

# INORGANIC AND ORGANIC FERTILIZERS COMBINED FOR EFFICIENT USE OF FERTILIZERS IN OIL PALM

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## ABSTRACT

*Efficient use of fertilizers was demonstrated by integrating inorganic fertilizer with bio-organic fertilizer. The plant-based organic matter helps to retain the nutrients minimising leaching losses of fertilizers. The soil chemical and physical qualities had improve, one of the parameters examined for example was the increase in soil pH leading to better availability of nutrients to the palm and higher FFB yields. More significantly this new fertilizer management approach has helped to reduce chemical fertilizer use, reduce the cost of fertilization, and increase the yield of FFB.*

Keywords: inorganic fertilizer, organic fertilizer, bio-compound, micro-organisms

## INTRODUCTION

The theme of the 6<sup>th</sup> International Planters Conference 2009 is Plantation Agriculture and Environment. The support papers solicited include Fertilizer Management and Productivity. Locally, fertilizers available are either purely inorganic or purely organic, rarely a combination of the two. The nutrient content of organic fertilizer is generally low in relation to its bio-mass. The oil palm industry depends therefore heavily on inorganic fertilizers and the rate applied yearly on mature palms amounts to 10 kg or more per palm. Proper management of fertilizer is obvious due to the large quantity use and the high cost of fertilizers. Organic fertilizer, despite its low nutrient content has many attributes which include restoring the quality of soils, minimising leaching of fertilizer and thus helps to lower the rate of inorganic fertilizer usage yet still maintain high FFB yields. It is therefore possible to evolve a fertilizer management approach to lower the rate of fertilizer used, reduce the cost of fertilization and at the same time to boost the yield of the crop. A trial was carried out to study the effect of integrating inorganic and organic nutrients on soil chemical and physical properties, nutrient uptake and FFB yield of oil palm.

## METHODOLOGY

The trial was carried out in plots of 5-year old palms planted on Segamat series soils. There were two treatments with four replicates totalling eight plots. Each plot consisted of 16x16 palms with 16 recorded palms.

Treatment 1 (T1)

4 kg Ammonium Sulphate (AS) + 2 kg Rock Phosphate (RP) + 2 kg Muriate of Potash (MOP) + 1 kg Kieserite (Kies)

Treatment 2 (T2)

2 kg AS + 1 kg RP + 2 kg MOP + 0.5 kg Kies + 4 kg Bio-organic fertilizer containing 20% inorganic and mine, 70% plant- based organic matter with EM micro-organisms and 10% Zeolite)

## **RESULTS and DISCUSSION**

### **Nutrient Analysis (Table 1)**

Treatment T1 which received inorganic fertilizer alone had lower total soil N (0.10%). This was compared with T2 which received inorganic and bio-compound organic fertilizer and it is likely that the organic portion of the fertilizer contributed to the higher total soil N (0.12%).

The soil available P in T2 was higher than T1 indicating that application of organic fertilizers helps to increase the available P in the soil. Similar result was obtained by Zulkifli *et al.* (2003).

Application of inorganic fertilizer alone in T1 gave lower exchangeable K as compared with T2, due probably to less leaching losses of K from the addition of organic fertilizer.

The levels of exchangeable Mg in T1 and T2 were quite similar. The levels of total soil organic carbon in T2 (0.93%) was higher than T1 (0.76%) due probably to the application of inorganic and organic fertilizers which contributes organic carbon to the soil that will increase over time. The increase of soil organic carbon will directly improve the soil quality and palm growth. Continued application of inorganic and organic fertilizers will help to increase the level of organic carbon in the soil.

Soil pH is one of the important soil parameters affected by fertilization. Soil pH in T2 (4.79) which received inorganic and organic fertilizers was higher than T1 (4.40) which received inorganic fertilizers only. Similar observation was reported by Rosenani *et al.* (1996) and Khalid *et al.* (2000) where they found significant increases on soil pH through application of organic matter of palm residues. This indicates that application of organic fertilizers over a period of time will directly increase the soil pH benefiting the soil in increasing the availability of other nutrients.

On the effect of inorganic and organic fertilizer treatments on leaf nutrient levels and palm growth, the result showed that the difference of leaf P concentrations of T1 and T2 was small, respectively 0.145% and 0.140%. Similarly, leaf K and Mg also showed small or no difference between treatments. This suggests that only leaf N was the limiting factor, which probably affects the oil palm growth and yield.

