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ภาคผนวก

Soil profile description

I Information on the site

Soil name	: Warin soil series
Classification	: Arenic Haplustult
Date of examination	: Jan 21, 2009
Described by	: Somchai Anusontpornperm, Suphicha Thanachit, Natthamon Apairee, Ekkarach Meewassana, Patra Prasertsombut
Location	: Ban Non Somboon, Tambon Huai Bong, Amphoe Dan Khun Thod, Changwat Nakhon Ratchasima
Elevation	: Approximately 330 m MSL
Map sheet number	: 5339 III Coordination : 47P 0769173^{E}, 1671549^{N}
Landform	
1. Physiographic position	: Upper erosion middle terrace
2. Surrounding landform	: Slightly Undulating
3. Slope on which profile site	: 2% Aspect : 34 Azi
Land use	: Maize experiment plot with remnant of dry dipterocarp tree species
Annual rainfall	: Approximately 1,212.5 mm
Mean temperature	: Approximately 27.5 $^{\circ}$C
Climate	: Tropical savanna
Others	: -

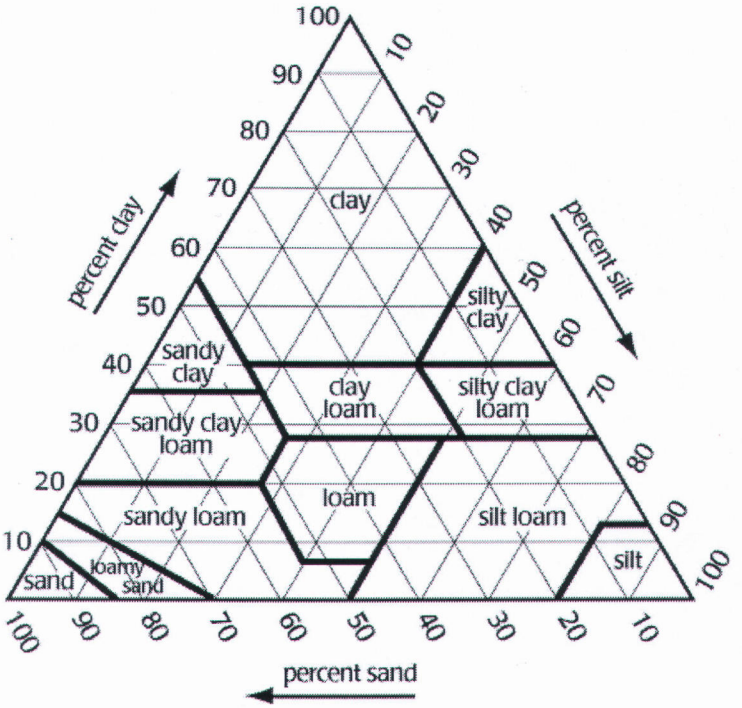
II General information on the soil

Parent material	: wash over residuum derived from sandstone
Drainage	: Well drained
Permeability	: Rapid
Runoff	: Moderate
Depth of ground water	: More than 160 cm at the time of sampling

III Profile description

Horizon	Depth (cm)	Description
Ap	0-32	Brown (7.5YR 4/4); loamy sand; weak very fine and fine subangular blocky structure; non-sticky and non-plastic, very friable moist, soft dry, few very fine variegated sands; many very fine vesicular pores; common very few and few fine roots; field pH 5.5; abrupt and wavy boundary to Bt1
Bt1	32-51	Reddish yellow (5YR 4/6); loamy sand; moderate fine subangular blocky structure; non-sticky and non-plastic, very friable moist, slightly hard dry; few faint clay coating on faces of peds and clay bridges between sand grains; many very fine coated sands; common very fine and few fine vesicular pores; common very fine roots; field pH 5.5; gradual and smooth boundary to Bt2

