THE USE OF EPPAWELA ROCK PHOSPHATE IN THE PLANTATION SECTOR AGRONOMIC ASPECTS

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The importance of phosphate in agriculture was realized in Sri Lanka at the end of the last century. Since then the application of phosphate fertilizers has become popular. With the discovery of an apatite bearing deposit in 1971 by the Geological Survey Department of Sri Lanka at Eppawela, situated in the North-central province, interest was created in Sri Lanka on the possibility of using this source of phosphate in Sri Lankan agriculture Several investigations were initiated to study the feasibility of using this locally available material as a source of phosphate for various crops in the country. The first batch of samples were distributed for investigation in 1972. To achieve maximum benefits from the investment in fertilizer phosphate, evaluations on the agronomic performance of the sources under local conditions and on Sri Lankan soils is of paramount importance.

A consistent large amount of imported rock phosphate has been used as fertilizer by the plantation sector of Sri Lanka. The extensive use of rock phosphate is because it is cheaper and as effective as soluble super phosphate when applied to Sri Lankan acid soils, which is contrary to the practice in temperate countries where in general, soluble superphosphate is considered agronomically far more superior than spareingly soluble rock phosphate. The types of rock phosphate available in the world market are given below. Cost had been the over-riding factor in the past in the choice of any particular source of rock phosphate as fertilizer and less attention had been given to the agronomic efficiency of the individual sources.

Phosphate	Total P_2O_5(%)	Citric Solubility (%)
Christmas Island	36	16.84
Citraphos	30	19.47
Jordanian	32	13.63
Egyptian	30	15.46
Highlands	30	16.89
Polyphos	31/32	13.52
Hyperphosphate	30	20.96
Togo	36/38	19.00

It is also however known that the phosphate content of a given source of rock phosphate fluctuates with different consignments and even the characteristics of rock phosphate from a single source can change considerably when exploitation moves from one layer to another. This is particularly evident in the locally available material. At times, the variability observed has been large. However, to ensure the quality of the product marketed, standards have been specified and that the permissible limit of variation for the actual phosphate content P (P O) is also specified.

Another important characteristic that has to be considered with regard to agronomic performance is fineness, as grinding rock phosphate to a fine particle size has been known to enhance its agronomic effectiveness.

Tea

Extensive investigations were done on Tea at the Tea Research Institute of Sri Lanka to compare the effectiveness of Eppawela rock phosphate with the traditional source of imported rock phosphate. The total phosphorus content of the two types of phosphate fertilizers used in these investigations and their exractability by various reagents are given above, at right.

These analyses showed that Eppawela rock phosphate contained higher total P and water soluble P than the imported source of phosphate. However, the solubility of imported rock phosphate in citric and malic acids was slightly higner than the Eppawela rock phosphate. It has also been reported that malic acid extracted more phosphorous from Eppawela rock phosphate than from imported rock phosphate mixed with acid soil, and the release was time dependent. It is relevant to note that it has been reported earlier that the roots of tea plants exude predominantly malic acid which could chelate with iron and aluminium in the soil and mobilize the phosphate for plant uptake. It was also reported that phosphate uptake is related to aluminium and there is a possibility of formation of organic aluminium phosphorus complexes in the uptake of phosphorus by tea plants. From these studies the authors concluded that because more phosphorus is extracted with malic acid from the acid soil treated Eppawela rock phosphate than with imported rock phosphate, the former is more suitable for tea. Moreover, in greenhouse studies with young tea the effect of the two fertilizers on nutrient uptake and dry matter accumulation did not differ significantly as can be seen in the table overleaf. It has therefore been recommended that Eppawela rock phosphate could be substituted for the imported rock phosphate for tea.

pH, total phosphorous and soluble phosphorus of imported rock phosphate and Eppawela rock phosphate

	Imported Rock Phosphate	Eppawela Rock Phosphate
pH in water	7.7	7.9
Water soluble P (ppm)	26.7	86.6
Total P O (%)	27.8	33.2
Citric acid soluble P O (%)	9.2	5.2
Malic acid - soluble P) (%)	11.7	9.2

(From Sivasubramaniam et al 1978)

Subsequent studies by Golden and others of the Tea Research Institute using radiotracer techniques confirmed that the normal levels of P, application of Eppawela rock phosphate seems to be either comparable or better for tea than imported rock phosphate.

Rubber

Phosphate availability is one of the major problems in the management of soil fertility for rubber cultivation.

Yield of dry matter and phosphorus uptake by young tea plants

(Phosphorus uptake in mg)

Treatment	Dry weight per plant(g)	Leaf	Stem	Root	Total per plant
Zero phosphate	94.8	15.4	22.0	11.0	48.4
Imported Rock phosphate	98.1	17.0	20.0	20.0	59.0
Eppawela Rock phosphate	102.7	20.1	23.5	20.2	68.8

(From Sivasubramaniam, et al, 1978)

Since most of the soils in the rubber growing areas are known to contain a high amount of sesquioxides, the phosphate adsorption capacity of these soils can be expected to be high. It is for this reason that the current phosphate fertilizer recommendation of the Rubber Research Institute involves split application and using the less soluble rock phosphate instead of the more soluble super phosphate.

