The Development of Virus-Free Citrus Propagation in Chongqing, China

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ABSTRACT. Chongqing is located in a huanglongbing-free area. Citrus plantings occupied 40,733 ha with the production of 231,000 metric tons in 1994. Trifoliate orange and tangerine are the most important rootstocks. Citrus tristeza virus (CTV) is widely distributed, but since the main rootstocks used are CTV-tolerant, the damage caused by CTV is not generally apparent. A survey of six orchards of sweet orange grafted on trifoliate orange rootstock in four counties revealed that the average incidence of exocortis was 9.7%. The Virus-Free Citrus Propagation Project commenced in 1991 and 25 citrus cultivars or superior budlines of sweet orange, pummelo, satsuma and lemon have been introduced into the project. Indexing by biological indicators or ELISA revealed that of the 25 originally selected trees, five were infected with exocortis, one with tatter leaf, none with satsuma dwarf and 21 with CTV. The exclusion of exocortis and tatter leaf was the Project's main objective. All 25 cultivars or budlines involved have been shoot-tip grafted (STG). The tatter leaf-infected plants underwent thermotherapy for more than 40 days prior to STG. The progeny plants of STG were indexed to establish their exocortis and tatter leaf status. After indexing, the progeny plants were planted in a field mother block. Since the project was established, exocortis-free, tatter leaf-free and satsuma dwarf-free progenies of 21 cultivars or budlines have been planted in the mother block, and 225,500 budlings and 79, 000 budsticks have been distributed to growers.

Chongqing has a long history of citrus cultivation. Citrus orchards covered 40,733 ha and produced 231,000 metric tons of fruit in 1994. Production consisted primarily of sweet oranges and mandarins, but pummelos and lemons are also produced. Trifoliate orange and tangerine are the most important rootstocks.

Chongqing is located in a huanglongbing-free area, but exocortis is a problem in some orchards of sweet orange grafted on trifoliate orange rootstock. A survey made in 1986-1989 in six citrus orchards of Jiangjin, Hechuan, Jijiang and Tongnan counties indicated that the average incidence of exocortis was 9.7%. Biological indexing detected tatter leaf infection in a few trees. Citrus tristeza virus (CTV) is widely distributed, but since the main rootstocks are tolerant, damage caused by CTV is not apparent in citrus orchards.

The Virus Free Citrus Propagation Project of Chongqing commenced in 1990 (1). Twenty-five superior cultivars or budlines of common sweet orange, navel orange, satsuma, pummelo and lemon were selected in Chongqing for the project. The goal of the project is to obtain exocortis-, tatter leaf- and satsuma dwarf-free materials in order to establish a municipality-wide system of virus-free citrus propagation. Since CTV and its effective vector, *Toxoptera citricida* (Kirkaldy) are widely distributed in the area, CTV cannot be controlled by using CTV-free materials, the exclusion of CTV has not been emphasized in the project.

CTV-free plants of native sweet orange and pummelo varieties are maintained in an insect-proof screenhouse for use in international exchanges.

The 25 cultivars or budlines involved in the project were indexed for exocortis using Etrog citron Arizona 861-S-1, for tatter leaf with Rusk citrange and for satsuma dwarf and CTV by ELISA. Most trees were also indexed for CTV with Mexican lime indicator. The results of the indexing are listed in Table 1.

TABLE 1
INDEXING RESULTS OF CULTIVARS AND BUDLINES IN THE CHONGQING VIRUS-FREE PROPAGATION PROJECT

Cultivar and budline		Exocortis	Tatter leaf	Satsuma dwarf	CTV
Common sweet orange					
Jin-cheng	Beibei 447	-	-	-	+
	Tong-shui 72-1	-	-	-	+
	Jiang-jin 78-1	-	-	-	+
	Large leaf- large fruit	-	+	-	+
	Zhong-yu No. 7	-	-	-	+
	Xin No. 2	-	-	-	+
Xian-feng-cheng	He-mu 77-1	-	-	-	+
An-liu-cheng	Ba-xian No. 1	+	-	-	+
Valencia	Wang No. 3	-	-	-	+
	Algerian No. 1	-	-	-	+
Campbell	No. 6	-	-	-	+
Cutter	No. 2	-	-	-	+
Navel orange					
Newhall		-	-	-	+
Navelina		-	-	-	+
Washington	J-164	-	-	-	+
Robertson	Pu-di-shan 89-10	+	-	-	+
Skagg's Bonaza		-	-	-	+
Seike		+	-	-	+
Shirayanagi		+	-	-	+
Pummelo					
Sha-tian-you	Gu-lao-qian	-	-	-	-
	Ju-hua-zin	-	-	-	-
	87-5	-	-	-	-
Wu-bu-you		-	-	-	-
Okitsu satsuma	Ba-xian-qu-shui 8-4	-	-	-	+
Eureka lemon	Jing-ku 79-5	+	-	-	+

Indexing revealed that 5 of the 25 original trees were infected with exocortis, 21 trees were infected with CTV, and one tree was infected with tatter-leaf. No trees were infected with satsuma dwarf.

Shoot-tip grafting (STG) as described by Navarro et al. (2) was carried out for all of the 25 original trees. In addition, the tatter leaf infected sweet orange was subjected to thermotherapy prior to STG. Progeny budlings of this tree were kept in a greenhouse during the hot season for more than 40 days where the maximum temperature was frequently over 50°C.

STG-produced plantlets from exocortis-infected mother trees were indexed on Etrog citron to confirm the exclusion of exocortis. The progenies of the tatter leaf infected tree were indexed on Rusk citrange to confirm them tatter leaf-free. ELISA was used to test for CTV.

After STG and indexing, one to five STG plants, with generally four plants per cultivar or budline were established for further propagation. After preliminary propagation, four plants of each cultivar or budline were planted in a screenhouse for preservation, three to ten plants were planted in the mother block while others were planted in an increase block.

All pruning clippers and grafting knives used in mother block, increase block and nursery were routinely disinfected with sodium hypochlorite. CTV-free progeny of native sweet orange cultivars,

including Jincheng, Xian-feng-cheng and pummelos including Sha-tian-you and Wu-bu-you are kept in a screenhouse, for possible use in international exchanges.

Exocortis-, tatter leaf- and satsuma dwarf-free material obtained in the project have now been propagated, and 225,500 budlings and 79,000 budsticks have been released for commercial planting.

The trees planted in mother block should be evaluated for horticultural characteristics each year and indexed for exocortis, tatter leaf and satsuma dwarf infection every three years. Off-type trees or branches and infected trees should be discarded. Trees in the increase block should be used for only a 3-yr duration.

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