

Evaluation of Abscisic Acid to Delay Budburst of Grapevines

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Spring frost damage is a significant production risk in many grape growing regions of the U.S. and crop losses can negatively impact vineyard profitability. Often, damage from a spring frost could be avoided if grapevine budburst was delayed until after the last frost event. Budburst delay has been achieved experimentally with the application of mineral oils, vegetable oils, alginate, cycocel, gibberellin, and ethephon, but none of these materials are commonly utilized in commercial production to delay budburst. The response to applied ethephon was related to enhanced synthesis of abscisic acid (ABA) within grapevines. ABA has long been considered to play a role in the induction and maintenance of bud dormancy in grapevines and numerous reports have demonstrated ABA levels to be related to dormancy of grapevine buds.

Application of exogenous ABA to grape cuttings was reported to delay budburst by Weaver et al. (1968). Of 30 cuttings receiving treatment with 10, 100, or 1000 mg/L ABA, 15, 8, and 0 (respectively) had exhibited budburst after 34 days compared to 17 of 30 cuttings of the untreated control. Thus the two higher ABA concentrations delayed budburst without significantly inhibiting their eventual growth.

Materials and Methods

A new experimental formulation of abscisic acid (ABA; Valent Biosciences VBC-30025) was evaluated for potential to delay budburst of *Vitis vinifera* L. winegrapes. Five experiments were conducted during 2004 and 2005 on dormant grapevine cuttings, container-grown vines, and field-grown vines to evaluate rates and/or timing of ABA applications. Spray application to buds and soil drench treatments were tested.

Preliminary ABA rate and timing trial. This study was conducted in 2004 as a factorial experiment with 4 rates of ABA (VBC-30025) and 5 application dates (timing). Treatments were replicated 3 times in a completely randomized design with each plot consisting of 10 single-bud cuttings of Sangiovese.

ABA Rate and timing trial on field-grown grapevines. This field study was designed as a factorial experiment with 3 rates of ABA (VBC-30025) and 4 application dates (timing) in a completely randomized design. Treatments were replicated 4 times with each plot consisting of 3 mature vines of Sangiovese grafted to 5C rootstock growing in a commercial vineyard in Ropesville, Texas.

ABA spray application to cuttings at wool stage. Based on the preliminary study that indicated later ABA applications were more effective, an experiment was conducted in 2005 with ABA treatments applied at the "wool" stage of bud development immediately preceding budburst. Three identical trials were conducted on dormant single-bud cuttings of Sangiovese. Twenty cuttings were randomly assigned to each of five treatment groups receiving ABA rates of 0, 100, 250, 500, and 750 mg/L.

ABA soil drench to container-grown grapevines. ABA applied as a soil drench to container-grown vines was evaluated in an experiment with 4 rates of ABA on two grape varieties: Sangiovese and Cabernet Sauvignon. Plants were one-year-old, dormant bare-rooted vines grafted on 1103P rootstock. Treatments were replicated 6 times per variety in single-vine plots arranged in a completely random design. Treatments were four rates of ABA (0, 10, 100, 1000 mg/L) applied in a one-liter soil drench; a second ABA application was made one week later at the same volume and rates for each treatment.

ABA soil drench to field-grown grapevines. ABA soil drench treatments to field-grown vines were evaluated in a study conducted on 6th leaf Sangiovese vines. Treatment plots consisted of single-vines replicated 6 times in a completely randomized design. ABA treatments were applied by soil drench at a rate of 0, 250, 500, or 1000 mg/L. Soil drench treatments were prepared in 8 liters of water and applied twice, 7 days apart beginning approximately 2 weeks prior to expected budburst for untreated vines.

Results and Discussion

Preliminary ABA rate and timing trial. Cuttings treated with ABA rates of 0, 10, 100, or 1000 mg/L did not differ in number of days to budburst or total number of buds that open at completion of the experiment. Timing of ABA applications significantly influenced days to budburst (Table 1). Later applications (Day 21 or Day 0 + 21) delayed budburst by about 8 days compared to the earliest ABA treatment (Day 7). There was no difference between single (Day 21) and double (Day 0 plus Day 21) late applications. Days to budburst was most responsive to later applications of higher rates of ABA. Total budburst was also influenced by timing of ABA treatments; later applications showed greatest reduction of total budburst.

