Effect of different rate of dolomite application on tea leaf nutrient content
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ABSTRACT

A field study was conducted to identify the effect of different rate of dolomite on mother leaf nutrient content of Tea. Trail was laid out in Randomized Complete Block Design consisting of five treatments in different rate of Dolomite (kg/ha/pruning cycle) namely T1 (Absolutely control), T2 (1000), T3 (2000), T4 (3000), T5 (4000). The data generated from the study was analyzed by using Analysis of Variance (ANOVA) in SAS statistical package. Treatment means were compared at probability p< 0.05 using LSD. This study shown there was no significant difference in major nutrient content in mother leaf (P, Ca, Mg, K, N), Trace element Fe and Al content also had no effect. Manganese content in mother leaf changed significantly, highest average mean value was obtained in control (2347 ppm).

Keywords: Dolomite, major nutrient, tea (camellia Sinensis L.), trace elements.

1. Introduction

Tea is an important economic crop which is widely planted in soils of the humid tropics and sub tropics (De Silva, 2007), Tea is one of the major plantation crops grown in Sri Lanka and its contribution to the national economy is highly significant owing to its large share in the annual foreign exchange earnings to the country. Sri Lanka has remained focused on orthodox tea, which accounted for almost 95% of its tea production in 2010(Sector Report), Sri Lanka as the 3rd biggest tea producing country hence Ceylon tea from Sri Lanka, acclaimed as the best tea producer in the world has its inherent unique characteristics and reputation running through more than a century.

Young tea shoot (two leaves and a bud) that are removed regularly by plucking for processing into drinking tea have higher phosphorus concentration (0.36-0.29%) than the older leaves (0.21-0.2%) (Hasselo, 1965). This phosphorus removal (6.8Kg P ha⁻¹yr⁻¹) in young tea shoot must be replaced by frequent application of phosphorous fertilizer. Problems frequently present in the tea soil have constrained the development of a successful sustainable tea production, due to conditions associated with high soil acidity and deficiency in plant available phosphorus caused by fixation of phosphorus by Fe and Al oxides and hydroxides (Golden et al., 1981). According to Sivasubramanium (1972) the distribution and mobility of phosphorus in the tea by the considerable range in Al. In the strongly acidic soil (pH<5), iron, aluminum, manganese and other bases are present in a soluble state and in more quantity.

The maintenance of soil pH between 4.5 and 5.5 is recommended for Sri Lanka (Anon, 2000). Any significant deviation from this range could cause difficulties in the uptake of nutrients owing to change in their chemical nature. Therefore, checking the soil pH helps the tea grower to adjust the soil chemical condition suitable for nutrient uptake and plant growth.
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(Koysa , 2002). Dolomite is recommended for amelioration of acidity in tea soil. Limited information is available about the effectiveness of dolomite on mother leaf nutrient content of Tea. Therefore this study was carried out with the aim of evaluate the effectiveness of different rate of dolomite application on mother leaf nutrient content of Tea.

2. Material and methods

2.1 Location

This field experiment was carried out at field No 17, Midland’s Lower Division, Ratota. Midlands is an estate(s) and is located in Central Province Matale District of Sri Lanka (Latitude: 7°31'4.44“ Longitude: 80°43'23.87“), The estimate terrain elevation above sea level is 884 meters.

2.2 Soil and Climate

Experiment area belongs to Mid Country wet zone and soil of the area falls into matale series. Theses soils are derived from the colluvial material Ukwela series which occurs on the hilly lands of the surrounding area. The soil are well drained and very deep having dark reddish brown, clay loam surface underlain by dark reddish brown, loam surface soils (Mapa.,1999), This region receives average rainfall is 1250-3150mm

2.3 Cultivar

The experiment was carried out by using the tea cultivar TRI 2023. The trail was initiated on October 2009.

