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Fruit Survival Ratings of Peaches and Nectarines Following Late Spring Freezes During Two Years[1]

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Abstract

Fifty-one peach and nectarine cultivars and selections growing in a grower cooperator test plot in the piedmont section of South Carolina were rated for amount of crop following −5°C on March 27, 1982, and —3.3°C on April 20 and 23, 1983. In both years, cultivar ratings ranged from no crop to those that needed heavy thinning. Generally, cultivars developed in climates similar to South Carolina's performed best.

In the South, dormant peach flower buds are seldom injured by midwinter temperatures. However, flowers and developing fruit are often injured by spring frosts. Varietal differences in spring frost hardiness have been reported (1, 7). Hardiness at this stage of bud development is not always correlated with hardiness of dormant flower buds (2). Generally, bud survival is correlated with time of bloom (2). However, late blooming cultivars have sometimes been injured more by late frosts than earlier blooming cultivars (1, 7).

Controlled freezing tests have been used to a limited degree to determine differences in cultivar hardiness (8). However, most information on cultivar hardiness has been based on natural freezes (1, 2, 4, 5, 6, 7). Hardiness of seedling populations has also been evaluated after natural freezes (3, 6). To fully evaluate spring frost hardiness of a cultivar it is important to test it over a number of years and at

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a number of stages of flower and fruit development. Test winters still provide the best opportunity to evaluate frost hardiness of a large number of cultivars. Most reports are on hardiness at pink bud to full bloom (1, 2, 4, 7). There are a few reports of resistance of the developing fruits after petal fall (5, 6). The springs of 1982 and 1983 provided opportunities to evaluate hardiness of developing fruit following two unusually late spring freezes.

Cultivars planted in a cooperative grower test orchard near Cowpens, South Carolina, were evaluated for injury following −5°C (23°F) on the night of March 27, 1982, and −3.3°C (26°F) on the nights of April 20 and 23, 1983. On April 7, 1982, the temperature dropped to −3.9°C (25°F) and killed all fruits of all cultivars preventing evaluation of any mature fruit. Crop ratings of the amount of live fruit following the March 27 freeze were made on April 8, 1982. Even though all fruits were dead when evaluated, those that had survived the first freeze were obviously larger than those killed in the first freeze, most of which had already abcised. In 1983, crop ratings were taken three weeks after the freeze. Surviving fruits had enlarged considerably and were easily distinguished from dead fruits.

Ratings were made on a 0 to 5 scale where 0 = all killed; 1 = one to several surviving fruits, but not enough for an economic crop; 2 = one-fourth to three-fourths of a full crop; 3 = full crop but no thinning necessary; 4 = full crop needing light thinning, 5 = very little injury, heavy thinning needed. From 1 to 8 trees of each cultivar were rated. Trees were not randomized and tree age varied from 3 to approximately 10 years. Elevation throughout the orchard varied less than 1 m.

At the time of the 1982 freeze fruit development of the various cultivars ranged from petal fall to calyx split. In 1983, fruit development ranged from just past calyx split to fruits approximately 2 cm in diameter.

The overall mean crop rating across all cultivars was 3.5 in 1982 and 2.6 in 1983. In both years ratings ranged from 0 to 5 indicating that in both years some cultivars had no fruit while others had a full crop that needed heavy thinning. The individual cultivar ratings for each year and the combined year mean ratings are given in Table 1. The correlation between years was r = .63 indicating that cultivar performance was fairly consistent between years. Only Summerset, Stagg and Fayette had many more live fruits in 1983 than in 1982. Most cultivars suffered somewhat more injury in 1983. Champion and Redtop exhibited dramatically more injury in 1983 while several including Milam, Durbin, Flavortop, Harken, Bicentennial, Sweet Sue, Fantasia, Redkist, Ellerbe, Jayhaven, LaGold and Camden did not have enough surviving fruits in 1982 to produce a full commercial crop but had less than a full crop in 1983. Several cultivars appeared to set heavy crops but many of the fruits did not develop properly. These buttons are an especially serious problem for commercial growers because they become a source of brown rot infection and make proper and timely thinning almost impossible. Milam, Sommerset, Harbrite, Flavortop and Majestic had some buttons while McNeely and LaGold had a large number of buttons. McNeely has also frequently produced buttons in North Carolina (Dennis Werner, personal communication).

There were no consistent differences between early and late ripening peaches nor between peaches and nectarines, indicating that it is possible to develop freeze tolerant peaches and nectarines ripening throughout the season.

Table 1. Crop ratings of peach and nectarine cultivars injured by spring freezes in 1982 and 1983.

