

Supplemental Information:

Impacts of Thermal and Smouldering Remediation on Plant Growth and Soil Ecology

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Part 1: ANOVA results for plant biomass and elongation data

Part 2: ANOVA results for bacterial qPCR data (DNA analysis)

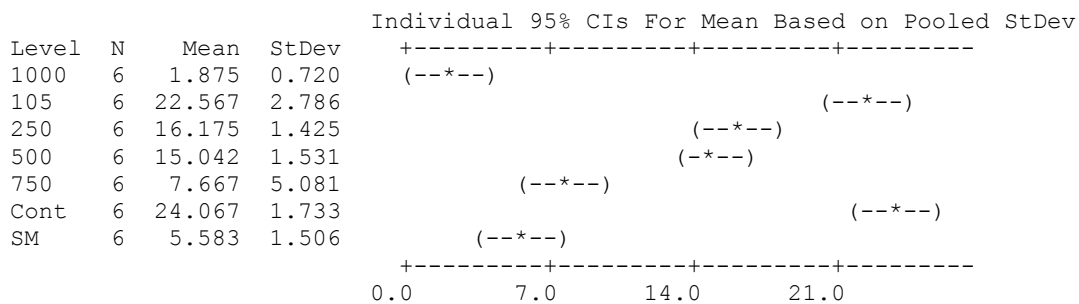
Part 1: ANOVA results for plant biometrics (biomass and elongation). There were no differences among inoculation (microbe) treatments within each thermal (heat) treatment, therefore the results were pooled.

Soil 1 - Clover

One-way ANOVA: Shoot extension versus heat treatment

Source	DF	SS	MS	F	P
Treat2	6	2609.41	434.90	69.60	0.000
Error	35	218.71	6.25		
Total	41	2828.12			

S = 2.500 R-Sq = 92.27% R-Sq(adj) = 90.94%

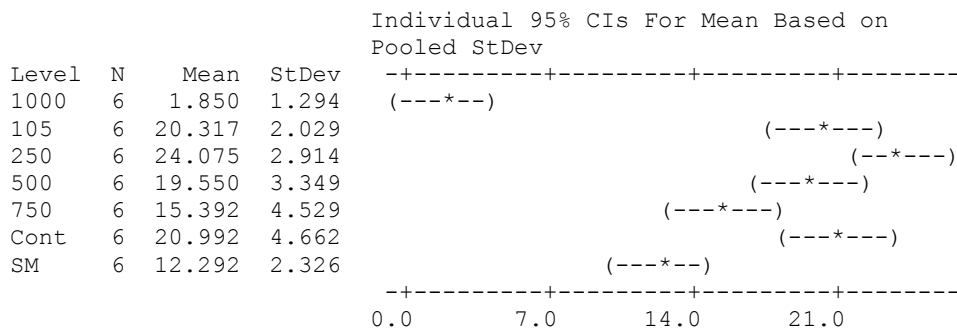


Pooled StDev = 2.500

One-way ANOVA: Root extension versus heat treatment

Source	DF	SS	MS	F	P
Treat2	6	2009.0	334.8	32.04	0.000
Error	35	365.8	10.5		
Total	41	2374.8			

S = 3.233 R-Sq = 84.60% R-Sq(adj) = 81.96%

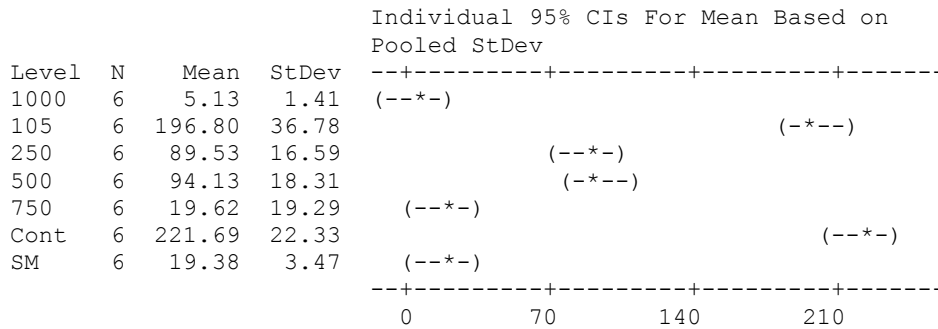


Pooled StDev = 3.233

One-way ANOVA: Shoot biomass versus heat treatment

Source	DF	SS	MS	F	P
Treat2	6	275226	45871	112.74	0.000
Error	35	14241	407		
Total	41	289467			