2.4 Experimental design

Trail was laid out in Randomized Complete Block Design consisting of five treatments in different rate of Dolomite (kg/ha/pruning cycle) namely T1 (Absolutely control), T2 (1000), T3 (2000), T4 (3000), T5 (4000) with 3 replicates. Field plots were established for five levels of treatments. Fifteen plots were marked out. Rectangular plots of highest length were recommended because of sloppiness of land. Two blocks were located in one contour line and the other one is separate due to unavailability of land area. Each plot was separated by the gourd row which separated the treated area in order to prevent the treatment effect in any adjacent plots to influence the experiment. Each individual plot was marked with 30 bushes.

2.5 Leaf sampling

Leaf samples were collected randomly selected bushes in each experimental plot by selecting mother leaf. During leaf sampling over mature and immature mother leaves, leaves with diseased, damaged leaves etc were excluded. From the leaf sample good mature leaves were selected and place in labeled paper plates and covered and allowed to oven drier for overnight at 105°C. The dried samples were crushed by hand and sub samples were ground in intermediate mill to pass through a 40 mesh stainless steel sieve prior to chemical analysis.

2.6 Leaf sample analysis

Leaf samples were oven dried for overnight at 80°C and ground prior to analysis. Then 0.2g of ground samples was weighed in to ash tubes and placed in a muffle furnace for overnight
at 480°C. When completely ashed it turned into white colour and allowed to cooling. To the ash 2 two drops of deionized water, 0.5ml of the digestion mixture (25ml conc HNO₃ + 25ml conc HCl made to 100ml final volume with water) was added. Then it allowed warming then 10ml 0.05N HCl was added in to it and covered by para films and shaken vigorously (Baker et al., 1964). The P concentration was measured by UV/Visible Spectrometer 425nm (Chapman and Pratt, 1961), K was read using Flame photometer (Isaac and Kerber (1971), Ca , Mg, Fe and Mn was read using AAS (Watson and Isaac, 1990), Al was read at 530nm by using spectrometer. Total nitrogen was determined by kjeldahl method.

2.7 Statistical analysis

The data collected from field experiments were tabulated and Analysis of Variance (ANOVA) was done by using Statistical Analysis System (SAS) (SAS Institute, 1999) version 9.1 and Microsoft Excel 2007 package. The least significance difference (LSD) test was used to separate significantly differing treatment means after main effects were found significant at P < 0.05. (Buysse et al., 2004).

3. Result and conclusion

3.1 Effect of dolomite on major nutrient content of mother leaf

The phosphorus is important macro nutrient which used for numerous metabolic processes in plants. It plays a great role in crop maturation and root development. The P content in mother leaf was not significantly differing among different rate of dolomite. It may due to transformation of leaf P into other forms (Table 1), It is well known that soil P, especially soil available P, and is generally coupled with leaf P concentration (Han et al., 2005).

There was no significant different observed in N, K, Mg, Ca content in mother leaf among different rate of dolomite (Table 1). These nutrients were more important to improve the accumulation of carbohydrates for plant growth. Ana viadé et al (2011) reported liming had no effect on potassium, either in soil or plants. It has been reported that Al inhibits the absorption of nutrients, especially Ca, Mg, Fe and Mo and less available P (Poschenrieder et al., 2008).

Table 1: Effect of application different rate of dolomite on major nutrient content in mother leaf

