Appendix A.
Chemical, Biological, and Physical Data for 0.0 – 2.5 cm and 2.5 – 5.0 cm Layer in Green and Tee Box Soils at Colbert Hills Golf Course (Chapter 3).

Table A.1. Bulk density of 0-5.0 cm in green and tee box soils.

		Pre-App	May	June	July	August	September	October
Site	Amendment				g cm^{-3}			
Green	Untreated	1.47 (0.07)*	1.53(0.10)	1.31 (0.04)	1.26 (0.11)	1.92 (0.04)	1.58 (0.04)	1.54 (0.13)
Green	Swine 1x	1.46 (0.07)	1.37 (0.05)	1.36 (0.06)	1.53 (0.11)	1.57 (0.03)	1.44 (0.10)	1.44 (0.08)
Green	Swine 2x	1.49 (0.10)	1.50 (0.06)	1.40 (0.03)	1.47(0.11)	1.53 (0.03)	1.55 (0.03)	1.41 (0.09)
Green	Dairy 1x	1.48 (0.02)	1.45 (0.06)	1.43 (0.14)	1.55 (0.04)	1.52 (0.02)	1.45 (0.15)	1.36 (0.07)
Green	Dairy 2x	1.46 (0.05)	1.46 (0.03)	1.37 (0.03)	1.54 (0.11)	1.52 (0.03)	1.52 (0.04)	1.24 (0.04)
Tee	Untreated	1.60 (0.10)	1.56 (0.05)	1.48 (0.09)	1.63 (0.05)	1.66 (0.03)	1.57 (0.04)	1.28 (0.07)
Tee	Swine 1x	1.58 (0.04)	1.42 (0.06)	1.44 (0.02)	1.48 (0.19)	1.53 (0.08)	1.61 (0.10)	1.39 (0.03)
Tee	Swine 2x	1.61 (0.02)	1.60 (0.04)	1.37 (0.04)	1.64 (0.10)	1.56 (0.03)	1.52 (0.07)	1.43 (0.03)
Tee	Dairy 1x	1.58 (0.01)	1.62 (0.11)	1.50 (0.01)	1.67 (0.06)	1.56 (0.05)	1.54 (0.04)	1.19 (0.06)
Tee	Dairy 2x	1.58 (0.03)	1.63 (0.03)	1.50 (0.06)	1.65 (0.07)	1.61 (0.02)	1.53 (0.12)	1.33 (0.09)

*Standard Deviation in parenthesis

Table A.2. Soil porosity of 0-5.0 cm in green and tee box soils.

		Pre-App	May	June	July	August	September	October
Site	Amendment				%			
Green	Untreated	44.4 (2.6)	42.1 (4.0)	50.5 (1.4)	52.3 (4.2)	38.7 (1.4)	40.3 (1.4)	41.7 (4.9)
Green	Swine 1x	45.0 (2.6)	48.5 (1.9)	48.8 (2.4)	42.4 (4.2)	40.7 (1.3)	45.6 (3.8)	45.4 (3.2)
Green	Swine 2x	43.6 (3.7)	43.4 (2.2)	47.1 (1.0)	44.4 (4.1)	42.4(1.1)	41.7 (1.2)	46.7 (3.5)
Green	Dairy 1x	44.0 (0.6)	45.2 (2.1)	46.0 (5.4)	41.6 (1.4)	42.8 (0.8)	45.3 (5.5)	48.7 (2.8)
Green	Dairy 2x	45.0 (2.0)	45.0 (1.3)	48.3 (1.0)	41.8 (4.0)	42.8 (1.0)	42.5 (1.3)	53.3 (1.4)
Tee	Untreated	39.7 (3.6)	41.3 (2.2)	44.0 (3.6)	38.6 (1.9)	37.2 (1.0)	40.7 (1.5)	51.6 (2.7)
Tee	Swine 1x	40.5 (1.7)	46.5 (2.3)	45.8 (0.9)	44.1 (7.3)	42.1 (3.1)	39.2 (3.8)	47.4 (1.1)
Tee	Swine 2x	39.2 (0.7)	39.5 (1.5)	48.2 (1.6)	38.0 (3.9)	41.1 (1.2)	42.8 (2.5)	46.2 (1.0)
Tee	Dairy 1x	40.4 (0.2)	39.1 (4.3)	43.2 (0.5)	36.9 (2.3)	41.2 (2.0)	41.8 (1.6)	55.1 (2.2)
Tee	Dairy 2x	40.3 (1.1)	38.5 (1.2)	43.3 (2.4)	37.9 (2.5)	39.4 (0.9)	42.2 (4.5)	49.9 (3.4)

*Standard Deviation in parenthesis

Table A.3. Exchangeable sodium of 0-2.5 cm layer in green and tee box soils.

Site	Amendment	Pre-App	May	June	July	August	September	October
					%			
Green	Untreated	0.50 (0.00)*	0.28 (0.16)	0.17 (0.9)	0.23 (0.40)	0.89 (0.11)	0.49 (0.07)	0.41 (0.11)
Green	Swine 1x	0.67 (0.01)	0.30 (0.03)	0.24 (0.16)	0.07 (0.06)	1.3 (0.36)	0.65 (0.10)	0.55 (0.04)
Green	Swine 2x	0.48 (0.01)	0.34 (0.08)	0.33 (0.08)	0.32 (0.40)	1.07 (0.23)	0.47 (0.08)	0.43 (0.04)
Green	Dairy 1x	0.55 (0.00)	0.43 (0.07)	0.17 (0.09)	0.00 (0.00)	1.24 (0.21)	0.75 (0.12)	0.35 (0.03)
Green	Dairy 2x	0.38 (0.01)	0.44 (0.21)	0.17 (0.05)	0.07 (0.12)	0.90 (0.17)	0.42 (0.07)	0.62 (0.07)
Tee	Untreated	1.09 (0.02)	1.91 (0.47)	0.93 (0.54)	1.94 (0.46)	2.55 (0.27)	1.46(0.25)	1.29 (0.15)
Tee	Swine 1x	1.03 (0.00)	1.47 (0.16)	2.34 (0.20)	2.59 (0.48)	6.9 (1.33)	4.06 (0.52)	4.23 (0.39)
Tee	Swine 2x	1.16 (0.00)	1.32 (0.09)	0.85 (0.18)	1.55 (0.36)	2.69 (0.24)	2.37 (0.28)	1.65 (0.09)
Tee	Dairy 1x	1.34 (0.01)	1.67 (0.28)	1.2 (0.17)	4.99 (0.80)	2.83 (0.08)	1.89 (0.34)	1.84 (0.55)
Tee	Dairy 2x	1.19 (0.02)	1.16 (0.15)	0.47 (0.04)	2.14 (0.67)	3.47 (0.20)	1.69 (0.25)	1.78 (0.48)

*Standard Deviation in parenthesis

Table A.4. Exchangeable sodium of 2.5 -5.0 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
					%			
Green	Untreated	NA	0.33	0.20	0.00	0.67	0.58	0.43
Green	Swine 1x	NA	0.25	0.12	0.00	0.77	0.66	0.47
Green	Swine 2x	NA	0.29	0.19	0.05	0.71	0.69	0.40
Green	Dairy 1x	NA	0.37	0.01	0.00	0.78	0.78	0.51
Green	Dairy 2x	NA	0.38	0.00	0.00	0.72	0.67	0.57
Tee	Untreated	NA	2.42	2.88	2.22	3.96	2.78	0.26
Tee	Swine 1x	NA	1.90	2.81	3.34	5.11	7.59	0.71
Tee	Swine 2x	NA	2.12	1.63	1.78	2.58	3.33	0.42
Tee	Dairy 1x	NA	2.02	2.44	5.61	4.32	3.09	0.38
Tee	Dairy 2x	NA	1.85	1.69	2.87	4.75	3.86	2.32

Table A.5. Electrical conductivity of 0-2.5 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
					dS m^{-1}			
Green	Untreated	0.39 (0.03)	0.89 (0.10)	0.82 (0.07)	0.97 (0.15)	1.03 (0.02)	1.39 (0.54)	0.96 (0.12)
Green	Swine 1x	0.45 (0.03)	1.2 (0.02)	0.78 (0.09)	0.75 (0.04)	1.25 (0.11)	1.30 (0.19)	1.43 (0.49)
Green	Swine 2x	0.47 (0.01)	1.13 (0.02)	1.03 (0.02)	0.74 (0.10)	1.07 (0.17)	1.39 (0.22)	0.80 (0.44)
Green	Dairy 1x	0.39 (0.02)	1.13 (0.04)	0.90 (0.11)	0.90 (0.16)	0.99 (0.04)	0.00 (0.00)	1.84 (0.20)
Green	Dairy 2x	0.38 (0.04)	1.29 (0.15)	0.85 (0.03)	0.90 (0.13)	0.95 (0.12)	1.50 (0.03)	1.93 (0.12)
Tee	Untreated	0.41 (0.00)	1.77 (0.09)	0.78 (0.06)	1.61 (0.21)	1.35 (0.06)	1.59 (0.40)	0.00 (0.00)
Tee	Swine 1x	0.69 (0.03)	1.78 (0.15)	1.13 (0.07)	1.7 (0.08)	3.15 (0.41)	0.64 (1.10)	0.00 (0.00)
Tee	Swine 2x	0.46 (0.01)	1.37 (0.16)	0.95 (0.05)	1.27 (0.06)	1.61 (0.15)	0.67 (1.15)	1.58 (0.08)
Tee	Dairy 1x	0.58 (0.03)	1.76 (0.04)	0.82 (0.09)	1.90 (0.17)	1.75 (0.35)	1.19 (0.86)	1.69 (0.28)
Tee	Dairy 2x	0.39 (0.03)	1.49 (0.07)	0.81 (0.10)	1.55 (0.17)	1.97 (0.18)	1.54 (0.13)	1.79 (0.20)

*Standard Deviation in parenthesis

Table A.6. Electrical conductivity of 2.5 -5.0 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
					dS m^{-1}			
Green	Untreated	NA	0.35	0.28	0.31	0.35	0.30	0.91
Green	Swine 1x	NA	0.46	0.22	0.25	0.39	0.90	0.88
Green	Swine 2x	NA	0.45	0.36	0.26	0.34	0.40	2.66
Green	Dairy 1x	NA	0.4	0.27	0.28	0.44	0.75	1.09
Green	Dairy 2x	NA	0.53	0.23	0.29	0.33	0.45	0.96
Tee	Untreated	NA	0.8	0.46	0.88	0.88	0.64	1.19
Tee	Swine 1x	NA	0.89	0.91	1.59	2.37	0.00	0.67
Tee	Swine 2x	NA	0.83	0.43	0.96	1.16	1.06	0.43
Tee	Dairy 1x	NA	0.84	0.53	1.63	1.92	0.78	1.36
Tee	Dairy 2x	NA	0.78	0.39	1.06	1.70	1.26	1.11

Table A.7. Cation exchange capacity (CEC) of 0-2.5 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
					cmol kg^{-1}			
Green	Untreated	1.0 (0.1)*	1.2 (0.6)	1.1 (0.1)	1.3 (0.2)	1.1 (0.1)	1.8 (0.3)	1.7 (0.2)
Green	Swine 1x	1.0 (0.2)	1.2 (0.7)	1.17 (0.2)	1.5 (0.2)	1.3 (0.4)	2.5 (0.1)	2.3 (0.3)
Green	Swine 2x	0.9 (0.0)	1.0 (0.5)	1.5 (0.1)	1.7 (0.4)	1.6 (0.3)	2.6 (0.1)	2.1 (0.4)
Green	Dairy 1x	1.4 (0.1)	1.3 (0.3)	1.5 (0.2)	1.5 (0.0)	1.4 (0.1)	1.7 (0.1)	1.9 (0.1)
Green	Dairy 2x	1.1 (0.3)	1.3 (1.0)	1.37 (0.1)	1.9 (0.2)	1.7 (0.2)	2.3 (0.5)	2.4 (0.3)
Tee	Untreated	11.4 (2.4)	10.8 (0.5)	7.07 (1.6)	7.4 (1.3)	7.0 (0.8)	8.4 (0.8)	6.9 (0.4)
Tee	Swine 1x	9.1 (0.8)	7.8 (0.5)	8.17 (0.3)	6.3 (0.5)	6.6 (0.5)	7.1 (0.6)	7.6 (0.4)
Tee	Swine 2x	9.1 (0.1)	7.9 (0.4)	9.4 (1.0)	9.7 (1.5)	8.3 (0.7)	8.4 (1.0)	7.7 (0.5)
Tee	Dairy 1x	8.1 (0.7)	8.1 (0.7)	8.5 (0.7)	7.6 (0.7)	8.3 (0.4)	7.5 (0.3)	6.9 (0.2)
Tee	Dairy 2x	8.6 (1.1)	8.3 (0.3)	8.2 (0.6)	8.1 (0.6)	7.8 (1.6)	7.9 (0.2)	9.3 (0.9)

*Standard Deviation in parenthesis

Table A.8. Cation exchange capacity (CEC) of 2.5 -5.0 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
					cmol kg^{-1}			
Green	Untreated	0.73	0.70	0.73	0.80	0.70	2.4	1.4
Green	Swine 1x	0.74	0.77	0.77	0.80	1.00	1.3	1.3
Green	Swine 2x	0.87	0.70	0.73	0.80	0.70	1.1	1.1
Green	Dairy 1x	0.77	0.77	0.73	0.80	0.80	1.6	1.3
Green	Dairy 2x	0.72	0.83	0.73	0.80	0.80	1.3	1.2
Tee	Untreated	11.71	9.10	9.03	8.30	7.10	9.4	8.1
Tee	Swine 1x	9.27	8.63	8.13	7.10	6.60	7.7	7.6
Tee	Swine 2x	9.71	7.80	9.37	8.00	7.20	7.7	6.9
Tee	Dairy 1x	9.76	8.77	7.27	8.30	7.50	7.8	7.3
Tee	Dairy 2x	7.27	8.33	8.63	8.10	7.40	8.7	7.9

Table A.9. Calcium concentration of 0-2.5 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
		mg Ca kg^{-1}						
Green	Untreated	293 (7)*	291 (36)	310 (55)	260 (18)	506 (28)	326 (77)	301 (59)
Green	Swine 1x	191 (21)	334 (12)	280 (33)	260 (25)	505 (28)	302 (35)	376 (14)
Green	Swine 2x	285 (46)	300 (13)	290 (41)	254 (17)	423 (77)	326 (38)	312 (27)
Green	Dairy 1x	348 (39)	342 (46)	294 (66)	282 (20)	546 (59)	256 (16)	264 (6)
Green	Dairy 2x	297 (54)	306 (16)	310 (27)	335 (25)	552 (95)	325 (38)	298 (30)
Tee	Untreated	3466 (205)	3048 (128)	2510 (279)	1918 (160)	2220 (68)	2191 (74)	1999 (124)
Tee	Swine 1x	2717 (98)	2997 (31)	2387 (147)	1722 (178)	2179 (186)	1867 (69)	1984 (79)
Tee	Swine 2x	2826 (82)	2824 (25)	2447 (36)	1850 (300)	2064 (28)	1856 (83)	1880 (77)
Tee	Dairy 1x	2577 (48)	2901 (189)	2616 (75)	2207 (155)	2429 (49)	2083 (39)	1891 (22)
Tee	Dairy 2x	2818 (165)	2829 (59)	2547 (50)	2124 (82)	2142 (154)	2143 (47)	2483 (316)

*Standard Deviation in parenthesis

Table A.10. Calcium concentration of 2.5 -5.0 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
		mg Ca kg^{-1}						
Green	Untreated	198	369	232	219	481	243	194
Green	Swine 1x	198	339	257	239	542	211	276
Green	Swine 2x	397	258	216	214	522	233	225
Green	Dairy 1x	283	341	250	231	632	274	334
Green	Dairy 2x	346	408	324	201	533	302	273
Tee	Untreated	3194	3048	3355	2766	2853	2991	2698.7
Tee	Swine 1x	3262	2997	3177	2631	2737	2848	2521.7
Tee	Swine 2x	3057	2824	3291	2641	2840	2924	2508.7
Tee	Dairy 1x	2853	2901	2961	2926	2928	2938	2604.0
Tee	Dairy 2x	3333	2829	3215	2781	2859	2952	2519.0

Table A.11. Calcium saturation (percentage) of 0-2.5 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
					%			
Green	Untreated	146	121	141	100	230	90	88
Green	Swine 1x	95	139	116	86	194	60	82
Green	Swine 2x	158	150	96	75	132	63	74
Green	Dairy 1x	124	131	98	94	195	75	69
Green	Dairy 2x	135	117	110	88	162	71	62
Tee	Untreated	152	141	176	129	158	130	145
Tee	Swine 1x	149	192	145	136	165	131	130
Tee	Swine 2x	155	178	130	95	124	110	122
Tee	Dairy 1x	159	179	154	145	146	139	137
Tee	Dairy 2x	164	170	155	131	137	135	133

Table A.12. Magnesium concentration of 0-2.5 cm layer in green and tee box soils.

