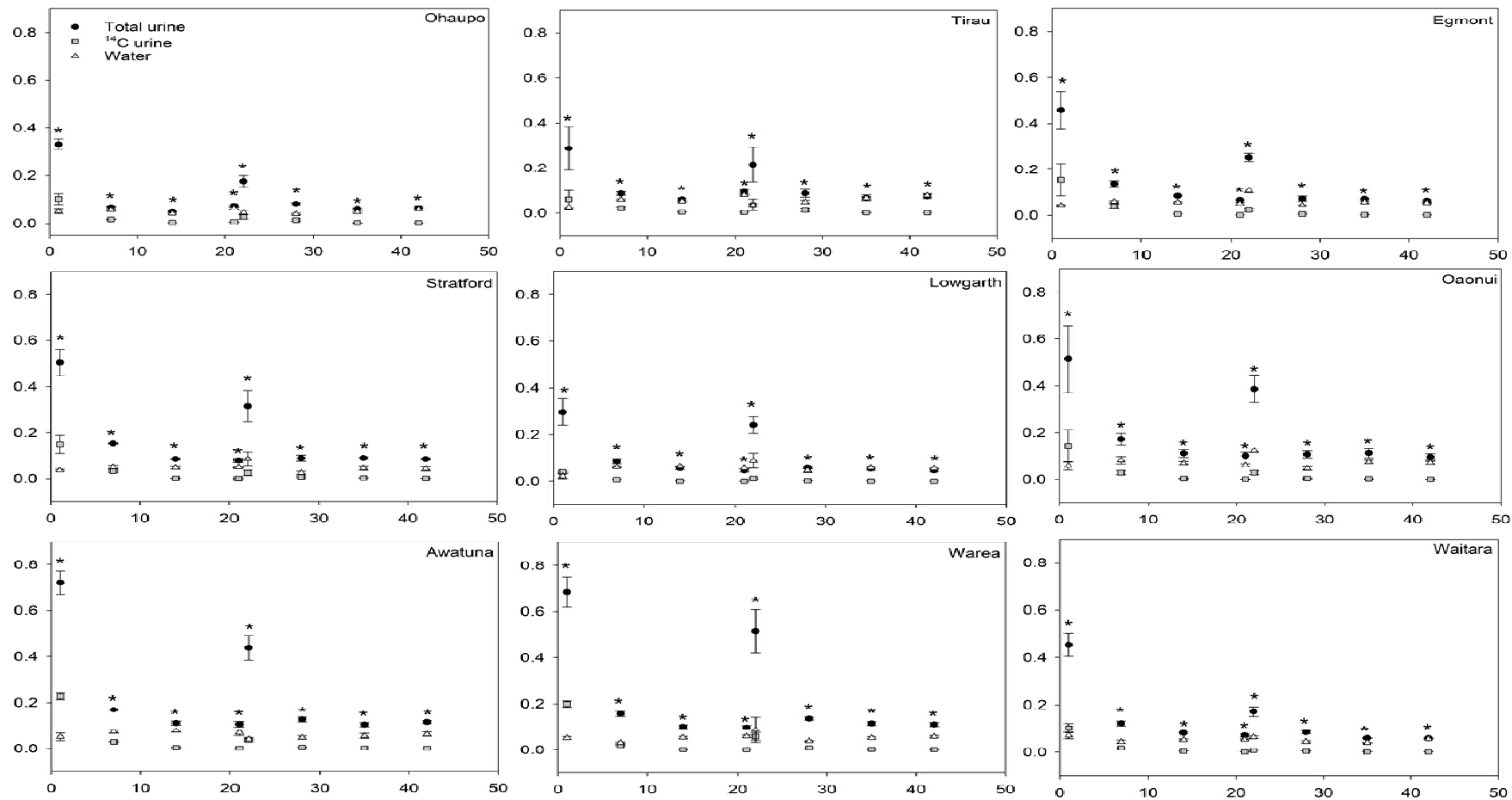
Supplementary Table S2: Linear regression analysis parameters for correlations between total priming of soil carbon decomposition and microbial biomass carbon, basal respiration, and soil moisture.

