DECLINIO OF CITRUS TREES IN BRAZIL. A REVIEW

Victoria ROSSETTI
Instituto Biológico, Division of Plant Pathology, São Paulo, Brazil

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Abstract. No microorganisms or nematodes have been found so far which could be responsible for "declinio". Research is under way, but the cause of the disease has not been determined and "declinio" has not been experimentally transmitted. Light microscopy showed the occurrence of filamentous plugs in the xylem similar to those found in blighted trees in Florida. Zinc and phenolics accumulate in the trunk of affected trees as occurs with blight. Water uptake, water-flow and airflow are severely reduced in affected trees. "Pera" orange trees preimmunized against "tristeza", show the same symptoms and reactions as other sweet orange cultivars. Trees on Rangpur lime (Citrus limonia Osh.), C. volkameriana and Poncirus trifoliata are affected by "declinio", but not trees budding on sweet orange. The specific weight of secondary roots of affected trees is consistently lower than for roots of healthy tree. Chromatography tests of trunk bark extracts did not show the presence of a fluorescent marker for "declinio". Declinio symptoms have been observed in Bahia and Sergipe, and the trees react similarly to "declinio" affected trees in São Paulo. Recovery and preventive methods such as scion rooting, pruning, and inarching are being studied, for application in orchards where the disease is very severe.

Introduction

A type of decline called "declinio" was detected about 10 years ago in citrus orchards of the State of São Paulo, and a similar disease was observed in 1970 in the State of Bahia. In 1980, declining trees were observed in the State of Sergipe.

The symptoms of declinio have been described.19,20,27 The disease occurs on bearing trees over 4 years old. The lack of new growth in the spring permits easy detection of diseased trees in the orchards. The foliage becomes dull green and withering of all or part of the canopy is followed by partial or total defoliation and dieback. Zinc and manganese deficiency symptoms often occur. Abundant and vigorous new shoots frequently develop in the inner part of the tree, from main branches and the trunk. Declining trees do not recover from the disease, although they may bloom lightly and develop some weak new growth. Generally, the fruits are smaller than normal, dull and pale green and yield less juice. Primary and secondary roots seem normal, except in very advanced stages. The weight of secondary roots of declining trees is consistently lower than that of normal trees.

The symptoms of "declinio" appear similar to the type of "definamiento" described for the Cajobi region of Brazil in 1967, strongly resemble those described for "declinio" in Argentina, "marchitamiento" in Uruguay and citrus blight in Florida.29,35 They differ consistently from those described in the Araracuara region of São Paulo State,31,35 and from "decaimiento" described in Tucuman, Argentina.
cultivars and locations in the State of São Paulo, and in Sergipe in 1980. Water uptake in trees of 'Valencia', 'Natal', 'Hamlin' oranges (C. sinensis Och.) and 'Tahiti' lime (C. aurantifolia (Christm.) Swingle) in São Paulo State was 5 to 15 times higher in healthy trees, similar to blight-affected trees in Florida. In Sergipe, water uptake was high on healthy trees of 'Valencia' orange on Rangpur lime rootstock while declining trees did not absorb as much water. 

Water uptake was 99.5% higher on apparently healthy trees (Kraussmann et al., unpublished data), showing that tangerines on Rangpur lime may also be affected by "declinio". 

Waterflow and airflow rates. Laboratory experiments were carried out at the Instituto Biológico to measure the secondary roots to conduct water using the method described by Bitancourt et al., for psorosis in Brazil and later by Gansey and Young in 1974. For studying waterflow rate in blighted trees in Florida. A technique was also developed to study airflow rates. Waterflows rate were 45% to 60% higher in roots of healthy trees. Airflow rates at 25°C were 4 to 5 times higher on roots of healthy trees. The same results were obtained with samples from Sergipe, as well as with the roots of Ponkan trees from Barretos and 'Pera' orange-preliminated or not with mild forms of tristeza. Results were somewhat different with samples from trees affected by "declinio" from Misiones, Argentina. 

Chromatography studies for possible indicator factors. Samples of bark pieces from the trunk of the scion and rootstock were collected and the extract was submitted to thin layer chromatography. No difference could be detected between declinio and declinio-affected and healthy trees.

