REACTIVE PHOSPHATE FERTILIZERS RECOMMENDED FOR YOUNG OIL PALM PLANTED ON INLAND SOILS

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For immature and young oil palm planted on inland soils, especially during the first 36 months after planting, it is normally recommended to use phosphate in the water-soluble form or in the form of reactive phosphate rock. During this stage of oil palm growth, soluble P such as ammonium phosphate and super-phosphates has been found to promote vegetative growth as compared to CIRP (Chan, 1982). The effectiveness of P fertilizers on crop performance depends not only on the characteristics of the P sources, but also on the chemical reactions between the P fertilizers and the soils to which they are applied and their physical factors. Malaysian soils are known to be highly weathered and are generally acidic and inherently low in P and high in P fixing capacities.

For many years in Malaysia, phosphate rock (PR) from Christmas Island (CIRP) has been used most exclusively as the P source for plantation crops including oil palm. This source was shown in oil palm trials to be as effective as soluble P fertilizer (Chan, 1982). The effects of direct application of phosphate rock on mature oil palm under Malaysian soil condition have been well studied (Foster *et al.*, 1988). However currently, with the declining availability and varying quality of CIRP, there is a need to consider a more reliable source of P fertilizers for use in oil palm planting.

In view of the differences in effectiveness of various phosphate fertilizers especially for oil palm, it is necessary to evaluate the commercially available P fertilizers for more cost-effective fertilizer usage. A field trial was conducted by MPOB to compare the agronomic effectiveness of various P fertilizers from different sources on immature and young palms planted on an inland soil.

FIELD EVALUATION OF P FERTILIZERS FOR OIL PALM

The performance of various P fertilizers from different sources on immature and young oil palm was conducted over a seven-year period. The palms (D x P) were planted on a cleared jungle plots at MPOB Research Station, Keratong, Pahang. A randomized complete block design (RCBD) trial with four replications was laid out on a Serdang series soil (fine loamy, kaolinitic, isohyperthermic, Typic Paleudult). Various sources of phosphate rock fertilizers, namely reactive phosphate rocks from Tunisia or Gafsa (TPR), North Carolina (NCPR) and Jordan (JPR), and the non-reactive phosphate rocks from Christmas Island (CIRP) and China (CPR), and soluble triple-super phosphate (TSP) were evaluated in this trial. The rates of P and other fertilizers applied in the trial followed the normal estate rates based on the age of the palms. The performance of the P fertilizers was evaluated based on their response to oil palm vegetative growth, FFB yield, and leaf nutrient content.

TOTAL P AND SOLUBILITY OF VARIOUS P FERTILIZERS

The total P composition and the solubility's of various P fertilizers is shown in *Table 1*. Triple super-phosphate (TSP) is the most soluble and has the highest total P content amongst the P fertilizers. Whilst among the phosphate rocks, the total P_20_5 ranges from 30% to 34%. In terms of solubility (citric acid), the reactive PR such as NCPR, TPR, and JPR generally has a relatively higher solubility (more than 40%) as compared to the non-reactive phosphate rocks such as CIRP and CPR (least soluble P). Generally, phosphate rock fertilizers have a higher content of calcium, ranging from 24% to 33%, whilst TSP has the lowest content (less than 12% calcium). The high calcium content in the phosphate rocks is beneficial in increasing soil pH and cation exchange capacity (CEC).

PERFORMANCE OF P FERTILIZERS ON PALM GROWTH AND FFB PRODUCTION

The mean performance of various P fertilizers on palm growth at 36 months after planting is shown in *Figure 1*. During this period, the mean performance of all the P rock

TABLE 1. TOTAL P AND SOLUBILITY OF P FERTILIZERS

P sources	Total P (%)		Total P_2O_5 soluble (%)			% Ca
	P_2O_5	P	2% CA*	2% FA	AAc	
CIRP	32.5	14.2	28.5	34.3	11.4	24.2
TPR	29.9	13.0	45.2	75.4	17.5	32.0
PR	32.5	13.0	40.9	66.2	15.9	32.6
NCPR	30.3	13.3	53.1	86.3	22.3	31.0
CPR	34.3	15.5	21.3	22.4	8.0	29.2
TSP	46.7	20.4	100.0	-	-	11.6

Note: *CA: citric acid; FA: formic acid.
AAc: ammonium acetate.

