Declinamiento of Valencia Late Orange on Poncirus Trifoliata in Bella Vista (Corrientes), Argentina

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ABSTRACT. In Argentina a decline of unknown etiology has been observed on late oranges on trifoliate rootstock, which is described herein. The juice of fruits from declining Valencia on trifoliate orange rootstock had higher soluble solids and acid and less vitamin C than healthy Valencia on other rootstocks. A marked decrease in growth of declining trees was observed, but fruit developed to normal size. Amino acid nitrogen in leaf extracts was lower in Valencia on trifoliate compared to healthy Valencia on other rootstocks. Paper chromatography showed absence of some amino acids. Wood samples of plants with and without "declinamiento" were analyzed for Zn, phenols, K and Mg, with inconclusive results.

At present there apparently exist biological factors that are producing a decline of commercial citrus combinations (3). Until now the etiology of "declinamiento" is not known. Similar diseases have been described in Florida (USA) (2), Brazil (9), Uruguay and Argentina (11).

The first report of "declinamiento" in Argentina was in 1964 and it was named "fruta bolita" (12). Rodriguez Pujol (8) reported that "declinamiento" could be a consequence of ecological factors and a virus. Schwarz and Fernández Valiela (10) hypothesized that "declinamiento" in Misiones, Argentina might be caused by a strains of tristeza virus (CTV).

The fertilization of plantings of Calderón orange on trifoliate orange rootstock with symptoms of "fruta bolita" or "declinamiento" does not bring about recovery (5). This is similar to CTV affected citrus. Casafús *et al.* (1) studying declining Valencia orange and Marsh grapefruit on trifoliate orange found some similarities with the disease called blight.

In Corrientes, there are commercial plantings of orange on trifoliate orange rootstock on which marked "declinamiento" has been observed. In the EEA of Bella Vista, Corrientes, there is a trial of Valencia Late orange on 5 different rootstocks, including trifoliate orange on which drastic "declinamiento" can be observed.

The objective of this work was to evaluate some characteristics of "declinamiento" on Valencia Late orange on trifoliate orange, in Bella Vista, Corrientes, Argentina.

MATERIALS AND METHODS

Valencia Late orange grafted on trifoliate orange, Rangpur lime, Cleopatra mandarin and rough lemon were the citrus combinations used.

The following juice components were analyzed in ten fruit samples of each combination: a) soluble solids by refractometry, expressed in °Brix; b) acidity, determined with NaOH and expressed as % citric acid; c) vitamin C determined by the iodine method and expressed as mg/100 ml of juice.

Plant height and canopy diameter were measured and multiplied to obtain area by which growth was followed throughout the years. The growth linear trend was determined (7). The fruit diameter of each combination was obtained for 10 years. They were analyzed by analysis of variance (ANOVA).

The nitrogen compounds from mature leaf extracts of all citrus

combination were analyzed from March to August. Separation of free amino acids was done by the Sorensen method and data were expressed as per cent of nitrogen on a dry weight basis. Paper chromatography was conducted by Ing. Agr. Ricardo Diez in the Departamento of Investigaciones Agrícolas of the Universidad del Nordeste, Corrientes, Argentina (4), to qualitatively determine amino acids in aqueous alcohol extracts of samples.

To test for CTV, Key lime seedlings were grafted with buds and leaf pieces from trees of Valencia/ trifoliate orange with symptoms of "declinamiento."

Trunk wood samples of 18 year-old trees with and without "declinamiento" were obtained. Zinc, water soluble phenolic levels and other elements used for blight diagnosis were analyzed by Dr. H. Wutscher, USDA, Orlando, Florida (13).

The water absorption of trees with and without declinamiento also was determined.

RESULTS AND DISCUSSION

When the juice of Valencia Late orange on different rootstocks was analyzed, the combination with "declinamiento" (Valencia/ trifoliate) had higher soluble solids and acidity and lower vitamin C (Table 1). Similarly, Feldman (6) reported that virus affected plants had lower vitamin C concentration and higher soluble solid and acidity levels.

The tests on Key lime with buds and leaf pieces from Valencia/trifoliate orange combinations showed no symptoms of CTV.

Though trifoliate orange rootstock causes dwarfing of the canopy, we do not believe that the observed growth decrease was due only to this cause. In Fig. 1, the growth of Valencia Late grafted on trifoliate orange, Rangpur lime and Cleopatra mandarin is compared. The combination with "declinamiento" (Valencia/trifoliate) shows less growth.

