

Oil Palm Fertilization – Sharing Some Perspectives*

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Introduction

Oil palm cultivation and palm oil production contribute significantly to the real GDP of Malaysia. This is expected to grow from 3.2% in 2008 to 7.6% in 2020. In 2009, export of palm oil totals 14.6 mil. metric tons valued at RM 38.5 bil. (7% of total exports). Projections of palm oil contribution in the years to come however will be pure conjecture if the sector does not consolidate its position first within the palm oil world, and then within the vegetable oil world. There is growing competition from other oil palm growing countries such as Indonesia, Thailand, Columbia, Nigeria and Papua New Guinea; and China has immediate plans to open huge tracts of land in parts of Africa to secure their own supply of palm oil. All these have inevitable reduced both our share and control of the market. Within the total vegetable oil market, palm oil faces immense challenges, demands and non-tariff trade barriers.

The need for Malaysian palm oil producers to remain competitive is ever pressing, as evident from the stake-holders' complaints of shortage of skilled labour, red-tape, and Government taxes. Individual plantations have also to deeply consider what are the factors causing the gap between the actual yields achieved and the maximum potential yield. Also rarely discussed is perhaps the Government's and the industry's apparent reluctance to capitalize on certain existing innovations and technologies to reduce wastage and improve productivity of the limited land resources within the country. In contrast, there seem to be great haste to look to upstream investment in other countries where conditions are less familiar. Just to name two of many such innovations and technologies are irrigation in rain shadow, drought-affected areas where yield increases can be very significant and viable especially at today's CPO price levels (Lee, et al, 2007), and methane gas capture for power production from POME (e.g. at Univanich, Thailand) which can help double as independent power producers (IPPs) throughout the country. Why are we (the Government inclusive) so slow to capitalize on such smart directions? In the light of this question, can oil palm fertilization, which is essential to maximize yield and minimize cost of production, also be improved with a change of mind-set?

Common fertilizer types available

In the early years of the plantation industry in the then Malaya, the Rubber Research Institute (RRIM) specified formulae for many fertilizer blends to suit various rubber clones grown under various soil types and weather regimes. Fertilizer suppliers produce and supply these formulations according to RRIM's specifications to the industry.

When oil palm was introduced, nutrient requirements were different from rubber, and the norm was to use the various **straight fertilizers** (usually single nutrient) in various amounts per year to replace nutrients removed by the crop. Thus for nitrogen, ammonium sulphate, ammonium chloride, and urea are commonly used, likewise, for phosphorus, ground rock phosphates from various origins such as Christmas Island, China and the Middle-east, for potassium, potassium chloride (MOP), for magnesium, Kieserite from Germany, synthetic magnesium sulphate (SMS) and local dolomite, and for boron, the easily available industrial sodium borate. Most agronomists continue to recommend the fertilizer program based on straight fertilizer inputs instead of nutrient levels.

Subsequently, local mixing or blending of these straight components to form a complete fertilizer mixture became also a common practice. Such mixing without going through a wet-phase to granulate it is called a "**dry-blend**". More expensive alternatives consist of blending of these components followed by granulation through a wet phase into a "**wet-blend**" or what is commonly called "**local compound**" fertilizer. A lot of these are produced locally, while some are imported as well. Also imported are **complex fertilizers** which are true compound fertilizers produced from more basic raw materials going through a chemical process, and then formed through compaction, granulation or prilling. These are usually the most homogenous and consistent in quality but also the most expensive.

The fact that many agronomists only recommend fertilizer programs in the form of straight fertilizers of their preference and not as nutrient levels often make it difficult for plantations to consider alternative nutrient sources and fertilizer types in order to take care of other problems such as those highlighted below.

Problems related to choice of fertilizer types

1. Inability to complete fertilizer program

In most areas in Malaysia, there are periods of high rainfall when fertilizer application is not recommended due to high surface run-off losses. The time period of good weather for fertilizer application may vary from 6-10 months. Where the window of months of good weather is small, the plantations usually find it not possible to complete application of the fertilizer recommended if they are in the form of many rounds of straight fertilizers. In a year, even by splitting the N and K into 2 rounds each, with one round each of P, Mg and B, means a total of 7 rounds. If N and K are split into 3 rounds, it is 9 rounds. Any delay of fertilization is in fact under-fertilization (assuming the rates are recommended for proper nutrient replacement and maintaining good yield), and will subsequently affect yield especially when this is a recurring situation.

