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SUPPLY OF MAGNESIUM FOR MATURE TEA IN SRI LANKA

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Soil magnesium levels in Sri Lankan tea soils are generally low and are adequate to sustain only modest yield levels. Observations made amongst potentially high yielding fields seem to indicate that soil magnesium may be a limiting factor to yield increases, with higher inputs of plant nutrients. On the basis of the actual removal of magnesium in the harvest and the finer prunings, the presently recommended rate of replenishment of soil magnesium with dolomite dressings at pruning, seem to be grossly inadequate. Appropriate amounts of dolomite dressings are proposed for varying yield slabs and further supplementation with magnesium-fortified fertilizer mixtures are suggested for high yielding clonal tea fields.

INTRODUCTION

Just as much as the productivity of tea is determined by supplies of the major nutrients, such as nitrogen and potassium, the available levels of soil magnesium also influence the attainable yield limits. The limited supplies of available soil magnesium, observed under the existing Sri Lankan soil conditions, seem to restrict the attainable yield response, in several of our potentially high yielding fields. There is also growing evidence to indicate that further yield response to higher inputs of potassium is limited by the available level of soil magnesium.

Evidence of magnesium deficiency in Ceylon (Sri Lanka) tea had been highlighted in the mid-1950s. Following such observations, a routine basal dressing with magnesium fertilizer was introduced, recommending the application of the locally available dolomitic limestone (dolomite), at 628 kg/ha, per cycle, purely as a prophylactic measure (Tolhurst, 1956). This recommendation was modified on the basis of yield slabs, to a maximum limit of 146 kg/ha/annum, of dolomite, for all fields yielding over 1,350 kg/ha (Tolhurst, 1959). This application of dolomite was later standardized as a post-prune basal dressing of 125 kg dolomite/ha/annum, for all fields, irrespective of yield slabs (Fernando et *al*, 1969).

The entire supply of magnesium needed for a given cycle has since been furnished in a single application, soon after pruning. Since the amount of dolomite applied was based on a fixed quantity (125 kg/ha) and on the cycle duration, irrespective of the yield potential of the relevant field, both low yielding seedling fields with modest requirements of magnesium as well as the younger clonal fields with a far greater yield potential and consequently imposing a greater drain on soil magnesium, have all been receiving the same supply of magnesium, merely as a basal dressing.

The soil acidity has also been reported to have increased very significantly in a large number of tea fields in Sri Lanka, particularly in the high elevation tea areas and in the Uva. Consequent to such recent observations, larger dressings with dolomite has been proposed, both as post-prune and mid-cycle applications (Sivapalan, 1988).

Supply and Retention of Magnesium

The actual amount of magnesium furnished will no doubt depend on the quantity, the nature and the condition of the dolomite that is broadcast in the field. The amount of magnesium in the dolomite is expressed in terms of per cent magnesium oxide (MgO), which amount in the dolomite is specified to a minimum level of 18% MgO. Apart from the specified minimum level of MgO, the release of magnesium is further determined by the particle size (mesh size) of the dolomite, that is expected to be broadcast in the field as evenly as possible.

On the basis of a minimum level of 18% MgO, a fixed amount of say, 500 kg of dolomite, should theoretically furnish 90 kg MgO/ha, during the course of the cycle. This amount of MgO should provide about 54 kg of actual magnesium over the four year period. This amount could be expected from the dolomite that is broadcast, provided the minimum stipulated amount of MgO is available and that the mesh size of the material broadcast conforms well to specifications. Further, a certain amount of the released magnesium would undoubtedly get leached away, the amount leached being dependent upon the nutrient retentive capability of the particular soil.

The clay fraction of almost all our tea soils is made up of the highly degenerate mineral, kaolinite the nutrient retentive capability of which is very low. Further, even though the mineralogical composition of Sri Lankan tea soils is almost similar to South Indian tea soils, the available total exchange capacity in our soils is further reduced, by the strong blocking effect caused by amorphous oxides (Ranganathan, pers. comm.). Consequently, there is bound to be a poorer retention of soil nutrients, including magnesium that is released from dolomite. Taking all the above limitations, one could expect only about a 50% efficiency in so far as the total supply of magnesium throughout a pruning cycle, from the single application of dolomite. Thus, from a supply of 500 kg dolomite per hectare, the amount of magnesium that is likely to be made available, would be, at best, only around 27 kg.

Nett Removal of Magnesium by Mature Tea in Harvest

Ranganathan and Natesan (1985) have shown that 5.5 kg of magnesium is removed per 1,000 kg of made tea, per hectare, per annum (Table 1). This is equivalent to 9.1 kg of MgO (5.5 x 1.658), per ha/annum.

TABLE· 1- *Nutrients assimilated and removed by tea to produce 100 kg black tea (Ran anathan and Natesan, 1985).*

Part	*Proportional Dry Weight*	*N*	*P*	*K*	*Ca*	*Mg*
				kg/100 kg		
Flush	100	4.0	0.5	2.0	0.6	0.25
Mature foliage	120	3.9	0.43	0.9	1.5	0.36
Branchlets & twigs	80	1.1	0.24	0.4	0.5	0.16
Wood	200	2.0	0.48	0.4	0.5	0.30
Total Assimilated		11.0	1.65	3.7	3.1	1.07
Amount removed (1 + 4)		6.0	0.98	2.4	1.1	0.55

The required amount of 9.1 kg of MgO should be made available from 50.5 kg dolomite (containing 18% MgO). This is so, provided the dolomite used matches perfectly well with specifications, is very evenly distributed throughout the field and the entire amount of MgO that is released over the protracted period of time, remains in the soil without any leaching losses. Taking all such limitations into account and consequently assuming only a 50% efficiency in this regard, the quantity of dolomite needed will then be 50.5 x 2 = 101 kg dolomite.

