THE EFFECT OF SOIL pH AND ORGANIC MATTER ON THE MAGNESIUM CONTENT OF SOIL AND LEAVES OF CITRUS ON ACID FLATWOODS SOILS

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Variability in the typical flatwoods soils of Florida makes them rather troublesome in obtaining correlated soil and leaf tissue data for use as a guide in citrus fertility control. Three or four, or more different soil types, or soil phases may exist within a designated area, and each may have different levels of soil test values for establishing acceptable nutrient ranges.

The mechanical process of bedding or deep plowing, adds greater variability due to inconsistent mixing of subsoil layers and surface soil.

In a chemical survey of Florida citrus soils (5) which included some flatwoods soils, it was concluded that the soil exchange capacity was the best single value for determining the relative potential fertility of soils for citrus. This survey included soils with varying amounts of organic matter and clay. Data presented in other work (1) has shown the variability of magnesium in leaf tissue due to different flatwoods soils.

The Duette Research Grove was established in 1960 with various fertility and cultivation treatments that have been reported elsewhere (2, 3). The typical flatwoods area selected for this 40-acre grove contained Pomello, a Leon-Immokalee complex, Ona and Rutledge soils. The Leon-Immokalee complex, a dominating soil of the area, is a mixture of small areas of Leon and Immokalee soils, each being too small in area to show on a map. Due to these soil variations, a modified experimental design was used in which every fifth plot in the grove was given a standard treatment to help evaluate and interpret crop and other experimental results.

Comparisons of soil and leaf tissue analyses with nutritional treatments have resulted in inconsistent data. An investigation as to possible causes for these variable data was initiated.

Experimental Procedure

Different intensities of shading as shown on an aerial photograph taken a few years after the Duette Research Grove was set, were deliniated and used as a basis for a soil map. This map was compared to the soils as they presently exist, and division lines for soil and leaf samples were made.

For more exact data, the original plots of fourteen trees were divided into two sampling areas of four trees each, plus border trees. If a division of soils occurred within one of these reduced plots, separate samples were taken from each part. Soil samples were taken in January, before fertilization, and leaf samples were taken in March, one month after fertilization. There was very little rainfall during the month before leaf sampling, and it is believed that this fertilization was not reflected in the leaf samples. Samples collected at that time were from the older well-matured leaves, which were composited according to like soils as indicated on the soils map.

A total of ten soil cores was taken per plot from the bed-side of trees to a depth of twelve inches. Cores of like soils, as indicated by the soils map, were composited within each reduced plot. Additional data of the native condition of these soils were obtained by sampling the surface foot and organic layers of surrounding areas which were either virgin or pasture land.

Data reported in this paper are from the magnesium variation treatments (Table 1) of the deep-plowed area of the Pineapple grove with sour orange rootstock. Trees of this area were more uniform with respect to size and age.

Soils were extracted with a 0.725 *N* ammonium acetate solution which had been adjusted

Table 1. Treatments and variability within treatments of magnesium content of leaf samples

Treatments [1]	Magnesium Content (%) [2] Replications I	II	III	IV	Ave.
1. No magnesium applied annually	0.31	0.54	0.69	0.36	0.47
2. 39 lbs. of MgO/A./yr., soluble material (Standard Treatment).	0.48	0.42	0.45	0.42	0.46
3. 78 lbs. of MgO/A./yr., soluble material	0.33	0.57	0.73	0.54	0.54
4. Slag, 1 ton every 2 years.	0.42	0.42	0.45	0.54	0.46
5. Slag, 2 tons every 2 years.	0.51	0.51	0.51	0.51	0.51
6. Dolomite, initial application of 4 tons/A.	0.51	0.69			0.60

1 Based on a tree count of 70 trees/A. All treatments had an initial application of 2 tons of dolomite in 1959.

2 Spring flush, samples 12/18/68.

to pH 4.8 with acetic acid, and were colorimetrically analyzed for magnesium (6). Additional analyses were made with an atomic absorption spectrophotometer.

Soil organic matter was determined by the Walkley-Black method (4), and a 1:1 soil:water ratio was used in determining pH.

Leaf tissue was ashed, taken up in the ammonium acetate solution and analyzed for magnesium with the atomic absorption spectrophotometer.

Results and Discussion

An example of the leaf analytical data obtained from the treatments as they were originally laid out in 14 tree plots is shown in Table 1. It can be seen that there is a great deal of variability within treatments. A procedure of investigation as has been described was initiated for determining possible factors and the possibility of redesigning this experimental area to obtain more precise, usable data for fertility control.

