Influence of Soil Liming on the Appearance of Declinamiento Symptoms on Citrus Trees

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ABSTRACT. Declined citrus trees with a blight-like symptomatology have been observed in the Concordia citrus area. The trees were on clayish soils having calcareous pans and a high pH. All these soils were also deficient in phosphorous. No trees grown on sandy soils have shown decline symptoms except for a plot of Valencia orange on trifoliate rootstock on a deep sandy soil treated with lime and different levels of fertilization. Analysis of the plot indicated that the lime application to soil could be related to the appearance of citrus decline symptoms. It has not been determined yet if this is the cause or if there is another etiological agent.
Index word. Blight.

Declining citrus trees found in Concordia, Entre Ríos, Argentina, show symptoms similar to those observed in plants affected by citrus blight in Florida, U.S.A., and other countries.

Trees of Valencia sweet orange and Marsh Seedless grapefruit grafted to trifoliate orange or rough lemon rootstocks show declinamiento symptoms when planted in alkaline soils with high clay content, where phosphorous is deficient and lime is found close to the soil surface. These soils are considered marginal for citrus production in the Concordia area. Declining Valencia sweet orange trees grafted to trifoliate orange were found on deep sandy soil at the INTA Concordia Experimental Station. This finding constitutes an exception since clay is present at 90-100 cm from the soil surface and this soil is considered excellent for citrus production.

Declinamiento symptoms appear on some branches initially and spread progressively over the whole tree. Symptoms include Zn deficiency, and wilted leaves which finally fall. Some leaves remain at the top of affected twigs and they are unusually large. The affected branches show abundant off-season bloom which also occurs on secondary and main branches. Fruits are smaller on the affected part of the tree. Diseased trees have little growth, small leaves, and Zn and/or Mg deficiency patterns on the leaves. Chlorosis or mottling appears on some leaves and green islands sometimes are found on chlorotic leaves. Diseased branches die back from the top, while vigorous shoots grow up from the main branches, trunk or rootstock of diseased plants. Dead roots and feeder roots are found in declining trees. A dark vascular cylinder appears when the bark of dying roots is removed. This work demonstrated a relation exists between alkaline soils containing lime and declining citrus trees.

MATERIALS AND METHODS

Trees of Valencia sweet orange grafted to trifoliate orange were planted in 1964. The trees are part of a fertilization test for N, P and K, which includes 1375 sweet orange trees in one plot. One half of this plot received lime, as $Ca(OH)_2$, in 1965, 1967, 1969, 1971, 1973 and 1976 at one ton/ha.

The pH was measured at several depths, with a soil-water ratio of 1:2.5. Extractable Al was determined by the Aluminon method (2). Extraction was done with 1N KCl. Phosphorous was determined by the Bray I method (6). Zinc and water soluble phenols in the wood were determined using the technique described by Wutscher *et al.* (7). Potassium content in the wood was determined by spectrophotometry (1). The water uptake test for blight was performed as described by Cohen (3).

Inoculation of Key lime and Pineapple sweet orange seedlings was done to check for the presence of tristeza virus (CTV) and transmissible psorosis from Concordia in the affected trees.

RESULTS

Declining trees were detected only in the limed sector of the test plot. Twenty-eight diseased trees have been recorded since the spring of 1978 when declining sweet orange trees were first seen. Twenty three of the 28 died. No declining trees were found in the non-limed sector of the plot. pH values determined in the limed and non-limed plot sector are shown in table 1.

TABLE 1
pH VALUES DETERMINED IN THE LIMED AND NON-LIMED PLOT SECTORS

Depth (cm)	pH (limed)	pH (non-limed)
0-20	6.5-7.2	5.6-6.2
20-40	6.0-6.3	5.2-5.4
40-60	5.9-6.2	5.0-5.2
60-90	5.5-5.8	4.8-5.4

Extractable Al in the non-limed sector was between 2 and 14 ppm at the 0-12 cm depth and from 22 to 54 ppm at 12-30 cm depth. Traces of Al were found in the limed soil at the 12-30 cm depth. Phosphorous content in the limed soil fluctuated between 6 and 12 ppm for all soil depths investigated. Phosphorous content in the soil should be more than 35 ppm for citrus production (5).

Water uptake, water soluble phenols, K, and Zn content in the wood of healthy and declining trees are shown in table 2.

Key lime seedlings showed vein clearing when inoculated either with bark of healthy or declined trees indicating that CTV was equally distributed in the plot. However, no virulent strains of CTV were detected by seedling inoculation. Tests for psorosis were negative for healthy and diseased trees.

DISCUSSION

Valencia sweet orange trees grafted to trifoliate orange rootstock showed symptoms of declinamiento when planted in deep sandy soil that received lime for several years. Strains of CTV detected in healthy and diseased trees were of moderate virulence.

However, when declining Valencia sweet orange trees grafted on rough lemon that belong to a

TABLE 2
WATER UPTAKE, WATER SOLUBLE PHENOLS, K AND Zn CONTENT IN THE WOOD OF HEALTHY AND DECLINING TREES

Tree condition	Number of trees studied	Water uptake (ml/24 hr)	Water soluble phenols (mg/g dry weight)	Zn (ppm)	K (%)
Diseased	14	26.5	4.23	14.12	0.246
Healthy	14	201.0b*	3.46b	9.68c	0.114a

* Distribution of "t": a = significant at 1%; b = significant at 5%; c = significant at 10%.

private citrus grower from the Concordia region were indexed using Palestine sweet lime, sweet orange, and Key lime seedlings, some inoculated plants showed pitting indicating the presence of virulent strains of CTV (Casafús, unpublished). Tristeza is endemic in this citrus production area. The influence of transmissible psorosis from Concordia in the appearance of declinamiento is disregarded because its presence was not detected in healthy or diseased trees under study.

Iley and Guilford (5) reported symptoms similar to those of "young tree decline" (YTD) on citrus trees fertilized with excess of dolomite and lime in Florida. Our data shows the influence of liming in the appearance of declined trees planted in sandy soil at Concordia.

The similarities between the declinamiento of sweet orange trees at Concordia and YTD were reported by several authors (1, 4, 8). The data presented here supports, those reports, but it is unclear whether liming caused the disease or is just a factor inducing susceptibility of citrus trees to an unknown pathogen.

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