

SERA014 Progress Report 2005

Texas Viticulture Research and Extension

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Evaluation of Applied Exogenous Abscisic Acid to Delay Budburst of Grapevines for Frost Avoidance

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Introduction

The objective of this research was to study the effects of exogenous ABA (Valent Biosciences VBC-30025) applications on time of budburst in *Vitis vinifera* winegrapes. Studies were conducted in the laboratory, greenhouse, and field during 2004 and 2005.

Dormant Bud Spray of Single-Node Cuttings - 2004

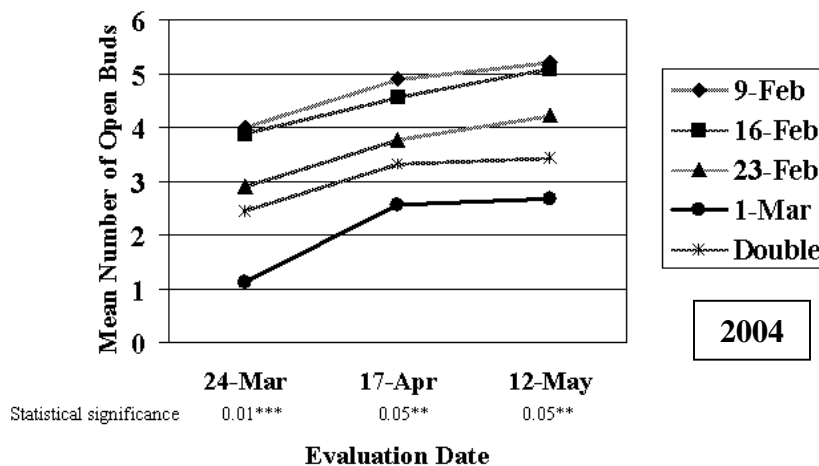
This study was designed as a factorial experiment with 4 rates of ABA (VBC-30025) and 5 application dates (timing). Treatments were replicated 3 times with each plot consisting of 10 single-bud cuttings of Sangiovese (clone 3). All cuttings were placed in moist vermiculite in a laboratory environment for spray applications, bud development and assessment. Rates of applied ABA were: 0, 10, 100, and 1000 mg/L. Timing treatments consisted of single spray applications of ABA made at one-week

intervals for four weeks and one double treatment receiving ABA applications three weeks apart. Treatments were applied using a hand sprayer until each cutting was thoroughly wet with the appropriate solution of ABA plus the adjuvant TWEEN-20.

Starting on 2-9-2004 cuttings were observed every 2 days for budburst. Budburst was defined as the point at which the first leaf had fully released from the bud base. The number of open buds was evaluated every two days.

There was no significant effect of ABA rate on time of budburst in this study. However, time of application was a statistically significant main effect (Figure 1). The greatest delay in budburst occurred in treatments applied later, with the greatest delay seen in the latest application date, 1-March.

Figure 1. Effect of Timing of ABA Spray Application to Buds on Budburst of Sangiovese Single-Node Cuttings



Dormant Bud Spray of Single-Node Cuttings - 2005

Based on the results in 2004, ABA treatment timing was limited to one application close to budburst. A large quantity of single-node cuttings of Sangiovese were brought into the laboratory and maintained with their basal ends submerged in a water bath. Bud development was closely observed and when sufficient numbers of cuttings had buds at stage 5 (wool stage), 100 cuttings were selected and 20 cuttings were randomly assigned to each of 5 experimental treatments with spray application of varying ABA rate: 0, 100, 250, 500, and 750 mg/L. Cuttings were maintained in the

water bath throughout the duration of this experiment. Observations of budburst were conducted every 2 days; buds were considered open when the first leaf had fully released from the bud base (stage 7). Three separate trials of this experiment were conducted in 2005 using the same experimental procedures.

Results. Budburst was generally delayed by ABA treatment in 2 of 3 trials. All ABA treatments delayed 50% budburst by about 3 days in trial one. Trial 3 demonstrated a similar 3-day delay for the lower rates of ABA (100, 250 mg/L) and a 5-day delay for the higher rates (500, 750 mg/L). No response to ABA was apparent in trial 2.