Site	Amendment	Pre-App	May	June	July	August	September	October
					mg Mg kg^{-1}			
Green	Untreated	45 (3)	36 (2)	51 (8)	44 (5)	47 (5)	39 (10)	45 (8)
Green	Swine 1x	55 (2)	54 (2)	76 (7)	55 (1)	70 (7)	52 (6)	78 (8)
Green	Swine 2x	39 (7)	47 (1)	103 (9)	64 (12)	73 (6)	63 (7)	59 (11)
Green	Dairy 1x	64 (2)	37 (3)	69 (9)	50 (6)	54 (3)	58 (6)	66 (10)
Green	Dairy 2x	63 (4)	34 (2)	46 (1)	61 (4)	61 (9)	60 (8)	82 (7)
Tee	Untreated	216 (23)	161 (10)	130 (22)	123 (16)	115 (8)	141 (14)	116 (8)
Tee	Swine 1x	181 (10)	179 (2)	213 (19)	202 (10)	186 (13)	176 (10)	221 (12)
Tee	Swine 2x	149 (7)	170 (3)	297 (70)	310 (14)	257 (16)	253 (14)	256 (17)
Tee	Dairy 1x	156 (3)	176 (9)	171 (5)	161 (15)	152 (5)	143 (6)	148 (2)
Tee	Dairy 2x	120 (9)	129 (6)	138 (6)	144 (4)	155 (14)	135 (8)	143 (27)

*Standard Deviation in parentheses

Table A.13. Magnesium concentration of 2.5-5.0 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
					mg kg^{-1}			
Green	Untreated	24.0	29	23	25	27	22.3	27.0
Green	Swine 1x	23.0	29	30	33	40	24.0	39.0
Green	Swine 2x	23.0	26	35	34	43	29.3	38.0
Green	Dairy 1x	22.0	27	23	29	37	25.7	35.7
Green	Dairy 2x	40.0	27	22	27	32	28.3	36.3
Tee	Untreated	185	132	130	118	82	113.3	102.0
Tee	Swine 1x	190	153	164	166	126	142.7	164.3
Tee	Swine 2x	160	123	146	145	121	136.0	130.7
Tee	Dairy 1x	161	138	136	174	124	123.0	141.3
Tee	Dairy 2x	160	106	119	115	135	120.7	119.3

A.14. Magnesium saturation (percentage) of 0-2.5cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
					%			
Green	Untreated	37	25	38	28	35	18	22
Green	Swine 1x	45	37	52	30	44	17	28
Green	Swine 2x	36	39	57	31	38	20	23
Green	Dairy 1x	38	23	38	27	32	28	29
Green	Dairy 2x	47	22	27	26	30	21	28
Tee	Untreated	16	12	15	14	14	14	14
Tee	Swine 1x	16	19	21	26	23	20	24
Tee	Swine 2x	13	18	26	26	25	25	27
Tee	Dairy 1x	16	18	17	17	15	16	18
Tee	Dairy 2x	11	13	14	15	16	14	13

Table A.15. Sodium concentration of 0-2.5 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
		mg Na kg^{-1}						
Green	Untreated	25 (0)*	13 (2)	8 (3)	13 (7)	26 (3)	18 (4)	13 (2)
Green	Swine 1x	31 (1)	15 (1)	9 (1)	15 (2)	41 (10)	22 (3)	16 (2)
Green	Swine 2x	17 (4)	13 (1)	14 (2)	17 (8)	32 (4)	23 (2)	13 (1)
Green	Dairy 1x	44 (4)	16 (3)	9 (3)	12 (2)	34 (5)	26 (4)	10 (1)
Green	Dairy 2x	49 (3)	14 (4)	6 (2)	14 (4)	32 (7)	26 (3)	16 (3)
Tee	Untreated	70 (6)	65 (6)	54 (7)	54 (12)	86 (2)	82 (7)	55 (5)
Tee	Swine 1x	57 4)	70 (2)	78 (6)	78 (3)	261 (55)	155 (13)	180 (14)
Tee	Swine 2x	42 (3)	47 (2)	52 (5)	52 (12)	101 (7)	96 (15)	73 (6)
Tee	Dairy 1x	59 (2)	79 (7)	126 (4)	126 (17)	103 (5)	82 (7)	85 (5)
Tee	Dairy 2x	40 (5)	49 (6)	64 (1)	64 (10)	136 (20)	75 (11)	89 (21)

*Standard Deviation in parenthesis

Table A.16. Sodium concentration of 2.5 -5.0 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
		mg Na kg^{-1}						
Green	Untreated	13	11	7	9	16	16	9
Green	Swine 1x	23	9	6	11	20	17	11
Green	Swine 2x	23	10	6	11	20	18	11
Green	Dairy 1x	22	9	2	19	20	25	12
Green	Dairy 2x	40	9	2	8	17	25	13
Tee	Untreated	35	83	66	86	109	108	102
Tee	Swine 1x	81	92	100	91	164	222	220
Tee	Swine 2x	52	77	52	52	76	113	86
Tee	Dairy 1x	79	88	82	151	144	139	134
Tee	Dairy 2x	55	69	54	85	176	140	91

Table A.17. Potassium concentration of 0-2.5 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
		mg K kg^{-1}						
Green	Untreated	210 (11)	117 (8)	92 (14)	121 (12)	91 (12)	89 (30)	106 (21)
Green	Swine 1x	265 (15)	194 (9)	113 (40)	63 (17)	86 (14)	89 (22)	106 (15)
Green	Swine 2x	140 (19)	167 (13)	157 (32)	57 (4)	74 (9)	78 (12)	119 (5)
Green	Dairy 1x	283 (13)	159 (8)	101 (8)	79 (12)	75 (5)	106 (29)	98 (21)
Green	Dairy 2x	279 (19)	111 (14)	139 (7)	127 (31)	89 (12)	111 (18)	108 (15)
Tee	Untreated	132 (11)	280 (23)	278 (45)	383 (92)	279 (20)	304 (14)	242 (36)
Tee	Swine 1x	283 (16)	242 (10)	278 (33)	430 (16)	274 (12)	305 (32)	293 (16)
Tee	Swine 2x	210 (12)	259 (26)	329 (3)	597 (28)	372 (29)	301 (27)	256 (16)
Tee	Dairy 1x	207 (6)	260 (10)	270 (37)	403 (62)	387 (37)	311 (57)	267 (19)
Tee	Dairy 2x	134 (11)	269 (16)	253 (7)	416 (61)	323 (10)	303 (29)	249 (40)

*Standard Deviation in parenthesis

Table A.18. Potassium concentration of 2.5 -5.0 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
		mg K kg^{-1}						
Green	Untreated	87	79	21	38	31	19	36
Green	Swine 1x	109	121	17	11	24	18	28
Green	Swine 2x	115	100	41	8	22	39	36
Green	Dairy 1x	82	74	31	30	37	31	48
Green	Dairy 2x	93	56	48	47	32	34	38
Tee	Untreated	237	143	140	178	149	203	188
Tee	Swine 1x	137	153	128	203	162	180	195
Tee	Swine 2x	110	113	122	226	202	197	232
Tee	Dairy 1x	207	135	115	231	229	207	271
Tee	Dairy 2x	166	122	121	189	251	202	198

A.19. Potassium saturation (percentage) for 0-2.5 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
					$\mu g\ Mg\ g^{-1}$			
Green	Untreated	53.7	24.9	21.4	23.8	21.2	12.6	15.9
Green	Swine 1x	67.8	41.3	24.1	10.7	16.9	9.1	11.8
Green	Swine 2x	39.8	42.7	26.8	8.6	11.8	7.7	14.5
Green	Dairy 1x	51.7	31.3	17.2	13.5	13.7	15.9	13.2
Green	Dairy 2x	64.9	21.8	25.4	17.1	13.4	12.3	11.5
Tee	Untreated	3.0	6.6	10.0	13.2	10.2	9.3	9.0
Tee	Swine 1x	8.0	7.9	8.7	17.5	10.6	11.0	9.9
Tee	Swine 2x	5.9	8.4	9.0	15.7	11.5	9.2	8.5
Tee	Dairy 1x	6.5	8.2	8.1	13.6	11.9	10.6	9.9
Tee	Dairy 2x	4.0	8.3	7.9	13.1	10.6	9.8	6.8

Table A.20. Soil pH (1:1 water) of 0-2.5 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
Green	Untreated	8.2 (0.6)*	7.2 (0.1)	7.0 (0.1)	6.8 (0.1)	7.1 (0.1)	7.2 (0.1)	7.1 (0.0)
Green	Swine 1x	8.0 (0.6)	7.1 (0.0)	7.0 (0.1)	6.9 (0.1)	7.0 (0.1)	6.9 (0.2)	7.0 (0.0)
Green	Swine 2x	8.0 (0.0)	7.1 (0.0)	7.0 (0.0)	6.9 (0.1)	7.2 (0.1)	6.9 (0.1)	7.0 (0.1)
Green	Dairy 1x	8.1 (0.0)	7.1 (0.0)	7.1 (0.1)	6.9 (0.1)	7.1 (0.1)	6.7 (0.1)	7.1 (0.1)
Green	Dairy 2x	7.9 (0.0)	7.1 (0.1)	7.0 (0.1)	6.9 (0.0)	7.1 (0.1)	6.7 (0.1)	6.9 (0.1)
Tee	Untreated	7.9 (0.1)	6.5 (0.1)	7.3 (0.0)	6.7 (0.1)	6.7 (0.1)	6.9 (0.2)	7.4 (0.1)
Tee	Swine 1x	7.8 (0.0)	6.4 (0.1)	7.2 (0.0)	6.6 (0.1)	7.1 (0.1)	7.0 (0.0)	7.0 (0.1)
Tee	Swine 2x	7.8 (0.1)	6.7 (0.1)	7.1 (0.1)	6.8 (0.1)	6.8 (0.2)	6.9 (0.6)	7.2 (0.1)
Tee	Dairy 1x	7.9 (0.0)	7.2 (0.1)	7.3 (0.0)	6.7 (0.1)	6.7 (0.2)	6.8 (0.3)	7.2 (0.1)
Tee	Dairy 2x	7.9 (0.0)	6.6 (0.1)	7.5 (0.1)	6.6 (0.1)	6.7 (0.1)	6.9 (0.1)	7.0 (0.4)

*Standard Deviation in parenthesis

Table A.21. Soil pH (1:1 water) of 2.5 -5.0 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
Green	Untreated	NA	7.3	7.7	7.3	7.5	7.7	7.8
Green	Swine 1x	NA	7.2	7.7	7.5	7.7	7.5	7.7
Green	Swine 2x	NA	7.2	7.7	7.3	7.5	7.3	7.7
Green	Dairy 1x	NA	7.2	8.0	7.4	7.6	7.2	7.6
Green	Dairy 2x	NA	7.2	8.0	7.1	7.5	7.2	7.6
Tee	Untreated	NA	7.3	7.7	7.3	7.5	7.3	7.8
Tee	Swine 1x	NA	7.2	7.7	7.5	7.7	7.3	7.7
Tee	Swine 2x	NA	7.2	7.7	7.3	7.5	7.2	7.8
Tee	Dairy 1x	NA	7.2	8.0	7.4	7.6	7.6	7.7
Tee	Dairy 2x	NA	7.2	8.0	7.1	7.5	7.4	7.9

Table A.22. Soil pH (2:1 $CaCl_2$) of 0-2.5 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
Green	Untreated	7.0 (0.2)	6.7 (0.1)	6.7 (0.1)	6.3 (0.3)	6.2 (05)	6.4 (0.3)	6.5 (0.1)
Green	Swine 1x	7.5 (0.2)	6.4 (0.1)	6.6 (0.1)	6.4 (0.1)	6.3 (0.0)	6.6 (0.1)	6.5 (0.1)
Green	Swine 2x	7.6 (0.1)	6.2 (0.1)	6.6 (0.0)	6.4 (0.0)	6.5 (0.0)	6.4 (0.0)	6.6 (0.0)
Green	Dairy 1x	7.6 (0.0)	6.7 (0.1)	6.6 (0.1)	6.4 (0.1)	6.3 (0.1)	6.5 (0.0)	6.9 (0.0)
Green	Dairy 2x	7.6 (0.0)	6.5 (0.0)	6.5 (0.0)	6.5 (0.0)	6.4 (0.1)	6.7 (0.1)	6.8 (0.2)
Tee	Untreated	7.6 (0.0)	7.3 (0.0)	7.1 (0.0)	7.0 (0.1)	7.0 (0.0)	6.9 (0.0)	7.0 (0.1)
Tee	Swine 1x	7.7 (0.0)	7.0 (0.0)	7.0 (0.1)	7.0 (0.0)	7.4 (0.0)	6.9 (0.0)	6.9 (0.1)
Tee	Swine 2x	7.6 (0.0)	7.1 (0.0)	6.8 (0.1)	7.4 (0.1)	6.7 (0.1)	7.0 (0.1)	7.7 (0.1)
Tee	Dairy 1x	7.7 (0.0)	7.1 (0.0)	6.8 (0.0)	7.0 (0.1)	7.0 (0.1)	7.4 (0.1)	7.6 (0.1)
Tee	Dairy 2x	7.7 (0.0)	7.2 (0.1)	6.9 (0.1)	7.0 (0.1)	6.9 (0.1)	7.3 (0.1)	7.3 (0.0)

*Standard Deviation in parenthesis

Table A.23 Soil pH (1:1 water) of 2.5 -5.0 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
Green	Untreated	NA	7.7	7.1	4.6	6.8	6.9	7.0
Green	Swine 1x	NA	6.6	7.2	5.4	6.7	6.9	7.0
Green	Swine 2x	NA	6.6	7.1	4.8	6.7	6.8	7.0
Green	Dairy 1x	NA	7.0	7.1	4.7	6.9	7.1	7.6
Green	Dairy 2x	NA	7.0	7.2	4.5	6.9	7.0	7.4
Tee	Untreated	NA	7.6	7.5	5.7	7.4	7.4	7.4
Tee	Swine 1x	NA	7.6	7.5	5.8	7.5	7.7	7.3
Tee	Swine 2x	NA	7.6	7.3	5.7	7.0	7.5	7.6
Tee	Dairy 1x	NA	7.5	7.4	5.8	7.4	7.7	7.4
Tee	Dairy 2x	NA	7.6	7.4	5.6	7.3	7.7	7.4

