The Influence of Viruses on the Mineral Composition of Citrus Leaves

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ANALYSIS of citrus leaves has been widely used as a guide to fertilization practices. That rootstock and scion varieties both influence the inorganic composition of citrus leaves has been shown several times (2, 6, 8). Other factors such as virus diseases (1, 4) also affect the mineral composition of citrus leaves.

Whether the virus diseases, exocortis, xyloporosis, and psorosis, affect the inorganic composition of Baianinha navel orange [*Citrus sinensis* (L.) Osb.] leaves budded on Caipira sweet orange and Rangpur lime (*C. limonia* Osb.) rootstocks, is the subject of this investigation.

Materials and Methods

Nucellar Baianinha navel orange budded on Caipira sweet orange and on Rangpur lime rootstocks were used in the experiment. When still in the nursery each plant was inoculated twice with exocortis, xyloporosis, or psorosis viruses, singly or in combination. Tristeza virus was present in all trees in the experiment. Uniform plants of each combination were planted at 7 x 7 m spacing in randomized plots with 3 replications. Analysis of soil from the plots revealed the following average characteristics: pH—4.90, PO_4—.04 milligram equivalents, K—.11 mg e, Ca plus Mg—1.10 mg e, and Al—1.40 mg e.

All plants in the experiment were subjected to the same cultural practices, fertilization, and soil management. For mineral analysis, 6-month-old leaves were taken from fruiting terminal branches of 6-year-old trees of Baianinha navel orange in all plots in February. The levels of 5 macro- (N, P, K, Ca, and Mg) and 5 micro-elements (Zn, Mn, Cu, and Fe) were determined by methods described in previous papers (3, 5).

Results and Discussion

The averages of three analyses for each combination of scion and rootstock and virus are presented in Table 1. The viruses were observed to influence the levels of micro- and macro-elements in the leaves as follows.

EXOCORTIS.—The extent to which exocortis virus diminished the levels of Zn in leaves of trees on both rootstocks, reduced B and Fe levels in leaves of trees on Rangpur lime, and reduced the level of N in leaves of trees on both rootstocks was significant at the 5 per cent level. The level

TABLE 1. AVERAGE LEVELS OF 10 MINERAL COMPONENTS IN LEAVES OF BAIANINHA NAVEL ORANGE TREES ON CAIPIRA SWEET ORANGE AND RANGPUR LIME ROOTSTOCKS, INOCULATED WITH EXOCORTIS, XYLOPOROSIS, AND PSOROSIS VIRUSES, SINGLY OR IN COMBINATION[a]

Treatments	Minor elements					Macro-elements				
	Zn	Mn	B	Cu	Fe	N	P	K	Ca	Mg
	ppm					per cent				
On Caipira sweet orange										
root, control	17.3	25	81	8.0	225	2.5	.13	2.1	3.0	.4
+ exocortis virus	14.6	100	68	6.9	258	2.2	.12	1.9	3.0	.3
+ xyloporosis virus	14.3	42	63	7.6	240	2.5	.12	2.2	2.9	.3
+ psorosis virus	13.5	45	75	5.6	232	2.4	.13	2.1	2.9	.3
+ E + X + P	17.9	24	84	8.1	226	2.5	.13	2.0	3.0	.4
On Rangpur lime										
root, control	18.9	61	88	6.2	240	2.5	.12	1.6	2.8	.3
+ exocortis virus	17.0	95	68	5.8	207	2.3	.12	1.8	2.7	.3
+ xyloporosis virus	15.6	86	66	5.2	166	2.4	.12	1.7	2.9	.3
+ psorosis virus	15.9	59	88	6.4	228	2.4	.12	1.8	2.8	.3
+ E + X + P	16.7	43	80	5.7	193	2.4	.13	1.7	3.1	.4
L.S.D. at 5 per cent level	± 1.62	± 20.8	± 13.5	± 1.42	± 31.9	± .15	± .01	± .16	± .15	± .05

a. All trees including the controls were infected with tristeza virus. Each figure is the average of 3 determinations.

of K was increased significantly in the presence of exocortis when the rootstock was Rangpur lime.

XYLOPOROSIS.—This virus depressed Zn and B levels in the leaves of trees on both rootstocks. In the leaves of trees on Rangpur lime, the Fe level was depressed.

PSOROSIS.—The presence of this virus reduced Zn levels in leaves of trees on both rootstocks and the Cu level when the rootstock was Caipira sweet orange, but it did not affect significantly the levels of other minor or macro-elements.

EXOCORTIS PLUS XYLOPOROSIS PLUS PSOROSIS.—This combination of viruses reduced the Zn level of the leaves when the rootstock was Rangpur lime, but not when the rootstock was Caipira. The levels of the other minor and macro-elements were not affected significantly.

Conclusions

In the present studies the level of Zn was reduced by all three viruses in trees on both rootstocks. However, the three viruses in combination caused no reduction of minerals in leaves of trees on Caipira rootstock. This is an anomaly for which no explanation is known at present. The element B was reduced by exocortis and xyloporosis viruses when the plants were grown on both Rangpur lime and Caipira sweet orange.

The levels of N and K were significantly influenced only by the exocortis virus. The N level was decreased by exocortis virus irrespective of the rootstock. The K level was decreased only when the rootstock was Caipira and was increased on Rangpur lime rootstock. In the absence of all viruses except tristeza, the level of K in the leaves of trees on Rangpur lime rootstocks was depressed. Perhaps the acidity of the soil influenced the low results obtained for Zn and other elements (7). Trees growing on other soil types may show different mineral levels.

Fertilizer recommendations based on foliar diagnosis should consider that low levels of certain minor or macro-elements may not represent the lack of some elements in the soil or reduced availability but may result from the effects of virus infection.

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