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'Rio Oso Gem' and 'Loring' Peach Flower Bud and Wood Hardiness as Affected By Different Rootstocks

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Abstract

Fourth leaf 'Rio Oso Gem' and 'Loring' peach (*Prunus persica* (L.) Batsch.) on their own roots or budded to nine rootstocks (Tzim Pee Tao, Harrow (H) 7141041, H7141049, H7338013, H7141064, H7338001, H7141137, Lovell, Halford, or Sinung Chumi) were evaluated for rootstock effects on flower bud hardiness after field exposure to -23°C in 1987 and -26°C in 1988. 'Rio Oso Gem' flower buds were hardier on H7141064 compared to H7141049 in 1987. 'Loring' flower buds were hardier on H7338001 compared to Tzim Pee Tao, H7141041, Sinung Chumi, self-rooted and H7141137 in 1988. In addition, 'Loring' flower buds on Lovell were hardier than on H7141137 or self-rooted 'Loring' trees. Pooled yearly data suggests that 'Loring' flower buds on H7338001 were hardier than 'Loring' on Tzim Pee Tao, H7141137 and self-rooted trees. No significant rootstock effect on 'Rio Oso Gem' flower bud hardiness was detected with pooled data. Controlled freezing tests indicated both a date and a rootstock effect on 'Loring' wood hardiness. Wood hardiness was low in November and increased to a maximum in January and March. 'Loring' wood hardiness on Tzim Pee Tao decreased in March compared to January. 'Loring' wood hardiness in January was lower in trees budded to Lovell compared to 'Loring' budded to H7338001, Sinung Chumi or Tzim Pee Tao.

Introduction

The major limiting factor preventing consistent peach production in much of the eastern US is the lack of sufficient flower bud hardiness. Selection of appropriate rootstocks which enhance flower bud hardiness could increase the likelihood of consistent cropping (1, 2, 3). Identification of suitable rootstocks is necessary before such an approach can be implemented. Limited information on specific rootstock effects on flower bud hardiness is available. 'Redhaven' flower buds budded to Siberian C were hardier than those budded to Harrow Blood or Rutgers Red Leaf (2) or when budded to Lovell (6).

Rootstock also affects wood tissue hardiness (2, 3, 6, 8). 'Redhaven' wood was hardier when budded to Lovell, Halford or NA 8 than when budded to Siberian C, Harrow 208, NRL 4 or 152AI-2 (7). Enhanced wood hardiness of 'Redhaven' on Siberian C has been reported (2) and was partially attributed to early scion dormancy on Siberian C compared to other rootstocks. This study was initiated to determine the effects of rootstock on scion flower bud and wood hardiness of 'Rio Oso Gem' and 'Loring.'

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Materials and Methods

Fourth leaf 'Rio Oso Gem' and 'Loring' peach (*Prunus persica* (L.) Batsch.) on their own roots or budded to nine rootstocks (Tzim Pee Tao, Harrow (H) 7141041, H7141049, H7338013, H7141064, H7338001, H7141137, Lovell, Halford, or Sinung Chumi) in a split plot designed orchard at Rutgers Fruit Research Center, Cream Ridge, NJ were used in this study. Main plot was cultivar and subplots were rootstocks. Main plots were arranged in a randomized complete block replicated 10 times. On 28 January 1987, the minimum orchard temperature went below -23°C (thermograph limit) for 4 hours. On 15 January 1988 the minimum orchard temperature was -26°C.

On 12 February 1987, twelve unbranched terminal shoots 30 cm ±5 cm were sampled from the periphery of three random trees per scion, thus the sampling design was a split plot with main plots completely random. Hardiness (bud viability) was determined by dissection and is expressed as a percentage of buds live.

On 21 January 1988 3 unbranched terminal shoots 30 ±5 cm at 1 M height were sampled from each tree from 3 replicates. Bud viability was determined by dissection.

Data for both years were combined and an analysis of variance (ANOVA) performed using a split split plot model with cultivar as main plot in a completely randomized design, rootstock as sub plot and year as sub-sub plot as suggested by Pearce (4). Main effect means were separated with the Ryan-Einot-Gabriel-Welsch (REGWF) multiple F test.