Table 1. Mean number of days to budburst and total budburst of 10 single-bud cuttings of Sangiovese grapevines treated with a spray application of ABA by timing of treatment application.

Time of ABA Application	Days to Budburst ^{z,y}	Total Budburst ^{x,y} (%)
Day 0	24.0b	52.0a
Day 7	23.6b	61.0a
Day 14	27.5ab	44.9ab
Day 21	31.3b	30.8b
Day 0 plus Day 21	32.2b	30.8b

^zMean number of days from Day 0 to growth stage 11.

^yMeans, within a column, followed by different letters are significantly different at $p < 0.05$ by Fisher's Protected Least Significant Difference Test.

^xPercentage of open buds out of 30 at completion of experiment.

ABA Rate and timing trial on field-grown grapevines. ABA rate had a significant effect on number of days to budburst for field-grown Sangiovese grapevines in 2004. Both rates (100 and 1000 mg/L) delayed budburst compared to untreated control, but only by a little more than one day. Timing of ABA had no effect on days to budburst in either year, and the interaction of rate x timing was non-significant. There was no effect of experimental treatments on total budburst in either year.

ABA spray application to cuttings at wool stage. ABA spray applications to wool-stage buds significantly delayed budburst in only one of three trials. In trial 3 (Table 2), a significant effect of ABA rate on days to budburst was demonstrated, with all ABA rates reaching budburst later than the untreated control. Overall, spray applications of ABA to wool-stage buds resulted at best in only a few days of delay in budburst and the response was inconsistent among trials.

ABA soil drench to container-grown grapevines. The number of days to reach budburst following treatment was comparatively short in year one and similar for both varieties, suggesting that buds were already in later stages of development at the time of treatment. In year two, days to budburst were more consistent with field observations. Soil drench applications of ABA to container-grown vines consistently increased the number of days to budburst of Cabernet Sauvignon compared to untreated control vines. For both years of this trial (Table 3), the highest rate (1000 mg/L) of ABA significantly delayed budburst of Cabernet Sauvignon by 3 to 7 days compared to the untreated control and the low rate (10 mg/L) of ABA.

ABA soil drench to field-grown grapevines. In contrast to the results with container-grown

vines, soil drench applications of ABA to field-grown vines were not effective in delaying budburst. Table 2. Mean number of days to budburst of 20 single-bud cuttings of Sangiovese grapevine treated with a spray application of five rates of ABA.

ABA (mg/L)	Days to Budburst ^{z,y}		
	Trial 1	Trial 2	Trial 3
0	9.3	9.6	9.5
100	12.1	13.4	11.9
250	11.5	9.0	13.3
500	13.8	10.4	11.4
750	12.3	11.2	13.0
F	ns	ns	4.24**
R ²	ns	ns	0.05*

^zMean number of days from time of treatment at growth stage 5 to growth stage 11.

**ABA rate significant by ANOVA at $p < 0.01$.

*Linear regression significant at $p < 0.05$.

Table 3. Mean days to budburst for container-grown grapevines treated with soil drench of 4 ABA rates.

ABA (mg/L)	Days to Budburst ^z			
	Cabernet Sauvignon		Sangiovese	
	2004	2005	2004	2005
0	11.3	20.3	12.0	13.3
10	8.8	20.7	10.0	15.0
100	11.8	22.8	12.0	17.7
1000	19.0	25.5	16.5	21.2
F	3.24*	7.03**	ns	9.92***
R ²	0.3671**	0.4390***	0.25*	0.48***

^zMean number of days from time of treatment to growth stage 11.

ABA rate significant by ANOVA at $p < 0.05^*$, $p < 0.01^{**}$, $p < 0.001^{***}$.

Linear regression significant at $p < 0.05^*$, $p < 0.01^{**}$, $p < 0.001^{***}$.

Applications of Research

- Methods for delaying grapevine budburst are advantageous for escaping spring frost damage.
- ABA was inconsistent in delaying budburst in this study, so is not ready for commercial use.
- Further investigations to improve efficacy of ABA are warranted.

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A complete report of this research has been published and is available online at:

http://winegrapes.tamu.edu/research/Hellman_ABA.pdf