The "declinamiento" named "fruta bolita" produced a marked decrease of fruit size in Misiones province, whereas in Valencia/trifoliate in Bella Vista (Corrientes) with symptoms of "declinamiento" this characteristic was not observed. Fruit size of Valencia orange on 5 rootstocks was compared. The fruit size of Valencia on Rangpur lime rootstock was considered average. The fruit size of Valencia orange on trifoliate and the other rootstocks was within or very close to the span of the confidence interval.

The amino acid nitrogen development of leaves through 6 months is shown in fig. 2. Low levels in plants with "declinamiento" were observed. In those plants, the chromatograms showed the absence

TABLE 1
COMPARISON OF SOLUBLE SOLIDS, ACID AND VITAMIN C IN FRUIT FROM DIFFERENT COMBINATIONS OF VALENCIA LATE ORANGE WITH AND WITHOUT "DECLINAMIENTO"

Combinations	Soluble solids (%)				Acid (%)		Vitamin C (mg/100 ml)	
Valencia/ trifoliate orange	10.76	xx	xx	xx	1.17	x	0.640	x
Valencia/ Rangpur lime	9.82				1.16		0.667	
Valencia/ Cleopatra mandarin	9.80				1.15		0.671	
Valencia/ rough lemon	9.30				1.13		0.659	

Paired differences x = α = 0.05; xx = α = 0.01.