S = 20.17 R-Sq = 95.08% R-Sq(adj) = 94.24%

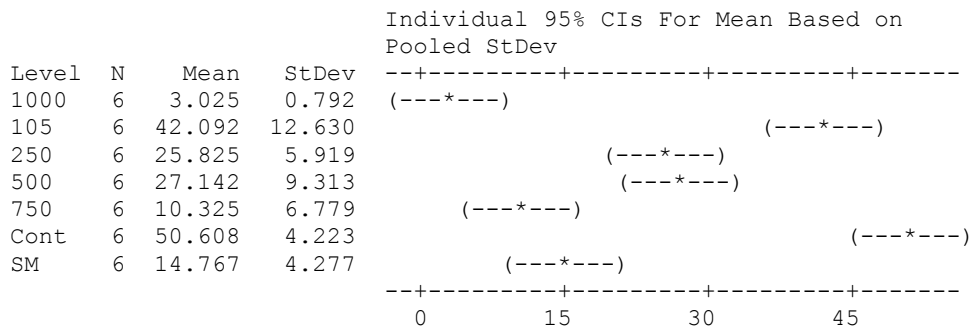


Pooled StDev = 20.17

One-way ANOVA: Root biomass versus heat treatment

Source	DF	SS	MS	F	P
Treat2	6	10535.7	1755.9	33.77	0.000
Error	35	1819.9	52.0		
Total	41	12355.6			

S = 7.211 R-Sq = 85.27% R-Sq(adj) = 82.75%



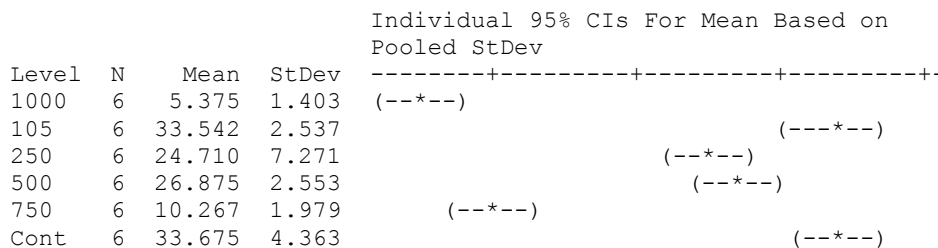
Pooled StDev = 7.211

Soil 1 - Fescue

One-way ANOVA: Shoot extension versus heat treatment

Source	DF	SS	MS	F	P
Treat2	6	4678.8	779.8	55.55	0.000
Error	35	491.3	14.0		
Total	41	5170.1			

S = 3.747 R-Sq = 90.50% R-Sq(adj) = 88.87%



SM	6	13.625	2.742	(--*--)
				-----+-----+-----+-----+-----
				10 20 30 40

Pooled StDev = 3.747

One-way ANOVA: Root extension versus heat treatment

Source	DF	SS	MS	F	P
Treat2	6	1100.37	183.40	30.10	0.000
Error	35	213.26	6.09		
Total	41	1313.63			

S = 2.468 R-Sq = 83.77% R-Sq(adj) = 80.98%

Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev	(--*--)
1000	6	1.325	0.524	(--*--)
105	6	15.458	0.928	(---*--)
250	6	11.750	2.770	(---*--)
500	6	14.375	2.494	(--*--)
750	6	10.192	1.976	(--*--)
Cont	6	17.750	2.424	(---*--)
SM	6	16.083	4.224	(---*--)

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0.0 6.0 12.0 18.0

Pooled StDev = 2.468

One-way ANOVA: Shoot mass versus heat treatment

Source	DF	SS	MS	F	P
Treat2	6	66812	11135	66.78	0.000
Error	35	5837	167		
Total	41	72648			

S = 12.91 R-Sq = 91.97% R-Sq(adj) = 90.59%

Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev	(--*--)
1000	6	2.25	1.19	(--*--)
105	6	98.61	22.14	(---*--)
250	6	62.73	15.53	(---*--)
500	6	47.06	8.42	(--*--)
750	6	5.23	2.20	(--*--)
Cont	6	102.85	18.81	(---*--)
SM	6	10.16	2.24	(--*--)

