

APPENDIX

## SOIL PROFILE DESCRIPTION

### Roi Et series

#### **I Information on the site**

Profile symbol	: Re
Soil name	: Roi Et series
Classification	: Typic Paleaquult
Date of examination	: April 18, 2004
Described by	: Irb Kheoruenromne, Nattaporn Prakongkep, Napaporn Wongpokhom, Chutharmard Kaewmano, Krichsana Ramsoot, Saranya Norkaew
Location	: Approximately 150 m East of Khon Kaen-Ban Fang road at km 3 from Ban Fang, Ban Fang, Tambon Nong Bua, Amphoe Ban Fang, Khon Kaen Province
Elevation	: Approximately 170 m (MSL)
Map sheet number	: 5541 IV      Coordination: 48 0251333 E 1819521 N
Landform	
1. Physiographic position	: Low terrace (erosional)
2. Surrounding land form	: Slightly undulating
3. Slope on which profile site	: 1%
Land use	: Paddy field under grasses at time of sampling
Annual rainfall	: Approximately 1,300 mm
Mean temperature	: Approximately 26°C
Climate	: Tropical savanna
Others	: Agricultural and Infrastructure development

#### **II General information on the soil**

Parent material	: Residuum derived from clastic sedimentary rock
Drainage	: Poorly drained
Permeability	: Slow
Runoff	: Slow
Depth of ground water	: Deeper than 2 m at time of sampling
Flooding depth	: 20-30 cm
Duration	: 3-4 months
Frequency	: Once a year
Human influence	: Agriculture

#### **III Profile description**

Horizon	Depth (cm)	Description
Apg1	0-14	Pale brown (10YR 6/3); sandy clay loam; moderate fine and medium subangular blocky structure; slightly sticky and moderately plastic, slightly firm moist, slightly hard dry; few very fine, common fine and few medium vesicular pores; common very fine, fine and medium roots; few traces of dead roots; strongly acid (field pH 5.5); clear and smooth boundary to Apg2.
Apg2	14-25/32	Pale brown (10YR 6/3); common fine faint yellowish brown (10YR 5/4), few medium distinct strong brown (7.5YR 5/6) and few medium prominent brownish yellow (10YR 6/8) mottles; sandy clay loam; moderate fine and medium angular blocky structure; moderately sticky and moderately plastic, slightly firm moist, slightly hard dry; some evidence of clay bridges among sand grains; common fine variegated sands; few very fine and common fine vesicular pores; common very fine and fine and few medium roots; common traces of dead roots; strongly acid (field pH 5.5); clear and wavy boundary to Btg1.
Btg1	32-45	Grayish brown (10YR 5/2); common fine distinct yellowish brown (10YR 5/6) and common fine distinct strong brown (7.5YR 4/6) mottles; sandy clay loam; strong fine and medium angular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; few faint clay coats on pore walls and common distinct clay bridges among sand grains; common fine variegated sands; very few very fine and common fine vesicular, and few fine simple tubular pores; few very fine and fine roots; moderately acid (field pH 6.0); clear and smooth boundary of Btg2.
Btg2	45-65	Grayish brown (10YR 5/2); common fine and few medium prominent yellowish brown (10YR 5/8) mottles; sandy clay loam; moderate fine and medium angular blocky structure; moderately sticky and moderately plastic, slightly firm moist, slightly hard dry; few faint clay coats on pore walls and common distinct clay bridges among sand grains; common fine variegated sands as patches; very few very fine and fine vesicular and few fine simple tubular pores; few very fine and fine roots; few fine cracks; strongly acid (field pH 5.5); clear and smooth boundary to Btg3.

Btg3	65-90	Pinkish gray (7.5YR 7/2); many fine and few medium prominent brownish yellow (10YR 6/8) mottles; fine sandy clay; moderate fine and medium semi-angular blocky structure; moderately sticky and moderately plastic, slightly firm moist, slightly hard dry; common distinct clay coats on ped faces and pore walls; common fine variegated sands; few very fine and fine vesicular and few fine simple tubular pores; few very fine and fine roots; common dark manganese oxide soft accumulation; very strongly acid (field pH 5.0); gradual and smooth boundary to Btg4.
Btg4	90-116	Mixed pinkish gray (7.5YR 7/2) 50%, light brownish gray (10YR 6/2) 42%; common medium prominent yellow (10YR 7/6) and few fine prominent yellowish brown (10YR 5/8) mottles; very fine sandy clay; moderate fine and medium semi-angular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common distinct clay coats on ped faces and pore walls; common fine variegated sands; few very fine and fine vesicular and few fine simple tubular pores; few very fine and fine roots; few fine cracks; very strongly acid (field pH 5.0); clear and smooth boundary to Btg5.
Btg5	116-140	Mixed gray (10YR 6/1) 50% and pinkish gray (7.5YR 7/2) 43%; common fine distinct strong brown (7.5YR 5/8) and few medium distinct brownish yellow (10YR 6/8) mottles; very fine sandy clay; strong fine and medium subangular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common distinct clay coats on ped faces and pore walls; common fine variegated sands; few very fine and fine vesicular and few fine simple tubular pores; few very fine and fine roots; few fine cracks; very strongly acid (field pH 5.0); clear and smooth boundary to Btg6.
Btg6	140-169	Mixed gray (10YR 6/1) 50%, very pale brown (10YR 7/3) 25% and light gray (10YR 7/2) 15%; common coarse and few medium prominent brownish yellow (10YR 6/8), common medium prominent yellowish red (5YR 5/8) and common fine prominent yellow (10YR 7/8) mottles; very fine sandy clay; strong fine and medium subangular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common distinct clay coats on ped faces and pore walls; common fine variegated sands; few very fine, common fine and few medium vesicular and few fine simple tubular pores; very few very fine and fine roots; common large band mottles (yellowish); very strongly acid (field pH 5.0); clear and smooth boundary to Btg7.
Btg7	169-200+	Mixed light gray (10YR 7/1) 45% and pinkish gray (7.5YR 6/2) 45%; common medium prominent olive gray (5Y 5/2) and common fine and medium prominent brownish yellow (10YR 6/8) mottles; very fine sandy clay; moderate fine and medium subangular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common distinct clay coats on ped faces and pore walls; common patches of pinkish gray silty materials; common very fine, fine and medium vesicular and few fine simple tubular pores; practically no roots; many clay bridges among sand grains, few fine variegated sand; neutral (field pH 7.0).

### Tha Tum series

#### I Information on the site

Profile symbol	: Tt
Soil name	: Tha Tum series
Classification	: Plinthic Endoaqualf
Date of examination	: May 17, 2004
Described by	: Irb Kheoruenromne, Nattaporn Prakongkep, Napaporn Wongpokhom, Chutharmard Kaewmano, Krichsana Ramsoot, Saranya Norkaew
Location	: 50 m Northeast of Ban Phon Than-Ban Kham road at 3.2 km from Ban Phon Than, Ban Kham, Tambon Prikalar, Amphoe Chumphol Buri, Surin Province
Elevation	: Approximately 129 m (MSL)
Map sheet number	: 5639 I      Coordination: 48 0347347 E 1700665 N
Landform	
1. Physiographic position	: Low terrace
2. Surrounding land form	: Very gently undulating
3. Slope on which profile site	: 1%
Land use	: Paddy rice, <i>Encalyptus</i> sp., Coconut, Jack Fruit
Annual rainfall	: Approximately 1,200 mm
Mean temperature	: Approximately 28°C
Climate	: Tropical savanna
Others	: Agricultural

#### II General information on the soil

Parent material	: Mixed alluvium over residuum
Drainage	: Somewhat poorly drained
Permeability	: Slow
Runoff	: Slow
Depth of ground water	: Deeper than 2 m at time of sampling
Flooding depth	: 30 cm
Duration	: 2-3 months
Frequency	: Once a year
Human influence	: Agriculture

#### III Profile description

Horizon	Depth (cm)	Description
Apg	0-12	Very dark gray (10YR 3/1); loam; moderate fine and medium subangular blocky partially parting to moderate fine granular structure; slightly sticky and slightly plastic, slightly firm moist, slightly hard dry; very few fine variegated sands; few very fine and fine vesicular pores and few fine simple tubular pores; many very fine and fine roots; few traces of dead roots; very strongly acid (field pH 5.0); clear and smooth boundary to ABg.
ABg	12-26	Mixed pale brown (10YR 6/3) 60% and brown (10YR 4/3) 38%; common fine distinct yellowish brown (10YR 5/6) mottles; clay loam; moderate fine and medium subangular blocky structure; slightly sticky and slightly plastic, friable moist, slightly hard dry; very few faint clay coats on pore walls; some fine clay balls; very few very fine, few fine and medium vesicular and few fine simple tubular pores; common very fine and fine roots; few traces of dead roots; very strongly acid (field pH 5.0); clear and smooth boundary to Btg1.
Btg1	26-43	Mixed light gray (10YR 7/2) 85% and dark grayish brown (10YR 4/2) 5%; common coarse and medium prominent yellowish brown (10YR 5/8) and common fine prominent brownish yellow (10YR 6/8) mottles; slightly gravelly clay loam; moderate fine and medium subangular blocky structure; slightly sticky and moderately plastic; slightly firm moist, slightly hard dry; common faint clay coats on ped faces and pore walls; few soft iron oxide accumulations; common very fine and fine vesicular pores, fine tubular pores; few very fine and fine roots; few traces of dead roots; very strongly acid (field pH 5.0); clear and smooth boundary of Btg2.
Btg2	43-70	Light gray (10YR 7/2); common coarse and medium prominent red (10R 4/8) and few fine prominent brownish yellow (10YR 6/8) mottles; slightly gravelly sandy clay loam; moderate fine and medium subangular blocky structure some partially parting along nodule surface; slightly sticky and moderately plastic, firm moist, hard dry; few faint clay bridges and clay coats on ped faces and pore walls; common soft to slightly hard iron oxides nodules and concretions; few very fine, fine and medium and few fine simple tubular pores; very few very fine and fine roots; common coarse manganese oxides nodules and concretions, few variegated sands; very strongly acid (field pH 5.0); clear and smooth boundary to Btg3.

Btg3	70-93	Light gray (10YR 7/1); common coarse and medium prominent red (10R 4/8) mottles; slightly gravelly sandy clay loam; moderate fine and medium semi-angular blocky structure; slightly sticky and moderately plastic, firm moist, hard dry; common faint clay coats on ped faces and pore walls; few fine crack; few very fine common fine and few medium vesicular and few fine simple tubular pores; very few very fine and fine roots; few variegated sands; very strongly acid (field pH 5.0); clear and smooth boundary to Btg4.
Btg4	93-123	Light gray (10YR 7/1); common medium and fine prominent yellow (10YR 7/8) and common medium and fine prominent red (10R 4/8) mottles; slightly gravelly fine sandy clay; moderate fine and medium semi-angular blocky structure; slightly sticky and moderately plastic, firm moist, hard dry; common faint clay coats on ped faces and pore walls; few fine crack; few very fine, common fine and few medium vesicular and few fine simple tubular pores; practically no roots; strongly acid (field pH 5.5); clear and smooth boundary to Btg5.
Btg5	123-157	Light gray (10YR 7/1); common fine prominent yellow (2.5Y 7/8) mottles; fine sandy clay; strong medium and coarse angular blocky structure; slightly sticky and moderately plastic, very firm moist, very hard dry; common faint clay coats on ped faces and pore walls; few fine cracks and few fine soft iron oxides accumulations; few very fine, common fine vesicular and few fine simple tubular pores; practically no roots; few soft accumulations of manganese oxides; strongly acid (field pH 5.5); clear and smooth boundary to Btg6.
Btg6	157-182	Light gray (10YR 7/2); common fine prominent brownish yellow (10YR 6/8), common medium prominent black (10YR 2/1) and few fine distinct yellowish brown (10YR 5/6) mottles; fine sandy clay; strong medium and coarse angular blocky structure; slightly sticky and moderately plastic, very firm moist, very hard dry; common faint clay coats on ped faces and pore walls; many soft manganese oxides accumulations and few soft iron oxides accumulations; few very fine and fine vesicular and few fine simple tubular pores; practically no roots; strongly acid (field pH 5.5); clear and smooth boundary to Btg7.
Btg7	182-200+	Light gray (10YR 7/2); common medium and coarse distinct yellow (10YR 7/8) and few fine prominent strong brown (7.5YR 5/6) mottles; fine sandy clay; weak coarse angular blocky semi-massive; moderately sticky and moderately plastic, very firm moist, very hard dry; common faint clay coats on pore walls; common fine cracks; few very fine and fine vesicular and common fine simple tubular pores; practically no roots; strongly acid (field pH 5.5).

