Damage from Exocortis in Japan

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EXOCORTIS WAS first recognized in Japan in 1963 by Dr. W. P. Bitters in some trees in the citrus variety collection at the Okitsu Branch, Horticultural Research Station (4). Since then a survey for the presence of the disease and a study of its effects have been made. The results are reported in this paper.

Results and Conclusions

EXOCORTIS SURVEY.—From 1963 to 1969, citrus plantings in the various prefectural experiment stations have been surveyed for exocortis by looking for stunting and bark shelling in the trifoliate orange rootstock on which the plants are grown.

Symptoms of exocortis were found in 57 trees, representing 31 varieties of 13 species of citrus (Table 1). The trees were severely stunted and exhibited characteristic bark shelling of their trifoliate orange rootstocks. Almost all these trees had been propagated with scions imported from foreign countries during the period 1920–40.

Surveys have also been made in commercial plantings of satsuma mandarin and natsudaidai trees, but no exocortis symptoms were seen in any of the trees. Orchards in Japan have thus far escaped damage from the disease.

INDEXING WITH ETROG CITRON.—Budwood of Etrog citron, USDCS 60-13, was imported from California and propagated on trifoliate orange rootstock. Two methods of indexing were employed. In one, 2-year-old potted seedlings of rough lemon or Marumera were budded simultaneously with Etrog citron and candidate tree buds according to the procedure of Calavan et al. (1). In the second, buds of Etrog citron were topworked on field-grown suspect trees at Okitsu and observed for about 1 year.

All 9 varieties of the affected field trees mentioned above indexed positive for exocortis virus. They were: Eureka and Everblooming lemon, common lumie, Marsh seedless and Thompson grapefruit, Bergamot sweet orange, Temple orange, takuma sudachi, and Cleopatra mandarin.

The indexing revealed that trees having other virus diseases—satsuma dwarf, citrus mosaic, Navel infectious mottling, and natsudaidai dwarf—but free of exocortis bark shelling, are free of exocortis virus. Thus, the causal agents of these diseases have no relation to exocortis virus. Apparently healthy satsuma mandarin and hassaku trees are also free of the virus.

In other experiments, Etrog citron buds were topworked on 3-year-old potted Temple orange trees not showing exocortis symptoms and on several old trees of Eureka and Everblooming lemon, common lumie, Marsh grapefruit, and takuma sudachi. Two to 6 months later, new shoots that grew from the citron buds developed severe epinasty. The results indicate that topworking with Etrog citron buds may be used as a quick and convenient field test for exocortis virus just as topworking with trifoliate orange and Rangpur lime can be.

TABLE 1. CITRUS VARIETIES AFFECTED BY EXOCORTIS IN JAPAN

Group	Number of Species	Number of Varieties	Number of Trees	Common name of affected tree
Lemon	1	6	16	Eureka, Lisbon, Villafranca, Genoa, Everblooming, Orange fleshed
Lumie	1	1	3	Common lumie
Shaddock	2	5	6	Suzuka, Egami, Kao Panne, Bannokan, Kawachi bankan
Grapefruit	1	3	7	Marsh seedless, Duncan, Thompson
Sour orange	1	1	1	Kikudaidai
Sweet orange	1	9	12	Bergamot, Fukuhara, Kanton, Malta, Mino, Navelencia, Pineapple, Valencia, Thompson navel
Tangor	1	1	4	Temple
Yuzu	1	1	4	Takuma sudachi
Mandarin	4	4	4	Shikaikan, Yuhikitsu, Cleopatra, Sunki
Total	13	31	57	

TREE SIZE AND FRUIT YIELD OF MARSH GRAPEFRUIT.—Three trees of Marsh grapefruit were propagated on trifoliate orange, yuzu, and yamamikan, respectively, in 1935 and transplanted to the field at Okitsu in 1937. Only the tree on trifoliate orange shows exocortis symptoms on the rootstock; the other 2 trees are growing vigorously. Height of tree, maximum and minimum diameter of crown, and trunk circumference were measured in 1967. Volume of crown was calculated as height × maximum diameter × minimum diameter × 0.7. The results (Table 2) demonstrate reduced tree size and fruit yield of the trees on trifoliate orange as compared with the trees on yuzu and yamamikan. By the citron test, these 2 healthy appearing trees also carry exocortis virus, indicating that yuzu and yamamikan as rootstocks are tolerant of exocortis virus.

EFFECT OF EXOCORTIS VIRUS ON SATSUMA MANDARIN.—In 1963, six 2-year-old potted satsuma mandarin trees on trifoliate orange were inoculated with buds from trees showing severe bark shelling on their trifoliate orange rootstock. Four noninoculated trees of the same kind served as controls. In May 1966, the trunk circumference 5 cm above the bud union and the total length of new shoots produced by these trees were measured. Newly developed shoots were cut back to 20 cm to force new growth.

TABLE 2. TREE SIZE AND FRUIT YIELD OF EXOCORTIS-AFFECTED MARSH SEEDLESS GRAPEFRUIT ON VARIOUS ROOTSTOCKS

Rootstock	Degree of bark shelling	Tree size: Height (m)	Max. dia. (m)	Min. dia. (m)	Trunk circumference (cm)	Volume of top crown (cm)	Fruit yield: No.	Weight (kg)
Trifoliate orange	severe	2.2	3.4	2.8	48	13.8	936	127.7
Yuzu	none	3.5	4.6	3.2	67	38.3	1993	360.4
Yamamikan	none	4.3	5.4	4.6	84	74.8	2764	590.2

Each year the shoots were measured and cut back until final measurements were made in 1968.

The results (Table 3) demonstrate a reduction of from 10 to 40 per cent in length of new shoots and trunk circumference in infected trees as compared with the controls. They support the reports by Sinclair and Brown (2, 3) that Owari satsuma mandarin is susceptible to exocortis virus and that growth and yield can be reduced by the disease. They answer the question whether satsuma mandarin on trifoliate orange in Japan is susceptible to exocortis virus—a very important question for the citrus industry of Japan.

TABLE 3. EFFECT OF EXOCORTIS VIRUS ON THE GROWTH OF SATSUMA MANDARIN NURSERY TREES

Months after inoculation	Ratio of inoculated/noninoculated: Length of new shoot	Trunk circumference
37	0.65	0.88
45	0.76	0.90
56	0.82	0.89
68	0.62	0.91

Literature Cited

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