

[10.1071/SR21149](https://doi.org/10.1071/SR21149)

Soil Research

Supplementary Material

Microbial community composition and activity in paired irrigated and non-irrigated pastures in New Zealand

Suzanne M. Lambie^{A,}, Paul L. Mudge^A, and Bryan A. Stevenson^A*

^AManaaki Whenua – Landcare Research, Private Bag 3127, Hamilton 3240, New Zealand.

*Correspondence to: Suzanne M. Lambie Manaaki Whenua – Landcare Research, Private Bag 3127, Hamilton 3240, New Zealand Email: lambies@landcareresearch.co.nz

Supplementary Information.

Supplementary Table S1: Region, Island, soil order, and duration of irrigation at soil sampling sites ($n = 28$) (Mudge et al., 2017).

North Island	Soil No.	Duration of irrigation (years)	Field moisture non- irrigated/irrigated (%)	South Island	Soil No.	Duration of irrigation (years)	Field moisture non- irrigated/irrigated ³ (%)
Bay of Plenty	1	33	27.5(2.0)/57.5(2.3) ²	Canterbury	15	20	10.1(1.0)/18.5(4.0)
region	2	20	24.0(0.5)/32.5(6.1)	region	16	6	11.9(1.2)27.8(3.3)
	3	12	21.3(0.4)/24.1(4.2)		17	10	14.9(0.6)/24.3(3.1)
	4	12	21.4(1.8)/38.4(2.2)		18	10	7.1(0.2)/16.1(0.5)
	5	13	19.3(1.9)/26.2(0.8)		19	15	26.7(0.2)/42.3(1.1)
	6	14	25.1(2.2)/29.5(2.2)		20	8	15.9(0.8)/25.6(0.8)

	7	12	32.6(4.7)/27.8(3.3)	21	12	9.8(0.6)/15.3(0.4)
Manawatū	8	30	13.2(0.1)/15.0(2.6)	22	3	9.6(2.7)/20.2(0.7)
region	9	14	8.8(1.0)/25.0(2.2)	23	10	10.8(0.1)/21.1(0.9)
	10	13	11.2(1.0)/25.8(1.1)	24	9	10.5(1.4)/28.9(0.6)
	11	12	30.7(5.3)/22.9(6.2)	25	10	16.1(0.3)/29.4(0.5)
	12	10	47.7(1.7)/53.8(0.4)	26	20	34.1(5.6)/29.5(1.6)
	13	12.5	10.0(0.6)/24.0(4.1)	27	5	27.0(0.4)/20.5(0.9)
	14	12.5	12.3(1.0)/20.0(2.1)	28	19	5.6(0.3)/30.8(0.1)

¹Soil numbers in multi-dimensional scaling analysis as presented in Figure 5 in manuscript. ²As classified by the New Zealand Soil Classification System (Hewitt, 1993). ³Mean soil moistures for non-irrigated and irrigated treatments at each site, values in brackets are the standard error of the mean where $n=2$ within each treatment.

Hewitt, A.E., 1993. New Zealand Soil Classification. Manaaki Whenua Landcare Press, Lincoln, New Zealand.

Mudge, P.L., Kelliher, F.M., Knight, T.L., O'Connell, D., Fraser, S., Schpper, L.A., 2017. Irrigated grazed pasture decreases soil carbon and nitrogen stocks.

Global Change Biology 23, 945–954.

Supplementary Table S2: Correlation coefficients (r^2) and level of significance (P values) for regression analyses for the relationships between the length of time under irrigation and microbial activity and compositional parameters.

Parameter	r^2	P value
Basal respiration	0.00	0.590
Substrate-induced respiration	0.00	0.507
AerMN ¹	0.00	0.398
Relative bacterial abundance	0.00	0.565
Absolute bacterial abundance	0.00	0.807
Relative fungal abundance	0.00	0.725
Absolute fungal abundance	0.00	0.747
Fungal:bacterial ratio	0.00	0.333
Actinomycetes	0.00	0.326
Gram-positive bacteria	0.05	0.136
Gram-negative bacteria	0.05	0.126

¹Aerobically mineralisable nitrogen.

