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# SOME ASPECTS OF DOLOMITE USE IN TEA CULTIVATION

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## Summary

The application of crushed dolomite powder to tea soils is an important agronomic practice. This helps the maintenance of sustainability of tea cultivation in Sri Lanka. Dolomite application ameliorates soil acidity while maintaining the soil pH at 4.5 - 5.5 which is considered optimum for tea. The Geological origin of dolomite is meta-sedimentary and chemically it is a double carbonate of Ca and Mg. Dolomite hardly dissolves in water. The dissolution of dolomite in soils is governed by many factors and soil acidity and moisture are considered as the key factors among them. The application of dolomite for rehabilitation grass is based on elevation, while for immature and mature tea it is entirely based on the soil pH. Dolomite application needs to be done judiciously because neither inadequate nor excess application would reap the expected benefits.

## Introduction

The total tea extent in Sri Lanka is about 180,000 ha. Based on elevation, tea growing areas are grouped into up country (> 1200 m), mid country (1200 – 600 m) and low country (< 600 m) and their approximate extents are 72,000 ha (40%), 54,000 (30%), and 54,000 ha(30%) respectively. About 20-33% of the total tea area in the country is earmarked for pruning annually, to maintain the vegetative phase of mature tea bushes to sustain economically viable yields. During pruning time, dolomitic limestone application to tea fields is a popular practice. The application of dolomitic limestone serves two purposes. It helps to neutralise soil acidity and maintain soil pH at the desirable range for tea, which is usually 4.5 – 5.5 (pH in water) and supply two important plant nutrients Mg and Ca to the soil. Soil pH below and above this range, could create chemical and biological conditions unfavourable for the growth of tea plant and particularly on the plant availability of certain nutrients. Thus, if soil pH is < 4.5, the availability of nutrient cations such as Mg, Ca and K could become poor and phosphorus is vulnerable for fixation as Fe and Al phosphates. On the other hand, when pH is > 5.5, Zn and Mn precipitate as hydroxides or carbonates making them unavailable for plant uptake. Therefore amelioration of soil pH using dolomite with proper quantity at the correct time is an important agronomic practice in

integrated plant nutrient management in acid tea soils. However, most tea soils are still found to be highly acidic due to indiscriminate use of synthetic N-fertilisers, intensive leaching of nutrient cations from the soils etc. and ignoring the timely application of appropriate quantity of dolomite.

The current annual production of dolomite in Sri Lanka is about 75,000 mt. and nearly 75% of the product is consumed as a fertiliser. The current estimated annual demand of dolomite in Sri Lankan tea sector is about 45,000 mt. This estimation was based on the relative distribution of tea extent in different elevation categories of the country, length of the pruning cycle in each category and assuming one mt $ha^{-1}$ is applied as the maintenance dose. In reality, a sizeable proportion of tea soils in the country could have pH < 4.5. No reported results available on this component, therefore it is logical to assume that if 1000 kg dolomite is used, it would maintain the soil pH > 4.5. The local producers involved in dolomite mining industry could meet the total current demand. However, the current actual dolomite usage in tea is about 35,000 mt $yr^{-1}$. The use of dolomitic limestone for tea has steadily increased in the recent past. This was mainly due to incremental benefits enjoyed by the growers and persuading the importance of dolomite in the functions of soils. However, still there is a significant gap between the estimated requirement and the actual usage of dolomite resembling a sizeable fraction of tea growers that are not using dolomite to their fields judiciously.

**Properties of dolomite**

Dolomite is abundantly found in areas falling in the famous dolomite mineral belt running across Matale, Kandy, Digana, Kundasale and Badulla. Geologically the origin of dolomite is meta-sedimentary and it is called metamorphic sedimentary dolomite marbles. Chemically dolomite is a double carbonate of Ca and Mg ($CaCO_3.MgCO_3$). As dolomitic limestones is a natural product, its composition is not homogeneous. It is crushed and ground to a powder to make it suitable for field application. Therefore in the same deposit as well as among different deposits, the Ca and Mg concentration in dolomitic limestone could vary significantly. According to the standards stipulated by the Sri Lanka Standard Institute, dolomite should contain minimum of 18% MgO for it to be used as a fertiliser in tea. Particularly for tea, this criteria is important to avoid influx of excess Ca into the soil because the lower the MgO, the higher the CaO in dolomite. Tea plant is a calcifuge and it does not tolerate high levels of Ca in the soil because excess Ca can cause deleterious effect on tea growth. The recommended particle size combination of dolomite is that not less than 90% of the particles passing through 0.5 mm aperture (30 BS mesh) and 40 – 60% of the particles passing through 0.15 mm aperture (100 BS mesh). The smaller particle may react in acid soil much quickly compared to larger particles. Smaller particles are important to increase soil pH quickly in the short-term whereas bigger particles could slowly increase soil pH in the long term.