Soil parameters	<i>P</i> value	r^2
Microbial biomass carbon*	0.540	-
Basal respiration*	0.827	-
Moisture	0.432	-

* Data from a complimentary study on the same soils collected after the 21-day incubation only.

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Supplementary Figures:



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Fig. S1. Total and ^{14}C labelled carbon dioxide fluxes from nine Allophanic soils applied with ^{14}C labelled dairy cow urine or water on day 0 and 21 and incubated for a total of 42 days. Error bars represent the standard error of the mean. Stars indicate differences between treatments on the incubation day ($P < 0.05$).

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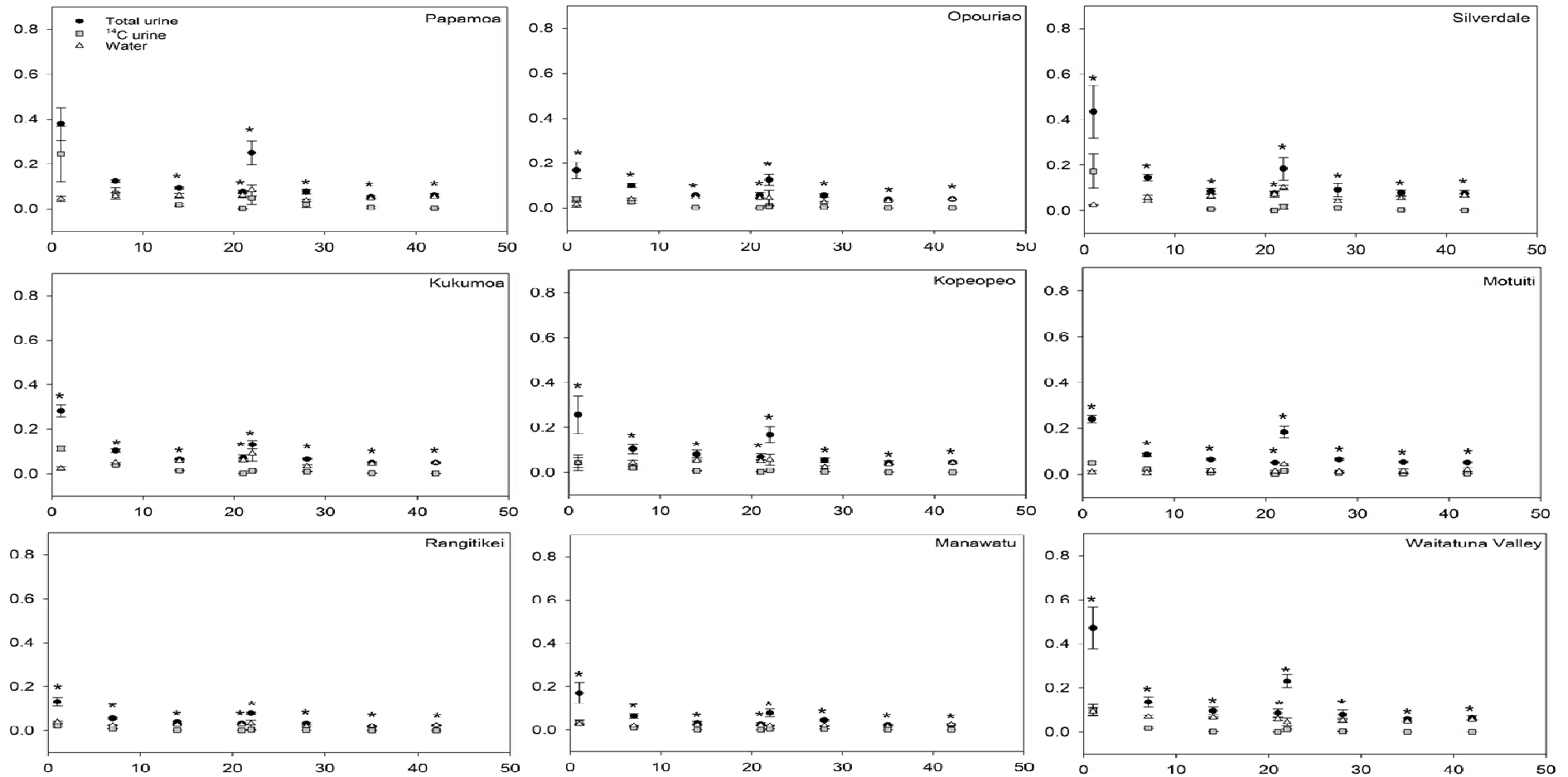


