Screening of Rootstocks for Citrus Blight Tolerance in South Africa—Preliminary Results

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ABSTRACT. In 1985 a trial to screen various rootstocks for blight tolerance was established in Letsitele, South Africa. Rough lemon, Troyer citrange, trifoliate orange, Swingle citrumelo, Empress and Cleopatra mandarin were approach root grafted to blighted trees to test their susceptibility to citrus blight. After 42 months the majority of the grafted trees with the exception of Swingle citrumelo exhibited typical visual symptoms of blight. This was accompanied by zinc accumulation in the bark.

Citrus blight appears to affect most commercially grown scion varieties and rootstocks in the citrus producing areas of the world where blight occurs (6, 8, 9). The most susceptible rootstock variety appears to be rough lemon followed by the citranges, trifoliate orange, and Swingle citrumelo in that order. More tolerant rootstocks appear to be rootstocks such as Cleopatra mandarin, sweet orange, and sour orange (2, 3, 8).

Until the inception of the Citrus Improvement Programme in South Africa in 1973, practically all commercial citrus orchards were on rough lemon rootstock (7). Since 1976, however, although rough lemon has retained its dominance, other rootstocks such as Troyer citrange and Volkamer lemon have become more popular. The use of trifoliate orange as a rootstock has declined to zero. The use of the rootstock varieties Carrizo citrange, Swingle citrumelo, and trifoliate hybrid X639 are on the increase. Cleopatra mandarin was also used to some extent in the past.

The discovery of citrus blight in the hot humid citrus producing areas of South Africa (4) and the alarming rate at which the disease was spreading in mature orchards prompted an intensive research effort into screening a large number of rootstock varieties for tolerance to citrus blight in these areas. In 1985 an experiment to test the tolerance of six different rootstock varieties to blight by root grafting young trees to blighted trees was initiated. In 1989 another nine rootstock varieties were planted for screening purposes (Gou Tou, Orlando tangelo, Sampson tangelo, Marsh grapefruit, Volkamer lemon, X639 hybrid, Minneola x trifoliate hybrid, sweet orange, and Sunki mandarin).

This paper reports briefly on the preliminary results obtained in this trial after a period of 42 months.

MATERIALS AND METHODS

Virus-free Delta Valencia sweet orange scion material was used throughout. The rootstock varieties used included rough lemon, Troyer citrange, trifoliate orange, Swingle citrumelo, Empress and Cleopatra mandarin. The nursery trees were 2 yr old when planted in August 1985. The different rootstocks were planted in pairs equidistant from a 15-yr-old blighted donor. Three to four of the roots 5-6 mm in diameter of one of the pair of the young receptor trees was approach grafted to the roots of the donor tree. Seven pairs of each rootstock were planted. Non-grafted trees constituted the controls. The donor blight affected trees were selected using standard diagnostic techniques (5). The trees were treated with granular formulations of aldicarb and metalaxyl every 12 weeks. Visual monitoring of the blight status of the trees was conducted every 3 months. Canopy symptoms were rated on a scale of 0 = healthy, 1 = mild (initial signs of zinc deficiency or blotchy mottle on 2-4 leaves on one branchlet), 2 = moderate (zinc deficiency and blotchy mottle symptoms on at least two branchlets and on more than 4 leaves), 3 = severe (zinc defi-

ciency and blotchy mottle symptoms spreading throughout the canopy, leaves flaccid with canopy becoming sparse). Zinc concentration in trunk phloem tissue was determined by the method of Albrigo and Young (1). As the diameters of the trunks were still relatively small, bark samples were collected over the budunions in order to avoid girdling the trees.

RESULTS AND DISCUSSION

By March 1988 the first visual symptoms of blight were visible in the trees on Troyer citrange. By August 1988 visual symptoms of blight were observed also in trees on rough lemon and trifoliate orange. During the survey in February 1989 visual symptoms of blight were observed in Empress and Cleopatra mandarin; the trees on Swingle citrumelo were still free of any visual symptoms. Elevated zinc levels accompanied these visual symptoms (Table 1). The order of susceptibility of the trees on different rootstocks appears to be (Table 1): rough lemon, Empress mandarin, Troyer citrange, trifoliate orange, Cleopatra mandarin, Swingle citrumelo. This follows the pattern observed by other researchers based on observations of natural spread of blight (2, 3, 8, 9). The reaction of Empress mandarin was however unexpected, being a relative of Cleopatra mandarin it was expected to have exhibited more tolerance. The growth of trees on rough lemon, though the most vigorous of the combinations, was affected most. This was followed by Troyer citrange, trifoliate orange, Cleopatra and Empress mandarin, and Swingle citrumelo, in that order. Trunk growth of trees on Swingle citrumelo was least affected (Table 2). Although screening for blight tolerance by root grafting to blighted trees is a very severe method of challenge as it places extreme pressure on the young nursery trees, it is an effective method of screening and will remain so until more is known of the etiology of blight. This method of screening further demonstrates that citrus blight is caused by a graft transmissible infectious agent.

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TABLE 1
DIAGNOSTIC CHARACTERISTICS OF INDIVIDUAL RECEPTOR AND CONTROL TREES 42 MONTHS AFTER INITIATION OF EXPERIMENT

Rootstock		Mean canopy rating[z]	Blight incidence (%)	Bark Zn (μg/g)[y]
Rough lemon	R[x]	1.9	71.4	65*
	C	0.0	0.0	38
Empress mandarin	R	1.7	71.4	51*
	C	0.0	0.0	28
Troyer citrange	R	1.7	57.1	38*
	C	0.0	0.0	15
Trifoliate orange	R	1.3	57.1	26*
	C	0.0	0.0	13
Cleopatra mandarin	R	0.6	28.6	32[ns]
	C	0.0	0.0	24
Swingle citrumelo	R	0.0	0.0	27[ns]
	C	0.0	0.0	22

[z]Rated on scale of 0 = healthy to 3 = severe
[y]Mean of four samples collected from the least vigorous trees. Means of receptor trees which are significantly different from the comparable control trees by Student's t-test ($P \leq 0.05$) are indicated by *, while differences which are not significant are indicated by [ns].
[x]R = Receptor; C = Control

TABLE 2
MEAN HEIGHT AND TRUNK GROWTH OF RECEPTOR AND CONTROL TREES 42 MONTHS AFTER INITIATION OF EXPERIMENT

Rootstock	Height (m)		Trunk diameter[z] (cm)	
	R[y]	C	R	C
Rough lemon	1.9	2.3	3.4	4.1
Empress mandarin	1.7	1.7	2.6	2.7
Troyer citrange	1.5	1.6	2.3	2.4
Trifoliate orange	1.5	1.7	2.6	2.6
Cleopatra mandarin	1.7	1.7	2.7	2.4
Swingle citrumelo	1.6	1.7	2.8	2.8

[z]Measured 10 cm above bud union
[y]R = Receptor; C = Control

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