**Phimai series****I Information on the site**

Profile symbol	: Pm1
Soil name	: Phimai series
Classification	: Vertic Endoaqualf
Date of examination	: December 26, 2004
Described by	: Irb Kheoruenromne, Nattaporn Prakongkep, Napaporn Wongpokhom, Krichsana Ramsoot, Saranya Norkaew, Ladawan Nukfon, Suphicha Thanachit, Punyisa Trakoonyingcharoen
Location	: 50 m Northeast of Ban Phon Than- Approximately 30 m North of Ban Talat Kae to Phi mai Road at 1 km Ban Talat Kae, Tambon Tarn Prasat, Amphoe Noan Soong, Nakhon Ratchasima Province
Elevation	: Approximately 148 m (MSL)
Map sheet number	: 5439II      Coordination: 47 0223640 E 1687144 N
Landform	
1. Physiographic position	: Floodplain
2. Surrounding land form	: Flat
3. Slope on which profile site	: 0%
Land use	: Paddy rice
Annual rainfall	: Approximately 1,300 mm
Mean temperature	: Approximately 26°C
Climate	: Tropical savanna
Others	: Agricultural and industrial setup on salt mining near by

**II General information on the soil**

Parent material	: Alluvium over residuum derived from weathered clastic sedimentary rock
Drainage	: Poorly drained
Permeability	: Slow
Runoff	: Slow
Depth of ground water	: More than 200 cm at time of sampling
Flooding depth	: 30-60 cm
Duration	: 3-4 months
Frequency	: Once a year
Human influence	: Agriculture

**III Profile description**

Horizon	Depth (cm)	Description
Apg1	0-12	Very dark grayish brown (10YR 3/2); common fine prominent yellowish red (5YR 5/8) and common fine prominent strong brown (7.5YR 5/8) mottles; clay; moderate fine and medium subangular blocky structure partially parting to moderate coarse granular structure; moderately sticky and very plastic, firm moist, slightly hard dry; few very fine and fine vesicular and few fine tubular pores; many very fine and fine roots; common traces of dead roots; slightly acid (field pH 6.5); clear and smooth boundary to Apg2.
Apg2	12-32	Mixed dark gray (7.5YR 4/1) 60% and dark grayish brown (10YR 4/2) 30%; common fine prominent yellowish red (5YR 5/8) mottles; clay; moderate medium and coarse semi-angular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; few faint clay coats on pore walls; few faint pressure faces, very few very fine common fine vesicular and few simple tubular pores; common very fine and fine roots; common traces of dead roots; neutral (field pH 7.0) clear and smooth boundary to Btg1.
Btg1	32-43	Mixed grayish brown (10YR 5/2) 67% and dark gray (10YR 4/1) 20%; common fine prominent yellowish red (5YR 5/8) mottles; clay; moderate medium and coarse subangular blocky structure; moderately sticky and very plastic, very firm moist, very hard dry; few faint clay coats on pore walls; common pressure faces; very few very fine common fine vesicular and tubular pores; few very fine and fine roots; traces of dead roots; slightly acid (field pH 6.5); clear and smooth boundary to Btg2.
Btg2	43-76	Mixed grayish brown (10YR 5/2) 54% and dark grayish brown (10YR 4/2) 30%; common fine and medium prominent olive yellow (2.5Y 6/6) and few fine prominent dark red (2.5YR 4/8) mottles; clay; moderate medium and coarse subangular blocky structure; very sticky and very plastic, very firm moist, very hard dry; few faint clay coats on pore walls; common pressure faces; common very fine and fine vesicular and common tubular pores; few very fine and fine roots; common vertical fine cracks; neutral (field pH 7.0); clear and smooth boundary to Btg3.

Btg3	76-105	Mixed gray (7.5YR 5/1) 40%, brown (10YR 5/3) 31% and gray (10YR 5/1) 20%; common fine and medium prominent light olive brown (2.5Y 5/6), common fine prominent yellowish brown (10YR 5/6) and few fine prominent red (10R 4/8) mottles; clay; moderate fine and medium subangular blocky structure; very sticky and very plastic, very firm moist, very hard dry; few faint clay coats on pore walls; common pressure faces; few very fine and fine vesicular and common tubular pores; very few very fine and fine roots; few vertical fine cracks; neutral (field pH 7.0); clear and smooth boundary to Btng1.
Btg4	105-140	Mixed gray (10YR 5/1) 30%, gray (10YR 6/1) 22%, dark gray (10YR 4/1) 20% and light olive brown (2.5Y 5/4) 15%; common fine prominent yellowish brown (10YR 5/8) and common fine prominent yellow (2.5Y 7/8) mottles; clay; weak coarse subangular blocky structure; very sticky and very plastic, very firm moist, very hard dry; very few very fine, fine faint clay coats on pore walls; common pressure faces and few large slickensides; few very fine and fine vesicular pores; very few very fine and fine roots; few vertical fine cracks; moderately alkaline (field pH 8.0) abrupt and smooth boundary to 2Btng2.
2Btg5	140-170	Mixed light gray (7.5YR 7/1) 20% and dark gray (10YR 4/1) 10%; many medium and coarse prominent brownish brown (10YR 6/8) and common medium and coarse prominent yellow (10YR 8/8); clay; weak coarse angular blocky structure semi-massive; very sticky and very plastic, very firm moist, very hard dry; few faint clay coats on pore walls and some cracks surfaces; common pressure faces and some large slickensides; common very fine, few fine vesicular pores and common tubular pores; practically on roots; few vertical fine cracks; moderately alkaline (field pH 8.0); gradual and smooth boundary to 2Btng3.
2Btg6	170-210	Mixed light gray (10YR 7/1) 40% and gray (10YR 5/1) 8%; many medium and coarse prominent brownish yellow (10YR 6/8), common medium and coarse prominent yellow (10YR 7/8) and common fine and medium prominent black (10YR 2/1); clay; weak coarse angular blocky structure semi-massive; very sticky and very plastic, very firm moist, very hard dry; common faint clay coats on pore walls and some crack surfaces; common pressure faces and some large slickensides; common very fine few fine vesicular pores and common tubular pores; practically on roots; moderately alkaline (field pH 8.0).

### Phimai Series

#### I Information on the site

Profile symbol	: Pm2
Soil name	: Phimai series
Classification	: Aeric Vertic Natraqualf
Date of examination	: May 19, 2004
Described by	: Irb Kheoruenromne, Napaporn Wongpokhom, Krichsana Ramsoot, Somchai Anusontpornperm, Chutharmard Kaewmano, Nattaporn Prakongkep and Saranya Norkaew
Location	: Approximately 240 m South of Talad Kae-Phimai Road (No. 2163) at $\approx$ 4.05 km from Talad Kae Crossroads, Ban Tum Yae, Tambon Krabuang Yai, Amphoe Phimai, Nakhon Ratchasima Province
Elevation	: Approximately 151 m (MSL)
Map sheet number	: 5439 I      Coordination: 48 0226230 E 1686066 N
Landform	
1. Physiographic position	: Floodplain
2. Surrounding land form	: Flat to almost flat
3. Slope on which profile site	: <2%
Land use	: Paddy field, ploughed at time sampling, <i>Eucalyptus sp.</i>
Annual rainfall	: Approximately 1100 mm
Mean temperature	: Approximately 28°C
Climate	: Tropical savanna
Others	: Agricultural and salt mining

#### II General information on the soil

Parent material	: Alluvium over residuum derived from clastic sedimentary rock
Drainage	: Poorly drained
Permeability	: Slow
Runoff	: Slow
Depth of ground water	: Approximately 110 cm at time of sampling

#### III Profile description

Horizon	Depth (cm)	Description
Ap <sub>g1</sub>	0-10	Brown (10 YR 4/3), common fine and medium prominent dark red (2.5YR 4/8) mottles; clay loam; moderate medium and coarse subangular blocky structure; moderately sticky and moderately plastic, firm moist, slightly hard dry; common very fine, few fine and medium vesicular pores; common very fine, fine and medium roots; few traces of dead roots; strongly acid (field pH 5.5); clear and smooth boundary to Ap <sub>g2</sub> .
Ap <sub>g2</sub>	10-22	Dark grayish brown (10YR 4/2), common fine and medium distinct strong brown (7.5YR 5/8) and common fine prominent yellowish red (5YR 4/6) mottles; clay; strong medium and coarse angular blocky structure; moderately sticky moderately plastic, firm moist, hard dry; few faint clay coats on pore walls; few faint pressure faces; few very fine, fine and medium vesicular and few fine dendritic tubular pores; few very fine and fine roots; few traces of dead roots; moderately acid (field pH 6.0); clear and smooth boundary to Btg <sub>1</sub> .
Btg <sub>1</sub>	22-38	Mixed brown (7.5YR 4/3) 45%, dark grayish brown (10YR 4/2) 30% and light brown (7.5YR 6/3) 10%, common fine distinct yellowish brown (10YR 5/8) mottles; clay; moderate fine and medium angular blocky structure; moderately sticky and moderately plastic, firm moist, slightly hard dry; common faint clay coats on ped faces and pore walls; common variegated sands, few fine cracks; few very fine and common fine vesicular and few fine dendritic tubular pores; few very fine and fine roots; common traces of dead roots; moderately acid (field pH 6.0); clear and smooth boundary to Btg <sub>2</sub> .
Btg <sub>2</sub>	38-60	Mixed brown (10YR 5/3) 65% and gray (10YR 5/1) 30%, common fine distinct dark yellowish brown (10YR 4/6) mottles; clay; moderate fine and medium angular blocky structure; moderately sticky and moderately plastic, firm moist, slightly hard dry; common faint clay coats on ped faces and pore walls; few fine cracks, common faint pressure faces; common very fine, fine and medium vesicular pores; very few very fine and fine roots; common traces of dead roots; moderately acid (field pH 6.0); clear and smooth boundary to Btg <sub>3</sub> .
Btg <sub>3</sub>	60-83	Gray (10YR 6/1), common fine distinct yellow (10YR 7/8) and common very fine prominent yellowish red (5YR 5/8) mottles; silty clay; moderate fine and medium angular blocky structure; moderately sticky and moderately plastic, very firm moist, hard dry; common faint clay coats on ped faces and pore walls; common fine cracks and faint pressure faces; few very fine and fine vesicular pores; very few very fine and fine roots; common traces of dead roots; neutral (field pH 7.0); clear and smooth boundary to Btng <sub>1</sub> .