### **FFB Yield (Table 2)**

The FFB yields of the first and second year of the experiment were omitted to ensure that the response obtained was from the effect of fertilizer treatment and to minimise the residual effect from the previous fertilizer application.

The FFB yield recorded in the third year of the experiment for T1 was 21.31tonnes/ha and for T2 was 23.33 tonnes/ha. The FFB yields increased in the fourth year, which recorded 25.48 tonnes/ha for T1 and 29.09 tonnes/ha for T2. The FFB yields of two years were 46.78 tonnes/ha and 50.42 tonnes/ha for T1 and T2 respectively. The fifth year yield recording was terminated due to certain constraint. Nevertheless the high yield of T2 suggested the efficient use of nutrients by integrating inorganic and organic fertilizers. Similar observation was reported by Goenadi (1998), where he found that the combination of bio-fertilizer and conventional fertilizers had doubled the fertilizer use efficiency in oil palm. He concluded that this would reduce the use of conventional fertilizers and yet still able to maintain high yields as full rate inorganic fertilizer application. He calculated that the cost saving was near to 35%. Taryo *et al.* (2006) in Indonesia recorded increase FFB yield when 75% chemical fertilizer was applied with 25% bio-fertilizer as compared to 100% chemical fertilizers.

**TABLE 1. EFFECT OF FERTILIZER TREATMENTS**

**A. ON SOIL CHEMICAL PROPERTIES (0-15 cm DEPTH)\***

Treatment	N (%)	Avail. P (ppm)	(meq./100 g soil)			C (%)	pH
			K	Ca	Mg		
T1	0.10	81.10	0.44	1.44	0.47	0.76	4.40
T2	0.12	121.90	0.55	2.40	0.55	0.93	4.79
LSD	0.03	113.1	0.33	2.42	0.65	0.57	1.58

\* Samples taken at the weeded four years after the treatments commenced.

**B. ON LEAF NUTRIENT CONCENTRATIONS**

Treatment	% Nutrient concentrations on (% dry matter)					
	N	P	K	Ca	Mg	Boron
T1	2.62	0.145	1.16	0.50	0.32	18.50
T2	2.56	0.140	1.16	0.50	0.33	14.65
LSD	0.68	0.016	0.10	0.07	0.06	4.65

**C. ON VEGETATIVE GROWTH OF PALMS**

Treatment	Frond dry weight (kg)	Frond length (m)	Total leaf area/frond (m <sup>2</sup> )	Palm height (m)
T1	3.38	5.53	9.79	2.03
T2	3.21	5.26	9.03	1.91
LSD	0.48	0.34	1.08	0.25

**TABLE 2. EFFECT OF FERTILIZER TREATMENTS****A. ON FFB YIELDS 3<sup>RD</sup> YEAR AFTER TREATMENTS COMMENCED**

Treatment	FFB yield (t/ha/yr)	Bunch weight. (kg)	Bunch number (no./palm/yr)
T1	21.31	14.27	10.07
T2	21.33	13.75	10.72
LSD	3.81	1.81	1.93

**B. ON FFB YIELDS 4<sup>TH</sup> YEAR AFTER TREATMENTS COMMENCED**

Treatment	FFB yield (t/ha/yr)	Bunch weight. (kg)	Bunch number (no./palm/yr)
T1	25.48	17.80	9.71
T2	29.09	17.79	11.00
LSD	5.71	2.02	2.06

**C. ON TWO YEARS' CUMULATIVE YIELDS**

Treatment	FFB yield (t/ha/yr)	Bunch weight. (kg)	Bunch number (no./palm/yr)
T1	46.78	32.08	19.78
T2	50.42	31.55	21.73
LSD	6.54	3.65	2.35

**CONCLUSION**

When comparing T1 and T2 fertilizer treatments of oil palms, combined use inorganic and organic fertilizers showed favourable soil chemical and physical conditions for oil palm growth and yields. The rate of T2 for Ammonium Sulphate, Rock Phosphate and Kieserite was half of T1, when combined with the bio-organic which also contains inorganic, T2 was still 23% less N, 16% less P and no difference in Mg, although K in T2 was 14% higher than T1. In terms of fertilizer usage therefore, there was less AS and RP applied to the soil. More significant is that the application cost of T2 was cheaper than T1 by RM 160/ha approximately. This is important in the light of present day high fertilizer cost and low CPO price. The trial has shown the beneficial effect of combining inorganic and organic fertilizers in oil palm fertilizer application: higher crop yield, lesser inorganic fertilizer input and thus saving in FFB production cost, above all the long term benefit of soil improvement and sustainability of oil palm.

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