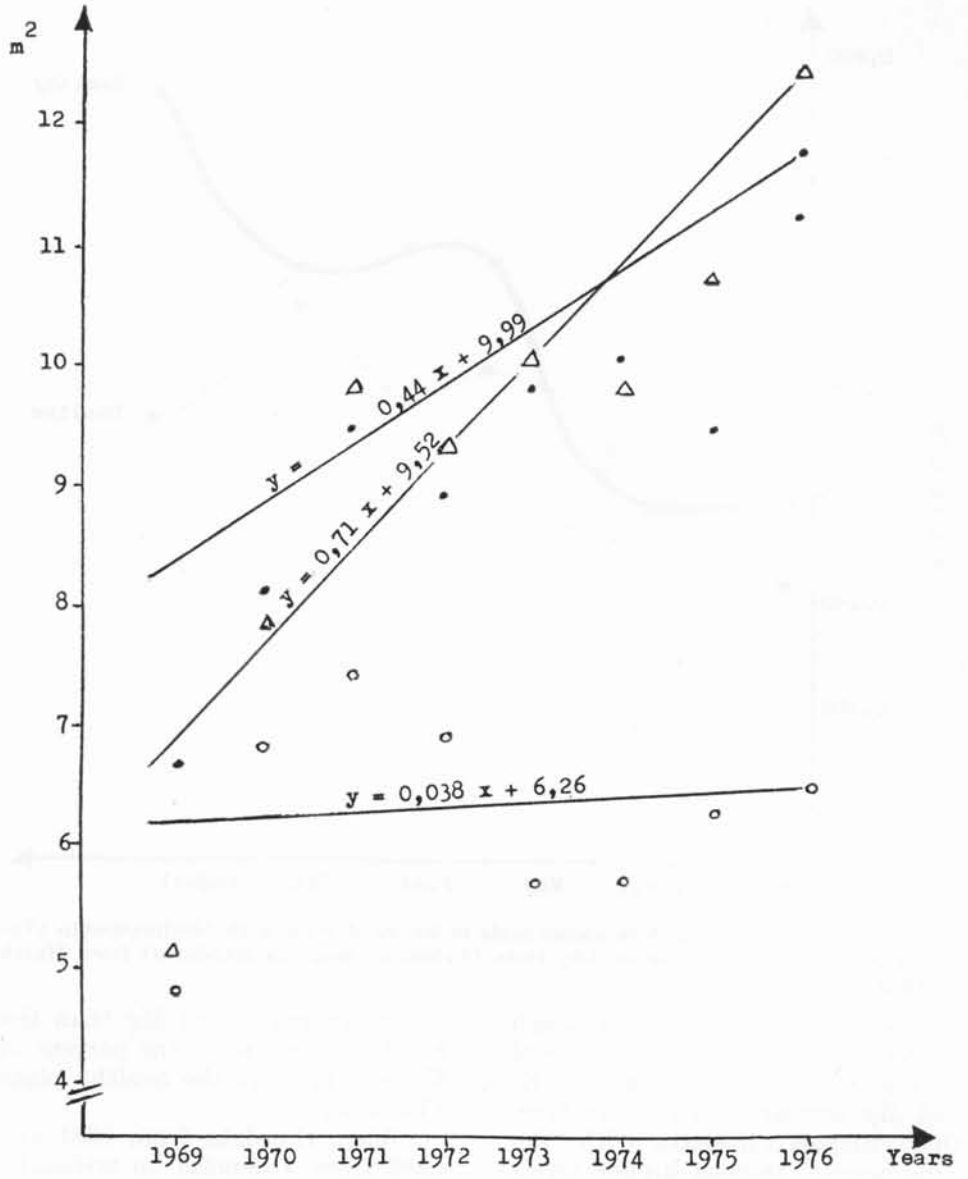

Fig. 1. Regression line of tree cross section (tree height times crown diameter) through the years. Growth of Valencia on trifoliate orange (○), Cleopatra mandarin (△) and Rangpur lime (●).

of some amino acids. They have not yet been identified because of lack of normal reference chromatograms, but this could provide a quick method to detect "declinamiento."

Some researchers have determined some similarities among plants affected by blight and by other similar declines (14). They found high levels of zinc, water-soluble phenols, potassium and magnesium in wood of affected trees.

Analyses to detect blight in material from Bella Vista, Corrientes, Argentina were inconsistent. In severely declined Valencia/trifoliate, some plants had normal and some high levels of zinc and phenols

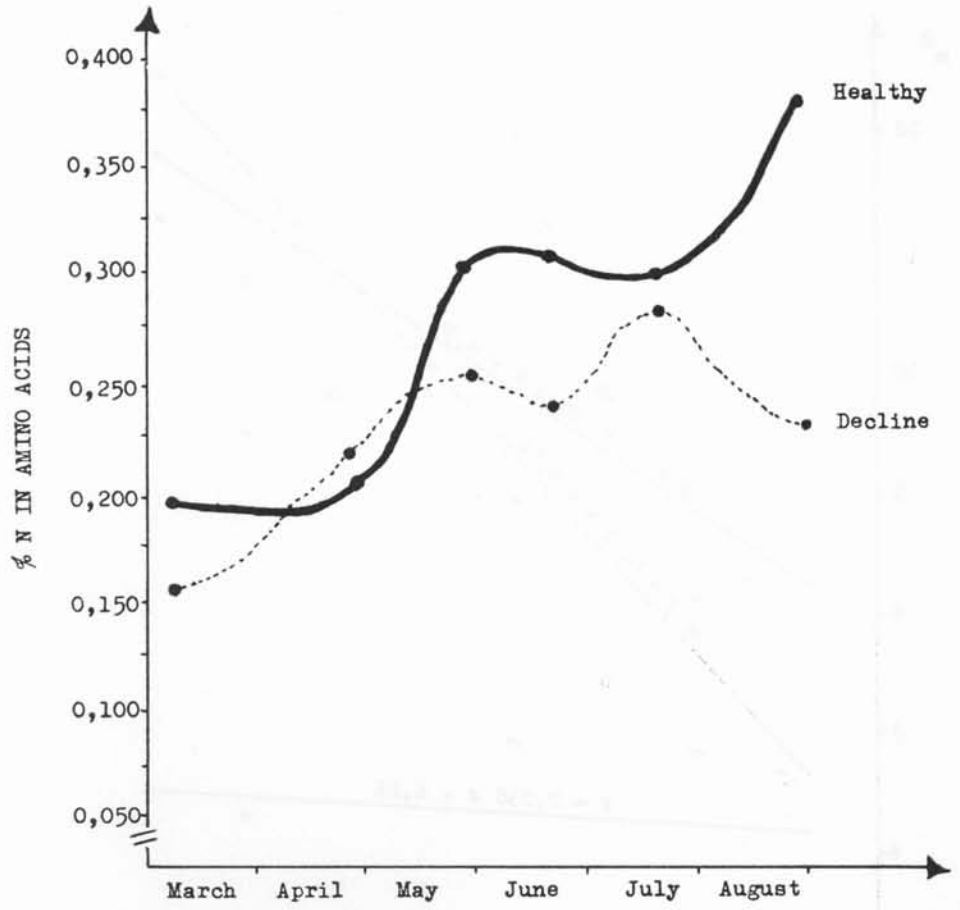

Fig. 2. Development of N in amino acids in leaves of trees with "declinamiento (Valencia/trifoliate orange) and healthy trees (Valencia/Cleopatra mandarin) from March to August, 1974.