Bt2	51-72	Reddish yellow (5YR 5/8); loamy sand; strong, fine subangular blocky structure; non-sticky and non-plastic, very friable (moist), slightly hard dry; common distinct clay coating on faces of peds and clay bridges between sand grains; few medium krotorinas many very fine coated sands; common very fine, very few fine vesicular and few very fine single tubular pores; common very fine, few fine and medium roots; field pH 5.5; clear and smooth boundary to Bt3
Bt3	72-101	Brownish yellow (2.5YR 5/8); loamy sand; moderate fine subangular blocky structure; non-sticky and non-plastic, very friable moist, soft dry; common distinct clay coating on faces of peds and clay bridges between sand grains; few very fine coated sands; many very fine and common fine vesicular pores; common very fine, fine and medium roots; field pH 5.0; gradual and smooth boundary to Bt4
Bt4	101-132	White (2.5YR 5/8) loamy sand; moderate fine subangular blocky structure; non-sticky and non-plastic, very friable moist, soft (dry); many distinct clay coating on faces of peds and clay bridges between sand grains; few very fine coated sands; many very fine and common fine vesicular pores; few very fine, fine and medium roots; field pH 5.5; diffuse and smooth boundary to Bt5
Bt5	132-150+	White (2.5YR 4/8) loamy sand; moderate fine and medium subangular blocky structure; non-sticky and non-plastic, very friable moist, soft dry; many distinct clay coating on faces of peds and clay bridges between sand grains; few very fine coated sands; many very fine and common fine vesicular pores; few very fine, few very fine and fine roots; field pH 5.0



ภาพผนวกที่ 1 ไดอะแกรมสามเหลี่ยมแจกแจงประเภทเนื้อดิน
ตามสัดส่วนโดยมวลของทราย (sand) ทรายแป้ง (silt) และดินเหนียว (clay)
(Soil Survey Division Staff, 1993)

ตารางผนวกที่ 1 ผลผลิตเมล็ดข้าวโพดที่ความชื้นร้อยละ 15 และน้ำหนักแห้งของต้นข้าวโพดภายใต้การไถพรวนดินแบบปกติและแบบอนุรักษ์

Tillage system	Plant uptake			
	2008		2009	
	Grain	Stem	Grain	Stem
	(---------- kg ha^{-1} ----------)			
Conventional tillage (CT)	1.93	0.76ab	3.23	2.06
Reduced tillage (RT)	2.13	0.88a	3.70	2.2
Mulch tillage (MT)	1.76	0.89a	3.67	2.1
No tillage (NT)	1.79	0.65b	3.10	2.2
F-test	ns	*	ns	ns

Remark: CT = 3 disc followed by 7 disc plough; RT = 7 disc plough; MT = 7 disc plough with mulching; NT = no tillage

ns = Means in a column are not significantly different at $P<0.05$ according to DMRT.

ตารางผนวกที่ 2 สมบัติดินบางประการภายใต้การไถพรวนดินแบบปกติและแบบอนุรักษ์

Soil property	Tillage system	Soil depth (cm)		
		0-10 cm	10-20 cm	20-30 cm
Bulk density ($Mg\ m^{-3}$)	Conventional tillage (CT)	1.49	1.46a	1.59
	Reduced tillage (RT)	1.48	1.48ab	1.58
	Mulch tillage (MT)	1.49	1.44a	1.55
	No tillage (NT)	1.52	1.55b	1.61
	F-test	ns	*	ns
Hydraulic conductivity ($cm\ h^{-1}$)	Conventional tillage (CT)	14.6	13	6.1
	Reduced tillage (RT)	13.4	9.1	2.4
	Mulch tillage (MT)	11.2	8.8	6.4
	No tillage (NT)	13.9	8.3	4.2
	F-test	ns	ns	ns
Water aggregate stability (%)	Conventional tillage (CT)	39.6	47.4	37.2
	Reduced tillage (RT)	48.5	47.8	50.5
	Mulch tillage (MT)	52.9	45.6	45.3
	No tillage (NT)	40.8	58.9	53.1
	F-test	ns	ns	ns
Available water capacity (%Vol.)	Conventional tillage (CT)	8.4	7.9	8.4
	Reduced tillage (RT)	9.1	9.0	8.6
	Mulch tillage (MT)	7.1	7.5	8.7
	No tillage (NT)	7.4	7.4	8.5
	F-test	ns	ns	ns
Total porosity (%)	Conventional tillage (CT)	44.0	44.8	40.2
	Reduced tillage (RT)	44.2	44.3	40.5
	Mulch tillage (MT)	43.9	45.8	41.4
	No tillage (NT)	42.8	41.6	39.3
	F-test	ns	ns	ns
Organic matter ($g\ kg^{-1}$)	Conventional tillage (CT)	5.4	5.8	3.5
	Reduced tillage (RT)	6.2	6.0	5.2
	Mulch tillage (MT)	5.0	5.1	3.9
	No tillage (NT)	5.5	3.9	4.0
	F-test	ns	ns	ns
Total N ($g\ kg^{-1}$)	Conventional tillage (CT)	0.16	0.16	0.14
	Reduced tillage (RT)	0.15	0.15	0.16
	Mulch tillage (MT)	0.24	0.17	0.15
	No tillage (NT)	0.18	0.19	0.11
	F-test	ns	ns	ns
Available P ($mg\ kg^{-1}$)	Conventional tillage (CT)	4.0	2.2	1.5
	Reduced tillage (RT)	5.1	3.8	1.5
	Mulch tillage (MT)	5.7	1.9	1.7
	No tillage (NT)	5.8	2.3	1.8
	F-test	ns	ns	ns
Available K($mg\ kg^{-1}$)	Conventional tillage (CT)	18.0	15.4	11.2
	Reduced tillage (RT)	22.5	16.0	14.6
	Mulch tillage (MT)	22.2	19.0	15.7
	No tillage (NT)	17.8	16.3	13.0
	F-test	ns	ns	ns