Btng1	83-102	Mixed light yellowish brown (2.5Y 6/3) 65% and brown (7.5YR 4/2)10%, common medium and coarse distinct yellow (2.5Y 7/6) and common fine distinct olive yellow (2.5Y 6/8) mottles; clay; moderate medium and coarse angular blocky structure; moderately sticky and moderately plastic, very firm moist, hard dry; common faint clay coats on ped faces and pore walls; common fine cracks and faint pressure faces; few very fine, common fine vesicular and few fine simple and dendritic tubular pores; very few very fine and fine roots; few traces of dead roots; moderately alkaline (field pH 8.0); abrupt and smooth boundary to 2Btng2.
2Btng2	102-121	Light brownish gray (2.5Y 6/2), many medium and coarse prominent olive yellow (2.5Y 6/8) and common fine prominent strong brown (7.5YR 4/6) mottles; fine sandy clay; moderate fine and medium angular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; few faint clay coats on pore walls; common fine cracks and few faint pressure faces; few very fine, common fine vesicular and few fine simple and dendritic tubular pores; practically no roots; few iron and aluminum oxide concretion, common traces of dead roots; moderately alkaline (field pH 8.0); clear and smooth boundary to 2Btng3.
2Btng3	121-140	Light gray (2.5Y 7/1), many medium and coarse prominent yellowish brown (10YR 5/6) and common medium distinct brownish yellow (10YR 6/8) mottles; fine sandy clay loam; moderate fine and medium angular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; few faint clay coats on pore walls and common faint clay bridges among sand grains; few fine cracks; few very fine, common fine vesicular and few fine simple and dendritic tubular pores; practically no roots; few iron and aluminum oxide concretion, common traces of dead roots; moderately alkaline (field pH 8.0); clear and smooth boundary to 2Btng4.
2Btng4	140-162	Mixed gray (10YR 6/1) 15% and light gray (10YR 7/2) 10%, many coarse prominent brownish yellow (10YR 6/8), common fine and medium distinct dark yellowish brown (10YR 4/6) and common fine prominent dark gray (10YR 4/1) mottles; fine sandy clay loam; moderate medium and coarse angular blocky structure; moderately sticky and slightly plastic, firm moist, hard dry; few faint clay coats on pore walls and common faint clay bridges among sand grains; few very fine and fine vesicular and few fine simple tubular pores; practically no roots; few traces of dead roots and manganese oxide soft accumulation; moderately alkaline (field pH 8.0); clear and smooth boundary to 2Btng5.
2Btng5	162-190+	Mixed pale yellow (2.5Y 7/4) 20% and very pale brown (10YR 7/3) 5%, many fine and medium prominent dark yellowish brown (10YR 4/6), common medium and coarse prominent yellowish brown (10YR 5/8) and common fine prominent dark gray (10YR 4/1) mottles; fine sandy clay loam; moderate medium and coarse angular blocky structure; slightly sticky and slightly plastic, slightly firm moist, slightly hard dry; few faint clay coats on pore walls and common faint clay bridges among sand grains; few very fine and fine vesicular and few fine simple tubular pores; practically no roots; few traces of dead roots and manganese oxide soft accumulation; moderately alkaline (field pH 8.0).

### Kula Ronghai series

#### **I Information on the site**

Profile symbol	: Ki
Soil name	: Kula Ronghai series
Classification	: Typic Natraqualf
Date of examination	: December 16, 2004
Described by	: Irb Kheoruenromne, Napaporn Wongpokhom, Saranya Norkaew, Somchai Anusontpornperm, Saowanuch Tawornpruek, Nattaporn Prakongkep, Krichsana Ramsoot and Supaluk Srithilertcharoen
Location	: Approximately 170 m East of Suwanaphume-Tha Tum Road (No. 214) at 9.90 km from Suwanaphume Crossroads, Ban Don Phiman, Tambon Sra Ku, Amphoe Suwanaphume, Roi-Et Province
Elevation	: Approximately 118 m (MSL)
Map sheet number	: 5740 II                      Coordination: 48 0372127 E 1717176 N
Landform	
1. Physiographic position	: Erosional plain
2. Surrounding land form	: Flat
3. Slope on which profile site	: 2%
Land use	: Paddy rice (KDML 105)/Eucalyptus
Annual rainfall	: Approximately 1300 mm
Mean temperature	: Approximately 26°C
Climate	: Tropical savanna
Others	: Agricultural

#### **II General information on the soil**

Parent material	: Wash over residuum derived from clastic sedimentary rock
Drainage	: Poorly drained
Permeability	: Slow
Runoff	: Slow
Depth of ground water	: More than 200 cm at time of sampling

#### **III Profile description**

Horizon	Depth (cm)	Description
Apg1	0-18	Mixed light yellowish brown (10YR 6/4) 60% and gray (10YR 5/1) 38%, common fine distinct dark yellowish brown (10YR 4/4) mottles; sandy loam; moderately weak fine and medium angular blocky structure; slightly sticky and slightly plastic, friable moist, slightly hard dry; few very fine, common fine vesicular and few fine simple tubular pores; many very fine and fine and medium roots; few traces of dead roots; moderately acid (field pH 6.0); clear and smooth boundary to Apg2.
Apg2	18-30	Mixed reddish yellow (7.5YR 6/6) 83% and brown (7.5YR 5/2) 15%, common fine distinct brownish yellow (10YR 6/8) mottles; loamy sand; moderately weak fine and medium angular blocky structure; slightly sticky and non plastic, vary friable moist, slightly hard dry; few fine variegated sands; common fine vesicular and few fine simple tubular pores; few very fine and fine roots; few hardened iron-manganese oxides nodules; slightly acid (field pH 6.5); abrupt and smooth boundary to Btg.
Btg	30-48	Light gray (10YR 7/2), common medium prominent weak red (10R 4/4) and common fine distinct yellowish brown (10YR 5/6) mottles; very fine sandy clay; strong coarse prismatic and columnar structure; very sticky and very plastic, vary firm moist, very hard dry; common fine faint clay coat on pore walls; common variegated sands and few fine iron-manganese nodules; very few very fine and common fine vesicular and fine simple and dendritic tubular pores; very few very fine and fine roots; few traces of dead roots; slightly acid (field pH 6.5); clear and smooth boundary to Btng1.
Btng1	48-73	Light gray (10YR 7/1), common coarse prominent weak red (10R 4/4) mottles; silty clay; strong coarse prismatic and columnar structure; moderately sticky and moderately plastic, vary firm moist, very hard dry; common faint clay coat on ped faces and pore walls; common pressure faces and few fine cracks; very few very fine, few fine vesicular and very fine simple tubular pores; very few very fine and fine roots; common traces of dead roots; slightly acid (field pH 6.5); clear and smooth boundary to Btng2.
Btng2	73-91	Light gray (10YR 7/1), common coarse prominent dark yellowish brown (10YR 4/6), common fine prominent dark red (2.5YR 4/6) and black manganese oxides (2.5Y 2.5/1) mottles; fine sandy clay; strong coarse prismatic and columnar structure; moderately sticky and moderately plastic, very firm moist, very hard dry; common faint clay coat on ped faces and pore walls; few pressure faces and common fine cracks; very few very fine vesicular and fine simple and dendritic tubular pores; practically no roots; common traces of dead roots and few iron-manganese and iron oxides nodules; slightly acid (field pH 6.5); clear and smooth boundary to Btng3.

2Btng3	91-118	Light gray (10YR 7/1), common fine and medium prominent dark red (2.5YR 4/6), common coarse prominent yellowish brown (10YR 5/8), common fine prominent black dead root (10YR 2/1) and very dark gray manganese oxides (2.5Y 3/1) mottles; silty clay (very fine sandy clay); strong medium and coarse semi-angular blocky structure; very sticky and very plastic, very firm moist, very hard dry; common faint clay coat on ped faces and pore walls; common iron-oxides impregnated soft nodules; very few very fine and common fine vesicular and few fine tubular pores; practically no roots; common traces of dead roots and few iron-manganese and iron oxides nodules; slightly acid (field pH 6.5); gradual and smooth boundary to 2Btng4.
2Btng4	118-150	Mixed light gray (10YR 7/1) 40% and (10YR 7/2) 20%, many coarse prominent yellowish brown (10YR 5/8), common medium prominent dark red (2.5YR 4/6), common fine prominent black dead roots (10YR 2/1) and very dark gray manganese oxides (2.5Y 3/1) mottles; very fine sandy clay; moderated medium and coarse semi-angular blocky structure; moderately sticky and very plastic, firm moist, hard dry; common faint clay coat on ped faces and pore walls; common iron-oxides impregnated soft nodules and few pressure faces; very few very fine and few fine vesicular and fine simple and dendritic tubular pores; practically no roots; common traces of dead roots; moderately acid (field pH 6.0); gradual and smooth boundary to 2Btng5.
2Btng5	150-185	Light gray (10YR 7/2) common coarse distinct yellowish brown (10YR 5/6), common medium prominent dark red (2.5YR 4/8), common coarse prominent yellowish brown (10YR 5/8) and common fine prominent black dead roots (10YR 2/1) and very dark gray manganese oxides (2.5Y 3/1) mottles; very fine sandy clay; moderated medium and coarse semi-angular blocky structure; moderately sticky and very plastic, very firm moist, very hard dry; common faint clay coat on ped faces and pore walls; few patches of pink sands and common impregnated; very few very fine and few fine vesicular and fine simple and dendritic tubular pores; practically no roots; common traces of dead roots; slightly acid (field pH 6.5); gradual and smooth boundary to 2Btng6.
2Btng6	185-210+	Very pale brown (10YR 7/3) many coarse prominent yellowish red (5YR 4/6), common coarse prominent yellowish brown (10YR 5/6), common medium prominent brownish yellow (10YR 6/8) and common fine prominent red (10R 4/6) mottles; very fine sandy clay; moderated medium and coarse semi-angular blocky structure; moderately sticky and very plastic, very firm moist, very hard dry; common faint clay coat on ped faces and pore walls; common iron-manganese impregnated spots in the matrix; very few very fine and few fine vesicular and simple tubular pores; practically no roots; common bright red spots in the iron oxides impregnated spots; moderately acid (field pH 6.0).

## Udon series

### **I Information on the site**

Profile symbol	: Ud
Soil name	: Udon series
Classification	: Vertic Natraqualf
Date of examination	: December 17, 2004
Described by	: Irb Kheoruenromne, Napaporn Wongpokhom, Supaluk Srithilertcharoen, Somchai Anusontpornperm, Saowanuch Tawornpruek, Nattaporn Prakongkep, Krichsana Ramsoot and Saranya Norkaew
Location	: Approximately 202 m North of Ban Phai – Chonnabot Road (No. 229) at 5.30 km from Ban Phai Crossroads, Ban Muang Pier, Tambon Muang Pier, Amphoe Ban Phai, Khon Kaen Province
Elevation	: Approximately 152 m (MSL)
Map sheet number	: 5541 III      Coordination: 48 0251599 E 1778144 N
Landform	
1. Physiographic position	: Depression on erosional plain
2. Surrounding land form	: Flat
3. Slope on which profile site	: 3%
Land use	: Left idle under salt tolerant grasses
Annual rainfall	: Approximately 1200 mm
Mean temperature	: Approximately 26 °C
Climate	: Tropical savanna
Others	: Settlement mainly

### **II General information on the soil**

Parent material	: Alluvium
Drainage	: Poorly drained
Permeability	: Slow
Runoff	: Slow
Depth of ground water	: Approximately 200 cm at time of sampling

### **III Profile description**

Horizon	Depth (cm)	Description
Ag	0-21	Dark grayish brown (10YR 4/2), common medium and coarse prominent strong brown (7.5YR 5/6) mottles; clay; weak very coarse angular blocky, semi-massive structure; very sticky and very plastic, very firm moist, very hard dry; few traces of dead roots and common large vertical cracks; few very fine, fine and very fine and medium vesicular and few fine simple tubular pores; many very fine and fine roots; few fine cracks; slightly acid (field pH 6.5); clear and smooth boundary to Btng1.
Btng1	21-41	Dark grayish brown (10YR 4/2), common fine and medium prominent yellowish brown (10YR 5/8) mottles; clay; moderate medium and coarse angular blocky structure; moderately sticky and moderately plastic, very firm moist, very hard dry; few faint clay coats on pore walls and few faint clay bridged among sand grains; very few translocated very fine sands patched in tubular pores; common very fine and fine vesicular and few tubular pores; common very fine and fine roots; few fine cracks; slightly acid (field pH 6.5); clear and smooth boundary to Btng2.
Btng2	41-66	Mixed light gray (10YR 7/2) 40% and dark grayish brown (10YR 4/2) 20%, many fine and medium distinct yellowish brown (10YR 5/6) and common fine and medium prominent yellowish brown (10YR 5/8) mottles; clay; moderate medium and coarse angular blocky structure; very sticky and very plastic, very firm moist, very hard dry; common faint clay coats on ped faces and pore walls; very few very fine variegated sands; few very fine and common fine vesicular and few fine tubular pores; few very fine and fine roots; trace of dead roots; slightly acid (field pH 6.5); clear and smooth boundary to Btng3.
Btng3	66-88	Mixed light gray (10YR 7/2) 35% and gray (10YR 5/1) 30%, common fine and medium prominent yellowish brown (10YR 5/8) and strong brown (7.5YR 5/8) and common fine and medium distinct dark yellowish brown (10YR 4/4) mottles; clay; moderate medium and coarse angular blocky structure; very sticky and very plastic, very firm moist, very hard dry; common distinct clay coats on ped faces and pore walls; very few very fine variegated sands; few very fine and common fine vesicular and few fine tubular pores; few very fine and fine roots; trace of dead roots; slightly acid (field pH 6.5); clear and smooth boundary to Btng4.