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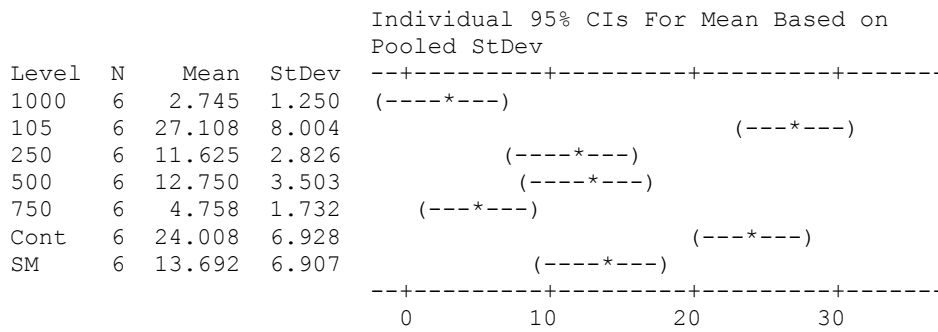
0 35 70 105

Pooled StDev = 12.91

One-way ANOVA: Root mass versus heat treatment

Source	DF	SS	MS	F	P
Treat2	6	2946.8	491.1	18.62	0.000
Error	35	923.0	26.4		
Total	41	3869.8			

S = 5.135 R-Sq = 76.15% R-Sq(adj) = 72.06%



Pooled StDev = 5.135

Soil 2 - Clover

One-way ANOVA: Shoot extension versus treatment

Source	DF	SS	MS	F	P
Treat2	6	5105.41	850.90	225.22	0.000
Error	49	185.13	3.78		
Total	55	5290.53			

S = 1.944 R-Sq = 96.50% R-Sq(adj) = 96.07%

One-way ANOVA: Root extension versus treatment

Source	DF	SS	MS	F	P
Treat2	6	1287.6	214.6	16.26	0.000
Error	49	646.7	13.2		
Total	55	1934.3			

S = 3.633 R-Sq = 66.57% R-Sq(adj) = 62.47%

One-way ANOVA: Above-ground biomass versus treatment

Source	DF	SS	MS	F	P
Treat2	6	719267	119878	74.55	0.000
Error	49	78797	1608		
Total	55	798064			

S = 40.10 R-Sq = 90.13% R-Sq(adj) = 88.92%

One-way ANOVA: Below-ground biomass versus treatment

Source	DF	SS	MS	F	P
Treat2	6	23586	3931	13.89	0.000
Error	49	13867	283		
Total	55	37454			

S = 16.82 R-Sq = 62.97% R-Sq(adj) = 58.44%

Soil 2 - Fescue

One-way ANOVA: Shoot extension versus treatment

Source	DF	SS	MS	F	P
Treat2	6	5265.5	877.6	82.15	0.000
Error	49	523.5	10.7		
Total	55	5789.0			

S = 3.268 R-Sq = 90.96% R-Sq(adj) = 89.85%

One-way ANOVA: Root extension versus treatment

Source	DF	SS	MS	F	P
Treat2	6	1241.83	206.97	38.42	0.000
Error	49	263.98	5.39		
Total	55	1505.81			

S = 2.321 R-Sq = 82.47% R-Sq(adj) = 80.32%

One-way ANOVA: Above-ground biomass versus treatment

Source	DF	SS	MS	F	P
Treat2	6	72268	12045	117.35	0.000
Error	49	5029	103		
Total	55	77297			

S = 10.13 R-Sq = 93.49% R-Sq(adj) = 92.70%

One-way ANOVA: Below-ground biomass versus treatment

Source	DF	SS	MS	F	P
Treat2	6	4515.9	752.6	9.83	0.000
Error	49	3753.5	76.6		
Total	55	8269.4			

S = 8.752 R-Sq = 54.61% R-Sq(adj) = 49.05%

Post-hoc, t-test for plant extension data.

