Closing In on Oil Palm Nutrient Uptake

Cycling of plant nutrients in the oil palm agro-ecosystem

Nutrients are needed for palm growth (i.e., fronds, trunks and roots); nutrients used for trunk growth needs continuous addition, but those contained in fronds, male inflorescences, and roots, would be recycled within the system if it is already in a steady, optimal state. Loss of leaf tissue, along with their nutrient contents, could occur with infestations of leaf-eating pests.

Nutrients are also used to produce yield (i.e., bunches). These nutrients are removed during harvesting of the fresh fruit bunches (FFB), though some of it may be returned with empty fruit bunches and palm oil mill effluent from the mill.

Nutrients are added into the system from the soil and atmosphere (i.e., rainfall); if legume cover plants are a part of the system, they may also contribute. When the nutrients needed for growth and yield are not sufficiently satisfied by these natural sources of nutrient supply, fertilizers need to be added. Part of the added nutrients will be lost from the system in surface runoff water and erosion of topsoil, as well as by leaching out from the soil.

Various methods are used by agronomists to estimate nutrient needed for oil palm plantings (for a good review, see Goh, 2011). With rapid expansion of oil palm cultivation, such data is not available for many new areas. Knowledge of general oil palm nutrient uptake values can help provide an initial approximation of nutrient requirements (see Table 1).

There have been relatively few detailed studies on oil palm nutrient uptake. The classic works of Dr. Ng Siew-Kee and his co-workers (Ng and Thamboo, 1967; Ng et al., 1968) remained for a long time the most commonly cited resource for Southeast Asian agronomists, even though their data was mainly from *dura* palms planted pre-1960. Nutrient uptake data of *tenera* palms have been reported in Malaysia (Tan, 1976; Tan, 1977; Teoh and Chew, 1988; Tarmizi and Tayeb, 2006) and Indonesia (Prabowo and Foster, 2006; Prabowo et al., 2006).

A key component in the nutrient balance sheet (Table 1) is the nutrients removed with FFB yield. Recent studies in Indonesia (Donough et al., 2014) and Malaysia (Tarmizi and Tayeb, 2006) on *tenera* oil palms suggest higher N and K contents in *tenera* FFB compared to the earlier results of Ng and Thamboo (1967) (Table 2). FFB nutrient contents from studies in North Sumatra (Table 2) show even higher values. Nutrient contents were higher in fertilized palms compared to unfertilized palms in North Sumatra.

Table 1. Approximation of fertilizer rates using nutrient uptake and loss values[1] in a nutrient balance sheet

		Nutrients (kg ha^{-1} $year^{-1}$)			
		N	P	K	Mg
Addition to system[2]		+17	+2	+32	+5
Losses from system[3]		-21	-2	-28	-6
Needed for	(a) Trunk growth	-42	-4	-122	-10
	(b) FFB yield	-99	-16	-130	-33
Nett balance		-145	-20	-248	-44
Fertilizers	(a) Type[4]	AS	TSP	MOP	KIES
	(b) Content (%)	21	20	50	16
	(c) Rate[5]	4.7	0.7	3.4	1.9

1 - Adapted from Goh and Teo (2011 Table 2; 2 - from rainfall only; 3 – runoff, leaching & erosion; 4 – AS = ammonium sulphate, TSP = triple superphosphate, MOP = muriate of potash, KIES = kieserite; 5 – based on 148 palms ha^{-1}.

Table 2. Nutrient contents in fresh fruit bunches (FFB) from tenera oil palms

Location and soil type or parent material	Nutrient content (kg ton^{-1} FFB)			
	N	P	K	Mg
Selangor, Malaysia – *dura* palms[1]	2.94	0.44	3.71	0.81
Johore, Malaysia – typic kandiudult[2]	3.10	0.37	3.92	0.68
Central Kalimantan – typic dystrudept[3]	3.10	0.39	3.89	0.52
North Sumatra – sandstone[4]	5.44	0.79	5.28	1.05
North Sumatra – sandstone[4] – unfertilized	5.05	0.55	3.99	0.68
North Sumatra – rhyolite (volcanic)[4]	5.64	0.81	6.28	0.97
North Sumatra – rhyolite (volcanic)[4] - unfertilized	5.11	0.58	5.33	0.73

1 – Ng and Thamboo, (1967) Table 14; 2 – Donough et al., (2014) Table 4; 3 – Tarmizi and Tayeb (2006) Table 4; 4 – recomputed from Table 8 of Prabowo and Foster (2006).

Early studies in Sumatra in the 1920s and 1930s (cited by Ng and Thamboo, 1967)[1] had reported high contents of N, P and K in dura FFB, but those results were dismissed as 'excessive'. In the light of the new findings, it now seems that soil fertility and fertilization, and environmental factors, may well have an influence on the nutrient contents in FFB.

[1] *Table 21 in Ng and Thamboo (1967)*

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Refer to the last printed page of this diary for sources.

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