Remark: CT = 3 disc followed by 7 disc plough; RT = 7 disc plough; MT = 7 disc plough with mulching; NT = no tillage
ns = Means in a column are not significantly different at $P<0.05$ according to DMRT.

ตารางผนวกที่ 3 ปริมาณของไนโตรเจนและโพแทสเซียมที่เหลืออยู่ในดินภายใต้การไถพรวนดินแบบปกติและแบบอนุรักษ์ที่ระดับความลึก 10, 30, และ 50 เซนติเมตร หลังจากการใส่ปุ๋ย (17 สิงหาคม - 3 ตุลาคม 2551)

Tillage	Depth (cm)	Nitrogen (g kg^{-1})										
		Date – Month 2008										
		17-Aug	19-Aug	24-Aug	29-Aug	3-Sep	8-Sep	13-Sep	18-Sep	23-Sep	28-Sep	3-Oct
CT	10	0.06	0.23	0.18	0.15	0.12	0.46	0.43	0.29	0.26	0.23	0.11
	30	0.03	0.19	0.16	0.15	0.14	0.42	0.50	0.26	0.21	0.16	0.09
	50	0.02	0.16	0.10	0.13	0.10	0.39	0.43	0.27	0.23	0.16	0.10
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
RT	10	0.06	0.18	0.18	0.14	0.14	0.47	0.50	0.31	0.30	0.18	0.10
	30	0.04	0.21	0.13	0.10	0.09	0.47	0.43	0.27	0.25	0.21	0.06
	50	0.02	0.15	0.10	0.10	0.09	0.40	0.46	0.29	0.25	0.10	0.08
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
MT	10	0.09	0.16	0.15	0.12	0.13	0.48	0.45	0.31	0.30	0.16	0.11
	30	0.06	0.25	0.18	0.12	0.11	0.40	0.43	0.25	0.27	0.25	0.10
	50	0.07	0.18	0.13	0.08	0.09	0.41	0.44	0.25	0.25	0.18	0.05
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
NT	10	0.08	0.21	0.16	0.13	0.13	0.44	0.44	0.32	0.28	0.21	0.10
	30	0.05	0.14	0.12	0.11	0.11	0.41	0.39	0.28	0.22	0.14	0.11
	50	0.03	0.17	0.15	0.15	0.12	0.39	0.30	0.26	0.23	0.17	0.06
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
		Potassium (mg kg^{-1})										
CT	10	10.3	40.02	18.10	15.80	13.73	26.1	29.7	37.7	24.8	20.20	17.97
	30	11.9	21.67	16.65	15.90	22.44	38.1	40.2	70.8	44.4	20.60	20.56
	50	11.4	22.68	10.80	13.80	19.56	56.4	58.0	90.0	49.5	22.40	15.21
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
RT	10	10.3	23.28	18.90	14.90	27.51	29.0	28.6	41.9	31.7	20.90	24.93
	30	11.9	16.25	14.50	10.10	18.98	42.3	42.9	61.3	47.6	36.24	18.17
	50	11.4	16.95	11.60	10.60	23.26	58.0	61.4	75.0	64.1	25.10	20.22
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
MT	10	10.3	39.82	15.60	12.30	27.60	32.1	29.6	45.7	36.1	19.60	34.36
	30	11.9	28.94	18.90	18.60	24.16	48.3	51.7	62.9	45.8	25.25	21.77
	50	11.4	25.27	13.60	19.80	24.45	59.5	70.2	74.8	59.3	30.18	42.61
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
NT	10	10.3	21.32	16.70	12.60	14.70	27.1	32.3	42.2	28.1	20.21	28.33
	30	11.9	15.95	12.90	11.90	16.33	45.7	37.3	49.0	43.6	40.12	25.31
	50	11.4	21.07	15.90	15.20	18.96	64.5	59.2	68.0	52.4	30.40	23.79
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Remark: Complete fertilizer (15-15-15) at rate of 250 kg ha^{-1} was applied equally at 18 August and 7 September 2008, respectively.
CT = 3 disc followed by 7 disc plough; RT = 7 disc plough; MT = 7 disc plough with mulching; NT = no tillage
ns = Means in a column are not significantly different at $P<0.05$ according to DMRT.

