EFFECT OF NUTRIENT APPLICATION FREQUENCY ON NUTRIENT UPTAKE IN OIL PALM PRODUCTION ON SANDY SOILS

Jóska Gerendás[1], Bayu Utomo[2], Kusnu Martoyo[2], Christopher R. Donough[3], Thomas Oberthür[3]
1 – K+S Kali GmbH; 2 – PT Sampoerna Agro Tbk; 3 – International Plant Nutrition Institute, Southeast Asia Program (IPNI SEAP)

INTRODUCTION

Fertilizer recovery efficiency (FRE) is inherently low in the oil palm production system, due to nutrient losses by leaching and surface runoff, and poorly managed recycling of nutrient-rich post-milling residues. In Indonesia, Kalimantan is where oil palm cultivation has been rapidly expanding in recent years. Sandy soils are common in the region and nutrient losses are expected to be particularly high especially during times of high rainfall. With reference to the 4R Nutrient Stewardship concept (IPNI, 2012), it is hypothesized that increasing the frequency of fertilizer application on such soils should reduce the losses of nutrients and increase the efficiency of the applied fertilizers. To test this hypothesis, a project was started at PT Sungai Rangit in Central Kalimantan by IPNI SEAP, K+S Kali GmbH and PT Sampoerna Agro Tbk.

MATERIALS AND METHODS

The project started in 2011 in 12 commercial blocks (approx. 25 ha each) with very light textured soils (ca. 80% sand). There are four treatments, comparing increased application frequency with standard estate applications frequency for two fertilizer application rates (standard rate, reduced rate). The 12 blocks were, thus, grouped into sets of four blocks each with three replications.

All blocks were planted in 1998 at similar plant densities with the same source of planting material. All other management and agronomic practices in each block were standardized. FFB yield per block was recorded by the estate teams. Nutrient management treatments started in October 2011. In the improved practice (BMP) treatment, blending of individual fertilizers viz. granular Urea (N = 46%), Ammofos (N = 16%, P_2O_5 = 20%, S = 12%), and Korn-Kali+B (K_2O = 40%, MgO = 6%, S = 4%, B_2O_3 = 0.8%), allowed for four applications of N, P, K, Mg, S, and B per year. The standard estate practice (SEP) treatment had two applications of N (as granular Urea), K, Mg, S and B (as Korn-Kali+B) and one application of P, N and S (as Ammofos) per year in the first year reported here. In the first year, the reduced rate treatments received 80% of the standard rate. All fertilizers were manually applied in the field. Samples of leaf, rachis and trunk tissues were taken annually, starting with baseline samples in September 2011.
Growth measurements were recorded annually, starting with baseline measurements in September 2011. FRE was derived from the ratio of nutrients utilized (i.e. nutrients removed in FFB plus nutrients immobilized in palm trunks) in relation to nutrients supplied from applied fertilizers.

RESULTS AND DISCUSSION

Results on FRE are presented for the standard rate treatments for the first year (October 2011 to September 2012) of the project, as part of an ongoing assessment process meant to allow adjustments to management as required. The SEP treatment reached a FRE of 53% for N (from Urea and Ammofos), 71% for P (from Ammofos), and 37% for K and 62% for Mg (both from Korn-Kali+B) (*Table 1*). Applying N and K sources four times in a year increased their efficiency by 10% and 18%, respectively. However, the efficiencies of the P and Mg sources was not improved with increased frequency of application; this is most likely attributable to the use of rock phosphate and dolomite, respectively, by the plantation prior to treatment initiation.

TABLE 1. NUTRIENT RECOVERY EFFICIENCY IN THE FIRST YEAR IN A NUTRIENT MANAGEMENT PROJECT IN CENTRAL KALIMANTAN

	N	P	K	Mg
BMP[1] treatment (fertilizers blended, then applied 4x per year)				
Nutrients supplied, i.e. applied in fertilizers (kg/ha)	134.6	12.2	243.0	26.5
Nutrients removed in FFB[3] & fixed in trunk growth (kg/ha)	78.7	8.7	107.2	16.1
Fertilizer recovery efficiency (FRE, in %)	*58.5*	*71.5*	*44.1*	*60.8*
SEP[2] treatment (fertilizers applied singly as straights)				
Nutrients supplied, i.e. applied in fertilizers (kg/ha)	129.2	11.7	233.3	25.4
Nutrients removed in FFB[3] & fixed in trunk growth (kg/ha)	68.5	8.3	87.2	15.9
Fertilizer recovery efficiency (FRE, in %)	*53.0*	*71.2*	*37.4*	*62.3*
% Difference BMP versus SEP treatments	*+10.3%*	*+0.5%*	*+18.0%*	*-2.5%*

1 – BMP = best management practice; 2 – SEP = standard estate practice; 3 – FFB = fresh fruit bunches

Nutrient concentrations in trunk tissue were much higher in the BMP (higher application frequency) treatment (*Table 2*). Nutrient contents in leaf (pinnae) tissue were comparable for both BMP and SEP treatments, generally falling in the optimal range defined in Appendix 3 of Fairhurst and Härdter (2003). FFB yield averaged 24.8 tons per ha, with no significant difference between treatments in this first year. These early results suggest that FRE may not be reflected in FFB yield and leaf nutrient concentrations. For better nutrient management, determination of the nutrient contents of storage tissues (rachis currently being the most practicable) may become necessary to provide additional indicators.

TABLE 2. PLANT NUTRIENT CONTENTS IN THE FIRST YEAR IN A NUTRIENT MANAGEMENT PROJECT IN CENTRAL KALIMANTAN

	N	P	K	Mg
Nutrients in leaf tissue (% of dry matter)				
BMP[1] (fertilizers blended, then applied 4x per year)	2.63	0.159	1.15	0.23
SEP[2] (fertilizers applied as straights/compounds)	2.59	0.156	1.25	0.22
% Difference BMP versus SEP treatments	*+1.5%*	*+1.9%*	*-8.0%*	*+4.5%*
Nutrients in rachis (% of dry matter)				
BMP[1] (fertilizers blended, then applied 4x per year)	0.37	0.058	1.61	N/A
SEP[2] (fertilizers applied as straights/compounds)	0.34	0.044	1.63	N/A
% Difference BMP versus SEP treatments	*+8.8%*	*+31.8%*	*-1.2%*	N/A
Nutrients in trunk tissue (% of dry matter)				
BMP[1] (fertilizers blended, then applied 4x per year)	1.08	0.071	2.40	0.09
SEP[2] (fertilizers applied as straights/compounds)	0.92	0.059	2.02	0.07
% Difference BMP versus SEP treatments	*+17.4%*	*+20.3%*	*+18.8%*	*+28.6%*

1 – BMP = best management practice; 2 – SEP = standard estate practice; NA = not analyzed

CONCLUSION

This first assessment from the ongoing project suggests that increasing nutrient application frequency using a multi-nutrient fertilizer blend improves efficiency of nutrient recovery for oil palms in the sub-optimal conditions prevailing at the project site. This is important for plantations in view of the large contribution of fertilizers to field costs. In a larger context, the results are important for sustainable intensification of oil palm production under similar conditions elsewhere.

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