Btng4	88-108	Mixed gray (2.5Y 6/1) 50% and grayish brown (10YR 5/2) 10%, many fine and medium prominent yellowish brown (10YR 5/8) and common fine prominent light olive brown (2.5Y 5/6) mottles; clay; moderate fine and medium angular blocky structure; very sticky and very plastic, very firm moist, very hard dry; common distinct clay coats on ped faces and pore walls; few fine pressure faces, few fine variegated sands and fine cracks; few very fine and common fine vesicular and few fine tubular pores; few very fine and fine roots; common large slickenside and common trace of dead roots; neutral (field pH 7.0); clear and smooth boundary to Btng5.
Btng5	108-132	Gray (2.5Y 6/1), common fine and medium prominent yellowish brown (10YR 5/8) and dark yellowish brown (10YR 4/6) mottles; silty clay; moderate medium and coarse angular blocky structure; very sticky and very plastic, very firm moist, very hard dry; few faint clay coats on ped faces and pore walls; few fine pressure faces; very few very fine and fine vesicular and few fine tubular pores; few very fine and fine roots; common large slickenside and few fine spots of manganese oxides accumulates ; neutral (field pH 7.0); clear and smooth boundary to Btng6.
Btng6	132-165	Gray (10YR 5/1), common fine and medium prominent red (10R 4/8) and yellowish brown (10YR 5/8) mottles; silty clay; moderate fine and medium semi-angular blocky structure; very sticky and very plastic, very firm moist, very hard dry; few faint clay coats on ped faces and pore walls; few fine spots of manganese oxide nodule; very few very fine and few fine vesicular and tubular pores; few very fine and fine roots and root cluster; common large slickenside; moderately alkaline (field pH 8.0); clear and smooth boundary to Btng7.
Btng7	165-184	Mixed gray (10YR 5/1) 60% and very dark grayish brown (10YR 3/2) 20%, common fine and medium prominent yellowish brown (10YR 5/8) and dark red (2.5YR 4/8) mottles; silty clay; moderate medium and coarse semi-angular blocky structure; very sticky and very plastic, very firm moist, very hard dry; few faint clay coats on ped faces and pore walls; few fine variegated sand and few pressure faces; very few very fine and few fine vesicular and tubular pores; few very fine and fine roots; few large slickenside; moderately alkaline (field pH 8.0); clear and smooth boundary to Btng8.
Btng8	184-202+	Mixed gray (10YR 5/1) 40% and very dark gray (10YR 3/1) 30%, many medium prominent dark red (2.5YR 4/8) and common fine and medium prominent yellowish brown (10YR 5/8) mottles; silty clay; weak very coarse semi-angular blocky, semi-massive structure; very sticky and very plastic, very firm moist, very hard dry; few faint clay coats on ped faces and pore walls; very few fine variegated sand and few pressure faces; few very fine and fine vesicular and few tubular pores; few very fine and fine roots; common large slickenside; moderately alkaline (field pH 8.0).

**Mae Sai series****I Information on the site**

Profile symbol	: Ms
Soil name	: Mae Sai series
Classification	: Aeric Endoaqualf
Date of examination	: June 9, 2004
Described by	: Irb Kheoruenromne, Nattaporn Prakongkep, Napaporn Wongpokhom, Chutharmard Kaewmano, Niwat Anonrak, Thirasak Saengsrichan, Ninlaphat Khongphuangsang
Location	: 34 Moo 12, Ko Klang road, Ban Hang Khwao, Tambon Thawangtan, Amphoe Saraphi, Chiang Mai Province
Elevation	: Approximately 299 m (MSL)
Map sheet number	: 4746II      Coordination: 47 0499510 E 2070035 N
Landform	
1. Physiographic position	: Low intermontane terrace
2. Surrounding land form	: Gently undulating
3. Slope on which profile site	: 2%
Land use	: Partially raised bed for vegetable and Longan
Annual rainfall	: Approximately 1,200 mm
Mean temperature	: Approximately 26°C
Climate	: Tropical savanna
Others	: Agricultural (Mango, Jack fruit, Coconut, Eucalyptus)

**II General information on the soil**

Parent material	: Alluvium
Drainage	: Poorly drained
Permeability	: Slow
Runoff	: Slow
Depth of ground water	: - cm at time of sampling
Flooding depth	: 20-40 cm
Duration	: 2-3 months
Frequency	: Once a year
Human influence	: Agriculture

**III Profile description**

Horizon	Depth (cm)	Description
Apg1	0-15	Mixed brown (10YR 4/3) 91% and grayish brown (10YR 5/2) 5%; common fine prominent reddish brown (5YR 4/4) and common fine distinct yellowish brown (10YR 5/6) mottles; silty clay; strong fine and medium semi-angular blocky structure; slightly sticky and moderately plastic, firm moist, hard dry; common fine cracks; few very fine and common fine vesicular pores and few fine tubular pores; common very fine, fine and medium roots; few traces of dead roots; neutral (field pH 7.0); clear and smooth boundary to Apg2.
Apg2	15-33	Mixed grayish brown (10YR 5/2) 71% , brown (10YR 5/3) 15% and gray (10YR 5/1) 5%; common fine and coarse distinct yellowish brown (10YR 5/6), common fine prominent strong brown (7.5YR 5/6) and common fine prominent yellowish red (5YR 5/6) mottles; silty clay; strong fine and medium semi-angular blocky structure; slightly sticky and moderately plastic, firm moist, hard dry; common faint clay coats on pore walls; common fine cracks; few very fine and common fine vesicular pores and few fine tubular pores; many very fine and fine and few medium roots; few traces of dead roots; neutral (field pH 7.0); clear and smooth boundary to Btg1.
Btg1	33-54	Mixed light brownish gray (2.5Y 6/2) 72% and gray (2.5Y 6/1) 15%; common fine and coarse prominent yellowish brown (10YR 5/6), common fine prominent strong brown (7.5YR 4/6) and common fine prominent strong brown (7.5YR 5/6) mottles; silty clay; moderate fine and medium subangular blocky structure; slightly sticky and moderately plastic, firm moist, hard dry; common faint clay coats on pore walls; few faint pressures faces and few small slickensides; common fine vesicular pores and few fine simple tubular pores; few very fine and fine roots; few traces of dead roots; moderately alkaline (field pH 8.0); gradual and smooth boundary to Btg2.
Btg2	54-70	Mixed brown (10YR 5/3) 72% and gray (10YR 6/1) 20%; common fine distinct yellowish brown (10YR 5/6) and few fine prominent yellowish red (5YR 4/6) mottles; clay; moderate fine and medium subangular blocky structure; slightly sticky and moderately plastic; firm moist, hard dry; common faint clay coats on pore walls; few fine cracks and faint pressure faces; very few very fine and common fine vesicular and fine simple tubular pores; few very fine and fine roots; few traces of dead roots; moderately alkaline (field pH 8.0); clear and smooth boundary to Btg3.

Btg3	70-94	Gray (10YR 5/1); common fine prominent strong brown (7.5YR 5/6) and common fine prominent yellowish brown (10YR 5/6) mottles; clay; moderate fine and medium subangular blocky structure; slightly sticky and moderately plastic, firm moist, hard dry; common distinct clay coats on ped faces and pore walls; few fine cracks and faint pressure faces; very few very fine and common fine vesicular and fine simple tubular pores and few fine dendritic tubular pores; very few very fine and fine roots; common fine clay balls; moderately alkaline (field pH 8.0); clear and smooth boundary to Btg4.
Btg4	94-125	Mixed weak red (2.5YR 5/3) 53% and dark reddish gray (2.5YR 5/1) 40%; common fine prominent yellowish brown (10YR 5/6) and common fine distinct light yellowish brown (2.5Y 6/4) mottles; clay; moderate fine and medium subangular blocky structure; slightly sticky and moderately plastic; firm moist, hard dry; common distinct clay coats on ped faces and pore walls; few faint pressure faces and few fine mica flakes; very few very fine and common fine vesicular and fine simple tubular pores and few fine dendritic tubular pores; very few very fine and fine roots; few fine clay balls; neutral (field pH 7.0); gradual and smooth boundary to Btg5.
Btg5	125-144	Mixed dark reddish gray (2.5YR 5/1) 50% and weak red (2.5YR 5/3) 44%; common fine distinct dusky red (2.5YR 4/4), common fine prominent dark yellowish brown (10YR 4/4) and few fine prominent yellowish brown (10YR 5/6) mottles; clay; moderate fine and medium subangular blocky structure; slightly sticky and moderately plastic, firm moist, hard dry; common faint clay coats on ped faces and pore walls; few faint pressure faces and few fine mica flakes; many fine vesicular and common fine tubular pores; very few very fine and fine roots; few fine clay balls; neutral (field pH 7.0); gradual and smooth boundary to Btg6.
Btg6	144-168	Mixed reddish gray (2.5YR 6/1) 62% and weak red (2.5YR 5/3) 30%; common fine and coarse distinct weak red (2.5YR 5/4), common fine prominent yellowish brown (10YR 5/6), common fine prominent yellowish brown (10YR 5/4) and few coarse prominent strong brown (7.5YR 5/6) mottles; clay; moderate fine and medium subangular blocky structure; slightly sticky and moderately plastic; very firm moist, hard dry; common distinct clay coats on ped faces and pore walls; few faint pressure faces and few fine cracks; common fine vesicular and few fine tubular pores; practically no roots; few fine clay balls; neutral (field pH 7.0); abrupt and smooth boundary to BCg.
BCg	168-200+	Mixed reddish gray (2.5YR 6/1) 63% and weak red (2.5YR 6/4) 30%; common fine and coarse prominent yellowish brown (10YR 5/6) and common fine prominent strong brown (7.5YR 5/6) mottles; clay; weak medium and coarse angular blocky structure, semi-massive; slightly sticky and moderately plastic; firm moist, hard dry; few faint clay coats on pore walls; common distinct pressures faces and few slickensides; few fine and medium vesicular and few fine simple tubular pores; practically no roots; common fine clay balls; neutral (field pH 7.0).

### Hang Dong series

#### I Information on the site

Profile symbol	: Hd
Soil name	: Hang Dong series
Classification	: Aeric Endoaqualf
Date of examination	: June 9, 2004
Described by	: Irb Kheoruenromne, Nattaporn Prakongkep, Napaporn Wongpokhom, Chutharmard Kaewmano, Niwat Anongrak, Thirasak Saengsrichan, Ninlaphat Khongphuang
Location	: Approximately 3 km North of San Pa Tong to Lamphun road, Ban Han Kaeo, Tambon Han Kaeo, Amphoe Hang Dong, Chiang Mai Province
Elevation	: Approximately 294 m (MSL)
Map sheet number	: 4746II      Coordination: 47 0492925 E 2061362 N
Landform	
1. Physiographic position	: Low erosional intermontane terrace
2. Surrounding land form	: Gently undulating
3. Slope on which profile site	: 3%
Land use	: Paddy field left idle at time of sampling
Annual rainfall	: Approximately 1,200 mm
Mean temperature	: Approximately 26°C
Climate	: Tropical savanna
Others	: Agricultural and settlement, Longan, Tamarind, <i>Bamboo</i> sp.