Table A.24. Total carbon of 0-2.5 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
					g C kg^{-1}			
Green	Untreated	2.0 (0.4)	4.0 (0.6)	3.9 (0.4)	4.8 (1.3)	2.5 (1.2)	4.0 (1.0)	5.2 (0.9)
Green	Swine 1x	2.1 (0.6)	4.3 (0.3)	6.2 (2.4)	5.4 (1.2)	6.1 (1.2)	5.4 (1.3)	6.8 (1.1)
Green	Swine 2x	2.0 (1.1)	3.8 (0.1)	6.6 (0.5)	5.0 (0.6)	5.5 (0.7)	6.3 (1.7)	4.2 (0.3)
Green	Dairy 1x	2.5 (0.6)	4.5 (0.2)	5.3 (0.5)	6.1 (1.3)	5.6 (0.7)	3.9 (0.5)	4.5 (0.5)
Green	Dairy 2x	2.7 (1.1)	4.1 (0.7)	3.8 (0.4)	8.1 (1.2)	6.3 (1.0)	6.6 (1.8)	7.4 (1.7)
Tee	Untreated	10.0 (0.8)	8.1 (0.6)	9.1 (1.3)	8.5 (0.4)	8.4 (1.0)	11.3 (3.0)	8.1 (0.7)
Tee	Swine 1x	6.6 (0.6)	7.8 (1.3)	11.5 (1.1)	8.9 (1.4)	8.5 (1.3)	8.5 (1.0)	8.1 (5.8)
Tee	Swine 2x	6.9 (0.6)	8.5 (0.6)	22.4 (9.4)	15.3 (1.6)	12.9 (2.7)	13.2 (4.9)	16.1 (0.4)
Tee	Dairy 1x	5.9 (0.5)	8.7 (0.9)	12.7 (1.6)	9.4 (0.2)	13.3 (0.1)	9.3 (0.9)	15.6 (1.7)
Tee	Dairy 2x	5.7 (0.3)	8.3 (1.0)	13.2 (3.6)	12.1 (0.9)	11.7 (2.1)	10.4 (0.2)	10.4 (8.5)

*Standard Deviation in parenthesis

Table A.25. Total carbon of 2.5 -5.0 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
					g C kg^{-1}			
Green	Untreated	1.0	1.5	1.0	1.2	1.2	1.1	1.2
Green	Swine 1x	0.7	1.2	0.7	1.1	1.4	1.1	1.4
Green	Swine 2x	1.2	1.3	1.5	1.3	1.4	1.3	1.3
Green	Dairy 1x	0.9	1.4	1.2	1.4	1.5	1.1	1.2
Green	Dairy 2x	1.1	1.5	0.7	1.3	1.3	1.8	1.4
Tee	Untreated	8.6	5.6	6.1	5.6	4.8	5.2	5.9
Tee	Swine 1x	5.7	5.4	5.5	5.1	4.5	5.6	4.9
Tee	Swine 2x	8.0	6.0	6.5	6.5	5.6	5.7	5.7
Tee	Dairy 1x	7.1	5.7	5.4	5.5	5.3	5.3	5.7
Tee	Dairy 2x	4.6	5.3	5.8	5.7	5.6	5.6	8.9

Table A.26. Total nitrogen of 0-2.5 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
					g N kg^{-1}			
Green	Untreated	0.21 (0.0)*	0.37 (0.0)	0.25 (0.0)	0.39 (0.1)	0.26 (0.3)	0.32 (0.1)	0.44 (0.1)
Green	Swine 1x	0.16 (0.0)	0.32 (0.0)	0.51 (0.3)	0.51 (0.1)	0.48 (0.1)	0.47 (0.1)	0.65 (0.1)
Green	Swine 2x	0.09 (0.1)	0.30 (0.0)	0.52 (0.1)	0.48 (0.1)	0.49 (0.1)	0.58 (0.2)	0.34 (0.0)
Green	Dairy 1x	0.31 (0.1)	0.35 (0.0)	0.35 (0.0)	0.49 (0.1)	0.39 (0.1)	0.26 (0.1)	0.29 (0.1)
Green	Dairy 2x	0.18 (0.1)	0.32 (0.1)	0.22 (0.0)	0.64 (0.0)	0.46 (0.1)	0.51 (0.1)	0.58 (0.1)
Tee	Untreated	0.64 (0.1)	0.44 (0.0)	0.52 (0.1)	0.58 (0.1)	0.52 (0.1)	0.77 (0.2)	0.45 (0.0)
Tee	Swine 1x	0.54 (0.2)	0.49 (0.1)	0.87 (0.0)	0.71 (0.1)	0.67 (0.1)	0.70 (0.1)	1.10 (0.4)
Tee	Swine 2x	0.43 (0.0)	0.61 (0.0)	2.07 (1.1)	1.47 (0.2)	1.15 (0.3)	1.33 (0.2)	1.46 (0.0)
Tee	Dairy 1x	0.37 (0.0)	0.48 (0.0)	0.91 (0.2)	0.68 (0.0)	1.03 (0.1)	0.65 (0.1)	1.33 (0.5)
Tee	Dairy 2x	0.31 (0.0)	0.52 (0.1)	0.94 (0.2)	0.87 (0.1)	0.73 (0.1)	0.74 (0.0)	0.82 (0.5)

*Standard Deviation in parenthesis

Table A.27. Total nitrogen of 2.5 -5.0 cm layer in green and tee box soils

Site	Amendment	Pre-App	May	June	July	August	September	October
					g N kg^{-1}			
Green	Untreated	0.02	0.06	0.03	0.10	0.03	0.02	0.02
Green	Swine 1x	0.03	0.03	ND	0.11	0.02	0.01	0.04
Green	Swine 2x	0.06	0.03	0.02	0.08	0.09	0.03	0.04
Green	Dairy 1x	0.04	0.04	0.02	0.10	0.04	0.01	0.02
Green	Dairy 2x	0.01	0.03	0.03	0.11	0.04	0.05	0.03
Tee	Untreated	0.58	0.25	0.32	0.37	0.25	0.25	0.26
Tee	Swine 1x	0.35	0.28	0.35	0.36	0.28	0.34	0.25
Tee	Swine 2x	0.49	0.32	0.44	0.40	0.34	0.32	0.27
Tee	Dairy 1x	0.42	0.26	0.35	0.37	0.26	0.27	0.30
Tee	Dairy 2x	0.21	0.25	0.38	0.42	0.27	0.30	0.57

Table A.28. Microbial biomass carbon of 0-2.5 cm layer in green and tee box soils

		July	August	September	October
Site	Amendment		μg C g^{-1} soil		
Green	Untreated	95.0 (138.6)	128.7 (51.4)	44.9 (49.3)	25.7 (18.1)
Green	Swine 1x	218.7 (190.3)	194.9 (56.7)	104.0 (32.9)	111.0 (13.4)
Green	Swine 2x	238.5 (197.3)	195.0 (56.0)	98.7 (91.2)	73.4 (18.0)
Green	Dairy 1x	160.2 (110.7)	113.7 (28.9)	70.3 (35.4)	82.2 (4.9)
Green	Dairy 2x	191.8 (216.5)	190.0 (80.0)	59.9 (20.2)	88.4 (21.9)
Tee	Untreated	34.1 (NA)	340.3 (208.3)	88.8 (92.9)	178.9 (47.0)
Tee	Swine 1x	NA	64.7 (8.9)	54.3 (NA)	199.4 (103.2)
Tee	Swine 2x	125.6 (81.2)	347.5 (81.9)	306.8 (136.4)	31.1 (18.2)
Tee	Dairy 1x	174.6 (220.2)	184.3 (68.5)	122.6 (54.4)	74.4 (53.7)
Tee	Dairy 2x	147.6 (120.0)	163.4 (88.1)	163.7 (93.9)	38.6 (31.4)

*Standard Deviation in parenthesis

Table A.29. Microbial biomass carbon of 2.5 -5.0 cm layer in green and tee box soils

		July	August	September	October
Site	Amendment		μg C g^{-1} soil		
Green	Untreated	ND	62.6	11.9	20.3
Green	Swine 1x	ND	57.6	23.9	16.2
Green	Swine 2x	ND	85.3	12.9	13.9
Green	Dairy 1x	ND	49.8	31.7	17.5
Green	Dairy 2x	ND	40.1	17.6	26.2
Tee	Untreated	214.0	193.0	159.2	54.9
Tee	Swine 1x	ND	146.6	124.9	64.8
Tee	Swine 2x	79.8	58.4	105.8	76.2
Tee	Dairy 1x	19.7	188.4	104.4	22.2
Tee	Dairy 2x	120.3	252.9	235.2	56.2

Table A.30 Mineralizable carbon of 0-2.5 cm layer in green and tee box soils

Site	Amendment	July	August	September	October
		μg C g^{-1} soil			
Green	Untreated	145.4 (46.6)	64.0 (7.0)	52.5 (4.5)	68.6 (10.7)
Green	Swine 1x	119.1 (34.6)	64.6 (52.7)	39.7 (42.1)	56.2 (57.2)
Green	Swine 2x	159.1 (94.5)	24.1 (0.5)	22.4 (2.9)	14.5 (4.2)
Green	Dairy 1x	118.0 (46.5)	43.9 (26.0)	42.8 (38.6)	26.2 (20.7)
Green	Dairy 2x	117.6 (92.3)	83.9 (15.8)	127.7 (14.9)	67.4 (13.4)
Tee	Untreated	206.3 (0.0)	96.9 (50.2)	192.4 (19.7)	161.5 (9.3)
Tee	Swine 1x	NA	137.5 (165.2)	236.2 (NA)	203.2 (NA)
Tee	Swine 2x	278.4 (49.8)	39.7 (3.5)	41.9 (17.8)	42.7 (1.3)
Tee	Dairy 1x	226.1 (25.1)	43.7 (44.8)	95.0 (56.0)	158.5 (134.9)
Tee	Dairy 2x	215.7 (4.9)	217.5 (19.6)	218.6 (55.0)	224.6 (26.8)

*Standard Deviation in parenthesis

Table A.31 Mineralizeable carbon of 2.5 -5.0 cm layer in green and tee box soils

Site	Amendment	July	August	September	October
		μg C g^{-1} soil			
Green	Untreated	34.9	1.9	13.6	13.8
Green	Swine 1x	97.1	85.0	122.3	98.7
Green	Swine 2x	71.5	51.6	43.9	80.9
Green	Dairy 1x	98.0	8.3	29.0	17.9
Green	Dairy 2x	61.3	14.9	26.2	17.9
Tee	Untreated	49.7	35.5	44.9	49.5
Tee	Swine 1x	77.0	241.4	241.2	160.3
Tee	Swine 2x	46.0	172.7	181.7	239.6
Tee	Dairy 1x	54.6	2.7	45.0	42.0
Tee	Dairy 2x	51.4	40.0	50.6	55.6

Table A.32 Microbial biomass nitrogen (ug N g^{-1} soil) of 0-2.5 cm layer in green and tee box soils

		July	August	September	October
Site	Amendment		μg N g^{-1} soil		
Green	Untreated	32.5 (23.5)	6.3 (4.7)	20.0 (3.8)	25.2 (12.7)
Green	Swine 1x	40.5 (51.3)	12.8 (3.1)	17.5 (15.9)	16.3 (6.7)
Green	Swine 2x	61.1 (35.3)	11.1 (2.9)	21.1 (16.8)	4.0 (1.0)
Green	Dairy 1x	42.2 (16.0)	10.9 (NA)	NA	13.8 (4.0)
Green	Dairy 2x	51.1 (72.6)	13.3 (2.22)	24.1 (13.8)	11.4 (4.8)
Tee	Untreated	82.8 (NA)	90.7 (14.5)	72.1 (4.9)	84.0 (4.3)
Tee	Swine 1x	NA	55.6 (18.4)	53.2 (NA)	57.4 (6.2)
Tee	Swine 2x	48.5 (14.2)	46.5 (21.5)	90.5 (29.4)	17.3 (NA)
Tee	Dairy 1x	74.3 (20.8)	95.5 (16.5)	70.7 (27.2)	62.2 (21.3)
Tee	Dairy 2x	96.9 (30.7)	97.8 (58.7)	66.6 (20.1)	92.9 (47.1)

*Standard Deviation in parenthesis

Table A.33 Microbial biomass nitrogen of 2.5 -5.0 cm layer in green and tee box soils

		July	August	September	October
Site	Amendment		μg C g^{-1} soil		
Green	Untreated	4.0	ND	9.1	9.2
Green	Swine 1x	4.4	3.3	5.2	6.9
Green	Swine 2x	4.5	ND	6.4	7.1
Green	Dairy 1x	5.7	0.5	9.0	5.8
Green	Dairy 2x	5.5	ND	6.8	6.9
Tee	Untreated	52.2	7.8	18.7	31.5
Tee	Swine 1x	13.1	19.4	13.5	18.2
Tee	Swine 2x	26.0	31.9	56.7	26.0
Tee	Dairy 1x	22.4	7.8	8.9	24.3
Tee	Dairy 2x	34.3	79.6	50.2	29.6

Table A.34 Mineralizable nitrogen of 0-2.5 cm layer in green and tee box soils

Site	Amendment	July	August	September	October
		μg N g^{-1} soil			
Green	Untreated	1.8 (3.9)	12.7 (1.4)	2.5 (1.8)	(-)8.1 (0.9)
Green	Swine 1x	(-)4.2 (12.3)	12.8 (3.3)	3.8 (2.5)	2.6 (5.6)
Green	Swine 2x	(-)2.4 (17.1)	9.6 (2.8)	3.9 (1.5)	(-)10.9 (3.4)
Green	Dairy 1x	(-)8.7 (7.3)	10.9 (NA)	NA	2.0 (7.1)
Green	Dairy 2x	(-)13.1 (7.5)	9.6 (2.3)	8.9 (5.0)	1.8 (4.2)
Tee	Untreated	3.7 (NA)	NA	4.6 (1.6)	(-)0.9 (5.9)
Tee	Swine 1x	NA	3.6 (2.2)	(-)1.6 (NA)	11.9 (2.4)
Tee	Swine 2x	14.2 (1.1)	10.0 (9.7)	(-)6.7 (23.5)	44.8 (8.9)
Tee	Dairy 1x	10.1 (5.5)	2.8 (NA)	10.8 (8.0)	30.7 (16.2)
Tee	Dairy 2x	1.3 (0.5)	2.6 (0.4)	4.7 (9.3)	0.8 (7.7)

*Standard Deviation in parenthesis

Table A.35 Mineralizeable nitrogen of 2.5 -5.0 cm layer in green and tee box soils

Site	Amendment	July	August	September	October
		μg C g^{-1} soil			
Green	Untreated	1.3	5.8	1.7	-1.4
Green	Swine 1x	1.5	5.2	2.3	0.1
Green	Swine 2x	0.2	5.9	1.6	-0.6
Green	Dairy 1x	0.4	4.8	2.1	-0.5
Green	Dairy 2x	0.3	5.7	3.7	-0.8
Tee	Untreated	0.8	1.9	4.5	-2.4
Tee	Swine 1x	3.7	4.4	4.8	-4.8
Tee	Swine 2x	10.4	ND	9.2	0.9
Tee	Dairy 1x	2.8	ND	5.2	0.5
Tee	Dairy 2x	0.8	2.4	2.5	-1.0

