Virus Sensitivity of New Sweet Cherry Rootstocks

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Mature trees in sweet cherry orchards around the world are commonly infected with two viruses: prune dwarf virus (PDV) and Prunus necrotic ringspot virus (PNRSV). Mild strains of these viruses are pervasive but seldom adversely affect orchard trees of either sweet cherry varieties or their common rootstocks. However, several of the new rootstock clones now being considered as candidate stocks for improving precocity and size control are adversely affected by these viruses. Reported here are results of studies over several years on the sensitivity of many new rootstocks to these viruses. The work was conducted to develop information to assist growers and nurseries in making rootstock decisions for new plantings.

Preliminary results of a portion of this work were reported previously (Lang et al., 1996, 1998). The results of these tests correspond with earlier work performed on rootstocks from Giessen, Germany (Uphoff et al., 1991).

MATERIAL AND METHODS

Field Tests

A portion of trees propagated for the NC-140 rootstock trials (planted in 1998) were planted to a split plot design at WSU-Prosser. Five replicates, each containing 4 trees of the candidate rootstocks, were established in the spring of 1998. A set of trees of three additional rootstocks was planted in the spring of 1999. These were similarly replicated. The scion portion (cv. Bing) of one tree of the four was inoculated with PNRSV, another with PDV and a third with both viruses on June 3, 1999. Inoculations were performed by chip-grafting infected bark and woody tissue to 2- and 3-year-old branches in the scion portion of test trees. The fourth tree of each set was left as a non-inoculated control. The trees were then observed and evaluated over the next two growing seasons.

The rootstocks in the study included several from Giessen, Germany [Gisela 6 (initially identified as GI 148-1), Gisela 5 (GI 148-2), Gisela 7 (GI 148-8), GI 195-20, GI 209-1, GI 318-17, and Gisela 4 (GI 473-10)], Edabriz, Mazzard seedling, *Prunus mahaleb* seedling (Mahaleb), P50, and the Weiroot clones W10, W13, W53, W72, W154, and W158. The second set of trees planted in 1999 included PHL-A, PHL-B and Maxma 14. The scion varieties on the PHL-A and PHL-B trees were a mixture of Bing, Sweetheart, Hedelfingen, Rainier, Royal Ann and Ulster.

The treatments were evaluated periodically for visual symptoms of tree death, gumming, leaf distortion, leaf color and vigor. Based on these observations, the reaction of the rootstocks to virus was then categorized as lethal (died in the presence of the virus), severe (strong adverse response, but non-lethal within 2 years), sensitive (mild virus symptoms noted but the tree not affected severely), and tolerant (no symptoms).

In addition to this test, similar field studies that were reported previously (Lang et al., 1996, 1998) are incorporated into the results to provide a current summary of our work on this group of rootstocks. Additional rootstocks included in these previous studies include Colt, Gisela 8 (GI 148-9), GI 154-7, GI 169-15, GI 172-7, Gisela 1 (GI 172-9), GI 173-1, Gisela 10 (GI 173-9), Gisela 11 (GI 195-1), GI 196-4, Gisela 12 (GI 195-2), GI 497-8, MxM2, MxM60, GM9 (Inmil), GM61/1 (Damil) and GM79 (Camil).

. . . several . . . new rootstock clones . . . for improving precocity and size control are adversely affected by . . . viruses.

Tests at Nurseries

Healthy Bing sweet cherry buds and buds with a combined infection of PNRSV and PDV were budded onto clonal rootstocks at four nurseries located in Washington State. The respective nursery budding crews chip or T-budded these buds onto 5 to 10 trees of each of 3 clonal rootstocks at each nursery. The clonal stocks were Gisela 6 (a PDV and PNRSV tolerant stock), Gisela 7

(a PNRSV sensitive stock) and Gisela 11 (a PDV sensitive stock).

Greenhouse Testing

A more rapid test to appraise virus sensitivity of new cherry rootstock candidates was evaluated under greenhouse conditions. A double budding technique was used. A dormant bud of the candidate clone was chip budded to a year-old *Prunus mahaleb* rootstock just after bud break. At the same time, two chips of tissue infected with virus were budded directly below that bud. By this method candidates were thus challenged by PDV, PNRSV, both viruses or left non-inoculated. One week later the mahaleb rootstock was cut off just above the candidate bud to induce its growth. Each treatment for each candidate rootstock was applied to four trees.

Virus Isolates

The PNRSV (Fulton G), PDV (CH62) and combined PNRSV/PDV (CH39) isolates used in this study were stored in mature trees of Bing sweet cherry on mahaleb rootstock. These isolates cause little, if any, visible symptoms on Bing. Tissue for inoculations was collected from the previous season's growth of these same trees.

RESULTS AND DISCUSSION

Field Tests

Virus-inoculated trees on specific rootstocks in the field tests started showed leaf bronzing, rolling and reddening within 2 months of being inoculated. Most of the PDV-inoculated trees on Gisela 4 were dead by this time. By October, all PDV-inoculated trees and two of the PNRSV-inoculated trees on this stock were dead. Other rootstocks that demonstrated strong sensitivity to one or both of the viruses by September of the following year were: W10, W13, W53, W154, GI 148-8 and GI 195-20. Tolerant clones included Edabriz, Gisela 6, Mahaleb, Mazzard, PHL-A, PHL-B and Maxma 14. A summary of the virus sensitivity of the various rootstocks in this and previous trials is given in Table 1.