Cultivar Variety	No. Trees	Crop Rating[z] 1982	1983	Avg.	Cultivar Variety	No. Trees	Crop Rating[z] 1982	1983	Avg.
L74-1-9[y]	2	0.0	0.0	0.0	Stagg	1	2.0	4.0	3.0
Springcrest	1	0.0	1.0	0.5	Suncrest	1	3.0	3.0	3.0
L72-3-3	2	0.5	0.5	0.5	Ellerbe	3	4.3	2.0	3.1
SC8-310	2	0.5	0.5	0.5	Jayhaven	2	4.5	2.0	3.2
FV3-778	2	1.5	0.5	1.0	LaGold	3	4.3	2.3[x]	3.3
Cary Mac	2	1.0	1.0	1.0	Camden	2	4.5	2.5	3.5
Summerset	1	0.0	2.0[x]	1.0	Garnet Beauty	2	4.0	3.0	3.5
Early Coronet	2	2.0	1.0	1.5	L9-6-4	1	4.0	3.0	3.5
L73-1-4	2	2.0	1.0	1.5	Marsun	1	3.0	4.0	3.5
L74-1-52	2	2.0	1.0	1.5	Sunshine	1	3.0	4.0	3.5
Majestic	2	2.0	1.0	1.5	Pocahontas	6	4.3	3.3	3.8
SC9-31	1	1.0	2.0	1.5	Correll	3	4.3	3.7	4.0
L73-2-42	2	1.5	2.0	1.7	Fayette	1	3.0	5.0	4.0
Milam	2	3.0	0.5[x]	1.8	L73-1-24	2	4.0	—	—
Durbin	3	3.0	1.0	2.0	Regina	1	4.0	—	—
Fairtime	1	2.0	2.0	2.0	Candor	2	4.0	5.0	4.5
Flavortop	1	3.0	1.0[x]	2.0	McNeely	3	5.0	4.0[x]	4.5
Harken	2	3.0	1.0	2.0	Harbrite	6	4.8	4.5[x]	4.6
SC9-85	2	2.0	2.0	2.0	Hamlet	2	4.5	5.0	4.7
Bicentennial	3	3.3	1.7	2.5	Pekin	2	4.5	5.0	4.7
Sweet Sue	4	3.2	2.2	2.7	Rubired	2	5.0	4.5	4.7
Champion	1	5.0	2.0	3.0	Cavalier	8	5.0	5.0	5.0
Fantasia	1	4.0	2.0	3.0	Clayton	2	5.0	5.0	5.0
Redkist	3	4.3	1.7	3.0	Norman	2	5.0	5.0	5.0
Redtop	1	5.0	1.0	3.0	Zachary Taylor	1	5.0	5.0	5.0
SC9-280	1	3.0	—	—					

[z]Crop rating based on a 0 = no fruit to 5 = a full crop requiring heavy thinning.
[y]L numbers are Louisiana selections and SC are South Carolina selections.
[x]These cultivars produced some buttoned fruits.

As expected, new selections and recent introductions generally suffered more injury than older established cultivars. This demonstrates the necessity of testing selections in several locations and years to determine if they will bear consistently. Cultivars developed in milder climates under less selection pressure also tended to sustain more injury than those developed in areas where spring freezes are common. The cultivars developed at Virginia Polytechnical Institute which emphasized spring freeze hardiness (6), as a group, exhibited superior freeze tolerance. The North Carolina breeding program at Jackson Spring, N.C., is located less than 100 miles away from the test plot and has a very similar climate. All the North Carolina cultivars tested, Correll, Candor, Hamlet, Pekin, Rubired, Clayton and Norman, with the exception of Ellerbe, had a full commercial crop both years. Ellerbe had a full crop in 1982 but only a partial crop in 1983. This illustrates how narrowly adapted most peach cultivars are and the importance of breeding and selecting new cultivars in the region where they are intended to be grown.

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Early Flowering and Fruiting in Potted Citrus Trees: Exploitation for Mutation Breeding

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Many commercially-important tree fruit cultivars have originated as naturally occurring mutants. Irradiation of mature clones has been employed to increase the frequency of mutation in clonally propagated plants (9). Mutagenesis is appropriate when minor changes are desired in an otherwise acceptable cultivar, and it has been employed extensively to reduce seediness in *Citrus* (3, 7, 8). Mutation breeding may accelerate cultivar development in comparison with conventional breeding (i.e., genetic recombination) because the juvenile phase is circumvented in the former. Propagules derived from budwood of mature (vs. juvenile) clones may flower and fruit earlier in response to various inductive treatments including root confinement (10).

Two parameters represent major obstacles to the efficiency of cultivar development in woody plant species: (a) the lengthy juvenile period which precedes flowering and fruiting and thus delays cultivar evaluation and (b) large plant size which impedes cultivar improvement by limiting the number of propagules which can be maintained and evaluated (2).

Restricted root volumes have been used to stimulate early cropping at the expense of vegetative growth in peaches (1), apple (4, 6), and citrus (5), but the phenomenon has not been exploited widely for cultivar improvement. Root confinement in conjunction with mutation breeding may facilitate early screening of mutants as the ability of ontogenetically mature clones to flower is not dependent on the attainment of large plant size (10).

This study was undetaken to confirm the potential advantages of root confinement (as compared to the unconfined root system of field-grown

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