countries. Brazil was one of the first countries outside New Zealand to plant 'Gala' and has been exporting fruit to Europe since 1989. In France, where 'Royal Gala' is being substituted for 'Red Delicious' in generic apple advertising, significant and expanding production is taking place. More recently, considerable interest has developed in 'Gala' in the Pacific Northwest (USA).

'Gala' and its sports have confounded the experts by their rise in popularity. Although few would dispute its eating quality and attractiveness, most believed 'Gala' fruit would be too small to appeal to the consumers, and the trees too difficult to manage in the orchard. It seems however, that Kidd's theory that eating quality is the most important marketing characteristic an apple can possess has been proved correct by 'Gala.' Unfortunately this new cultivar is being drawn into the same cycle that caused the demise of 'Delicious.' The quest for redder selections by nurseries, anxious for something that will provide them with a competitive edge, is underway without any consideration being given to eating quality. The lesson we must learn is that the people buy apples to eat, not to look at, and they cannot be fooled forever.

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Frost Tolerance of Some Peach and Japanese Plum Cultivars

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Abstract

A freeze with temperatures of about -3C (26.6F) during bloom provided an opportunity to assess frost tolerance of 17 peach and nectarine cultivars (*Prunus persica* (L.) Batsch), and 8 Japanese plum cultivars (interspecific hybrids of *P. salicina*). Ovary survival of recently opened flowers varied significantly among peach cultivars, with 'Junegold' and 'Coronet' among the most tolerant, and 'Loring' and 'Fantasia' among the least tolerant. 'Bruce' and 'Santa Rosa' were by far the hardiest, and 'Ozark Premier' among the least tolerant of the plums, which were all in the post-bloom stage of development during the freeze.

Cropping following frost differs widely among peach cultivars. Lamb and Way (2) found differences in freeze survival of peach flower buds ranging from near 0% up to 70%. Scott and Cullinan (4) grouped cultivars into hardy and tender classes on the basis of yield following frost. Cultivars included in their hardy classification, such as 'Eclipse,' 'Cumberland,' and 'Greensboro,' had high numbers of flowers per tree, consequently, they produced a fair crop from a small fraction of uninjured flowers even though a high percentage of blossoms were killed. This characteristic is also exemplified in the recently introduced frost-tolerant 'Texstar' and 'TAMU Denman' peach cultivars (1, 5).

Variation among cultivars in frost tolerance as determined by cropping after a freeze may be accounted for by differences in date of bloom, and

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therefore may not be indicative of freezing tolerance of ovaries. Moreover, previous studies included data on relatively few cultivars that are used currently. The objective of this study was to characterize differences among peach and Japanese plum cultivars for freezing tolerance of ovaries, and identify tolerant and intolerant cultivars for future research. A freeze with temperatures near the 50% killing point for peach flowers at full bloom and plum flowers at post-bloom (3) provided an opportunity to evaluate some cultivars for freezing tolerance.

Materials and Methods

An unusually warm February caused bud break to occur 2 to 3 weeks earlier than normal at the Horticulture Research Farm near Athens, Georgia, predisposing many cultivars to damage following an advective freeze on February 25, 1990. Wind speed and bud temperature data were logged hourly in a lower elevation 'Loring' peach planting, and a rabbiteye blueberry planting approximately 500 m to the northwest and 5 m higher in elevation than the peach planting. Bud temperatures were measured with 24-gauge copper-constantan thermocouples, and minima averaged -3.1C (26.4F) and -2.8C (27F) at sunrise in the peach and blueberry plantings, respectively. Hence, bud temperatures fell within the range reported to produce 10 to 50% ovary mortality to 'Elberta' peach at full bloom (3). High wind speed provided for low spatial variability in bud temperature (sd = ± 0.2C), and therefore allowed comparisons among cultivars planted at various locations on the farm. Wind decreased steadily throughout the night from 5.6 $m \cdot s^{-1}$ (12.5 mph) to 1.6 $m \cdot s^{-1}$ (3.6 mph). Frost did not form on flowers or elsewhere due to the low dewpoint and windy conditions.

Flowering shoots of 17 peach and nectarine cultivars and 8 Japanese plum cultivars were taken from mature trees in the afternoon following the freeze, brought to the laboratory and placed in beakers of water. Mortality of ovaries of only recently opened flowers was assessed after 24 hr by visual observation; green, turgid ovaries were assumed undamaged, and brown-black, partially desiccated ovaries were assumed dead. At least 30 flowers on stems taken from each of 5 different trees per cultivar were rated for most peaches. However, for some nectarines ('Snowqueen,' 'Fantasia,' 'Flavortop'), and all plum cultivars, only 2-3 trees existed, and 5 replicates of flowering shoots were obtained from available trees in these cases. Nevertheless, at least 150 flowers per cultivar were examined. Stage of flowering was also determined for each cultivar by dividing the number of open flowers by the total number of flowers on each stem, with about 50 stems per cultivar evaluated.

Percent survival was determined for each replicate, and percentages were converted to arc sine values for analysis of variance procedures (SAS Institute, Cary, NC). Duncan's multiple range test (5% level) was used to separate means.

Results and Discussion

Differences in ovary survival occurred among peach and plum cultivars (Table 1). Lower survival for some plum than peach cultivars reflects the more advanced stage of development for plum (post-bloom, petal fall), which is correspondingly less tolerant of freezing. Similarly, low survival of 'Flordaking' and 'Flordaprince' peaches was due to their more advanced development, since these culitvars bloomed 2-3 weeks prior to other peaches.