Investigations on the use of ERP as a source of phosphate for rubber were started by the Rubber Research Institute of Sri Lanka in 1972. Although the results obtained during the early stages of the investigations suggested that growth of immature budded stumps will not be retarded if this product is used as the source of phosphate from subsequent investigations it appeared that Eppawela rock phosphate may not be suitable for immature rubber plants.

When efficiency of fertilizer utilization by rubber in production is concerned it has been demostrated, as can be seen from the data presented below that both Eppawela and imported rock phosphate are equally effective at the currently recommended rates.

Yield of rubber (kg/ha/yr)

	1981	1982	1983	1984	1985	1986	1987
Zero phosphate	1011	875	1102	940	1673	1339	1555
Eppawela rock phosphate							
current recommendation	1025	918	1108	1040	1897	1494	1662
Double	1071	940	1209	1034	1986	1494	1656
Imported rock phosphate							
current recommendation	1007	948	1147	1051	1880	1472	1718
Double	1098	910	1130	1139	2009	1499	1751

Moreover, fertilizers to mature rubber are now recommended on the basis of leaf analysis and the use of ERP had been recommended on a 50% substitution basis since January 1981. The leaf P values from most of the estates where this recommendation has beer implemented also suggest that the use of Eppawela rock phosphate had not had any adverse effect on leaf P levels in these plantations. Most of the values were within the catergory of medium to high and in some cases very high levels of leaf P suggesting efficient uptake of P form ERP.

The RRI has taken all these and several other aspects of phosphate fertilization of rubber and associated ground cover crops under our soil conditions into consideration and had recomme-

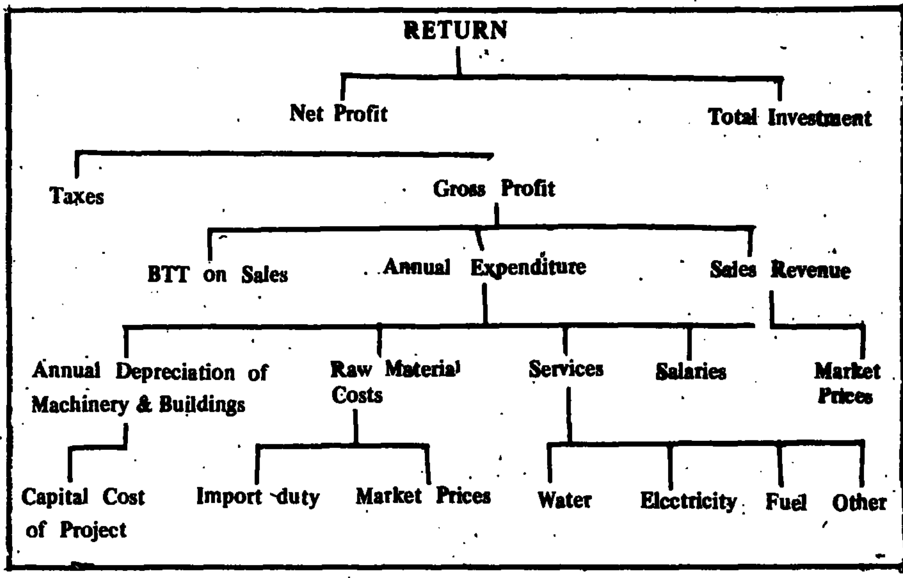

FIG. 1 Factors Influencing the Rate of Return of a Project

nded the use of Eppawela rock phosphate as the only source of phosphate or rubber in production in Sri Lanka. The use of imported rock phosphate is however recommended for immature ubber.

Coconut

As the soils in the coconut growing areas are less acidic than that of the tea and rubber soils, phosphate fixation is not considered a problem. It is known that phosphate absorption in soils decreases with increase of pH of the reacting medium and this is atributed to the lower activity of multivalent irons at higher pH levels causing a lower fixations of P. It therefore appears that for coconut soils, a comparatively more soluble form of rock phosphate such as the imported rock phosphate is prefered.

In general, phosphate deficiency in plantation crops is not as common as deficiency of other nutrients eg: nitrogen, potassium, and magnesium and also the response of plantation crops to phosphorus is not as significant as other macronutrients. However, phosphorus is of great importance for crop production. For a rapid correction of a phosphate deficiency in an acid soil the water soluble phosphate are quicker acting whilst the general raising of phosphate fertility may be more economically achieved with rock phosphate incorporated into the soil. The usefulness of Eppawela rock phosphate in this regard cannot be overlooked. However, for short season, quick growing crops and those with restricted root systems generally a fertilizer containing a high proportion of water soluble P_2O_5 would be required for maximum yields.

Reference

Sivasubramaniam, S., Wickremasinghe, K. and Ayadurai S. (1978). Journal Soil Science Society of Ceylon, 1974/78, Vol III, 45 - 54.