		Aboveground Extension								Belowground Extension										
Treat.	T-test p	Cont.	105	250	500	750	1000	SM	Group	T-test p	Cont.	105	250	500	750	1000	SM	Group		
Soil 1 Clover	Cont.	0.91	0.29	0.00	0.00	0.00	0.00	0.00	a	0.85		0.75	0.20	0.55	0.06	0.00	0.00	ab		
	105	0.00		0.00	0.00	0.00	0.00	0.00	a	0.66			0.03	0.64	0.05	0.00	0.00	ab		
	250	0.56			0.21	0.01	0.00	0.00	b	0.90				0.03	0.00	0.00	0.00	a		
	500	0.56				0.01	0.00	0.00	b	0.19					0.10	0.00	0.00	b		
	750	0.33					0.04	0.37	c	0.07						0.00	0.18	bd		
	1000	0.54						0.00	d	0.13							0.00	e		
	SM	0.26	ANOVA p=0.00								c	0.42	ANOVA p=0.00							
Soil 2 Clover	Cont.	0.05	0.59	0.12	0.00	0.00	0.00	0.00	ab	0.54		0.95	0.22	0.20	0.00	0.00	0.01	a		
	105	0.29		0.03	0.00	0.00	0.00	0.00	a	0.66			0.18	0.18	0.00	0.00	0.00	a		
	250	0.41			0.00	0.00	0.00	0.00	b	0.09				0.71	0.00	0.00	0.00	a		
	500	0.01				0.00	0.00	0.00	c	0.08					0.00	0.00	0.00	a		
	750	0.00					0.06	0.00	d	0.06						0.79	0.02	b		
	1000	0.37						0.00	d	0.17							0.07	bc		
	SM	0.72	ANOVA p=0.00								e	0.01	ANOVA p=0.00							
Soil 1 Fescue	Cont.	0.54	0.95	0.03	0.01	0.00	0.00	0.00	a	0.94		0.07	0.00	0.04	0.00	0.00	0.43	ab		
	105	0.09		0.03	0.00	0.00	0.00	0.00	a	0.64			0.02	0.34	0.00	0.00	0.74	abc		
	250	0.96			0.51	0.00	0.00	0.01	b	0.00				0.12	0.29	0.00	0.07	cd		
	500	0.29				0.00	0.00	0.00	b	0.41					0.01	0.00	0.42	d		
	750	0.00					0.00	0.04	c	0.68						0.00	0.02	e		
	1000	0.09						0.00	d	0.72							0.00	f		
	SM	0.78	ANOVA p=0.00								e	0.32	ANOVA p=0.00							
Soil 2 Fescue	Cont.	0.19	0.16	0.19	0.56	0.00	0.00	0.00	a	0.98		0.15	0.12	0.00	0.00	0.00	0.00	a		
	105	0.36		0.86	0.07	0.00	0.00	0.00	a	0.88			0.77	0.00	0.00	0.00	0.00	a		
	250	0.23			0.08	0.00	0.00	0.00	a	0.14				0.01	0.00	0.00	0.00	a		
	500	0.30				0.00	0.00	0.00	a	0.78					0.01	0.00	0.23	b		
	750	0.70					0.03	0.01	b	0.72						0.00	0.08	c		
	1000	0.02						0.92	c	0.67							0.00	d		
	SM	0.62	ANOVA p=0.00								c	0.69	ANOVA p=0.00							

Post-hoc, t-test for plant biomass data.