Fig. S2. Total and ¹⁴C labelled carbon dioxide fluxes from three Brown (Papamoa, Opouriao, Silverdale) and six Recent soils applied with ¹⁴C labelled dairy cow urine or water on day 0 and 21 and incubated for a total of 42 days. Error bars represent the standard error of the mean. Stars indicate differences between treatments on the incubation day.

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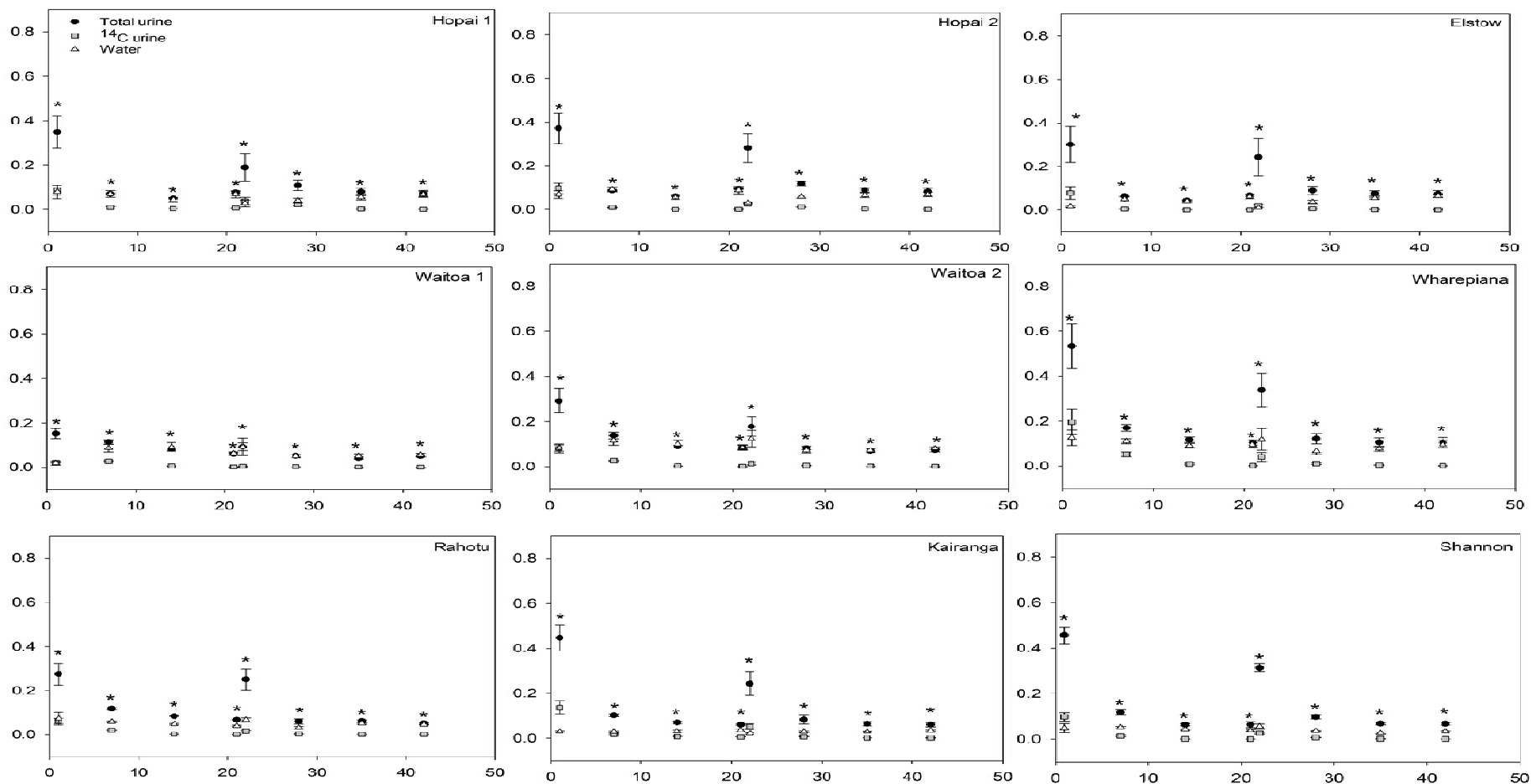