Supplementary Table S3: Microbial parameters for each soil in the irrigation and non-irrigated treatments.

Phospholipid fatty acid groups are presented as absolute biomass (nmol g^{-1}) and relative abundance (%) in brackets. Basal respiration (BR) and substrate induced respiration (SIR) are presented as $\mu\text{g g}^{-1}\text{hr}^{-1}$ and aerobically mineralisable nitrogen (AerMN) as $\mu\text{g g}^{-1}$.

Soil No.	TB ¹	Bacteria	Fungi	Gram+	Gram-	Act ²	Stress	BR	SIR	AerMN
1I ³	181	94 (52)	3 (1.5)	44 (24)	49 (27)	14 (8)	0.26	1.38	5.54	81.23
1NI ⁴	153	80 (52)	2 (1.5)	45 (29)	34 (22)	15 (10)	0.40	1.63	4.95	85.78
2I	242	131 (54)	3 (1.2)	71 (29)	58 (24)	22 (9)	0.24	1.32	8.31	140.03
2NI	156	82 (53)	2 (1.2)	55 (35)	26 (16)	17 (11)	0.83	0.98	4.17	69.05
3I	118	65 (55)	1 (1.1)	33 (28)	31 (26)	9 (8)	0.31	1.05	6.24	92.84
3NI	89	49 (55)	1 (1.3)	28 (31)	20 (22)	9 (9)	0.48	0.69	4.46	53.21
4I	114	63 (55)	1 (1.2)	30 (26)	32 (28)	29 (7)	0.28	1.00	5.62	79.00
4NI	214	111 (52)	4 (2.0)	51 (24)	59 (27)	14 (6)	0.30	1.16	5.20	115.31

5I	364	183 (50)	5 (1.2)	85 (23)	95 (26)	29 (7)	0.36	1.87	9.29	149.27
5NI	329	159 (48)	5 (1.5)	77 (32)	21 (16)	9 (7)	0.33	1.55	6.38	108.83
6I	198	103 (52)	3 (1.7)	53 (27)	48 (24)	8 (7)	0.35	1.25	8.09	110.24
6NI	130	65 (50)	2 (1.5)	42 (32)	21 (16)	9 (7)	0.73	0.93	4.20	77.86
7I	134	74 (55)	2 (1.7)	36 (27)	37 (27)	27 (6)	0.32	1.01	4.04	79.79
7NI	139	69 (50)	4 (2.7)	42 (30)	26 (18)	11 (8)	0.59	0.82	5.09	76.87
8I	384	194 (51)	8 (2.1)	85 (22)	105 (27)	27 (7)	0.34	2.57	13.32	201.10
8NI	222	103 (46)	6 (2.5)	51 (23)	50 (22)	15 (7)	0.31	1.84	9.06	96.09
9I	199	96 (48)	4 (2.0)	46 (23)	48 (24)	15 (7)	0.31	2.08	10.42	138.05
9NI	193	94 (49)	4 (2.2)	48 (25)	44 (23)	13 (7)	0.35	1.67	10.65	107.89
10I	294	143 (49)	7 (1.9)	71 (24)	68 (23)	25 (8)	0.43	2.04	15.66	135.18
10NI	293	139 (48)	7 (2.5)	73 (25)	63 (22)	25 (8)	0.44	1.86	13.03	141.26

