

# Evidence of Magnesium Deficiency in Ceylon Soils\*

S. KANDIAH and D. M. RODRIGO

INSTANCES of abnormal condition in plants which have been considered by the Pathologist as not being caused by any pathogens are brought to the notice of the Chemist from time to time and these are investigated. When factors such as drought, inadequate soil drainage, &c., are eliminated from being the cause, the possibility of nutritional deficiency is investigated.

A comparison of the diseased leaf specimens with the plates reproduced in "Hunger signs in Crops" or "The mineral deficiency of Plants" did not always give a clue to the trouble. In the instances cited below, though magnesium was found to be the deficient element, the colour symptoms varied with the variety of plants. A comparative analysis of leaves of about the same stage of maturity from the diseased and from healthy plants proved to be far more helpful in diagnosing the cause of the trouble. Where a marked deficiency of any particular nutrient element was observed steps were taken to apply a material rich in that element in sufficient quantity and to watch the effect of the application on the condi-

tion of the crop. In the cases referred to below, foliar analysis revealed a deficiency of magnesium and the application of dolomitic lime brought about an improvement in the condition of the plants.

## Sickle Leaf of Cocoa

The name "sickle leaf" for the diseased cocoa aptly describes the condition of the leaf, which narrows down to the base with a curvature to one side resembling a sickle. The two halves of the leaf blade are unequal, one being broader than the other. The affected leaves are often chlorotic, the chlorosis being intravascular with the veins remaining green, as opposed to "vein clearing" connected with another disease presumed to be a virus. In advanced cases, defoliation of the twigs takes place and the entire tree presents an unthrifty appearance. The analysis of leaves collected from healthy and diseased trees at the Departmental Station, Kundasale, and from healthy trees at Gannoruwa, where this disease does not occur are given in Table 1.

Table 1

Cocoa	%Ash	% Nitrogen	% Phosphoric acid (P <sub>2</sub> O <sub>5</sub> )	%Potash (K <sub>2</sub> O)	%Lime (CaO)	%Magnesium (MgO)
1. Healthy tree—Kundasale	8.50	2.48	.87	2.05	.98	1.29
2. Diseased tree	9.75	2.11	.42	2.55	1.14	.94
3. Healthy tree	12.81	2.13	.45	1.62	2.38	1.32
4. Diseased tree	9.82	1.99	.51	2.69	1.31	.97
5. Healthy tree	12.97	2.06	.41	1.33	2.24	1.44
6. Diseased tree treated with dolomitic lime—Kundasale	11.18	2.28	.58	1.53	1.67	1.46
7. Healthy tree—Gannoruwa	9.06	2.05	.47	1.96	1.11	1.43

\* A paper read at the ninth annual sessions of the Ceylon Association for the Advancement of Science held in November, 1953.

A glance at the results would indicate a generally low level of nutrients in the diseased leaf, but the potash content is much higher and the magnesium content much lower in the diseased leaf when compared with those in the healthy one for these two constituents. It is a significant fact that cocoa cultivated on soils derived from dolomitic lime stone is free from "sickle leaf" and that the two estates, Kundasale and Pallekelle, where this disease is severe do not contain any dolomitic lime stone. It therefore appeared reasonable to infer that a deficiency of magnesium was responsible for the disease at Kundasale and the effect of applying dolomitic lime was tried out. The treated trees show a marked improvement in their general condition, a reduction in chlorosis and in the number of sickle shaped leaves. The increase in magnesium in the plants treated with dolomitic lime would appear to confirm that magnesium was the limiting factor.

### Citrus at Helbodde

Practically all the Tahita seedless lime trees planted at the Fruit Station at Helbodde had turned chlorotic in spite of regular dressings of cattle manure, application of coral lime and artificial fertilizers and periodic spraying of zinc sulphate. The affected leaves drop off prematurely and the twigs remain bare giving an unthrifty appearance to the

whole plant. The soils are deep and the plants are planted in terraces. There was no evidence of any water logging. As the soils are acid lateritic loams, it was considered possible that available phosphoric acid was the limiting factor but an application of basic slag given at the rate of three pounds per tree failed to bring about any improvement.

Leaf analysis shown in Table 2 was carried out at this stage and it revealed a deficiency of lime and of magnesium. As the chlorotic condition persisted even after the application of coral lime, it was decided to test the effect of dolomitic lime, calcium-magnesium carbonate. A fairly heavy dose of 7 lb. per tree was given on November 23, 1951. After a period of about 6-9 months, some improvement was noticed in every one of the trees, but the response in some cases was more marked than in others. A few of those that did not show much improvement were selected and treated on October 22, 1952, with 4 lb. per tree of magnesium sulphate, to which these trees responded remarkably. A similar dose was thereafter given to the other trees also. At present none of the treated trees shows any symptoms of chlorosis and all of them are in a flourishing condition and have begun to bear fruits after a period of about five years. The improvement in the plant is reflected in the higher content of magnesium in the leaves of the treated plants.

