Measuring Response to Fertilizer in Oil Palm

Global production of oil palm has increased almost 20-fold since 1961 to over 250 million tons today, worth over $40 billion (USDA, 2014). Experimental research (Tinker & Smilde, 1963; Ng & Thamboo, 1967 and Ng *et al.*, 1968), indicates that oil palm needs 22-35 kg of nutrients (N, P, K and Mg) annually to produce one ton of fresh fruit bunches (FFB), so that the total FFB tonnage represents an annual offtake approaching 9 million tons of nutrient. Fertilizer application is consequently a major operation in an oil palm plantation and accounts for more than 50% of the total farm costs (Veloo *et al.*, 2013).

With so much money invested in fertilizers for oil palm, it seems reasonable to assume that managers know how much FFB it generates. But–while it is standard practice to infer response indirectly, from plot trials and foliar analysis–we found no such method that uses data from the whole plantation. Yet such data exists, and International Plant Nutrition Institute (IPNI) developed a method to estimate the response to fertilizer from commercial data by comparing variable FFB with variable inputs.

IPNI Southeast Asia Program (SEAP) developed the *Plantation Intelligence*® approach for measuring fertilizer response using existing commercial plantation data. *Plantation Intelligence*® offers a process, based on the analysis of large databases of crop performance, to quantify and subsequently, increase returns on investment by optimizing fertilizer management.

Fertilizer efficiency depends on many linked factors such as oil palm productivity, cost of fertilizer, labor availability and cost, soil and weather. Each factor differs in space and time, which introduces uncertainty to decision-making. In *Plantation Intelligence*® analyses, we use stepwise linear regression to measure the response to fertilizer. The analysis tracks the components of variation as they individually influence the estimated response to fertilizer. Hence, *Plantation Intelligence*® is able to reduce uncertainty and provides management with options to modify fertilizer rates. Management is able to use existing soil survey information to assist in their interpretation of calculated fertilizer response.

Management domains for which response to fertilizers can now easily be calculated using *Plantation Intelligence*® include for example:

1. Global fertilizer response for the entire production area. This provides an initial estimate of fertilizer response, and should be for blocks of the same age classification, normally for those in the plateau stage. It provides a measure of overall response but also contains different sources of

variation. Multiple linear regression helps break overall variation into its respective sources, looking at variation for different estates, soils or years. The approach is quick and robust. However, the other production factors are not controlled as they would be in conventional experimentation, and care is required during interpretation to guard against confounding effects from these production factors.

2. Analysis by soil management group (SMG) which shows the responses on 'easy' and 'difficult' soils. Management factors and seasonal effects will both influence the potential response, and have to be accounted for. Analysis of SMG by years shows how response fluctuates between years on different SMGs; some SMGs provide stable response, difficult soils can yield strongly sometimes, but may collapse in difficult years. Response lines become more stable with increasing number of blocks that are included into the analyses. On the other hand, too many blocks introduce more variation of other production factors. The visual analyses process of *Plantation Intelligence*® helps to balance the benefits of large samples–which are stable but mixed–with analysis from small samples, which are less ambiguous but unstable.

References:

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