Table A.36 Microbial biomass carbon:total carbon ratio (MBC/TC) of 0-2.5 cm layer in green and tee box soils

		July	August	September	October
Site	Amendment	MBC:TC			
Green	Untreated	0.020	0.051	0.011	0.005
Green	Swine 1x	0.041	0.032	0.019	0.016
Green	Swine 2x	0.048	0.035	0.016	0.017
Green	Dairy 1x	0.026	0.025	0.018	0.018
Green	Dairy 2x	0.024	0.030	0.009	0.012
Tee	Untreated	0.004	0.041	0.008	0.022
Tee	Swine 1x	NA	0.008	0.006	0.025
Tee	Swine 2x	0.008	0.027	0.023	0.002
Tee	Dairy 1x	0.019	0.014	0.013	0.005
Tee	Dairy 2x	0.012	0.014	0.016	0.004

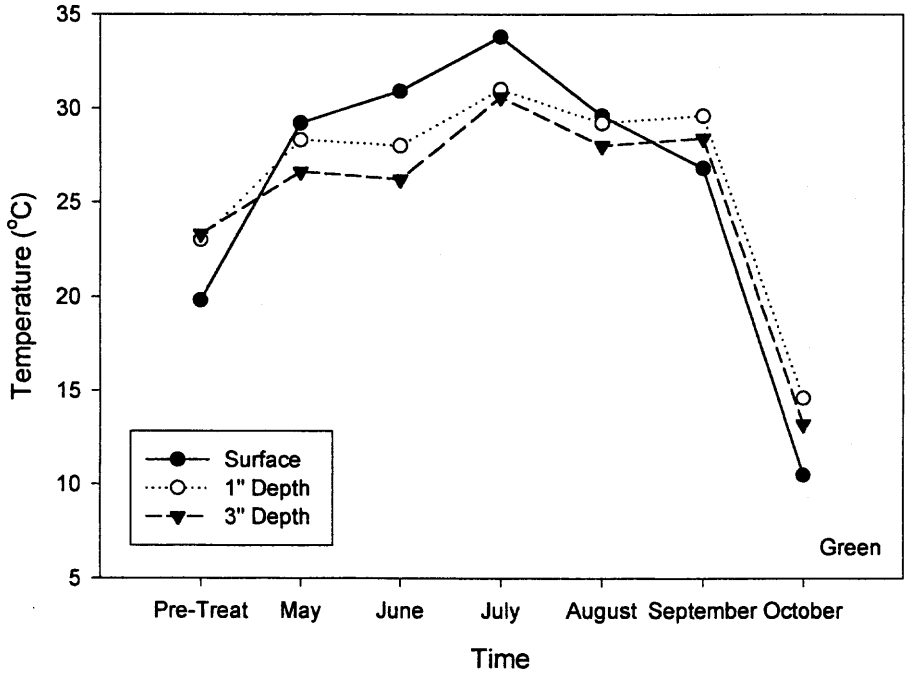
Table A.37 Microbial biomass nitrogen:total nitrogen ratio (MBN/TN) of 0-2.5 cm layer in green and tee box soils

		July	August	September	October
Site	Amendment	MBN:TN			
Green	Untreated	0.083	0.024	0.063	0.057
Green	Swine 1x	0.079	0.027	0.037	0.025
Green	Swine 2x	0.127	0.023	0.036	0.012
Green	Dairy 1x	0.086	0.028	NA	0.048
Green	Dairy 2x	0.080	0.029	0.047	0.020
Tee	Untreated	0.143	0.174	0.094	0.187
Tee	Swine 1x	NA	0.083	0.076	0.052
Tee	Swine 2x	0.033	0.030	0.068	0.012
Tee	Dairy 1x	0.109	0.093	0.109	0.047
Tee	Dairy 2x	0.111	0.134	0.090	0.113

Table A.38. Microbial respiration of 0-2.5 cm layer in green and tee box soils

Site	Amendment	August	September	October
			μg C hr^{-1}	
Green	Untreated	2.4	2.7	5.0
Green	Swine 1x	2.7	2.9	3.8
Green	Swine 2x	2.2	2.8	2.9
Green	Dairy 1x	2.1	3.8	2.8
Green	Dairy 2x	9.3	5.4	3.5
Tee	Untreated	7.7	7.0	10.1
Tee	Swine 1x	9.4	6.4	9.6
Tee	Swine 2x	7.3	7.8	7.7
Tee	Dairy 1x	10.5	7.7	11.3
Tee	Dairy 2x	11.5	5.8	5.9

Appendix B.
Temperature Data for Green and Tee Box Soils at Colbert Hills Golf Course (Chapter 3).



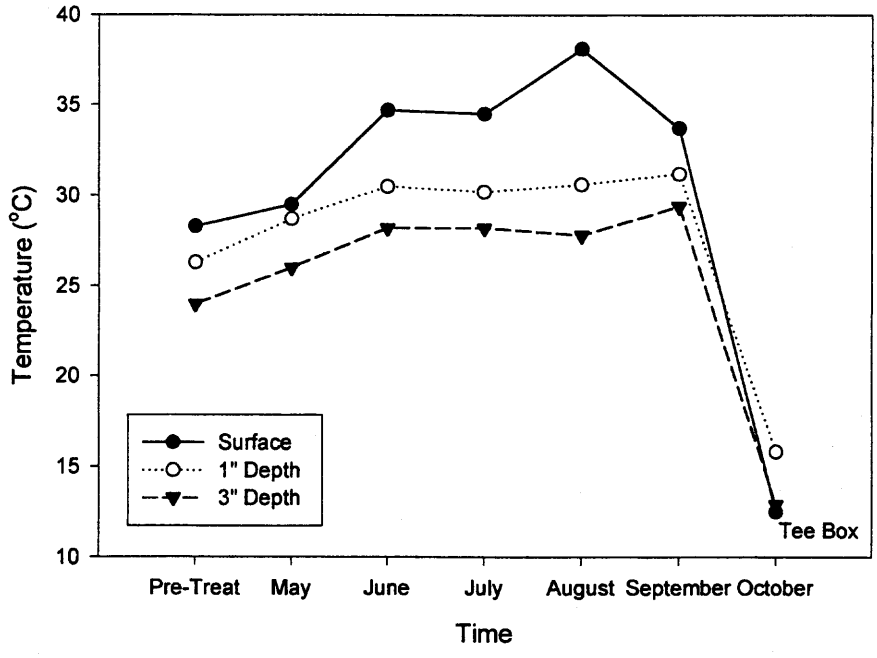
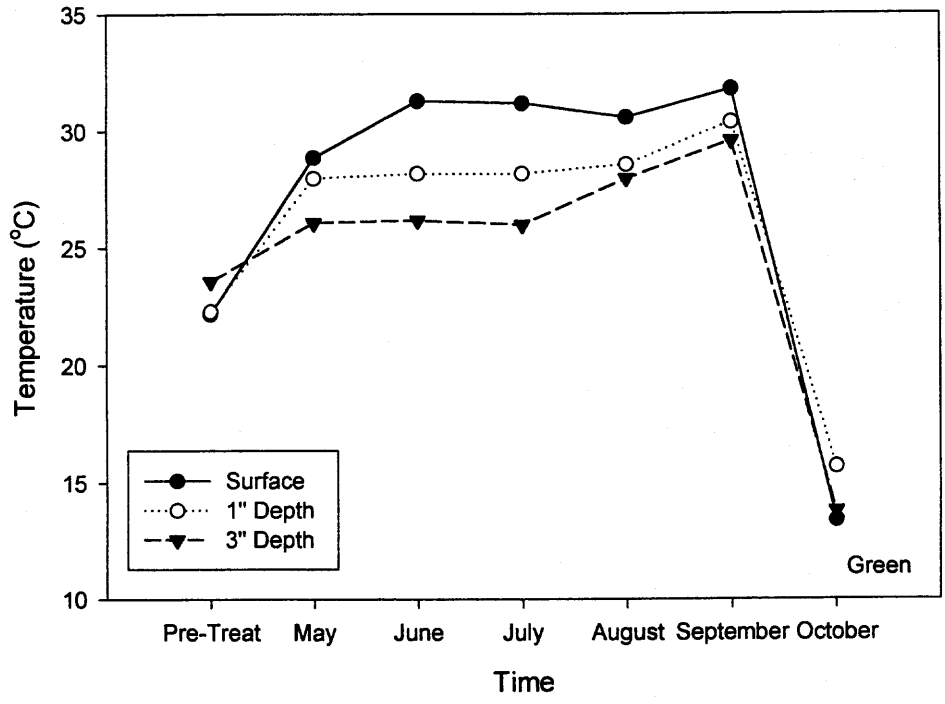


Figure B.1. Temperature measurements at surface, 2.5 cm and 7.6 cm depths in untreated green and tee box soils.



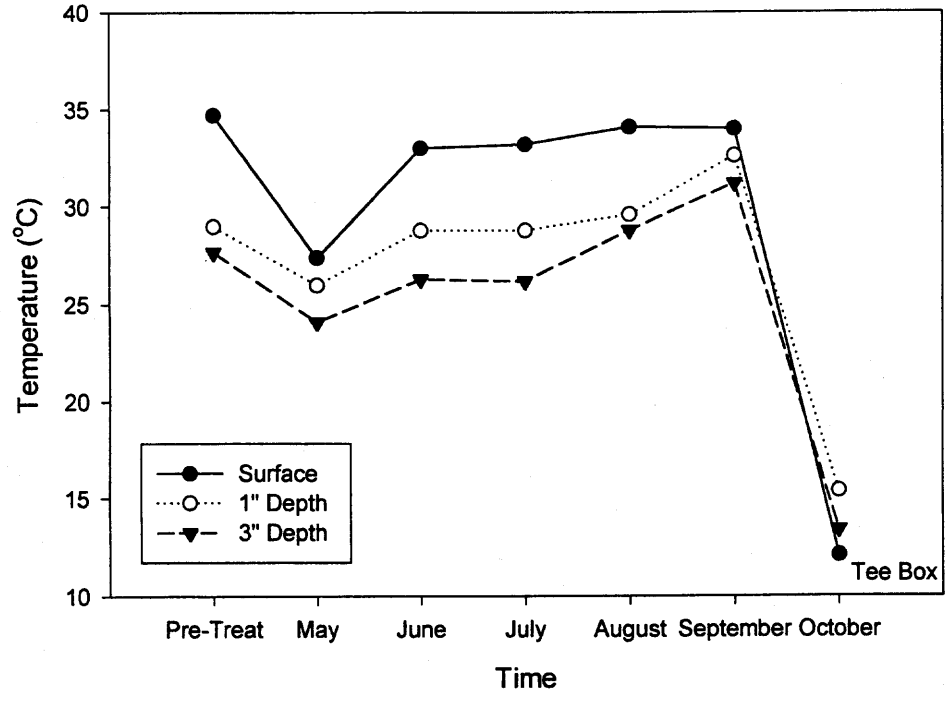
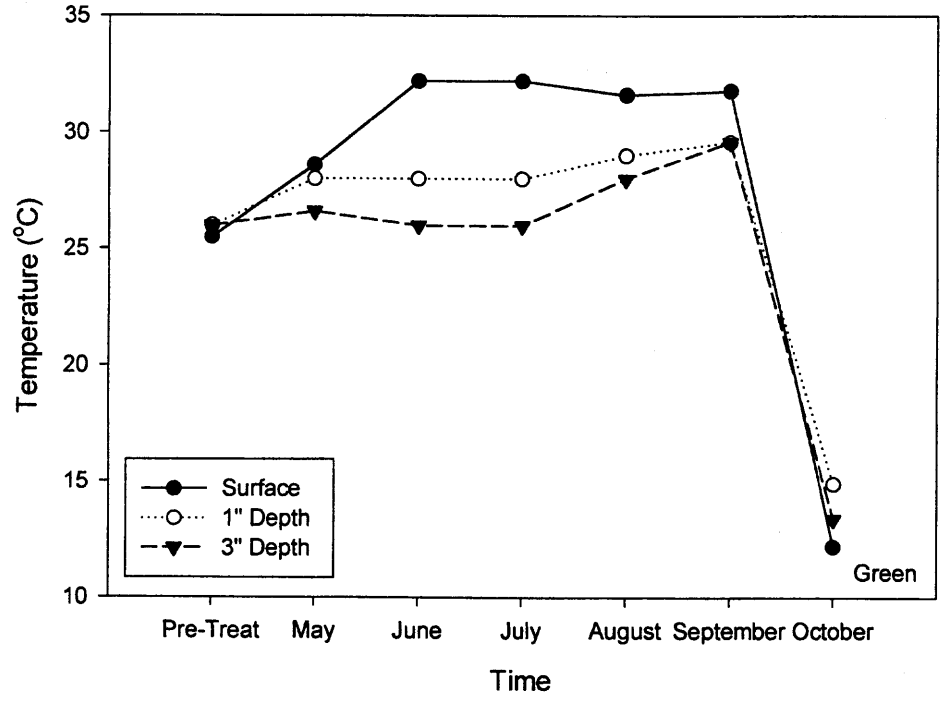


Figure B.2. Temperature measurements at surface, 2.5 cm and 7.6 cm depths in swine 1x amended green and tee box soils.



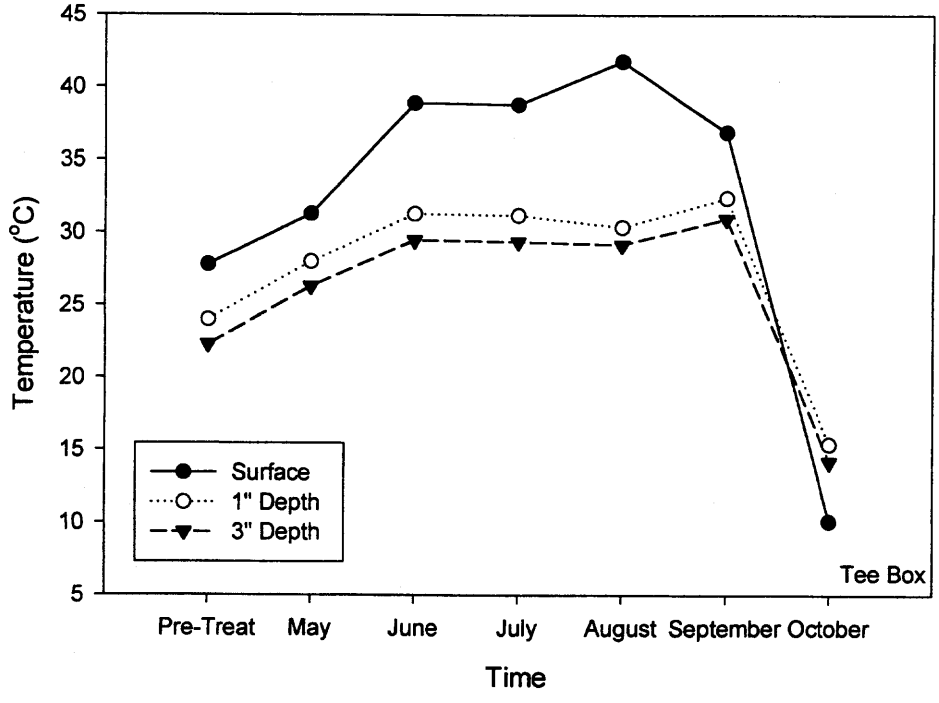
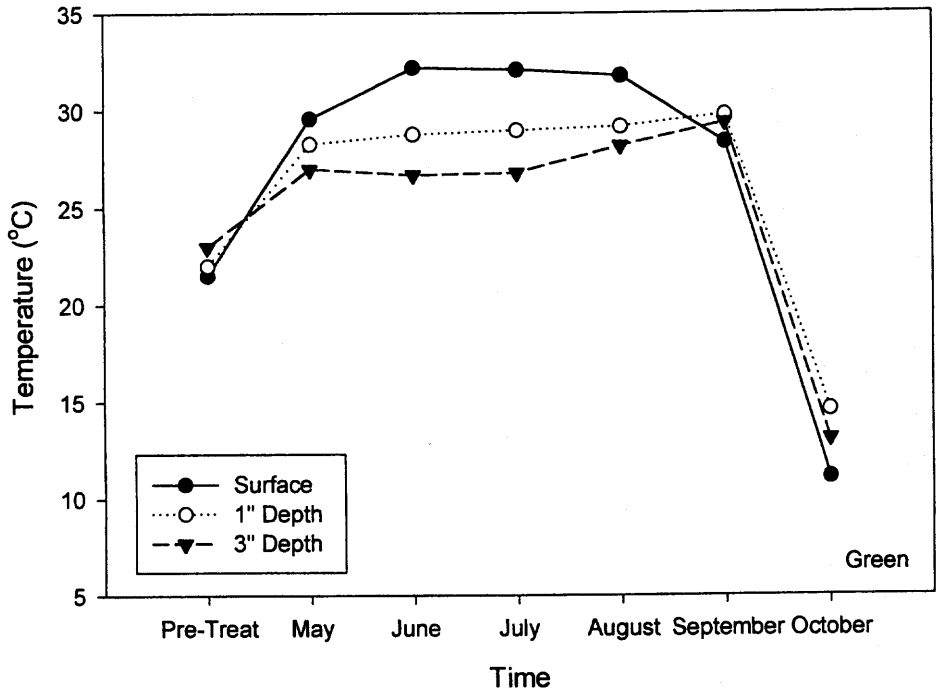


Figure B.3. Temperature measurements at surface, 2.5 cm and 7.6 cm depths in swine 2x amended green and tee box soils.



