Zero Plots in Commercial Operations – Essential for Changing Fertilizer Management

Most commercial oil palm growers use fertilizers because added nutrients are needed to sustain high yields (Table 1) on typically cultivated soils that are acidic and inherently low in fertility status (Mutert, 2001).

Table 1. Fresh fruit bunch yield (t ha-1) response in fertilizer trials in Malaysia[1]

Soil type[2]	No.of trials	Control (i.e., zero) Plots[3]	Maximum Yield Plots[4]	Yield response[5]
Inceptisols	11	18.3 – 34.0	23.7 – 36.1	+1.1 – +9.3
Ultisols	10	8.6 – 28.1	25.5 – 36.8	+4.9 – +23.8
Oxisols	5	11.6 – 25.9	27.9 – 34.6	+2.0 – +23.0

1 – adapted from Tarmizi et al. (1992); 2 – USDA classification; 3 – Observed yield range in unfertilized control plots; 4 – Observed yield range in maximum yielding fertilized plots; 5 – observed range of yield response

Fertilizer cost is a major concern for growers as it can account for up to 60% of on-farm cost of production (Ramesh *et al.*, 2013), but yield response to added nutrients is not measured as part of normal commercial operations. Fertilizers are assumed to be profitable based on extrapolations from experiments often removed in time and space from actual commercial sites. Growers can now measure yield response to fertilizers by using the *Plantation Intelligence*® (PI) analysis approach (Oberthür *et al.*, 2017) developed by IPNI Southeast Asia. However, applied rates in commercial operations are optimal rates from experiments where yield response is levelling out as maximum yield is approached, so the desired yield response will be low.

'Zero' plots, i.e., where no fertilizers are applied, allow a clear measure of yield response to fertilizers, and assurance that money is spent profitably. 'Zero' plots can be established in commercial operations without significant yield loss. They need not be many, but the genotypes planted, as well as major soil types under cultivation, should be represented. The plots do not have to be large – a convenient design is to have complete palm rows so that yield can be recorded conveniently by growers. Six rows, i.e., 3 harvesting paths, suffice. Typical fields in Indonesian plantations have approx. 125 palm rows, so 6 rows are just under 5% of the total.

Data from 'zero' plots also permit calculation of nutrient performance indicators (IPNI, 2012) such as (a) Recovery Efficiency (RE) i.e., how much of the applied nutrients were taken up by the crop, and (b) Agronomic Efficiency (AE) i.e., how much extra yield accrued from the applied nutrients.

Oil palm, with its unrivalled yield and small cultivation footprint, has an undeniable role in helping the world meet the future needs of its growing population. Measuring the efficiency of nutrient performance in oil palm cultivation, not just its return on investment, is important in optimizing fertilizer use for sustainable yield intensification. Indicators like RE above, as well as Partial Nutrient Balance (PNB, i.e., how much nutrients are removed from the production system with the harvested crop), help ensure that precious soil resources are maintained or enhanced, not depleted. Measures like AE, and Partial Factor Productivity (PFP, i.e., how much yield is produced per unit nutrient applied), as well as the yield responses measured using PI, provide guidance for yield intensification.

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