Dormant Bud Spray of Field-Grown Vines – 2004-2005

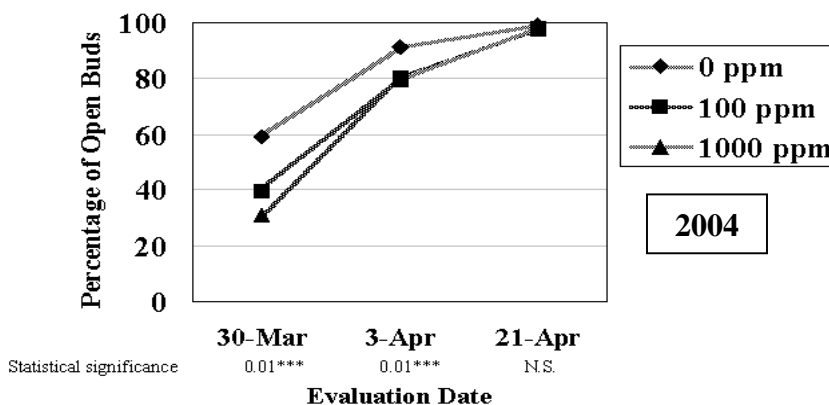
This field study was designed as a factorial experiment with 3 rates of ABA (VBC-30025) and 4 application dates (timing). Treatments were replicated 4 times with each plot consisting of 3 dormant vines of Sangiovese (clone 3) in a commercial vineyard in Ropesville, Texas. Treatment vines were pruned to 12 two-bud spurs, six spurs per cordon. All plots received the same management practices.

Experimental rates of ABA were 0, 100, and 1000 mg/L. Timing treatments included three application dates (3/11, 3/18, 3/25) and a double application treatment that was sprayed twice (3/11 and 3/25). All applications were made between 1:00 and 2:30 PM in full sun. The VBC-30025 / TWEEN-20 was applied using a hand spray bottle until each two-bud spur was thoroughly wet.

Observations of budburst were conducted every 3 days; buds were considered open when the first leaf had fully released from the bud base (stage 7). This experiment was conducted twice (2004, 2005) using the same experiment procedures and methods.

In 2004, vines treated with ABA had a significant reduction in percent budburst at the earlier evaluation dates (Figure 2) and both rates of ABA performed similarly. ABA rate had no effect on time of budburst in 2005. There was no effect of time of ABA application in this study, however all of the treatment applications were made within 3 weeks of first budburst of untreated vines, which is a similar timeframe as the most effective treatments in our single-node-cutting laboratory study conducted in 2004.

Figure 2. Effect of ABA Spray Application to Buds on Budburst of Field-Grown Sangiovese



Soil Drench of Container-Grown Dormant Vines – 2004-2005

This greenhouse study was designed to test 4 rates of ABA (VBC-30025) on container-grown vines of two grape varieties: Sangiovese (clone 3) and Cabernet Sauvignon (clone 4). Plants were one-year-old nursery grown, dormant bare-rooted vines grafted on 1103P rootstock and planted in Metromix 700 medium in 3-gallon containers. Treatments were replicated 6 times per variety in single-vine plots arranged in a completely random design. Treatments were three rates of ABA (0, 100, 1000 mg/L) applied in a one-liter soil drench at the time vines were planted into containers. A second ABA application was made one week later at the same volume and rates for each treatment. The vines were monitored every two days for budburst using the criteria described above. Experimental procedures and methods were the same in both years of this study. Potted vines were 2-years-old in 2005.

Soil drench ABA rate had a highly significant effect on time of budburst for both Sangiovese and Cabernet Sauvignon in 2004 (Figure 3 and Figure 4). For both varieties, the high rate of 1000 mg/L ABA significantly reduced budburst compared to 0 and 100 mg/L for as long as 3 weeks. Final rate of budburst was decreased by 1000 mg/L ABA, particularly in Sangiovese in 2004. Results in 2005 were similar except that a greater response in budburst delay was seen at lower rates of ABA. The low rate of 10 mg/L delayed 50% budburst slightly, but 100 and 1000 mg/L delayed 50% budburst

by 5 to 7 days. Final rate of budburst of ABA treated vines was only slightly lower than that of the control.