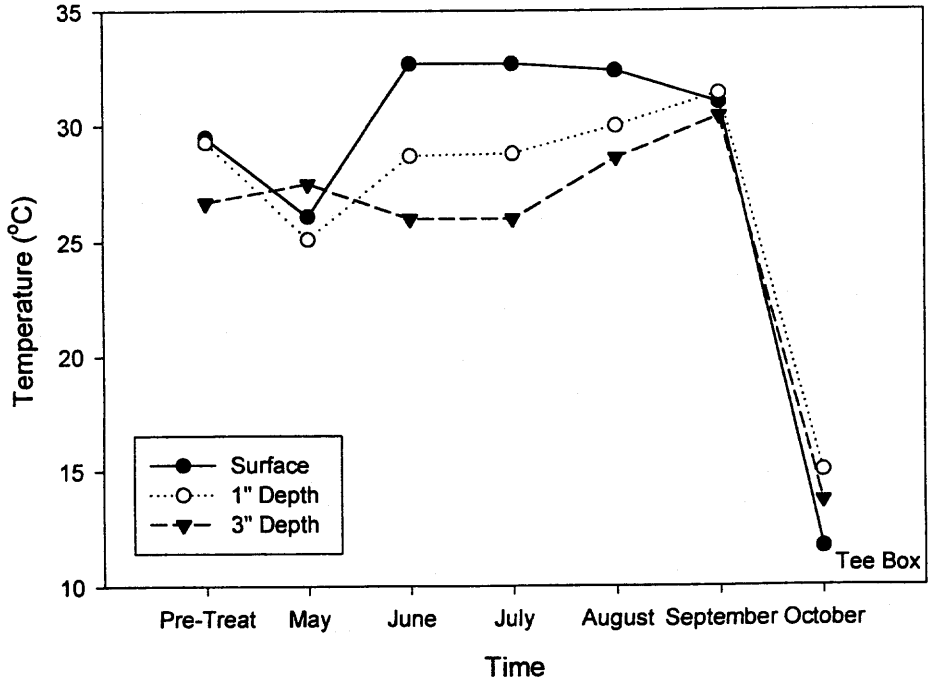
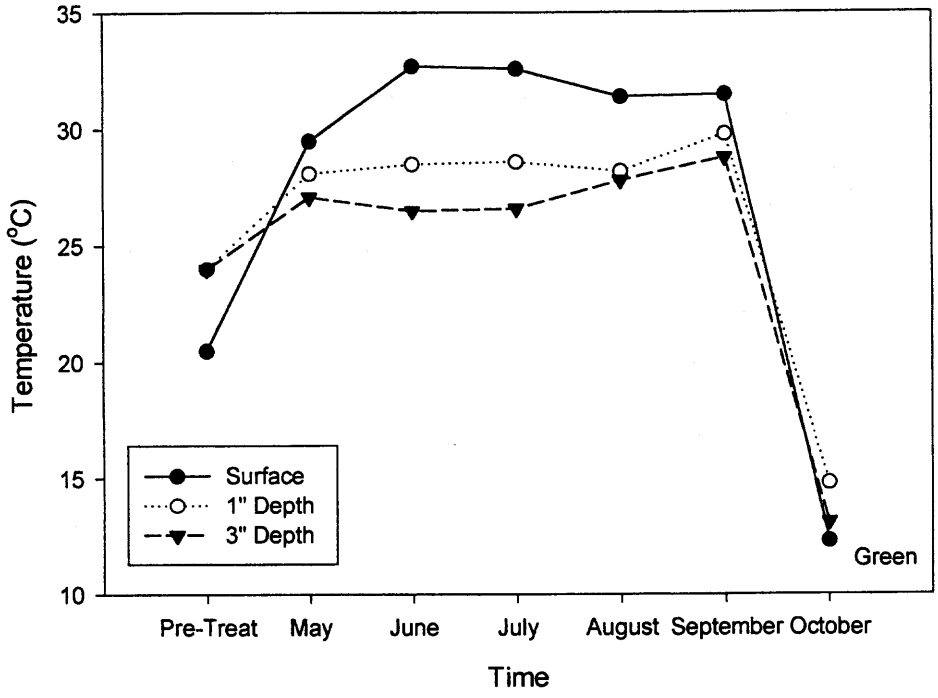


Figure B.4. Temperature measurements at surface, 2.5 cm and 7.6 cm depths in dairy 1x amended green and tee box soils.



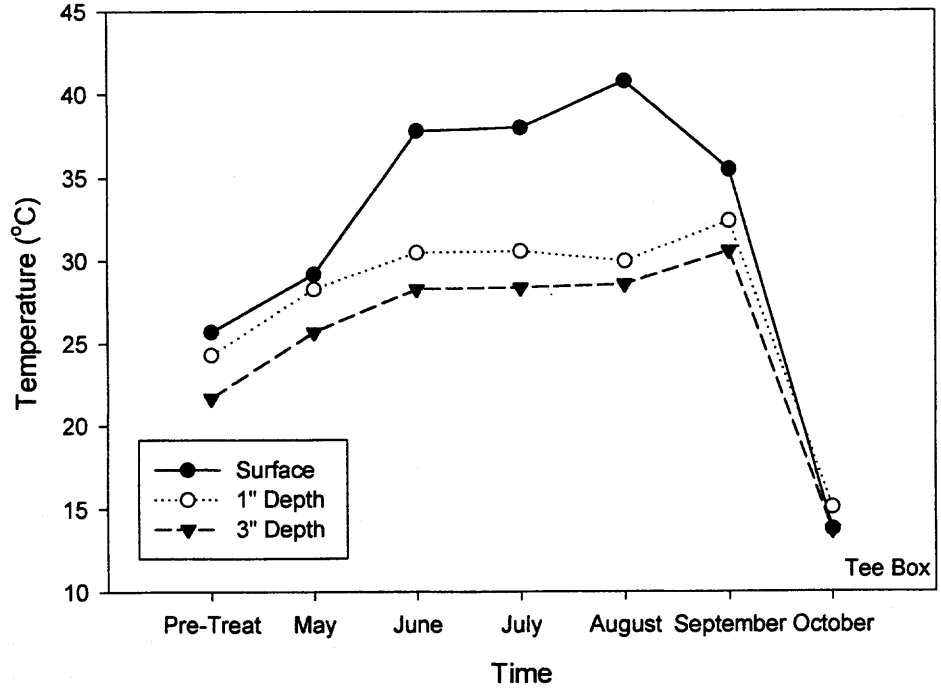
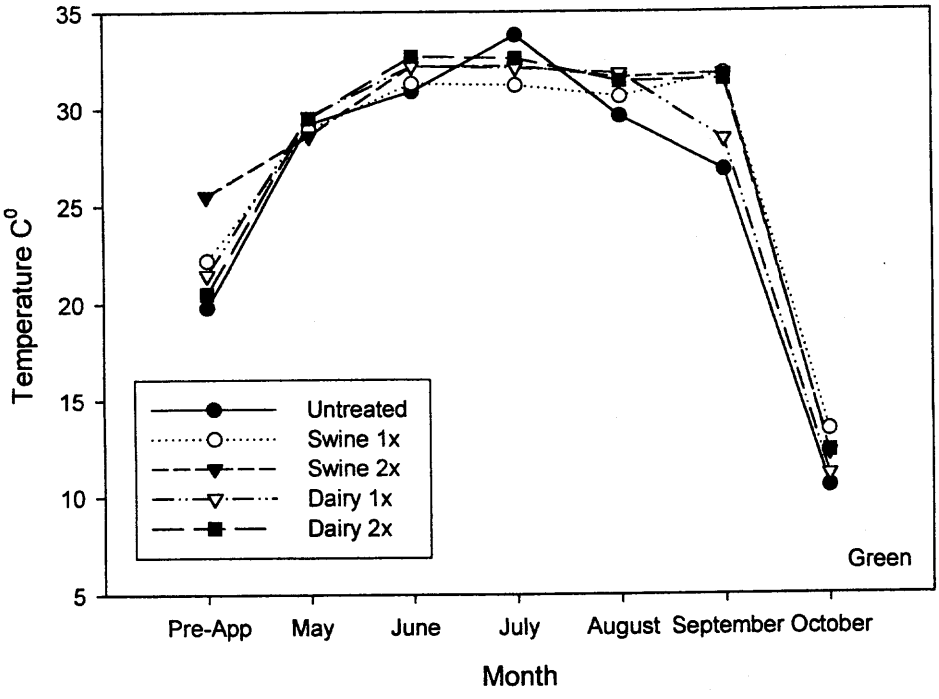


Figure B.5. Temperature measurements at surface, 2.5 cm and 7.6 cm depths in dairy 2x amended green and tee box soils.



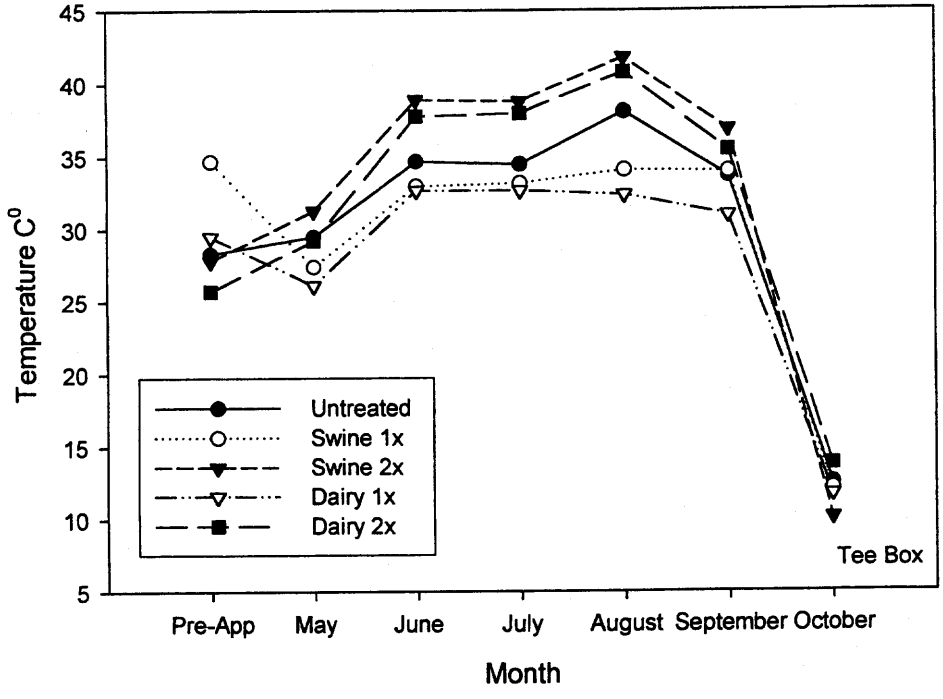
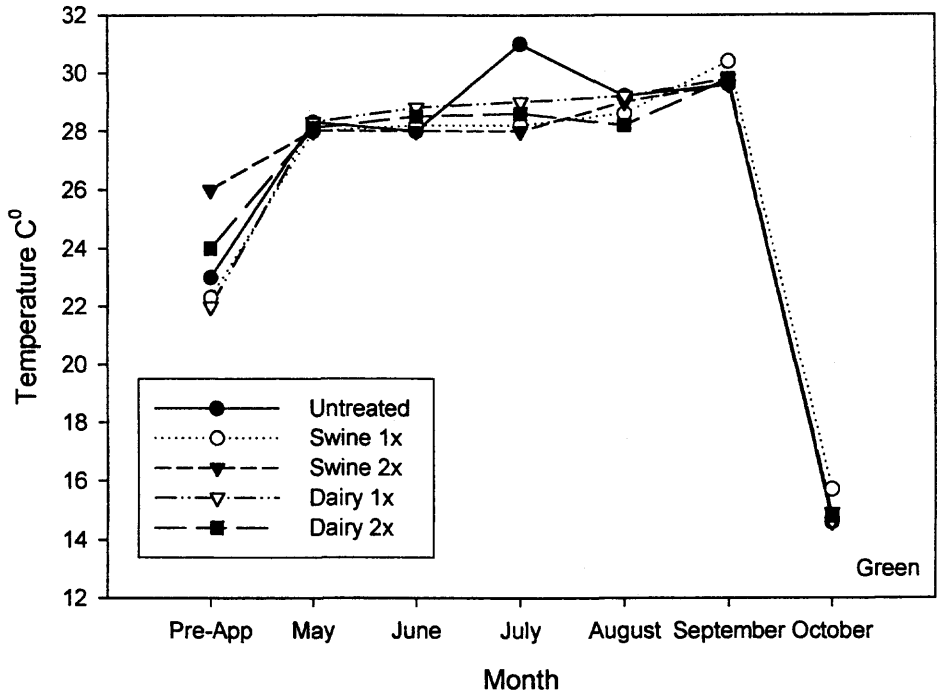


Figure B.6. Surface temperature measurements for all amended and untreated green and tee box soils.



