Leaf Nutrient Analysis as a Management Tool in Yield Intensification of Oil Palm

Leaf analysis is the most common method used to assess the nutrient status of the oil palm crop. Leaf analysis values are usually compared with established critical levels to determine whether a nutrient deficiency exists in the plant. From this standpoint, leaf analysis and critical nutrient levels serve as a diagnostic tool to indicate when fertilizer should be applied to the crop. Various factors affect leaf nutrient concentrations and, hence, critical levels. Some critical levels for nitrogen (N), phosphorus (P), and potassium (K) found in the literature are shown in Table 1.

Table 1. Critical values for N, P, and K in oil palm leaf

Deficient levels			Optimum levels			Reference:
N	P	K	N	P	K	
2.7	0.15	1.00				Prevot and Ollagnier (1954)
2.5	0.15	1.00	2.6-2.7	0.16-0.17	1.1-1.2	Ng (1969)
2.5	0.15	1.00				Ochs and Olivin (1976)
			2.9-3.0[a]	0.18-0.19	1.1-1.2	Foster and Chang (1977)
			2.6-2.7[b]	0.17-0.18	0.9-1.1	
2.5[c]	0.15	1.00	2.6-2.9	0.16-0.19	1.1-1.3	Von Uexkull and Fairhurst (1991)
2.3[d]	0.14	0.75	2.4-2.8	0.15-0.18	0.9-1.2	
2.6; 2.3[e]	0.13		2.5-3.0	0.15-0.19	0.9-1.3	Goh and Haerdter (2003)
		1.00[f]			1.3-1.6[f]	Teoh and Chew (1988)

[a] *Optimum levels for inland soils of West Malaysia;*
[b] *Optimum levels for coastal soils of West Malaysia;*
[c] *Critical and optimum levels for palms <6 years after planting (YAP);*
[d] *Critical and optimum levels for palms >6 YAP;*
[e] *Critical level: 2.6 for palms <6 years after planting (YAP); 2.3 for palms >6 YAP;*
[f] *Rachis K*

The Southeast Asia Program of IPNI evaluated a suite of best management practices (BMP) for yield intensification of oil palm in large-scale commercial plantations in six sites in Indonesia, and compared it with estate management practices (REF) (Oberthür et al., 2013). Over four years, nutritional status, fertilizer application, yield, and other growth indicators were monitored in BMP and REF blocks. Across years, average leaf N levels in the BMP and REF treatments were below the published optimum range for N. Leaf N was similar between BMP and REF across sites and for most years. Leaf P levels for both treatments were mostly within the optimum range (0.15 - 0.19%) in all sites and years. Leaf P levels were similar between the BMP and REF treatments. Leaf K levels for both treatments were mainly within the optimum range (0.9 - 1.3%).

Leaf K levels were higher in the BMP treatment only in two sites, but similar between the treatments in other sites.

Nutrient levels measured in the treatment blocks reflected neither the differences in yield nor the differential nutrient inputs in BMP and REF. The BMP treatment consistently yielded more fresh fruit bunch yield than the REF across all sites and years. The greater yield was attributed to crop recovery during the first year and to the combined effect of recovery and yield-making (principally improved nutrition) in later years (Oberthür et al., 2013). Leaf nutrient levels varied over time in some sites, however, the patterns and magnitude of this variation was similar in the REF and BMP treatments.

Foster (2003) indicated that nutrient concentrations alone might not be a very good indicator of oil palm nutrient requirements. Here we hypothesize that it might be possible that increased availability of nutrients increases leaf (or rachis) nutrient content up to a certain level under given conditions, and that beyond that level the plant responds by increased growth with no change in nutrient levels. If this occurs with increased leaf growth leading to greater light interception then yield could increase with no change in nutrient status. This would then suggest that an estimation of the total nutrient content of the fronds or the total cation content would be a better indicator of nutrient status as it takes into account both the nutrient concentration and the total growth of the fronds.

Fairhurst and Mutert (1999) suggest that effective fertilizer recommendations are usually the result of combining the results of leaf analysis with field knowledge and common sense. Improvement of field knowledge to relate yield to nutrient contents can be obtained from carefully designed field trials (see for example Prabowo et al., 2010). However, other options exist: The recently developed concept of Plantation Intelligence (see Planter's Diary 2013) as a mechanism to deploy operational research, may provide a means to possibly adjust leaf nutrient concentration indicators to more adequately suit local conditions, and thereby assess the suitability of these indicators in nutrient management for high yields. Plantation Intelligence is designed as a learning process based on the observed performance of individual management blocks of estates.

This information is derived from an article in Better Crops with Plant Food:

Pasuquin, J.M., J. Cock, C.R. Donough, T. Oberthür, Rahmadsyah, G. Abdurrohim, K. Indrasuara, T. Dolong, and S. Cook. 2014. Leaf Nutrient Analysis as a Management Tool in Yield Intensification of Oil Palm. Better Crops with Plant Food, Vol. 98 (1). In Press.

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

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