Figure 3. Effect of ABA Soil Drench on Budburst of Container-Grown Sangiovese

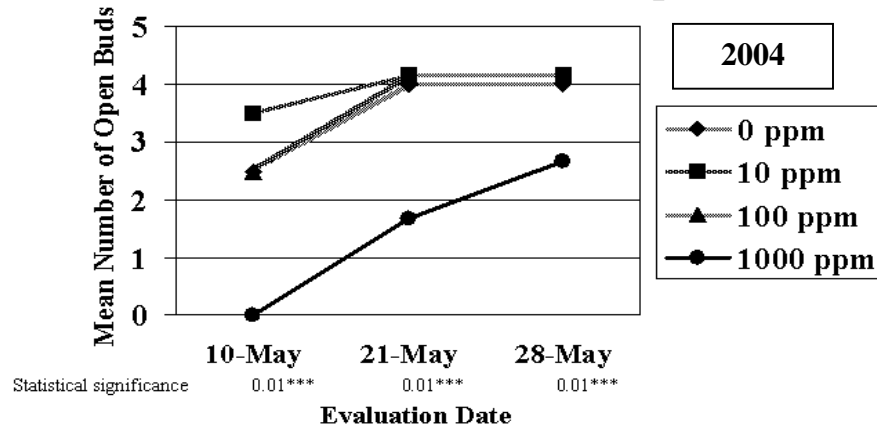


Figure 4. Effect of ABA Soil Drench on Budburst of Container-Grown Cabernet Sauvignon

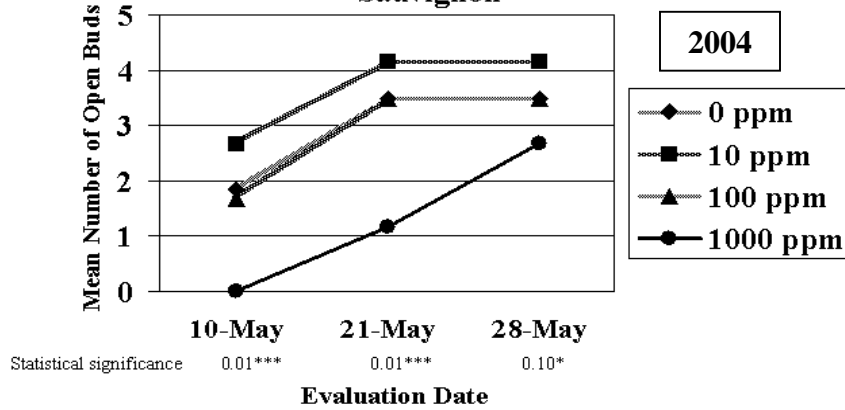
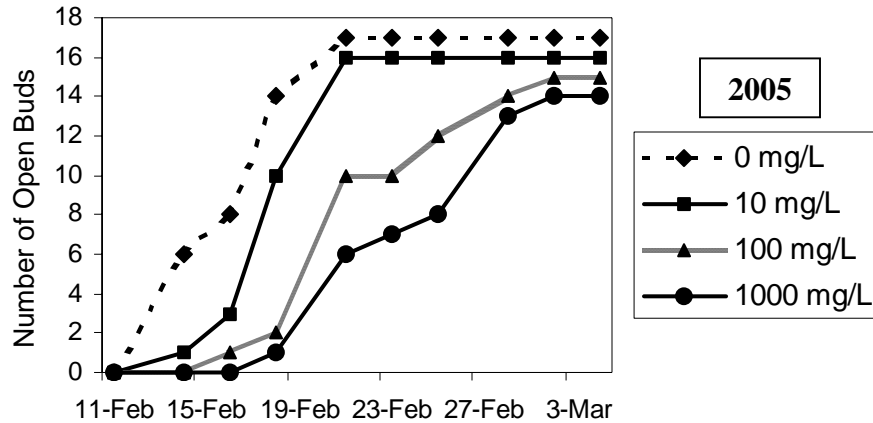


Figure 5. Effect of ABA Soil Drench on Budburst of Container-Grown Sangiovese



Budburst Delay – Conclusions

1. ABA delayed budburst of dormant grapevines to some extent in all 3 experiments.
2. ABA applications were most effective when made within 3 weeks of normal time of budburst
3. High rates of ABA were most effective at delaying budburst, but 1000 ppm soil drench reduced total budburst and appears to be supraoptimal
4. Sangiovese and Cabernet Sauvignon responded similarly to ABA applications
5. Greatest response to ABA was observed with soil drench treatment of potted vines.

Acknowledgements

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**The Texas Pierce's Disease Program:
Vineyard Survey and GIS Project**

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Texas A&M University and Texas Tech University

Pierce's Disease of grapevine, caused by the bacterium *Xylella fastidiosa*, is a deadly disease that has caused significant losses to vineyards in Texas and other southern states where the pathogen is endemic. The disease is the single greatest limiting factor for commercial grape production in some growing regions of Texas. The Pierce's Disease problem in Texas is being addressed by a multidisciplinary interagency program that includes Texas A&M, Texas Tech University, the University of Houston-Downtown, and the USDA-APHIS.