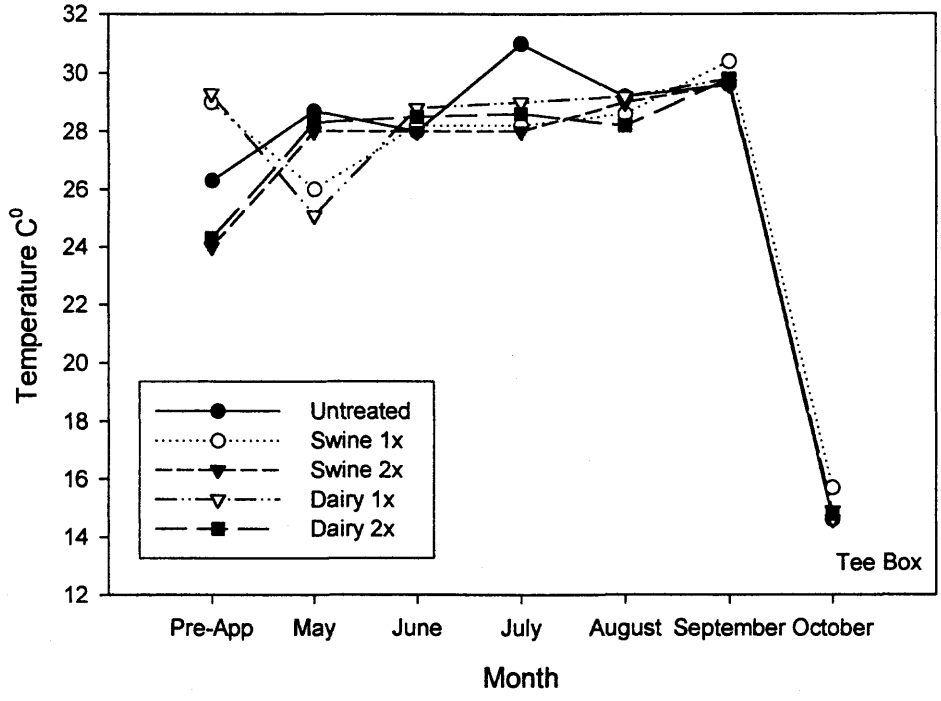
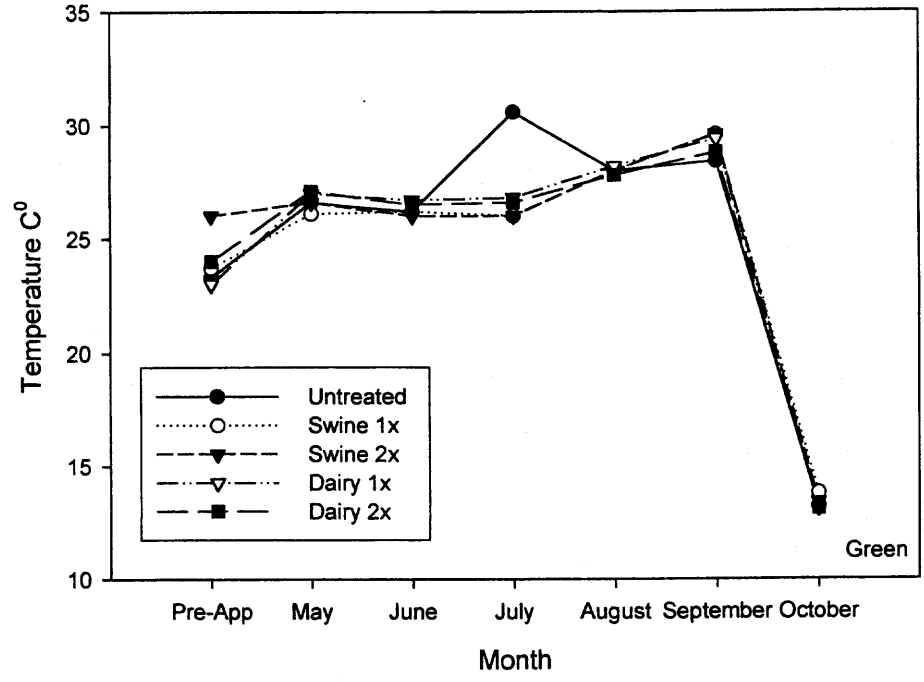


Figure B.7. 2.5 cm depth temperature measurements for all amended and untreated green and tee box soils.



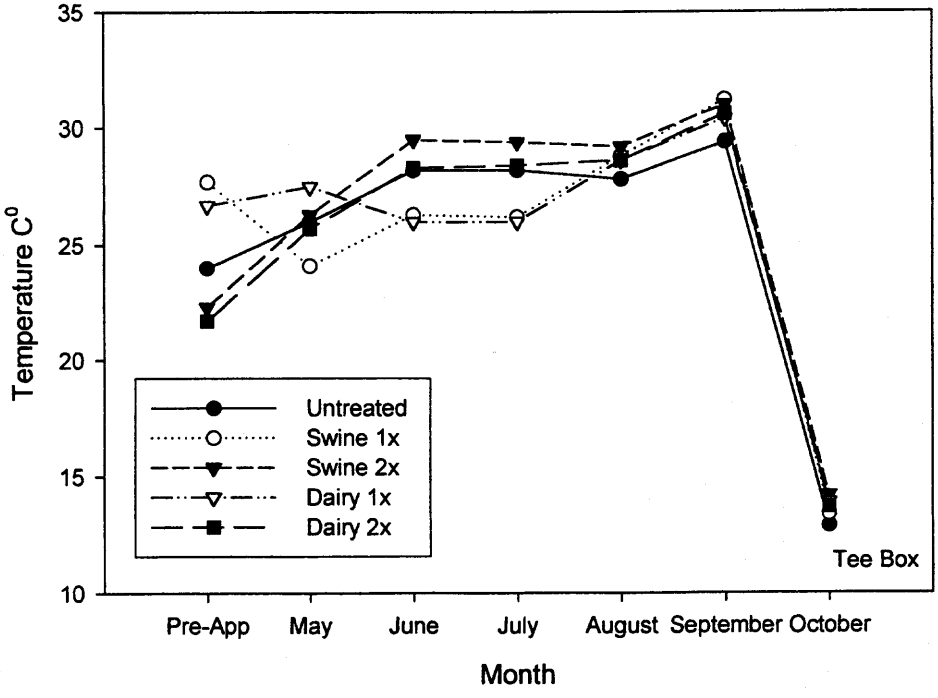


Figure B.8. 7.6 cm depth temperature measurements for all amended and untreated green and tee box soils.

Appendix C

Standardized Data for Green and Tee Box Soils Before First Compost Application and 45 Days After Last Compost Application (October 26th, 2000). (Chapter 3)

Table C.1. Standardized data for high sand green before first compost application (May 11th, 2000)

Treatment	BD	Porosity	pH 1	pH 2	Ca Sat	K sat	Mg sat	CEC	Total N	Total C	% Na	EC	MBM C Ratio	MBM N Ratio	Min C	Min N	MR
	g cm^{-3}	%			%	%	%	cmol kg^{-1}	g N kg^{-1}	g C kg^{-1}		dS m^{-1}	%	%	µg C g^{-1}	µg N g^{-1}	µg C hr^{-1}
G-U	1.47	44.2	8.2	7	150	53.7	37	0.99	0.21	2.0	0.5	0.39	0*	0	0	0	0
G-S1	1.46	44.8	8	7.5	100	67.8	45.3	1.01	0.16	2.1	0.67	0.45	0	0	0	0	0
G-S2	1.49	43.4	8	7.59	160	39.8	35.7	0.86	0.09	2.0	0.48	0.47	0	0	0	0	0
G-D1	1.48	43.8	8.1	7.59	120	51.7	37.6	1.37	0.31	2.5	0.55	0.39	0	0	0	0	0
G-D2	1.46	44.7	7.9	7.63	140	64.9	47.1	1.08	0.18	2.7	0.38	0.38	0	0	0	0	0

*Values were not reported till July

Threshold Limits																	
Lower	1.3	51	5.5	5.5	65	2	10	1	0.1**	1.0	0	0.25	0.01	0.02	0	0	0
Upper	1.7	36	7.5	7.5	85	7	20	14	1.0	20.0	15	3	0.04	0.06	100	25	10

**Underlined limits were chosen based on values for similar textures or soils under similar management.

Treatment	BD	Porosity	pH 1	pH 2	Ca Sat	K sat	Mg sat	CEC	Total N	Total C	% Na	EC	MBM C Ratio	MBM N Ratio	Min C	Min N	MR
	Standardized values (sustainable range between 0 - 100)																
G-U	42.5	55	135	75	425	1034	170	-0.1	12	5	3.3	5	0	0	0	0	0
G-S1	40	59	125	100	175	1316	253	0.1	7	6	4.5	7	0	0	0	0	0
G-S2	47.5	49	125	104.5	475	756	157	-1.1	-1	5	3.2	8	0	0	0	0	0
G-D1	45	52	130	104.5	275	994	176	2.8	23	8	3.7	5	0	0	0	0	0
G-D2	40	58	120	106.5	375	1258	271	0.6	9	9	2.5	5	0	0	0	0	0

Table C.2. Standardized data for high sand green 45 days (October 26th) after last compost application

Treatment	BD	Porosity	pH 1	pH 2	Ca Sat	K sat	Mg sat	CEC	Total N	Total C	% Na	EC	MBM C Ratio	MBM N Ratio	Min C	Min N	MR
	g cm^{-3}	%			%	%	%	cmol kg^{-1}	g N kg^{-1}	g C kg^{-1}		dS m^{-1}	%	%	µg C g^{-1}	µg N g^{-1}	µg C hr^{-1}
G-U	1.54	41.5	7.1	6.5	90	15.9	21.8	1.7	0.44	5.2	0.41	0.96	0.005	0.06	68.6	-8.1	4.98
G-S1	1.44	45.3	7	6.5	80	11.8	27.9	2.3	0.65	6.8	0.55	1.43	0.016	0.03	56.2	2.6	3.82
G-S2	1.41	46.5	7	6.6	70	14.5	23.1	2.1	0.34	4.2	0.43	0.8	0.017	0.01	14.5	-10.9	2.85
G-D1	1.36	48.5	7.1	6.9	70	13.2	28.6	1.9	0.29	4.5	0.35	1.84	0.018	0.05	26.2	2	2.79
G-D2	1.24	53.1	6.9	6.8	60	11.5	28.1	2.4	0.58	7.4	0.62	1.93	0.012	0.02	67.4	1.8	3.54
Threshold Limits																	
Lower	1.3	51	5.5	5.5	65	2	10	1	0.1*	1.0	0	0.25	0.01	0.02	0	0	0
Upper	1.7	36	7.5	7.5	85	7	20	14	1.0	20.0	15	3	0.04	0.06	100	25	10

**Underlined limits were chosen based on values for similar textures or soils under similar management.

Treatment	BD	Porosity	pH 1	pH 2	Ca Sat	K sat	Mg sat	CEC	Total N	Total C	% Na	EC	MBM C Ratio	MBM N Ratio	Min C	Min N	MR
	Standardized values (sustainable range between 0 - 100)																
G-U	60	37	80	50	125	278	118	5.4	38	21	2.7	26	-17	100	69	-32	50
G-S1	35	62	75	50	75	196	179	10.0	61	29	3.7	43	20	25	56	10	38
G-S2	27.5	70	75	55	25	250	131	8.5	27	16	2.9	20	23	-25	15	-44	29
G-D1	15	83	80	70	25	224	186	6.9	21	18	2.3	58	27	75	26	8	28
G-D2	-15	114	70	65	-25	190	181	10.8	53	32	4.1	61	7	0	67	7	35

Table C.3. Standardized data for tee box areas before first compost application (May 11th, 2000)

Treatment	BD $g\ cm^{-3}$	Porosity %	pH 1	pH 2	Ca Sat %	K sat %	Mg sat %	CEC $cmol\ kg^{-1}$	Total N $g\ N\ kg^{-1}$	Total C $g\ C\ kg^{-1}$	% Na	EC $dS\ m^{-1}$	MBM C Ratio %	MBM N Ratio %	Min C $\mu g\ C\ g^{-1}$	Min N $\mu g\ N\ g^{-1}$	MR $\mu g\ C\ hr^{-1}$
T-U	1.6	39.5	7.9	7.6	150	3	15.6	11.4	0.64	10.0	1.09	0.41	*0*	*0*	*0*	*0*	0
T-S1	1.58	40.3	7.8	7.7	150	8	16.4	9.1	0.54	6.6	1.03	0.69	*0*	*0*	*0*	*0*	0
T-S2	1.61	39	7.8	7.6	160	5.9	13.5	9.1	0.43	6.9	1.16	0.46	*0*	*0*	*0*	*0*	0
T-D1	1.58	40.2	7.9	7.7	160	6.5	15.8	8.1	0.37	5.9	1.34	0.58	*0*	*0*	*0*	*0*	0
T-D2	1.58	40.1	7.9	7.7	160	4	11.5	8.6	0.31	5.7	1.19	0.39	*0*	*0*	*0*	*0*	0
Threshold Limits																	
Lower	1.3	51	5.5	5.5	65	2	10	3	0.1**	1.0	0	0.25	0.01	0.02	0	0	0
Upper	1.7	36	8.0	8.0	85	7	20	20	2.5	20.0	15	3	0.04	0.06	300	100	15

*Values were not reported till July

**Underlined limits were chosen based on values for similar textures or soils under similar management.

Treatment	BD	Porosity	pH 1	pH 2	Ca Sat	K sat	Mg sat	CEC	Total N	Total C	% Na	EC	MBM C Ratio	MBM N Ratio	Min C	Min N	MR
Standardized values (sustainable range between 0 - 100)																	
T-U	75	23	96	84	425	20	56	49.4	23	45	7.3	6	0	0	0	0	0
T-S1	70	29	92	88	425	120	64	35.9	18	28	6.9	16	0	0	0	0	0
T-S2	77.5	20	92	84	475	78	35	35.9	14	30	7.7	8	0	0	0	0	0
T-D1	70	28	96	88	475	90	58	30.0	11	25	8.9	12	0	0	0	0	0
T-D2	70	27	96	88	475	40	15	32.9	9	24	7.9	5	0	0	0	0	0

Table C.4. Standardized data for tee box areas 45 days (October 26th) after last compost application

Treatment	BD g cm^{-3}	Porosity %	pH 1	pH 2	Ca Sat %	K sat %	Mg sat %	CEC cmol kg^{-1}	Total N g N kg^{-1}	Total C g C kg^{-1}	% Na	EC dS m^{-1}	MBM C Ratio %	MBM N Ratio %	Min C µg C g^{-1}	Min N µg N g^{-1}	MR µg C hr^{-1}
T-U	1.28	51.5	7.4	7	140	9	13.8	6.9	0.45	8.1	1.29	0	0.022	0.19	161.5	-0.9	10.14
T-S1	1.39	47.2	7	6.9	130	9.9	23.9	7.6	1.1	8.1	4.23	0	0.025	0.05	203.2	11.9	9.61
T-S2	1.43	46	7.2	7.7	120	8.5	27.4	7.7	1.46	16.1	1.65	1.58	0.002	0.01	42.7	44.8	7.71
T-D1	1.19	54.9	7.2	7.6	140	9.9	17.7	6.9	1.33	15.6	1.84	1.69	0.005	0.05	158.5	30.7	11.25
T-D2	1.33	49.7	7	7.3	130	6.8	12.7	9.3	0.82	10.4	1.78	1.79	0.004	0.11	224.6	0.8	5.86
Threshold Limits																	
Lower	1.3	51	5.5	5.5	65	2	10	3	0.1*	1.0	0	0.25	0.01	0.02	0	0	0
Upper	1.7	36	8.0	8.0	85	7	20	20	2.5	20.0	15	3	0.04	0.06	300	100	15

**Underlined limits were chosen based on values for similar textures or soils under similar management.

Treatment	BD	Porosity	pH 1	pH 2	Ca Sat	K sat	Mg sat	CEC	Total N	Total C	% Na	EC	MBM C Ratio	MBM N Ratio	Min C	Min N	MR
	Standardized values (sustainable range between 0 - 100)																
T-U	-5	103	76	60	375	140	19	22.9	15	36	8.6	-9	40	425	54	-1	68
T-S1	22.5	75	60	56	325	158	69.5	27.1	42	36	28.2	-9	50	75	68	12	64
T-S2	32.5	67	68	88	275	130	87	27.6	57	76	11.0	48	-27	-25	14	45	51
T-D1	-27.5	126	68	84	375	158	38.5	22.9	51	73	12.3	52	-17	75	53	31	75
T-D2	7.5	91	60	72	325	96	13.5	37.1	30	47	11.9	56	-20	225	75	1	39

Appendix D.
Chemical, Biological, and Physical Data for 0.0 – 12 cm Layer in Fairway Soils at Colbert Hills Golf Course (Chapter 4).