Analytical data indicated possible relationships among factors such as soil test magnesium, leaf magnesium, pH and organic matter content of the soils. Soils sampled were those as delineated on the prepared soils map. Percent organic matter in the soil was used as a scale to further separate soils since clear-cut characteristics that distinguish soil types or soil phases were modified in the deep plowing and bedding operations.

To investigate the relationship between pH and soil test magnesium, a linear correlation was made between these two factors from eighty soil samples taken within the experimental area. These areas had received an annual application of 39 pounds of MgO per acre in addition to an initial application of 2 tons of dolomite ten years earlier. A correlation coefficient of 0.53 was obtained, which was highly significant.

Since the soil data showed high magnesium contents for the darker soils, the possibility of native occurring quantities of magnesium in the darker soils or in the organic layer of the lighter soils, was investigated. This included analysis of soil profile components from adjacent areas which were virgin areas or only slightly disturbed at the surface. Results (Table 2) indicate that native quantities in the surface and organic layer are very low. Higher values in the surface soil of the pasture are due to additions when the pasture was improved. Therefore, it easily could be said that magnesium values within the experimental area are from additions, and not of native origin. A possible pH-soil magnesium relationship, as determined by analysis, may be biased and due to an uneven distribution of dolomite in the initial application.

Table 2. Magnesium content of soil adjacent to the Duette Research Grove

Land Use	Soil Type	Sample	pH	Magnesium (ppm)
Pasture	Leon, light phase	0-12 in.	5.8	13
		Organic Layer (pan)	4.6	4
Pasture	Leon	0-12 in.	5.4	18
		Organic Layer (pan)	4.4	2
Pasture	Ona	0-12 in.	5.3	18
		Organic Layer (stain)	5.1	1
Virgin	Leon	0-12 in.	4.5	1
		Organic Layer (pan)	4.4	2

A linear correlation between soil test magnesium and organic matter gave a correlation coefficient of 0.78 (Figure 1). Data from the treatments without annual additions of magnesium, with annual additions of 39 pounds and 78 pounds of MgO per acre, and with the application of slag every two years, were plotted (Figure 2) to show this possible relationship. Comparing soil test magnesium values in Figure 2, it is noted that the general trend is for an increase in soil test magnesium as the organic matter increases, but this is not a smooth line as would be desired. As found, the magnesium present is only that applied; therefore, if there were no doubts that equal distribution of magnesium had been made over all soils, the graphs would probably be much smoother and the correlation coefficient would be much better. Due to equipment difficulties, and a severe hurricane which eroded the beds, the belief is that the dolomite is not as uniformly distributed over the beds as would be desired.

Because of this lack of smoothness, it is difficult to make positive statements from these data, but there are points that should be brought out. It appears that the acid flatwoods soils low in organic matter, may retain some magnesium from yearly applications of soluble magnesium, while soils containing more than 1.5 percent organic matter, had sufficient magnesium present from the dolomite application ten years earlier. Slag applications gave high soil test magnesium on the low organic matter soils, and very high values as the organic matter increased.

Leaf tissue data correlates exceptionally well with soil test values where soluble magnesium was applied. There are two points which do not agree, one at the 1.95 percent organic matter on