2. Labour shortage

The problem of labour shortage, especially of skilled workers for harvesting, will continue to become increasingly critical. It does not make sense to divert labour to complete a manuring program that involves many application rounds, to result in increased yields that remain unharvested due to lack of labour. In the future the use of mechanical application of fertilizers in all suitable terrain will no longer be just an option. Mechanized application can help relieve scarce labour supply towards harvesting, and help hasten fertilizer application during good weather months. Granular fertilizers which are more suited for even spreading by mechanical application will have to be the preferred choice for even application to be possible. However, application in steep terrain areas will have to look towards other means to facilitate optimization of labour usage and reduction of surface run-off losses.

3. Nutrient imbalance and antagonism

The application of all nutrients as straight fertilizers in each application period is not practical as it involves too many rounds. When they are applied over intervals, a situation of spikes in the availability the nutrient that has been just applied exists resulting in continuous imbalance of nutrients which is not desirable. Figure 1 provides a typical example.

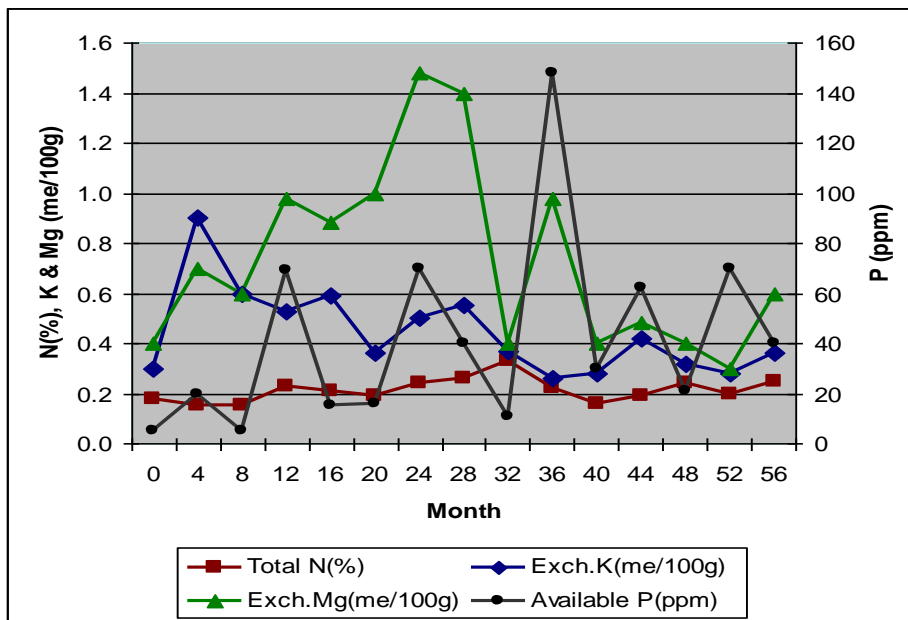


Figure 1: Change of soil nutrients at 0-15 cm depth when straight fertilizers are used (Source:Khalid and Tarmizi, 2010)

Such spikes, especially of cations, can cause antagonistic effects of suppressing other bases e.g. K suppressing Mg, and Ca suppressing K. Use of complete fertilizers can reduce such situations.

4. Application of small amounts

Micronutrient fertilizers e.g. Borate, copper & zinc sulphates (in peat), are usually applied in small quantities of 100-200 g per palm. This makes both application and supervision of these fertilizers tedious and difficult. It is totally possible, and has often happened that errant workers deliberately miss the palms in the less accessible areas e.g. hill-tops or ravines, and overdose the more accessible areas causing both deficiency and toxicity problems.

5. Unavailable or poor quality components

In many dry-blends and wet-blends, you have to check whether the declared nutrients, especially MgO or P₂O₅ are indeed soluble and plant-available. In such products the straight fertilizer components used may not be soluble or less plant available e.g. magnesite, non-reactive rock phosphate. Use of nitrogenous sources may also be compromised e.g. urea in place of or mixed with ammonium sulphate, synthetic magnesium sulphate (SMS) or even GML in place of Kieserite, etc. SIRIM specifications do not required the raw materials used to be declared.