Table D.1. Bulk density of 0-5.0 cm layer on fairway soils at Colbert Hills Golf Course

	May 2000	October 2000	May 2001	October 2001
Site		g cm^{-3}		
CH-10	1.41 (0.05)*	1.46 (0.03)	1.38 (0.14)	1.45 (0.07)
CH-12A(F)	1.33 (0.11)	1.41 (0.09)	1.38 (0.08)	1.52 (0.04)
CH-12B(T)	1.20 (0.11)	1.45 (0.09)	1.44 (0.04)	1.55 (0.06)
CH-13	1.29 (0.10)	1.27 (0.08)	1.26 (0.08)	1.10 (0.11)
CH-14	1.42 (0.07)	1.46 (0.08)	1.45 (0.07)	1.56 (0.07)
CH-15	1.38 (0.13)	1.37 (0.17)	1.33 (0.05)	1.37 (0.05)
CH-18	1.56 (0.18)	1.50 (0.22)	1.47 (0.11)	1.48 (0.03)

*Standard Deviation in parenthesis

Table D.2. Porosity of 0-5.0 cm layer on fairway soils at Colbert Hills Golf Course

	May 2000	October 2000	May 2001	October 2001
Site		%		
CH-10	46.8 (1.7)*	45.0 (0.9)	47.8 (5.3)	45.2 (2.5)
CH-12A(F)	50.0 (4.1)	46.7 (3.5)	48.0 (3.1)	42.7 (1.4)
CH-12B(T)	54.7 (4.1)	45.2 (3.5)	45.5 (1.4)	41.5 (2.3)
CH-13	51.1 (3.9)	52.0 (2.9)	52.7 (2.8)	58.4 (4.0)
CH-14	46.2 (2.7)	44.8 (3.1)	45.4 (2.4)	41.0 (2.4)
CH-15	48.1 (5.1)	48.8 (6.3)	49.9 (1.6)	48.4 (1.8)
CH-18	41.0 (6.6)	43.3 (8.1)	44.5 (4.1)	44.1 (1.0)

*Standard Deviation in parenthesis

Table D.3. Aggregate stability (MWD) of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

	October 1999	May 2000	October 2000	May 2001	October 2001
Site			mm		
CH-10	1.00 (0.12)*	2.78 (0.16)	5.24 (0.32)	4.16 (0.39)	5.85 (0.26)
CH-12A(F)	1.22 (0.10)	3.97 (0.11)	5.72 (0.22)	2.30 (0.10)	6.04 (0.06)
CH-12B(T)	0.90 (0.13)	4.16 (0.21)	5.93 (0.24)	5.37 (0.33)	5.93 (0.09)
CH-13	2.84 (0.16)	4.22 (0.18)	4.62 (0.52)	3.89 (0.16)	5.65 (0.25)
CH-14	1.75 (0.57)	4.05 (0.21)	5.45 (0.21)	3.77 (0.22)	5.99 (0.06)
CH-15	0.96 (0.12)	4.58 (0.22)	5.78 (0.15)	3.76 (0.22)	5.95 (0.09)
CH-18	0.28 (0.05)	2.93 (0.07)	4.04 (0.21)	2.17 (0.32)	4.86 (0.08)

*Standard Deviation in parenthesis

Table D.4. Aggregate stability (GMD) of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

	October 1999	May 2000	October 2000	May 2001	October 2001
Site			mm		
CH-10	0.56 (0.08)	1.22 (0.11)	4.49 (0.51)	2.70 (0.42)	4.92 (0.80)
CH-12A(F)	0.58 (0.03)	2.56 (0.09)	4.97 (0.40)	4.68 (0.56)	5.74 (0.15)
CH-12B(T)	0.42 (0.07)	2.95 (0.21)	5.46 (0.49)	1.10 (0.04)	5.25 (0.22)
CH-13	1.60 (0.13)	3.08 (0.39)	3.08 (0.66)	2.24 (0.25)	4.74 (0.41)
CH-14	0.91 (0.29)	2.69 (0.21)	4.38 (0.33)	1.99 (0.25)	5.33 (0.16)
CH-15	0.44 (0.05)	3.14 (0.25)	5.20 (0.25)	1.89 (0.19)	5.16 (0.30)
CH-18	0.18 (0.02)	1.31 (0.07)	2.16 (0.24)	0.70 (0.12)	3.61 (0.10)

*Standard Deviation in parenthesis

Table D.5. Sodium concentration of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

	October 1999	May 2000	October 2000	May 2001	October 2001
Site			mg Na kg^{-1}		
CH-10	138 (1)*	89 (4)	69 (2)	74 (3)	105 (6)
CH-12A(F)	42 (1)	109 (5)	125 (2)	50 (5)	90 (5)
CH-12B(T)	49 (14)	120 (4)	111 (2)	69 (3)	96 (13)
CH-13	32 (3)	199 (4)	149 (1)	125 (16)	104 (17)
CH-14	48 (2)	177 (4)	154 (5)	85 (4)	100 (13)
CH-15	66 (0)	136 (3)	145 (2)	73 (13)	108 (3)
CH-18	41 (1)	145 (6)	139 (1)	118 (12)	99 (4)

*Standard Deviation in parenthesis

Table D.6. Sodium saturation of 0-12.0 cm on fairway soils at Colbert Hills Golf Course

	October 1999	May 2000	October 2000	May 2001	October 2001
Site			%		
CH-10	2.8	3.7	1.6	1.3	2.3
CH-12A(F)	0.8	1.7	2.1	0.9	1.5
CH-12B(T)	0.9	2.6	2.1	1.2	1.8
CH-13	0.6	3.1	2.6	1.9	1.8
CH-14	1.0	3.1	3.7	1.7	1.9
CH-15	1.3	2.4	2.5	1.4	1.8
CH-18	1.0	3.0	3.2	2.7	2.3

Table D.7. Electrical conductivity of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

Site	October 1999	May 2000	October 2000	May 2001	October 2001
			dS m^{-1}		
CH-10	1.39 (0.27)*	1.44 (0.05)	2.35 (0.39)	1.10 (0.12)	2.47 (2.08)
CH-12A(F)	3.17 (0.61)	1.42 (0.16)	1.98 (0.20)	1.60 (0.50)	1.48 (0.16)
CH-12B(T)	1.70 (0.45)	1.32 (0.05)	1.95 (0.13)	1.11 (0.24)	1.15 (0.23)
CH-13	1.53 (0.09)	1.60 (0.13)	2.76 (0.09)	1.57 (0.34)	1.20 (0.06)
CH-14	1.56 (0.15)	1.56 (0.04)	1.71 (0.66)	1.02 (0.14)	1.15 (0.08)
CH-15	1.20 (0.22)	1.21 (0.02)	2.03 (0.02)	1.15 (0.36)	1.29 (0.17)
CH-18	1.50 (0.28)	1.30 (0.04)	2.48 (0.04)	1.34 (1.07)	1.39 (0.11)

*Standard Deviation in parenthesis

Table D.8. Cation exchange capacity (CEC) of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

Site	October 1999	May 2000	October 2000	May 2001	October 2001
			cmol kg^{-1}		
CH-10	21.7 (0.3)	10.4 (1.2)	18.5 (1.0)	24.7 (1.6)	19.8 (1.8)
CH-12A(F)	22.2 (1.0)	27.4 (2.1)	25.4 (1.0)	25.5 (0.9)	25.4 (1.4)
CH-12B(T)	23.4 (0.7)	20.4 (1.3)	23.2 (1.0)	25.2 (1.3)	22.9 (2.8)
CH-13	24.6 (0.3)	27.5 (1.7)	24.7 (0.4)	28.4 (1.2)	24.8 (4.0)
CH-14	20.6 (0.5)	24.5 (1.7)	18.3 (3.7)	22.2 (1.2)	23.4 (2.3)
CH-15	22.2 (2.4)	24.8 (0.9)	24.9 (0.9)	22.4 (3.4)	26.8 (1.6)
CH-18	17.6 (0.4)	20.7 (1.5)	18.9 (1.1)	18.9 (3.7)	18.9 (0.8)

*Standard Deviation in parenthesis

Table D.9. Calcium concentration of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

	October 1999	May 2000	October 2000	May 2001	October 2001
Site			mg Ca kg^{-1}		
CH-10	3460 (10)*	3009 (176)	3801 (140)	4212 (357)	4178 (336)
CH-12A(F)	4329 (29)	5589 (77)	4379 (70)	4085 (109)	4274 (157)
CH-12B(T)	4844 (42)	3896 (168)	4273 (13)	4262 (793)	3811 (5)
CH-13	4531 (49)	4990 (75)	3335 (73)	4085 (64)	4217 (297)
CH-14	3257 (8)	3519 (16)	3595 (144)	3024 (168)	3077 (148)
CH-15	3762 (87)	4215 (59)	3849 (35)	3756 (139)	3552 (116)
CH-18	4553 (27)	5504 (81)	4236 (66)	4467 (307)	4707 (134)

Table D.10. Calcium saturation of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

	October 1999	May 2000	October 2000	May 2001	October 2001
Site			%		
CH-10	79.6	144.4	102.5	85.0	105.5
CH-12A(F)	97.4	101.7	86.0	79.8	83.9
CH-12B(T)	103.3	95.1	91.8	84.3	83.2
CH-13	91.8	90.4	67.5	71.9	84.9
CH-14	78.8	71.6	98.2	67.9	65.6
CH-15	84.6	84.8	77.2	83.8	66.1
CH-18	129.3	132.9	111.9	118.2	124.5

Table D.11. Magnesium concentration of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

Site	October 1999	May 2000	October 2000	May 2001	October 2001
			mg Mg kg^{-1}		
CH-10	610 (6)	313 (15)	306 (8)	462 (31)	452 (31)
CH-12A(F)	420 (3)	471 (1)	424 (6)	346 (12)	447 (22)
CH-12B(T)	392 (5)	360 (15)	354 (4)	363 (19)	372 (3)
CH-13	460 (1)	460 (7)	360 (4)	386 (15)	398 (30)
CH-14	491 (5)	474 (5)	382 (1)	406 (9)	435 (42)
CH-15	533 (8)	530 (2)	467 (2)	411 (20)	509 (15)
CH-18	376 (2)	436 (8)	357 (6)	378 (16)	356 (7)

*Standard Deviation in parenthesis

Table D.12. Magnesium saturation of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

Site	October 1999	May 2000	October 2000	May 2001	October 2001
			%		
CH-10	23.1	24.8	13.6	15.4	18.8
CH-12A(F)	15.6	14.1	13.7	11.1	14.5
CH-12B(T)	13.8	14.5	12.5	11.8	13.4
CH-13	15.4	13.7	12.0	11.2	13.2
CH-14	19.6	15.9	17.2	15.0	15.3
CH-15	19.7	17.6	15.4	15.1	15.6
CH-18	17.6	17.4	15.5	16.5	15.5

Table D.13. Potassium concentration of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

	October 1999	May 2000	October 2000	May 2001	October 2001
Site			%		
CH-10	265 (4)	190 (11)	240 (2)	359 (57)	356 (55)
CH-12A(F)	341 (3)	471 (43)	567 (15)	443 (21)	447 (13)
CH-12B(T)	339 (18)	481 (12)	498 (3)	411 (38)	411 (29)
CH-13	554 (3)	686 (7)	606 (7)	547 (52)	608 (39)
CH-14	334 (3)	476 (15)	423 (33)	457 (26)	443 (29)
CH-15	308 (5)	413 (3)	468 (9)	445 (40)	429 (27)
CH-18	254 (4)	356 (8)	369 (12)	343 (8)	359 (20)

*Standard Deviation in parenthesis

Table D.14. Potassium saturation of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

	October 1999	May 2000	October 2000	May 2001	October 2001
Site			%		
CH-10	3.1	4.7	3.3	3.7	4.6
CH-12A(F)	3.9	4.4	5.7	4.4	4.5
CH-12B(T)	3.7	6.0	5.5	4.2	4.6
CH-13	5.8	6.4	6.3	4.9	6.3
CH-14	4.1	5.0	5.9	5.3	4.8
CH-15	3.5	4.3	4.8	5.1	4.1
CH-18	3.7	4.4	5.0	4.6	4.9

Table D.15. Soil pH (1:1 water) of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

Site	October 1999	May 2000	October 2000	May 2001	October 2001
CH-10	6.8 (0.1)	7.3 (0.3)	7.6 (0.0)	7.32 (0.2)	7.5 (0.1)
CH-12A(F)	7.1 (0.1)	7.4 (0.0)	7.2 (0.0)	7.5 (0.0)	7.4 (0.0)
CH-12B(T)	7.5 (0.0)	7.6 (0.0)	7.2 (0.1)	7.5 (0.1)	7.3 (0.0)
CH-13	7.3 (0.0)	7.5 (0.0)	6.9 (0.0)	7.4 (0.0)	7.1 (0.2)
CH-14	6.8 (0.0)	6.8 (0.0)	7.2 (0.0)	6.9 (0.1)	6.6 (0.1)
CH-15	6.8 (0.0)	7.2 (0.1)	7.0 (0.0)	7.2 (0.0)	7.0 (0.0)
CH-18	7.9 (0.1)	7.8 (0.0)	7.6 (0.0)	7.6 (0.1)	7.7 (0.0)

*Standard Deviation in parenthesis

Table D.16. Soil pH (2:1 $CaCl_2$) of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

Site	October 1999	May 2000	October 2000	May 2001	October 2001
CH-10	6.3 (0.4)	7.2 (0.0)	7.4 (0.0)	7.1 (0.1)	7.1 (0.2)
CH-12A(F)	6.9 (0.2)	7.2 (0.0)	7.2 (0.1)	7.3 (0.1)	7.2 (0.1)
CH-12B(T)	7.3 (0.0)	7.3 (0.0)	7.0 (0.2)	7.3 (0.0)	7.1 (0.1)
CH-13	7.2 (0.0)	7.2 (0.0)	6.7 (0.0)	7.2 (0.0)	7.1 (0.0)
CH-14	6.4 (0.0)	6.5 (0.0)	6.9 (0.0)	6.5 (0.2)	6.4 (0.2)
CH-15	6.6 (0.0)	6.9 (0.0)	6.7 (0.0)	6.8 (0.1)	6.8 (0.1)
CH-18	7.5 (0.0)	7.4 (0.0)	7.2 (0.0)	7.4 (0.1)	7.3 (0.1)