#### II General information on the soil

Parent material	: Mixed local alluvium over residuum derived from weathered clastic metasedimentary rocks
Drainage	: Poorly drained
Permeability	: Slow
Runoff	: Slow
Depth of ground water	: Deeper than 2 m at time of sampling
Flooding depth	: 20-30 cm
Duration	: 2-3 months
Frequency	: Once a year
Human influence	: Agriculture

#### III Profile description

Horizon	Depth (cm)	Description
Apg1	0-15	Mixed very dark grayish brown (10YR 3/2) 59% and gray (10YR 5/1) 35%; common fine prominent strong brown (7.5YR 5/6) and common fine prominent strong brown (7.5YR 4/6) mottles; silty clay; strong fine and medium subangular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; few fine cracks; very few very fine and fine common medium vesicular and few fine tubular pores; common very fine and fine roots; common traces of dead roots; moderately acid (field pH 6.0); clear and smooth boundary to Apg2.
Apg2	15-29	Mixed dark gray (2.5Y 4/1) 89% and light olive brown (2.5Y 5/3) 10%; few fine prominent yellowish brown (10YR 5/6) mottles; silty clay; moderate medium and coarse semi-angular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; few faint clay coats on ped faces and pore walls; few fine cracks and common faint pressure faces; common very fine and few fine vesicular and few fine simple tubular pores; few very fine and fine roots; few clay balls; moderately alkaline (field pH 8.0); clear and smooth boundary to Btg1.
Btg1	29-50/53	Mixed gray (2.5Y 5/1) 93% and grayish brown (2.5Y 5/2) 5%; common fine prominent yellowish brown (10YR 5/6) mottles; clay; moderate medium and coarse angular blocky structure; moderately sticky and moderately plastic, firm moist, slightly hard dry; common faint clay coats on ped faces and pore walls; common fine cracks and very few fine variegated sands; few very fine and fine vesicular and few fine simple tubular pores; very few very fine and fine roots; few iron-manganese oxide nodules; moderately alkaline (field pH 8.0); clear and smooth boundary to Btg2.
Btg2	53-68	Mixed gray (2.5Y 5/1) 85% and grayish brown (2.5Y 5/2) 10%; common fine prominent yellowish brown (10YR 5/6), few fine prominent olive yellow (2.5Y 6/6) and few fine prominent brownish yellow (10YR 6/6) mottles; clay; moderate fine and medium angular blocky structure; moderately sticky and moderately plastic, firm moist, slightly hard dry; common faint clay coats on ped faces and pore walls; few faint pressure faces and slickensides; few very fine common fine vesicular and few fine simple tubular pores; very few very fine and fine roots; few fine variegated sands and few iron-manganese nodules; moderately alkaline (field pH 8.0); clear and smooth boundary to Btg3.

Btg3	68-88/90	Mixed light brownish gray (10YR 6/2) 72%, weak red (2.5YR 6/4) 15% and gray (10YR 5/1) 5%; many fine and medium distinct olive yellow (2.5Y 6/6) and common medium prominent brownish yellow (10YR 6/8) mottles; clay; moderate fine and medium semi-angular blocky structure; slightly sticky and moderately plastic, firm moist, very hard dry; common faint clay coats on ped faces and pore walls; few fine cracks; few very fine common fine vesicular and few fine simple tubular pores; very few very fine and fine roots; few fine variegated sands; moderately alkaline (field pH 8.0); clear and smooth boundary to 2Btg4.
2Btg4	90-102/105	Gray (2.5Y 6/1); common medium prominent yellowish brown (10YR 5/6), common medium prominent olive yellow (2.5Y 6/6) and common fine prominent yellowish red (5YR 5/6); slightly gravelly clay; moderate fine and medium semi-angular blocky structure; moderately sticky and moderately plastic, firm moist, very hard dry; common faint clay coats on ped faces and pore walls; common faint pressure faces and common cracks; few very fine common fine vesicular and few fine simple tubular pores; practically no roots; few ferruginous rock fragments and sesquioxides nodules concretions; moderately alkaline (field pH 8.0); abrupt and smooth boundary to 2Btg5.
2Btg5	105-124	Mixed gray (2.5Y 6/1) 79% and gray (2.5Y 5/1) 7%; common fine prominent yellowish brown (10YR 5/8), common fine prominent brownish yellow (10YR 6/8) and common fine prominent red (10R 4/8) mottles; gravelly clay; moderate fine and medium subangular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common faint clay coats on ped faces and pore walls; few faint pressure faces, few fine cracks; very few very fine and few fine vesicular and fine simple tubular pores; practically no roots; common rock fragments and sesquioxides nodules and concretions; moderately alkaline (field pH 8.0); clear and smooth boundary to 2Btg6.
2Btg6	124-148	Mixed light gray (2.5Y 7/1) 76% and gray (2.5Y 6/1) 10%; common coarse and medium prominent brownish yellow (10YR 6/6), common medium prominent yellowish brown (10YR 5/8) and few fine prominent black (10YR 2/1) mottles; slightly gravelly silty clay; moderate fine and medium subangular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; few faint clay coats on ped faces and pore walls; common faint pressure faces; very few very fine and few fine vesicular and fine simple tubular pores; practically no roots; few angular weathered quartz fragment and manganese oxides nodules; moderately alkaline (field pH 8.0); gradual and smooth boundary to 2Btg7.
2Btg7	148-174	Mixed light gray (2.5Y 7/1) 73% and gray (2.5Y 6/1) 10%; common coarse and medium prominent yellowish brown (10YR 5/6) and common coarse and medium prominent olive yellow (2.5Y 6/6) mottles; clay; weak medium and coarse angular blocky structure, semi-massive; slightly sticky and moderately plastic, firm moist, hard dry; few faint clay coats on pore walls; common distinct pressure faces and common fine cracks; few very fine and fine vesicular and few fine simple tubular pores; practically on roots; few rock fragments and sesquioxides and manganese oxide nodules; moderately alkaline (field pH 8.0); gradual and smooth boundary to 2Btg8.
2Btg8	174-200+	Mixed light gray (2.5Y 7/1) 80% and light brownish gray (2.5Y 6/2) 5%; common fine and medium prominent brownish yellow (10YR 6/8), common fine and medium distinct yellowish brown (10YR 5/6), common fine and medium prominent olive yellow (2.5Y 6/6) and few fine prominent red (10R 5/6) mottles; clay; weak medium and coarse angular blocky structure semi massive; slightly sticky and moderately plastic, firm moist, hard dry; few faint clay coats on pore walls; common distinct pressure faces and common fine cracks; few very fine and fine vesicular and few fine simple tubular pores; practically on roots; few rock fragments and sesquioxides and manganese oxide nodules; moderately alkaline (field pH 8.0).

### San Sai series

#### **I Information on the site**

Profile symbol	: Sai
Soil name	: San Sai series
Classification	: Typic Endoaqualf
Date of examination	: June 9, 2004
Described by	: Irb Kheoruenromne, Nattaporn Prakongkep, Napaporn Wongpokhom, Chutharmard Kaewmano, Niwat Anongrak, Thirasak Saengsrichan, Ninlaphat Khongphuang
Location	: Moo 13, Mooban Pattanatambonsaikaeo Soi 3, Tambon Papai, Amphoe San Sai, Chiang Mai Province
Elevation	: Approximately 61 m (MSL)
Map sheet number	: 4846IV      Coordination: 47 0503698 E 2087586 N
Landform	
1. Physiographic position	: Upper part of Low erosional intermontane terrace
2. Surrounding land form	: Gently undulating
3. Slope on which profile site	: 3%
Land use	: Paddy field left idle at time of sampling
Annual rainfall	: Approximately 1,200 mm
Mean temperature	: Approximately 26°C
Climate	: Tropical savanna
Others	: Agricultural, Long bean, Coconut and some settlement

#### **II General information on the soil**

Parent material	: Wash deposits on residuum derived from weathered granite
Drainage	: Poorly drained
Permeability	: Moderate
Runoff	: Slow
Depth of ground water	: Deeper than 70 cm at time of sampling
Flooding depth	: 20-30 cm
Duration	: 2-3 months
Frequency	: Once a year
Human influence	: Agriculture

#### **III Profile description**

Horizon	Depth (cm)	Description
Apg1	0-13/17	Very dark grayish brown (10YR 3/2); sandy loam; moderate fine and medium subangular blocky structure; slightly sticky and slightly plastic, slightly firm moist, soft dry; few fine variegated sands; few very fine and common fine vesicular pores; common very fine and fine and medium roots; common traces of dead roots; neutral (field pH 7.0); clear and smooth boundary to Apg2.
Apg2	17-30/40	Mixed dark brown (7.5YR 3/2) 93% and light brown (7.5YR 6/3) 5%; common fine distinct strong brown (7.5YR 4/6) 2% mottles; sandy loam; moderate fine and medium subangular blocky structure; slightly sticky and slightly plastic, slightly firm moist, slightly hard dry; common faint clay bridges among sand grains; common variegated sands; many very fine and fine vesicular pores; few very fine and fine roots; few traces of dead roots and few sesquioxides nodules; slightly acid (field pH 6.5); clear and wavy boundary to Btg1.
Btg1	40-50	Mixed pink (7.5YR 7/3) 88% and pinkish gray (7.5YR 7/2) 10%; common fine distinct strong brown (7.5YR 5/6) mottles; slightly gravelly sandy loam; moderate fine and medium subangular blocky structure; slightly sticky and non-plastic, slightly firm moist, slightly hard dry; common faint clay coats on ped faces and pore walls and clay bridges among sand grains; many variegated sands; very few very fine and common fine vesicular and very few fine simple tubular pores; very few very fine and fine roots; few sesquioxides nodules; moderately alkaline (field pH 8.0); clear and smooth boundary to Btg2.
Btg2	50-70	Pinkish gray (7.5YR 7/2); few fine distinct strong brown (7.5YR 4/6) mottles; slightly gravelly sandy loam; moderate fine and medium subangular blocky structure; slightly sticky and non-plastic, friable moist, slightly hard dry; few faint clay coats on ped faces and pore walls and clay bridges among sand grains; common variegated sands; very few very fine and common fine vesicular and very few fine simple tubular pores; practically no roots; few sesquioxide nodules; neutral (field pH 7.0); gradual and smooth boundary to Btg3.

Btg3	70-90	Pinkish gray (7.5YR 7/2); few fine distinct strong brown (7.5YR 4/6) mottles; slightly gravelly sandy loam; moderate fine and medium subangular blocky structure; slightly sticky and non-plastic, friable moist, slightly hard dry; few faint clay coats on ped faces and pore walls and clay bridges among sand grains; common variegated sands; very few very fine and common fine vesicular and very few fine simple tubular pores; practically no roots; common traces of medium and large dead roots; neutral (field pH 7.0); abrupt and smooth boundary to 2Btg4.
2Btg4	90-115	Mixed pinkish gray (7.5YR 7/2) 63%, light gray (10YR 7/1) 30% and pale brown (10YR 6/3) 5%; common fine prominent strong brown (7.5YR 5/8) mottles; slightly gravelly sandy loam; moderate fine and medium subangular blocky structure; slightly sticky and slightly plastic, slightly firm moist, slightly hard dry; few distinct clay coats on pore walls and common clay bridges among sand grains; common variegated sands and few manganese oxides and sesquioxide nodules; very few very fine and common fine vesicular and few fine simple tubular pores; practically no roots; common traces of medium and large dead roots; slightly acid (field pH 6.5); gradual and smooth boundary to 2Btg5.
2Btg5	115-135+	Light gray (10YR 7/2); few fine distinct brownish yellow (10YR 6/6) mottles; slightly gravelly sandy clay loam; moderate fine and medium subangular blocky structure; moderately sticky and slightly plastic, firm moist, hard dry; common distinct clay coats on pore walls and clay bridges among sand grains; common variegated sands and few manganese oxides and sesquioxide nodules; very few very fine, common fine vesicular and few fine simple tubular pores; practically no roots; common traces of medium and large dead roots; slightly acid (field pH 6.5).