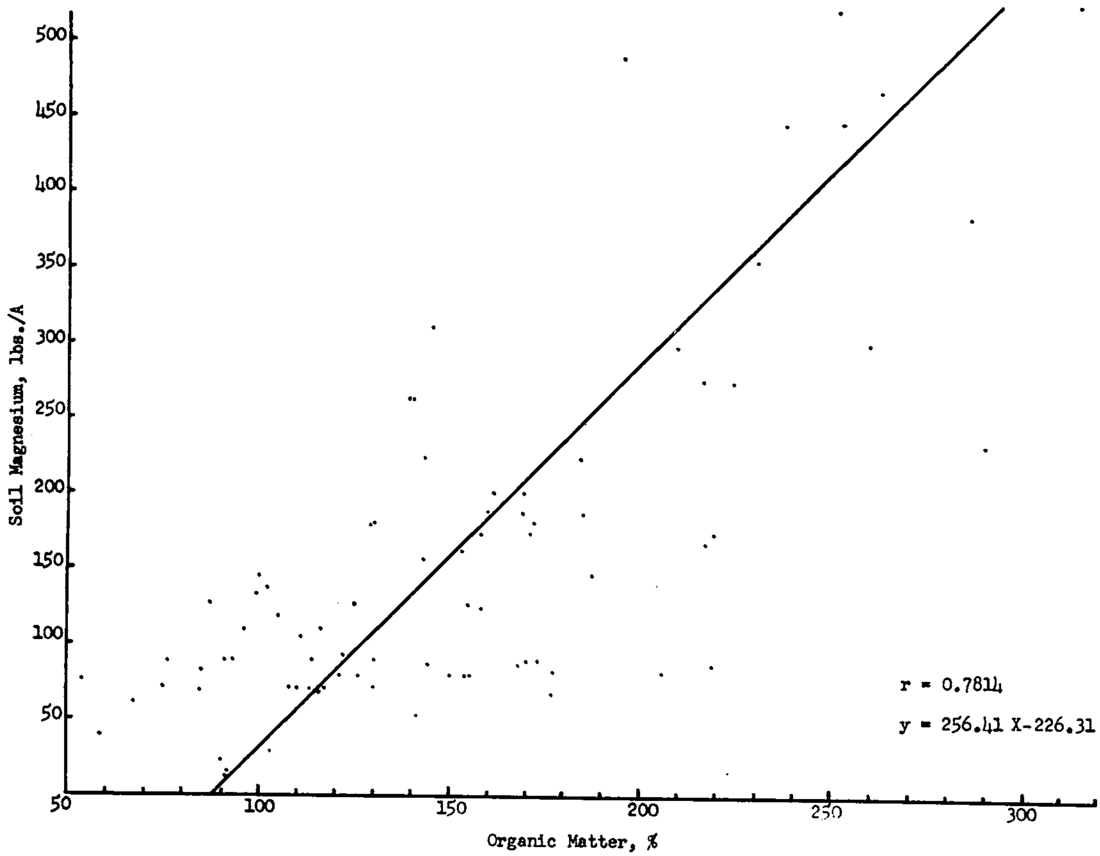

Figure.1. Regression of soil magnesium on soil organic matter.

the graph without annual Mg, and the other at the 1.55 percent organic matter on the graph of 78 lbs. MgO/A annually (Figure 2). A lapse of time after the fertilizer application prevented the complete checking of these two points; but, even with these two points off, the correlation appears to be very good.

These leaf tissue samples were taken at the initiation of spring growth, when the new growth was less than one-half inch from initiation. This is not the recommended time for sampling, but from the results obtained, sampling at this time may have possibilities.

From these data there is no doubt that the great variability in the results as obtained from the original experimental plan is due to the varied soils and soil phases throughout the experimental area. By using the criterion in this investigation, organic matter for the differentiation of soils, it can be said that the organic matter has an influencing effect on the magnesium content of soil and leaf tissue as well as in soil sampling. The trees may all look similar, but it may be the soil in which they grow, along with what was applied, that makes the greater difference.

Since yield data are not available at this time along the lines as described herein, there is not much that can be said relating these results to production. But, this is an explanation of soil and leaf tissue variability as compared to treatments, and a word of caution in commercial leaf tissue sampling on these acid flatwoods areas.

SUMMARY

An investigation was made of possible factors influencing results from magnesium trials on a deep-plowed bedded orange grove. Data