Wood hardiness of 'Loring' scion wood from four of the rootstocks (Lovell, Sinung Chumi, Tzim Pee Tao, and H7338001) was determined on 4 dates (11 November, 15 December, 12 January, and 4 March 1986-87) by the electrical conductivity method (9). Three single trees were sampled for each scion. Terminal shoots were collected and prepared for freezing in the field between 8 and 10 am. Two cm sections of nodal tissue with flower buds attached were placed in plastic bags in Dewar flasks and brought to the lab for freezing in a Revco Ultra Low freezer. Samples were frozen at the rate of 10°C/hr, and removed at -15°, -20°, -25° and -30°. A non-stressed control sample was also taken. Samples were allowed to thaw in Dewar flasks overnight to room temperature (21°), flower buds removed and the remaining tissue transferred to test tubes with 10 ml HPLC grade water (18 MOhm resistivity, 0-5 uohms conductivity). Samples were held at 21° for 24 hrs and conductivity of the leachate measured. Samples were autoclaved at 120°C, 15 lbs pressure for 20 minutes. Twenty-four hours after autoclaving, conductivity was remeasured. Wood hardiness is expressed as 1 - (C1/C2) where C1 = post stress conductivity and C2 = conductivity after autoclaving.

Data were analyzed separately for each date and scion by regressing wood hardiness on stress temperature considering both linear and quadratic components. Homogeneity of regression coefficients was tested within date to detect differences among scion combinations (7).

Variability within a stion was estimated for % live flower buds by using Leven's test for homogeneity of variances (5). Lower variability from tree to tree within a stion may provide a measure of consistency from tree to tree within a stion. Absolute deviations from the mean were subjected to an ANOVA and mean deviations separated with the REGWF test.

Results and Discussion

The ANOVA for % live flower buds indicated significant cultivar by rootstock and year by rootstock interactions. To simplify discussion, rootstock effects for each cultivar in each year will be presented as well as rootstock effects on each cultivar pooled over the two years.

1987 Flower Bud Hardiness Assessment. A significant rootstock effect on flower bud hardiness was detected for 'Rio Oso Gem' but not for 'Loring' (Table 1). 'Rio Oso Gem' flower buds on H7141064 were significantly hardier than those on H7141049 (Table 1).

1988 Flower Bud Hardiness Assessment. A significant rootstock effect was detected for 'Loring' but not 'Rio-Oso-Gem.' In general, buds were hardier in 1988 than in 1987 due to colder temperatures prior to the stress in 1988 compared to warmer temperatures prior to the stress in 1987. 'Loring' buds on H7338001 were significantly hardier than those on Tzim Pee Tao, Sinung Chumi, H7141041, H7141137 and self-rooted trees (Table 1). In addition, 'Loring' buds on Lovell were hardier than those on H7141137 or self rooted trees.

Variability of Flower Bud Hardiness. To be commercially useful, a rootstock should be consistent from tree to tree as well as imparting hardiness to the scion. Testing for significant departure from the assumption of homogeneous variances within rootstock provides a test for consistency. In 1987, variability of 'Rio Oso Gem' hardiness on Tzim Pee Tao was signifi-

Table 1. Flower bud hardiness and variability of hardiness expressed as absolute values of the deviations from the mean for Loring and Rio Oso Gem peach on 9 rootstocks under field exposure to -23°C in 1987 and -26°C in 1988.