Table 2

<i>Citrus</i>	% Ash	% Nitrogen	% Phosphoric acid ( $P_2O_5$ )	% Potash ( $K_2O$ )	% Lime ( $CaO$ )	% Magnesium ( $MgO$ )
1. Healthy tree—Helbodde	.. 10.72	.. 2.06	.. .44	.. 1.76	.. 2.02	.. .98
2. Diseased tree—Helbodde	.. 5.20	.. 1.09	.. .31	.. 1.82	.. 1.13	.. .55
3. Diseased tree treated—Helbodde	.. 8.83	.. 1.86	.. .60	.. 1.78	.. 1.94	.. 1.11

**Guava at Meerahawatte**

The guava plants at Meerahawatte are about 7-8 years old but all of them were affected to varying degrees by what is known as "rosetting". Here the leaves turn purple, the veins alone remaining green. Analysis of healthy and diseased leaves carried out on March 10, 1951, revealed a generally low plant nutrient status in the diseased leaves compared with that of the healthy ones. A deficiency of magnesium was not unfortunately suspected at this stage and this element had not therefore been determined in the leaves. A heavy application of artificial fertilizers given to the seriously affected trees failed to

show any improvement. Further analysis of leaves from healthy and affected trees were carried out on June 23, 1952, and a general deficiency of plant nutrients in the affected leaves was detected. As the application of a fertilizer mixture had failed to bring about any improvement the effect of an application of dolomitic lime was tested on July 7, 1952, by treating the trees at seven pounds per tree. The treated trees showed a remarkable improvement in their condition and the leaves had all turned green. Here again the improvement in the condition of the plants is reflected among other nutrients in the increased magnesium content of the leaf.

Table 3

<i>Guava</i>	%Ash	%Nitrogen	%Phosphoric acid ( $P_2O_5$ )	%Potash ( $K_2O$ )	%Lime (CaO)	%Magnesium (MgO)
1. Healthy tree—Meerahawatte	.. —	.. 2.05	.. .42	.. .84	.. 1.05	.. —
2. Diseased tree	.. —	.. 1.78	.. .26	.. .55	.. .83	.. —
3. Healthy tree	.. 6.45	.. 2.12	.. .42	.. .82	.. 1.01	.. .93
4. Diseased tree	.. 3.77	.. 1.94	.. .32	.. .62	.. .80	.. .67
5. Diseased tree treated	.. 6.39	.. 2.10	.. .44	.. .80	.. 1.04	.. .95

**Sorghum at Gal Oya**

Specimens of affected sorghum plants were received on January 27, 1953. The leaves were normal in size but they were reddish purple in colour, the change in colour starting with the tips and proceeding downwards in streaks along the mid ribs. The two edges of

the leaves remained green, but as the affection advanced, the entire leaf turned more and more purplish. A healthy sample from an adjacent area was called for and a comparative analysis carried out. The affected leaf showed a definite deficiency of magnesium, as could be seen from the results in Table 4.

Table 4

<i>Sorghum</i>	%Ash	%Nitrogen	%Phosphoric acid ( $P_2O_5$ )	%Potash ( $K_2O$ )	%Lime (CaO)	%Magnesium (MgO)
1. Healthy plant—Gal oya	.. 11.78	.. 2.87	.. .75	.. .80	.. .97	.. .60
2. Diseased plant	.. 15.02	.. 2.66	.. .79	.. .84	.. .98	.. .33

Although unmistakable evidence of magnesium deficiency has been detected, it has not unfortunately been possible to test the effect of an application of dolomitic lime, as sorghum is cultivated in these areas only once a year. Action has however been taken to apply dolomitic lime to the affected areas this season.

### Maize at Vakaneri

Affected maize from Vakaneri near

Valachenai showed similar discolouration as the sorghum and comparative analysis of healthy and diseased leaf samples (Table 5) carried out revealed a generally low level of nutrients in the affected leaf. The deficiency of magnesium was however far more marked than of the other elements. Here again for the reasons stated above, it has not been so far possible to test the effect of treating with dolomitic lime.

Table 5

<i>Maize</i>	% <i>Ash</i>	% <i>Nitro- gen</i>	% <i>Phos- phoric acid (P<sub>2</sub>O<sub>5</sub>)</i>	% <i>Potash (K<sub>2</sub>O)</i>	% <i>Lime (CaO)</i>	% <i>Mag- nesium MgO</i>
3. Healthy plant—Vakaneri	.. 14.86 ..	2.65 ..	.75 ..	1.04 ..	.85 ..	.39
4. Diseased plant ..	.. 8.22 ..	1.28 ..	.65 ..	.84 ..	.67 ..	.13

From the foregoing it will be clear that these soils are deficient in magnesium. It will be observed that all the cases detected so far have been confined to lateritic soils in the wet zone or the sandy soils in the dry zone. It is a well established fact that laterization brings down a marked reduction in bases. Holland<sup>1</sup> states that during weathering of silicates in the tropics, the silica, alkalies and alkaline earths are removed in solutions whilst the alumina and ferric oxide remain behind. Robinson<sup>2</sup> however points out that during the decomposition of fresh diorite as much as 97 per cent. each of calcium and of magnesium is lost while the corresponding loss for potash is 39 per cent. A deficiency of magnesium in the lateritic soils is therefore easily understood. Sandy soils due to their low percentage of the clay complex are

deficient in most plant nutrients including magnesium. The statement on page 20 of the Imperial Bureau of Soil Science Technical Communication No. 31 would indicate how very important is the issue of magnesium deficiency in plant nutrition: "Magnesium is one of the most soluble and most weakly absorbed of the common exchangeable cations and actual deficiencies in soil may be much more common than has yet been recognised".

### References

<sup>1</sup> Holland-Commonwealth Bureau of Soil Science—*Technical Communication No. 47.*

<sup>2</sup> ROBINSON, G. W.—*Soils: Their Origin, Constitution and Classification.*