11I	400	194 (49)	5 (2.4)	94 (23)	91 (24)	30 (7)	0.38	1.69	11.22	148.54
11NI	336	157 (47)	9 (2.6)	84 (25)	69 (20)	22 (8)	0.43	1.84	10.72	124.26
12I	295	142 (48)	5 (1.8)	68 (23)	70 (24)	21 (8)	0.37	1.07	9.82	107.08
12NI	288	134 (47)	8 (2.6)	65 (22)	67 (23)	22 (8)	0.38	1.74	10.74	95.07
13I	317	153 (48)	6 (1.9)	79 (25)	70 (23)	30 (10)	0.46	1.45	9.60	129.27
13NI	255	125 (49)	8 (3.1)	70 (27)	52 (20)	23 (9)	0.56	1.26	8.48	119.44
14I	297	145 (49)	5 (1.7)	71 (24)	71 (24)	22 (8)	0.37	1.18	11.08	130.65
14NI	310	137 (44)	8 (2.7)	73 (24)	61 (20)	26 (8)	0.42	1.76	7.93	93.99
15I	257	135 (52)	7 (3)	63 (24)	70 (27)	20 (8)	0.34	1.67	13.457	138.19
15NI	236	115 (49)	6 (3)	65 (28)	48 (20)	25 (11)	0.50	1.64	6.67	87.65
16I	235	113 (48)	7 (3)	55 (24)	55 (23)	17 (7)	0.33	1.04	8.83	118.02
16NI	153	71 (46)	4 (2)	41 (27)	28 (18)	14 (9)	0.59	0.83	4.54	70.11

17I	288	155 (54)	6 (2)	78 (27)	75 (26)	23 (8)	0.42	1.61	7.69	133.83
17NI	266	135 (51)	6 (2)	72 (27)	61 (23)	27 (10)	0.44	1.56	8.57	89.26
18I	207	99 (48)	7 (3)	51 (25)	46 (22)	19 (9)	0.36	1.25	5.45	104.66
18NI	168	74 (44)	7 (4)	42 (25)	29 (17)	16 (9)	0.56	1.34	5.77	90.30
19I	354	187 (52)	8 (2)	93 (26)	91 (25)	32 (9)	0.40	1.38	5.46	170.71
19NI	278	136 (49)	8 (3)	77 (28)	56 (20)	29 (10)	0.42	0.97	3.58	100.62
20I	195	101 (51)	4 (2)	54 (27)	46 (23)	16 (8)	0.48	0.82	5.35	111.26
20NI	238	110 (46)	9 (4)	61 (26)	45 (19)	20 (9)	0.45	1.49	3.33	122.28
21I	139	71 (51)	3 (2)	35 (25)	34 (25)	13 (9)	0.39	0.73	6.24	68.60
21NI	202	104 (51)	4 (2)	55 (27)	47 (23)	20 (10)	0.49	1.30	7.48	93.28
22I	274	145 (53)	6 (2)	73 (27)	69 (25)	23 (8)	0.43	1.38	11.92	146.26
22NI	205	97 (47)	5 (2)	54 (26)	41 (20)	22 (11)	0.54	1.23	7.20	103.05

23I	175	91 (52)	3 (2)	46 (26)	43 (24)	14 (8)	0.37	0.89	8.90	86.44
23NI	154	76 (49)	4 (2)	42 (27)	33 (21)	16 (11)	0.42	0.65	7.15	71.03
24I	291	143 (49)	6 (2)	68 (23)	71 (25)	24 (8)	0.31	0.91	9.97	155.29
24NI	330	155 (47)	10 (3)	42 (26)	66 (20)	30 (9)	0.48	1.27	11.66	116.74
25I	260	132 (51)	5 (2)	65 (25)	65 (25)	20 (8)	0.43	1.16	10.12	114.89
25NI	224	110 (49)	5 (2)	85 (25)	51 (23)	22 (10)	0.49	1.02	7.31	87.14
26I	352	177 (51)	9 (2)	82 (23)	94 (27)	27 (8)	0.34	1.66	17.69	146.20
26NI	391	197 (50)	9 (2)	92 (24)	101 (26)	36 (9)	0.34	1.76	13.30	155.54
27I	250	131 (52)	6 (2)	64 (26)	65 (26)	20 (8)	0.35	1.85	6.44	122.06
27NI	183	93 (51)	5 (3)	46 (25)	45 (25)	16 (9)	0.38	1.46	8.16	115.03
28I	188	93 (49)	5 (3)	45 (24)	46 (24)	14 (7)	0.36	0.95	6.85	97.80
28NI	252	170 (48)	9 (3)	101 (29)	64 (18)	28 (8)	0.62	2.08	9.70	126.69

¹Total biomass, ²Actinomycetes, ³Irrigated, ⁴Non-irrigated