ตารางผนวกที่ 4 ปริมาณของไนโตรเจนที่เหลืออยู่ในดินภายใต้การไถพรวนดินแบบปกติและแบบอนุรักษ์ที่ระดับความลึก 10, 30, และ 50 เซนติเมตร หลังจากการใส่ปุ๋ย (4 กรกฎาคม - 1 ตุลาคม 2552)

Tillage	Depth (cm)	Nitrogen (g kg^{-1})																			
		Date – Month 2009																			
		4-Jul	6-Jul	8-Jul	10-Jul	12-Jul	14-Jul	16-Jul	18-Jul	20-Jul	22-Jul	13-Sep	15-Sep	17-Sep	19-Sep	21-Sep	23-Sep	25-Sep	27-Sep	29-Sep	1-Oct
CT	10	0.13	0.12	0.19	0.18	0.13	0.18	0.12	0.11	0.06	0.17	0.40	0.22	0.20	0.12	0.24	0.38	0.16	0.25	0.18	0.11
	30	0.13	0.17	0.12	0.18	0.20	0.19	0.19	0.13	0.13	0.06	0.11	0.16	0.10	0.11	0.36	0.33	0.15	0.23	0.20	0.11
	50	0.10	0.18	0.12	0.12	0.07	0.12	0.23	0.06	0.13	0.16	0.11	0.17	0.17	0.13	0.21	0.27	0.17	0.06	0.27	0.27
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
RT	10	0.18	0.31	0.30	0.24	0.20	0.17	0.17	0.18	0.22	0.06	0.18	0.29	0.20	0.24	0.32	0.18	0.27	0.21	0.21	0.21
	30	0.11	0.24	0.18	0.17	0.18	0.18	0.12	0.06	0.07	0.13	0.12	0.33	0.19	0.24	0.21	0.36	0.16	0.11	0.11	0.11
	50	0.16	0.18	0.18	0.06	0.14	0.28	0.12	0.12	0.25	0.06	0.18	0.10	0.12	0.30	0.18	0.32	0.17	0.28	0.15	0.15
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
MT	10	0.16	0.24	0.12	0.19	0.25	0.25	0.06	0.06	0.12	0.11	0.20	0.20	0.16	0.27	0.11	0.15	0.21	0.12	0.26	0.10
	30	0.13	0.21	0.12	0.12	0.18	0.13	0.06	0.12	0.11	0.12	0.13	0.17	0.12	0.20	0.19	0.16	0.27	0.10	0.19	0.21
	50	0.12	0.19	0.12	0.12	0.19	0.42	0.11	0.11	0.12	0.11	0.18	0.15	0.13	0.23	0.11	0.16	0.35	0.06	0.21	0.16
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
NT	10	0.18	0.24	0.06	0.17	0.18	0.12	0.12	0.00	0.18	0.11	0.18	0.28	0.23	0.26	0.18	0.15	0.11	0.18	0.18	0.23
	30	0.14	0.19	0.23	0.06	0.12	0.13	0.18	0.06	0.12	0.12	0.25	0.23	0.19	0.24	0.24	0.21	0.24	0.12	0.10	0.27
	50	0.14	0.18	0.17	0.17	0.19	0.12	0.11	0.12	0.17	0.06	0.22	0.17	0.25	0.30	0.21	0.10	0.23	0.06	0.15	0.18
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Remark: Complete fertilizer (15-15-15) at rate of 187.5 kg ha^{-1} and 125 kg ha^{-1} was applied at 3 July and 12 September 2009, respectively.