There was no significant correlation between ovary survival and flowering stage among peach cultivars ($p < .05$). This suggests that as long as only recently opened flowers are examined, comparisons of ovary freezing toler-

Table 1. Ovary survival of peach and Japanese plum cultivars following exposure to -3C (26.6F) during the bloom or post-bloom period in Athens, Georgia, February, 1990.

Peach Cultivar	Flowering Stage[z]	Survival[y] (%)	Plum Cultivar	Survival (%)
Junegold	85.6	98.4 a	Bruce	96.1 a
Coronet	74.7	97.6 ab	Santa Rosa	93.6 a
Marsun	61.8	95.0 ab	Six Weeks	80.0 b
La Gold	74.7	94.7 ab	Methley	64.1 c
Lovell	96.1	93.3 ab	Frontier	43.6 d
Derby[x]	45.2	92.7 bc	Purple	39.8 d
Majestic	74.2	85.3 cd	Wade	31.0 d
SpringGold	63.3	85.2 cd	Ozark Premier	29.4 d
Snow Queen[x]	87.2	85.1 cd		
Ouachita Gold	63.4	84.6 cd		
Fantasia[x]	56.7	73.2 de		
Topaz	81.6	68.1 e		
Loring	54.4	66.7 e		
Flavortop[x]	63.2	66.4 e		
La Feliciana	95.6	61.0 e		
Flordaking[w]	---	24.3 f		
Flordaprince[w]	---	19.9 f		

[z][No. open flowers/total No. flowers] x 100.
[y]Means followed by same lower case letter not significantly different, Duncan's multiple range test, 5% level.
[x]Nectarine.
[w]2-3 weeks post-bloom at time of freeze.

ance among cultivars differing in flowering stage is justified, at least for cultivars with similar chilling requirements as in this study.

Survival of recently opened flowers of peach and nectarine cultivars was greater than 50%, which agrees closely with published values of temperatures causing injury of 'Elberta' peach (3). Relatively low survival of 'Loring' and 'Topaz' confirms observations of poor cropping of these cultivars following frost compared to others. High survival of 'Junegold' illustrates that early blooming and maturing characteristics can occur along with ovary freezing tolerance in peach genotypes. This is desirable from the standpoint of breeding frost tolerant cultivars which ripen early and therefore have the potential for high profitability.

The cultivar 'Bruce' had the highest survival among plums, which agrees with field observations and laboratory freezing studies (Lu and Rieger, unpublished). In addition to high bloom density and a relatively long bloom period, 'Bruce' also apparently possesses a high degree of ovary freezing tolerance, and represents a model genotype with respect to frost tolerance. However, these characteristics may unduly exacerbate thinning needs in areas not prone to frost damage.

These observations suggest that variability exists in ovary freezing tolerance among some peach and Japanese plum cultivars, which may be useful in breeding programs directed toward frost tolerance. Further studies are being conducted in the laboratory to confirm field observations and identify the mechanisms and possible phenotypic markers of ovary freezing tolerance in *Prunus* species.

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The Minn. #78 Grape — Lady of Mystery

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In 1884 Louis Suelter of Carver, Minnesota offered for sale plants of his hybrid seeding grapes obtained by pollinating a local wild *Vitis riparia* with pollen of 'Concord' (1). He named four of these: 'Beta,' 'Dakota,' 'Monitor,' and 'Suelter.' They were all very similar in foliage and fruit characters and very distinctive in flavor, with acid too high to be considered good table grapes. Though only four were named, at least five were propagated by cuttings and sold to the public. 'Beta' soon became the one most offered by nurseries; it is still being sold today. Through the intervening years, there has been much confusion as to the specific identity of these varieties and it is well known that at least two distinct varieties are sold as 'Beta.' Because of the confusion and uncertainty surrounding them, they have a certain aura of mystery and romance. In fact both Dr. Alderman (2) at the University of Minnesota and Dr. A. F. Yeager (3) when at North Dakota State University doubted they were true hybrids, since their 'Beta' when selfed showed no reversion back to the *V. riparia* and *V. labrusca* species from which it was supposedly descended. This same pattern was experienced by T. V. Munson (4); when he selfed 'Herbemont,' a southern *V. aestivalis* hybrid which he designated a distinct species, *V. borquiniana*.

I was born in 1913 and it must have been near that time that Dr. M. J. Dorsey (5), then at the University of Minnesota, initiated a grape breeding project using 'Beta' as the hardy, adaptive parent and 'Agawam,' 'Campbell,' 'Concord,' 'Janesville,' 'Jessica,' 'Lutie,' 'Salem,' and 'Witt' as quality parents. From seedling populations resulting from these crosses many selections were made for propagation by cuttings in a second-test vineyard planted in 1923.

In 1944 four of these selections were named, #45 = 'Red Amber,' a red of very good flavor; #66 = 'Moonbeam,' a large-berried white of rather bland flavor; #69 = 'Bluejay,' a blue of improved quality; #158 = 'Bluebell,' a bit smaller than 'Concord,' of similar flavor but having a more tender and juicy pulp. Also considered for naming at that time was #78, a blue with larger clusters than 'Beta,' of similar flavor but lower in acid and having, in my opinion, the best texture of them all. Dr. A. N. Wilcox, then the small fruits breeder at the University of Minnesota, had these five selections sent to me that spring. As soon as they fruited, I used them all except 'Moonbeam' in breeding. I quickly saw that Minn.#78 was a very superior seed parent; its seedlings were winter hardy, ripened the fruit and wood very early even when the pollen parent was a grape of late maturity and had the highest sur-

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