in the wood. One Valencia/rough lemon with "declinamiento" had normal levels of Zn, phenolics, K, and Mg similar to a healthy tree. One Valencia/Cleopatra with "declinamiento" showed higher levels of Zn, phenolics and Mg than the healthy plant, while the percent of K was higher in the healthy plant (Table 2).

When the data from 1981 and 1982 from Valencias on trifoliate,

TABLE 2
VALUES FOR Zn, PHENOLS, K AND Mg IN WOOD OF 18-YEAR-OLD VALENCIA ORANGE IN GROVES OF INTA-BELLA VISTA, CORRIENTES, ARGENTINA

Rootstock	No. of plants	Tree condition	Zn (ppm)	Phenols (mg/g)	K (%)	Mg (ppm)
Trifoliate orange	23	Severe Decline	8.6	6.9	0.336	664
Trifoliate orange	10	Severe Decline	3.7	5.6	0.362	643
Cleopatra mandarin	1	Decline	8	7.7	0.217	850
Cleopatra mandarin	1	Healthy	5	6.3	0.239	520
Rough lemon	1	Decline	2	4.4	0.184	399
Rough lemon	1	Healthy	4	3.5	0.214	400

Cleopatra mandarin and rough lemon were compared an increase in Zn, phenolics, K and Mg levels was observed in the second year. In a healthy Valencia/rough lemon Zn and phenolics increased drastically in the second year, but no explanation was found for these results (Table 3).

When the water absorption of the trunk was tested, severely declined Valencia/trifoliate showed poor absorption and high levels of Zn and phenolics in the wood similar to blight. However, a declined Valencia/Rangpur lime absorbed the same amount of water as an apparently healthy plant. Both plants showed similar concentrations of Zn and phenolics (Table 4).

When the material with "declinamiento" from the Bella Vista area was tested for blight the results were not absolute.

There is no doubt that it is necessary to know the normal level of the elements that are measured for each citrus combination and each environment. Also other viruses such as exocortis and psorosis can change the biochemical components of plants.

TABLE 3
CONTENT OF Zn, PHENOLS, K and Mg, IN THE WOOD OF 18-YEAR-OLD VALENCIA ORANGE TREES DURING 2 CONSECUTIVE PERIODS. TREES ARE LOCATED AT INTA, BELLA VISTA, CORRIENTES, ARGENTINA

Rootstock		Tree condition	Zn (ppm)	Phenols (mg/g)	K (%)	Mg (ppm)
Trifoliate orange	1981	Severe Decline	8.6	6.9	0.336	664
Trifoliate orange	1982	Severe Decline	8.4	12.6	0.388	609
Trifoliate orange	1981	Severe Decline	3.7	5.6	0.362	643
Trifoliate orange	1982	Severe Decline	5.8	12.4	0.408	669
Cleopatra mandarin	1981	Decline	8	7.7	0.217	850
Cleopatra mandarin	1982	Decline	11	11.6	0.272	725
Cleopatra mandarin	1981	Healthy	5	6.3	0.239	520
Cleopatra mandarin	1982	Healthy	5	8.8	0.235	496
Rough lemon	1981	Decline	2	4.4	0.184	399
Rough lemon	1982	Decline	19	8.7	0.259	468
Rough lemon	1981	Healthy	4	3.5	0.214	400
Rough lemon	1982	Healthy	13	7.1	0.236	414

TABLE 4
ABSORPTION OF WATER AND CONCENTRATION OF Zn AND PHENOLS IN THE WOOD OF 15-YEAR-OLD VALENCIA ORANGE TREES

Rootstock	Tree condition	Water absorption	Zn (ppm)	Phenols (mg/g)
Trifoliate orange	Decline	135	9	7.6
Trifoliate orange	Decline	15	12	9.0
Rangpur lime	Decline	14	4	7.9
Rangpur lime	Healthy	14	4	7.7

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