Bud Hardiness of Peach Cultivars in Utah

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Abstract

Thirteen peach and one nectarine cultivars were tested for bud hardiness during the winters of 1974-1975, 1975-1976, and 1976-1977. Killing temperature ranged from −4 to −25.2 C during the winters. All cultivars attained maximum hardiness during early January. The average range in bud hardiness among cultivars was 2.1 C. The greatest range in T_{50} temperatures (8.4 C) occurred in early October, 1976. Among the cultivars 'Reliance' was the hardiest, while 'Velvet' and 'Washington' were the tenderest.

Introduction

Few investigators have compared the hardiness of peach cultivars in killing chambers (2), others have surveyed damage following a severe winter or late spring freeze and reported the relative survival of peach blossoms (12). While such studies are useful, they do not show comparative hardiness of cultivars throughout the winter. By developing a killing chamber with an automatic retrieval system at Utah State University, we have been able to determine killing (T_{50}) temperatures of quantities of buds heretofore impractical.

It has been recognized that rootstocks (3, 5, 6), cultural practices (7), applied growth regulators (4, 9), and predisposing temperatures (8) influence cold hardiness of peach trees. However, hardiness difference among cultivars are primarily of genetic origin. The purposes of this study were to compare the bud hardiness of several peach cultivars throughout three winters and to determine if any observed differences were correlated with different rates of spring bud development.

Materials and Methods

Composite samples of terminal shoots, eight to ten inches in length, from two or more trees of each cultivar were collected from the south side of eight-year-old peach trees grown

Table 1. Bud Hardiness of Peach Cultivars 1975-1976

	T_{50} Temperature (°C)									
Cultivar	11/13/75	12/19/75	1/7/76	1/20/76	2/18/76	2/27/76	3/19/76	4/8/76	4/21/76	5/3/76
Reliance	−22.8	−24.6	−25.2	−24.0	−23.1	−20.3	−19.3	−8.9	−8.4	−6.0
Jefferson	−22.4	−23.7	−24.1	−22.5	−23.2	−20.1	−17.2	−8.0	−7.9	−4.8
Gleason	−22.6	−23.9	−24.0	−23.0	−22.2	−20.4	−17.5	−7.0	−8.1	−4.1
Sunhaven	−22.3	−23.9	−23.2	−22.7	−22.2	−19.3	−18.3	−6.6	−7.9	−4.4
Redhaven	−20.7	−23.7	−24.2	−22.6	−22.3	−19.7	−18.2	−7.1	−7.9	−4.4
Redgold nectarine	−21.1	−23.7	−23.9	−22.8	−22.3	−20.0	−18.6	−6.6	−7.2	−4.4
Redskin	−22.7	−23.3	−23.4	−22.5	−22.4	−20.1	−18.2	−6.4	−6.1	−4.4
Johnson	−21.6	−23.3	−22.8	−22.3	−22.0	−19.6	−18.6	−7.6	−6.8	−4.3
Regina	−21.4	−23.4	−23.8	−22.9	−22.0	−19.3	−17.8	−6.0	−7.9	−4.2
Red Globe	−21.6	−23.3	−24.2	−22.7	−22.1	−19.6	−17.8	−5.6	−6.8	−4.4
Richhaven	−22.3	−22.3	−23.7	−22.6	−22.2	−19.2	−18.3	−6.8	−6.2	−4.3
Washington	−20.7	−23.2	−23.9	−22.5	−22.3	−19.7	−18.6	−6.7	−6.1	−4.6
Velvet	−20.6	−22.2	−23.2	−22.1	−21.9	−18.9	−17.9	−5.0	−6.4	−4.1
	Chill Unit Accumulation									
	400	710	742	830	994					

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on common seedling rootstock during the winter of 1974-75. The shoots were divided into six bundles and placed in a freezing unit programmed to cool at a rate of 1.1 C per hour. Bundles were retrieved automatically at two-hour intervals. Forty eight hours later, 50 buds per cultivar from each killing temperature were cut and their percent survival determined by visual observation of flower browning. Percentages were plotted and a curve constructed that would allow extrapolation of the T_{50} (50% bud survival) temperature (10). It was later found that assaying 30 buds per cultivar at each retrieval time would give nearly as accurate a T_{50} estimation; this sample size was used throughout 1975-76 and 1976-77.