CT = 3 disc followed by 7 disc plough; RT = 7 disc plough; MT = 7 disc plough with mulching; NT = no tillage

ns = Means in a column are not significantly different at $P<0.05$ according to DMRT.

ตารางผนวกที่ 5 ปริมาณของโพแทสเซียมที่เหลืออยู่ในดินภายใต้การไถพรวนดินแบบปกติและแบบอนุรักษ์ที่ระดับความลึก 10, 30, และ 50 เซนติเมตร หลังจากการใส่ปุ๋ย (4 กรกฎาคม - 1 ตุลาคม 2552)

Tillage	Depth (cm)	Potassium (mg kg^{-1})																			
		Date – Month 2009																			
		4-Jul	6-Jul	8-Jul	10-Jul	12-Jul	14-Jul	16-Jul	18-Jul	20-Jul	22-Jul	13-Sep	15-Sep	17-Sep	19-Sep	21-Sep	23-Sep	25-Sep	27-Sep	29-Sep	1-Oct
CT	10	47.27	27.46	20.37	25.73	51.91	19.72	30.05	13.73	18.89	16.56	20.85	23.49	22.21	25.06	32.44	30.53	17.97	21.03	22.60	40.02
	30	42.24	21.62	19.69	19.90	23.00	24.69	18.87	22.44	18.68	15.09	19.67	18.76	23.56	17.74	18.23	19.96	20.56	21.73	26.20	21.67
	50	43.09	25.26	20.89	21.25	36.18	21.66	19.69	19.56	21.37	17.12	22.14	23.18	27.06	20.64	22.29	23.50	15.21	19.28	27.54	22.68
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
RT	10	51.10	22.36	14.60	25.15	32.79	22.57	18.89	27.51	21.10	17.68	26.89	21.54	22.41	26.61	30.64	28.01	24.93	25.67	25.69	23.28
	30	44.41	26.43	18.07	19.07	23.63	25.83	21.91	18.98	24.71	16.32	30.65	20.90	24.79	26.15	25.87	23.46	18.17	20.45	19.80	16.25
	50	71.30	25.52	21.29	20.36	24.00	33.17	21.32	23.26	24.88	17.55	26.09	24.30	20.65	21.90	25.27	21.28	20.22	16.96	24.38	16.95
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
MT	10	59.86	27.03	27.72	26.49	30.18	20.14	24.58	27.60	15.67	15.30	23.20	19.29	29.15	26.72	24.26	23.26	34.36	16.99	31.82	39.82
	30	49.25	18.55	24.01	23.78	27.99	25.41	22.86	24.16	22.82	20.19	24.18	26.58	21.77	17.44	16.55	25.94	21.77	19.42	23.78	28.94
	50	60.39	26.32	20.12	24.77	24.52	22.48	20.94	24.45	22.70	22.33	24.06	25.54	25.58	27.08	23.25	20.92	42.61	18.94	26.66	25.27
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
NT	10	30.83	20.41	15.92	17.09	19.16	20.73	14.84	14.70	17.33	16.81	30.23	24.39	24.32	22.87	20.33	30.48	28.33	31.73	20.45	21.32
	30	36.76	18.87	15.55	21.33	16.62	21.09	18.01	16.33	25.25	16.97	19.36	22.32	21.18	21.02	17.01	19.07	25.31	20.92	25.30	15.95
	50	48.33	19.12	18.68	20.39	25.85	20.68	17.34	18.96	31.38	18.21	18.29	24.95	26.39	18.82	19.43	24.70	23.79	19.79	20.44	21.07
F-test		ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Remark: Complete fertilizer (15-15-15) at rate of 187.5 kg ha^{-1} and 125 kg ha^{-1} was applied at 3 July and 12 September 2009, respectively.