6. Quality issues

a) Straight fertilizers

Usually the quality issues of straight fertilizers are more in terms of physical quality e.g. high moisture content, caking, etc, although during this period of high fertilizer prices, adulteration of fertilizers has been reported in many instances e.g. crushed red bricks for MOP, GML for Kieserite, and even poor quality ash of unknown origin for bunch ash!

b) Wet blends (local compounds)

Different wet-blend granulation plant processes exist in the country involving urea-melt, or steam, or water in the wet phase. Some use pre-mixing before granulation, whilst others do not. Some use batch feeding, some use continuous feeding. All these affect the final quality and consistency of the products. A good optimized process aims to reduce the down time by reducing the off-spec materials that need to be recycled. During peak demand periods if the plant tries to increase output by reducing recycle of off-spec materials the result is often off-specification, poor analysis products. Such granular product may appear good physically, but the buyer should always analyze the product for which a high price, often 30-50% higher than straight fertilizers, is paid.

c) Dry-blends (mixtures)

Segregation of components of different particle size during handling is the main problem in maintaining the declared analysis of dry-blends. It is therefore an inherent problem with such materials even from good reliable suppliers. Nevertheless, analysis of blends from a good supplier can often be better than that of wet-blends in the market. The ways to minimize segregation are to use materials of similar granulometry (e.g. granular blends), to minimize the number of components used, and to minimize particle movement within the bags by reducing the free space. Very good quality materials can be achieved through these means.

Special fertilizers for oil palm

Over the recent years, Behn Meyer together with K+S Kali has developed fertilizer solutions specifically to help tackle some of the problems highlighted above, without taxing the users in terms of exorbitant additional cost:

1. KieserBor[®] 23-5 (Kieserite as carrier for Borate)

KieserBor 23-5 is a dry-blend product consisting of ESTA[®] Kieserite from Germany used as a carrier for a slow-release borate - Anchor-Bor[®] - from Peru. Anchor-Bor contains approximately 10% water-soluble B₂O₃ and about 36% in the form of citric-acid soluble B₂O₃. The prolonged availability of B in the soil makes it an ideal source for oil palm in which boron is phloem immobile. The ESTA Kieserite is closely similar in particle size to Anchor-Bor making it an ideal carrier for the latter. The finely blended product helps to solve the problem

of carrying small quantities of Borate fertilizer to each palm. One kilogram of KieserBor 23-5 contains 900 g of ESTA Kieserite plus 100 g of Anchor-Bor.

2. Korn-Kali® +B

In Germany, the principal source of K nutrient is not MOP but Korn-Kali, a granular fertilizer containing 40% K₂O + 6% MgO + 4% S. This product is preferred because it contains K, Mg and S, all in each granule, thereby minimizing labour and avoiding antagonistic effects that usually follow single nutrient applications. Contrary to common belief that K should not be applied together with Mg to avoid antagonistic effects, this is erroneous as K-induced Mg deficiency has been documented in many crops. Hence, K should ideally be applied together with Mg to have optimal uptake of both nutrients.

In 2006, K+S Kali GmbH, in collaboration with Behn Meyer, specially formulated and produced **Korn-Kali+B (40% K₂O + 6% MgO + 4% S + 0.8% B₂O₃)** for oil palm, and introduced it to Malaysia.

The special features of this fertilizer are:

- The compounded fertilizer contains K, Mg, S and B in a balanced and homogenous proportion for mature oil palm. Application of 6 kg of this fertilizer per palm per year supplies the equivalent of 4 kg of MOP + 1.4 kg Kieserite + 100 g borate (2.40 kg K₂O + 0.36 kg MgO + 0.24 kg S + 0.05 kg B₂O₃). This amount can be split into 2-4 applications as desired.
- It enables Mg, S and especially B to be applied evenly with each application of K.
- It can be blended with a granular N source of choice e.g. granular ammonium chloride, granular ammonium sulphate or granular urea to form a very good granular blend of only two components of similar granulometry.
- Where Mg is required in a smaller proportion, Korn-Kali+B can be used to replace only a portion of the MOP requirement.
- As the fertilizer is granular, it is a desirable material for even distribution, and most suitable for mechanical application on flat or slightly undulating terrain.

Field trial results with Korn-Kali+B

Preliminary experiments comparing the yield response of oil palm to Korn-Kali+B vs. straight fertilizers were carried out in several estates. A representative experiment is described in the following. Three sets (pairs) of comparable blocks were selected on the basis of year of planting, planting material and yield history (pair 1: Marihat, 91/92; pair 2: Marihat, 92/93; pair 3: Socfin, 95/96). Within each set of blocks, plots of 2.5-2.75 ha were chosen and fertilized either using straight fertilizers or using Korn-Kali+B, providing roughly similar amounts of total nutrients (Table 1).