### Chiang Rai series

#### **I Information on the site**

Profile symbol	: Cr
Soil name	: Chiang Rai series
Classification	: Plinthic Paleaqualf
Date of examination	: June 10, 2004
Described by	: Irb Kheoruenromne, Nattaporn Prakongkep, Napaporn Wongpokhom, Chutharmard Kaewmano
Location	: 200 m South of Sukhothai-Tak road at approximately 7 km from Sukhothai, Ban Phet Fai, Tambon Ban Klui, Amphoe Muang, Sukhothai Province
Elevation	: Approximately 61 m (MSL)
Map sheet number	: 4943II      Coordination: 47 0579962 E 1880875 N
Landform	
1. Physiographic position	: Higher part of low alluvial terrace
2. Surrounding land form	: Gently undulating
3. Slope on which profile site	: 2%
Land use	: Paddy field left fallow waiting for transplanting
Annual rainfall	: Approximately 1,100 mm
Mean temperature	: Approximately 26°C
Climate	: Tropical savanna
Others	: Agricultural, Tamarind, Mango, Bamboo

#### **II General information on the soil**

Parent material	: Old alluvium
Drainage	: Poorly drained
Permeability	: Slow
Runoff	: Slow
Depth of ground water	: Deeper than 2 m at time of sampling
Flooding depth	: 30 cm
Duration	: 3 months
Frequency	: Once a year
Human influence	: Agriculture

#### **III Profile description**

Horizon	Depth (cm)	Description
Apg1	0-12	Gray (5Y 6/1); common fine prominent yellowish brown (10YR 5/4) and common fine prominent brownish yellow (10YR 6/8) mottles; clay loam; moderate fine and medium subangular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common traces of dead roots; few very fine and fine vesicular and few fine tubular pores; many very fine, fine and common medium root; abundant small earthworms; moderately acid (field pH 6.0); clear and smooth boundary to Apg2.
Apg2	12-25/30	Mixed gray (5Y 5/1) 70% and gray (5Y 6/1) 20%; common fine and medium prominent yellowish brown (10YR 5/6), common fine prominent strong brown (7.5YR 5/6) and few fine prominent dark yellowish brown (10YR 4/4) mottles; clay; moderate fine and medium semi-angular blocky structure; slightly sticky and moderately plastic, firm moist, hard dry; very few faint clay coats on pore walls; few variegated sands and common traces of dead roots; few very fine and fine vesicular and fine tubular pores; few very fine, fine and medium roots; slightly acid (field pH 6.5); clear and wavy boundary to Btg1.
Btg1	30-53	Mixed light brownish gray (10YR 6/2) 70%, reddish gray (2.5YR 6/1) 10% and pale yellow (2.5Y 7/3) 10%; common fine and medium prominent brownish yellow (10YR 6/8), common fine prominent yellowish brown (10YR 5/8) and few fine prominent strong brown (7.5YR 5/6) mottles; slightly gravelly clay; moderate fine and medium subangular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common distinct clay coats on pore walls and ped faces; few iron-manganese oxides nodules; common very fine, fine and few medium vesicular pores and fine simple tubular pores; few very fine and fine roots; few traces of dead roots; slightly acid (field pH 6.5); clear and smooth boundary to Btcg1.
Btcg1	53-80/90	Mixed pale yellow (2.5Y 7/3) 65%, light gray (2.5Y 7/2) 10% and light gray (2.5Y 7/1) 10%; common fine and medium prominent yellowish brown (10YR 5/6), common medium prominent black (10YR 2/1), common fine prominent red (2.5YR 6/6) and common fine distinct olive yellow (2.5Y 6/6) mottles; gravelly clay; moderate fine and medium subangular blocky structure; slightly sticky and moderately plastic, firm moist, hard dry; common distinct clay coats on pore walls, ped faces and some nodule surfaces; common iron-manganese and sesquioxides concretion; few very

		fine and fine vesicular and few fine simple tubular pores; few very fine, fine and medium roots; moderately acid (field pH 6.0); clear and wavy boundary to Btg2.
Btg2	90-106	Light gray (2.5Y 7/2); common fine prominent light red (10R 6/8), common fine distinct brownish yellow (10YR 6/8) and common fine prominent black (10YR 2/1) mottles; clay; moderate fine and medium subangular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common faint clay coats on ped faces and pore walls; few iron-aluminum oxide nodules; few very fine and fine vesicular and few fine simple tubular pores; few very fine, fine and medium roots; few soft accumulation of manganese oxides; strongly acid (field pH 5.5); gradual and smooth boundary to Btg3.
Btg3	106-123	Light gray (2.5Y 7/2); common fine prominent light red (10R 6/8), common fine prominent brownish yellow (10YR 6/8) and common fine prominent black (10YR 2/1) mottles; clay; moderate fine and medium semi-angular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common faint clay coats on ped faces and pore walls and some nodule surfaces; few faint pressure faces, few fine cracks and variegated sands; few very fine and fine vesicular and few fine tubular pores; very few very fine and fine and coarse roots; common dark spots of manganese oxides accumulation; strongly acid (field pH 5.5); clear and smooth boundary to Btg4.
Btg4	123-144	Light gray (2.5Y 7/2); common fine prominent yellowish brown (10YR 5/6), common fine distinct olive yellow (2.5Y 6/6) and common fine prominent black (10YR 2/1) mottles; clay; moderate fine and medium semi-angular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common faint clay coats on ped faces and pore walls and some nodule surfaces; few faint pressure faces, few fine cracks and variegated sands; few very fine and fine vesicular and few fine tubular pores; very few very fine and fine roots; common dark spots of manganese oxides accumulation; strongly acid (field pH 5.5); clear and smooth boundary to Btcg2.
Btcg2	144-166	Mixed light gray (10YR 7/1) 65% and light gray (2.5Y 7/2) 20%; common fine and medium prominent olive yellow (2.5Y 6/6), common fine and medium prominent black (10YR 2/1) and common fine prominent yellowish brown (10YR 5/8) mottles; slightly gravelly clay; moderate fine and medium semi-angular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common faint clay coats on ped faces and pore walls and some nodule surfaces; few faint pressure faces, few fine cracks and variegated sands and common iron-manganese oxides semi-hardened accumulations; few very fine and fine vesicular and few fine tubular pores; practically no roots; many dark spots of manganese oxides accumulations; strongly acid (field pH 5.5); clear and smooth boundary to Btcg3.
Btcg3	166-190+	Mixed pale yellow (2.5Y 7/3) 45% and light gray (2.5Y 7/1) 40%; common fine and medium prominent strong brown (7.5YR 5/6), common medium and coarse prominent yellowish brown (10YR 5/8) and common fine prominent black (10YR 2/1) mottles; clay; moderate medium and coarse angular blocky structure; moderately sticky and moderately plastic; firm moist, hard dry; common faint clay coats on ped faces and pore walls; few fine cracks and fine variegated sands and few faint pressure faces; few very fine and fine vesicular and fine simple tubular pores; practically no roots (very few very fine roots); common dark spots of iron-manganese oxides accumulations and few iron-manganese oxides nodules; strongly acid (field pH 5.5).



Btg4	82-109	Mixed gray (10YR 6/1) 58% and pale brown (10YR 6/3) 10%; common medium and coarse prominent red (10R 4/6) and common fine and medium distinct yellowish brown (10YR 5/6) mottles; clay; moderate medium and coarse subangular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common distinct clay coats on ped faces and pore walls; common faint pressure faces and few slickenside; very few very fine and fine vesicular and few fine tubular pore; very few very fine and fine roots; iron oxides and iron-manganese oxides nodules, very few iron oxide nodules; neutral (field pH 7.0); clear and smooth boundary to Btg5.
Btg5	109-131	Gray (10YR 6/1); many medium and coarse prominent red (10R 4/6) and common fine distinct yellowish brown (10YR 5/6) mottles; clay; moderate medium and coarse subangular blocky structure; very sticky and very plastic, very firm moist, very hard dry; common faint clay coats on ped faces and pore walls; common faint pressure faces and slickensides; few very fine and fine vesicular pore and fine simple tubular pore; very few very fine and fine roots; iron oxides and iron-manganese oxide nodules, very few iron oxide nodules and few fine cracks; slightly acid (field pH 6.5); clear and smooth boundary to Btg6.
Btg6	131-152+	Gray (10YR 6/1); many medium and coarse prominent red (10R 4/6) and few fine distinct yellowish brown (10YR 5/6) mottles; clay; moderate fine and medium subangular blocky structure; very sticky and very plastic, very firm moist, very hard dry; common faint clay coats on ped faces and pore walls; common faint pressure faces and slickensides; few very fine and fine vesicular pore and fine simple tubular pore; practically on roots; slightly acid (field pH 6.5).



		translocation of sand and silt materials filling the cracks; neutral (field pH 7.0); clear and smooth boundary to Btg3.
Btg3	87-110	Mixed gray (10YR 5/1) 67% and very pale brown (10YR 7/3) 20%; common fine and medium distinct black (10YR 2/1), common fine and medium prominent olive yellow (2.5Y 6/8) and common fine and medium prominent brownish yellow (10YR 5/8) mottles; sandy clay loam; strong fine and medium semi-angular blocky structure; moderately sticky and moderately plastic, very firm moist, very hard dry; common distinct clay coats on ped faces and pore walls; common variegated sands and some dark orange accumulations; few fine vesicular and fine simple tubular pores; very few very fine and fine roots; evidence of large vertical cracks with some translocation of sand and silt materials filling the cracks; common fine cracks; moderately alkaline (field pH 8.0); clear and smooth boundary to Btg4.
Btg4	110-130	Mixed gray (10YR 6/1) 50% and very pale brown (10YR 7/3) 38%; common fine and medium prominent yellowish brown (10YR 5/8), common fine and medium prominent olive yellow (2.5Y 6/6) and few fine distinct black (10YR 2/1) mottles; sandy clay loam strong fine and medium semi-angular blocky structure; moderately sticky and moderately plastic, firm moist, very hard dry; common faint clay bridges among sand grains and common faint clay coats on pore walls; common variegated sands and few elongated clay balls (1-3 mm length); very few very fine and fine vesicular and few fine simple tube pores; abundance of dark brown soft manganese and iron accumulation; moderately alkaline (field pH 8.0) gradual and smooth boundary to Btg5.
Btg5	130-150	Mixed gray (10YR 6/1) 45% and light gray (10YR 7/2) 20%; many medium and coarse prominent yellowish brown (10YR 5/8), common medium distinct black (10YR 2/1), common fine and medium prominent brownish yellow (10YR 6/8) and few medium prominent light olive brown (2.5Y 5/4) mottles; sandy clay loam; strong fine and medium subangular blocky structure; moderately sticky and moderately plastic, firm moist, very hard dry; common faint clay bridges among sand grains and common faint clay coats on pore walls; common variegated sands; few fine cracks; very few very fine few fine vesicular and tubular pores; very few very fine and fine roots; common dark brown soft manganese and iron and iron aluminum oxide accumulation; moderately alkaline (field pH 8.0); clear and smooth boundary to Btg6.
Btg6	150-175	Mixed light gray (10YR 7/1) 40%, pink (7.5YR 7/3) 20% and gray (2.5Y 6/1) 15%; common fine and medium prominent yellowish brown (10YR 5/8), few fine prominent yellowish red (5YR 5/6), common medium prominent olive yellow (2.5Y 6/6), few fine and medium prominent black (10YR 2/1) and few medium prominent light reddish brown (5YR 6/4) mottles; sandy clay loam; strong fine and medium subangular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common faint clay bridges among sand grains and few fine faint clay coats on pore walls; common variegated sands; very few very fine few fine vesicular and tubular pores; very few very fine and fine roots; few fine clay balls and iron aluminum soft nodules; moderately alkaline (field pH 8.0); gradual and smooth boundary to Btg7.
Btg7	175-192+	Mixed gray (10YR 5/1) 50% and light gray (10YR 7/2) 38%; common fine and medium prominent yellowish brown (10YR 5/8), common fine and medium prominent olive yellow (2.5Y 6/6) and common fine and medium prominent dark red (2.5YR 4/8) mottles; sandy clay; strong fine and medium semi-angular blocky structure; moderately sticky and moderately plastic; firm moist; very hard dry; common faint clay coats on ped faces and pore walls; common variegated sands, few fine clay balls; very few very fine and fine vesicular and few fine simple tubular pores; practically no roots; moderately alkaline (field pH 8.0).