CT = 3 disc followed by 7 disc plough; RT = 7 disc plough; MT = 7 disc plough with mulching; NT = no tillage

ns = Means in a column are not significantly different at $P<0.05$ according to DMRT.

ตารางผนวกที่ 6 ข้อจำกัดต่าง ๆ ที่ใช้ในการประเมินระดับของสมบัติดิน (เอิบ, 2542; Dent and Changprai, 1973; Land Classification Division and FAO Project Staff, 1973; Soil Survey Division Staff, 1993)

Soil properties	Range	Rating
Bulk density (Mg m^{-3})	< 1.2	Very low
	1.2-1.4	Low
	1.4-1.6	Moderate
	1.6-1.8	Moderately high
	1.8-2.0	High
	>2.0	Very high
Saturated hydraulic conductivity (cm h^{-1})	<0.125	Very slow
	0.125-0.50	Slow
	0.50-2.00	Moderately slow
	2.00-6.25	Moderate
	6.25-12.50	Moderately rapid
	12.50-25.00	Rapid
	> 25.00	Very rapid
Soil pH (1:1 Soil: H_2O)	< 3.5	Ultra acid
	3.5-4.4	Extremely acid
	4.5-5.0	Very strongly acid
	5.1-5.5	Strongly acid
	5.6-6.0	Moderately acid
	6.1-6.5	Slightly acid
	6.6-7.3	Neutral
	7.4-7.8	Slightly alkaline
	7.9-8.4	Moderately alkaline
	8.5-9.0	Strongly alkaline
	> 9.0	Very strongly alkaline
Organic matter (g kg^{-1})	< 5	Very low
	5-10	Low
	10-15	Moderately low
	15-25	Moderate
	25-35	Moderate high
	35-45	High
	> 45	Very high
Total nitrogen (g kg^{-1})	< 1.0	Very low
	1.0-2.0	Low
	2.0-5.0	Moderately
	5.0-7.5	High
	> 7.5	Very high
Available P by Bray II (mg kg^{-1})	< 3	Very low
	3-6	Low
	6-10	Moderately low
	10-15	Moderately
	15-25	Moderate high
	25-45	High
	> 45	Very high

ตารางผนวกที่ 6 (ต่อ)

Soil properties	Range	Rating
Available K by NH_4OAc ($mg\ kg^{-1}$)	< 30	Very low
	30-60	Low
	60-90	Moderately
	90-120	High
	> 120	Very high
Extractable bases ($cmol\ kg^{-1}$)		
Ca	< 2.0	Very low
	2-5	Low
	5-10	Moderately
	10-20	High
	> 20	Very high
Mg	< 0.3	Very low
	0.3-1.0	Low
	1.0-3.0	Moderately
	3.0-8.0	High
	> 8.0	Very high
K	< 0.2	Very low
	0.2-0.3	Low
	0.3-0.6	Moderately
	0.6-1.2	High
	> 1.2	Very high
Na	< 0.1	Very low
	0.1-0.3	Low
	0.3-0.7	Moderately
	0.7-2.0	High
	> 2.0	Very high
Sum bases	< 2.6	Very low
	2.6-6.6	Low
	6.6-14.3	Moderately
	14.3-31.2	High
	> 31.2	Very high
CEC by NH_4OAC ($cmol\ kg^{-1}$)	<3	Very low
	3-5	Low
	5-10	Moderately low
	10-15	Moderately
	15-20	Moderately high
	20-30	High
	>30	Very high
Base saturation (%)	<35	Low
	35-75	Moderately
	>75	High
Extractable acidity ($cmol\ kg^{-1}$)	<1	Very low
	1-2	Low
	2-5	Moderate
	5-10	Moderately high
	10-20	High
	>20-30	Very high