During the second year 12 peach and one nectarine cultivar were tested 10 times during a period from mid-November until full bloom the following April and May. Budwood was collected from the same two or three-tree replication of each cultivar throughout the sampling season. Six representative cultivars from the studies of 1975-76 plus 'Delp Early Hale,' which growers reported to be quite hardy, were further tested during 1976-77 beginning in early October prior to leaf fall.

Results and Discussion

The winter of 1975-76 was a mild one for Utah. The coldest temperature recorded at the Farmington Field Station was −18 C January 2nd. All peach cultivars tested had a T_{50} temperature lower than −22 C on January 7 (Table 1). No winter injury was observed on any fruit cultivar that year. Considerable variation in bud hardiness was observed between cultivars. 'Reliance' had the lowest T_{50} at every sampling date and was significantly hardier than all other peaches evaluated (Table 2). Conversely 'Velvet' and 'Washington' tended to be bud tender and were less hardy than most other cultivars.

Table 2. Relative Bud Hardiness and Bloom Date of Peach Cultivars

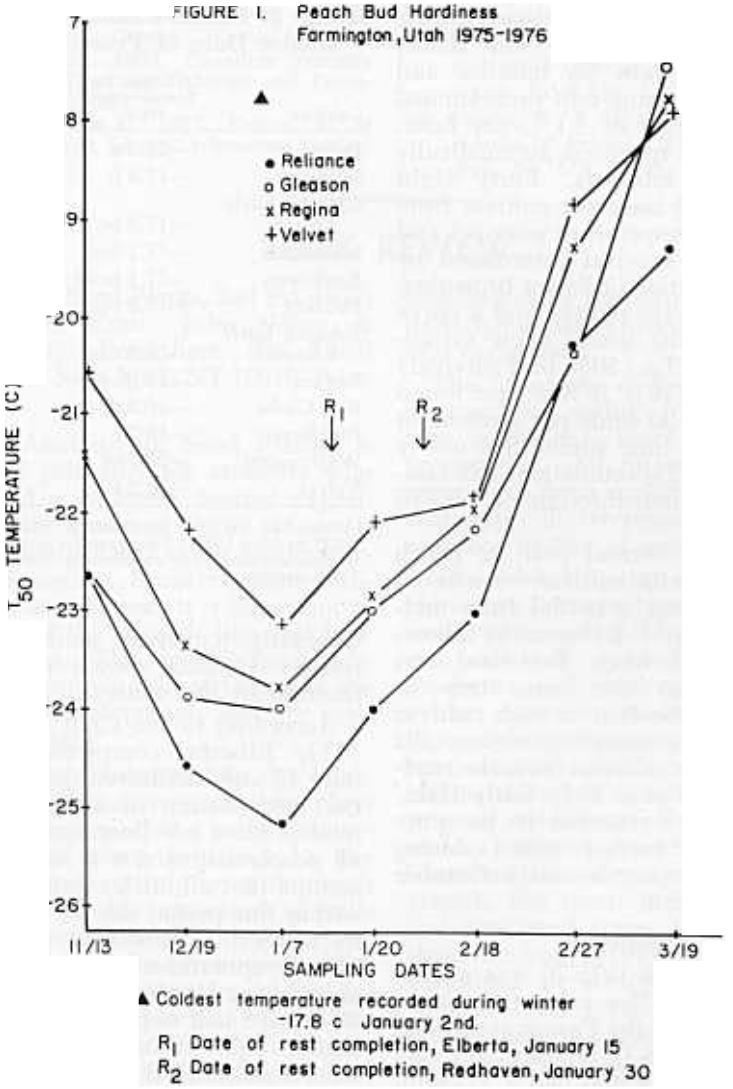
Cultivar	Average T_{50} Temperature[1] (°C)	Date of First Bloom
Reliance	−18.3 a	4/30/76
Jefferson	−17.4 b	4/25/76
Gleason Early Elberta	−17.3 bc	4/25/76
Sunhaven	−17.1 bcd	4/28/76
Redhaven	−17.1 bcde	4/27/76
Redskin	−17.0 cde	4/21/76
Johnson Early Elberta	−16.9 cde	4/21/76
Regina	−16.9 cde	4/27/76
Red Globe	−16.8 de	4/28/76
Richhaven	−16.7 e	4/27/76
Washington	−16.7 ef	4/28/76
Velvet	−16.2 f	4/21/76

