

IMPROVING PHOSPHATE ROCK EFFICIENCY USING CIPR-TSP MIXTURES

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Introduction

One of the fertility restrictions in Malaysian soils is the low level of available phosphorus (P) resulting either from P deficiency or its high capacity to immobilise P. Use of conventional water-soluble P fertilisers such as Triple Superphosphate (TSP) which constitutes a high P analysis, has been limited primarily by cost constraints. Thus the use of phosphate rocks (PRs) or modified forms of PRs, as an alternative P source is being widely explored in many developing countries. Our investigation dealt with increasing the reactivity of CIPR by mixing with water-soluble TSP. The reaction of TSP will yield phosphoric acid and calcium phosphate. Theoretically, the resulting phosphoric acid will aid the dissolution of CIPR since PR dissolution is relatively increased in the presence of H ions (Terman and Allen, 1964), thus increasing its reactivity. The objective of this study was to evaluate the effectiveness of P release from TSP-mixed CIPR on two Malaysian soils.

Materials and Methods

Two Malaysian soils of contrasting pH regime were used in the study, viz. Munchong series (acidic) and Merhamah series (alkaline). Commercial TSP was used as the mixing agent for the PR under study i.e. CIPR. Both TSP and CIPR were physically mixed into 1:1 and 1:3 ratios, and pelletised using a 2 tonne hydraulic press. Treatments employed in this study comprised single application of TSP and CIPR, and mixtures of TSP-CIPR. Single applications of TSP and CIPR ranged between 50-200 $\mu\text{g g}^{-1}$ and 100-300 $\mu\text{g g}^{-1}$, respectively. The mixtures were evaluated at 2 different levels (200 and 400 $\mu\text{g g}^{-1}$) for each ratio of mix. The parameters measured consisted of i) extractable P, using 0.5M NaOH (Mackay et al. 1986), and ii) exchangeable Ca, using 0.5 BaCl₂-TEA buffered at pH 8.1 (Bascomb, 1964). Release of P and Ca were computed on ΔP and ΔCa derived by subtracting values

recorded in the untreated soil from the treated soil after 90 days.

Results and Discussion

Release of P from TSP, CIPR and TSP-CIPR mixtures increased with increasing rates of application. The higher P release from TSP as compared to CIPR, at corresponding rates, was expected since TSP is inherently more soluble and reactive than CIPR. Release of P from the TSP-CIPR mixtures, at both ratios, was indifferent to that of TSP, and higher than that of CIPR. Higher P release from the mixtures when compared to the singly applied CIPR can be attributed to the formation of H₃PO₄ resulting from TSP. These results are in conformity with current literature (Chien et al. 1996). Apparently, the ratio of mixtures only affected P release at the higher rate (400 $\mu\text{g g}^{-1}$) whereby TSP-CIPR at 1:1 resulted in greater release than 1:3, thus suggesting that mixture ratios are critical only at higher rates of application. The release of Ca from among the phosphate sources was highest in the TSP-CIPR mixture at 400 $\mu\text{g g}^{-1}$. Rate of CIPR application did not affect ΔCa , reactivity. Release of Ca from TSP-CIPR mixtures was comparable to that from singly applied TSP and CIPR at corresponding rates. The results seem to suggest that TSP-CIPR mixture can potentially be used as a Ca source for crops.

Conclusions

Results generally showed that TSP-mixed CIPR underwent higher dissolution, in both acidic and alkaline soils, when compared to the singly-applied CIPR. This provides a potential for TSP-mixed CIPR to be used as a suitable P source. However, release of P from the mixture was comparatively higher in the acid soil.

References

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