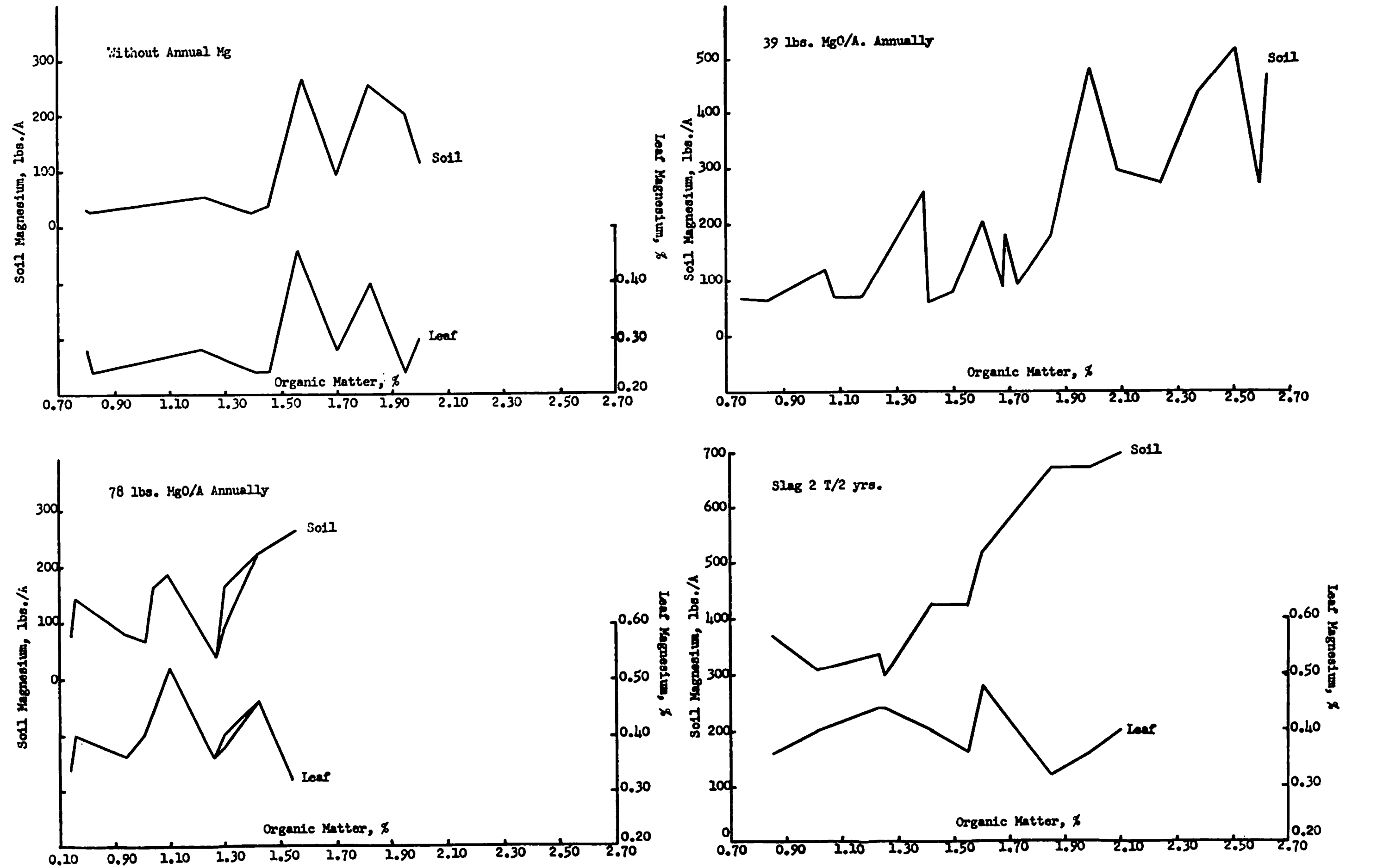

Figure 2. Relationship of soil and leaf magnesium values as affected by treatment and organic matter.

indicated the factor to be soil differences as determined by observed differences in an aerial photograph, and the organic matter content of the soil. Additional information indicated that annual applications of soluble magnesium to low-organic soils may maintain some retention by these soils, but that an application of dolomite ten years earlier to soils with an organic matter content greater than 1.5 percent, still provided sufficient magnesium as determined by soil and leaf analyses.

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THE NUTRITIONAL STATUS OF THE 'ORLANDO' TANGELO (Citrus paradisi MACF. 'DUNCAN' x C. reticulata BLANCO 'DANCY')[1]

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ABSTRACT

A survey of 30 commercial 'Orlando' tangelo groves in Florida showed several meaningful trends. The predominant rootstock was 'Cleopatra' mandarin (*C. reticulata* Blanco) which characteristically results in low yields, and many groves had no provisions for ensuring satisfactory fruiting either through cross-pollination or girdling of this self-incompatible variety.

Nitrogen levels decreased more rapidly and were generally lower than those reported for sweet orange, *C. sinensis* Osbeck. Together with significant correlations between fertilizer N, leaf N, and yields, the generally low levels of leaf N in 'Orlando' groves in this survey indicate this variety needs to be more heavily fertilized than sweet orange.

None of the other mineral elements in this study were low as compared with sweet orange leaf standards and leaf K and Mg were high.

Soil analyses were not related to leaf analyses in general but the calcareous nature of soils in some groves appeared to depress leaf K.

INTRODUCTION

The most promising and important of the interspecific hybrids in the genus *Citrus* are the tangelos (6). Approximately 3½ million boxes of tangelos were produced in Florida during the 1966-67 and 1967-68 crop years, with the 'Orlando' being by far the leading variety (4, 6).

One of the most important factors influencing the growth and productivity of fruit crops is the nutritional status of the tree (5). However, except for a greenhouse study by Northey *et al.* (12), a review of the literature reveals a noticeable lack of information concerning the nutrition of the 'Orlando' tangelo.

In order to investigate the nutritional factor

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