Fig. S3. Total and ¹⁴C labelled carbon dioxide fluxes from nine Gley soils applied with ¹⁴C labelled dairy cow urine or water on day 0 and 21 and incubated for a total of 42 days. Error bars represent the standard error of the mean. Stars indicate differences between treatments on the incubation day.

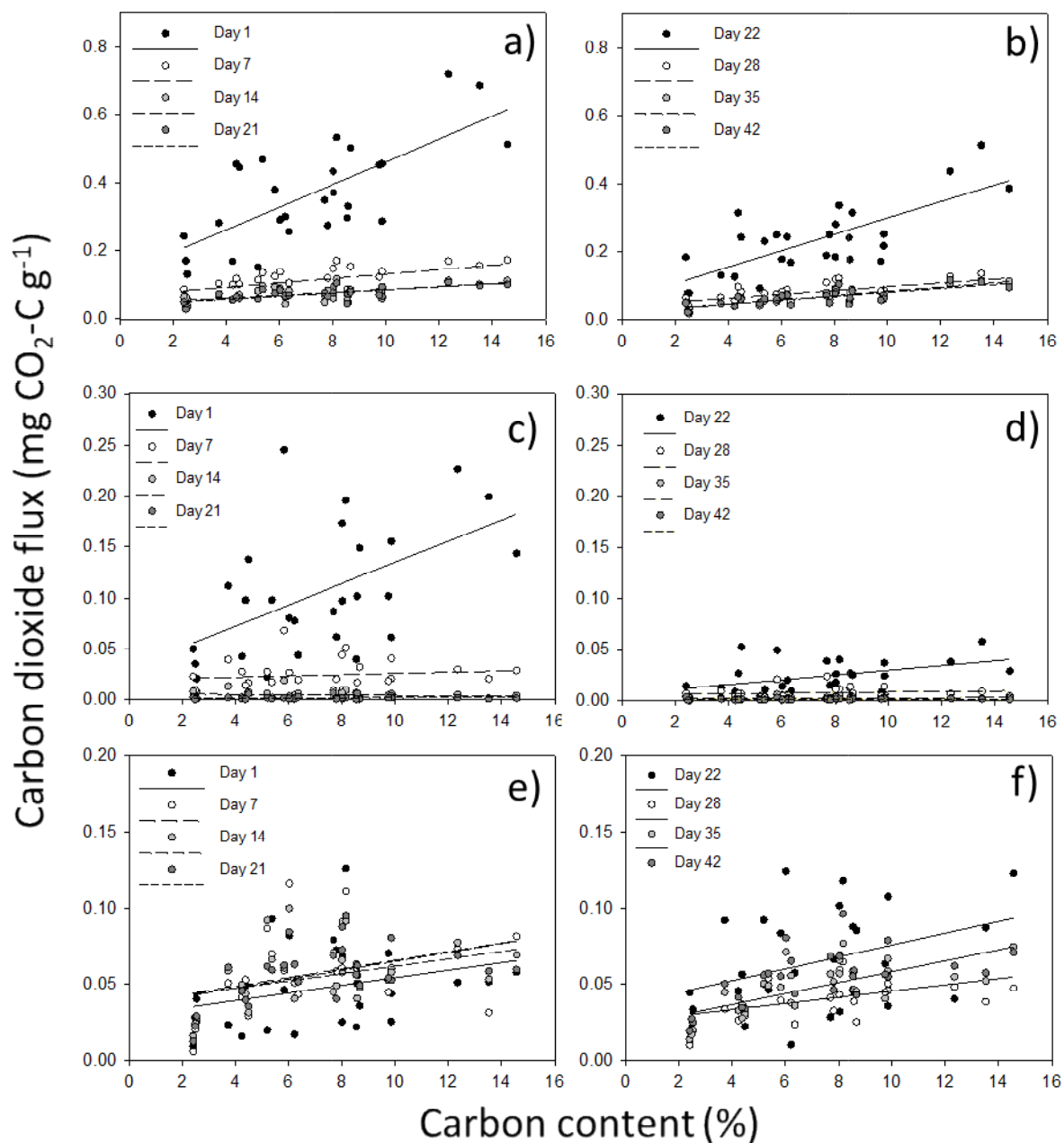


Fig. S4. Linear regression analyses of carbon dioxide fluxes on Day 1, 7, 14 and 21 (a and c) and Day 22, 28, 35 and 42 (b and d) of the incubation against total carbon concentration in urine treated soils where