**Klaeng series****I Information on the site**

Profile symbol	: Kl
Soil name	: Klaeng series
Classification	: Typic Plinthaquult
Date of examination	: November 20, 2004
Described by	: Irb Kheoruenromne, Nattaporn Prakongkep, Napaporn Wongpokhom, Saranya Norkaew, Punyisa Trakoonyingcharoen, Suphicha Thanachit, Krichsana Ramsoot
Location	: Ban Sa Khlong 3, Moo 8, Tambon Nong Hiang, Amphoe Phanat Nikhom, Chon Buri Province
Elevation	: Approximately 7 m (MSL)
Map sheet number	: 5235IV      Coordination 47 0734730 E 1488551 N
Landform	
1. Physiographic position	: Low terrace-floodplain transition
2. Surrounding land form	: Gently undulating
3. Slope on which profile site	: 0%
Land use	: Paddy rice under preparation for seedling bed
Annual rainfall	: Approximately 1,600 mm
Mean temperature	: Approximately 26°C
Climate	: Tropical monsoonal
Others	: Settlement and agricultural

**II General information on the soil**

Parent material	: Alluvium
Drainage	: Poorly drained
Permeability	: Slow
Runoff	: Slow
Depth of ground water	: Less than 150 cm at time of sampling
Flooding depth	: 20-30 cm
Duration	: 2-3 months
Frequency	: Once a year
Human influence	: Agriculture

**III Profile description**

Horizon	Depth (cm)	Description
Ap <sub>g1</sub>	0-13/15	Grayish brown (10YR 5/2); common fine prominent strong brown (7.5YR 5/6); sandy loam; moderate fine and medium subangular blocky structure; slightly sticky and slightly plastic, slightly firm moist, slightly hard dry; few variegated sands; very few very fine and fine and common medium vesicular pores; common very fine, fine and few medium roots; few traces of dead roots; strongly acid (field pH 5.5); abrupt and smooth boundary to Ap <sub>g2</sub> .
Ap <sub>g2</sub>	15-30	Mixed brown (7.5YR 4/2) 60%, brown (7.5YR 4/3) 30% and light brown (7.5YR 6/3) 5%; common fine distinct strong brown (7.5YR 5/6) mottles; sandy clay loam; strong medium and coarse subangular platy structure; moderately sticky and slightly plastic, firm moist, very hard dry; few clay bridges among sand grains; common variegated sands; few very fine and fine vesicular and few fine simple tubular pores; few very fine and fine roots; common traces of dead roots; slightly acid (field pH 6.5); clear and smooth boundary to B <sub>tg</sub> .
B <sub>tg</sub>	30-57	Light brownish gray (10YR 6/2); common fine prominent strong brown (7.5YR 5/8) and common fine prominent dark red (2.5YR 4/8) mottles; sandy clay loam; moderate fine and medium subangular blocky structure; moderately sticky and moderately plastic, slightly firm moist, slightly hard dry; common faint clay bridges among sand grains and clay coats on pore walls; few variegated sands; very few very fine and few fine vesicular and simple tubular pores; common very fine and fine roots; few traces of dead roots; very strongly acid (field pH 5.0); clear and smooth boundary to B <sub>vg1</sub> .
B <sub>vg1</sub>	57-72	Light brownish gray (10YR 6/2); common fine prominent strong brown (7.5YR 5/8) and common fine prominent dark red (2.5YR 4/8) mottles; slightly gravelly sandy clay loam; moderate fine and medium subangular blocky structure; moderately sticky and moderately plastic, firm moist, slightly hard dry; common faint clay bridges among sand grains and clay coats on pore walls; few traces of dead roots; common very fine and fine vesicular and few fine simple tubular pores; few very fine and fine roots; common red spots of iron oxides separation; very strongly acid (field pH 5.0); gradual and smooth boundary to B <sub>vg2</sub> .

Bvg2	72-100	Light brown (7.5YR 6/3); common fine and medium prominent reddish yellow (7.5YR 6/8) and common fine and medium prominent dark red (2.5YR 4/8) mottles; slightly gravelly sandy clay loam; moderate fine and medium subangular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common faint clay bridges among sand grains and clay coats on pore walls; few fine variegated sands; common very fine and fine vesicular and few fine simple tubular pores; few very fine and fine roots; few traces of dead roots; very strongly acid (field pH 5.0) gradual to smooth boundary to Bvg3.
Bvg3	100-125	Light brown (7.5YR 6/3); common fine and medium prominent strong brown (7.5YR 5/8) and common fine prominent dark red (2.5YR 4/8) mottles; gravelly sandy clay loam; moderate fine and medium subangular blocky structure; slightly sticky and moderately plastic, firm moist, hard dry; common faint clay bridges among sand grains and few faint clay coats on ped faces and pore walls; few fine variegated sands; common very fine and fine vesicular and few fine simple tubular pores; few very fine and fine roots; very strongly acid (field pH 5.0); clear and smooth boundary to Bvg4.
Bvg4	125-155	Pinkish gray (7.5YR 7/2); common fine and medium distinct strong brown (7.5YR 5/6) and common fine and medium prominent dark red (2.5YR 4/8) mottles; slightly gravelly sandy clay loam; moderate fine and medium subangular blocky structure; moderately sticky and moderately plastic, firm moist, hard dry; common faint clay bridges among sand grains and few faint clay coats on ped faces and pore walls; common variegated sands; very few very fine and fine and few medium vesicular and fine simple tubular pores; very few very fine and fine roots; very strongly acid (field pH 5.0); gradual and smooth boundary to Bvg5.
Bvg5	155-180+	Pinkish gray (7.5YR 7/2); common fine and medium prominent dark red (2.5YR 4/8) and common fine distinct strong brown (7.5YR 5/6) mottles; sandy clay; moderate fine and medium subangular blocky structure; slightly sticky and moderately plastic, firm moist, hard dry; common faint clay bridges among sand grains and common faint clay coats in ped faces and pore walls; common variegated sands; very few very fine and fine and few medium vesicular and fine simple tubular pores; practically on roots; very strongly acid (field pH 5.0).

### Lop Buri series

#### **I Information on the site**

Profile symbol	: Lb
Soil name	: Lop Buri series
Classification	: Typic Haplustert
Date of examination	: June 3, 1999
Described by	: Irb Kheoruenromne, Piboon Kanghae, Saowanuch Tawornpruek, Sumitra Watana, Pattarodom Chainaronk, Pornporm Pormdacha, Niwat Anongrak, Sirin Chaisiri, Wipawan Thaymuang
Location	: Approximately 200 m West of Adirake 2 Road, Ban Nong Khai Nam Tambon Huai Pa Wai, Ampoe Pha Phutthabat, Saraburi Province
Elevation	: Approximately 24 m (MSL)
Map sheet number	: 5138 II      Coordination: 16 04 201 N 47 689 0960 E
Landform	
1. Physiographic position	: Toeslope of limestone mountain
2. Surrounding land form	: Flat
3. Slope on which profile site	: 1%
Land use	: Alternating crops between rice and corn
Annual rainfall	: Approximately 1200 mm
Mean temperature	: Approximately 27°C
Climate	: Tropical savanna
Others	: Rain trees, banana, papaya, local weeds and village settlement

#### **II General information on the soil**

Parent material	: Local alluvium derived from limestone
Drainage	: Moderately well drained
Permeability	: Slow
Runoff	: Slow
Depth of ground water	: Deeper than 2 m at time of sampling
Flooding depth	: Approximately 30 cm
Duration	: 2-3 months
Frequency	: Once a year
Human influence	: Agriculture

#### **III Profile description**

Horizon	Depth (cm)	Description
Ap	0-23	Very dark gray (10YR 3/1); loamy clay; moderate fine and medium subangular blocky structure; hard dry, firm moist, moderately sticky and very plastic; few fine vesicular and few fine simple tubular pores; many very fine and few medium roots; few secondary limestone fragments of variable sizes, very few fine rounded quartz fragments, few trace of dead roots; moderately alkaline (field pH 8.0); clear, smooth boundary to Bw.
Bw	23-42	Very dark gray (10YR 3/1); clay; moderate fine and medium subangular blocky structure; hard dry, very firm moist, very sticky and very plastic; few very fine and fine vesicular and common fine simple tubular pores, common fine cracks; common very fine, and fine roots, common pressure faces; moderately alkaline (field pH 8.0); clear, smooth boundary to Bss1.
Bss1	42-70	Dark gray (10YR 4/1); clay; moderate medium and coarse angular blocky structure; very hard dry, very firm moist, very sticky and very plastic; few very fine and fine vesicular and few fine simple tubular pores, few fine cracks; few very fine, and fine roots; many large quartz slickensides and common pressure faces; moderately alkaline (field pH 8.0); clear, smooth boundary to Bss2.
Bss2	70-90	Very dark grayish brown (10YR 3/2); clay; moderate medium and coarse angular blocky structure; very hard dry, very firm moist, very sticky and very plastic; few very fine and fine vesicular and few fine simple tubular pores, few fine cracks; very few very fine and fine roots; many large quartz slickensides and common pressure faces; moderately alkaline (field pH 8.0); clear, smooth boundary to Bss3.
Bss3	90-110	Very dark grayish brown (10YR 3/2); clay; moderate medium and coarse angular blocky structure; very hard dry, very firm moist, very sticky and very plastic; few very fine and fine vesicular and few fine simple tubular pores, common fine cracks; very few very fine and fine roots; many large quartz slickensides and common pressure faces; moderately alkaline (field pH 8.0); gradual, smooth boundary to Bss4.

Bss4	110-130	Very dark grayish brown (10YR 3/2), few fine distinct yellowish brown (10YR 5/4) mottles; clay; moderate coarse angular blocky structure; very hard dry, very firm moist, very sticky and very plastic; few fine vesicular pores, common fine cracks; very few very fine and fine roots; many large quartz slickensides and common pressure faces; moderately alkaline (field pH 8.0); abrupt, smooth boundary to Bck.
Bck	130-155	Dark grayish brown (10YR 4/2), common fine distinct yellowish brown (10YR 5/6) mottles; clay; moderate fine and medium angular blocky structure; hard dry, firm moist, very sticky and very plastic; few very fine and fine vesicular and simple tubular pores, common fine cracks; common marl nodules; very few very fine and fine roots, common pressure faces; strongly alkaline (field pH 8.5); abrupt, smooth boundary to Ck.
Ck	155-182+	Very dark gray (10YR 3/1); silty clay; moderate fine and medium angular blocky structure; hard dry, firm moist, moderately sticky and moderately plastic; very few very fine and fine vesicular and few fine simple tubular pores, few fine cracks; practically no root; few part marl fragments of variable sizes; strongly alkaline (field pH 8.5).

