IMPROVING NUTRIENT MANAGEMENT OF OIL PALMS ON SANDY SOILS IN KALIMANTAN USING THE 4R CONCEPT OF IPNI

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INTRODUCTION

On the sandy soils common in Kalimantan, nutrient losses by leaching are expected to be particularly high during times of high rainfall. Based on the 4R nutrient stewardship concept (right source, right rate, right time, right place) (IPNI, 2012) promoted by the International Plant Nutrition Institute (IPNI), increased frequency of fertilizer application on such soils should reduce losses of nutrients and increase efficiency of the applied fertilizers. To test this hypothesis, a project was started in 2011 at PT Sungai Rangit in Central Kalimantan by IPNI SEAP, K+S Kali GmbH and PT Sampoerna Agro Tbk. Higher frequency of application (4 rounds per year for each nutrient) using a fertilizer blend, i.e. the nutrition best management practice (NBMP) treatment, is compared to standard estate practice (SEP) where straight fertilizers are applied in the usual manner. Within the two practices, two application rates i.e. full and low (=80% of full rate) are compared. After 1 year, the apparent fertilizer recovery efficiency (FRE) of N and K was 10% and 18% higher, respectively, with NBMP compared to SEP (Gerendas *et. al.*, 2013). Here, we present results up to the 2nd year of the project.

MATERIALS AND METHODS

The project is implemented in 12 commercial blocks (approx. 25 ha each) with very light textured soils (ca. 80% sand), classified as typic dystrudepts. Each of the 4 treatments viz. NBMP full rate, NBMP low rate, SEP full rate, and SEP low rate, is replicated 3 times. Nutrient management treatments started in October 2011. All blocks were planted in 1998 at similar plant densities with the same source of planting material. All other practices in each block were standardized. FFB yield per block was recorded by the estates involved. All fertilizers were manually applied in the field. Samples of leaf, rachis and trunk tissues (for nutrient content analysis), and growth measurements, were taken annually, starting with baseline samples in September 2011. Bunch analysis (BA) started in April 2012 with bunches sampled during each harvesting round; the BA procedure was modified from June 2013 to allow for nutrient content analysis. Apparent 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

FFB yield in the 2nd year of the project was lower than the 1st year (Table 1), reflecting an overall yield decline due to dry conditions before the project commenced. In both years, the FFB yield difference between treatments was marginal, with no clear trend in treatment rankings. The apparent lack of any effect on FFB yield from a 20% lower application rate does not necessarily mean that fertilizer rates can be cut, as it is likely that the first two years of yield is still influenced by past fertilization, so it will be prudent to wait for the next two years results before any conclusion is made with respect to application rate.

Unlike the 1st year, there was lack of a clear advantage in FRE for N and K with NBMP in the 2nd year (Table 2). In the case of P and Mg, as noted by Gerendas *et. al.* (2013), NBMP did not improve FRE due to residual effects of rock phosphate and dolomite used in these blocks prior to project initiation. Two years may not be enough to exhaust residual effects from past fertilization, and there may be other unidentified effects associated with the general yield decline in the second year. FRE for N and K were generally higher at the low rate compared to the full rate, except for K in the NBMP treatment where there was no difference. In the SEP treatment, FRE for all nutrients were higher with the lower rate of application.

Leaf nutrient values (results not shown) did not differ with either higher frequency or application rate, justifying the approach taken in excluding frond nutrients in the FRE calculation. Rachis values (results not shown) for N and K were marginally lower in the reduced rate treatments. In the 1st first year, Gerendas *et. al.* (2013) noted that trunk values better reflected observed differences in FRE for N and K due to application frequency. In the 2nd year, this seemed no longer the case.

Nutrient content of FFB was determined in the 2nd year of the project; results from bunches sampled between May and September 2013 are shown in Table 3. The P and Mg contents in FFB appear independent from both application frequency and application rate, which is attributable to the substantial 'memory' effect of the nutrient sources employed prior to treatment initiation. N and K contents in FFB appeared unaffected by application rate but seemed to be higher with higher application frequency. The results are comparable to values reported by Tarmizi and Tayeb (2006) in Malaysia. Prabowo et. al. (2006) reported much higher values in North Sumatra, suggesting that FFB nutrient contents may differ with environmental conditions.

TABLE 1. FFB YIELD (kg ha^{-1}) IN THE FIRST TWO YEARS IN A NUTRIENT MANAGEMENT PROJECT IN CENTRAL KALIMANTAN

	NBMP Full Rate	SEP Full Rate	NBMP Low rate	SEP Low Rate
FFB Yield (kg ha^{-1}) Year 1	24,435	25,336	25,264	24,136
FFB Yield (kg ha^{-1}) Year 2	21,595	20,871	20,649	21,530
% Difference (Yr 2 vs Yr 1)	*-12%*	*-18%*	*-18%*	*-11%*
FFB Yield (kg ha^{-1}) average	23,015	23,104	22,957	22,833

TABLE 2. FERTILIZER RECOVERY EFFICIENCY (FRE, in %) IN THE 2ND YEAR IN A NUTRIENT MANAGEMENT PROJECT IN CENTRAL KALIMANTAN

	NBMP Full Rate	SEP Full Rate	NBMP Low rate	SEP Low Rate
Nitrogen (N) FRE (%)	38.2	32.7	49.0	42.7
Phosphorus (P) FRE (%)	62.8	88.6	92.2	116.9
Potassium (K) FRE (%)	35.1	34.6	35.2	52.7
Magnesium (Mg) FRE (%)	42.4	46.6	52.8	58.2

TABLE 3. NUTRIENT CONTENTS IN FFB (kg ton^{-1}) IN A NUTRIENT MANAGEMENT PROJECT IN CENTRAL KALIMANTAN

	N	P	K	Mg
NBMP Full Rate	3.06	0.37	4.02	0.52
SEP Full Rate	3.02	0.40	3.76	0.51
NBMP Low Rate	3.20	0.38	3.91	0.50
SEP Low Rate	3.12	0.39	3.86	0.52

CONCLUSION

After 2 years, a lack of clear differences between treatments for FFB yield, plant nutrient concentrations, and FRE, makes it premature to draw any conclusions on nutrient application frequency or application rate for oil palms grown under the conditions prevailing at the project site. As the project enters its last 2 years, the picture may yet change. Initial results of FFB nutrient contents are in line with assumed values used for fertilizer budgeting at this site, but are much lower than values found in North Sumatra. Future reports on this ongoing project will include analysis of cost-benefit, FFB yield with and without fertilizers, oil and kernel yields, and soil indicators. The results will be important for sustainable intensification of oil palm production in similar sub-optimal conditions elsewhere.

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