Table 1: Detailed fertilizer doses of Korn-Kali+B and control treatments.

Month	Fertiliser	Dose (kg/palm)	Month	Fertiliser	Dose (kg/palm)
Jan	RP/TSP	1.00	Jan	RP/TSP	2.00
Feb	Urea	1.50	Feb	Korn-Kali+B	2.50
Mar	MOP	1.50	Mar	Urea	2.00
Apr	ESTA-Kieserite	1.00	Apr	-	-
May	RP/TSP	1.00	May	-	-
Jun	Urea	1.00	Jun	Korn-Kali+B	1.50
Jul	MOP	1.00	Jul	-	-
Aug	-	-	Aug	Urea	1.00
Sep	ESTA -Kieserite	0.75	Sep	-	-
Oct	Urea	1.00	Oct	-	-
Nov	MOP	1.00	Nov	Korn-Kali+B	1.00
Dec	-	-	Dec	-	-

The experiment was carried out for three consecutive years and the results are depicted in *Figure 2*. A yield increase of 3.6 to 7.1% as compared to the control treatment (straight fertilizers) was observed. A similar experimental setup revealed that the major yield component responsible for the instantaneous yield increase is bunch weight, while bunch number does not respond initially, in accordance with the long interval from flower initiation to harvest.

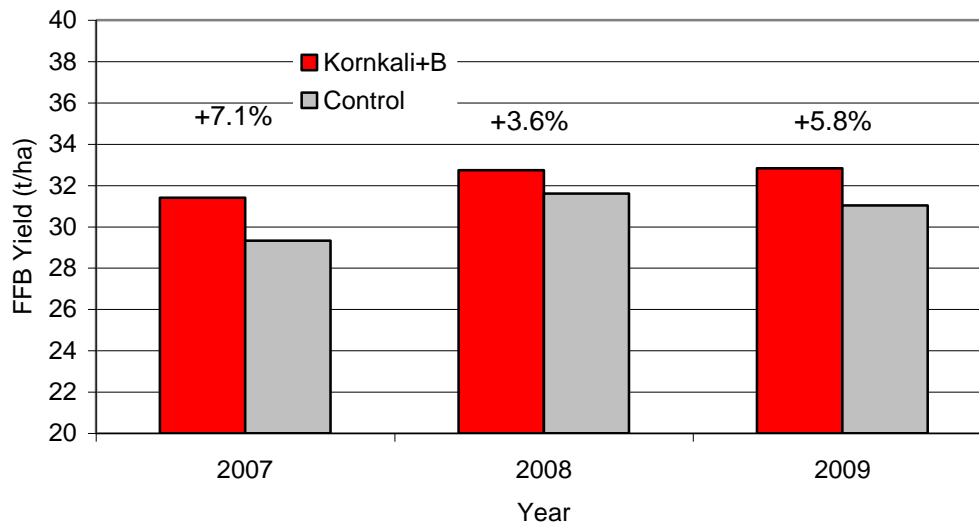


Figure 2: Yield response of oil palm to Korn-Kali+B vs. straight fertilizers. The experiment involved three pairs of plots within three different blocks.

Conclusion

The importance of proper fertilization of oil palm in order to maximize yield cannot be over-emphasized. Part of the nutrient management solution is to be able to provide fertilizer types that:

1. are of good quality both physically and chemically
2. can ensure that nutrients applied are available to the crop
3. does not cause nutrient imbalance and antagonistic effects
4. can minimize labour and supervision requirements by minimizing the number of application rounds, whilst supplying all nutrients in each round
5. allow increasing the number of rounds in certain soil, s e.g. sandy soils, to minimize leaching losses, whilst supplying all nutrients in each round
6. are granular, and can be applied using mechanical application to hasten operations and save labour

The days of high fertilizer prices have come and may not go away completely due to depleting sources and high fuel prices. Fertilizer cost will continue to make up a significant proportion of the total cost of production of palm oil, and therefore oil palm growers have to choose a fertilizer program using materials that are the most cost effective and, at the same time, can contribute towards optimizing the labour requirements of the whole plantation.

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