[1]Average of ten T_{50} temperatures from November 1975 to May 1976. Temperatures not followed by a common letter are significantly different by .05 LSD analysis.

Generally, cultivars maintained the relative ranking shown in Table 2 throughout the winter.

According to the Chill Unit Model (11), 'Elberta,' completed rest January 15 and 'Redhaven' January 30 at the field station in 1976. Although models have not been completed for all peach cultivars, it is reasonable to assume that all others terminated rest within this period due to the similarity of their hardiness curves (Figure 1). Temperatures warmed considerably during late February and March. By April 8 half of the growing-degree-hours required for full bloom had been accumulated. A consequent loss in bud hardiness was evident (of T_{50} 3/19/76 with 4/8/76, Table 1).

Superficially, bud hardiness appeared to be correlated with the date of flowering. 'Reliance,' the hardiest cultivar being evaluated, was the latest to flower and 'Velvet,' the tenderest, was one of the earliest to bloom. However, 'Redskin' and 'Johnson Early Elberta' blossomed with 'Velvet' and both were significantly hardier. Furthermore 'Jefferson' and 'Gleason



Early Elberta' blossomed three days earlier than 'Red Globe' or 'Washington' and both were significantly more cold hardy than the latter. On the last (in-bloom) sampling date, 'Reliance' was signifiicantly hardier than the other tested cultivars. Hardiness, therefore, did not appear to be correlated with date of flowering in peaches. Similar observations have been recorded in almonds (1).

The peach cultivars differed significantly in their rate of bud hardiness development in the fall. On the October 5, 1976 sampling date, a 8.4 C difference in T_{50} temperatures was observed (Table 3). Although 'Delp Early Hale' developed a hardiness level nearly as great as 'Reliance' by mid-winter, it was tender in October. Conversely, 'Velvet,' which is relatively bud tender in mid-winter, began

Table 3. Bud Hardiness of Peach Cultivars 1976-1977

Cultivar	T_{50} Temperature (°C) 10/5/76	11/4/76	11/23/76	12/6/76	12/20/76	1/5/77
Reliance	−13.6	−22.7	−22.1	−24.3	−24.7	−24.9
Delp Early Hale	− 7.9	−19.2	−21.2	−23.6	−23.3	−24.7
Redhaven	−14.7	−22.1	−20.4	−23.8	−23.2	−24.2
Jefferson	−14.6	−18.3	−20.1	−23.2	−22.6	−24.2
Regina	− 6.3	−19.8	−20.7	−22.4	−22.4	−23.8
Velvet	−13.3	−22.2	−20.1	−23.6	−22.3	−23.6
Washington	− 6.9	−20.4	−20.1	−22.0	−21.8	−22.4
	Chill Unit Accumulation					
	34	302	528	608	688	778

hardiness development early. In areas subject to an early onset of cold temperatures, such rates of hardiness development by different peach cultivars could be important.

Our results substantiate the recommendation that 'Reliance' be planted in areas where the more tender varieties lack sufficient bud hardiness for consistent production.

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Errata re: Characteristics of the Wine Grape Cultivar Vidal 256 as Grown in Erie County, Pennsylvania.

C. W. Haeseler reports the following corrections:

1. Under the section *Yields* the low of 1.4 t-ha should be 10.4 t-ha.
2. Under the section *Cluster weights* the low 11.06 gms should be 110.6 gms and
3. Under the section *Berry weights* the low of 1.45 gms should be 1.27 gms.
4. Also, under *Berry weights* (Table 1) should be (Table 2).