Suitability of Soils for Oil Palm in Southeast Asia

By E. Mutert

Soil physical properties such as depth, texture and structure are important factors in determining suitability for large scale oil palm planting.

It it estimated that more than 95 percent of oil palms are grown on acid, low fertility soils. This becomes evident from topsoil characteristics of eight representative soil types commonly used for oil palm in Southeast Asia (**Table 1**).

Table 1. Topsoil (0 to 30 cm) characteristics of eight soil types commonly used for oil palm in Southeast Asia.

						Exchangeable						
		pH,	Corg,	Ntot,	P Bray II,	Ca	Mg	K	Al	Clay	Silt	Sand
Pedon	Soil type	H_2O	%	%	mg/kg	cmol(+)/kg				%		
1	Terric Troposaprist	3.8	24.5	1.1	35	0.85	1.56	0.24	9.50	55	32	13
2	Typic Sulfaquept	4.1	2.5	0.2	18	0.18	0.20	0.32	12.50	72	21	7
3	Typic Hapludox	4.4	1.1	0.1	6	0.28	0.25	0.16	0.60	37	9	54
4	Xanthic Kandiudox	4.3	1.8	0.2	15	0.86	0.48	0.24	3.20	63	5	32
5	Typic Paleudult	4.4	1.2	0.1	12	0.16	0.03	0.09	1.40	18	8	76
6	Typic Hapludult	4.1	1.4	0.1	8	0.76	0.18	0.15	1.80	20	19	61
7	Typic Kandiudult	4.9	0.8	0.1	5	0.19	0.10	0.05	0.80	33	7	60
8	Typic Melanudand*	4.8	6.4	0.5	8	1.86	0.25	0.07	0.80	18	53	29

*12 percent allophane was present in the less than 2 mm soil mineral fraction.

The soils are illustrated in **Figure 1**. All of these soils have a pH less than 5.0, six of the eight have low to very low contents of nitrogen (N), available phosphorus (P), and exchangeable potassium (K). Half of them have low to very low contents of exchangeable magnesium (Mg) when evaluated for fertility parameters with regard to oil palm (**Table 2**).

With the exception of P and Mg on the Terric Troposaprist soil, oil palms planted on these soils are expected to respond to applications of N, P, K, and Mg.

While soil amendments such as empty fruit bunches (EFB) and fertilizers can be applied to correct nutrient shortages, soil physical limitations such as impenetrable layers and poor water retention are difficult to rectify. Thus, physical properties such as depth, texture and structure of the soil are major criteria for assessing suitability for large scale oil palm planting. Terrain is of great importance. In order to avoid greater cost of establishment, problems with harvesting, and losses from run-off and erosion, areas exceeding slopes of 15 percent should be not extensive.

Table 2. Soil fertility evaluation for oil palm.

Property	V. low	Low	Mod.	High	V. high
pH	<3.5	4.0	4.2	5.5	>5.5
Org. C, %	<0.8	1.2	1.5	2.5	>2.5
Total N, %	<0.08	0.12	0.15	0.25	>0.25
Total P, mg/kg	<120	200	250	400	>400
Avail. P, mg/kg	<8	15	20	25	>25
Ex. K, cmol(+), kg	<0.08	0.20	0.25	0.30	>0.30
Ex. Mg, cmol(+), kg	<0.08	0.20	0.25	0.30	>0.30
ECEC, cmol(+), kg	<6	12	15	18	>18
Deficiency	likely	possible	—	—	induced
Hidden hunger	—	—	likely	—	possible
Fertilizer response	definite	likely	possible	—	possible

Source: after Goh Kah Joo, 1997
Methods and Extractants
pH: H_2O, 1:2.5; Organic C: Walkley & Black; Total N: Kjeldahl; Total P: 25% HCl; Available P: Bray II; Exchangeable K, Mg, and CEC: Leaching with 1M ammonium acetate at pH 7.0.
cmol(+)/kg = meq/100g
mg/kg = parts per million (ppm)