carbon dioxide fluxes are from ¹⁴C labelled urine and soil pools (a and b), ¹⁴C urine only (c and d) and water (e and f) treated soils. Regression parameters are displayed in Table 1.

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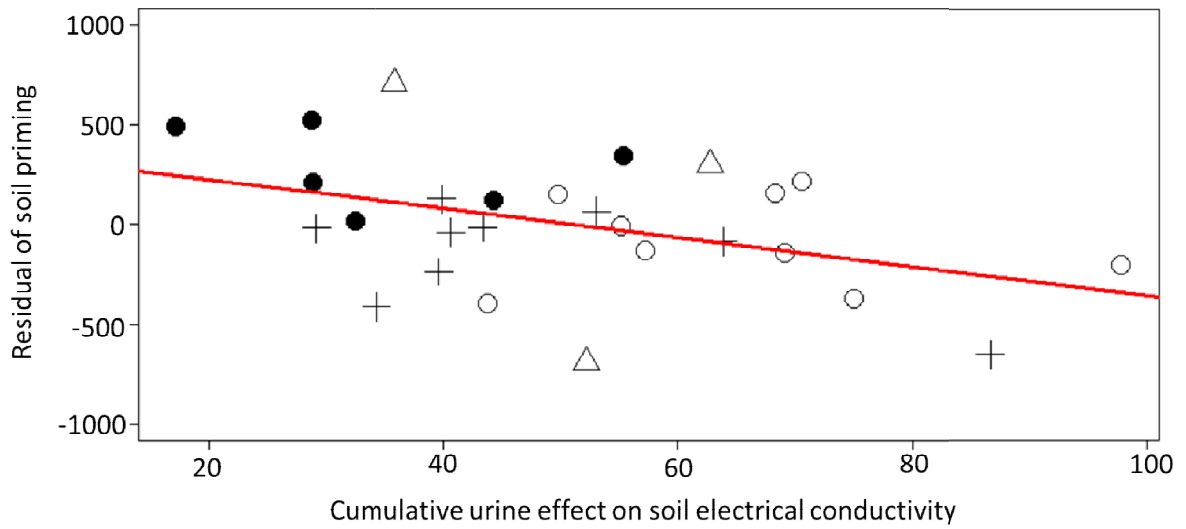


Fig. S5. Cumulative urine effect on soil electrical conductivity versus priming following the second urine and priming in four soil orders ($n=27$). White circles represent Allophanic, white triangles represent Brown, black circles represent Recent and crosses represent Gley soils.