Since these viruses are nearly ubiquitous in mature cherry orchards around the world, it would be wise not to use the virus-sensitive rootstock clones on a large commercial scale. Orchards established on these stocks should be isolated from other infected trees and from bees carrying virus-laden pollen.

Tests at Nurseries

Nursery trees were similarly affected by these two viruses. Virus-infected buds placed on sensitive rootstocks often did not survive. The results were nearly identical at all four nurseries participating in the study. In this study the overall percent bud-take for the healthy buds ranged between 56 and 76%. Bud-take of virus-infected buds on Gisela 6 was also 56%. However, bud-take for virus-infected buds on Gisela 11 was zero and on Gisela 7 only two of the 25 infected buds grew (Table 2).

It is obvious that use of budwood from non-certified sources to propagate trees on these virus-sensitive clones is very risky. Few, if any, trees will be successfully propagated and grown for sale if virus-infected budwood is used.

Greenhouse Testing

The validity of the more rapid greenhouse test was determined by comparing such results with those from field trees. Seventeen candidate rootstocks were tested in

TABLE 1

Sensitivity of cherry rootstocks to prune dwarf (PDV) and Prunus necrotic ringspot (PNRSV) viruses (-=tolerant, ?=inconclusive, +=sensitive, *=lethal or severe reaction, blank=no test).

Sensitivity category	Rootstock clone	PNRSV	PDV	Both
Tolerant	Colt			-
	Edabriz	-	-	-
	Gisela 6 (GI 148-1)	-	-	-
	Gisela 5 (GI 148-2)	-	-	-
	GI 169/15			-
	Gisela 12 (GI 195-2)			-
	GI 196-4			-
	GM 9 (Inmil)			-
	GM 61/1 (Damil)			-
	Mahaleb	-	-	-
	Mazzard	-	-	-
	Maxma 14[1]	-	-	-
	MxM 2			-
	MxM 60			-
	P50	-	-	-
	PHL-A[1]	-	-	-
	PHL-B[1]	-	-	-
Inconclusive or mild reaction	GI 209-1	?	?	?
	GI 318-17	?	?	?
	GI 497-8	?	+	?
	W72	-	?	+
	W158	?	?	?
Virus-sensitive	Gisela 7 (GI 148-8)	*	-	*
	Gisela 8 (GI 148-9)			*
	GI 154-7			*
	GI 172-7			*
	Gisela 1 (GI 172-9)	*	*	*
	GI 173-1	*	*	*
	Gisela 10 (GI 173-9)			*
	Gisela 11 (GI 195-1)	-	*	*
	GI 195-20	*	*	*
	Gisela 4 (GI 473-10)	*	*	*
	W10	-	*	*
	GM 79 (Camil)			*
	W13	-	*	*
	W53	-	*	*
	W154	-	*	*

[1] = preliminary data

TABLE 2

Effect of rootstock on bud-take of PDV and PNRSV-infected buds at commercial nurseries.

	Surviving plants (of 25 budded)	
Rootstock clone	Non-inoculated	Inoculated with PDV & PNRSV
Gisela 6 (GI 148-1)	17	14
Gisela 7 (GI 148-8)	19	2
Gisela 11 (GI 195-1)	14	0

both locations. With 12 of the 17 rootstocks, the results from both locations matched (Table 3). In four cases (GI 195-20, GI 318-17, W154 and W158), the field evaluation indicated that the rootstock clones were more sensitive to virus than the greenhouse test suggested. In one case (W72) the greenhouse test suggested the rootstock to be more sensitive than what was observed under field conditions. However, in no case did the greenhouse test suggest the extreme, that a tolerant clone was severely virus-sensitive or vice versa. Although the effects of a single infection by one of the two viruses are not depicted in Table 3, those effects were similar between both types of tests. These comparisons show that the greenhouse test is a reasonable indicator of a clone's potential field sensitivity to PDV and PNRSV. While the greenhouse tests are not quite as representative as the field tests to orchard conditions, breeders and others could effectively use this test to rapidly evaluate new rootstock candidates before advancing them for production and orchard development.

TABLE 3

Comparison of cherry rootstock virus sensitivity between field and greenhouse experiments. Symbols represent combined infections of Prunus necrotic ringspot virus and prune dwarf virus (-=tolerant, ?=inconclusive, +=mild virus symptoms, **=severe reaction, ***=lethal reaction).

Rootstock	Greenhouse	Field	Rootstock	Greenhouse	Field
Gisela 6	-	-	W10	***	***
Gisela 5	-	-	W13	***	***
Gisela 7	**	**	W53	***	***
Gisela 1	***	***	W72	***	+
Gisela 11	***	***	W154	+	***
GI 195-20	+	***	W158	?	+
GI 209-1	+	+	Mazzard	-	-
GI 318-17	?	+	*Prunus mahaleb*	-	-

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