<table>
<thead>
<tr>
<th>Level of Dolomite (Kg/ha/pruning cycle)</th>
<th>N %</th>
<th>P %</th>
<th>K %</th>
<th>Ca %</th>
<th>Mg %</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>3.50a</td>
<td>0.23a</td>
<td>1.42a</td>
<td>1.27a</td>
<td>0.20a</td>
</tr>
<tr>
<td>1000</td>
<td>3.51a</td>
<td>0.21a</td>
<td>1.37a</td>
<td>1.35a</td>
<td>0.21a</td>
</tr>
<tr>
<td>2000</td>
<td>3.19a</td>
<td>0.23a</td>
<td>1.45a</td>
<td>1.44a</td>
<td>0.23a</td>
</tr>
<tr>
<td>3000</td>
<td>3.07a</td>
<td>0.23a</td>
<td>1.43a</td>
<td>1.52a</td>
<td>0.20a</td>
</tr>
<tr>
<td>4000</td>
<td>3.43a</td>
<td>0.25a</td>
<td>1.49a</td>
<td>1.29a</td>
<td>0.25a</td>
</tr>
<tr>
<td>LSD Value (&lt;0.05% P)</td>
<td>0.568</td>
<td>0.084</td>
<td>0.2113</td>
<td>0.381</td>
<td>0.0533</td>
</tr>
<tr>
<td>CV %</td>
<td>9.033</td>
<td>18.86</td>
<td>7.81</td>
<td>14.69</td>
<td>12.98</td>
</tr>
<tr>
<td>P value</td>
<td>0.357</td>
<td>0.830</td>
<td>0.762</td>
<td>0.550</td>
<td>0.298</td>
</tr>
</tbody>
</table>

Means followed by the same letter in each column are not significantly different to LSD at 5% level.

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3.2 Effect of dolomite on trace element content in mother leaf

The result indicated that there was no significant effect on Fe content in mother leaf while Mn content in mother leaf shown significant different (Table 2). Higher Mn content was observed in untreated control treatment. Acidic nature of soil is the positive reason that induces the availability of soil manganese as well as uptake. Excess available Mn occurs in acid soils with a pH of 5.5 or less, especially for soils low in organic matter and temporarily waterlogged. The low Mn content in mother leaf due to low uptake of Mn coupled by the its low availability in soil caused by precipitation of Mn as un reactive MnO or MnCO$_3$ with increasing rates of Dolomite. These results are consistent with research reported by Pathirana (2000).

Table 2: Effect of application of different rate of dolomite on trace elements content in mother leaf

<table>
<thead>
<tr>
<th>Level of Dolomite (Kg/ha pruning cycle)</th>
<th>Fe (ppm)</th>
<th>Mn (ppm)</th>
<th>Al (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>92.67$^a$</td>
<td>2347$^a$</td>
<td>485$^a$</td>
</tr>
<tr>
<td>1000</td>
<td>69.67$^a$</td>
<td>2220$^{ba}$</td>
<td>378$^a$</td>
</tr>
<tr>
<td>2000</td>
<td>106.0$^a$</td>
<td>1434.3$^{bc}$</td>
<td>472$^a$</td>
</tr>
<tr>
<td>3000</td>
<td>145.3$^a$</td>
<td>1750.3$^{bac}$</td>
<td>469$^a$</td>
</tr>
<tr>
<td>4000</td>
<td>86.67$^a$</td>
<td>1246.6$^c$</td>
<td>451$^a$</td>
</tr>
<tr>
<td>LSD Value (&lt;0.05% P)</td>
<td>76.072</td>
<td>788.15</td>
<td>205</td>
</tr>
<tr>
<td>CV %</td>
<td>40.37</td>
<td>23.26</td>
<td>24.14</td>
</tr>
<tr>
<td>P value</td>
<td>0.292</td>
<td>0.047</td>
<td>0.765</td>
</tr>
</tbody>
</table>

Means followed by the same letter in each column are not significantly different to LSD at 5% level.

The results of Al content of mother leaf had not significant difference. Highest mean value of Al concentration was obtained in control plot. Under acidic condition, Al is accumulated in tea plants mainly in leaves, especially in old leaves (Average 5600mg Al per Kg) and followed by young leaves (Wong et al., 1998). Accumulation of Al in the older leaves could be a mechanism of tolerance as older leaves may possess up to ten times the level of Al found in younger leaves (Jayaman and Sivasubramaniam 1980).

4. Conclusion

The results obtained from this study indicated that Dolomite application did not influence major nutrient content and trace elements such as Fe and Al content in mother leaf but Manganese content in mother leaf changed significantly, highest average mean value was obtained in control.

5. References

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