	Loring					
	1987		1988		Combined years	
Rootstock	% Live buds	|Dev|	% Live buds	|Dev|	% Live buds	|Dev|
Tzim Pee Tao	9.7 A[z]	0.05 A	26.0 BC	0.07 AB	17.8 B	0.08 C
Harrow 7141041	17.0 A	0.03 A	32.3 BC	0.14 AB	24.7 AB	0.12 BC
Harrow 7141049	17.7 A	0.04 A	53.3 ABC	0.22 AB	35.5 AB	0.23 ABC
Lovell	12.0 A	0.03 A	66.0 AB	0.22 A	39.0 AB	0.29 AB
Harrow 7338013	20.7 A	0.01 A	36.3 ABC	0.03 B	28.5 AB	0.08 C
Harrow 7141064	14.7 A	0.02 A	43.7 ABC	0.21 AB	29.2 AB	0.16 ABC
Sinung Chumi	15.0 A	0.02 A	24.0 BC	0.05 AB	19.5 AB	0.06 C
Harrow 7338001	11.7 A	0.03 A	83.0 A	0.09 AB	47.3 A	0.36 A
Self-rooted	14.7 A	0.06 A	16.0 C	0.07 AB	15.3 B	0.06 C
Harrow 7141137	15.7 A	0.04 A	13.7 C	0.05 B	14.7 B	0.04 C

	Rio Oso Gem					
	1987		1988		Combined years	
Rootstock	% Live buds	|Dev|	% Live buds	|Dev|	% Live buds	|Dev|
Tzim Pee Tao	21.0 AB	0.22 A	32.3 A	0.14 A	26.7 A	0.19 A
Harrow 7141041	25.3 AB	0.01 B	31.3 A	0.20 A	28.3 A	0.11 A
Harrow 7141049	3.7 B	0.02 B	56.7 A	0.24 A	30.2 A	0.30 A
Lovell	12.0 AB	0.02 B	44.7 A	0.19 A	28.3 A	0.18 A
Harrow 7338013	10.3 AB	0.05 B	27.7 A	0.10 A	19.0 A	0.11 A
Harrow 7141064	31.3 A	0.03 B	53.7 A	0.14 A	42.5 A	0.13 A
Sinung Chumi	13.0 AB	0.01 B	56.3 A	0.22 A	34.7 A	0.22 A
Harrow 7338001	6.3 AB	0.02 B	37.0 A	0.06 A	21.7 A	0.15 A
Self-rooted	15.7 AB	0.02 B	30.0 A	0.03 A	22.8 A	0.07 A
Harrow 7141137	15.0 AB	0.05 B	39.3 A	0.16 A	27.2 A	0.15 A

[z]Mean separation within year and scion cultivar by R-E-G-W-F test, 0.05 level.

