Potash – Ever So Important for Oil Palm Productivity

Oil palm requirement for potassium (K): Among the four main nutrients nitrogen (N), phosphorus (P), potassium (K), and magnesium (Mg), oil palms require K in the largest quantity. Recent studies (Tarmizi & Tayeb, 2006) indicate that current planting materials require even more K.

Physiological role of K: K plays a role in many physiological functions including (a) synthesis of starch and proteins, (b) transport of assimilates, and (c) osmo-regulation. In photosynthesis, K helps to convert sunlight into biochemical energy to enable water and carbon dioxide to combine and form carbohydrates (including starch). K is needed for the conversion of N into proteins, thus these two nutrients are synergistic. K helps transport the products of photosynthesis from where they are produced in the leaves to where they are needed in other parts of the plant (e.g. developing inflorescences and bunches). Lastly, K plays an important role in water regulation, helping plants use soil moisture more efficiently.

Responses to fertilizer K: Over 95% of oil palms in Southeast Asia are grown on acidic, low fertility soils, with low or very low content of plant-available K (Mutert, 1999). Indeed, yield responses to K fertilizer has been recorded in many fertilizer experiments on various soil types in different environments in Malaysia and Indonesia (Tables 1a & 1b).

Table 1a: Oil palm response to K in Malaysia(adapted from Goh et. al., 1994)

Environment	Soil orders	No. of trials	Yield response (%)		K rate tested (kg palm^{-1} year^{-1})	
			Average	Range	Average	Range
Coastal	Inceptisols	19	+7.3	-0.4 to +45.4	2.52	0 to 5.40
Riverine	Ultisols	2	+13.5	+5.7 to +25.0	4.03	2.50 to 6.00
Inland	Ultisols	19	+16.3	+8.3 to +24.0	3.82	2.10 to 7.00
Inland	Oxisols	3	+14.4	+3.1 to +43.0	3.97	2.00 to 6.00

Yield response to K is site-specific, depending the baseline yield level in the absence of K input, soil properties (Foster et. al., 1985; Foster and Tarmizi, 1988) such as organic matter content, cation exchange capacity, and plant available K status, and water deficit (Pujianto et. al., 2006).

Table 1b: Oil palm response to K in Indonesia

Location	Soil type or parent material	No. of trials	Annual rainfall (mm $year^{-1}$)	Yield without K (ton ha^{-1})	Extra yield with K (ton ha^{-1})	MOP rate (kg $palm^{-1}$ $year^{-1}$)
North Sumatra[1]	Rhyolite	3	1,500 – 4,000	24.05	+1.80	2.25
	Sandstone	1	1,500 – 2,000	16.04	+3.93	2.50
South Sumatra[1]	Dacite, claystone	2	2,500 – 4,000	25.12	+3.63	4.00
Riau[2]	Typic Dystropept	1	2,000 – 2,500	19.30	+7.62	2.00
Lampung[2]	Typic Paleudult	2	2,000 – 2,500	18.74	+3.84	2.50
South Kalimantan[2]	Typic Hapludalf	2	1,500 – 2,000	20.68	+5.03	2.50

Adapted from following sources: 1 – Tohirudin et. al., 2006; 2 – Pujianto et. al., 2006

K removal & immobilization in mature oil palms: In mature oil palms, K is 'lost' from the system with removal of bunches (containing ca. 4kg K ton^{-1}, approx. 50% of total N, P, K and Mg content) and immobilization in new trunk growth (ca. 60kg K ha^{-1} $year^{-1}$) (Tarmizi and Tayeb, 2006); these amounts need to be replaced with fertilizer K to maintain soil fertility and sustain high yield. Loss of applied K due to leaching and surface runoff can be minimized by adopting the 4R Nutrient Stewardship approach i.e., apply the right source of nutrients, at the right rate, at the right time and the right place.

Importance of maintaining K input for sustained high yield: Palm oil prices fluctuate year-to-year, and with fertilizer cost being the largest component of direct cost of production in Malaysia (Veloo et. al., 2013) and Indonesia (Susanto et. al., 2013), it can be tempting for growers to adjust annual fertilizer budgets to the rise and fall of palm oil prices. K is the largest, thus the costliest, component of the fertilizer budget, so growers may wish to reduce K inputs, wherever possible substituting with empty bunches or bunch ash.

Firstly, it is important to note that oil palm bunches take a long time to develop: two years elapse from the time an oil palm inflorescence is determined as female until it becomes a bunch ready for harvest (Breure, 2003). The effects of applied fertilizers will last throughout this two-year time frame of the 'yield making' process. Cutting fertilizers based on a time frame shorter than this puts future yield at risk.

Secondly, K substitutes like empty bunches or bunch ash are harder to manage due to variation in nutrient values and difficulties in handling and application. Thirdly, an input reduction introduces a new factor in yield cycles, further complicating proper interpretation of yields in relation to plant nutritional status.

Therefore, to sustain high yields and palm health, it is best to maintain an adequate level of fertilization with the proper balance of nutrients. In short, follow the 4R Nutrient Stewardship approach at all times.

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

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