The Texas PD Program is conducting research on the causal organism of the disease, *Xylella fastidiosa*, its sharpshooter vectors, and supplemental host plant species, seeking knowledge that will ultimately lead to effective management options for commercial vineyards. Research results should find application in other regions facing PD problems including California. Scientists are investigating the dynamics of disease spread, supplemental hosts of the pathogen and vectors, known and potential insect vectors, vector-host relationships, vineyard ecosystem composition, and related topics. The Program will integrate these data into a Geographic Information System that may lead to discovery of important relationships between the vector and/or pathogen and environmental factors or vineyard conditions.

The Texas vineyard survey plans to visit every commercial vineyard in the State that is growing at least one acre of grapes. One of the objectives is to collect geographic coordinates with a global positioning system (GPS) so that each vineyard can be accurately located on a map. The survey also collects information about the vineyard itself, selected production practices, and surrounding vegetation. To date, the project has surveyed more than 75 vineyards across the state. The survey is scheduled to be completed by the end of the 2006 season.

For each vineyard, the survey records grape acreage by variety, type of cover crop, extent of weed control, use of the insecticide imidicloprid, proximity to bodies of

water, and the type of surrounding vegetation. Observations also are made looking for symptoms of Pierce's Disease, glassy-winged sharpshooters, and potential supplemental hosts for *Xylella fastidiosa*. Survey data is incorporated into a geographic information system (GIS) that associates the vineyard's data with its accurate location on a map.

In addition to the vineyard location and survey data, the GIS system incorporates other preexisting datasets that characterize the climate, soils, topography, and vegetation of Texas. Each of these datasets can be presented in map form with vineyard attributes overlain to look for patterns at a broad landscape level across the State that might suggest potential relationships. For example, we could display the locations of vineyards that are known to have Pierce's Disease onto a map showing the geographic distribution of the average number of days in January with freezing temperatures. Perhaps this would demonstrate a possible relationship between winter cold and the distribution of Pierce's Disease in Texas. Beyond visualization, spatial analysis statistical procedures can be applied to discover potential relationships between PD or sharpshooters and vineyard or geophysical attributes.

The PD Program's entomologists will also be able to add their insect trapping data to the GIS system to help them study sharpshooter biology and movements at the landscape level in relation to vineyards and geophysical factors. Completion of the GIS and spatial analysis may give us new insights into Pierce's Disease and the glassy-winged sharpshooter that ultimately could lead to improved management recommendations and reduced losses from PD.

Pierce's Disease – Extension & Applied Research Activities

1. Genetic analysis of *Xylella fastidiosa* strains in Texas

Collaborative effort with Lisa Morano, University of Houston-Downtown.

a. Importance

- i. Determine genetic variability of *X. fastidiosa* in Texas and compare to diversity in California
- ii. Determine evolutionary relatedness of strains in Texas to strains in California
- iii. Diversity of strains within single vineyards
- iv. Identify strains in plant reservoirs as identical or different from those of infected vineyards
- v. To better understand the virulence and potential weaknesses of the genus *Xylella*, it is imperative that the genetic diversity in the pathogen's center of origin be explored. These findings may provide insight into development of bio-rational methods of pathogen management.

b. Timeline

- i. Provide L. Morano with grape and other *X. fastidiosa* infected plant material from across Texas
- ii. Morano will grow strains and use genetic analysis with gyrase B gene (for sequencing) and SSR (small sequence repeats banding patterns). Technology and initial comparisons should be possible in spring and summer of 2005. Blake Bextine (UT Tyler) and Andy Walker (UC Davis) have committed to help.

c. Technology transfer

- i. Poster or talk of initial strains at ASEV in June 2005
- ii. Present data (even if preliminary tree of *X. fastidiosa* relatedness) at next year's PD meeting in December
- iii. Completion will depend on how many strains can be successfully extracted and cultured.
- iv. Results will be relayed via semi-annual reports to USDA-APHIS.

2. **Impact of hickory soils on survival of *Xylella* in grapevines**

Collaborative effort with Mark Black, Extension Plant Pathologist, Uvalde, TX

a. Importance

- i. Anomalous absence of Pierce's Disease in the Hickory sands area may provide links to the Achilles heel of the vector. This unique area appears somehow to exclude the growth and reproduction of this pathogen in insect vectors, grape and other known plant hosts. Any insight may provide overall management tools for Pierce's Disease of grape.
- ii. Verifying or denying the influence of these soils on *X. fastidiosa* survival may provide important insight on site selection or mitigation of sites to improve grapevine survival.
- iii. Growers considering grape production need to know specific soil/site considerations that may ameliorate virulence or pathogenicity of *X. fastidiosa*.

b. Timeline

- i. Initial survival or impact should be completed within one year of inoculation.
- ii. Preliminary findings may give rise to a second set of media studies which should be completed within two years

c. Technology transfer

- i. Work will be reported in appropriate journals such as Plant Disease
- ii. Results will be described in regular semi-annual reports and presented at extension educational events.