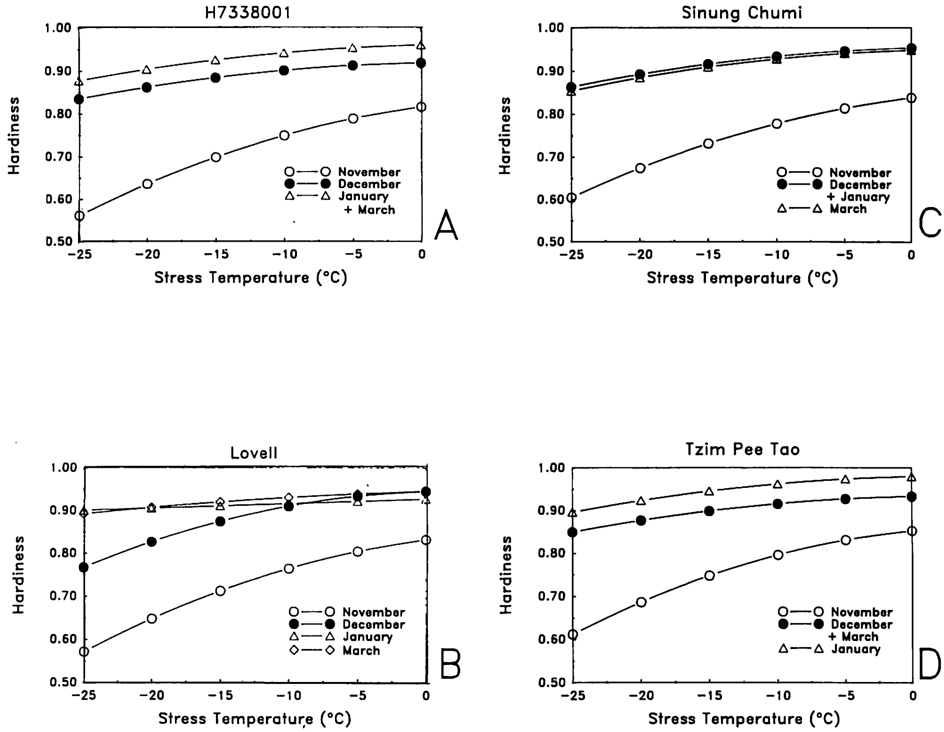

Figure 1. Hardiness of one year old wood of 'Loring' peach budded to four rootstocks. Different lines within rootstock indicate statistically significant differences over time.

cantly greater than on any other rootstock as shown by the absolute deviations from the mean in Table 1 as suggested by Levene (5). In 1988 variability of 'Loring' bud hardiness was greater on Lovell compared to H733-8013 and H7141137. No differences for 'Rio Oso Gem' bud hardiness variability were detected.

Pooled 1987-1988 Flower Bud Hardiness. Pooled over the two year test, rootstock did not influence flower bud hardiness or variability of flower bud hardiness in 'Rio Oso Gem' (Table 1). Rootstock did influence flower bud hardiness and variability of flower bud hardiness of 'Loring' pooled over two years. 'Loring' flower buds on H733-8001 were significantly hardier than those on Tzim Pee Tao, H7141137 or self rooted trees. Variability of 'Loring' flower bud hardiness was significantly affected by rootstock when deviations are pooled over two years (Table 1). Variability was high on H7338001 compared to Tzim Pee Tao, H7141041, H7338013, H7141137, Sinung Chumi or self rooted trees. Variability was also high on Lovell compared to Tzim Pee Tao, H7338013, H7141137, Sinung Chumi or self rooted trees. While H733-8001 imparted significant hardiness to 'Loring' flower buds, its variability was also high which may be undesirable, since consistent hardiness from tree to tree is preferred. However,

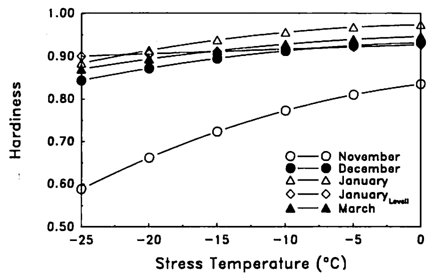

Figure 2. Hardiness of one year old wood over time for 'Loring' peach on four rootstocks. Unless otherwise indicated, rootstocks were combined and presented as one line for each of the test dates.

variability may be desirable if the rootstock effect is lost at extremely low temperatures, since then at least a few trees may have live flower buds.

Wood Hardiness. Hardiness values are presented in Figure 1 for individual rootstocks as predicted lines from the regression analysis. Sampling date differences are indicated by separate lines.

Hardiness of 'Loring' on Harrow 7338001 was low in November and increased significantly in December. Hardiness in January and March was not different from each other and was significantly different from November or December hardiness (Figure 1A).

Hardiness on Lovell was similar to that on Harrow 7338001 except that January and March were statistically different from each other (Figure 1B). The difference was so slight that the practical significance is questionable.

Hardiness on Sinung Chumi was low in November and increased to its highest level in December and January (Figure 1C). March hardiness was slightly lower than December and January levels. Sinung Chumi root system hardiness has been reported as 'medium tender' (1).

Hardiness on Tzim Pee Tao increases from November through January but decreases in March to levels found in December (Figure 1D).

Rootstock effects on hardiness within dates are presented in Figure 2. Hardiness of 'Loring' on Lovell in January was significantly lower than on the other three rootstocks. Generally, wood hardiness was low in November but increased dramatically by December and remained relatively high through March.

This survey detected a significant effect of rootstock on scion flower bud hardiness under field conditions. 'Loring' scion wood hardiness is affected by rootstock, however sampling date has a much greater influence than rootstock. Assessment of other attributes such as yield, suckering and resistance to adverse soil conditions must be made to supplement these observations.

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