## Chemical changes of dolomite in soil

Dolomite hardly dissolves in water. When it is applied to soils, it dissolves slowly due to acidity of the soil. Dolomite dissolution in soils with low pH is much quicker than that in soils with high pH. The dissolution of dolomite in soil is governed by many soil factors viz. initial soil pH, moisture content, pH buffering capacity, cation exchange capacity and exchangeable Ca and Mg in soil. The mineralogy and the particle size of dolomite also affect the rate of dissolution of dolomite in soil. The dissolution of dolomite in soil can be represented by the following equation.

$$CaCO_3.MgCO_3 + 4\,H^+ \rightarrow Ca^{2+} + Mg^{2+} + 2\,H_2O + 2\,CO_2$$

Plant uptake, leaching and adsorption into cation exchange sites are possible ways of removal of the dissolved products of dolomite ($Ca^{+2}$ and $Mg^{+2}$) from the reaction sites. Carbon dioxide is evolved as a gas to air. The net result is an increase in soil pH caused by reduction of $H^+$ concentration in soil. Practically, it is difficult to give a general formula, using the above reaction to estimate dolomite requirement of a field to raise soil pH from a given level to a desired level due to variability of many inherent soil factors as explained above. Nevertheless, some useful guidelines based on the recent experimental results and field observations could be given for general use of dolomite in tea cultivation.

## Guidelines for dolomite use in tea cultivation

1. Dolomite should be applied to the rehabilitation fields at the beginning. Soil pH should be checked prior to dolomite application. The amounts of dolomite recommended for up, mid and low country are 4, 3 and 2 mt $ha^{-1}$ respectively.
2. In new clearings, if the soil pH at the time of planting is below 4.5, dolomite should be applied at 500 kg $ha^{-1}$ in the 1st and 2nd year. At the time of bringing into bearing, if soil pH is still below 4.5, apply dolomite at 750 kg $ha^{-1}$. The next dolomite application should be carried out at the first pruning.
3. Mature tea fields should be checked for soil pH leaving an interval of 4 – 6 weeks following the last fertiliser application prior to pruning. It is best to apply dolomite to the pruned fields just before pruning because it helps dolomite particles to react with soil directly. If the application is done after pruning, dolomite particles that fall on the leaf litter may take more time to contact with soil.
4. Dolomite for mature tea fields should be applied once in a pruning cycle. The rate of application is entirely based on soil pH determined just prior to pruning and the criteria of application is given below:

| Soil pH | Amount of Dolomite (kg $ha^{-1}$ $cycle^{-1}$) |
|---|---|
| Less than 3.9 | 2500 |
| From 3.9 - 4.2 | 2000 |
| From 4.2 - 4.5 | 1500 |
| From 4.5 but less than 5.5 | 1000 |

5. Dolomite should be applied on a non-windy day because the fine particles of dolomite could blow away with wind and deposit in other areas causing environmental problems. The people that are employed for broadcasting dolomite may need to wear safety gear (e.g. masks) to avoid inhalation of fine particles.
6. Dolomite should be applied when soil is moist. Prolong rainy periods should be avoided to reduce the possible losses by runoff.
7. Dolomite should never be used in excess as it could induce manganese (Mn) deficiency in plants which is usually caused by the increase in soil pH > 5.5. If Mn deficiency symptoms (intervenial chlorosis and reddish brown necrotic spots on leaf blade) are observed, soil pH should be determined for a reasonable confirmation of the cause. To resolve the problem, 2% solution of manganese sulphate should be sprayed to the foliage preferably at 3 to 4 week intervals until the symptoms disappear completely. Also any scheduled dolomite application to the field should be immediately suspended.
8. Excessive levels of dolomite application could create large release of Mg and Ca to the soil solution while causing a reduction in potassium (K) ion concentration. This may cause less K available for plant uptake due to the mass action Ca and Mg ions in the soil solution and their plant uptake. Therefore, care should be taken not to exceed the recommended dosage of dolomite.