3. **Texas statewide vineyard survey**

Cooperative effort with Ed Hellman, Extension Viticulturist, Lubbock, TX

a. Importance

- i. This work is important in order to better understand the spatial and geographic limitations of Pierce's Disease in Texas.

- ii. These data are needed to help justify the project to stakeholders and legislators.
 - iii. Mapping vineyards with and without Pierce's Disease will help develop data necessary for quantification of the impact of the disease on the Texas grape industry and economy.
 - b. Timeline
 - i. Some vineyards have been surveyed and data dictionaries are being revised to accommodate current needs.
 - ii. Vineyards currently existing should be mapped by the end of 2006.
 - c. Technology transfer
 - i. Work will be relayed at grower meetings, shared with legislators and included in semi-annual reports as it develops over time.
 - ii. Updated maps will be available for public viewing via the Program's website.
- 4. **Screening rootstocks commonly used in TX for reaction to *X. fastidiosa***

Cooperative effort with Mark Black, Extension Plant Pathologist, Uvalde, TX.

 - a. Importance
 - i. Rootstocks vary in reaction to *X. fastidiosa* based on work at Cornell/Florida, and in California. We need information on those used in Texas, because some are unique, e.g. need for resistance to *Phymatotrichopsis omnivorum* (cotton root rot) in Texas.
 - ii. We need to know which rootstocks to avoid in high-risk areas of Texas and California. Resistant scions on susceptible rootstocks would likely fail and cause growers to avoid very useful scion cultivars.
 - b. Timeline
 - i. This project started in 2005, with 12 entries (5 reps) in Llano County vineyard with long and severe history of PD. The vineyard owner is willing to provide space, irrigation, and all management once vines are planted, so our expense would be primarily for

monitoring and sampling plants for *X. fastidiosa* and symptoms for 3 years. Expected termination of the trial is in December 2007.

- ii. The Llano Co. site probably has cotton root rot (personal communication, G. R. McEachern), so this trial may need to be repeated at a PD site with no history of cotton root rot starting in 2006 or later. Bell Co. grower that works with Morano is a possibility.

c. Technology transfer

5. Pierce's Disease information transfer

d. Importance

- i. Generation of data without interpretation and presentation to growers is of little value.
- ii. Understanding PD risk factors in choosing sites will reduce disease impact for the next generation of growers.
- iii. Understanding cultural practice and chemical inputs that can mitigate disease risk has immediate value for those currently suffering losses from Pierce's Disease.

e. Timeline

- i. Information on insect activity will be available to growers via web-based information system. This information is critical to growers making the best decisions on a timely basis.
- ii. Details on information transfer activities will be included in semi-annual reports.
- iii. The creation of a decision-making matrix will be started after the 2006 season.

f. Technology transfer

- i. As in the past, extension education seminars will be conducted to relay latest research findings to the grape growing community.
- ii. As in the past, presentations on the progress of the Texas Pierce's Disease project will be given to university administrators, local

community development groups, rural county judges' association, the greater research community and grower educational functions.

Fungal Pathogen Identification & Management

Over the past three growing seasons, it has become apparent that there are novel pathogens that are causing direct losses of fruit. It was no surprise that in years where extremely high rainfall levels caused fruit cracking, numerous fungal and bacterial agents were isolated from fruit. In the past three drier years however, several cases of fruit loss have resulted in the identification of other pathogens that need attention. *Pseudocercospora*, cited in the literature as "Fruit Blight", has appeared and caused catastrophic losses in two Hill Country vineyards. In both cases, these vineyards were all 'Cabernet Sauvignon' and management efforts with sterol-inhibiting fungicides has produced some, but not complete control..

Aspergillus niger, which has been identified as the causal agent in canker formation in one Hill Country Vineyard is also suspected of causing direct fruit loss in 2005. In one additional location, fruit infection has occurred that resembles *Phoma* or *Phomopsis*. While there appears to be direct berry infection and cane lesions, no leaf symptoms have been associated with these infections.

Work continues with the Texas Plant Disease Diagnostic Lab to identify these pathogens and to begin to formulate disease management strategies.