Supplies of Dolomite Based on Yield Slabs

On the basis of the above calculation, the approximate annual quantity of dolomite needed per hectare, to supply the required amounts of Mg for the different yield slabs, are as follows:

1,000 kg and below		M.T./ha...	100	kg	dolomite/ha/yr	
1,000 to 1,500	kg	"	150	kg	"	"
1,500 to 2,000	kg	"	200	kg	"	"
2,000 to 2,500	kg	"	250	kg	"	"
2,500 to 3,000	kg	"	300	kg	"	"
3,000 to 3,500	kg	"	350	kg	"	"
3,500 to 4,000	kg	"	400	kg	"	"
4,000 to 4,500	kg	"	450	kg	"	"
4,500 to 5,000	kg	"	500	kg	"	"

On the present recommended basis, high-yielding VP fields, yielding in the range of 3,000 kg/ha/yr are receiving a far less amount of Mg than what is needed. Such high-yielding fields that are on, say 4-year cycle, are presently receiving only 500 kg dolomite, whilst the required quantity, as per the above calculation is:

300 x 4 = 1,200 kg dolomite.

Consequently, the present supply is only 42 % of the required amount. It is therefore, not surprising to observe Mg deficiency symptoms showing up early in the cycle and limiting productivity in such fields.

In the case of fields yielding over 2,500 kg/ha and on a cycle duration of four years and above, it is best to split the supply of dolomite into two applications, with one half given at pruning and the other around mid-cycle.

Since the total supply of dolomite is determined by the cycle duration, it would be most unwise to extend pruning cycles on an *ad hoc* basis, mid way in the cycle. If one is compelled to extend the cycle due to certain special circumstances, compensatory measures should be taken to supply the additional requirement of magnesium, such as by supplying magnesium–fortified fertilizer mixtures.

Specification of Standards for Dolomite

A significantly large number of dolomite samples received at the Institute for routine analyses have revealed that the content of MgO is well below specification (18%MgO), in the region of about 10%. As such, even though the total quantity furnished is worked out correctly, the relevant fields are receiving only about half the required amount of magnesium. This situation is further compounded, when the particle size is also not in keeping with the specifications. Plantations are, therefore, advised to check for specifications, well in advance and change the supply source, if necessary.

Required Soil Magnesium Levels

As shown above, a field yielding 1,000 kg made tea/ha/yr will remove 9.1 kg MgO/ha/yr. Hence, over a four year period (4-year cycle), the required amount of MgO is 4 x 9.1 = 36.4 kg MgO.

Since 1 milliequivalent (120 ppm) of Mg in the soil is equivalent to 448 kg of MgO per hectare, the above stated quantity of 36.4 kg of MgO would be equivalent to approximately 10 ppm Mg.

Consequently, for a yield slab of 1,000 kg M.T./ha, on a four year cycle, the critical soil Mg is approx. 10 ppm.

Yield Slab	*Critical Level Of Soil Magnesium (approx.)*
1,000 kg/ha	10 ppm
1,500 kg/ha	15 ppm
2,000 kg/ha	20 ppm
2,500 kg/ha	25 ppm
3,000 kg/ha	30 ppm
3,500 kg/ha	35 ppm
4,000 kg/ha	40 ppm
5,000 kg/ha	50 ppm

The average values for soil magnesium levels obtained from Sri Lankan tea soil reveal that the levels are low, generally ranging in the order of only 10 to 20 ppm, even in potentially high yielding clonal tea fields. It is not uncommon to encounter a large number of soil samples with very low magnesium levels, well below 10 ppm.

Under such conditions of depleted soil magnesium, fields having the potential for high yields, would not respond adequately to increasing inputs of nitrogen. These fields are bound to show typical symptoms of magnesium deficiency, very early in the cycle. One is, therefore, compelled to resort to expensive corrective measures such as foliar supplementation with magnesium salts (Epsom salt).

Supplementation of Magnesium for High Yielding Fields

Besides Epsom salts ($MgSO_4 . 7H_2O$), another readily available source of magnesium is Kieserite ($MgSO_4 . H_2O$). The latter is an essential component in young tea fertilizer mixtures, that provide an adequate supply of magnesium to the young tea that are in the formative years. In the case of the high yielding clonal tea fields (yielding over 3,000 kg per hectare), it would be prudent to supplement magnesium along with one or two applications of fertilizer in the relevant years in the cycle when such yields are to be attained. Such special "magnesium-fortified" fertilizer mixtures may be prepared, along with a higher content of potash as well.

A proposed suitable mixture will have the following composition :

Sulphate of Ammonia	292	parts
Rock Phosphate (ERP)	63	parts
Muriate of Potash	75	parts
Kieserite	30	parts
Total	460	

A mixture with the above composition will furnish 13.1% of nitrogen (N), 3.8% phosphate (P_2O_5), 9.8% potash (K_2O) and 1.6% magnesium (MgO).

A quantity of 612 kg/ha of the above special mixture (T 460) will deliver 80 kg N, 23 kg P_2O_5, 60 kg K_2O and 9.5 kg of MgO. High yielding fields may be supplemented with one such application of this special magnesium-fortified mixture, especially in the relevant high yielding years of the cycle, such as the second and third years.

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