peratures reduced flower survival and fruit set.

Cytospora canker was not a significant problem on any surviving trees nor was it a cause of tree death.

Conclusion

Apricot culture does not hold much promise in southern New Jersey's loamy sand and sandy loam soils with the cultivar rootstock combinations tested. Management practices to reduce summer and fall moisture stress and protect trees from low temperatures in winter and spring may help prolong tree life. Most cultivars bloom too early to set consistent crops.

Continued efforts in breeding must be focused on cultivars with greater retention of winter hardiness and late blooming characteristics.

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Cold Hardiness in Grape Cultivar Development

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Abstract

The selection process in grape breeding programs must include consideration of cold hardiness for temperate region cultivation. Traditional breeding methodology has addressed cold hardiness problems through long-term evaluation before cultivar release. Two cultivars from the University of Arkansas grape breeding program, 'Mars' and 'Saturn,' differ in appearance and cold hardiness response. 'Mars' which has a *Vitis labrusca* L. appearance acclimated sooner and to a greater degree of hardiness than did 'Saturn,' which has vine and fruit characteristics more closely resembling many *V. vinifera* L. cultivars. Screening advanced selections of grapes using differential thermal analysis has been incorporated at the University of Arkansas to reduce selection time.

free water. Since free water may nucleate and freeze (resulting in cell death) at a relatively high temperature, these tissues are more susceptible to freeze injury than non-supercooling tissues at certain times of the year. This is particularly evident when the plant is fully acclimated to cold weather (9). Freezing points of water in supercooled tissues are easily detected as exotherms (peaks) in differential thermal analysis (DTA) plots (7). Adaptation of thermoelectric modules to DTA has allowed an increase in the number of samples that may be easily tested (1). Methodology in freezing tests utilizing thermopiles has been shown to be critical in determining reliable cold hardiness estimates from grape buds (12).

Ability to screen selections for cold hardiness facilitates the efforts of the plant breeder. Although winter low temperature extremes do not occur with regularity in northern Arkansas (average minimum temperature > -20 C), this has not prevented the selection of very hardy grape cultivars. The cultivar 'Reliance' (released 1982) has survived temperatures as low as -34 C (4) and 'Mars' (released 1984) has survived temperatures as low as -26 C (5). While each of these cultivars was screened for over ten years, the use of DTA could have speeded the selection process. We are using DTA for such a purpose now. Since most of our breeding lines possess some component of tender *V. vinifera* germplasm in their backgrounds, hardiness of selections is a concern. A new cultivar, 'Saturn' (6) possesses many *V. vinifera* characteristics: upright shoot growth, berry flavor is non-labrusca with an adhering skin, and growth continues later into the summer than many *V. labrusca* cultivars. Since 'Saturn' has so many *V. vinifera* attributes, the possibility that cold hardiness was lacking was a concern. We evaluated 'Saturn' and 'Mars' bud hardiness at several dates in the fall and winter of 1988-89. At each sampling date multiple buds were evaluated on each thermoplie. At the first sampling date, 1 October, only three large (primary bud) low temperature exotherm (LTE) peaks were seen for 48 sampled buds of 'Saturn.' In the case of 'Mars,' 39 large LTE peaks were seen for 48 sampled buds. The average exotherm temperatures for 'Saturn' and 'Mars' were -5.4 C and -10.1 C respectively. By 29 October, the average exotherm temperatures were -7.2 C and -11.2 C respectively; out of a total of 24 buds sampled from each cultivar, 16 and 23 exotherms seen for 'Saturn' and 'Mars' respectively. By the second collection date, no freezing temperatures had occurred. On the third sampling date, 26 November, 'Saturn' had an average exotherm temperature of -18.3 C while 'Mars' had an average LTE temperature of -20.1 C. Out of a total of 48 buds sampled for each cultivar, 46 and 47 large LTE peaks were seen for 'Saturn' and 'Mars' respectively. This third sampling date followed the first frost of the season on 17 November.

These data illustrate that 'Saturn' acclimated more slowly than did 'Mars.' There appeared to be a correlation between shortening days and growth response in these two cultivars. While 'Saturn' shows growth late into the autumn season (no growth data were taken), 'Mars' shows an earlier growth cessation. There appears to be a correlation between shortening daylength, growth response, and onset of hardiness in these two cultivars. A hardiness response to shortened daylength alone was noted in apples (3). However, a lack of hardening response to short days alone has been noted before in *V. vinifera* grapes (8). Wolpert and Howell (13) found significant negative correlation between water content of primary buds and cold hardiness of those tissues. That is, loss of water was found concomitant to increased hardiness. We have found that concurrent with an increase in hardiness of grape

buds following first frost, a reduction in peak height of exotherms occurred. This would suggest a loss of water from the primary buds, since peak height is a reflection of heat lost as the buds freeze. Also, we have found that the hardier genotypes of grapes that we have tested have smaller exotherms than those that are less hardy. However, within a genotype, we have seen that different buds freeze over a range of 5-6 C on a given date. Although we have not attempted to quantify the relationship between bud size, water content, and exotherm size, we can definitely say that the largest LTE's do not always occur at the highest temperatures within a sample of buds.

Our experiences in Arkansas indicate that genetics play an important role in cold hardiness. It has been shown that the development of new cultivars with a high degree of hardiness is possible using traditional breeding methodology, relying on screening in the field. However, the use of differential thermal analysis offers a quick, accurate evaluation of bud cold hardiness, from which inferences may be made about vine cold hardiness.

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Seed Number—Fruit Ca—Breakdown

In a population of 'Delicious' apples (*Malus domestica* Borkh.) with varying seed number at harvest, fruit size and Ca concentration in fruit increased with seed number. Neither K nor Mg concentration in fruit was related to seed number. In another population of 'McIntosh' apples from 50 commercial orchard blocks, the percentage of fruit that developed senescent breakdown, a Ca-deficiency disorder, decreased linearly as seed number per fruit increase. Low seed number is probably a factor contributing to Ca deficiency in apple fruit. Greater attention to pollination conditions and other factors that may influence seed number in fruit is a practical approach to helping cope with the pervasive problem of Ca deficiency in apples.

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