Studies on the Possibility of Recovering Affected Trees and Preventing "Declinio" in Orchards Where the Disease is Very Severe

Scion-rooting has been used lately in Argentina to recover trees affected by "declinio" and prevent its occurrence in orchards where the disease is very severe. In some cases the results seem to be promising. This technique and inarching are being tested in Brazil.

Scion rooting. Several experiments with modified methods have been carried out in 2 severely affected citrus-growing farms in the State of São Paulo, as follows:

For recovery. From 1979 to 1981, 5 experiments totaling about 400 experimental trees have been carried out at 2 different locations in the State of São Paulo to make declining trees recover. After 20 months, scion-rooting alone did not result in good recovery. The trees that showed severe symptoms died, although a new root system had started to grow. Those with less severe or early symptoms were not killed by declinio, did not recover satisfactorily although some trees developed a new root system and sprouted new shoots. The new root system which develops from the bud union by scion-rooting is probably not sufficient to support a full tree canopy. For this reason, other experiments were carried out to combine scion-rooting plus a severe pruning of the trees. These trees are reacting with apparently new shoots and are developing a vigorous new root system after treatment. With conclusions can not be drawn about recovery until these trees mature and bear fruit.

For prevention. In 1980 and 1981, 2 experiments, totaling 160 experimental trees, were conducted on scion-rooting of 6-year-old, apparently healthy trees of 'Hamlin' orange on P. trifoliata, and 'Valencia' orange on Rangpur lime as a possible method to prevent "declinio" in severely affected orchards. Results are not yet available. Four other experiments on preventive scion rooting in older trees were carried out with 5 treatments and 3 replications each in each experiment totaling 360 trees. Treatments were applied every 2 months to observe the root formations at different times of the year. Results are not yet available.

Inarching. An experiment totaling 80 experimental trees was carried out in December 1980 to affect recovery of "declinio" affected trees by inarching 15-year-old trees of 'Valencia' orange on Rangpur lime with 'Caipira' sweet orange. Results are not yet available. 

Regions Affected by "Declinio" in Brazil

In 1970, declinio symptoms were detected in sweet orange on Rangpur lime trees in several orchards in the State of Bahia. In 1980, similar symptoms were found in the State of Sergipe, close to Bahia, where citrus industry is developing rapidly. Water uptake field tests were carried out as well as laboratory water and air flow tests through secondary root segments. Results were comparable to those obtained in the State of São Paulo, on "declinio"-affected trees. These results indicate that declinio occurs in the northern states of Brazil. In the State of São Paulo, "declinio" is prevalent in the central and northern areas. It is estimated that ca. 3% of the trees are affected. It has not been found, so far, in the southern areas of the São Paulo State, or in the southern states of Brazil.

General Preliminary Conclusions

1. No causal microorganisms or nematodes have been found for "declinio", but research on this subject is under way.
2. "Declinio" has not been transmitted experimentally but new experiments are under way.
3. Light microscopy shows the occurrence of xylem obstructions (filamentous plugs, similar to those associated with blight in Florida.
4. Zinc and phenolics accumulate in the trunk of affected trees, as well as magnesium and potassium, in a lower scale. This is also similar to blight in Florida.
5. As with blight, water uptake is severely reduced on affected trees. The rates of water-flow and airflow through root segments are also severely reduced on affected trees, showing that occlusion or dysfunction of the water-transport system occurs in the trunk and in the roots.
6. 'Pera' orange trees pre-liminated with mild isolate of tristeza show the same symptoms and reactions as other sweet orange cultivars affected by "declinio".
7. Trees of sweet oranges, tangerines, 'Tahiti' and 'Galego' limes on Rangpur lime, C. volkameriana and P. trifoliata rootstocks are affected by "declinio", but it has not been detected on trees budded on Caipira sweet orange.
8. The specific weight of secondary roots of affected trees is consistently lower than that of healthy tree roots.
9. Chromatography tests of trunk bark extracts did not show a specific fluorescent marker for "declinio".
10. "Declinio" symptoms similar to the "declinio"-affected trees in São Paulo, have been observed in the States of Bahia and Sergipe.
11. Recovery and preventive methods are being studied, which may eventually be applied in orchards where the disease is very severe and losses are high. These include scion-rooting, pruning and inarching methods.
12. Injections in the trunk by pressure, with different fungicide and bactericide products are also being tested as an auxiliary method for determining the causal agent of "declinio", and for its eventual control.

Literature Cited


