Reaction of Nucellar Hamlin Orange on Rangpur Lime to Several Exocortis Strains

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Some citrus growers believe that exocortis may promote the production and early maturation of citrus trees, resulting in fruit from affected trees bringing better prices than fruit from normal trees. Calavan *et al.* (*1*) reported precocity of fruit production on diseased trees during the first years.

In this paper, nine groups of Hamlin orange trees, identical except for their content of exocortis virus, are compared with respect to yield and tree growth.

MATERIALS AND METHODS

In 1962, eight isolates of exocortis (*4*) classified as mild and severe were inoculated into Hamlin orange trees propagated from a single nucellar clone budded on Rangpur lime in the nursery. In January, 1964, the experimental trees were planted at Limeira Experimental Station, São Paulo, at 6.5 × 6.5-m spacing in a randomized design (two plants per plot, three replications). Control trees were free of exocortis, but carried tristeza virus.

Weight and number of fruits, physical and chemical qualities of fruit, and vigor of the trees were studied from 1968 to 1971. Volume of the trees was estimated by the formula $\frac{2}{3} \pi a^2 b$ (*7*); a being the average half diameter at the top of the tree at 1 m from the soil level and b the height of the tree.

TABLE 1

AVERAGE NUMBER AND WEIGHT OF FRUITS OF TWO TREES OF HAMLIN ORANGE INOCULATED WITH ISOLATES OF EXOCORTIS IN 1962

Strain of exocortis*	Average production in:								Total	
	1968		1969		1970		1971			
	No. fruit	Wt. (kg)	No. fruit	Wt. (kg)	No. fruit	Wt. (kg)	No. fruit	Wt. (kg)	No. fruit	Wt. (kg)
1	744	108	944	134	901	134	1,976	222	4,565	598
2	942	123	1,141	143	450	69	2,795	276	5,328	611
3	791	104	879	102	808	109	2,253	214	4,731	529
4	605	82	668	95	886	118	1,555	148	3,714	443
5	674	90	994	133	844	127	1,655	189	4,167	539
6	852	109	1,087	137	1,038	145	2,361	236	5,338	627
Average	768	103	952	124	821	117	2,099	214	4,640	558
7	647	86	721	100	843	110	1,218	136	3,429	432
8	817	104	821	114	1,097	146	1,458	150	4,193	514
Average	732	95	771	107	970	128	1,338	143	3,811	473
9	622	83	992	133	963	132	1,775	199	4,352	547

* 1 to 6 = mild; 7, 8 = severe; 9 = control.

TABLE 2
PHYSICAL AND CHEMICAL QUALITIES OF HAMLIN ORANGE FRUITS IN 1972, FROM TREES INOCULATED WITH EXOCORTIS VIRUS IN 1962

Date analyzed and exocortis type	Fruit characteristics					Ratio SS/A
	Av. weight	Av. no. seeds per fruit	Juice	Brix	Acid	
	gm		per cent	per cent	per cent	
May 8, 1972:						
Mild	187	4	48	8.3	0.69	12.0
Severe	178	4	46	7.5	0.71	10.6
Control	160	4	50	7.9	0.72	11.0
May 25, 1972:						
Mild	186	4	46	8.3	0.65	12.8
Severe	185	5	46	8.1	0.67	12.1
Control	169	4	49	8.1	0.64	12.7
June 23, 1972:						
Mild	176	4	45	8.6	0.58	14.8
Severe	172	4	46	8.6	0.62	13.9
Control	151	4	49	8.9	0.65	13.7

RESULTS

Production. The first production records in 1967 were favorable to the diseased trees, but generally were not of economic importance. Table 1 gives data from 1968 to 1971. Average production of the trees affected with the mild strains (treatments 1 to 6 inclusive) reached 68.4 kg per tree during this four-year period, almost the same as controls (treatment 9, 68.3 kg). Trees affected by severe exocortis (treatments 7 and 8) produced 59.1 kg per tree, 13 per cent less.

Growth. The exocortis strains had a different influence on the growth of the trees: the more severe the strain, the more stunted the tree. The average volume (cubic meters) of the trees, for the nine treatments, were: 1 = 14.50; 2 = 18.51; 3 = 13.53; 4 = 12.09; 5 = 14.20; 6 = 15.48; 7 = 10.59; 8 = 8.46; 9 = 22.86. The average for the mild strains was 14.72 m^3; for the severe strains, 9.50 m^3; and for the controls, 22.86 m^3.

Fruit analyses. Three analyses of fruits were made in 1972 (table 2).

DISCUSSION AND CONCLUSIONS

The effects of the strains of exocortis on production were statistically different at the 1 and 5 per cent levels in the *F* test, but by the Dunnet test (*2, 3*), at 5 per cent of bilateral probability, there was no difference. The trees carrying mild strains of exocortis produced the same yield on smaller trees as did the larger, healthy controls. Reduction in tree size without a corresponding reduction in yield appears to be economically advantageous. Such trees could be more closely spaced in the orchard and could be more economically picked than healthy controls. Exocortis-infected trees may be more drought-resistant (*6*). Severe strains reduced fruit production in comparison with controls, and induced more stunting than did mild strains.

Longevity of diseased trees and their over-all performance as compared with normal trees is not known. In a 36-year-old rootstock experiment conducted under similar ecological conditions as the experiments described above, Baianinha orange trees on trifoliate orange rootstock carrying severe exocortis still survive and produce fruit (*5*).

Check trees had smaller fruits than diseased ones, but fruits were more juicy. Brix and citric acid levels were the same, with the ratio increasing from May to June in all treatments.

Data do not support the idea that fruit matures earlier on diseased trees than on controls although the ratio of soluble solids/acid of fruit from trees carrying mild exocortis was higher than that from control trees on May 8 and June 23, but was not appreciably higher on May 25.

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