		Aboveground Biomass								Belowground Biomass										
Treat.	T-test p	Cont.	105	250	500	750	1000	SM	Group	T-test p	Cont.	105	250	500	750	1000	SM	Group		
Soil 1 Clover	Cont.	0.63	0.19	0.00	0.00	0.00	0.00	0.00	a	0.73		0.17	0.00	0.00	0.00	0.00	0.00	a		
	105	0.15		0.00	0.00	0.00	0.00	0.00	a	0.24			0.02	0.04	0.00	0.00	0.00	a		
	250	0.30			0.66	0.00	0.00	0.00	b	0.22				0.78	0.00	0.00	0.00	b		
	500	0.46				0.00	0.00	0.00	b	0.21					0.01	0.00	0.02	b		
	750	0.14					0.13	0.98	cd	0.23						0.05	0.21	c		
	1000	0.73						0.00	d	0.52							0.00	d		
	SM	0.82	ANOVA p=0.00								c	0.15	ANOVA p=0.00							
Soil 2 Clover	Cont.	0.51	0.17	0.03	0.00	0.00	0.00	0.00	a	0.31		0.01	0.17	0.67	0.01	0.00	0.00	a		
	105	0.52		0.00	0.00	0.00	0.00	0.00	a	0.59			0.07	0.04	0.00	0.00	0.00	b		
	250	0.35			0.00	0.00	0.00	0.00	b	0.17				0.54	0.00	0.00	0.00	ab		
	500	0.01				0.00	0.00	0.00	c	0.13					0.04	0.02	0.01	a		
	750	0.00					0.38	0.17	d	0.05						0.13	0.03	c		
	1000	0.00						0.66	d	0.25							0.06	cd		
	SM	0.01	ANOVA p=0.00								d	0.15	ANOVA p=0.00							
Soil 1 Fescue	Cont.	0.27	0.73	0.00	0.00	0.00	0.00	0.00	a	0.17		0.49	0.00	0.01	0.00	0.00	0.03	a		
	105	0.01		0.01	0.00	0.00	0.00	0.00	a	0.01			0.00	0.00	0.00	0.00	0.01	a		
	250	0.41			0.05	0.00	0.00	0.00	b	0.28				0.55	0.00	0.00	0.52	b		
	500	0.34				0.00	0.00	0.00	c	0.46					0.00	0.00	0.77	b		
	750	0.00					0.02	0.00	d	0.48						0.05	0.02	c		
	1000	0.22						0.00	e	0.06							0.01	c		
	SM	0.51	ANOVA p=0.00								f	0.32	ANOVA p=0.00							
Soil 2 Fescue	Cont.	0.00	0.00	0.00	0.21	0.00	0.00	0.00	a	0.18		0.00	0.04	0.20	0.00	0.00	0.00	a		
	105	0.54		0.03	0.00	0.00	0.00	0.00	b	0.44			0.53	0.21	0.00	0.00	0.00	b		
	250	0.55			0.00	0.00	0.00	0.00	c	0.02				0.19	0.01	0.01	0.01	b		
	500	0.29				0.00	0.00	0.00	a	0.57					0.01	0.00	0.00	ab		
	750	0.55					0.28	0.00	d	0.03						0.63	0.18	c		
	1000	0.05						0.14	de	0.02							0.62	c		
	SM	0.46	ANOVA p=0.00								e	0.86	ANOVA p=0.00							

Part 2: ANOVA results for bacterial qPCR data (DNA analysis). There were no differences among the plant and inoculation (microbe) treatments within each thermal (heat) treatment, therefore the results were pooled.

Soil 1 –

One-way ANOVA: 16s rRNA genes (total bacteria) versus treatment

Source	DF	SS	MS	F	P
Treat	6	42.688	7.115	42.14	0.000
Error	35	5.910	0.169		
Total	41	48.597			

S = 0.4109 R-Sq = 87.84% R-Sq(adj) = 85.75%

One-way ANOVA: *amoA* (ammonia oxidising bacteria) versus treatment

Source	DF	SS	MS	F	P
Treat	6	1.862	0.310	1.88	0.111
Error	35	5.767	0.165		
Total	41	7.628			

S = 0.4059 R-Sq = 24.40% R-Sq(adj) = 11.44%

One-way ANOVA: *nirS* (Fe-dependent denitrifiers) versus treatment

Source	DF	SS	MS	F	P
Treat	6	15.617	2.603	5.70	0.000
Error	35	15.996	0.457		
Total	41	31.614			

S = 0.6760 R-Sq = 49.40% R-Sq(adj) = 40.73%

One-way ANOVA: *nirK* (Cu-dependent denitrifiers) versus treatment

Source	DF	SS	MS	F	P
Treat	6	5.118	0.853	3.60	0.007
Error	35	8.289	0.237		
Total	41	13.407			

S = 0.4866 R-Sq = 38.18% R-Sq(adj) = 27.58%

One-way ANOVA: *nifH* (nitrogen fixing bacteria) versus treatment

Source	DF	SS	MS	F	P
Treat	6	10.863	1.810	2.64	0.032
Error	35	23.958	0.685		
Total	41	34.821			

S = 0.8274 R-Sq = 31.20% R-Sq(adj) = 19.40%

Soil 2 –

One-way ANOVA: 16s rRNA genes (total bacteria) versus treatment

Source	DF	SS	MS	F	P
Treat	6	54.826	9.138	56.53	0.000
Error	35	5.658	0.162		
Total	41	60.484			

S = 0.4021 R-Sq = 90.65% R-Sq(adj) = 89.04%

One-way ANOVA: *amoA* (ammonia oxidising bacteria) versus treatment

Source	DF	SS	MS	F	P
Treat	6	3.2851	0.5475	6.16	0.000
Error	35	3.1123	0.0889		
Total	41	6.3974			