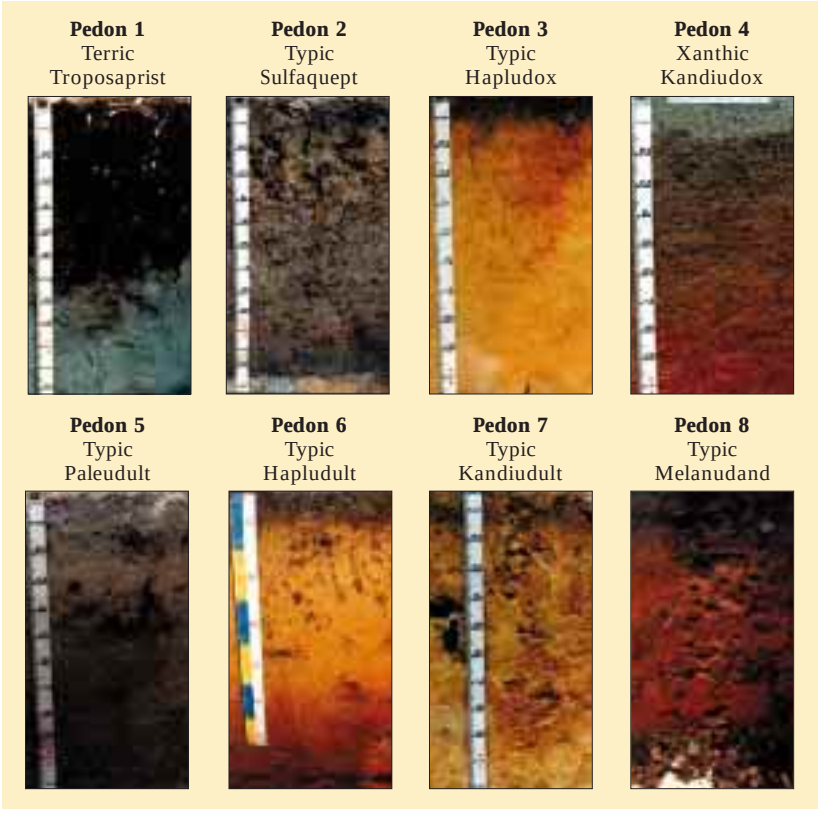

Figure 1. Eight representative soil types commonly planted to oil palm in Southeast Asia.

Table 3. Suitability characteristics of eight soil types commonly used for oil palm in Southeast Asia.

Pedon	Soil type	Parent material	Terrain	Drainage	Constraints	Advantage	Treatment
1	Terric Troposaprist	Marine clay	Flat	Poor	Poor anchorage; subsidence; K deficiency	Constant water availability	Hole in hole planting; water management
2	Sulfaquept	Estuarine clay	Flat	Imperfect	Acidity; stagnant water	Constant water availability	Keep water > 20 cm below surface
3	Typic Hapludox	Granite	Steep (30%)	Well drained	P fixation; moisture stress; erosion; P, K deficiency	No stagnant water	P placement; mulch (EFB); terraces
4	Xanthic Kandiudox	Reworked materials	Gentle rolling	Well drained	High clay content; low fertility	Good moisture retention	Mulch (EFB); fertilization
5	Typic Paleudult	Subrecent terrace	Undulating	Imperfect	Moisture stress; low fertility; K, Mg deficiency	Easy to work	Mulch (EFB); fertilization
6	Typic Hapludult	Colluvium	Undulating	Moderately well	Low fertility; P, K, Mg deficiency	Sufficient moisture	Mulch (EFB); fertilization
7	Typic Kandiudult	Granite	Rolling	Well drained	Low fertility; N, P, K, Mg deficiency	Easy to work	Mulch (EFB); fertilization
8	Typic Melanudand	Volcanic ash	Gentle rolling	Well drained	K deficiency	Excellent structure	Fertilization, particularly K

Although the majority of oil palm roots are found within the first 60 cm of the soil, firm anchorage of adult palms of more than 8 m height can only be assured in a deep soil (greater than 90 cm). Thus, a soil suitable for oil palm permits extensive root development, firm anchorage, and...due to its clay loam texture and friable consistency...stores sufficient water and plant nutrients. It provides adequate drainage during the wet season in flat to gently undulating terrain. As the oil palm is thought to have evolved in swampy, wet levees, a well drained alluvial soil as found in coastal areas of Southeast Asia is probably most suited.

However, a wide range of soils derived from igneous and sedimentary rocks, peat, and volcanic ash (which are of lower nutrient status) are commonly planted to oil palm in Southeast Asia (**Tables 1** and **3**).

At present, highly weathered and light textured soils (Pedon 5, 6, 7 in **Tables 1** and **3**) derived from granite and Pleistocene sediments and deep peat soils (see page 22 of this issue)...all of very low inherent fertility...are being successfully planted in oil palm expansion areas throughout Southeast Asia. **BCI**

Dr. Mutert is Director, PPI/PPIC East and Southeast Asia Programs, Singapore.