*Standard Deviation in parenthesis

Table D.17. Total carbon of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

	October 1999	May 2000	October 2000	May 2001	October 2001
Site			g C kg^{-1}		
CH-10	21.3 (0.6)	15.5 (0.6)	16.1 (0.6)	21.1 (4.0)	15.0 (0.7)
CH-12A(F)	20.4 (0.2)	20.3 (0.9)	21.5 (0.7)	19.8 (1.0)	18.4 (0.2)
CH-12B(T)	19.3 (0.5)	23.2 (1.3)	20.5 (0.6)	18.8 (1.6)	19.6 (0.7)
CH-13	36.4 (0.5)	35.1 (0.9)	26.8 (1.6)	33.9 (2.7)	32.9 (5.0)
CH-14	24.5 (0.7)	23.8 (0.6)	20.9 (0.7)	22.1 (1.1)	22.4 (1.6)
CH-15	30.5 (0.3)	23.4 (0.8)	28.2 (0.5)	27.8 (0.6)	24.1 (2.2)
CH-18	12.1 (0.1)	19.3 (0.5)	18.0 (0.7)	21.1 (5.4)	14.0 (1.0)

*Standard Deviation in parenthesis

Table D.18. Total nitrogen of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

	October 1999	May 2000	October 2000	May 2001	October 2001
Site			g N kg^{-1}		
CH-10	1.74 (0.10)	1.01 (0.06)	1.15 (0.03)	1.65 (0.30)	1.12 (0.03)
CH-12A(F)	1.72 (0.04)	1.50 (0.05)	1.75 (0.02)	1.52 (0.02)	1.51 (0.01)
CH-12B(T)	1.56 (0.06)	1.82 (0.10)	1.72 (0.14)	1.51 (0.11)	1.55 (0.02)
CH-13	2.92 (0.02)	3.93 (2.14)	2.22 (0.05)	2.70 (0.17)	2.67 (0.38)
CH-14	1.73 (0.05)	1.67 (0.02)	1.67 (0.07)	1.79 (0.11)	1.82 (0.09)
CH-15	2.27 (0.04)	1.66 (0.04)	2.22 (0.03)	2.18 (0.02)	1.98 (0.18)
CH-18	0.72 (0.02)	1.10 (0.01)	1.26 (0.04)	1.50 (0.48)	0.91 (0.09)

*Standard Deviation in parenthesis

Table D.19. Free $CaCO_3$ of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

Site	October 1999	May 2000	October 2000	May 2001	October 2001
			%		
CH-10	0.20 (0.35)	1.57 (0.47)	2.33 (0.73)	0.69 (0.42)	1.55 (0.71)
CH-12A(F)	0.37 (0.21)	0.57 (0.55)	1.80 (0.50)	1.00 (0.90)	0.11 (0.19)
CH-12B(T)	0.63 (0.78)	0.20 (0.26)	1.17 (0.32)	0.36 (0.49)	0.39 (0.26)
CH-13	1.07 (0.97)	0.97 (1.12)	0.67 (1.15)	0.56 (0.96)	0.92 (0.82)
CH-14	0.57 (0.67)	0.57 (0.98)	0.30 (0.52)	NA	0.17 (0.17)
CH-15	NA	0.61 (0.20	1.07 (0.61)	0.42 (0.17)	0.67 (1.15)
CH-18	2.13 (0.15)	3.10 (0.20)	2.03 (0.20)	2.17 (0.96)	2.53 (0.18)

*Standard Deviation in parenthesis

Table D.20. Microbial biomass carbon of 0-12.0 layer cm on fairway soils at Colbert Hills Golf Course

Site	May 2000	October 2000	May 2001	October 2001
		$\mu g\ C\ g^{-1}$ soil		
CH-10	157.0 (129.0)	228.1 (7.4)	279.8 (91.5)	226.7 (26.6)
CH-12A(F)	175.6 (87.6)	275.7 (3.9)	265.8 (111.8)	432.8 (78.9)
CH-12B(T)	552.3 (27.8)	522.0 (147.2)	305.3 (44.6)	510.5 (156.0)
CH-13	375.3 (210.5)	389.9 (23.2)	405.7 (30.7)	347.0 (28.1)
CH-14	534.3 (108.1)	638.8 (53.1)	647.1 (64.5)	682.1 (29.8)
CH-15	367.1 (131.0)	527.6 (77.4)	364.1 (41.2)	584.9 (4.8)
CH-18	235.5 (77.6)	448.5 (5.2)	263.9 (97.5)	136.4 (16.5)

*Standard Deviation in parenthesis

Table D.21. Mineralizable carbon of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

	May 2000	October 2000	May 2001	October 2001
Site		$\mu g\ C\ g^{-1}$ soil		
CH-10	207.4 (75.9)	62.0 (11.5)	103.4 (28.5)	115.7 (14.7)
CH-12A(F)	98.4 (40.5)	47.4 (8.9)	126.2 (37.2)	77.1 (22.3)
CH-12B(T)	151.8 (32.7)	88.1 (31.9)	129.3 (24.0)	68.4 (53.3)
CH-13	128.4 (73.9)	27.5 (8.7)	221.1 (25.6)	118.8 (24.2)
CH-14	114.3 (98.5)	113.5 (14.3)	153.5 (24.4)	79.4 (30.2)
CH-15	128.5 (53.4)	56.3 (14.4)	234.8 (54.8)	106.8 (5.4)
CH-18	120.9 (42.5)	50.1 (8.4)	118.4 (44.4)	26.5 (3.6)

*Standard Deviation in parenthesis

Table D.22. Microbial biomass nitrogen of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

	May 2000	October 2000	May 2001	October 2001
Site		$\mu g\ N\ g^{-1}$ soil		
CH-10	124.5 (7.1)	78.4 (8.1)	109.1 (26.9)	46.4 (24.8)
CH-12A(F)	78.1 (4.8)	86.7 (2.3)	124.1 (13.2)	135.9 (4.7)
CH-12B(T)	172.1 (6.0)	160.6 (0.9)	137.7 (48.7)	140.4 (17.9)
CH-13	139.9 (20.4)	88.0 (2.4)	161.4 (12.3)	135.5 (8.5)
CH-14	122.2 (22.3)	180.6 (59.1)	186.4 (13.9)	166.1 (21.2)
CH-15	138.1 (9.6)	126.8 (2.5)	167.6 (15.9)	155.0 (3.9)
CH-18	91.2 (11.3)	122.8 (29.3)	86.6 (37.4)	44.7 (7.3)

*Standard Deviation in parenthesis

Table D.23. Mineralizable nitrogen of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

	May 2000	October 2000	May 2001	October 2001
Site		$\mu g\ N\ g^{-1}$ soil		
CH-10	14.4 (3.8)	1.5 (0.4)	12.4 (1.8)	27.1 (4.8)
CH-12A(F)	13.2 (2.6)	10.0 (0.7)	9.1 (0.6)	9.2 (0.3)
CH-12B(T)	16.0 (3.2)	3.9 (1.9)	-4.7 (3.1)	7.1 (3.1)
CH-13	18.7 (5.1)	6.2 (1.6)	8.6 (5.1)	12.2 (1.5)
CH-14	6.1 (3.0)	4.9 (0.3)	0.9 (0.5)	6.2 (1.2)
CH-15	13.5 (3.5)	10.9 (0.4)	6.6 (2.0)	4.2 (0.6)
CH-18	3.5 (1.1)	5.6 (0.3)	2.7 (0.4)	3.8 (1.0)

*Standard Deviation in parenthesis

Table D.24. Microbial biomass carbon:total carbon ratio of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

	May 2000	October 2000	May 2001	October 2001
Site		MBC:TC		
CH-10	0.010	0.014	0.013	0.015
CH-12A(F)	0.009	0.013	0.013	0.024
CH-12B(T)	0.024	0.026	0.016	0.026
CH-13	0.011	0.015	0.012	0.011
CH-14	0.022	0.031	0.029	0.030
CH-15	0.016	0.019	0.013	0.024
CH-18	0.012	0.025	0.013	0.010

Table D.25. Microbial biomass nitrogen:total nitrogen ratio of 0-12.0 cm layer on fairway soils at Colbert Hills Golf Course

	May 2000	October 2000	May 2001	October 2001
Site	MBN:TN			
CH-10	0.123	0.068	0.066	0.041
CH-12A(F)	0.052	0.050	0.081	0.090
CH-12B(T)	0.095	0.094	0.091	0.091
CH-13	0.036	0.040	0.060	0.051
CH-14	0.073	0.108	0.104	0.091
CH-15	0.083	0.057	0.077	0.078
CH-18	0.083	0.098	0.058	0.049

Appendix E

Standardized Data for Fairway Soils From October 1999 to October 2001. (Chapter 4)

Table E.1. Standardized data for fairway soils in October 2001 at Colbert Hills Golf Course

Treatment	BD	Porosity	Agg. Stab	pH 1	pH 2	EC	CaCO3	Ca Sat	K sat	Mg sat	Na sat	CEC	Total N	Total C	MBM C Ratio	MBM N Ratio	Min C	Min N
	g cm^{-3}	%				dS m^{-1}	%	%	%	%	%	cmol kg^{-1}	g N kg^{-1}	g C kg^{-1}	%	%	µg C g^{-1}	µg N g^{-1}
CH-10	1.45	45.2	5.85	7.5	7.1	2.47	1.55	105.5	4.6	18.8	2.3	19.8	0.11	1.50	0.015	0.041	115.7	27.1
CH-12F	1.52	42.7	6.04	7.4	7.2	1.48	0.11	83.9	4.5	14.5	1.5	25.4	0.15	1.84	0.024	0.090	77.1	9.2
CH-12T	1.55	41.5	5.93	7.3	7.1	1.15	0.39	83.2	4.6	13.4	1.8	22.9	0.16	1.96	0.026	0.091	68.4	7.1
CH-13	1.1	58.4	5.65	7.1	7.1	1.20	0.92	84.9	6.3	13.2	1.8	24.8	0.27	3.29	0.011	0.051	118.8	12.2
CH-14	1.56	41.0	5.99	6.6	6.4	1.15	0.17	65.6	4.8	15.3	1.9	23.4	0.18	2.24	0.031	0.091	79.4	6.2
CH-15	1.37	48.4	5.95	7.0	6.8	1.29	0.67	66.1	4.1	15.6	1.8	26.8	0.20	2.41	0.024	0.078	106.8	4.2
CH-18	1.48	44.1	4.86	7.7	7.3	1.39	2.53	124.5	4.9	15.5	2.3	18.9	0.09	1.40	0.010	0.049	26.5	3.8
Threshold Limits																		
Lower	1.3	36	1	4.5	4.5	0.25	0	0.65	2	10	0	15	0.05**	1.0	0.01	0.02	0	0
Upper	1.7	51	6.4	7.5	7.5	3	2	0.85	7	20	15	30	0.45	5.0	0.04	0.06	300	50

**Underlined limits were chosen based on values for similar textures or soils under similar management.

Treatment	BD	Porosity	Agg. Stab	pH 1	pH 2	EC	CaCO3	Ca Sat	K sat	Mg sat	Na sat	CEC	Total N	Total C	MBM C Ratio	MBM N Ratio	Min C	Min N
	Standardized values (sustainable range between 0 - 100)																	
CH-10	38	62	90	101	85	81	78	202	52	88	15	32	16	13	17	53	39	54
CH-12F	54	45	93	96	89	45	6	94	50	45	10	70	25	21	47	176	26	18
CH-12T	63	37	91	93	87	33	20	91	52	34	12	52	26	24	54	177	23	14
CH-13	-50	150	86	88	86	35	46	99	85	32	12	65	54	57	2	77	40	24
CH-14	65	33	92	71	63	33	8	3	57	53	12	56	33	31	68	178	26	12
CH-15	18	82	92	82	78	38	33	5	42	56	12	79	37	35	48	146	36	8
CH-18	45	54	71	106	94	41	126	297	57	55	15	26	10	10	-1	73	9	8

Table E.2. Standardized data for 10th fairway from October 1999 to October 2001 Colbert Hills Golf Course

Treatment	BD g cm^{-3}	Porosity %	Agg. Stab	pH 1	pH 2	EC dS m^{-1}	CaCO3 %	Ca Sat %	K sat %	Mg sat %	Na sat %	CEC cmol kg^{-1}	Total N g N kg^{-1}	Total C g C kg^{-1}	MBM C Ratio %	MBM N Ratio %	Min C μg C g^{-1}	Min N μg N g^{-1}
CH-10 O 99	NA*	NA*	1.00	6.8	6.3	1.38	0.2	79.6	3.1	23.1	2.8	21.7	1.74	21.3	NA*	NA*	NA*	NA*
CH-10 M 00	1.41	46.8	2.78	7.3	7.2	1.44	1.57	144.4	4.7	24.8	3.7	10.4	1.01	15.5	0.0101	0.123	207.4	14.4
CH-10 O 00	1.46	45	5.24	7.6	7.4	2.35	2.33	102.5	3.3	13.6	1.6	18.5	1.15	16.1	0.0142	0.068	62	1.5
CH-10 M 01	1.38	47.8	4.16	7.3	7.1	1.10	0.69	85	3.7	15.4	1.3	24.7	1.65	21.1	0.0133	0.066	103.4	12.4
CH-10 O 01	1.45	45.2	5.85	7.5	7.1	2.47	1.55	105.5	4.6	18.8	2.3	19.8	1.12	15.0	0.015	0.041	115.7	27.1

*Values were not reported

Threshold Limits																		
Lower	1.3	36	1	4.5	4.5	0.25	0	0.65	2	10	0	15	0.5**	10.0	0.01	0.02	0	0
Upper	1.7	51	6.4	7.5	7.5	3	2	0.85	7	20	15	30	4.50	50.0	0.04	0.06	300	50

**Underlined limits were chosen based on values for similar textures or soils under similar management.

Treatment	BD	Porosity	Agg. Stab	pH 1	pH 2	EC	CaCO3	Ca Sat	K sat	Mg sat	Na sat	CEC	Total N	Total C	MBM C Ratio	MBM N Ratio	Min C	Min N
												Standardized values (sustainable range between 0 - 100)						
CH-10 O 99	0	0	0	77	60	41	10	73	22	131	19	45	31	28	0	0	0	0
CH-10 M 00	28	72	33	93	90	43	79	397	54	148	25	-31	13	14	0	258	69	29
CH-10 O 00	40	60	79	103	97	76	117	188	26	36	11	23	16	15	14	120	21	3
CH-10 M 01	20	79	59	93	87	31	35	100	34	54	9	65	29	28	11	115	34	25
CH-10 O 01	38	61	90	100	87	81	78	203	52	88	15	32	16	13	17	53	39	54

Appendix F.
Water Quality Analysis of the Water System for the City of Manhattan, KS.

Table F.1. Water quality analysis for the City of Manhattan's water system. A portion of Colbert Hills irrigation water is from the city water system.

Parameter	Units	Level Detected	Sampling Date
Calcium	(mg L^{-1})	32.36	7/10/00
Magnesium	(mg L^{-1})	6.74	7/10/00
Sodium	(mg L^{-1})	41.29	7/10/00
Chloride	(mg L^{-1})	50.7	7/10/00
Sulfate	(mg L^{-1})	88.7	7/10/00
Total Hardness	(mg L^{-1})	109	7/10/00
Alkalinity as $CaCO_3$	(mg L^{-1})	40.99	7/10/00
pH		9.03	7/10/00
Specific Conductivity	(dS m^{-1})	0.48	7/10/00
Total Dissolved Solids	(mg L^{-1})	269.01	7/10/00
Total Phosphorus (P)	(mg L^{-1})	0.23	7/10/00

Source: Durar, A., G.M. McIntyre, P. Armesto, and G. Kincy. 2000. City of Manhattan 2000 Annual Water Quality Report. City of Manhattan. Utilities Department