S = 0.2982 R-Sq = 51.35% R-Sq(adj) = 43.01%

One-way ANOVA: *nirS* (Fe-dependent denitrifiers) versus treatment

Source	DF	SS	MS	F	P
Treat	6	7.962	1.327	3.47	0.009
Error	35	13.400	0.383		
Total	41	21.362			

S = 0.6188 R-Sq = 37.27% R-Sq(adj) = 26.52%

One-way ANOVA: *nirK* (Cu-dependent denitrifiers) versus treatment

Source	DF	SS	MS	F	P
Treat	6	6.631	1.105	3.83	0.005
Error	35	10.098	0.289		
Total	41	16.729			

S = 0.5371 R-Sq = 39.64% R-Sq(adj) = 29.29%

One-way ANOVA: *nifH* (nitrogen fixing bacteria) versus treatment

Source	DF	SS	MS	F	P
Treat	6	14.296	2.383	9.47	0.000
Error	35	8.809	0.252		
Total	41	23.105			

S = 0.5017 R-Sq = 61.87% R-Sq(adj) = 55.34%

Post-hoc t-tests:

		Soil 1								Soil 2								
Treatment		Cont.	105	250	500	750	1000	SM	Group	Cont.	105	250	500	750	1000	SM	Group	
16s	Cont.		0.74	0.45	0.00	0.00	0.00	0.00	a		0.06	0.00	0.00	0.00	0.00	0.00	a	
	105			0.38	0.00	0.00	0.00	0.00	a			0.04	0.00	0.00	0.00	0.00	a	
	250				0.00	0.00	0.00	0.00	a				0.00	0.00	0.00	0.00	b	
	500					0.08	0.00	0.39	b					0.19	0.07	0.62	cd	
	750						0.00	0.92	b						0.00	0.67	c	
	1000								c							0.07	d	
	SM		ANOVA p=0.00							b		ANOVA p=0.00						
amoA	Cont.		0.03	0.92	0.64	0.49	0.14	0.30	ac		0.17	0.06	0.28	0.10	0.04	0.00	a	
	105			0.16	0.02	0.00	0.41	0.05	b			0.46	0.90	0.54	0.01	0.04	a	
	250				0.73	0.80	0.33	0.55	ab				0.64	0.93	0.00	0.24	ab	
	500					0.11	0.16	0.17	a					0.71	0.02	0.17	ab	
	750						0.03	0.04	a						0.01	0.26	ab	
	1000							0.33	bc							0.00	c	
	SM		ANOVA p=0.11							a		ANOVA p=0.00						
nirS	Cont.		0.19	0.22	0.03	0.39	0.11	0.09	a		0.04	0.00	0.99	0.24	0.16	0.15	a	
	105			0.85	0.21	0.68	0.81	0.06	ab			0.89	0.10	0.68	0.92	0.05	b	
	250				0.14	0.62	0.65	0.07	ab				0.05	0.70	0.84	0.05	b	
	500					0.82	0.28	0.04	b					0.25	0.21	0.15	ab	
	750						0.75	0.05	ab						0.66	0.05	ab	
	1000							0.06	ab							0.06	ab	
	SM		ANOVA p=0.00							ab		ANOVA p=0.01						
nirK	Cont.		0.34	0.09	0.01	0.00	0.28	0.77	a		0.31	0.57	0.56	0.00	0.06	0.81	a	
	105			0.04	0.02	0.01	0.72	0.58	a			0.69	0.71	0.00	0.13	0.57	a	
	250				0.00	0.00	0.06	0.89	a				0.65	0.00	0.10	0.65	a	
	500					0.73	0.07	0.12	b					0.09	0.78	0.52	a	
	750						0.03	0.09	b						0.00	0.01	b	
	1000							0.50	a							0.19	a	
	SM		ANOVA p=0.01							a		ANOVA p=0.01						
nifH	Cont.		0.71	0.96	0.30	0.35	0.12	0.15	ab		0.19	0.01	0.12	0.02	0.12	0.02	a	
	105			0.65	0.46	0.49	0.20	0.11	ab			0.47	0.84	0.54	0.64	0.00	ab	
	250				0.25	0.31	0.07	0.15	ab				0.62	0.90	0.95	0.00	b	
	500					0.93	0.77	0.06	ab					0.70	0.77	0.00	ab	
	750						0.91	0.07	ab						0.99	0.00	b	
	1000							0.05	a							0.00	ab	
	SM		ANOVA p=0.03							b		ANOVA p=0.00						