### Tha Rua series

#### I Information on the site

Profile symbol	: Tr
Soil name	: Tha Rua series
Classification	: Chromic Vertic Endoaqualf
Date of examination	: June 3, 1999
Described by	: Irb Kheoruenromne, Piboon Kanghae, Saowanuch Tawornpruek, Sumitra Watana, Pattarodom Chainaronk Pornporm Pormdacha, Niwat Anongrak, Sirin Chaisiri, Wipawan Thaymuang
Location	: 50 m Southwest of Tha Rua-Pha Chi Road, Tambon Tha Chao Sanuk, Amphoe Tha Rua, Ayuttaya Province
Elevation	: Approximately 9 m (MSL)
Map sheet number	: 5138 III      Coordination: 16 04 088 N 47 620 0868 E
Landform	
1. Physiographic position	: Low terrace
2. Surrounding land form	: Flat
3. Slope on which profile site	: 2%
Land use	: Rice-based cropping (rice-mung bean)
Annual rainfall	: Approximately 1200 mm
Mean temperature	: Approximately 27°C
Climate	: Tropical savanna
Others	: Local trees, weeds

#### II General information on the soil

Parent material	: Alluvium over old local alluvium
Drainage	: Poorly drained
Permeability	: Slow
Runoff	: Slow
Depth of ground water	: Approximately 180 cm at time of sampling
Flooding depth	: Approximately 40 cm
Duration	: 3-4 months
Frequency	: Once a year
Human influence	: Agriculture

#### III Profile description

Horizon	Depth (cm)	Description
Ap <sub>g1</sub>	0-18	Dark gray (10YR 4/1); few fine distinct yellowish brown (10YR 5/6) mottles; clay; moderate fine and medium subangular blocky structure; very hard dry, very firm moist, very sticky and very plastic; common very fine and fine vesicular and few fine simple tubular pores, few fine pressure faces, few rock fragments, few fine iron and manganese oxide nodules; common very fine and fine roots; few trace of dead root; moderately alkaline (field pH 8.0); clear, smooth boundary to Ap <sub>g2</sub> .
Ap <sub>g2</sub>	18-35	Dark gray (10YR 4/1); few fine distinct yellowish brown (10YR 5/4) mottles; clay; moderate fine and medium subangular blocky structure; very hard dry, very firm moist, very sticky and very plastic; common very fine and fine vesicular and few fine simple tubular pores, common fine cracks, few fine pressure faces, few fine iron and manganese oxide nodules; few very fine and fine roots; few trace of fine charcoal fragments; moderately alkaline (field pH 8.0); abrupt, smooth boundary to Btg <sub>1</sub> .
Btg <sub>1</sub>	35-60	Mixed very dark grayish brown (10YR 3/2) 70% and yellowish brown(10YR 5/6) 30%; clay; moderate fine and medium subangular blocky structure; very hard dry, very firm moist, very sticky and very plastic; few thin clay coats on ped face, few on pore walls; few very fine and fine vesicular and few fine simple tubular pores; few very fine and fine roots; few trace of fine charcoal fragments; common fine rock fragment (2 <sup>nd</sup> limestone), few fine pressure faces; strongly alkaline (field pH 8.5); clear, smooth boundary to Btg <sub>2</sub> .
Btg <sub>2</sub>	60-88	Mixed very dark grayish brown (10YR 3/2) 60% and yellowish brown(10YR 5/6) 40%; silty clay; moderate fine and medium semi-angular blocky structure; hard dry, firm moist, moderately sticky and very plastic; common thin clay coats on ped face, few on pore walls; few very fine and fine vesicular and very fine and find simple tubular pores, few fine cracks, common soft accumulation of manganese oxide nodules, common pressure faces; few very fine and fine roots; few trace of dead roots; strongly alkaline (field pH 8.5); abrupt, smooth boundary to 2Btg <sub>3</sub> .
2Btg <sub>3</sub>	88-110	Mixed dark grayish brown (10YR 4/2) 70% and yellowish brown (10YR 5/6) 30%, few fine faint very dark brown (10YR 2/2) mottles; silty clay; moderate fine and medium subangular blocky structure; hard dry, firm moist, moderately sticky and very plastic; common thin clay coats on ped

		face and pore walls; few very fine and fine vesicular and fine simple tubular pores; very few very fine and fine roots; few rock fragments, few fine manganese oxide nodules, few fine pressure faces; strongly alkaline (field pH 8.5); clear, smooth boundary to 2Btg4..
2Btg4	110-140	Mixed dark brown (10YR 3/3) 70% and yellowish brown (10YR 5/6) 30%, few fine faint very dark brown (10YR 2/2) mottles; silty clay; moderate fine and medium subangular blocky structure; hard dry, firm moist, very sticky and very plastic; common medium thick clay coats on ped face and pore walls; few very fine and fine vesicular and fine simple tubular pores; few fine cracks; very few very fine and fine roots; few fine pressure faces, few trace of dead roots, few soft accumulation of manganese oxide as streak; strongly alkaline (field pH 8.5); clear, smooth boundary to 2Btg5.
2Btg5	140-170	Mixed dark brown (10YR 3/3) 70% and yellowish brown (10YR 5/4) 30%, common fine faint very dark brown (10YR 2/2) mottles; silty clay; moderate fine and medium subangular blocky structure; hard dry, firm moist, very sticky and very plastic; common medium thick clay coats on ped face and pore walls; few very fine and fine vesicular and fine simple tubular pores; few fine pressure faces; very few very fine and fine roots; few fine rock fragments, soft accumulation manganese oxide nodules, few trace of dead roots; strongly alkaline (field pH 8.5); abrupt, smooth boundary to 2Btg6.
2Btg6	170-180+	Mixed very dark grayish brown (10YR 3/2) 60% and dark yellowish brown (10YR 4/6) 40%, common fine faint very dark brown (10YR 2/2) mottles; silty clay; moderate fine and medium subangular blocky structure; hard dry, firm moist, very sticky and very plastic; common medium thick clay coats on ped face and pore walls and manganese expected; few very fine and fine vesicular and few fine simple tubular pores, few fine cracks; practically no roots; few lime and manganese oxide accumulation as spots, few pressure faces; strongly alkaline (field pH 8.5).

### Khok Krathiam series

#### **I Information on the site**

Profile symbol	: Kk
Soil name	: Khok Krathiam series
Classification	: Ustic Endoaquert
Date of examination	: June 8, 1999
Described by	: Irb Kheoruenromne, Piboon Kanghae, Saowanuch Tawornpruek, Sumitra Watana, Pattarodom Chainaronk Pornporm Pormdacha, Niwat Anongrak, Sirin Chaisiri, Wipawan Thaymuang
Location	: Approximately 60 m South of Angthong-Don Pud Road at km 13.1 Ban Don Pud, Tambon Don Pud, Amphoe Don Pud, Sarsburi, Province
Elevation	: Approximately 2 m (MSL)
Map sheet number	: 5138 III
	Coordination: 16 04 128 N 47 620 0756 E
Landform	
1. Physiographic position	: Flood plain
2. Surrounding land form	: Flat
3. Slope on which profile site	: 0.8%
Land use	: Local hydrophilic weeds, rain trees / rice (left fallow at time of sampling)
Annual rainfall	: Approximately 1200 mm
Mean temperature	: Approximately 27°C
Climate	: Tropical savanna
Others	: Some distinct surface cracks

#### **II General information on the soil**

Parent material	: Recent alluvium
Drainage	: Poorly drained
Permeability	: Slow
Runoff	: Slow
Depth of ground water	: Approximately 160 cm at time of sampling
Flooding depth	: Approximately 100 cm
Duration	: Approximately 3 months / year
Frequency	: Once a year
Human influence	: Agriculture

#### **III Profile description**

Horizon	Depth (cm)	Description
Apg1	0-10	Dark gray (10YR 4/1); common fine faint dark brown (7.5YR 4/4) root mottles; clay; weak coarse angular blocky mixed with semi-massive; very hard dry, very firm moist, very sticky and very plastic; few very fine and fine vesicular pores, few fine cracks, common traces of dead roots; many very fine and fine and medium roots; few big shell fish; slightly acid (field pH 6.5); clear, smooth boundary to Apg2.
Apg2	10-27	Dark gray (10YR 4/1); common fine faint dark brown (7.5YR 4/4) root mottles; clay; weak coarse angular blocky mixed with semi-massive; very hard dry, very firm moist, very sticky and very plastic; few very fine and fine vesicular pores, few fine cracks; common trace of charcoal fragments, common traces of dead roots, common pressure faces, few small shell fish; slightly acid (field pH 6.5); clear, smooth boundary to Bg1
Bg1	27-45	Dark grayish brown (10YR 4/2); common fine faint dark brown (7.5YR 4/4) mottles; clay; moderate fine and medium subangular blocky structure; very hard dry, very firm moist, very sticky and plastic; few very fine and fine vesicular and few fine simple tubular pores, common fine cracks; few very fine and fine roots; many pressure faces, common traces of dead roots; common trace of charcoal fragments; slightly acid (field pH 6.5); clear, smooth boundary to Bg2
Bg2	45-63	Grayish brown (10YR 5/2); few fine distinct yellowish brown (10YR 5/8) mottles; clay; moderate fine and medium subangular blocky structure; very hard dry, very firm moist, very sticky and plastic; common very fine and few fine vesicular and few fine simple dendritic tubular pores, common fine cracks; very few very fine and fine roots; few traces of dead roots; common pressure faces; slightly acid (field pH 6.5); gradual, smooth boundary to Bg3
Bg3	63-82	Gray (10YR 5/1); common fine distinct yellowish brown (10YR 5/8) mottles; clay; moderate fine and medium semi-angular blocky structure; very hard dry, very firm moist, very sticky and very plastic; few very fine and fine vesicular and few fine simple tubular pores, few fine cracks; very few very fine and fine roots; few traces of dead roots, few fine slickensides, common large pressure faces, few trace of charcoal fragments; mildly alkaline (field pH 7.5); clear, smooth boundary to Bssg1

Bssg1	82-100	Gray (10YR 5/1); few fine distinct yellowish brown (10YR 5/8) mottles; clay; moderate fine and medium semi-angular blocky structure; very hard dry, very firm moist, very sticky and plastic; few very fine and common fine vesicular and common fine simple tubular pores, few fine cracks; very few very fine and fine roots; common large pressure faces, common slickensides; moderately alkaline (field pH 8.0); gradual, smooth boundary to Bssg2.
Bssg2	100-120	Gray (10YR 5/1); few fine distinct dark yellowish brown (10YR 4/4) mottles; clay; moderate fine and medium semi-angular blocky structure; very hard dry, very firm moist, very sticky and plastic; few very fine and fine vesicular and few fine simple tubular pores, few fine cracks; very few very fine and fine roots; common large pressure faces, common slickensides; moderately alkaline (field pH 8.0); clear, smooth boundary to Bssg3.
Bssg3	120-140	Gray (10YR 5/1), few fine distinct dark yellowish brown (10YR 4/4) mottles; clay; moderate medium and coarse semi-angular blocky structure; very hard dry, very firm moist, very sticky and plastic; few very fine and very few fine vesicular and very few fine simple tubular pores, few fine cracks; practically no roots; common large pressure faces; moderately alkaline(field pH 8.0); clear, smooth boundary to Bg4.
Bg4	140-170	Grayish brown (10YR 5/2), few fine distinct dark yellowish brown (10YR 4/6) mottles; clay; weak coarse semi-angular blocky structure; very hard dry, firm moist, very sticky and moderately plastic; few very fine and fine vesicular and few fine simple tubular pores, few fine cracks; practically no roots; common large pressure faces; moderately alkaline (field pH 8.0); clear, smooth boundary to Bg5.
Bg5	170-180+	Gray (10YR 6/1), common fine distinct yellowish brown (10YR 5/6) mottles; clay; semi-massive; very hard dry, firm moist, very sticky and vary plastic; very few very fine and few fine vesicular and very few fine simple tubular pores, few fine cracks; practically no roots; common fine pressure faces; moderately alkaline (field pH 8.0).



		moderately sticky and very plastic; common fine crack and few fine mica flake and very few fine pressure faces; few very fine and common fine vesicular and common fine simple and dendritic tubular pores; few very fine and fine roots; moderately alkaline (field pH 8.0); gradual, smooth boundary to Bg3.
Bg3	115-150	Light olive gray (5Y 6/2), common fine prominent dark yellowish brown (10YR 3/6) and common fine prominent dark yellowish brown (10YR 4/6) and common fine prominent yellowish brown (10YR 5/6) streak mottles; silty clay; very weak angular blocky (semi-massive) structure; slightly hard dry, firm moist, moderately sticky and moderately plastic; few very fine mica flake and common fine crack; few very fine and fine vesicular and few fine simple tubular pores; very few very fine and fine roots; common krotovinas very dark gray (10YR 3/0); moderately alkaline (field pH 8.0); clear, smooth boundary to Bg4.
Bg4	150-180+	Light olive gray (5Y 6/2), common fine prominent dark yellowish brown (10YR 3/6) and common fine prominent dark yellowish brown (10YR 4/6) and common fine prominent yellowish brown (10YR 5/6) streak mottles; silty clay; very weak angular blocky (semi-massive) structure; slightly hard dry, firm moist, moderately sticky and moderately plastic; few very fine mica flake and common fine crack; few very fine and fine vesicular and few fine simple tubular pores; very few very fine and fine roots; moderately alkaline (field pH 8.0).