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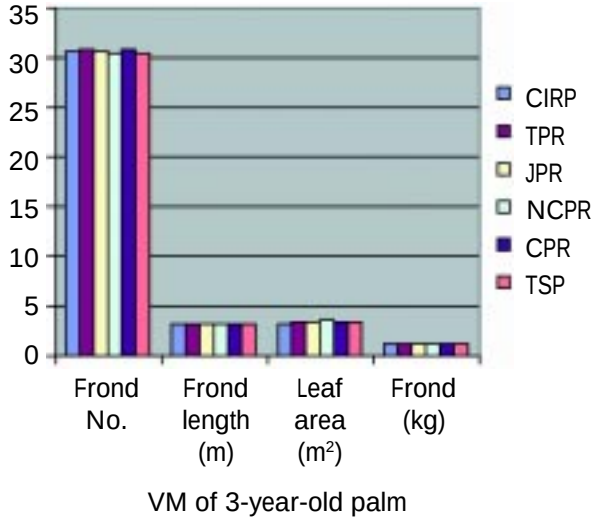

Figure 1. Performance of various P fertilizers on vegetative measurements (VM) of three-year-old palm (after field planting).

fertilizers on vegetative growth of the palm was comparable to the soluble TSP.

The response of the P fertilizers on FFB yield for the first five years of production is shown in *Figure 2*. Generally, the P fertilizers gave a varying significant performance on FFB yield during the five-year period. However, the reactive P rocks such as NCPR, JPR and TPR appear to perform overall superior in terms of FFB production as compared to the TSP and non-reactive PR such as CIRP and CPR.

In terms of leaf nutrient content, all the P fertilizer sources was observed to have well above the adequate level of leaf P. However, TSP treatment has a significantly higher leaf P than the other treatments.

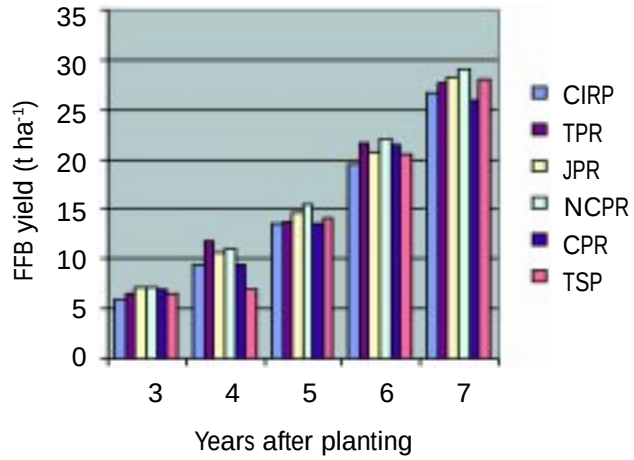

Figure 2. Performance of various P fertilizer sources on FFB yield at different ages of palms.

RELATIVE AGRONOMIC EFFECTIVENESS OF P FERTILIZERS

The relative agronomic effectiveness (RAE) of the P fertilizers was computed with TSP as a standard comparison (*Figure 3*). Based on the mean FFB production (first five-year period), TPR, NCPR, and JPR gave a higher percentage of RAE *i.e.* 137%, 131% and 115%, respectively,

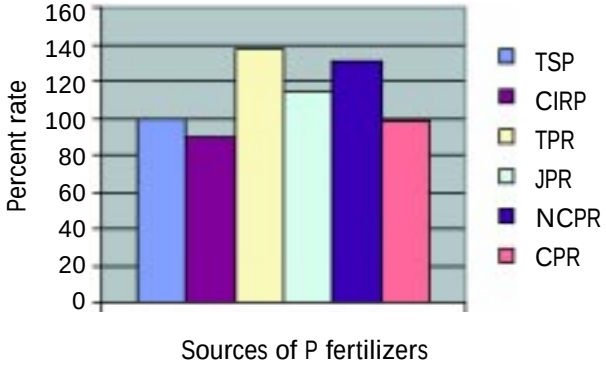

Figure 3. Mean percent relative agronomic effectiveness (RAE) of various P sources on FFB yield (5-year period).

when compared to the soluble TSP (100% RAE). Other P sources such as CPR and CIRP with 98% and 91% RAE, respectively, is considered as relatively less effective when compared with the other P rocks.

ECONOMIC ANALYSIS

Based on the mean FFB yield performance for the various P fertilizers (five-year period), the return to investment (ROI) was computed. Overall, reactive PR such as NCPR, JPR and TPR (Gafsa) gave the best ROI with values of 1.71, 1.68, and 1.65 respectively, whilst TSP is 1.62.

CONCLUSION

Based on the results of the above field trial, it can thus be concluded that reactive PR fertilizers such as TPR, NCPR, and JPR are most effective and recommended for use in oil palm production planted on inland soils, especially during the early phase of palm growth. Based on economic analysis, reactive PR fertilizers are more cost-effective to use for oil palm production in inland soils.

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